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CONTENTS

Resistance in rice genotypes against brown planthopper, *Nilaparvata lugens* 14

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ABSTRACT: Nineteen rice genotypes were evaluated by standard seed box screening technique, honeydew test, nymphal survival method and days to wilt test for resistance against brown planthopper (BPH) under glasshouse conditions. Five genotypes, *IR* 36, IR-65482-7-2-216-1-2-B, PTB 33, RP 2068-18-3-5 and T12 were found to be resistant with a damage score ranging from 1.4 to 4.1. The resistant genotypes showed very less honeydew secretion and nymphal survival rate as compared to the susceptible entries, however, the days taken to wilt was comparatively longer on the resistant entries. Among the entries evaluated, RP 2068-18-3-5 was found to be the most resistant cultivar with a damage score of 1.4, secreting 22.75 mm of honeydew, 23.4 per cent nymphal survival and 18.6 days to wilt, respectively.

Key words: Brown plant hopper, days to wilt, genotypes, honeydew excretion, *Nilaparvata lugens*, nymphal survival, rice, resistance, screening, seed box technique

Rice has been the most important cereal crop of India, where almost 90 per cent of its population is entirely dependent on rice. Biotic stress is considered as the major limiting factor challenging the productivity of rice (Singh and Tiwari, 2020). Rice inhabits almost 800 species of insect pest limiting its production in field as well as during storage leading to an annual loss of 35.55 million tonnes (Dhaliwal *et al*., 2015). Brown plant hopper (BPH), *Nilaparvata lugens* (Stal) alone accounts for almost 60 per cent of yield loss both by sucking plant sap and transmitting viruses (Kumar *et al.,* 2012). Pesticides are the most popular approach for management of hoppers among farmers (Garrood *et al.,* 2016). However, injudicious and indiscriminate use of pesticides have resulted in environmental pollution, decreased natural enemies' population dynamics, resistance of many major insects (Yin *et al.,* 2008) and secondary outbreak of many minor insect and pests. In the advent of time increased awareness about the drawbacks of pesticide application have created a thrust for an alternative method of management of BPH. In this context, the concept of host plant resistance has emerged as an alternative approach of management of *N. lugens* since they are simple, easy to implement, environmentally safe and economically viable (Alam and Cohen, 1998; Renganayaki *et al.,* 2002). However, the status of resistance is subjected to vary or break with respect to geographical distribution or time. Thus, with a view to identify larger number of resistant cultivars the present study was undertaken to evaluate the reaction of different cultivars to BPH as well as to ascertain the mechanism responsible for the different degree of resistance.

MATERIALS AND METHODS

Rearing of Insect

The mass rearing of the brown plant hopperswas done in glass house under controlled conditions (Temp 27º±2° C and RH 70-80 %) on the susceptible cultivar Taichung Native 1 (TN-1). The stock culture of BPH is maintained at the Rice Entomology Lab, Dept. of Entomology, G. B. Pant University of Agriculture and Technology, Pantnagar since last 15 years. For conducting the experiments, 10-15 adults were taken from the stock culture and were released on pots planted with 30-40 days old TN-1 plants. The pots were then transferred to wire mesh rearing cages of dimension 1 x1.5 x1 cubic meters. The released adult mate and oviposit on the plants and after a week they were transferred to other plants which was followed by hatching of the eggs and emergence of first instar nymphs. However, for conducting the experiments second instar nymphs were preferred. The main constraint in rearing BPH in the laboratory was attack of several natural enemies' *viz.* mirid bugs, ants, spiders and lizards which was supervised regularly so as to eliminate them.

Planting Material

Rice genotypes were procured from ICAR-Indian Institute of Rice Research (IIRR), Hyderabad under Plant hopper special screening trial (PHSS-2020).

Standard Seed Box Screening Technique

The technique aims in mass screening of different genotypes so as to eliminate the susceptible variant and retain the entries with moderate to high level of resistance. In seed box method the seeds were pre-soaked in water for 24 hrs prior to sowing. Sowing is done in plastic trays of

dimensions 42cmx32cmx7cm. The trays accommodate 12 equidistant rows of different cultivars including 2 border rows with susceptible checks (TN-1). After 12 days when the plants attain 3-leaf stage, they were infested with first instar nymphs of BPH in such a way that each seedling gets 6-7 nymphs, respectively. Approximately after 6-7 days, when the border rows with susceptible check shows 90 per cent mortality, scoring was done based on the scoring system developed by International Rice Research Institute (IRRI, 2014).

Honeydew excretion test

The excretion of honeydew is most common in homopteran insects which act as an indicator of resistance when compared among different genotypes. The excretion of honeydew is measured with the help of filter paper stained with 4% bromocresol solution in ethanol with a hole at its centre through which a month-old rice cultivar is inserted and covered with mylar sheet. Five one day old females were starved for 2-3 hours and were then released on the rice cultivars. The adult BPH was allowed to feed for 24 hours. On feeding and excreting honeydew blue spots appear on the filter paper. The area of each spot was then calculated graphically.

Nymphal survival method

The test depicts the survival percentage of nymphs on different genotypes at 10 one day old nymphs were released on 30 days old rice plant and the numbers of surviving nymphs were monitored and depicted on daily basis until they become adult. The percentage nymphal survival can be determined by

Nymph survival percentage = (Number of adult emerged/Number of nymphs released) X 100

Days to wilt test

The level of tolerance of the above genotypes against the damage of BPH was determined by estimating the relative days to wilting after release of twenty-five 1st or 2nd instar nymphs on to 30days old cultivar. Observation on plant health was taken daily up to 40 days and days taken by the cultivar to wilt completely after release of nymphs was recorded.

RESULTS AND DISCUSSION

Standard seed box screening technique

Nineteen entries were screened and evaluated for different mechanism of resistance against *N. lugens* and the results indicated that damage score of the entries ranged from 1.4 to 9.0. None of the entries was found to be immune, however, IR 36, IR-65482-7-2-216-1-2-B, PTB 33, RP 2068-18-3-5 and T12 were found to be resistant with a damage score ranging from 1.4 to 4.1 (Table 1). Apart from that five entries *viz.,* ASD7 (Acc 6303), Chinasaba (Acc33016), IR-71033-121-15, Milyang 63 and Swarnalatha (Acc33964) were found to be moderately resistant with damage score ranging from 5.2 to 6.8 followed by the four entries *viz.,* IR64, Pokkali, TN1 and Ratu Heenati which were designated as moderately susceptible varieties. However, rest all genotypes were susceptible to *N. lugens* damage. The results corroborate the findings of IIRR, 2019 which states RP 2068-18-3-5as

Table 1. Reactions and mechanism of resistance of different genotypes of PHSS-2020 against Brown plant hopper, *Nilaparvata lugens* (Stal.)

S.No.	Entries	Damage Score (DS)	Honeydew extraction	Percent nymphal survival	Days to wilt	Level of Resistance (LR)
1	ASD7 (Acc 6303)	6.8	175.25	63	9.6	MR
2	Babawee	9.0	288.25	74.4	7.6	S
3	Chinasaba (Acc33016)	5.7	140.75	47.8	13.8	MR
4	IR 36	2.9	78.5	27	18.4	R
5	ARC 10550	9.0	286.5	60.2	7.4	S
6	IR64	7.9	353.5	71.4	11.4	MS
7	IR-65482-7-2-216-1-2-B	3.5	97.25	35.6	12	R
8	IR-71033-121-15	5.6	112.5	44.2	13.6	MR
9	Milyang 63	5.2	117.5	40.2	11.6	MR
10	MUTNS 1	9.0	451.5	76	6.6	S
11	OM 4498	9.0	616.25	86.2	9.2	S
12	Pokkali	7.2	187.25	38.2	9.8	MS
13	PTB 33	4.1	72.5	26.4	14.4	R
14	TN1	8.5	376.75	53.2	9.4	MS
15	Ratu Heenati	7.0	217.5	38.6	8.6	MS
16	Swarnalatha (Acc33964	5.3	107.75	40.4	10.6	MR
17	RP 2068-18-3-5	1.4	22.75	23.4	18.6	R
18	T12	2.5	58.5	25.8	16	R
19	TN1	9.0	706.75	80.6	7.2	S

(S: susceptible; **MS**: moderately susceptible; **R**: resistant; **MR**: moderately resistant)

the most resistant entry under Pantnagar conditions.

Honeydew excretion test

The amount of honeydew excreted was measured in mm^2 unit. The amount of sap ingested is directly proportional to the amount of honeydew excreted by the hopper where the susceptible entries excreted more honey dew. In the present study, maximum honey dew was excreted by the susceptible genotypes which ranged from 286.5 mm^2 to 706.75 mm^2 whereas the resistant genotypes excreted relatively lesser amount of honeydew ranging from 22.75 mm^2 to 97.25 mm^2 (Table 1). RP 2068-18-3-5 was found to be the most resistant genotype secreting 22.75 mm^2 honeydew followed by T12 (58.5 mm^2), PTB 33 (72.5 mm^2), IR36 (78.5 mm^2) and IR-65482-7-2-216-1-2-B (97.25 mm^2), respectively. The results corroborate the findings of Udyashree and Rajanikanth (2018) and Nugaliyadde *et al.*(2014) where a similar trend in honeydew excretion was observed.

Nymphal survival method

The test was performed to estimate the antibiotic effect of different genotypes against *N. lugens*. The results revealed that the survival percentage among the entries varied from 23.4 to 86.2 per cent. The nymphs were seen to survive less on the resistant entries *viz.,* IR 36, IR-65482-7-2-216-1-2-B, PTB 33, RP 2068-18-3-5 and T12. However, the least survival percentage was observed on RP 2068-18-3-5(23.4%). The results were more or less similar to the findings of Thamarai and Soundararajan (2017) who reported 26.27 per cent nymphal survival on the resistant check PTB 33. The survival percentage gradually increased when compared to the susceptibility of the rice genotypes where the maximum survival was observed in OM 4498 (86.2%) having a damage score of 9.0.

Days to wilt test

The experiment was conducted to determine the level of tolerance shown by different genotypes against *N. lugens*. Tolerance is one of the mechanisms of resistance which can be described as the inherent capacity of the cultivar to withstand the damage caused by *N. lugens*. In the present study it was observed that resistance was directly proportional to the number of days taken by the cultivar to wilt. The mean number of days taken by the genotypes to wilt ranged from 6.6 to 18.6 days (Table 1). The resistant entries RP 2068-18-3-5, IR 36and T12were seen to be highly tolerant to *N. lugens* since they wilted after 18.6, 18.4and 16 days, respectively. However, other two resistant entries *viz.*, IR-65482-7-2-216-1-2-B and PTB 33were comparatively less tolerant to BPH as they wilted after 12 and 14.4 days, respectively. The susceptible entry TN1 wilted just after 7.2 days. The results were in accordance with Bhanu *et al.,* 2014, who also reported that resistant cultivars showed a higher tolerance to BPH since they took longer days to wilt.

CONCLUSION

Thus, we conclude that out of all the 19 genotypes of PHSS, five genotypes namely IR 36, IR-65482-7-2-216-1-2-B, PTB 33, RP 2068-18-3-5 and T12 were found to be resistant to *N. Lugens* at Pantnagar. However, the screened genotypes must be evaluated further at multilocation to validate the resistant traits.

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