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EVALUATION OF WILD RICE ACCESSIONS FOR RESISTANCE TO BROWN PLANT HOPPER [NILAPARVATA LUGENS (STÅL.)]

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ABSTRACT

Brown plant hopper [*Nilaparvata lugens* (Stål.)] is one of the most destructive pests of rice, which causes significant yield losses worldwide. Identification of resistant varieties is very important as the biotypes of the pest is changing its behaviour from time to time and the earlier released resistant rice varieties showing susceptibility to the pest. Identification of new sources of resistance and verification of resistance reaction of already reported donors is very important. The screening of 53 wild rice accessions were carried out by standard seed box screening technique, mark probing technique and nymphal survival technique in the greenhouse in order to confirm the resistance and susceptibility. During screening, TN1 and PTB33 were used as susceptible and resistant checks, respectively. The results of standard seed box technique showed low damage score in twenty two rice accessions namely *Oryza latifolia*, MS:21, VS:39, VS:48, VS:62, VSR:6, VSR 14, VSR:33, VSR:54, VSR:74, VS:54, VS:83, VS:89, VSR:11, VSR:13, VSR:47, D:3, D:28, D:29, D:30, D:32, PTB 33 were categorized as highly resistant (HR). Higher number of probes was observed in the PTB 33 followed by MS: 42, VS: 48, *Oryza officinalis*, VSR: 54, VSR: 14

KEY WORDS
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resistant
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INTRODUCTION

Rice is one of the important cereal crops of the world and forms the staple food for more than 50 per cent of population. Even though, there are many constraints in rice production, insects' pests remain a constant problem in all the rice growing regions (Manikandan Narayanasamy *et al*., 2014). Brown planthopper (BPH), Nilaparvata lugens (Stal) (Hemiptera: Delphacidae) is a typical piercing sucking insect pest of rice (Oryza sativa L.; Poaceae), which feeds on phloem sap and thus affects the growth of rice and results in "hopper burn" in rice fields (Park *et al*., 2008). In addition to direct damage, BPH also transmits viruses, such as the ragged stunt virus and grassy stunt virus, and associated diseases to rice plants (Jena *et al*., 2006).Attempts to control brown planthopper with chemical pesticides have given rise to many problems, including elimination of natural predators, environmental pollution, resurgence and outbreak (Balakrishna and Satyanarayana, 2013).It is considered viable to search the available genotypes for sources of resistance against BPH for use in breeding programme. In 1966, International Rice Research Institute, Philippines started work on varietal resistance for BPH. Extensive damage by BPH in India was first observed in Kerala during 1973. Subsequently reports were received from Andhra Pradesh, Bihar, Haryana, Orissa, Punjab, Tamil Nadu, and Uttar Pradesh (Kalode 1974; Kulshrestha *et al*., 1974). Glass house screening is the primary method for identify of resistance donors further these isolated genotypes should be used for field screening then after identify the responsible gene for resistance. In this way, an attempt has been made in this study to examine the mass screening, probing marks and honeydew excretion for identification of new source of resistance against BPH. Moreover in the present WTO era where a lot of stress is given on quality parameters, the search for alternate methods of control becomes important (Tetarwal *et al*., 2014). Thus, the present studies were conducted to identify the new sources of resistance against brown plant hopper in rice.

MATERIALS AND METHODS

Screening for BPH Resistance

The material was evaluated for resistance against BPH in green house under controlled condition during *kharif* 2014. The screening methods includes (i) standard seed box Screening technique (SSST) developed at IRRI, (ii) mark probing technique and (iii) Nymphal survival technique.

Standard Seed Box Screening Technique

The experiment was conducted at a temperature of 28 to 30ºC and relative humidity of 70% to 80%. The seeds were pre-soaked and sown in rows in wooden trays ($50 \times 40 \times 7$ cm) along with resistant and susceptible checks. Each tray accommodated 20 test rows each with 20 seedlings, 2 middle rows of resistant

check of PTB 33, and 4 susceptible border rows of TN1.The wooden trays were placed in water in 7.5cm deep trays to maintain humidity suited to the insects and to keep away ants. Ten (10) 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 accessions were scored as scoring system developed by the International Rice Research Institute.

Probing mark test

Probing mark test was carried out according to methodology suggested by Natio (1964).For this purpose, seeds of different rice genotypes and check varieties *i.*e. TN1 and PTB 33 were germinated separately .Germinated seeds were sown in wooden trays containing well puddle soil. After seven days, the seedling of each variety was removed from trays and washed thoroughly with water and then transferred individually into 15cm long test tubes containing a few drops of water. One female (two days old) was introduced individually into each test tube and test tube was plugged with sterilized cotton swab. The female was allowed to make punctures on the seedlings for overnight (12hrs).There after; the seedlings were taken for staining in another tube containing 1.0 per cent erythrosine dye aqueous solution .Insects probing marks stained thereby counted visually after 30 minutes of staining. Three replicates were maintained for each rice genotypes and each replicate contains one seedling.

Nymphal survival test

The nymphal survival test shows the differences for survival of nymphs in different of wild rice accessions.The well germinated seeds of selected rice genotypes were sown in earthen pots filled with fertilizer enriched puddle soil. After 40 days, the plants were covered by the Mylar tube with ventilating windows. Then 10 nymphs (first and second instar) were released in such tubes then the open end of the tube covered by the muslin cloth and tied with rubber band. The plants were observed daily for survival of nymph and emergence of adult.

RESULTS

Standard seed box screening technique

Standard seed box screening technique was conducted to evaluate the 53 wild rice accessions against brown plant hopper. The results of phenotypic response of rice accessions to brown plant hopper screening at seedling stage (10 hoppers per seedling) indicated varied responses. The rice accessions were scored when TN1 showed hopper burn with a damage score 9. The results of standard seed box technique showed low damage score in twenty two rice accessions namely *Oryza latifolia*, MS:21, VS:39, VS:48, VS:62, VSR:6, VSR 14, VSR:33, VSR:54, VSR:74, VS:54, VS:83, VS:89, VSR:11, VSR:13, VSR:47, D:3, D:28, D:29, D:30, D:32, PTB 33 were categorized as highly resistant (HR).

Probing mark test

Probing mark test was conducted to evaluate the 53 wild rice accessions against brown plant hopper. Higher number of probes was observed in the PTB 33 followed by MS: 42, VS: 48, *Oryza officinalis*, VSR: 54, VSR: 14.TN1 shows the lowest number of probes which shows
highest susceptibility to brown plant hopper.

Nymphal survival test

survival test was performed to know antibiosis mechanism of resistance. Low Minimum average plant damage score by BPH through standard seed box technique tested against BPH was observed in Twenty two rice accessions namely *Oryza latifolia*, MS:21, VS:39, VS:48, VS:62, VSR:6, VSR 14, VSR:33, VSR:54, VSR:74, VS:54, VS:83, VS:89, VSR:11, VSR:13, VSR:47, D:3,

Table 1 : List of tested wild rice accessions

S. No	Accessions . No	S. No	Accessions No.No.	S. No	Accessions No.	S. No	Accessions No.	S. No	Accessions No.	S. No	Accessions No.
1	O.officinalis	11	VS:52	21	VSR:74	31	MS:17	41	VSR:35	51	D:30
2	O.latifolia	12	VS:62	22	VSR:76	32	MS:34	42	VSR:47	52	D:11
3	MS:3	13	VS:74	23	D:40	33	MS:50	43	VSR:53	53	D:32
4	MS:19	14	VS:98	24	D:24	34	VS:54	44	VSR:56	54	TN1
5	MS:21	15	VSR:6	25	D:31	35	VS:83	45	VSR:70	55	PTB 33
6	MS:32	16	VSR:14	26	D:13	36	VS:89	46	D:1		
7	MS:36	17	VSR:16	27	D:34	37	VSR:11	47	D:3		
8	VS:39	18	VSR:33	28	D:37	38	VSR:13	48	D:5		
9	VS:40	19	VSR:54	29	MS:6	39	VSR:26	49	D:28		
10	VS:48	20	VSR:58	30	MS:7	40	VSR:30	50	D:29		

Table 2 : Showing Reaction of Wild Rice Accessions Against Bph Through Standard Seed Box Technique

Sno	% Damage	Accession Number	Remark
0	No Damage	Oryza Latifolia Ms:21 Vs:39 Vs:48 Vs:62 Vsr:6 Vsr 14 Vsr:33 Vsr:54 Vsr:74 Vs:54 Vs:83 Vs:89 Vsr:11 Vsr:13 Vsr:47 D:3 D:28 D:29 D:30 D:32 Ptb 33	Hr
1	Very Slight Damage	Oryza Officinalis Ms:32 Vs:40d:13 Ms:50 Vsr:35 D:11	R
3	First And Secxond Leaf Of Most Plant Partially Damage Pronounced Yellowing And Stunting Of 10-25%Plants	Vs:52 Vsr:58 Vsr:70	Mr Ms
7	More Than Half Plant Yellowing And Damage	Ms:19 Vsr:76 D:40 D:31 D:37 D:5	S
9	Plant Dead	Ms:3 Ms:36 Vs:74 Vs:98 Vsr:16 D:34 Ms:6 Ms:7 Ms:17 Ms:34 Vsr:26 Vsr:53 Vsr:56 D:1 Tn1	Hs

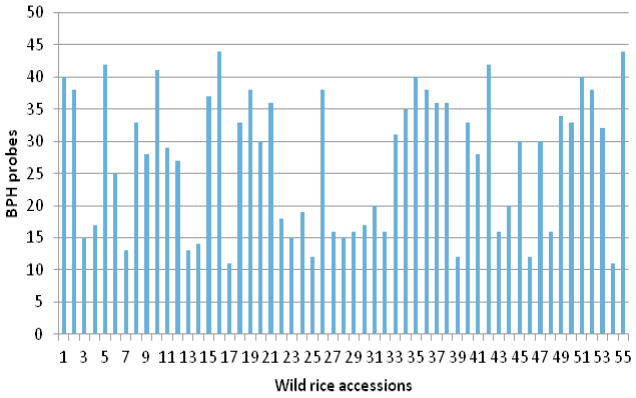

Figure 1:

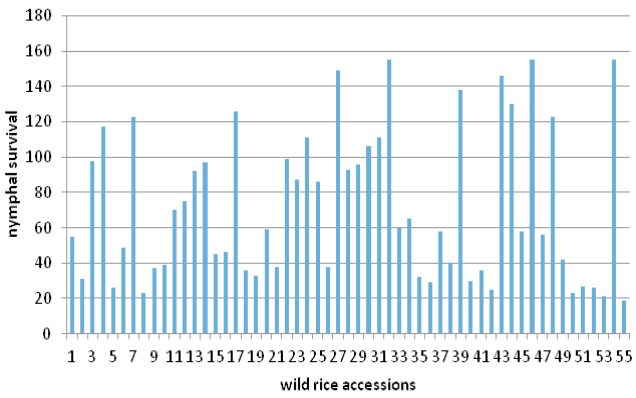

Figure 2 :

D:28, D:29, D:30, D:32, PTB 33 were categorized as highly resistant (HR).Maximum average plant damage score was observed in MS:3, MS:36, VS:74, VS:98, VSR:16, D:34, MS:6, MS:7, MS:17, MS:34, VSR:26, VSR:53, VSR:56 and D:1 and TN1 were categorized as highly susceptible.

The PTB 33 showed maximum probed marks (44.00), followed by *Oryza nivara*, MS: 42 (42), *Oryza nivara*, VS:48 (41),*Oryza officinalis* (40), *Oryza nivara* VSR:54 (38), *Oryza nivara* VSR:14 (38). The TN 1 had the minimum number of probed mark (13).The highly significant negative correlation (r = -0.94) was observed between average plant damage score and probe marks by feeding of brown plant hopper.

The PTB 33 showed minimum nymphal survival value followed by *Oryza nivara*, D:32 ,*Oryza nivara*, D:29 and *Oryza nivara*,D:11.The TN1 showed maximum nymphal survival value, followed by *Oryza nivara* , D:1 and *Oryza nivara* ,MS:34. The highly significant positive correlation (r= 0.89) was observed between average plant damage score and percent nymphal survival for brown plant hopper.

DISCUSSION

Present study reveals that some of the wild rice accessions showed higher degree of resistance against brown plant hopper. Minimum average plant damage score , minimum nymphal survival and maximum number of probes were shown by MS:21, VSR:14, VS:83, VS:89 VSR:47 , *Oryza latifolia* and PTB 33(Resistant check). The wild rice accessions found promising in all the three tests mostly belong to *Oryza nivara* group.

Santhalakshmi *et al*. (2010) reported the genotype Ptb 33 as highly resistant to Indian biotype, while the variety Swarna was found susceptible to BPH. Likewise Velusamy *et al*.(1995) conducted study on three wild rice species *viz Oryza officinalis*, *Oryza punctata*, and *oryza latifolia* to determine their mechanisms of resistance to *Nilaparvata lugens*. In a seed box screening test wild rice species had maintained their high level of resistance through the 48 h exposure to *Nilaparvata lugens* and significantly more individuals settled on susceptible TN 1 followed by cultivated resistant varieties. *Nilaparvata lugens* caged on resistant wild rice had show slow nymphal development, reduced longevity, low fecundity and low egg hatchability as compared to *Nilaparvata lugens* on cultivated resistant varieties**.**

Also the study is in accordance with the Pham Thi Mui and Bui Ba Bongwork (1999) They showed the wild rice species (O. rufipogon, O.officinalis, O. nivara) possessed a high frequency of resistant accessions (68.2% at scale 1-3) and almost all the traditional varieties in the Mekong Delta were susceptible to BPH.

Also Shri Chandana Bhogadhi *et al*. (2015)screened Rice Genotypes for Resistance to Brown Plant Hopper. They screened 20 rice genotypes in field by standard evaluation system (IRRI, 1992). Further these genotypes were screened by standard seed box screening technique (SSST), honey dew test and nymphal survival test in the greenhouse in order to confirm the resistance and susceptibility. The results of field screening and SSST showed low BPH damage score (3.0) in BM71, ACC5098, ACC2398, MTU1001, Rathuheenathi Low honeydew excretion and low nymphal survival rate was observed in BM71, ACC5098 and Rathuheenathi reflecting non-preference feeding behaviour and antibiosis mechanism of resistance, respectively.

Madurangi *et al*. (2010) evaluated the nature of BPH resistance in seventeen *O. nivara* (WRAC 01, 02, 04, 07, 11, 12, 14, 19, 21, 22, 24, 25, 35, 41, 46, 62, and 9864) accessions through standard seed box screening test. According to the results WRAC 04, 41, 25 and PTB 33 recorded as resistant (score 0-3), WRAC 46, 35, 24, 22, 21, 14, 7, 2,1, 9864 and Bg 379/2 as resistant to moderately resistant (score 3.1- 4.0), WRAC 11, 12 and Bg 300 as moderately resistant (score 4.1-5.0), WRAC 19 and 62 as moderately resistant to moderately susceptible (score 5.1-6.0), while no checked accessions were recorded as susceptible to the BPH indicating potential of using *Oryza nivara* as a source of BPH resistance.

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