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Phenotypic Screening of Rice Cultures for Resistance against Brown Plant Hopper (*Nilaparvata lugens* Stal) at Warangal, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Brown planthopper (BPH), *Nilaparvatalugens* Stal (Homoptera: Delphacidae), is one of the most destructive insect pests causing significant yield losses in rice production. During *Kharif,* 2021, a set of 91 rice cultures were screened against brown plant hopper (BPH) through standard seed box technique in screen house at Regional Agricultural Research Station, Warangal. Resistant checks RP 2068-18-3-5 recorded Damage Score (DS) of <3, Mo-1 recorded DS of 3.67, PTB 33 recorded DS of 3.29. Mean damage score was 8.94 in the susceptible check Taichung Native 1(TN-1) against BPH. The 2 entries viz., RPGP-1066-36-12-1-2 and WS-18-OYT-72/BPH were found to be highly resistant to BPH. RPGP-1386-3-1-1-1 was found to be resistant to BPH. 5 entries viz., BPT 3025, RPGP-1011-100-56-1-4-1, RPGP-2212-8-1-2-2, KNM 12505 and WS-18-AYT-10/BPH were found to be moderately resistant to BPH. Cultivation of resistant cultures will reduce the cost of plant protection against BPH in addition to protection of natural enemies and environment. The rice cultures exhibiting resistance against BPH may be helpful in crossing programmes to develop BPH resistant varieties which shall be used in IPM as a component.

Keywords: Brown plant hopper; rice cultures; seed box technique; resistance.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is a prominent staple food crop for more than 50% of the world population and it accounts for more than 50% of the daily calorie intake of the population [1]. Among the biotic liming factors, insect pests and diseases are the key biotic stress factors and limit rice production significantly. Among the serious insect pests of rice, brown planthopper (BPH), *Nilaparvatalugens* Stal (Homoptera: Delphacidae), is one of the most destructive insect pests causing significant yield losses [2]. These insects draw nutrients from the phloem of rice plants. High BPH populations can destroy a plant in a short period of time [3,4]. BPH can consume more than 28% of the total dry matter of rice plants infested at reproductive stage [5]. Many chemical insecticides are registered to control rice BPH, but unscientific and injudicious use of these insecticides may break the natural pestdefender ratio in the field [6,7]. Host-plant resistance is an important factor in developing an integrated pest management system in low-input farming conditions, especially in India. Development of resistant rice cultivars through host plant resistance is generally considered to be the most economic and effective way for controlling BPH damage. With this background this study was taken up and objective of this study was to identify promising resistant rice cultures against rice BPH.

2. MATERIALS AND METHODS

This study was conducted in screen house during *Kharif* 2021 at Regional Agricultural Research Station (RARS), Warangal.

2.1 Mass rearing of Insects (BPH)

Initial BPH population was collected from the rice fields of farmers in Warangal district. The BPH was mass reared on the susceptible rice variety Taichung Native 1 (TN1) [8]. The gravid females were collected with an aspirator and left on pre-cleaned 35 days old potted plants of TN1, placed in oviposition cages (45 x 45 x 60 cm) having wooden frames, glass top, door and wire mesh side walls. Twenty females along with five males were released per plant. The ovipositing insects were removed three days later and plants with eggs were taken out of cages and placed in separated cages for the nymphs to emerge. The emerged nymphs were then transferred to 15 days old TN1 seedlings raised in the germination trays. The seedling trays were changed as and when necessary. Using this technique, a continuous pure culture of the BPH was maintained.

2.2 Standard Seed Box Screening Technique

Twenty healthy seeds of the test entries were soaked in separate petridishes and water was removed after one day. The seeds were sprouted within 2 days and water was sprinkled on the germinated seeds to prevent drying. Took seed boxes (plastic trays) of size 50 x 40 x 7 cm and filled the box with fertilizer enriched puddled soil. Thirteen lines were drawn at equal distance in the seed box width wise leaving 4 cm gap at both the margins. Two lines were drawn with 5 cm space across theses lines in the center of the box lengthwise cutting all the horizontally drawn

Table 1. Criteria for BPH resistance score

Resistance score	Plant state
0	None of the leaves yellow or dried
1	One bottom leaf yellow
3	One or two leaves yellow or one leaf dried
5	One or two leaves dried or one leaf healthy
7	All leaves dried/ yellow but stem green
9	Plant dead

Table 2. Categorization of levels of resistance based on damage score

S.No.	Reaction	Damage Score Range
0	Highly Resistant	0-<1.0
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

lines. Thirty sprouted seeds of susceptible check TN1 were sown in the two border rows. In the middle row sow 30 sprouted seeds of resistant check PTB 33. In the remaining 20 lines (each line only ½ the width of the box), the test entries were sown with 15 sprouted seeds in each line. The boxes were covered so as to enhance seedling growth. When the seedlings were 8-10 days old with 2-3 leaves, 1st or 2nd instar hopper nymphs were released in the screening trays so that each seedling has 6-8 nymphs.

When 90% of the plants of the susceptible check line TN1 were killed, recorded the score for the entries for damage. Followed the below criteria for scoring the damage of individual plants.
Score on individual plant basis. Average the score of all the plants in a test line and report it as the damage score. 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) [9] as detailed in Table 1. After scoring as per Standard Evaluation System (SES) the SSST (Standard Seedbox Screening Test) entries were categorized as described in the Table 2 [10].

3. RESULTS AND DISCUSSION

During *Kharif,* 2021, a set of 91 entries were screened against brown plant hopper (BPH) through standard seed box technique in screen house. Among these entries, 8 entries viz., RPGP-1066-36-12-1-2 (DS 0.20), WS-18-OYT-72/BPH (DS 0.82), RPGP-1386-3-1-1-1 (DS 2.08), BPT 3025 (DS 3.46), RPGP-1011-100-56-1-4-1 (DS 3.64), RPGP-2212-8-1-2-2 (DS 3.30), KNM 12505 (DS 4.92) and WS-18-AYT-10/BPH (DS 5) were found promising against brown plant hopper. Resistant checks RP 2068-18-3-5 recorded Damage Score (DS)of <3, Mo-1 recorded DS of3.67, PTB 33 recorded DS of 3.29. Mean damage score was 8.94 in TN-1against BPH. The 2 entries viz., RPGP-1066-36-12-1-2 and WS-18-OYT-72/BPH were found to be highly resistant to BPH. RPGP-1386-3-1-1-1 was found to be resistant to BPH. 5 entries viz., BPT 3025, RPGP-1011-100-56-1-4-1, RPGP-2212-8-1-2-2, KNM 12505 and WS-18-AYT-10/BPH were found to be moderately resistant to BPH.

Previously several scientists have reported PTB-33 as resistant to BPH which is being currently used as a resistant check in the screening studies [11-15]. Udayasree et al., [16] reported that, of 39 promising rice genotypes screened, 17 genotypes were moderately resistant with damage score ranging between 3.6 -5.0 andamong 17 genotypes, KNM 2305 and RNR 21571 recorded lowest damage score of 3.6.

Similar to our findings, Soundararajan et al., [17] also recorded significantly low BPH population on PTB-33 followed by IR 64 and it was high in TN1. Jena et al. [18] reported that, of the 58 rice genotypes including 39 landraces from Odisha phenotyped against BPH population, 9 were highly resistant (HR), 9 as resistant (R) and 7 as moderately resistant (MR).

Deekshita et al. [19] evaluated 28 paddy advanced cultures for resistance against BPH and reported that 4 cultures viz., BPT 2789, BPT 2703, BPT 2787 and BPT 2688 were resistant with a damage score of 3.00 while remaining 24 genotypes viz., BPT2702, BPT 2717, BPT 2719, BPT 2741, BPT 2766, BPT 2768, BPT 2769, BPT 2678, BPT 2677, BPT 2680, BPT 2780, BPT 2781, BPT 2782, BPT 2783, BPT 2784, BPT 2786, BPT 2788, BPT 2790, BPT 2791, BPT 2793, BPT 2795, BPT 2796, BPT 2797 and BPT 2798 were found to be moderately resistant with a damage score of 5.00.

Prathima et al., [20] reported that, out of 45 rice genotypes screened, 12 genotypes had shown resistance reaction under both field and green house conditions to BPH. 3 genotypes viz., Siddhi-BC2F6 BPH BL-43, Siddhi-BC2F6 BPH BL- 30 andSiddhi-BC2F6 BPH BL-64 were resistant; 9 genotypes viz., Siddhi-BC2F6 BPH BL -11, SiddhiBC2F6 BPH BL-12, Siddhi-BC2F6 BPH BL-19, SiddhiBC2F6 BPH BL-24, Siddhi-BC2F6 BPH BL-52, SiddhiBC2F6 BPH BL-56, Siddhi-BC2F6 BPH BL-57, SiddhiBC2F6 BPH BL-60 and Siddhi-BC2F6 BPH BL-61were moderately resistant.

Host plant resistance has an ability to reduce BPH and it is a good and best alternative method for use of chemical insecticides. In this study reaction of rice cultures against BPH is revealed to us and the resistant cultures may be grown in BPH endemic areas. Further the highly resistant and resistant genotypes can be utilized in the rice breeding programmes to develop resistant varieties with high yield and other suitable traits. Cultivation of resistant cultures will reduce the cost of plant protection against BPH in addition to protection of natural enemies and environment. Molecular confirmation or confirmation through biochemical analysis would further enable us for using these resistant cultures as donor parents in crossing programmes for development of resistant rice varieties.

Table 3. Damage score of rice cultures against BPH in Rice at Regional Agricultural Research Station (RARS), warangal (standard seed box technique)

S.No.	Designation	Average Damage Score	S.No.	Designation	Average Damage Score
1	BPT 3025	3.46	47	KNM 7660	7.09
2	CB 18 156	5.15	48	KNM 10081	5.27
3	CB 17 135	8.67	49	KNM 12367	8.88
4	CB 18 107	8.23	50	KNM 12368	8.88
5	CB 16 217	8.27	51	KNM 12392	9.00
6	CB 16 660	6.50	52	KNM 12423	9.00
7	CB 16 618	8.67	53	KNM 12424	9.00
8	CB 16 580	5.54	54	KNM 12510	8.86
9	CB 16 566	9.00	55	KNM 12511	9.00
10	CB 16 605	8.60	56	KNM 11532	7.33
11	CB 16 656	9.00	57	KNM 11551	8.07
12	HWR-1-IR83784-5-28-B	9.00	58	KNM 11555	7.71
13	HWR-8-IR 54751-1-2-44-15-2-3-B	7.13	59	KNM 12504	8.54
14	HWR-15-IR 75870-5-8-5-B-5-B	9.00	60	KNM 12505	4.92
15	HWR-16-IR73382-80-9-3-13-2-2-1-3-B	8.33	61	KNM 12509	6.77
16	IBT-BPH 1	8.87	62	PTB 21	9.00
17	IBT-BPHM11	8.14	63	RDR-1199	9.00
18	IBT-BPHM12	9.00	64	RDR-1200	8.60
19	IBT-BPHM13	7.38	65	WGL 1533	8.18
20	IBT-BPHM15	9.00	66	RP 2068-18-3-5	0.16
21	IBT-BPHM16	9.00	67	WGL 1537	9.00

S.No.	Designation	Average Damage Score	S.No.	Designation	Average Damage Score
22	IBT-BPHM17	7.00	68	WGL 1543	9.00
23	IBT-BPHM19	8.60	69	WGL 1551	9.00
24	IBT-BPHM20	7.61	70	WGL 1557	9.00
25	IBT-BPHM23	8.23	71	WGL 1571	9.00
26	JGL 35076	9.00	72	WGL 1588	9.00
27	JGL 35085	6.08	73	WGL 1620	9.00
28	JGL 35158	2.60	74	WGL 1622	9.00
29	JGL 37180	6.27	75	WGL 1623	9.00
30	JGL 37216	7.73	76	WGL 1624	9.00
31	RP2068-18-3-5	0.43	77	WGL 1289	9.00
32	JGL 36175	9.00	78	WGL 1246	9.00
33	JGL 37088	8.54	79	RPGP-984-4-5-1-1-1-1	5.73
34	JGL 38021	9.00	80	RPGP-1066-36-12-1-2	0.20
35	JGL 38053	7.46	81	RPGP-1011-100-56-1-4-1	3.64
36	JGL 38067	8.20			
37	JGL 38071	9.00	82	RPGP-2022-412-21-3-2	5.40
38	JGL 38105	8.33	83	RPGP-2212-8-1-2-2	3.30
39	JGL 38125	8.00	84	RPGP-1386-3-1-1-1	2.08
40	JGL 38156	9.00	85	WS-18-AYT-10/BPH	5.00
41	JGL 38162	6.43	86	RMS-ISM-BpH33-24	9.00
42	JGL 38168	7.92	87	WS-18-OYT-72/BPH	0.82
43	JGL 38206	7.82	88	PTB33	3.29
44	JGL 38237	8.62	89	RP2068-18-3-5	2.10
45	JGL 38159	9.00	90	MO1	3.67
46	JGL 38190	7.10	91	ISM recurrent parent	9.00
	TN-1 (Susceptible check)	8.94#			

#Average of damage score of 356 seedlings in standard seed box test

Table 4. Reaction of rice cultures against BPH at RARS, warangal in standard seed box technique

S.No.	Designation	Reaction to BPH	S.No.	Designation	Reaction to BPH
1	BPT 3025	MR	47	KNM 7660	S
2	CB 18 156	MS	48	KNM 10081	MS
3	CB 17 135	S	49	KNM 12367	S
4	CB 18 107	S	50	KNM 12368	S
5	CB 16 217	S	51	KNM 12392	HS
6	CB 16 660	MS	52	KNM 12423	HS
7	CB 16 618	S	53	KNM 12424	HS
8	CB 16 580	MS	54	KNM 12510	S

S.No.	Designation	Reaction to BPH	S.No.	Designation	Reaction to BPH
9	CB 16 566	HS	55	KNM 12511	HS
10	CB 16 605	S	56	KNM 11532	S
11	CB 16 656	HS	57	KNM 11551	S
12	HWR-1-IR83784-5-28-B	HS	58	KNM 11555	S
13	HWR-8-IR 54751-1-2-44-15-2-3-B	S	59	KNM 12504	S
14	HWR-15-IR 75870-5-8-5-B-5-B	HS	60	KNM 12505	MR
15	HWR-16-IR73382-80-9-3-13-2-2-1-3-B	S	61	KNM 12509	MS
16	IBT-BPH 1	S	62	PTB 21	HS
17	IBT-BPHM11	S	63	RDR-1199	HS
18	IBT-BPHM12	HS	64	RDR-1200	S
19	IBT-BPHM13	S	65	WGL 1533	S
20	IBT-BPHM15	HS	66	RP 2068-18-3-5	HR
21	IBT-BPHM16	HS	67	WGL 1537	HS
22	IBT-BPHM17	MS	68	WGL 1543	HS
23	IBT-BPHM19	S	69	WGL 1551	HS
24	IBT-BPHM20	S	70	WGL 1557	HS
25	IBT-BPHM23	S	71	WGL 1571	HS
26	JGL 35076	HS	72	WGL 1588	HS
27	JGL 35085	MS	73	WGL 1620	HS
28	JGL 35158	R	74	WGL 1622	HS
29	JGL 37180	MS	75	WGL 1623	HS
30	JGL 37216	S	76	WGL 1624	HS
31	RP2068-18-3-5	HR	77	WGL 1289	HS
32	JGL 36175	HS	78	WGL 1246	HS
33	JGL 37088	S	79	RPGP-984-4-5-1-1-1-1	MS
34	JGL 38021	HS	80	RPGP-1066-36-12-1-2	HR
35	JGL 38053	S	81	RPGP-1011-100-56-1-4-1	MR
36	JGL 38067	S	82	RPGP-2022-412-21-3-2	MS
37	JGL 38071	HS	83	RPGP-2212-8-1-2-2	MR
38	JGL 38105	S	84	RPGP-1386-3-1-1-1	R
39	JGL 38125	S	85	WS-18-AYT-10/BPH	MR
40	JGL 38156	HS	86	RMS-ISM-BpH33-24	HS
41	JGL 38162	MS	87	WS-18-OYT-72/BPH	HR
42	JGL 38168	S	88	PTB33	MR
43	JGL 38206	S	89	RP2068-18-3-5	R
44	JGL 38237	S	90	MO1	MR
45	JGL 38159	HS	91	ISM recurrent parent	HS
46	JGL 38190	S		TN-1	HS

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

4. CONCLUSION

Among the test entries, 8 entries viz., RPGP-1066-36-12-1-2, WS-18-OYT-72/BPH, RPGP-1386-3-1-1-1, BPT 3025, RPGP-1011-100-56-1-4-1, RPGP-2212-8-1-2-2, KNM 12505 and WS-18-AYT-10/BPH were found promising against brown plant hopper. The 2 entries viz., RPGP-1066-36-12-1-2 and WS-18-OYT-72/BPH were found to be highly resistant to BPH. RPGP-1386-3-1 -1-1 was found to be resistant to BPH. 5 entries viz., BPT 3025, RPGP-1011-100-56-1-4-1, RPGP-2212-8-1-2-2, KNM 12505 and WS-18-AYT-10/BPH were found to be moderately resistant to BPH. Since most of the cultivating rice varieties are susceptible to BPH, identification of BPH resistant rice cultures will be very useful in development of BPH resistant rice varieties. These promising rice cultures can be exploited as resistant donors or may be considered for release of varieties if they are good at yield.

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DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Khush GS. What it will take to feed five billion rice consumers by 2030. Plant Mol. Biol. 2005;59, 1–6.
2. Park DS, Song MY, Park SK, Lee SK, Lee JH. Molecular tagging of the Bph 1 locus for resistance to brown planthopper (*Nilaparvata lugens* Stal.) through representational divergence analysis. Molecular Genetics and Genomics.2008; 280:163-172.
3. Huang Z, Shu L, Li X, Zhang Q. Identification and mapping of two brown planthopper resistance genes in rice. Theor. Appl. Genet. 2001;102:929-93.
4. Yang HY, Ren X, Weng QM, Zhu LL, He GC. Molecular mapping and genetic analysis of a rice brown planthopper (*Nilarparvata lugens* Stål) resistance gene. Hereditas 2002;136:39-43.
5. Sogawa K, Gallagher KD, Kenmore PPE. Pest management in tropical paddy ecosystems. Japanese J. Trop. Agric. (in Japanese with English abstract) 1994; 38:361-368.
6. Sarao PS, Mangat GS. Manage rice insect pests to get higher crop yield. Progressive Farming.2014;50:4–6.
7. Roy D, Chakraborty G. Bio-efficacy of novel chemicals and tribal pesticide-based integrated modules against brown planthopper in rice. International Journal of Tropical Insect Science.2022;42: 203–213
8. Heinrichs EA, Medrano FD, Rapusas HR. Genetic Evaluation for Insect Resistance in rice. In: Heinrichs E. A., Rapusas H and Medrano F. (eds) International Rice Research Institute, LosBanos, Philippines. 1985;1-356.
9. International Rice Research Institute. Standard evaluation system of rice (SES). 5th Edition. LosBanos; Phillipines; 2014.
10. Jegadeeswaran M, Anandakumar CR, Maheswaran M. Phenotypic screening of rice (Oryza sativa L.) varieties for brown planthopper [*Nilaparvata lugens* (Stal.)] resistance. Trends in Bioscience. 2014;7(16):2257- 2266.
11. PrakashRao PS, Israel P, Krishna AG. Brown planthopper attack in East Godavari. A.P., India. International Rice Research Newsletter.1976;1:17.
12. Jena M, Panda RS, Sahu RK, Mukherjee AK, Dhua U. Evaluation of rice genotypes for rice brown planthopper resistance through phenotypic reaction and genotypic analysis. Crop protection. 2014;78:119-126.
13. Bhanu KV, Satyanarayana PV, Reddy PS, Reddy AV. MTU IJ 206- 7-4-1 (BM 71), A new brown planthopper resistant donor with high levels of antixenosis and antibiosis effects. International Journal of Innovative and Applied Research. 2014; 2(12):35- 41.

14. Sarao PS, Sahi GK, Neelum K, Mangat GS, Patra BC, Singh K. Donors for resistance to brown planthopper *Nilaparvata lugens* (Stal.) from wild rice species. Rice Science. 2016;23(4) :1-6.
15. Thamarai M, Soundararajan RP. Reaction of rice genotypes against specific population of brown planthopper, *Nilaparvata lugens* (Stal.). Annals of Plant Protection Science. 2017;25(1):74-77.
16. Udayasree M, Rajanikanth P, Varma NRG, Sreedhar M. Screening of Selected Rice Genotypes for Their Resistance against Brown Planthopper, *Nilaparvata lugens* (Stal). Int.J.Curr. Microbiol. App.Sci. 2018;7 (11):3138-3143.
17. Soundararajan RP, Kadirvel P, Gunathilagaraj K, Maheswaran M. Mapping of quantitative trait loci associated with resistance to brown planthopper in rice by means of a doubled haploid population. Crop Science 2004;44:2214-2220
18. Jena M, Panda RS, Sahu RK, Mukherjee AK, Dhua U. Evaluation ofricegenotypesfor brown plant hopper resistance through phenotypic reaction and genotypic analysis. Crop Protection. 2015; 78:119-126
19. Deekshita K, Rao CVR, Rani CS, Kumari VP. Field screening of different paddy advanced cultures against brown planthopper, *Nilaparvata lugens*(Stal.). The Andhra Agricultural Journal. 2017; 64(2): 410-412.
20. Prathima Kumari B, Anusha Ch, Shravan Kumar R, Rajendra Prasad K, Hari Y. Screening of rice genotypes for their resistance against Brown Plant Hopper, *Nilaparvatalugens* (Stal.) under field and glasshouse conditions. Biological Forum- An International Journal. 2022; 14(3):1-5.

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