**Resistance of selected rice varieties against brown plant hopper (*Nilaparvata lugens*) at Raisen District of Madhya Pradesh, India**

**Abstract**

The brown planthopper (Nilaparvata lugens) is one of the most economically damaging pests in rice cultivation, causing significant yield losses across major rice-growing regions. In this study, eighteen rice varieties were field-screened under natural infestation conditions in Madhya Pradesh to assess their resistance levels against BPH. Eighteen varieties of paddy (*Oryza sativa* L.) were screened under field condition during Kharif 2022 & 2023, to evaluate their performance against BPH. The trial was laid out in randomized block design with three replications, at RNTU ARC farm, Raisen. Susceptible and resistant check varieties were TN-1 and PTB-33, respectively. The population of *Nilaparvata lugens*, was recorded throughout the crop period at 10 days intervals. MTU 1060 recorded the lowest brown planthopper density, indicating it was the least preferred by the pest. Close behind were the genotypes PTB-33 and Poornima, which had similarly low populations of 1.16 and 1.47 hoppers per plant, respectively. Statistical analysis showed that the differences in pest density among MTU 1060, PTB-33, and Poornima were not significant, indicating that these three genotypes exhibited similar levels of resistance to brown planthopper infestation. These findings provide valuable insights for selecting region-specific resistant genotypes and could be effectively utilized in rice breeding programs and integrated pest management strategies to combat BPH in a sustainable manner.

**Key words:** paddy, brown plant hopper, genotype and *Nilaparvata lugens*

**Introduction**

Brown Planthopper (BPH) is indeed a devastating pest in rice cultivation, leading to substantial yield losses. As the authors rightly pointed out, the long-term and repeated use of chemical pesticides can result in the development of resistance in BPH populations. This underlines the necessity for more sustainable management strategies. Among these, the development and deployment of BPH-resistant rice varieties stands out as one of the most effective and environmentally sound approaches. The manuscript's emphasis on this aspect is timely and relevant.

Oryza sativa L. belongs to the angiosperm family Poaceae (Syn. Gramineae) It is one of the most widely cultivated crop in the world, providing the main source of nutrition for more than 60% of the world's population (Include reference). The anticipated total paddy production for 2022–2023 is 1357.55 lakh metric tonnes (LMT). Sustenance for almost 60% of the global populace. Numerous biotic and abiotic elements affect rice crops. Insect fauna is a major contributor to the reduced productivity among many other biotic stress components. Approximately 52% of the world's rice crop is lost each year as a result of biotic causes, with damages caused by insect pest fauna are accounting for 21% of this loss. “Major insect pest fauna of rice include the yellow stem borer (*Scirpophaga incertula*s Wlk), brown planthopper (*Nilaparvata lugens* Stal.), white backed planthopper (*Sogatella furcifera* Horvath), green leafhopper (*Nephotettix virescens* Distant), gundhi bug (*Leptocorisa acuta* Thumb), rice hispa (*Dicladispa armigera* Oliv), gall midge (*Orseolia oryzae* Wood Mason), leaf folder, (*Cnaphalocrocis medinalis* Gueni), rice horned caterpillar (*Melanitis leda* ismena Cramer), armyworm (*Mythimna seprata*), paddy skipper (*Pelopidas mathias* Fabricius) & case worm (*Nymphula depunctalis* (Guenee)) and recorded to cause frequent or sporadic damage to the crop” [Anonymous 1996]( Mandloi Rishikesh, et al., 2018). “Among all insect pest fauna, the hopper complex is one of the most consumptive pest complexes of rice causing enormous yield losses every year throughout the rice grown areas of Asia” (Park D.S. 2008) ( Mandloi Rishikesh, et al., 2018). “In Madhya Pradesh and Chhattisgarh area the brown planthopper (*N. lugens*) assumed greater importance due to it’s severe outbreak in 1975 and consequent yield losses reported to the extent of 34.3%” (Gangrade 1978). “The hopper complex causes direct harm as sucking pest and functions as vector for various paddy disease causing viruses, thereby considered to cause, considerable production losses in sensitive varieties every year” (Satpathi 2012). In the rice ecosystem, a high population of hopper complex is also favored by many suggested agronomical techniques, such as close plant spacing and excessive fertilizer application. Numerous issues, including pest resurgence, insecticide resistance, loss of natural enemies, emergence of novel biotypes, pesticide residues in grains, etc., have arisen as a result of attempts to control this pest chemically. This study was performed to screen resistant or tolerant rice genotypes and varieties as a tool for IPM programs.

**Material and Methods**

Eighteen genotypes were sown in Randomized Block Design (RBD) with 3 replications for evaluation against sucking insect pests’ complex. Observations on population density of sucking pests were recorded at 10 days’ intervals, starting with 10 days old transplanted rice. Sample unit was individual plant and 10 randomly selected plants were observed in every plot. Total numbers of white ears were also recorded at the dough stage of the crop. Incidence of insect pests on genotypes during Kharif 2022 and 2023 was studied.

Screening trials of paddy varieties against brown plant hopper (N. lugens) were conducted under field conditions at Agriculture Research Farm, Rabindranath Tagore University, Raisen (M.P.), during the years 2022 and 2023 (Kharif). The experimental material consisted of eighteen paddy varieties ( 1), including TN-1 and PTB-33 as standard susceptible and resistant checks, respectively. All varieties were collected from the different locations utilized for “All India Coordinated Research Project” on Paddy. A nursery of these varieties was prepared as per the recommended practices. Thirty-day-old healthy seedlings were transplanted in the field. Late transplanting was done to ensure maximum hopper infestation. The seedlings were transplanted in a randomized block design with three replications to evaluate them against brown plant hoppers. A single seedling was transplanted per hill. All the recommended agronomical practices were adopted during crop cultivation. Transplanting was done at a spacing of 15×15 cm to enhance the multiplication of sucking pests as proposed by Satpati *et al.* (2012).

Each plot contained 24 rows of test varieties, and each row was 2.10 m long with a total of 12 plants. 288 plants were contained in each plot. The susceptible check TN-1 plot and the resistant check variety PTB-33 were transplanted in a randomized manner. Fertilizers (N: P: K) were applied @ 100:50:30 kg/ha. No pesticide application was done against insect pests in the experiment area. The population density of brown plant hoppers was recorded at 10-day intervals, starting with 10-day-old transplanted paddy. The sample unit was an individual plant, and 10 randomly selected plants were observed in every plot. Population data on insect pests were subjected to analysis of variance at the 5% level of significance.

**Statistical analysis**

The population data of hopper complex on different varieties & genotypes were subjected to the statistical analysis of variance at 5% level of significant.

**Result and Discussion**

The seasonal average population of *Nilaparvata lugens*, commonly known as the brown planthopper, varied significantly across different paddy genotypes. The population density of brown planthoppers per plant ranged from a high of 20.71 hoppers on the TN-1 genotype to a low of 1.08 hoppers on the MTU 1060 genotype. Among the tested paddy genotypes, MTU 1060 recorded the lowest brown planthopper density, indicating it was the least preferred by the pest. Close behind were the genotypes PTB-33 and Poornima, which had similarly low populations of 1.16 and 1.47 hoppers per plant, respectively. Statistical analysis showed that the differences in pest density among MTU 1060, PTB-33, and Poornima were not significant, indicating that these three genotypes exhibited similar levels of resistance to brown planthopper infestation. Murty *et al.* (1988) also screened traditional paddy cultivars for resistance to brown planthopper in Madhya Pradesh, in 1987 and reported cultivars namely Anjania, Badidhan, Badshah Bhog, Bangoli 3, Budiya Bomko, Bansbhira, Barhi, Barik safed, Basangi, Lal Basant, Bataru, Benwar, Bewara, Baspatri and Chapdo to be resistant to BPH. In present tests the cultivar Badshah Bhog was also evaluated, however, its performance was not at par with the least susceptible entries. Chen *et al.* (1991) investigated several rice varieties in China for their resistance to *Nilaparvata lugens*. They reported good resistance in Indica strain IR 36. In present trials the IR 36 was also evaluated but its performance was not equivalent to the least preferred entries. Genotype Mahamaya was reported to be least susceptible in trials conducted by Oudhia *et al.* (1999) which do not match with the present rating, probably due to the fact that an altogether different range of entries has been evaluated that show promise as on date. Genotype Kranti suffered from moderate population of brown planthopper which is in conformity to the findings of Bhogadhi *et al.* (2015) who also reported the genotype to be moderately resistant. The resistant and susceptible checks used in the present experiment have been much studied earlier by several scientists. Genotype TN-1 has been reported to be susceptible by Chen *et al.* (1991), Nanda *et al.* (1999), Alice and Sujatha (2001) and Alagar *et al*. (2007). Workers like Bhattacharya *et al.* (1983), Kushwah et al. (1986), Reddy and Mishra (1995b), Suresh *et al.* (1999), Mandloi *et. al.* (2018) , Mai *et al.* (2017) etc have conducted field screening trials against rice sucking insect pests with different plant material which is not directly comparable to the present findings. Sukumar *et. al.,* (2022) report that “Six different rice entries along with susceptible and resistant check varieties were evaluated under glasshouse conditions for different parameters of antixenosis and antibiosis resistance against brown planthopper (BPH, Nilaparvata lugens Stål). In antixenosis studies, proportion of insects settled on test entries in relation to the susceptible control TN1 was recorded, with average lower proportion of nymphs settled on N22-CCDTM- 893 and Ptb 33 in relation to those on TN1. In antibiosis studies adult population, adult longevity and population build-up were recorded. N22-CC-DTM-893 and Ptb 33 displayed significantly better performance as compared to other test entries in these parameters studied and did not differ from each other”.

**Table 1: Seasonal mean population density/plant of *Nilaparvata lugens* on different varieties of paddy (Year 2022-23)**

|  |  |  |  |
| --- | --- | --- | --- |
| Genotype code | Genotypes |  |  |
| Year 2022 | Year 2023 |
| G1 | Kalinga | 4.93 (2.44) | 5.08 (2.46) |
| G2 | Vandana | 5.53 (2.55) | 5.81 (2.61) |
| G3 | Aditya | 12.77 (3.71) | 12.84 (3.72) |
| G4 | MTU1060 | 1.08 (1.44) | 1.01 (1.42) |
| G5 | Kranti | 4.05 (2.25) | 3.85 (2.20) |
| G6 | PR-103 | 12.09 (3.61) | 12.09 (3.61) |
| G7 | Poornima | 1.47 (1.57) | 1.40 (1.55) |
| G8 | Danteshwari | 14.73 (3.97) | 14.39 (3.92) |
| G9 | Indira Barani Dhan 1 | 11.41 (3.52) | 12.40 (3.66) |
| G10 | Pusa 1121 (PS-4) | 8.47 (3.08) | 8.67 (3.11) |
| G11 | Shymla | 6.16 (2.68) | 6.32 (2.70) |
| G12 | Kali Muchh | 5.54 (2.56) | 5.66 (2.58) |
| G13 | PB-1 | 16.89 (4.23) | 17.30 (4.28) |
| G14 | IR 36 | 8.49 (3.08) | 8.49 (3.08) |
| G15 | Karma Masuri | 17.00 (4.24) | 16.20 (4.15) |
| G16 | Mahamaya | 6.03 (2.65) | 6.33 (2.71) |
| G17 | TN-1 (Susceptible check) | 20.71 (4.65) | 23.87 (4.99) |
| G18 | PTB-33 (Resistant check) | 1.16 (1.47) | 1.12 (1.46) |
|  | SEm± | 0.07 | 0.06 |
|  | CD (5%) | 0.20 | 0.18 |

**Conclusion**: This indicates a consistent susceptibility, as evidenced by the large pest population. In contrast, Genotype G18 (PTB-33), designated as the resistant check, showed the lowest pest populations, with values of 1.16 and 1.12 across the two years, underscoring its effectiveness in repelling or resisting the brown planthopper. Notably, other genotypes also demonstrated varying levels of pest resistance. For instance, G4(MTU1060) and G7 (Poornima) reported low pest populations, suggesting moderate resistance, while genotypes like G13 (PB-1) and G15 (Karma Masuri) showed higher susceptibility with populations nearing those of the susceptible check. G10 (Pusa 1121) and G14 (IR 36) exhibited moderate susceptibility with moderate brown planthopper populations across both years.These findings highlight genetic variability in resistance, with some genotypes showing consistent performance across seasons. The inclusion of standard checks, TN-1 and PTB-33, helped establish baseline susceptibility and resistance, respectively, for comparison across genotypes.

**Disclaimer**

Option 1:

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 the writing or editing of this manuscript.

**References**

Alagar M, Suresh S, Saravanan PA. (2008). Feeding behavior of *Nilaparvata lugens* on selected rice genotypes. *Ann. Pl. Protec. Sci*; 16:43-45.

Alice and Sujeetha. (2001). The effect of 7 rice cultivars on the population of rice brown plant hopper (BPH), Nilaparvata lugens. *Environmental Entomology* 13 : 1271-1278.

Anonymous. Standard Evaluation System, IRRI, Philippines, 1996, 20.

Bhattacharyya PR, Bhattacharyya AK and Verma SK. (1983). Reaction of some rice germplasms to planthopper and Hyderabad population of brown planthopper Nilaparvata lugens (stal*.). Indian Journal of Entomology* 45(2): 108-119.

Bhogadhi SC and Bentur JS. (2015). Screening of rice genotypes for resistance to brown plant hopper biotype 4 and detection of BPH resistance genes. *International Journal of Life Sciences Biotechnology and Pharma Research* 4(2).

Chen DM, Yuan QC, Hu GW, Tang J, Ma JF, Chen ZX and Pan QW. 1991. Non preference and antibiosis evaluation of BPH, Nilaparvata lugens in japonica and indica varieties. Acta Agriculturae Shanghai 7(2): 10-15.

Chen W, Shen K, Li J and Zhang R. 2005. Seasonal trend of light-trap collections of brown planthopper [Nilaparvata lugens]. *Journal of Southwest Agricultural University* 27(3): 285-292.

Gangrade GA, (1978). Insect pests of summer paddy in India. International Rice Research Newsletter; 3(6):16.

Kumar and Tiwari (2010). New sources of resistance against rice brown plant hopper, *Nilaparvata lugens* (Stal.) Indian Journal of Entomology.; 72(3):228-232.

Kushwaha KS, Mrig KK and Singh R. (1986). Field evaluation of rice for whitebacked planthopper (WBPH) and leaf folder (LF) resistance. International Rice Research Newsletter 11 (1): 8-9.

Oudhia P, Pandey N, Tripathi RS and Ganguli RN. (1999). Response of different hybrid rice varieties to brown planthopper Nilaparvata lugens (Stal.) (Hemiptera: Fulgoridae). Insect Environment 5 (1): 10-11.

Park DS, Song MY, Park SK, Lee SK, Lee JH. (2008). Molecular tagging of the Bph locus for resistance to brown plant hopper. Journal of Entomology and Zoology Studies lugens Stal) through planthopper (*Nilaparvata* representational divergence analysis. Molecular Genetics and Genomics. 2008; 280:163-172.

Reddy KD and Misra DS. 1995b. Varietal response of rice against brown plant hopper, Nilaparvata lugens stal. *Indian Journal of Entomology* 57 (3): 169-178.

Mandloi Rishikesh, *et al*. (2018). Field screening of rice (*Oryza sativa* L.) varieties & genotypes against hopper complex. *Journal of Entomology and Zoology Studies;* 6(3): 487-490

Mai TV, Yoshimura A and Yasui H. (2017). Characterization of resistance to the green rice leafhopper (Nephotettix cincticeps Uhler) in a core collection of land races in rice (Oryza sativa L.). *American Journal of Plant Sciences* 8: 236-256.

Murty B, Sahu RK and Shrivastava MN. (1988). Short duration donors for brown planthopper resistance. *International Rice Research Newsletter* 13 (16): 16-17.

Satpathi CR, Chakraborty K, Acharjee P. (2012). Impact of seedling spacing and fertilizer on brownn plant hopper, *Nilaparvata lugens* Stal. Incidence in rice field. *J Biol. Chem. Res*; 29(1):26-36.

Sukumar S., Kennedy J. S., Raveendran M., Balasubramani V. and Pushpam R. (2022) Antixenosis and antibiosis mechanism of resistance in selected rice entries against brown planthopper, *Nilaparvata lugens* (Stal). *Eco. Env. & Cons*. 28 (October Suppl. Issue); pp. (S367-S372).

Sogawa K, Liu GJ, Shen JH. (2003). A review on the hyper susceptibility of Chinese hybrid rice to insect pests. *Chinese Journal of Rice Science*; 17:23-30.

Suresh S, Paramasivan KS and Muppidathi N. (1999). Screening of F1 rice hybrids against brown planthopper Nilaparvata lugens. *Madras Agriculture Journal*.86 (7/9): 481-483.

Singh Beant, Shukla KK. (2008). Screening of rice germplasm against stem borers and white backed planthopper. *Indian Journal of Entomology*; 34(2):157-159.

Sri Chandana Bhogadhi, Bentur JS. (2015). Screening of rice genotypes for resistance to brown plant hopper biotype 4 and detection of BPH resistance genes. *International Journal of Life Sciences Biotechnology and Pharma Research*; 4(2):90-95.

Yarasi B, Sadumpati V, Immanni CP, Reddy V, Venkateswara RK. (2008). Transgenic rice *O. sativa* expressing Allium sativum leaf agglutinin (ASAL) exhibits high level resistance against major sap-sucking pests. *BMC Plant Biology*; 8:102.