

Evaluation of Rice Germplasm against Brown Planthopper

Ritu R Saxena* and Ravi R Saxena

Department of Plant Breeding and Genetics,
Indira Gandhi Agricultural University, Raipur – 492 006, Chattisgarh

Abstract

In all 198 accession of rice germplasm and 6 checks were evaluated against brown plant hopper (BPH) in glass house by adopting internationally accepted screening technique of IRRI. In this study, twenty six entries were identified as promising ones which includes 12 resistant genotypes namely, Musari, Badshah Bhog, Rajga, Basta Bhog, Mehar Dhan, Kursso dhan, Badshah Bhog, Dubraj, Kursso dhan, Dubraj, Kekdo, Jeera Shankar and, 14 moderately resistant genotypes whereas, 178 entries were susceptible to BPH insect.

In Chhattisgarh state, rice is an important and staple crop with an area of 38.07 lakhs hectare and a production of 47 lakhs metric tones (Anonymous, 2000) productivity of rice is only 1.3-1.4 t/ha which is half of the national average productivity. More than 100 species of insects are pests of rice but only about 20 of them are of major economic significance (Pathak, 1977; Pathak and Khush, 1979). The brown plant hopper, *Nilaparvata lugens* (Stal) is one of the serious threats to rice production. In India, this pest was first observed in Kerala during 1973 causing severe damage (Nalini Kumari and Mammen, 1975). In Chhattisgarh also, this pest has assumed a status of major pest. In 1976, its severe outbreak in the region reduced the yields by 34.4 % (Gangrade *et al.* 1978). A general increase trend in the insect population has been observed during the past few years. The use of resistant varieties is logical and the most effective method of combating insect pest. Because resistance to pest is inherited in plants it involves no extra cost to the farmers, nor does it impair the quality of the environment. Considering the importance of resistant varieties and of diverse

resistant sources for controlling BPH, the present investigation was undertaken with the objective to screen the collected germplasm for resistance against brown plant hopper.

Materials and Methods

Insect reaction: The experiments for insect reaction i.e., screening of rice germplasm against brown plant hopper (*Nilaparvata lugens* (Stat) were conducted in the glass house of Department of Entomology, IGAU, Raipur. The experimental material consisted of one hundred ninety-eight accessions along with six check varieties of rice germplasm with TN-1 and Ptb-33 as susceptible and resistant check varieties, respectively.

Rearing and maintenance of BPH: Brown plant hoppers initially collected from field were maintained throughout the year in the air-cooled glass houses of Department of Entomology. They were reared on one-month-old TN-1 seedlings in clay plots. The pots were placed inside rearing cages of 75x75x75 cms³, size consisting of an iron frame with glass panels and small window on front side and fine wire mesh on top and other sides. Adult insects were placed inside rearing cages for egg laying on the susceptible variety TN-1; at least 25 adults were placed in a single pot. After 2-3 days, the females started laying eggs inside the stalk of paddy plant. Later on, when adults emerged they were transferred to another pot for egg laying. For transferring the adults, an aspirator is used which works on the suction of the air principle.

Nymphs emerged within 5 to 8 days from the eggs. Second to third instar nymphs were collected and used to infest the test materials.

Observations recorded: The observations were recorded 7-10 days after releasing insects when the insect killed more than 90 per cent of TN-1

* Corresponding author

seedlings. The reactions were recorded on a 0-9 scale (IRRI, 1980).

Screening of rice germplasm: Mass screening tests were employed under controlled glass house conditions. The test and check varieties were pre-germinated in Petri dishes (10 cm. diameter) and these germinated seeds were transferred to wooden boxes of the size 60x40x10 cm³ containing well mixed homogeneous and sterilized soil. Each seed box contained 20 test lines with 15 seedlings of each including 2 middle rows of resistant check (Ptb-33) and 4 border rows of susceptible check (TN-1). After sowing the seed, boxes were placed on cemented platform with 6-8 cm border and 3-4 inches water to provide adequate humidity for the insects and protection against ants. In the glass house 100 per cent relative humidity and a temperature of $30^{\circ} \pm 5^{\circ} \text{C}$ were maintained. The observations were recorded 7-10 days after releasing the insects when more than 90% of TN-1 seedlings were killed by the BPH. The reactions were recorded on 0-9 scale (IRRI, 1980). The entries showing damage score up to 3 were further evaluated in three replications for confirming their resistance.

Feeding test: Feeding test was assessed by quantifying the area of honeydew excreted by the insect on filter paper in 24 hr of confinement on the test variety. (Pathak and Heinrichs, 1982). The amount of feeding by the insect on the test varieties as well as susceptible and resistant checks expressed in terms of honey dew excretion per female in mm² unit.

Probing mark test: This test was carried out according to methodology suggested by Naito (1964). Six replicates were used for each promising accessions and each replicate had one seedling.

Results and Discussion

Varietal resistance: In all 198 accession of rice germplasm and 6 checks were evaluated against brown plant hopper (BPH) in glass house by adopting internationally accepted screening technique of IRRI. In this study, twenty six entries were identified as promising ones which include

12 resistant genotypes (Table 1) namely, 9 Musari, 42 Badshah Bhog, 54 Rajga, 73 Basta Bhog, 100 Mehar Dhan, 108 Kursso dhan, 114 Badshah Bhog, 141 Dubraj, 157 Kursso dhan, 173 Dubraj, 182 Kekdo, 194 Jeera Shankar and, 14 moderately resistant genotypes (Table 2) whereas, 178 entries were susceptible to BPH insect.

Resistant cultivars: Twelve identified resistant donors along with resistant check Ptb- 33 and susceptible check TN-1 were studied in depth for BPH feeding and probing mark tests to find out the mechanism of resistance involved in these entries. All the 12 resistant entries (Table 1) exhibited plant damage score ranging from 0.04 - 2.98 while honeydew values varied from 2.50 to 59.50 mm². The, number of probing marks were in the range of 6.75 to 13.75/ seedling. In TN-1, the susceptible check variety (7.12 damage score), honeydew excretion value was maximum (158.50/ mm²) and corresponding probing marks 19 per seedling. Resistant check variety Ptb 33 showed 1.47 plant damage score and corresponding honeydew and probing marks values were 75 mm² and 5.25 per seedling, respectively. All 12 test entries exhibited variable values with respect to all these traits. For better understanding, all identified BPH resistant varieties were further categorized in 3 groups based on plant damage score values. Six varieties were placed in 0-1 plant damage score, 2 in 1.01 to 2.00 and 4 entries in 2.01 to 3.00 plant damage score.

In first group, six varieties viz., 114 Badshah Bhog, 100 Mehar Dhan, 108 Kursso Dhan, 141 Dubraj, 173 Dubraj and 194 Jeera Shankar had feeding values ranging between 2.50 and 59.50 mm² and their corresponding probing marks ranged from 8.50-13.75/seedling. Out of these six varieties, 114 Badshah Bhog showed least plant damage score (0.04) and received third highest probing marks (11.50/seedling).

Three varieties 100 Mehar Dhan, 194 Jeera Shankar and 114 Badshah Bhog in this group had given least feeding values of 2.50, 2.75 and 6.75 mm², respectively with corresponding probing marks 12.75, 13.75 and 11.50/ seedling. This indicated

Table 1: Plant damage, amount of honeydew excretion and probing marks of brown plant hopper on selected resistant rice genotypes

Entry Number	Genotypes	Average Plant damage score	Honeydew in 24 h (mm ² /♀)	Average Probing marks /seedling
9	Musari	1.27	44.00	8.25
42	Badshah Bhog	1.04	4.75	11.50
54	Rajga	2.48	51.50	10.00
73	Basta Bhog	2.64	40.25	8.00
100	Mehar Dhan	0.18	2.50	12.75
108	Kursoo Dhan	0.71	31.50	8.50
114	Badshah Bhog	0.04	6.75	11.50
141	Dubraj	0.99	59.50	11.50
157	Kursoo Dhan	2.69	47.75	6.75
173	Dubraj	0.89	14.00	9.75
182	Kekdo	2.98	37.25	7.50
194	Jeera Shankar	0.86	2.75	13.75
R. Check	Ptb - 33	1.47	55.75	5.25
S. Check	TN - I	7.12	158.50	19.00

Table 2: Amount of honeydew and probing marks of BPH on moderately resistant rice cultivars genotypes

Entry Number	Cultivar / Genotypes	Damage Score	Honeydew (mm ² /24 h)	Average Probing Marks/ seedling
37	Kursoo Dhan	3.43	138	25
38	Dadamali	4.90	145	23
44	Badro Dhan	4.44	280	14
46	Chote Gharmour	3.40	148	20
60	Dubraj	4.83	160	20
71	Basan mundi	3.76	75	22
92	Lalat	4.81	140	19
93	Luchai	4.67	45	15
110	Gurmata	3.98	160	26
112	Kadam Phool	3.82	171	18
136	Raichuri	4.76	250	28
138	Kursoo Dhan	4.60	140	30
142	A Isanga	4.34	256	22
169	Lal Dhan	3.37	300	25
R. Check	Ptb - 33	2.18	72	28
S. Check	TN-I	9.00	266	16

Table 3: Summary of the 12 BPH resistant genotypes along with yield and quality traits

Characters	9 Musari (L)	42 Badshah Bhog (L)	54 Rajga (E)	73 Basta Bhog (L)	100 Meher Dhan (M)	108 Kurso Dhan (L)	114 Badshah Bhog (L)	157 Kurso Dhan (L)	173 Dubraj (L)	182 Kekdo (L)	194 Jeera Shankar (L)	141 Dubraj (M)
Plant height (cm)	140.46	185.67	132.46	166.47	130.19	162.39	160.53	158.89	138.07	159.99	160.19	141.87
Number of tillers	3.99	7.00	5.73	7.07	7.56	3.76	7.20	4.73	5.67	3.26	5.66	5.87
Panicle length (cm)	22.24	28.47	24.07	29.20	22.11	25.91	32.27	24.81	21.60	24.51	27.31	21.07
No. of filled spikelets	223.72	223.73	120.12	185.47	100.89	192.69	205.33	156.16	196.87	147.69	161.49	192.80
No. of unfilled spikelets	12.13	26.00	8.13	32.67	35.43	29.63	46.07	19.59	17.47	17.49	21.69	22.80
Total no. of spikelets	235.85	263.07	128.25	224.80	136.32	222.32	254.73	175.75	211.00	165.18	183.18	218.93
Hundred seed weight (g)	1.51	1.65	2.54	1.65	2.17	2.64	1.27	2.60	1.88	2.49	1.25	2.12
Biological yield per plant (g)	37.25	53.30	17.49	34.86	29.02	38.93	36.60	47.39	27.40	43.34	33.69	37.77
Harvest index (%)	9.41	45.03	49.47	25	9.70	7.07	6.16	43.09	3.50	31.50	27.81	41.99
Length of rough rice (mm)	5.20	5.53	8.01	5.97	9.52	9.10	5.27	9.40	7.60	9.10	7.40	8.03
Breadth of rough rice (mm)	3.09	2.07	2.98	1.97	2.92	3.08	1.73	3.44	1.97	2.68	1.93	2.17
Length: breadth ratio	1.68	2.68	2.69	3.04	3.26	2.95	3.16	2.73	3.88	3.40	3.83	3.71
Seed yield per plant (g)	14.68	13.87	8.67	13.40	11.52	14.43	9.44	20.42	16.61	13.69	9.37	14.71
Hulling (%)		80.96		79.85			78.60		79.34		83.79	82.12
Milling (%)		75.75		75.29			71.58		71.96		79.64	77.78
KL of milled rice (mm)		4.25		10			75		5.30		4.25	5.80
LIB ratio of milled rice		2.39		2.28			2.09		2.95		2.36	3.44
KLAC (mm)		6.90		6.65			6.40		8.35		6.35	8.10
LIB ratio of cooked rice		2.38		2.34			2.17		3.10		2.54	3.49
Elongation ratio		1.62		1.62			1.71		1.58		1.49	1.39
Elongation index		0.99		1.03			1.05		1.05		1.08	1.01
G.T.		4.95		2.20			5.05		3.46		3.93	3.90
Amylose (%)		22.0		18.94			19.8		25.12		21.76	27.63
Protein (%)		8.49		7.16			7.61		7.16		7.10	10.03
Head rice recovery (%)		61.15		60.72			65.01		43.33		48.99	66.19

Note: E = Early, M = Medium and L = Late duration genotypes

the ability of these genotypes to resist the attack of BPH insect as removal of nutrients from these genotypes was negligible. Two varieties, viz., 141 Dubraj and 108 Kursso Dhan suffered high draining of sap (feeding values 59.50 and 31.50 mm³) even though their plant damage values were restricted to the extent of 0.99 and 0.71. This showed the capacity of these genotypes to recover the loss of plant sap.

In second group which contains 2 varieties with plant damage score between 1.04-1.27. Two varieties viz., 42 Badshah Bhog and 9 Musari had feeding values of 4.75 and 44.00 mm³, respectively with corresponding probing marks of 11.50 and 8.25/seedling. Plant sap loss by BPH insect feeding was very less on these varieties, thereby providing sufficient logic for the presence of feeding deterrent in the plant sap of these genotypes.

Third group comprised of 4 genotypes in the range of 2.48 to 2.98 plant damage score. The insect feeding was maximum (37.25-31.50 mm³). In these four varieties viz., 182 Kekdo, 73 Basta Bhog, 157 Kursso Dhan and 54 Rajga with corresponding probing marks ranged between 6.75 - 10.00/seedling. In spite of the high feeding values, these varieties exhibited resistant plant stand.

Moderately resistant cultivars: In the varietal resistance studies, 14 entries were isolated as moderately resistant to BPH insect. Plant damage score in these varieties ranged between 3.37 to 4.90. compared to 2.18. The Ptb-33 resistant check and 9.0 in 1N-I susceptible check variety (Table 2). In general, feeding values and probing marks of BPH insect on these varieties are much higher as compared to the resistant varieties. Lal Dhan showed highest feeding value of, 300 mm³ (250

mm²) followed by (280 mm²) Alsanga (250 mm²) and Raichuri (250 mm²). The corresponding probing marks were 25, 14, 22, and 28 marks per seedling. Two varieties, Luchai and Basanmundi had lower feeding values of 45 and 75 mm² respectively with corresponding low probing marks 15 and 22. Another eight varieties of this group had intermediate feeding values and probing mark values.

Identification of resistant donors and their use in breeding programme has earlier been attempted by various workers. Kalode *et al.* 1983, Misra 1978, 1982 and 1983 Heinrichs 1984 Balasumbramanian, 1978; Khush, 1979; Bhattacharya *et al.*, 1983; Sahu, 1987 and Velusamy, 1988. In continuation of these effects, the present study had lead to identification of twelve genotypes showing resistance reaction of less than 3.0 against BPH. (Pophaly and Rana, 1993a).

In present study, all 12 identified resistant entries were evaluated for specific tests viz., feeding pattern and probing marks against BPH and has given un-identical values in relation to plant damage score obtained. These tests suggested that most probably these lines carry genetic material, which differ with each other. However, in this identified group of 12 varieties, six varieties viz., 100 Mehar Dhan, 108 Kursso Dhan, 114 Badshah Bhog, 141 Dubraj, 173 Dubraj and 194 Jeera Shankar had given plant damage score ranging between 0.04 to 0.99 with abnormal feeding and probing mark values and same is the case with varieties, viz., 42 Badshah Bhog and 9 Musari in which plant damage score ranged between 1.04 to 1.27. Third group comprises 4 varieties viz., 54 Rajga, 73 Basta Bhog, 157 Kursso Dhan and 182 Kekdo having plant damage score ranging between 2.48 to 2.98.

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