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In vitro Evaluation of Rice Genotypes for Brown Plant hopper (*Nilaparvata lugens* Stal.) Resistance

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ABSTRACT

A glass house experiment was conducted at Department of Entomology, IGKV, Raipur (Chhattisgarh), during 2014-15 to evaluate different rice genotypes for brown planthopper (BPH) resistance. A total of 392 rice genotypes were evaluated, of which 58 were from IRRI, 78 were aromatic types and rest 256 represented the local germplasm. Of 58 rice genotypes from International Rice Research Institute six *viz.* Ptb 33 (0.17), IR 03A159 (0.45), IR 09N522 (0.66), IR 07A179 (0.67), IR 08N136 (0.90) and IR 09N538 (0.91), were found to be highly resistant to BPH while 32.7% were resistant. Among the 78 aromatic rice genotypes tested for BPH reaction, eight were identified as resistant *viz.* Lua Nhe Den (1.66), Bong Cay (1.67), KDML 105 (1.94), UPR-2828-7-2-1 (2.39), IR 754286-3 (2.56), Improved Pusa Basmati 1 (2.79), Shyamjeera (3.00) and Longku Labat (3.00), while six as moderately resistant and rest as susceptible. In another set of experiment conducted with 265 rice germplasm, only 11.32% exhibited resistance to BPH, lowest plant damage score being recorded with 579004 (1.40), followed by 464205 (1.50) and 578983 (1.50) while 55 were moderately resistant and rest were susceptible.

Introduction

Rice (*Oryza sativa* L.) is a primary staple food crop for billions of people worldwide. India has the biggest area under rice cultivation, as it is one of the principal food crops. During the kharif marketing season 2012-13, Chhattisgarh recorded production of over 7.12 MT of paddy worth Rs 11,000 crore and was crowned as the rice bowl of India (FAO 2013). However, production of this crop is greatly hampered by several biotic and abiotic factors. Among the biotic factors brown planthopper (BPH), *Nilaparvata lugens* (Stal.) (Homoptera: Delphacidae) is consisted as one of the most important insect pest in rice. It was first reported as a sporadic pest of rice in 1927 around Tenali in Guntur district of Andhra Pradesh, India (Tirumalarao, 1950). Brown planthopper infest the rice crop at all stages of plant growth. The nymphs and adults of the insect are usually found at the bases of the canopy, where area is shady and humidity is high. As a result of feeding by both nymphs and adults at the base of the tillers, plants turn yellow and dry up rapidly. At early infestation, round, yellow patches appear, which soon turn brownish due to the drying up of the plants. The loss in grain yield due to this insect range from 10% in moderately affected fields to 70% in those severely affected. The damage to the standing crop sometimes reached 100%. Farmers mostly depend on chemical pesticides for the control of this pest. Though insecticide application is providing immediate control, ill effects like resurgence, secondary out break and development of resistance to insecticides are most common with BPH. Hence, cultivation of resistant rice varieties is the most economical and efficient method for the management of BPH (Renganayaki *et al*., 2002).

For over 50 years, the development of host plant resistance against these insect has been a major focus at the International Rice Research Institute (IRRI) and other national and international rice research canters (Peng and Khush, 2003; Brar *et al*., 2009; Jena and Kim, 2010). Standard seed box screening test has been effectively used for screening resistant lines (Heinrichs *et al*., 1985).

Chhattisgarh has relatively more virulent population of BPH. The international material which is being screened worldwide for BPH resistance may have the good source of host plant resistance against this pest. Hence the study was conducted to know the reaction of rice genotypes against Raipur BPH population.

Materials and Methods

Fifty eight entries received from IRRI (International Rice Research Institute) under IRBPHN (International Rice Brown Planthopper Nursery), 78 (Seventy Eight) aromatic rice genotypes provided by CANP (Aromatic Network Project) under DBT (Department of Biotechnology) and 265 rice germplasm were used for this study. The entries were evaluated by adopting internationally accepted standard seed box screening technique of IRRI. The rice varieties Ptb 33 and TN 1 were taken as resistant and susceptible check respectively.

Rearing of insect

Initially BPH population was collected from the rice field. The collected insects were reared and maintained in 45 days old host plants in separate culture room which was protected with wire mesh. The test and check genotypes were pre-germinated in petri dishes (10 cm diameter). Wooden box of standard size (50x40x7 cm) was filled with fine wet soil and levelled properly.

Each test entry was sown in single row containing 20 pre-germinated seeds with a spacing of 2 × 1cm including in middle separate rows of resistant check PTB33 and susceptible check TN1 were sown on borders and in between the rows of test entries respectively. After seven days of sowing, the seedling were infested with second and third instar nymphs of BPH at the rate of eight to ten nymphs per seedling constitutes an optimum population to differentiate the resistant and susceptible lines. The final damage rating was taken when the insect killed more than 90 per cent of TN l seedlings. The reactions were recorded on a 0-9 scale (IRRI - IRTP, 1975) as shown in Table 1.

Results and Discussion

The indiscriminate use of chemical pesticides with the aim to maximize crop productivity has witnessed severe consequences to environment. It not only leads to harmful effect on soil micro and micro flora but also greatly increases the chances of deleterious effect of residual toxicity on human and animal health. The demand for pesticide free food urgently requires the alternatives to the chemical pesticides. The use of resistant genotypes presents one of the viable options to this. With this aim the present work was focussed to screen the rice genotypes resistant to BPH. A total of 58 rice genotypes were collected from International Rice Research

Institute (IRRI) and screened for resistance to BPH. It was observed that the IRRI has a wide range of resistance sources for BPH although rice genotypes exhibited varied response to the Raipur BPH population. Table 2 enlists the average plant damage score of rice genotype entries from IRRI (IRBPHN). The results of 58 IRBPHN screening trials showed that the rice genotypes *viz.* Ptb33 (0.17), IR 03A159 (0.45), IR 09N522 (0.66), IR 07A179 (0.67), IR 08N136 (0.90) and IR 09N538 (0.91) were highly resistant. The BPH resistance of genotype Ptb33 has already been cited (Jairin *et al.*, 2007).

The average plant damage score of 32.7% of rice genotypes ranged from 1.00 to 3.00 and were categorized as resistant ones. The genotype IR 09A136 showed the least plant damage score (1.00) followed by IR 06M144 (1.13) and IR 06M143 (1.18).

In comparison to IRRI rice genotypes, aromatic rice and local genotypes were less resistant to BPH. Of 78 aromatic genotypes tested, only eight were categorized as resistant, Lua Nhe Den recorded the lowest plant damage score (1.66) followed by Bong Cay (1.67) and KDML 105 (1.94) while six were moderately resistant (Table 3).

Among 265 local rice germplasm tested, thirty genotypes were categorized as resistant while only 20.7% were moderately resistant. The genotype 579004 surpassed others with the lowest plant damage score (1.40) followed by 464205, 578983 (1.50) (Table 4).

Table.1 Standard for rating damage by brown planthopper (IRRI-IRTP, 1975)

Grade of damage	Rating*	Symptom
0	HR	No visible damage
1	R	Partial yellowing at first leaf
3	MR	First and second leaves partially yellow
5	MS	Pronounced yellowing and some stunting
7	S	Wilting and severe stunting
9	HS	All test plants dead

*HR = highly resistant; R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible; HS = highly susceptible

Table.2 Average plant damage score of rice genotypes (IRBPHN) against BPH, *Nilaparvata lugens* (Stal.)

S. No.	Designation	*Average plant damage score	**Rating
1	Ptb 33	0.17	HR
2	IR 03A159	0.45	HR
3	IR 09N522	0.66	HR
4	IR 07A179	0.67	HR
5	IR 08N136	0.90	HR
6	IR 09N538	0.91	HR
7	IR 09A136	1.00	R
8	IR 06M144	1.13	R
9	IR 06M143	1.18	R
10	IR 08N195	1.36	R
11	IR 06M150	1.47	R
12	IR 06N155	1.64	R
13	IR 04A115	1.69	R
14	IR 05N419	1.89	R
15	IR 10A110	1.89	R
16	IR 05N170	1.93	R
17	IR 06N234	2.05	R
18	TME80518	2.08	R
19	IR 10F203	2.25	R
20	IR 06N119	2.32	R
21	IR 10A155	2.38	R
22	IR 10F388	2.61	R
23	IR 09A152	2.63	R
24	IRRI 151	2.67	R
25	Pokkali	3.00	R
26	IR 10F336	3.01	MR
27	IR 09A228	3.22	MR
28	RP 4964-100-10-9-5-1-1	3.24	MR
29	IR 09N142	3.28	MR
30	IR 10N269	3.39	MR
31	IR 10N304	3.95	MR
32	IR 09F436	4.38	MR
33	IR 13146-45-2-3	4.54	MR
34	IR 09N500	4.97	MR

* Average plant damage score based on 3 replications

Table.3 Average plant damage score of aromatic rice genotypes against BPH, *Nilaparvata lugens* (Stal.)

S. No.	Accession No.	Designation	Source	*Average plant damage score	**Rating
1	CANP 421	Lua Nhe Den	VIETNAM/DRR	1.66	R
2	CANP 406	Bong Cay	VIETNAM/DRR	1.67	R
3	CANP 121	KDML 105	THAILAND/CBT	1.94	R
4	CANP 521	UPR-2828-7-2-1	PANTNAGAR	2.39	R
5	CANP 535	IR 75428-6-3	IRRI/DRR	2.56	R
6	CANP 309	Improved Pusa Basmati 1	IARI/DRR	2.79	R
7	CANP 168	Shyamjeera	RPR	3.00	R
8	CANP 422	Longku Labat	INDONESIA/DRR	3.00	R
9	CANP 496	JGL 1798	JGL/DRR	3.11	MR
10	CANP 510	Kh.Sakani	DRR	3.24	MR
11	CANP 410	Daw Leuang	THAILAND/DRR	3.25	MR
12	CANP 339	-	-	3.33	MR
13	CANP 412	Guinata	PHILIPPINES/DRR	3.67	MR
14	CANP 549	IET 18033 (RP 3644-9-5-3-2)	DRR	4.86	MR

* Average plant damage score based on 3 replications

Table.4 Average plant damage score of rice germplasm against BPH, *Nilaparvata lugens* (Stal.)

S. No.	IC. No.	*Average plant damage score	**Rating
1	579004	1.40	R
2	464205	1.50	R
3	578983	1.50	R
4	578984	1.70	R
5	578969	1.80	R
6	578979	1.80	R
7	465043	1.90	R
8	578674	2.00	R
9	578149	2.10	R
10	577517	2.30	R
11	577293	2.40	R
12	578401	2.40	R
13	578972	2.40	R
14	578717	2.50	R
15	579011	2.50	R
16	577390	2.60	R
17	578443	2.60	R
18	578992	2.60	R
19	464884	2.70	R
20	577663	2.80	R
21	578417	2.80	R

22	466399	2.81	R
23	578017	2.90	R
24	578144	2.90	R
25	464129	3.00	R
26	578102	3.00	R
27	578128	3.00	R
28	578137	3.00	R
29	579022	3.00	R
30	578927	3.00	R
31	578721	3.10	MR
32	578406	3.11	MR
33	578957	3.11	MR
34	579010	3.12	MR
35	578527	3.13	MR
36	578329	3.18	MR
37	578131	3.22	MR
38	578135	3.22	MR
39	578358	3.22	MR
40	579035	3.25	MR
41	466603	3.26	MR
42	579030	3.31	MR
43	466609	3.40	MR
44	463306	3.50	MR
45	578413	3.50	MR
46	463854	3.55	MR
47	578967	3.55	MR
48	578139	3.58	MR
49	578737	3.60	MR
50	579034	3.60	MR
51	578459	3.63	MR
52	578965	3.66	MR
53	463905	3.72	MR
54	578680	3.78	MR
55	577478	3.80	MR
56	578148	3.88	MR
57	579036	3.90	MR
58	463018	4.00	MR
59	462531	4.00	MR
60	577788	4.00	MR
61	578500	4.00	MR
62	578914	4.00	MR
63	579012	4.00	MR
64	579013	4.00	MR
65	578444	4.05	MR
66	578371	4.16	MR

*Average plant damage score based on 3 replications

Same kind of results was reported by Ali *et al*. (2012) the donors like Mudgo, ASD7, Raghu hematic, Babawee, ARC10550, Swarnalatha, T12, Chin saba and Balamawee showed no resistance to BPH. Most of the genotypes which were proven as resistant to BPH in earlier by different parts of the world, were found to be susceptible in our screening at Chhattisgarh, Bharat. Bhimrao *et al*., (2005) have screened 4324, 50423, 38,168, and 121 entries, respectively and stated 20, 555, 5, 7 and 3 varieties under resistant category. This study indicated that a major portion of the tested rice genotypes are resistant to the BPH population.

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