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Evaluation of resistance in rice genotypes against the brown plant hopper (*Nilaparvata lugens* Stal)

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Abstract

Rice genotypes were evaluated for resistance to the Brown Plant Hopper (BPH), *Nilaparvata lugens* Stal in SVPUA & T Meerut, were evaluated for resistance in greenhouse screening tests. Over a period of two years (2017 and 2018), 17 rice cultivars were screened using the plant standard seed box screening technique. The results showed 6 rice varieties viz. REMRE-1, RPMRE-2, RPMRE-3, RPMRE-5, RIL-501 and PTB-33 were possessing high level of resistance to the BPH. 3 rice varieties viz., Vallabh Basmati-24, Pusa Sugandha-5, Taraori Basmati and Pusa Basmati-1 were moderately resistant. 4 rice varieties viz., Kasturi, Vallabh Basmati-23, Vallabh Basmati-22, Improved Pusa Basmati-1460 were moderately susceptible and 3 rice varieties viz., Pusa Basmati-6, Pusa Basmati-1121 and Pusa Basmati-1509 were susceptible, according to standard evaluation system (IRRI, 1992) Standard Seed Box Screening technique (SSST).

Keywords: Rice, germplasm, screening, *Nilaparvata lugens*, resistance

Introduction

Rice is one of the most important staple food crops of India for more than 2/3rd of its human population and it is the world's largest cereal crop providing the caloric need for millions of people. It is the predominant dietary energy source for 17 countries in Asia and the Pacific, 9 countries in North and South America and 8 countries in Africa. It provides 20% of the world's dietary energy supply. The nutrition value of rice depends on the strain of rice, nutrient quality of the soil grown in, its processing and preparation before cooking. The brown plant hopper, *Nilaparvata lugens* Stål (Homoptera: Delphacidae), is a destructive and widespread insect pest throughout the rice growing areas in Asia. The BPH feeds specifically in rice, using stylet like mouthparts to penetrate the plant tissues and sucks assimilates from the phloem. Feeding by a large number of BPH may result in drying of the leaves and wilting of the tillers resulting in a condition called 'Hopper Burn'. It also serves as a vector that transmits rice grassy stunt virus and ragged stunt virus, which are serious diseases in the tropical region (Du, *et al.*, 2007) [2]. In recent years, BPH infestations have intensified across Asia, causing heavy rice yield losses (Normile, 2008) [8].

Materials and Methods

Insect rearing

We used the method described by IRRI (Pathak and Khush 1977) [9] to rear the BPH. The insects were collected from the rice field and continuously rearing on rice plants under fine net cover. For screening purpose the rice genotypes were infested by Brown Plant Hopper insect in the field. The insects were reared on 35 to 45 day old rice plants, inside a 60×45×10cm seed box. This plastic seed box covered with a fine net cover to screen rice plants. The box bottom was open and setting in water. The original BPH insect population per box was started by 10-15 BPH adults. Eggs of about the same day age were obtained by placing the plants in a cage with BPH male and female adults for two days.

Screening procedures

For evaluating the BPH resistance of each rice genotype, the standard seed box screening technique was followed with some modifications (IRRI 1988) [4]. The experiment was conducted at a temperature of 28 to 30 °C and relative humidity of 70% to 80%. The seeds were pre-soaked and sown in rows in 60×45×10cm seed boxes.

4 to 5 seedlings per row were maintained per genotype. Twenty (20) day old seedlings were infested with first instar nymphs at the rate of eight to 10 per seedling. Approximately one week after infestation “Hopper Burn” symptom was

observed. The genotypes were scored as scoring system developed by the International Rice Research Institute (Harini A.S. *et al.* 2013) [3]. All of the screening was conducted in SVPUA&T Meerut, during the period 2017 and 2018.

Table 1: Criterion for brown planthopper resistance scores

Scale	Description	Reaction
0	No damage	Highly resistant
1	Very slight damage	Resistant
3	One to two leaves were yellowing or slight stunting	Moderately resistant
5	More than half the leaves shrunk	Moderately susceptible
7	More than half of the plant dead and remaining alive	Susceptible
9	Whole plant dead	Highly susceptible



Fig 1: Rice crop under standard seed box screening technique

Result

A set of 17 rice genotypes were screened for their reaction against BPH infestation. Screening was done as per the

methodology according to standard evaluation system (IRRI, 2010) [5] Standard Seed Box Screening technique (SSST). The rice varieties were pregerminated and transferred to plastic boxes containing well mixed standardized soil. Each seed box contains 10-15 rice seedlings. The boxes were covered by the fine net cover to enhance seedling growth. After sowing, the seed boxes were placed under field condition and 3-4 inches water level to provide sufficient humidity for the insect. When the seedlings were 9-10 days old with 2 to 4 leaves in the screening trays so that each seedlings has reared with 8-10 nymphs. Observation was recorded 10-12 days after releasing insects. The observation was recorded on the basis of 0-9 scale.

Table 2: Reaction of 17 rice germplasm lines against BPH infestation

S. No.	Rice varieties	Average damage score	Reaction	Result
1	Kasturi	5	Pronounced yellowing or some stunting	MS
2	Pusa Basmati-1	3	First and second leave partially yellowing	MR
3	Pusa Basmai-6	7	Mostly wilted plant but alive	S
4	Vallabh Basmati-23	5	Pronounced yellowing or some stunting	MS
5	Vallabh Basmati-24	3	First and second leave partially yellowing	MR
6	Pusa Basmati-1121	9	Whole plant dead	S
7	Vallabh Basmati-22	5	Pronounced yellowing or some stunting	MS
8	Improved Pusa Basmati-1460	5	Pronounced yellowing or some stunting	MS
9	Pusa Sugandha-5	3	First and second leave partially yellowing	MR
10	Taraori Basmati	5	First and second leave partially yellowing	MR
11	Pusa Basmati-1509	7	Pronounced yellowing or some stunting	S
12	REMRE-1	1	Partially yellowing of first leave	R
13	RPMRE-2	1	Partially yellowing of first leave	R
14	RPMRE-3	1	Partially yellowing of first leave	R
15	RPMRE-5	1	Partially yellowing of first leave	R
16	RIL-501	1	No visible damage	R
17	Pitambi-33	1	Partially yellowing of first leave	R

Out of 17 rice varieties, 6 rice varieties viz., REMRE-1, RPMRE-2, RPMRE-3, RPMRE-5 and PTB-33 showed the plant damage score of (0-1) 1, 1, 1, 1, 1 respectively i.e. resistant. 3 rice varieties viz., Vallabh Basmati-24, Pusa Sugandha-5, Taraori Basmati and Pusa Basmati-1, showed the plant damage score of (3-5) 3, 3, 5, 3 respectively i.e. moderately resistant. 4 rice varieties viz., Kasturi, Vallabh

Basmati-23, Vallabh Basmati-22, Improved Pusa Basmati-1460 showed the average plant damage score of (5-6.9) 5, 5, 5, 5 respectively i.e. moderately susceptible. 3 rice varieties viz., Pusa Basmati-6, Pusa Basmati-1509 and Pusa Basmati-1121 showed the average plant damage score of (7-9) 7, 7, 9 respectively i.e. susceptible.

Table 3: Summary of BPH reaction of 17 rice germplasm lines

Average plant damage score (Range)	Rice varieties	Reaction
0-1	6 Rice varieties (REMRE-1, RPMRE-2, RPMRE-3, RPMRE-5 and PTB-33)	Resistant
3-5	3 Rice varieties (Vallabh Basmati-24, Pusa Sugandha-5, Taraori Basmati and Pusa Basmati-1)	Moderately Resistant
5-6	4 Rice varieties (Kasturi, Vallabh Basmati-23, Vallabh Basmati-22, Improved Pusa Basmati-1460)	Moderately Susceptible
7-9	3 Rice varieties (Pusa Basmati-6, Pusa Basmati-1121 and Pusa Basmati-1509)	Susceptible

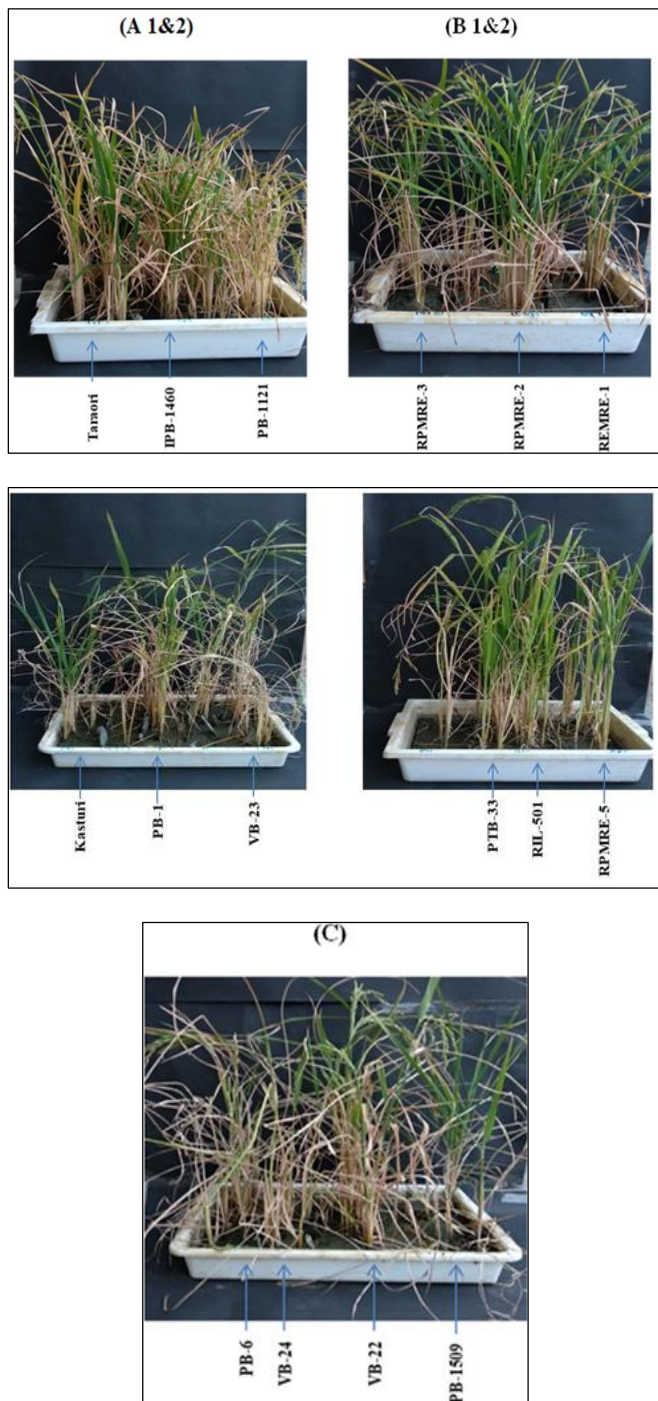


Fig 2: Evaluation of rice genotype according to standard seed box screening (SSST) technique. In figure A1: Taraori Basmati, IPB-1460, PB-1121, A2: Kasturi, PB-1, VB-23, B1: RPMRE-3, RPMRE-2, REMRE-1, B2: PB-1121, PTB-33, RIL-501, RPMRE-5, and C: PB-6, VB-24, VB-22, PB-1509

Discussion

Out of 17 tested rice genotypes collected from different sources only 6 were found to be resistant to the BPH (Table 2). IRRI has a wide range of resistance sources for BPH. The incorporation of resistance gene to improve the rice varieties is essential because our data showed that the frequency of the different rice varieties resistant to BPH was quite low. Jena and Kim (2010) [6] reported that Mudgo, ASD7, Raghu Hematic, Babawee, ARC10550, Swarnalata, T12, Chin Saba, Balama we are resistant donor. But the present study showed that some rice varieties had resistance to the BPH at the seedling stage in Seed box screening. Our study suggested

that the resistant rice variety should cultivated by farmers to avoid the yield loss due to BPH insect.

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