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In vitro assessment of different rice genotypes for resistance to brown plant hopper Nilaparvata lugens (Stal.)

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Abstract
Five hundred twenty rice genotypes were screened against BPH, (*Nilaparvata lugens (Stal*). Out of these, 5 genotypes were categorized as highly resistant, 128 as resistant, while 82 as moderately resistant and rest as moderately susceptible and susceptible to BPH. The average plant damage score of highly resistant genotypes was ranged from 0.50 to 0.91 whereas 1.00 to 2.98 in resistant and 3.01 to 5.00 in moderately resistant category. The average probing marks per seedling was ranged from 12.00 to 35.00. The genotype R1723-1413-357-1 had the highest (35.00) average probing marks followed by R1959-173-3-27-1 (31.80), R1600-1124-3-619-1 (31.20), BP10625-BB4-19-BB8 (30.80) and IR64 (30.60). The minimum average probing marks per seedling (11.30) was observed in susceptible check TN1. Significantly higher number of probing marks was found in all resistant genotypes as compared to susceptible check TN1. As regards to days required to wilt due to BPH feeding, the genotype IR78554-145-1-3-2 required the maximum days (35.80) followed by R1959-173-27-1 (35.60), IR64 (35.20) and Ganjeikalli (32.80). All the resistant genotypes had significantly higher number of days required to wilt in comparison to susceptible check TN1.

Keywords: Rice, Brown plant hopper, Screening, Mark probing, wilting test

Introduction
Rice (*oryza sativa* L. is prime food crop in India. In world rice has occupied an area of 156.1 m ha with a total production of 80 m. t. India is the second largest producer of rice after china an area of over 45.77 m ha with the production of 105.31 m.t. and average productivity is 2393 kg/ha (Anonymous 2012). More than 100 species of insects are pests of rice but nly about 2 of them are of major economic significance (Pathak and Khus 1979) [9]. Brown plant hopper (BPH) *Nilaparvata lugens* is one of the seriouspests of rice (Hung *et al*. 2001) [4]. And has become a major problem to rice production in many Asian countries. Application of insecticides is not advantageous always because of the tendency of the BPH for insecticides resistance resurgence and out breaks. Host plant resistance has played an important role in the management of pest successfully during past two decades. Several resistance varieties have been developed and grown in different area of India (Mathur et.al. 1999, Krishnaiah et.al.1999) [7, 6]. Screening of rice genotypes infestation is used tas tool to assess the resistance and susceptible of different genotypes. Present study reports some finding on this aspect.

Materials and Methods
The experiment was carried out in the glass house, department of entomology, collage of agriculture, indra Gandhi krishi vishwavidylaya, Raipur during 2013-2014. Screening of rice genotypes was carried out as per methodology suggested by (kalode *et al*. 1979) [5]. The test and check varieties were pre germinated I petridishes (10cm diameters) and these germinated seeds were sown I rows 5 cm apart in 50*40*7 cm plastic trays, containing well puddle homogenous soil. Each tray accommodated 10-12 rows o test entries with 25 seedlings in one row. In middle one row of resistant check Ptb 33 and at border two rows of susceptible check TN1 were sown. After attaining the age 7 to10 days sufficient number of first and second instars nymph were uniformly released n these seedlings so that each seedlings shall get infested with at least 8 to 10 nymphs. The observations were recorded on the basis of 0-9 scale, when more than 90 percent TN1seedlings were killed by the BPH infestation. The reaction was completed in 7-10 days after the release of insects. Observation of seedlings were taken on the basis of visual plant damage symptoms (0-9 scale) which are as follows: probing mark test was carried out according to methodology suggested by Natio (1964) [8].f for this purpose, seeds of identified resistant rice Genotypes and check varieties i.e.

TN1 and Ptb33 were germinated separately in Petri dishes. Germinated seeds were sown in wooden/plastic tray containing well puddle soil. After seven days, the seeding of each variety was removed from trays and washed thoroughly with water and then transferred individually into 15 cm long test tubes containing a few drops of water. One female was introduced individually into each test tube and test tubes were plugged with sterilized cotton swab. The female was allowed to make punctures on the seedling for overnight (12 hours): Thereafter, the seedlings were taken for staining in another tube containing 1.0 percent erythrosine dye aqueous solution. Insect probing marks stained therby counted visually after 30 minutes of staining.

*Score	Rating	Symtoms
0	Highly resistant	No visible damage
1	Resistant	Partial yellowing at first leaf
3	Moderately resistant	Partial yellowing first and second leaves
5	Moderately susceptible	Pronounced yellowing and some wilting
7	Susceptible	Pronounced yellowing and some wilting
9	Highly susceptible	More than halves of the plants are wilted o Remaining plants severely stunted All plant dead

*Mean score of plant damage was calculated (Anonymous 1996) [1]

Day to wilt test was carried out as per method adopted by Soundarrajan *et al*. (2004) [12]. For this experiment, well germinated seeds of test genotypes were sown in 500 ml earthen pots filled with fertilizers enriched soil. After 30 days, the plants were covered by Mylar tubes with ventilating windows. On such covered plants, twenty five (first and second instars) nymphs were released and the open end of the tubes was covered by muslin cloth with the help of rubber band. At the wilt stage (all leaf dried) of the rice genotypes the days required to attain it was noted. This observation was recorded up to 40 days after release of the test insect on rice genotypes.

Results and Discussions

A total of 520 rice genotypes procured from Department of Genetics and Plant Breeding. IGKV, Raipur were evaluated against BPH in glass house by adopting internationally accepted screening of 520 rice genotypes, 5 genotypes were categorized as highly resistant, 128 genotypes as resistant, while 82 genotypes as moderately resistant and rest as moderately susceptible and susceptible to BPH. The average plant damage score of highly resistant genotypes was ranged from 0.50 to 0.91 (Table 1). As per the norms of internationally scale for plant damage score, all these genotypes were ranked as highly resistant. The genotypes R1930-577-3-711-1 had the lowest plant damage score (0.50) followed by Ganjeikalli (0.57). Among the highly resistant genotypes, the genotype Chandrahasini had the highest plant damage score (0.91) followed by IR 10N253 (0.90). The resistant check Ptb 33 had the plant damage score of 1, whereas it was 9.00 in susceptible check TN1. The average plant damage score of resistant genotypes ranged from 1.00 to 2.98 (Table 2). The genotype R1921-504-2-574-1 showed the least plant damage score (1.00) followed by HR-852-13 (1.10) and IR64 (1.13), whereas it was highest in IRH-97 (2.98) followed by R1921-513-2-591-2, CR2713-179 (2.94) and R1532-1101-1-119-1 (2.80).

The average plant damage score of moderately resistant genotype ranged from 3.01 to 5.00. The genotype R1661-1372-1-601-1 showed least (3.01) plant damage score followed by R1656-3171-414-1 (3.03) and R1656-75-1-44-1 (3.05) while it was the highest in the genotype SUVT 333, R2032-462-1-501-1 (5.00) followed by R1661-605-84-1, R1138-688-3-533-1 (4.95) and R1607-28-3-19-1 (4.93). Similar finding have been reported by Anonymous (2002) [1], Su *et al*. (2006) [13] found that Kaharamana was resistant to biotype 1 of BPH with score 7.70. It was stated that Kaharamana was less resistant than Rathu Heenati whose resistant score was 0.40 on the other hand Tripathi (2012) [14] noted the genotype screened against BPH the genotype Ganjekalli had the least plant damage score (0.54) followed by R1688-2077-1-262-1 (0.63) due to BPH infestation.

Table 1: Plant damage score of highly resistant rice genotypes caused against BPH, *Nilaparvata lugens* (Stal.)

Designation Rating	Average plant damage Score
R1930-577-3-711-1 HR	0.50
Ganjeikalli HR	0.57
SUVT 313 HR	0.71
IR10N253	0.90
Chandrahasini S	0.91
Ptb-33 R	1.01
TN-1 S	9.00

*Plant damage score based on 0-9 scale, HR-highly resistant, R-resistant, S-susceptible

Out of 520 rice genotype, 16 resistant rice genotypes the average probing marks values per seedling were ranged from 12.00 to 35.00, although in resistant check Ptb33, the probe marks was 38.60 per seedling per female. Out of the sixteen genotype tested, R1723-1413-357-1 had the highest (35.00) average probing marks followed by R1959-173-3-27-1 (30.80) and IR64 (30.60), however these were statistically at par with each other. The average probing marks per seedling in resistant check Ptb 33 had the maximum number of probe marks (38.60) which was significantly higher than any other rice genotypes tested. Among all resistant genotypes tested, the genotype R1959-173-3-4-28-1 had the lowest (12.00) average probing marks per seedling followed by R1707-2291-3-2392-1 (12.30), R1656-1793-1-750-1 (12.40) and R1723-1411-1-355-1 (15.90) and there were statistically at par each other. The lowest average probing marks per seedling (11.3) was observed in susceptible check TN1. Similarly finding to the probing behavior of BPH on sixteen resistant rice genotypes sable (2010) [11] found that probing frequency ranged from 21.40 to 38.80 which was significantly higher than susceptible check TN1 (10.33). Similarly Rana and Dubey (2010) [10] studied probing marks behavior of BPH on 23 selected resistant rice donors. They found that the probing marks ranged from 13.10 to 25.10 which were significantly higher than susceptible check TN1 (10.33). They suggested that susceptible host received less probe marks owing to easier penetration of insect stylets as well as the adequate host sustainability to insect, in resistant host the more probe marks are the indication of unsuitability to the insect thereby insect exerting the extra efforts in quest of it. The resistance genotypes probably contain feeding deterrent, thereby restricted feeding activity by BPH, consequently the number of probes were also found increased. If nutritional require of insect was not fulfilled, insect did not continue to feeding deterrent like high phenol presence, which probably play the main factor to restrict the feeding of BPH on host plant. Similarly in another study, Verma (2013) [16] observed that the maximum number of probes was found in the genotype R

1688-2077-1-262-1 and Ganjeikalli. Both the genotypes R 1688-2077-1-262-1and Ganjeikalli had shown least average plant damage score, higher number of probe marks and identified as potential donors against BPH

Table 2: Probing mark and days to wilt on resistant rice genotypes against BPH

Designation	*Average Probing Marks	*Days to Wilt
R1959173-3-27-1 (6.04)	31.80 (5.66)	35.60 (6.04)
R1959-173-3-4-28-1	12.00 (3.49)	17.00 (4.22)
BP 10625-BB4-19-BB8	30.80 (5.61)	21.80 (4.77)
IR10N253	27.60 (5.30)	22.40 (4.83)
IR64	30.60 (5.55)	35.20 (4.83)
R2032-456-2-491-2	25.30 (5.07)	22.60 (4.84)
Chandrahasini	26.70 (5.20)	21.40 (4.72)
R1656-1793-1-750-1	12.40 (3.55)	20.20 (4.58)
IR78554-145-1-3-2	29.10 (5.42)	35.80 (6.05)
R1723-1411-1-355-1	15.90 (4.03)	26.40 (5.21)
R1723-1413-357-1	35.00 (5.93)	20.60 (4.63)
R1600-1124-3-619-1	31.20 (5.61)	23.60 (4.94)
R1707-2291-3-2392-1	12.30 (3.52)	29.00 (4.45)
R1700-2247-1-2313-1	26.70 (5.20)	28.20 (5.38)
R1656-430-10-1965-1	18.70 (4.40)	22.20 (4.80)
Ganjeikalli	25.10 (5.03)	32.80 (5.79)
TN-1	11.30 (3.46)	14.80 (3.96)
Ptb-33	38.60 (6.25)	37.00 (6.15)
SEm±	0.25	0.19
CD	0.72	0.54

Figures in the parentheses are square root transformed value
*Average mark probing includes ten replications
*Average days to wilt include five replication

Out of 520 rice genotypes, 16 resistant rice genotypes, Ptb-33 (Resistant Check) and TN 1 (Susceptible Check) were selected to study the days to wilt test. All these selected genotypes exhibited average days to wilting value varied from 17.00 to 35.80 days, which was dsignificantly higher than the susceptible check TN 1. Sixteen different rice genotypes tested for the days required to wilt due to BPH feeding had shown that the rice genotype IR78554-145-1-3-2 required the maximum days (35.80) followed by R1959-173-3-27-1 (35.60), IR64 (35.20), and Ganjeikalli (32.80) however, all these genotype were found statistically at par. The resistant check rice genotype Ptb33 had taken the maximum number of days (37) to show wilting due to BPH infestation which was statistically superior to any other rice genotype tested. All the highly resistant genotypes had significantly higher number of days required to wilt in comparison to susceptible check TN1. Similarly finding the days to wilting in 15 selected resistant rice genotype after infestation of brown Plant hopper Kumar (2011) revealed that in all the selected resistant rice genotype, average days to wilting value varied from 11.02 to 21.80 days, which was significantly higher than the susceptible check TN1. Whereas Verma (2013) [16] found that the days to wilting in selected rice genotypes after infestation of BPH ranged between 15.50 to 22.00 and the susceptible check required only 8.75 days. The time taken by all the thirteen highly resistant genotype to wilt was significantly more than the time taken by susceptible check TN1.

Out of 520 rice genotype screened against BPH, *Nilaparvata lugens* (Stal), 5 genotypes were categorized as highly resistant, 128 as resistant, while 82 as moderately susceptible and susceptible to BPH. Feeding behavior of BPH on sixteen resistant rice genotypes revealed that the genotype R1723-1413-357-1 had the highest (35.00) average probing marks followed by R1959-173-3-27-1 (31.80), R1600-1124-3-619-1 (31.20), BP10625-BB4-19-BB8 (30.80) and IR64 (30.60). Days to wilting by BPH on sixteen resistant genotype in was observed that the maximum number of days (35.80) required to wilting was noted in genotype IR78554-145-1-3-2 followed by R1959-173-3-27-1 (35.60), IR64 (35.20) and Ganjeikalli (32.80), However, in susceptible check TN1, it required 14.80 days to wilt due to BPH infestation.

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