Int.J.Curr.Microbiol.App.Sci (2018) *7*(11): 3138-3143

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 11 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.711.360

Screening of Selected Rice Genotypes for Their Resistance against Brown Planthopper, *Nilaparvata lugens* (Stal)

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A B S T R A C T

Keywords

Rice genotypes, Resistance, Brown planthopper, *Nilaparvata lugens* (Stal)

Article Info

Accepted:
26 October 2018
Available Online:
10 November 2018

The development of biotypes and existence of variability in Brown planthopper population always demands for the identification of new sources of resistance from time to time. However, the presence of desirable quality and yield traits in the genotypes along with source of resistance to BPH will be an added advantage. Screening was carried out with 39such promising rice genotypes and three checks following standard seed box technique. The test revealed 17 genotypes to be moderately resistant with damage score ranging between 3.6 -5.0. Among 17 genotypes, KNM 2305 and RNR 21571 recorded lowest damage score of 3.6. Further investigations on presence of other mechanisms of resistance such as antixenosis, antibiosis and tolerance needs to be studied to identity the best genotype among the 17 genotypes that could to be used for developing BPH resistant / tolerant variety with desirable yield and quality traits.

Introduction

Rice is a major staple food grain as well as a major source of carbohydrate and energy in the daily diet of an average Indian and demand for rice is likely to increase with an ever growing population of the country. More than 90 per cent of the world's rice is grown and consumed in Asia where 60 per cent of the global population lives. It is cultivated in about 154 million hectares annually which is equivalent to 11 per cent of the world's cultivated land. Rice is affected by more than two hundred insect pests of which about a dozen are economically important (Grist and Lever, 1969) and brown plant hopper is one among them.

The brown planthopper, is a phloem-sap-sucking insect pest of rice (Sogawa, 1982). Both nymphs and adults suck the sap from the lower portion of the plant, which results in yellowing of leaves, reduction in tiller number, plant height, and finally results in unfilled grains. Feeding also causes reduction in chlorophyll and protein content of leaves followed by reduced rate of photosynthesis, in case of severe attack, it causes extensive plant mortality referred to as 'hopper burn' symptom. BPH also transmits rice grassy stunt virus (GSV) and ragged stunt virus (RSV) as a vector (Khush and Brar, 1991). In recent years, BPH infestations have increased across Asia, causing heavy yield losses in rice. As the popular rice varieties are susceptible to planthoppers, farmers are forced to depend solely on chemical pesticides for controlling this insect, which is expensive in terms of labour, cost and also pose environmental hazards. In addition, overuse of pesticides destroys the natural predators and leads to the development of insecticidal resistance, which results in pest resurgence. The best alternative for managing the pest is to follow integrated pest management using two important components *viz.*, first adoption of resistant or tolerant variety and second use of insecticides with different modes of action from time to time.

Materials and Methods

A set of 39 elite rice genotypes (Table 1) found promising during initial field screening trials conducted at Rice Research Centre, ARI, Rajendranagar having desirable yield traits were selected for screening studies along with resistant check (PTB33, BM-17) and susceptible check (TN1). Screening of selected rice entries was carried out in polyhouse by following Standard Seed box Screening Technique (Heinrichs *et al.,* 1985). The seeds of selected cultures were soaked in water for 24 hours by placing them in petri plates containing optimum quantity of water. The water was drained out after 24 hours and the soaked seeds were kept in the same petri plate for another 24 hours to allow proper germination. The pre-germinated seeds were planted in the plastic trays of size (45 x 35 x 10 cm) filled with fertilizer enriched puddled soil. The sown seeds were covered with thin layer of soil and watered as and when required.

First and second instar nymphs of BPH were released on 12-13 day old seedlings of the test entries by tapping heavily infested plants from oviposition cages on the screening trays, ensuring that each test seedling was 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 trays were rotated by 180˚ at frequent intervals for attaining even reaction of plant response to BPH infestation and to avoid the susceptible germplasm seedlings showing quick reaction compared to resistant. All the test entries were replicated thrice. A maximum of 20 entries with PTB-33 (resistant check) at the centre and TN1 susceptible cultivar on either side of the tray was planted/tray. The position of 20 entries that were planted in each standard seed box were also randomized in three replications. A total of six such standard seed boxes were set up to evaluate the resistance response of 39 test entries.

The infested seedlings were monitored until the susceptible check (TN1) seedlings showed 90 per cent mortality. When more than 90 per cent plants of the susceptible check, TN1 were killed, the scoring was done based on 0-9 scale using Standard Evaluation System (SES) developed by the International Rice Research Institute (IRRI, 2014) as detailed in Table 2. After scoring as per Standard Evaluation System (SES) the SSST entries were categorized as described in the Table 3 (Jegadeeswaran *et al.,* 2014).

Results and Discussion

Perusal of data (Table 2) revealed that, among 42 entries, two entries *viz.*, PTB 33 and BM 71 with damage score of 3.0 were found to be resistant (R), while 17 entries recorded damage score ranging from 3.6-4.9 showing moderately resistant reaction. Among the moderately resistant entries, 2 entries *viz.*, KNM 2305 and RNR 21571 registered damage score of3.6 while MTU 1010 and RNR 23079 showed 4.2 and 4.3 damage score, respectively. Similarly, 3 entries *viz.,* MTU 1001, RNR 11718 and KNM 2307 exhibited damage score of 4.4 followed by JGL 24423 (DS 4.5) (Table 4).

Table.1 Selected rice genotypes for mass screening against BPH following Standard Seed box Screening Technique (SSST)

S. No.	Rice Genotypes	Parentage / Cross	S. No.	Rice Genotypes	Parentage / Cross
1	BM 71	Vajram/ Darrington	22	KNM 1638	JGL 11727 × JGL 17004
2	PTB 33	Pure line selection from land race from Pattambi	23	KNM 3457	JGL 18799 × NLR 34449
3	KNM 2305	JGL 11471 × Himalaya 741	24	RNR 26100	Akshayadhan × RNR 2458
4	RNR1571	MTU 1010 × JGL 3855/MTU//1010/NLR 34449	25	RNR 26101	Akshayadhan × RNR 2458
5	MTU 1010	Krishnaveni/IR 64	26	JGL 24332	MTU 1010 × NLR 34449
6	RNR 3079	CR 1009/NLR145	27	KNM 4058	JGL 11470 × GEB 35
7	MTU 1001	Vajram/MTU 7014	28	KPS 7558	BM 71 × NLR 34449
8	KNM 2307	JGL 11727 × JGL 17004	29	JGL 25153	JGL17653/RP 2421
9	RNR 1718	MTU 1010/NLR 34449	30	Sinnasivappu	-
10	JGL 24423	MTU 1010 × NLR 34449/MTU/1010	31	Sabita	-
11	RNR 5838	Sumathi × IR 79216 – 141 – 1 – 3 – 3	32	WGL 962	BPT 5204/GEB 24//PTB 5204/Shathabdhi
12	RNR 0933	Sagar samba × BM 71	33	KPS 7988	Akshayadhan × BM 71
13	RNR 6111	MTU 1010 × Raasi	34	RNR 26121	RNR 17469 × BVM 1
14	RNR 993/2	2K3 – 339 – 7 – 5 – 1 – 3 × JGL/1798	35	KNM 4068	JGL 3844 × IR 8222-851/ MTU/1075
15	RNR 5792	Bhadrakali × NSN 20894	36	KNM 733	MTU 1010 × JGL 11470
16	IET 23993	IR64/ Ady. Selection @	37	RNR 23605	Pusa 1121 × BM 71
17	JGL 24527	JGL 11727 × RP 2421	38	RNR 23563	RNR 2458 × BM 71
18	KNM 4073	JGL 18047 × IR8222-851//MTU1075	39	RNR 23593	Yamini × BM 71
19	RNR 3595	Yamini × BM 71	40	RNR 23646-2	WGL 14 × MTU 1081
20	RNR 3606	Pusa 1121 × BM 71	41	RNR 26120	RNR 17469 × Tellahamsa//MTU/1010
21	RNR 3646-1	WGL 14 × MTU 1081	42	TN1	Dee-Geo-Wu-Gen/Tsai-yuan-chu

Table.2 Standard Evaluation System (SES) describing the damage score of plant based on its reaction to BPH incidence

Plant state	Damage Score
No damage	0
Very slight damage	1
Lower leaf wilted with two green upper leaves	3
Two lower leaves wilted with one green upper leaf	5
All three leaves wilted but stem still green	7
Plant is dead	9

Table.3 Categorization of levels of resistance based on damage score

S. No.	Reaction	Damage score range
1	Resistant (R)	1.0-3.0
2	Moderately Resistant (MR)	3.1-5.0
3	Moderately Susceptible (MS)	5.1-7.0
4	Susceptible (S)	7.1-8.9
5	Highly Susceptible (HS)	9.0

Table.4 Reaction of different rice cultures against BPH

S. No.	Rice Genotype	Mean Damage Score ± SE	Reaction	S. No.	Rice Genotype	Mean Damage Score ± SE	Reaction
1	BM 71	1.3 ±0.835	R	22	RNR 23606	6.0 ±0.200	MS
2	PTB 33	2.6 ±0.306	R	23	RNR 23646-1	6.0±0.200	MS
3	KNM 2305	3.6 ±0.400	MR	24	KNM 1638	6.1 ±0.067	MS
4	RNR 21571	3.6 ±0.400	MR	25	KNM 3457	6.6 ±0.133	MS
5	MTU 1010	4.2 ±0.033	MR	26	RNR 26100	6.7 ±0.067	MS
6	RNR 23079	4.3 ±0.291	MR	27	RNR 26101	6.8 ±0.000	MS
7	MTU 1001	4.4 ±0.200	MR	28	JGL 24332	6.8 ±0.000	MS
8	KNM 2307	4.4 ±0.333	MR	29	KNM 4058	6.8 ±0.067	MS
9	RNR 11718	4.4 ±0.333	MR	30	KPS 7558	7.4 ±0.067	S
10	JGL 24423	4.5 ±0.371	MR	31	JGL 25153	7.6 ±0.000	S
11	RNR 25838	4.6 ±0.200	MR	32	WGL 962	7.6 ±0.000	S
12	RNR 20933	4.6 ±0.231	MR	33	KPS 7988	8.3 ±0.467	S
13	RNR 26111	4.7 ±0.176	MR	34	RNR 26121	9.0 ±0.000	HS
14	SABITA	4.7 ±0.176	MR	35	KNM 4068	9.0 ±0.000	HS
15	RNR 25993/2	4.8 ±0.000	MR	36	KNM 733	9.0 ±0.000	HS
16	RNR 25792	4.8 ±0.067	MR	37	RNR 23605	9.0 ±0.000	HS
17	SinnaSivappu	4.8 ±0.067	MR	38	RNR 23563	9.0 ±0.000	HS
18	IET 23993	4.8 ±0.133	MR	39	RNR 23593	9.0 ± 0.000	HS
19	JGL 24527	5.0 ±0.000	MR	40	RNR 23646-2	9.0 ± 0.000	HS
20	KNM 4073	6.0 ±0.115	MS	41	RNR 26120	9.0 ± 0.000	HS
21	RNR 23595	6.0±0.115	MS	42	TN1	9.0 ± 0.000	HS

R - Resistant, MR - Moderately Resistant, MS - Moderately Susceptible, S - Susceptible, HS - Highly Susceptible

Further, two entries *viz.*, RNR 25838 and RNR 20933 (DS 4.6), two entries *viz.*, RNR 26111 and Sabita (DS 4.7), four entries *viz.*, RNR 25993/2, RNR 25792, Sinnasivappu and IET 23993 (DS 4.8) and one entry *viz.*, JGL 24527 registered damage score 5.0.

Among the remaining 23 entries, 10 entries were identified as moderately susceptible with damage score ranging from 5.1-7.0, while four entries were designated as susceptible which registered damage score ranging from 7.1 to 8.9. The remaining 9 entries including TN1 were found highly susceptible recording damage score of9.0. Several workers have reported PTB-33 as resistant to BPH which is being currently used as a resistant check in the screening studies (PrakashRao *et al.*, 1976, Jegadeshwaran *et al.*, 2014, Jena *et al.*, 2014, Bhanu *et al.*, 2014, Sarao *et al.*, 2016 and Thamarai *et al.*, 2017). Bhanu *et al.*, 2014 reported BM 71 as highly resistant culture against BPHwhich, in accordance with the results obtained in the present study. The present investigation has identified 17 moderately resistant donors which could be useful in breeding for developing resistant varieties against BPH. However, further investigations on presence of other mechanisms of resistance such as antixenosis, antibiosis and tolerance needs to be studied to identity the best genotype among the 17 genotypes that could to be used for developing BPH resistant / tolerant variety with desirable yield and quality traits.

Acknowledgement

My first and earnest, acknowledgement must go to my guide, Dr. P. Rajanikanth and members N.R.G. Varma, M. Sreedhar for their scholastic guidance, unceasing interest, valuable knowledge, technical advice. I thank all my teachers, friends and university for their cooperation and help during the research programme.

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How to cite this article:

Udayasree, M., P. Rajanikanth, N.R.G. Varma and Sreedhar, M. 2018. Screening of Selected Rice Genotypes for Their Resistance against Brown Planthopper, *Nilaparvata lugens* (Stal). *Int.J.Curr.Microbiol.App.Sci.* 7(11): 3138-3143. doi: https://doi.org/10.20546/ijcmas.2018.711.360