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Identification of New Sources of Resistance against Brown Plant Hopper

Research Article

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Abstract

One hundred twenty rice genotypes belonging to Plant Hopper Screening (PHS) and Multiple Resistance Screening Trials (MRST) received from All India Co-ordinated Rice Improvement Programme (AICRIP) during kharif 2013 were evaluated against Brown Plant Hopper under glasshouse conditions at G.B.P.U.A.T. Pantnagr. During present study RP 2068-18-3-and CR3006-8-2 were found resistant while 10 other entries were recorded as moderately resistant against this insect in PHS. Under MRST none of the entries showed resistant reaction however RP 4918-228(S) and PTB33 showed moderate level of resistance against BPH.

Keywords: Brown Plant Hopper; *Nilaparvata lugens*; *Oryza sativ*; Screening; Resistance

Introduction

Brown plant hopper (BPH), *Nilaparvatalugens* (Stal.) (Homoptera: Delphicidae) is a major pest of rice in several countries [1-3] where it cause 30-50% loss in yield [4,5]. Although, insecticides are used to control it in most of the agro-ecosystem, resistance in the rice genotype has been found to play significant role in reducing the population [6-8] and a number of varieties resistant to this insect pest are now available for commercial cultivation in many countries including India [9]. Substantial progress has been made in the area of evaluation of rice entries for resistance, however, promising varieties are not available for each and every agro-ecosystem including *tarai* and plains of Uttrakhand which are most frequently attacked by this pest. The present study was undertaken to identify the new sources of resistance against BPH so that resistant varieties could be developed for this region.

Material and Method

One hundred twenty entries ofPlant Hopper Screening trial (PHS) and Multiple Resistance Screening trial (MRST) received under All India Co-ordinated Rice Improvement Programme (AICRIP) *kharif* 2013were evaluated against brown plant hopper. In PHS PTB33 and RP 2068-18-3-5 were used as resistant check while TN1 was taken as susceptible check. In case of MRST Suraksha and PTB 33 were used as resistant check while TN1 was treated as susceptible check.

The adults of BPH were collected from stock culture maintained in glasshouse on TN1 since 2011. The stock culture was developed in aluminium rearing cages (200 X 80 X 92 cm) fixed with insect proof nylon net and glass. Approximately 10-15 adults were transferred on 50-60 days old potted plants of Taichung Native-1 (TN-1), placed in rearing cages. After one week adults were removed from pots. The cages were examined regularly for the presence of predators and

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other insect species. Whenever the predators or other species of insects were observed in the cages, they were removed to facilitate the development of BPH population.

Seed bed screening method was used for bulk screening of entries. The purpose of bulk screening was to reject the susceptible ones and to find out entries showing moderate to high level of resistance against BPH. All the screening tests were done in plastic tray size of 42cmx32cmx7cm in glasshouse.

Plastic petridishes were marked with respective entry number and fifty seeds of each entry were kept on double layered moist filter papers. Water was added to each petridish for seed soaking which was removed after 24 h. Thereafter, petridishes were placed in incubator maintained at 30 °C temperature for efficient germination.

The germinated seeds of each test entry were sown in the tray (42cmx32cmx7cm) with the help of forceps. Each tray was having 17 rows of different entries. Twenty pre-germinated seed was sown in each row and labelled. The distance between the rows was maintained at 2 cm apart, while distance between seeds was kept at 1 cm. Nine rows of entries were alternated with one row of susceptible check TN 1. After completing the sowing sufficient water was added to ensure the healthy growth of seedlings. At 12 days after sowing (DAS) tray was filled with 5 cm water level and each row was thinned to about 20 seedlings / row after which the 2nd and 3rd instar nymphs of BPH from the culture were distributed uniformly on the test entries at the rate of approximately 10 nymphs per seedling. Number of dead and surviving plant of each entry was counted at two day interval. The

Table 1: Reaction of AICRIP, PHS(2013) entries to *N. lugens* under glasshouse condition.

Ent No.	Designation	Cross	Per cent seedling mortality		Mean mortality (%)	Final score	Resistance grade**
			Istscreening*	IInd screening*			
PHS1	CR 3006-8-2	Pusa44/Salkathi	10 (5)	5 (1)	7.50	3	R
PHS 2	RP 5312-66-2-2-2-3-2	Samba Mahsuri/ Sinnasivappu	45 (7)	70 (9)	57.50	7	MS
PHS 3	RP 5320-124-10-1-2-2-1	Improved samba Mahsuri/Sinnasivappu	20 (5)	10 (5)	15.00	5	MR
PHS 4	IR 65482-7-216-1-2-B	IR 31917-45-3-2-2*3/*O. australieansis*	15 (5)	20 (5)	17.50	5	MR
PHS 5	IR 71033-121-15		80 (9)	75 (9)	77.50	9	S
PHS 6	C2485-7-3-45-1R	Khandagiri/IR 72402-B-P-25-3-1	100 (9)	85 (9)	92.50	9	S
PHS 7	CR 2702-62-6	Swarna/Ratna	80 (9)	75 (9)	77.50	9	S
PHS 8	GNV 05-02-1	Mutant of IR 64	75 (9)	45 (7)	60.00	7	MS
PHS 9	RAU 678-82-4	Sanlcheap-2/Sita	65 (9)	55 (7)	60.00	7	MS
PHS10	TN1	Check	100 (9)	100 (9)	100.00	9	S
PHS11	MTU 1121	BPT 5204/MTU DP 13	45 (7)	65 (9)	55.00	7	MS
PHS 12	RP Bio 4919-501	KMR3/ *O.rufipogon* BC2F14	95 (9)	40 (7)	67.50	9	S
PHS 13	CRK 27	FR42 B/ Pankaj	90 (9)	75 (9)	82.50	9	S
PHS 14	CR 2754-62-3	Swarna/Gayatri	80 (9)	100 (9)	40.00	7	MS
PHS 15	NDR 3325	NDR 3025-1/NDR 359	75 (9)	55 (7)	65.00	9	S
PHS 16	RP Bio 4919-409	KMR3/ O.rufipogon BC2F15	65 (9)	60 (7)	62.50	9	S
PHS 17	CR 2711-149	Tapaswini/Dhobanumberi	15 (5)	35 (7)	25.0	5	MR
PHS 18	HKR 06-47	PR 116/ HKR 96-54	55 (7)	55 (7)	55.00	7	MS
PHS 19	NDRK 50026	Vijeta/CSR 89 IR 23	75 (9)	65 (9)	70.00	9	S
PHS 20	PBT 33	Check	35 (7)	20 (5)	27.50	7	MS
PHS 21	CR 2274-3-1-2-1-1	Jalaprava/ Mahsuri	15 (5)	30 (7)	22.50	5	MR
PHS 22	R 2212-RF-75	Danteshwari/ Dagaddeshi	60 (7)	55 (7)	57.50	7	MS
PHS 23	TR 2004-029	Iet 15683/iet 15687	85 (9)	95 (9)	90.00	9	S
PHS 24	CR 2459-12-8	Swarna/IR 64	35 (7)	45 (7)	40.00	7	MS
PHS 25	KAUM 179-1		25 (5)	15 (5)	20.00	5	MR
PHS28	KAUM 179-4		20 (5)	25 (5)	22.50	5	MR
PHS29	KAUM 179-5		35 (7)	55 (7)	45.00	7	MS
PHS30	TN1	Check	100 (9)	100 (9)	100.00	9	S
PHS31	KAUM 179-6		45 (7)	85 (9)	65.00	9	S
PHS32	KAUM 179-7		75 (9)	75 (9)	75.00	9	S
PHS33	KAUM 180-1		40 (5)	75 (9)	57.50	7	MS
PHS34	KAUM 180-2		65 (9)	40 (7)	52.50	7	MS
PHS35	KAUM 180-3		75 (9)	55 (7)	65.00	9	S
PHS36	KAUM 181-1		90 (9)	85 (9)	87.50	9	S
PHS37	KAUM 182-1		20 (5)	25(5)	22.50	5	MR
PHS39	CB11 607	CB04 110/ADT 43	90 (9)	95 (9)	92.50	9	S
PHS40	RP 2068-18-3-5	Check	10 (5)	5 (1)	7.50	3	R
PHS41	CB11 565	CB04 110/ADT 43/BPT5204	80 (9)	30 (7)	55.00	7	MS
PHS42	CB 11 609	CB 04 110/JGL 1798	90 (9)	70 (9)	80.00	9	S

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PHS43	CB 602	CB 04 110/CB 05 501	95 (9)	70 (9)	82.50	9	S
PHS44	CB 08 702	IR 80013-B-141-4	55 (7)	80 (9)	67.50	9	S
PHS45	CB 06 803	PMK-3/ Norungan	100 (9)	100 (9)	100.00	9	S
PHS46	CB 06 563	ADT 37/IET 16618	65 (9)	75 (9)	70.00	9	S
PHS47	CB 126	BPT 5204/CO50	90 (9)	55 (7)	72.50	9	S
PHS48	CB 09 512	OR 1797-4/Varapukudanchan	85 (9)	90 (9)	87.50	9	S
PHS49	CB 09 516	RR 4065-381-245/UPR-2893-97	80 (9)	75 (9)	77.50	9	S
PHS50	TN1	Check	100 (9)	100 (9)	100.00	9	S
PHS51	TNRH 344	COMS 24A/CB 344R	75 (9)	70 (9)	72.50	9	S
PHS52	TNRH 337	COMS 23 A/CB 237 R	80 (9)	95 (9)	87.50	9	S
PHS53	TNRH 222	COMS 23 A/CB 222 R	80 (9)	75 (9)	77.50	9	S
PHS54	TRG 167	(Bph18)(IR 65482-7-216-1-2)	70 (9)	35 (7)	52.50	7	MS
PHS55	TRG 170	(Bph20/21)(IR 71033-121-15)	15 (5)	35 (7)	25.00	5	MR
PHS56	KNM 71	WGL 32100/NLR 34452/WGL 14377	100 (9)	70 (9)	85.00	9	S
PHS58	KNM 78	JGL 7046/NLR 34452/WGL 14377	55 (7)	70 (9)	62.50	9	S
PHS59	KNM 109	MTU 1010/JGL 13595	70 (9)	70 (9)	70.00	9	S
PHS61	KNM 110	MTU 1010/JGL 13595	30 (7)	60 (7)	45.00	7	MS
PHS62	KNM 113	MTU 1010/JGL 13595	55 (7)	95 (9)	75.00	9	S
PHS63	KNM 116	MTU 1010/JGL 13595	50 (7)	75 (9)	62.50	9	S
PHS64	KNM 118	MTU 1010/JGL 13595	50 (7)	25 (5)	37.50	7	MS
PHS65	KNM 120	MTU 1010/JGL 13595	45 (7)	70 (9)	57.50	7	MS
PHS66	KNM 122	MTU 1010/JGL 13595	35 (7)	55 (7)	45.00	7	MS
PHS67	KNM 124	MTU 1010/JGL 13595	15 (5)	35 (7)	25.00	5	MR
PHS68	KNM 134	WGL 32100/JGL 3844	70 (9)	55 (7)	62.50	9	S
PHS69	KNM 468	IET 20473/JGL 11118	95 (9)	85 (9)	90.00	9	S
PHS70	TN1	Check	100 (9)	100 (9)	100.00	9	S
PHS71	KNM 489	JGL 13595/JGL 11470	70 (9)	75 (9)	72.50	9	S
PHS72	KNM 539	JGL 11727/JGL 11470	55 (7)	70 (9)	62.50	9	S
PHS73	KNM 557	JGL 13595/JGL 11470	65 (9)	95 (9)	80.00	9	S
PHS74	KNM 561	JGL 13595/JGL 11470	**80**(9)	90 (9)	85.00	9	S
PHS75	KNM 563	JGL 13595/JGL 11470	80 (9)	85 (9)	82.50	9	S
PHS76	KNM 604	MTU 1010/JGL 11727	50 (7)	50 (9)	50.00	7	MS
PHS77	KNM 605	MTU 1010/JGL 11727	60 (7)	30 (7)	45.00	7	MS
PHS78	KNM 620	MTU 1010/JGL 11727	80 (9)	45 (7)	62.50	9	S
PHS79	KNM 637	MTU 1010/JGL 3855	70 (9)	70 (9)	70.00	9	S
PHS90	TN1		100 (9)	100 (9)	100.00	9	S

*Value in parenthesis indicates the rating score at each screening.
** I= Immune, HR= Highly Resistant, R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible

Table 2: Reaction of AICRIP, MRST(2013) entries to *N. lugens* under glasshouse condition.

Ent No.	Designation	Cross	Per cent seedling mortality			Mean mortality (%)	Final score	Resistance grade**
			Ist screening*	IIndscreening*	IIIrd screening*			
1	KAUM 166-2	Makom/PTB 9	65 (9)	60 (7)	65(9)	53.75	7	MS
2	KAUM 168-1	Pavizham/Arikkailari	60 (7)	65 (9)	75(9)	65.00	9	S
3	CB 07 540	ADT 39/Mutant	55 (7)	75 (9)	70 (9)	72.50	9	S
4	RNR 14956	NLR 34449/ JGL 3844	50 (7)	85 (9)	70 (9)	73.75	9	S
5	RNR 15038	MTU 1010/JGL 3855	60 (7)	65 (9)	85 (9)	63.75	9	S
7	RP Bio 4918-142	Swarna/O. nivaralls	65 (9)	75 (9)	70 (9)	77.50	9	S
8	RP Bio 4918-236	Swarna/O. nivara ILs	60 (7)	65 (9)	70 (9)	71.25	9	S
9	RP Bio 4918-24K	Swarna/O. nivara ILs	50 (5)	75 (9)	80 (9)	73.75	9	S
10	TN1	S. check	85 (9)	100 (9)	90 (9)	90.00	9	S
11	RP Bio 4918-248	Swarna/O. nivara ILs	75 (9)	55 (7)	55 (7)	61.25	9	S
12	RP Bio 4919-198	KMR3/ O. rufipogon	60 (7)	75 (9)	55 (7)	56.25	7	MS
13	RP Bio 4919-501	KMR3/ O. rufipogon	65 (9)	80 (9)	75 (9)	75.00	9	S
14	RP Bio 4919-40	KMR3/ O. rufipogon	35 (7)	60(7)	60 (7)	57.50	7	MS
15	RP 4918-221(S)	Swarna/O. nivara	65 (9)	60 (7)	50(7)	60.00	7	MS
16	RP 4918-228(S)	Swarna/O. nivara	15 (5)	20 (5)	25 (5)	20.00	5	MR

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17	RP Bio 4919-50-12	KMR3/ O. rufipogon	50 (7)	35 (7)	30 (7)	51.25	7	MS
18	RP Bio 4919-50-13	KMR3/ O. rufipogon	55 (7)	75 (9)	80 (9)	71.25	9	S
19	RP Bio 4919-363-5	KMR3/ O. rufipogon	50 (7)	65 (9)	65 (9)	66.25	9	S
20	Suraksha	R. check	20 (5)	30 (7)	30 (7)	27.50	7	MS
21	W1263*(DRR)		70 (9)	60(7)	45(7)	58.33	7	MS
22	SB 143		35 (7)	35 (7)	30 (7)	33.33	7	MS
23	SB 319		40 (7)	50 (7)	50 (7)	47.50	7	MS
24	SB 479		55 (7)	90 (9)	70 (7)	62.50	9	S
25	CO 43		40(7)	25 (5)	20 (5)	33.75	7	MS
26	PTB 33		25 (5)	10 (5)	25 (5)	20.00	5	MR
26	PTB 33		25 (5)	10 (5)	25 (5)	20.00	5	MR
27	W 1263 (CBT)		60(7)	35(7)	65(9)	56.25	7	MS
28	W1263*(ACC)		35(7)	50(7)	50(7)	48.75	7	MS
29	DRRH-2		45(7)	75(9)	60(7)	57.50	7	MS
30	TN1		100(9)	100(9)	100(9)	100.00	9	S

*Value in parenthesis indicates the rating score at each screening.
** I= Immune, HR= Highly Resistant, R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible.

final score was taken when the seedlings of susceptible check variety TN-1 became 100 percent dead. The rating was based on the following scoring system:

Rating scale

Scale	Percent dead seedlings	Level of resistance
0	0	Immune (I)
1	1-5	Highly resistant (HR)
3	6-9	Resistant (R)
5	10-25	Moderately resistant (MR)
7	26-60	Moderately susceptible (MS)
9	61-100	Susceptible (S)

In the above rating scale particulars in 'scale' 'and level of resistance' were taken from [9] but the ranges for percent dead seedlings were constructed to facilitate the rating based on percent seedling mortality due to BPH damage.

Results and Discussion

In Plant Hopper Screening trial (PHS) mean seedling mortality varied from 7.5 to 100 percent among 90 entries screened [Table 1]. Breeding lines RP 2068-18-3-and CR 3006-8-2 recorded 7.5 percent seedling mortality and rated as resistant against BPH. Moderate level of resistant (MR) was observed in RP 5320-124-10-1-2-2-1, IR 65482-7-216-1-2-B, CR 2711-149, CR 2274-3-1-2-1-1, KAUM 179-1, KAUM 179-4, KAUM 182-1, TRG 170 and KNM 124 which showed 15 to 25 percent seedling mortality. The rest of the entries were moderately susceptible or susceptible against brown plant hopper.

These results were in accordance with multilocation trials of AICRP [10] where breeding lines *viz.*, IR 65482-7-216-1-2-B, CR 2711-149, KAUM 179-1 and KAUM 182-1were reported as promising while tests entry CR 3006-8-2 reported resistant.

In the Multiple Resistance Screening trial (MRST) only one breeding line RP 4918-228(S) showed moderate level of resistance in which mean seedling mortality was 20 per cent. Resistant check PTB 33 also showed moderate level of resistance. Rest of the 28 entries showed 33.75 to 100 per cent mortality and exhibited moderate susceptibility to susceptible reactions against BPH presented in table 2. These results were in confirmation with trial conducted at Ludhiana in greenhouse where RP Bio 4918-228(S) was identified as promising with a mean damage score of 1.5 [10].

Conclusion

Results indicate that among all genotype screened CR 3006-8-2 and RP 2068-18-3-5 were found to be promising against brown plant hopper at Pantnagar and could be used in developing resistant varieties against BPH for *tarai* region of Uttrakhand.

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