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Screening of Rice accessions for assessing resistance to Brown Planthopper, *Nilaparvata lugens* Stål

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Abstract
Rice accessions were evaluated for their resistance to the brown plant hopper, *Nilaparvata lugens* Stål (BPH) using a greenhouse experiment. A set of 30 cultivated varieties of rice was screened to assess the level of resistance to BPH. The level of resistance was evaluated based on the severity of symptoms caused by insects and screening studies revealed that three varieties (Rathu Heenati, PTB 33 and ASD 18) to be resistant with a damage score of 3 or less. Twelve varieties were found to be moderately resistant to BPH with a damage score of 3.1- 5.0 whereas ten varieties were found to be susceptible with a damage score of 5.1- 7.0. The other five rice varieties were categorized as highly susceptible with a damage score of 7.1- 9.0.

Keywords: rice, screening, *Nilaparvata lugens*, resistance

Introduction
Rice is the world's most important staple food crop, and more than half of the world's population, mostly in Asia, depends upon it. Rice is infested by more than 100 species of insects. About 20 of them are considered as serious pests as they cause significant damage to rice crop. Among them, Brown Plant Hopper (BPH), is one of the most destructive insect pests causing significant yield loss in rice cultivars every year [1, 2]. Both BPH nymphs and adults directly damage rice plants through sucking the cell sap from base (stem) of the plants. In addition to causing physiological damage to rice plant, BPH also causes indirect damage by acting as a vector for rice grassy stunt virus and ragged stunt virus [3]. The details on BPH outbreak in India are reviewed by Gunathilagaraj and Ganeshkumar (1997) [4]. Application of insecticides is the conventional method of controlling BPH, even though it is expensive and hazardous to the environment. In addition resurgence, a phenomenon of pest population increase after application of insecticides. In recent years, BPH has caused devastating damages to rice crop in China, Japan, Korea and Vietnam. In 2005 and 2008, China reported a combined yield loss of 2.7 million tons of rice due to direct damage by BPH, while a yield loss of 0.4 million tons in Vietnam was mainly due to two virus diseases, RGSV and RRSV, transmitted by BPH [5]. The frequent outbreaks of BPH along with the hazardous effects of pesticides prompted researchers to seek BPH resistant germplasm from various sources and to utilize the resistant genes for rice improvement. Developing resistant cultivars is generally considered as the most effective and economical means of pest management and thus breeding of insect resistance has taken priority in rice improvement programme.
The use of resistant rice varieties is the most effective method for controlling the BPH [6], therefore it is essential to identify BPH-resistance genes from diverse sources and incorporate them into cultivated rice varieties by molecular breeding. The pest populations continue to change their virulence pattern and new genes for resistance must be constantly identified [7]. With this background, in the present study, an attempt has been made to explore the level of resistance to BPH in rice accessions to identify cultivars that can be used as donors in the rice breeding program.

Materials and Methods
Mass rearing of brown planthopper
Mass culturing of the BPH is a prerequisite for continuous screening of rice accessions under glass house. The BPH were mass reared on a susceptible rice variety Taichung Native 1 (TN 1) following the method of Heinrichs *et al*. (1985) [8]. Initial BPH population was collected

from the rice fields at Paddy Breeding Station (PBS), Coimbatore. The adults were confined on 35days old potted plants of TN 1 placed in oviposition cages (45 x 45 x 60 cm) having wooden frames, glass top, door and wire mesh sidewalls. The insects were removed three days after oviposition and plants with eggs were taken out of cages, placed in separate cages for the nymphs to emerge. The emerged nymphs were then transferred to 15 days old TN 1 seedlings raised in the germination trays which in turn were placed in galvanized iron trays (62 x 47 x 15cm) containing 5 cm depth of water to increase humidity.

Seedling box screening rice cultivars for BPH resistance

There are different screening methods for different aspects of research on rice like for abiotic stresses as well as biotic stresses [9, 10]. In the present study A set of 30 cultivated varieties (Table 1) was screened to assess the level of resistance to BPH. Out of the 30 rice varieties, TN 1 (susceptible check) and PTB 33 (resistant check) were screened in the glass house in three replications. The pre-germinated seeds of test lines were sown 3 cm apart in 20 cm rows in 50 x 50 x 10 cm wooden boxes. Each line was planted in three replications across the width of the seedling box in such a way so as to have at least 15 plants per row. One row each of the susceptible check TN 1 and the resistant check, PTB 33 were sown at random in all the seedling boxes. On the seventh day of seeding, the wooden seedling boxes were transferred to galvanized iron trays (62 x 47 x 15 cm) filled with 5 cm of water. Ten days after seeding, the seedlings were infested with first to third instars nymphs of BPH at the rate of approximately 3 to 5 nymphs per seedling. After infestation, the wooden seedling boxes with seedlings were covered with wire mesh wooden cages. The test plants were observed daily for damage by BPH. Damage rating of the test lines was done on a row basis when 90 per cent of the plants in the susceptible check row were killed. The test lines were graded using the Standard Evaluation System for Rice (SES) scale (IRRI, 1998). The criteria for brown plant hopper resistance-scoring used in this study (investigated when most of the Taichung Native 1 plants died) is given in Table 2:

Table 1: Rice varieties used in the present study and their parentage

S. No	Varieties	Parentage	Reaction to BPH as in previous literature
1	CO43	Dasal / IR20	Susceptible
2	IR50	IR2153-14-1-6-2 / IR28 / IR36	Resistant to bph 1 and 2 biotype and Susceptible to bph 3 and 4 biotype
3	ASD16	ADT31/CO39	Resistant
4	ADT36	Triveni / IR20	Moderately resistant
5	PTB18	Variety from Kerala	Resistant
6	BASMATI 370	Selection from Local cultivars of Punjab	Susceptible
7	IR44	IR1529-6803/CR94-13/IR480-5-9-3	Resistant to bph 1 and 2 biotype and Susceptible to bph 3 and 4 biotype
8	TN1	Local cultivars of Taiwan	Susceptible
9	IR36	IR1561-228 / IR244/*O. nivara* / CR94-13	Resistant to bph 1 and 2 biotype and Susceptible to bph 3 and 4 biotype
10	ASD7	Pureline-kar samba	Resistant
11	IR32	IR20 / *O.nivara* / CR94-13	Resistant to bph 1 and 2 biotype and Susceptible to bph 3 and 4 biotype
12	TKM9	TKM7 / IR8	Susceptible
13	RATHU HEENATI	Srilankan landrace	Resistant
14	IR64	IR5657-33-2-1/IR2061-465-1-53	Resistant to all biotypes
15	PTB33	Variety from Kerala	Resistant
16	W1263	Local land race from Andhra pradesh	Moderately resistant
17	PY3	IR3403-2671(PTB33 / IR36)	Moderately resistant
18	TKM6	GEB24/CO18	Moderately resistant
19	ASD18	ADT31/IR50	Resistant
20	PMK2	IR13564-149 / ASD4	Susceptible
21	TKM10	CO31 / C	Susceptible
22	ASD19	Lainakanda / IR30	Susceptible
23	ADT37	BG280-12 / PTB33	Susceptible
24	AZUCENA	Traditional japonica cultivar	Susceptible
25	ADT41	Mutant of Basmati370	Susceptible
26	IR26	IR24/TKM6	Resistant to bph 1 and 3 biotype and Susceptible to bph 2 and 4 biotype
27	IR38	IR20 / *O.nivara*/CR94-13	Resistant to bph 1 and 2 biotype and Susceptible to bph 3 and 4 biotype
28	MDU3	IR8 / Chithiraikar	Susceptible
29	PTB20	Variety from Kerala	Susceptible
30	IR30	IR1543-102-6-3/IR20/*O.nivara*	Resistant to bph 1 and 2 biotype and Susceptible to bph 3 and 4 biotype

Table 2: The criteria for brown plant hopper resistance-scoring (IRRI, 1988[13])

Score	Damage
0	None
1	Very slight damage
3	First and second leaves of most plants partially yellowing
5	Pronounced yellowing and stunting or about half of the plants wilting or dead
7	More than half of the plants wilting or dead and remaining plants severely stunted
9	All the plants died

Results and Discussion

Screening studies revealed that three varieties (Rathu Heenati, PTB 33 and ASD 18) to be resistant with damage score of 3 or less. Screening of rice varieties as a parameter for BPH resistance was done in the greenhouse using modified seed box screening test[3] developed at IRRI, Philippines. BPH

damage rating of 0-3 was considered as resistant while 3.1- 5 was considered as moderately resistant. Damage score rating from 5.1 to 7 was considered as susceptible while 7.1 to 9 was considered as highly susceptible. Screening studies revealed that three varieties (Rathu Heenati, PTB33, ASD18) were found to be resistant, twelve varieties (PTB 18, IR 36, TKM 9, ADT 37, IR 38, IR 64, W 1263, TKM 10, ASD 19, IR 26, ASD 16, AZUCENA) as moderately resistant, ten varieties (PMK 2, IR 30, ADT 36, ASD 7, IR 32, PY 3, IR 44, ADT 41, MDU 3, PTB 20) as susceptible and five rice varieties (CO 43, TKM 6, IR 50, Basmati 370, TN1) as highly susceptible. A test is considered as valid, when damaged leaves in susceptible check average at least 50 per cent [3]. Twelve varieties (PTB 18, IR 36, TKM 9, ADT 37, IR 38, IR 64, W 1263, TKM 10, ASD 19, IR 26, ASD 16, AZUCENA) were found to be moderately resistant to BPH with a damage score of 3.1- 5.0 whereas ten varieties (PMK 2, IR 30, ADT 36, ASD 7, IR 32, PY 3, IR 44, ADT 41, MDU 3, PTB 20) were found to be susceptible with a damage score of 5.1- 7.0. The other five rice varieties (CO 43, TKM 6, IR50, Basmati 370, TN 1) were categorized as highly susceptible with a damage score of 7.1- 9.0. The level of resistance to BPH among 30 varieties was evaluated based on the severity of symptoms caused by insects at the day on which TN 1; the susceptible control was completely killed by the insects. The mean damage score was minimum in Rathu Heenati (2.33) followed by PTB 33 and ASD 18 (3.00) whereas it was maximum in TN 1 (9.00). In the current study, the damage in all lines was recorded when susceptible check was damaged to tune of more than 70 per cent. The resistant reaction found in Rathu Heenati, PTB 33, and ASD 18 in this study was in conformity with the screening results of previous workers with Coimbatore BPH population [11]. The resistance reaction observed by earlier workers in case of ASD16 was slightly varied (as moderately resistant) in the current study. The susceptible reaction with respect to CO 43, TKM 6, IR 50, Basmati 370 and TN1 were also in accordance with the earlier reports [12].

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