

# Screening of Rice Germplasm accessions for Resistance to Brown Plant Hopper (*Nilaparvatalugens* Stal.)

## ABSTRACT

An investigation was carried out with twenty-nine rice germplasm accessions to identify source of resistance to Brown planthopper, *Nilaparvatalugens* (Stal.) during *Rabi* 2024 at RARS, Jagtial under polyhouse conditions. These rice germplasm accessions were screened following Standard Seedbox Screening Test (SSST), along with one resistant check (PTB 33) and one susceptible check (TN1) to evaluate the level of resistance to BPH infestation. Among 29 germplasm accessions only five accessions viz., IR 23352-7R, RP-4516-3-6, JMS 13 A × RP 4516-3-6, CMS 59A × RP 4516-3-6 and CMS 59A × KNM 7660 exhibited damage score (DS) ranging from 1 to 3 and were designated as resistant (R). Eleven accessions viz., RMS1A, IET 23993, JMS24A × IR 23352-7R, JMS24A × IR 10198-66-2R, JMS24A × RP-4516-3-6, JMS 13 A × IR 23352-7R, JMS 13 A × IR 10198-66-2R, CMS 59A × IR 23352-7R, RMS 1 A × IR 10198-66-2R, RMS 1 A × RP 4516-3-6 and RMS 1 A × KNM 7660 exhibited damage score ranging between 3.1-5.0 were designated as moderately resistance. The remaining 13 accessions were identified as moderately susceptible with damage score ranging between 5.1-7.0. Further investigations on the mechanisms of resistance such as antixenosis, antibiosis and tolerance are required to identify the best genotypes that could be used for developing BPH resistant / tolerant variety with desirable yield and quality traits.

**Key words:** Rice, germplasm accessions, screening, *Nilaparvatalugens*, resistance.

## 1. INTRODUCTION

Rice (*Oryza sativa* L.), one of the world's most important food crop is affected by serious pests which pose a major threat to production causing cumulative yield losses of about 25% (Dhaliwal *et al.*, 2010). Among these, the brown plant hopper (BPH), *Nilaparvatalugens*(Stal.) (Hemiptera: Delphacidae) is a serious pest causing significant yield losses under epidemic conditions. It is considered as an important insect pest affecting rice cultivation with an annual yield loss up to 80% which is \$300 million in Asia (Satturu *et al.*, 2020).

Nymphs and adults both cause direct damage by sucking the phloem sap and thereby resulting in 'hopper burn' (Lakshminarayana and Khush, 1977). also transmits rice grassy stunt virus (GSV) and ragged stunt virus (RSV) as a vector (Khush and Brar, 1991).

The application of chemical pesticides like imidacloprid is the primary strategy used to control BPH attack in plants. However, this strategy is not only expensive but also dangerous for environment and human health. Additionally, it inadvertently eliminates natural predators and promotes the growth of BPH biotypes that are resistant to insecticides (Tanaka *et al.*, 2000).

Therefore, using host-plant resistance approach to manage insects and increase yield is the most cost-effective, efficient and ecologically friendly (Ramalingam *et al.*, 2020b). Given the significance of resistant and tolerant varieties in managing BPH, it has become essential to identify new sources of resistance with enhanced quality parameters to introgress these traits into high-yielding varieties.

## 2. MATERIALS AND METHODS

## 2.1 Mass rearing of BPH

BPH was mass reared on the susceptible rice variety Taichung Native 1 (TN1) to produce enough nymphs for infestation. BPH population was initially collected from the rice fields and pure

Plant State	Score	Resistance classification
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culture was maintained in the glass house at a temperature of  $30^{\circ}\text{C} \pm 5^{\circ}\text{C}$  with a relative humidity of  $60 \pm 5\%$  on 40-50 days old potted plants of TN1. Mass rearing was done in cages. First and second instars were collected and used for experiments.

## 2.2 Screening Procedure

A total of 31 rice genotypes including a susceptible check (TN1) and a resistant check PTB33 were screened against BPH using the Standard Seedbox Screening Test (SSST) developed by the International Rice Research Institute (IRRI, 2013), (Heinrichs *et al.*, 1985). Mass screening technique as described by (Kalodeet *et al.*, 1975). The method involves infestation of young seedlings (about 12 days old) of test entries grown in screening trays (50 cm x 40 cm x 8 cm) filled with fertilizer enriched puddled soil. Use of puddled soil helps in uniform growth of seedlings and avoids soil problems. Each screening tray includes the test lines, one row of resistant check (PTB 33) in the middle and two rows of susceptible check, TN1 in the borders.

First and second instar nymphs will be released on test entries at 12-13 days after sowing by tapping heavily infested plants from oviposition cages on the screening trays, ensuring that each test seedling to be infested with at least 6-8 nymphs. The screening trays with BPH nymphs were covered with mylar cages to prevent escape of the nymphs. The infested trays will be monitored regularly for the plant damage. When TN1 plants on one side showed severe damage, the tray will be rotated by  $180^{\circ}$  for even reaction on both sides. When more than 90 percent plants of susceptible check, TN1 killed, the test entries will be scored for the damage reaction, based on a 0-9 scale of international standard evaluation system (IRRI, 2013) as described in Table1.

After scoring as per SES, means damage score of three replications was calculated. All the SSST entries were then categorized as resistant (R), moderately resistant (MR), moderately susceptible (MS), susceptible (S) and highly susceptible (HS) based on damage score shown in Table 2.

No injury	0	Highly Resistant
Very slight injury	1	Resistant
First and second leaves of most plants partially yellowing	3	Moderately Resistant
Pronounced yellowing and stunting or about 10 to 25 % of the plants wilting or dead and remaining plants severely stunted or dying	5	Moderately Susceptible
More than half of the plants	7	Susceptible
All plants dead	9	Highly Susceptible

**Table 1: Classification of level of resistance based on damage reaction**

### 3. RESULTS AND DISCUSSION

Results regarding to screening of 29 rice germplasm accessions only five accessions viz., IR 23352-7R, RP-4516-3-6, JMS 13 A × RP 4516-3-6, CMS 59A × RP 4516-3-6 and CMS 59A × KNM 7660 exhibited damage score (DS) ranging from 1 to 3 and were designated as resistant (R). Eleven accessions viz., RMS 1A, IET 23993, JMS 24A × IR 23352-7R, JMS 24A × IR 10198-66-2R, JMS 24A × RP-4516-3-6, JMS 13 A × IR 23352-7R, JMS 13 A × IR 10198-66-2R, CMS 59A × IR 23352-7R, RMS 1 A × IR 10198-66-2R, RMS 1 A × RP 4516-3-6 and RMS 1 A × KNM 7660 exhibited damage score ranging between 3.1-5.0 were designated as moderately resistance. The remaining 13 accessions were identified as moderately susceptible with damage score ranging between 5.1-7.0.

From the investigation that the five resistant rice accessions showed resistance characteristics on par with that of PTB33 can serve as donors of resistance for breeding BPH resistance lines. It was observed that only, IR 62 and IR 64 were resistant and IR 34, IR 36 and IR 56 showed moderately resistant reaction against BPH at Raipur (Pophaly and Rana 1993). The 38 elite rice lines out of them five elite lines were found to be resistant to BPH (Shen *et al.*, 2002). In all 121 promising rice genotypes of IGAU were evaluated against brown plant hopper (BPH) in glasshouse by adopting internationally accepted screening technique out of these genetic stock, three genotypes were found to be resistant and 20 were moderately resistant whereas, 98 genotypes were susceptible to brown planthopper infestation (Kale *et al.*, 2007). Similarly to the present studies, the studies carried out among 400 germplasm accessions three accessions were found to be resistant and thirteen

S. No.	Entry	Mean Damage Score (0-9scale)	Reaction
<b>Lines</b>			

1	JMS24A	5.375	MS
2	JMS13A	6.5	MS
3	CMS59A	6.0	MS
4	RMS1A	4.6	MR
<b>Testers</b>			
5	IET 23993	3.7	MR
6	IR 23352-7R	3.0	R
7	IR-10198-66-2R	5.8	MS
8	RP-4516-3-6	2.8	R
9	KNM-7660	5.32	MS
<b>Hybrids</b>			
10	JMS24A × IET 23993	5.1	MS
11	JMS24A × IR 23352-7R	3.1	MR
12	JMS24A × IR 10198-66-2R	3.2	MR
13	JMS24A × RP-4516-3-6	3.4	MR
14	JMS 24 A × KNM 7660	5.2	MS
15	JMS 13 A × IET 23993	5.1	MS
16	JMS 13 A × IR 23352-7R	3.5	MR
17	JMS 13 A × IR 10198-66-2R	3.22	MR
18	JMS 13 A × RP 4516-3-6	1.87	R
19	JMS 13 A × KNM 7660	5.8	MS
20	CMS 59A × IET 23993	6.02	MS
21	CMS 59A × IR 23352-7R	3.66	MR
22	CMS 59A × IR 10198-66-2R	4.53	MS
23	CMS 59A × RP 4516-3-6	2.77	R
24	CMS 59A × KNM 7660	3	R
25	RMS 1 A × IET 23993	5.133	MS
26	RMS 1 A × IR 23352-7R	6.125	MS
27	RMS 1 A × IR 10198-66-2R	3.28	MR
28	RMS 1 A × RP 4516-3-6	3.21	MR
29	RMS 1 A × KNM 7660	3.2	MR
<b>Checks</b>			
30	TN-1(SusceptibleCheck)	9	HS
31	PTB-33(ResistantCheck)	2	R

**Table 2: Reaction and damage score of selected germ plasm accession**

R - resistant, MR - moderately resistant, MS - moderately susceptible, S - susceptible, HS - highly susceptible

accessions were moderately resistant (Ramulamma *et al.*, 2015). Of the seeds of 1989 wild rice accessions, 159 accessions are resistant during 2012. Of the 159 accessions that had shown resistant reaction during 2012, 31 accessions were again screened during 2013. Seven *O. nivara* accessions and *O. longistaminata* accession IRGC81967 were resistant over the two years, while one accession and IRGC81967 were moderately resistant during 2013. The remaining 22 accessions showed resistant reaction during both the two years (Sarao *et al.*, 2016). Among the tested 121 potential rice cultivars in a glasshouse for brown planthopper (BPH) resistance. Three genotypes were found to be resistant and their damaged scores ranged between 0.6 to 2.90 and 20 were found to be moderately resistant whereas 98 genotypes were found vulnerable to BPH infestation (Kale *et al.*, 2021). BILs of CBMAS14065 with different combinations of BPH

resistant genes were evaluated for their resistance against brown plant hopper (BPH) along with CBMAS14065 (recipient parent), IR71033-15B (donor parent), PTB33 (resistant check) and susceptible check (TN1). CBMAS14065 was moderately susceptible, IR71033-15B and BILs were moderately resistance (Vignesh *et al.*, 2023).

#### 4. CONCLUSION

The screening test unveiled that out of 29 rice germplasm accessions, only five accessions viz IR 23352-7R, RP-4516-3-6, JMS 13 A × RP 4516-3-6, CMS 59A × RP 4516-3-6 and CMS 59A × KNM 7660 exhibited as resistant (R). Eleven accessions exhibited moderate resistance (MR) to BPH and remaining accessions which was exhibited as moderately susceptible along with one resistant check (PTB 33) and one susceptible check (TN1).

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