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# Broadening Genetic Base of Rice and Identification of Pre-Breeding Lines for Resistance to Brown Plant Hopper, *Nilaparvata lugens* (Stål.)

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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

Pre-breeding includes basic research to achieve wide crosses and facilitate the use of exotic materials or wild relatives for both qualitative and quantitative traits. The main objective is to provide breeders with more 'attractive' PGR that are easier to use, i.e. resistance sources in acceptable genetic background; or inbreeding tolerant forms of out crossing species for hybrid breeding. Forty seven pre-breeding lines were evaluated against Brown Plant Hopper under glasshouse condition over a period of two years (2018 and 2019). Out of these, two pre-breeding lines were moderately resistant to BPH having score 3. Two pre-breeding lines were moderately susceptible to BPH having score 5, five lines were susceptible having score 7 and rest thirty nine pre-breeding lines were highly susceptible to BPH with a score of 9.

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## 1. INTRODUCTION

The variability and germplasm resources available for many cultivated varieties are becoming extremely limited. As additional genetic resources are required to enrich the germplasm, unique and imaginative procedures are required to exploit fully the potential of our crop plants. Utilization of wild species therefore, is one method designed to introduce additional germplasm into cultivated varieties. Variability in the cultivated germplasm for economic traits such as resistance to rice tungro virus, sheath blight, yellow stem borer, drought and salt tolerance is limited. This necessitated search for the genes in secondary and tertiary gene pool of genus *Oryza.* Fortunately, wild species are important reservoir of useful genes for resistance to major disease and pests. Pre-breeding may be very much useful for development of 'Base' or 'Buffer' populations from genetically extremely diverse materials useful to farmers and professional breeders. Brown plant hopper (BPH), *Nilaparvata lugens* (Stal.) (Homoptera: Delphicidae) is a major pest of rice in several countries, where it cause 30-50% loss in yield. Rice (*Oryza sativa* L.) is a diploid (2n = 24) self pollinated crop widely grown in tropical agro - climatic zone around the world. Rice being cultivated in warm and humid tropical conditions is prone to high insect pest attack. It is estimated that approximately 52 per cent of global rice production is lost annually by biotic stresses (insects, diseases, weeds, etc.), of which one -fourth is due to insect pests [1]. Rice is attacked by more than hundred species of insects, of which around 20 cause significant economic damage and one among them is brown plant hopper. It is a very dangerous pest; under favourable conditions its population can increase rapidly and result in plant death in large areas known as "hopper burn" [2]. It is also reported to cause huge yield losses every year in East and South Asian countries [3]. The brown plant hopper is a serious insect pest of rice, especially in tropical Asia, where rice crops are continuously cultivated [4]. In recent years, BPH infestations have intensified across Asia in response to resurgence inducing insecticides resulting, in heavy rice yield losses [5-6]. The BPH also transmits viruses such as rice ragged stunt (RRSV) and rice grassy stunt (RGSV), which cause severe losses [7-8]. The use of resistant rice varieties is the most economical and efficient method for controlling the BPH [9-12]. Therefore it is imperative to identify BPH-resistance genes from diverse sources and incorporate them into rice cultivars by the use of modern molecular tools with a view to widening the genetic base so as to enable the reliable use of BPH resistance breeding. Thus we undertook a screening evaluation to determine the reaction of different breeding lines of wild rice derivatives against BPH biotype to identify cultivars that can be used as donors in the rice breeding program.

## 2. MATERIALS AND METHODS

### 2.1 Insect Rearing

We used the method described by IRRI [13] to rear the BPH. The source insects were collected from the field and continuously reared in greenhouse for screening purpose. The insects were reared on 40- to 50-day-old rice plants (susceptible variety TN1) inside a 0.5 × 0.5 × 1.0 m cage. This cage consists of a steel frame covered with a fine mesh wire screen. The cage bottom was open and setting in water. Potted plants were changed as needed. Each cage could accommodate several potted plants that could support 2,000 to 3,000 late-instar BPH nymphs. The original colony per cage was started by 30–40 gravid adults. Eggs of about the same day age were obtained by placing the plants in a cage with gravid adults for two days.

### 2.2 Screening Procedures

The experiment was conducted in net house condition during wet seasons (2018 and 2019) at National Rice Research Institute, Cuttack and described by Heinrichs *et al*. [14] were adopted in this study. Forty seven pre-breeding lines along with one susceptible check TN1 and one resistant check PTB-33 were screened for BPH. Pre germinated seeds of each entry (at least 25 seeds /entry) were sown in 3 cm apart in the wooden box including susceptible check TN-1 and resistance check PTB-33. Twelve days after sowing, the seeds were infested with 3-5 nymph per seedling. After infestation the wooden seed boxes with seedling were covered with cages. Three replications for each genotype along with control were maintained. The test plants were daily observed for BPH damage. After 20 days of infestation, hopper burn symptoms appeared due to BPH damage on test lines. When damage rate of 90% was observed in susceptible lines then

test lines were scored on 1-9 scale using SES for rice [15]. Each accession was scored on individual plant basis as 0 (no visible damage), 1 (partial yellow of 1st leaf), 3 (1st and 2nd leaf yellow), 5 (yellow and stunting or half of the plant wilted/dead), 7 (more than half of the plants dead) and 9 (All plants dead).

## 3. RESULTS AND DISCUSSION

Out of forty nine pre-breeding lines including susceptible check TN1 and resistant check PTB-33, no lines are having score 1. Two lines were moderately resistant to BPH having score 3. The resistant lines were EC796771, EC796772 (Table-1). Two lines were moderately susceptible having score 5, five lines were susceptible having score 7 and thirty eight lines were highly susceptible to BPH having score 9. Timmangouda and Mahaswaran [16] evaluated 25 rice varieties and reported three resistant varieties (Table 1, Fig. 1, Fig. 2). Ali *et al*., [17] reported 87 genotypes and Bhogadhi *et al*. [18] also reported three resistant varieties. Score 3 and 5 were reported by 4% each of the accessions; 10% of the accessions reported score 5 and score 7 was reported by 80% of the accessions.

**Table 1. Screening of pre-breeding lines against BPH with their SES score in control condition**

| SL No. | Damage score | No. of pre-breeding lines | Genotypes |
|---|---|---|---|
| 1 | 0 | | - |
| 2 | 1 | 1 | PTB-33 (check) (Resistant control) |
| 3 | 3 | 2 | EC796771, EC796772 |
| 4 | 5 | 2 | EC796762, EC796750 |
| 5 | 7 | 5 | EC796778, EC796749, EC796761, EC796763, EC796768 |
| 6 | 9 | 39 | EC796734, EC796735, EC796736, EC796737, EC796738, EC796739, EC796740, EC796741, EC796742, EC796743, EC796744, EC796745, EC796746, EC796747, EC796749, EC796750, EC796751, EC796752, EC796753, EC796754, EC796755, EC796756, EC796757, EC796758, EC796759, EC796760, EC796764, EC796765, EC796766, EC796767, EC796769, EC796770, EC796774, EC796776, EC796777, EC796779, EC796780, EC796783, TN-1 (check) (Susceptible control) |
| Total | | 49 | |

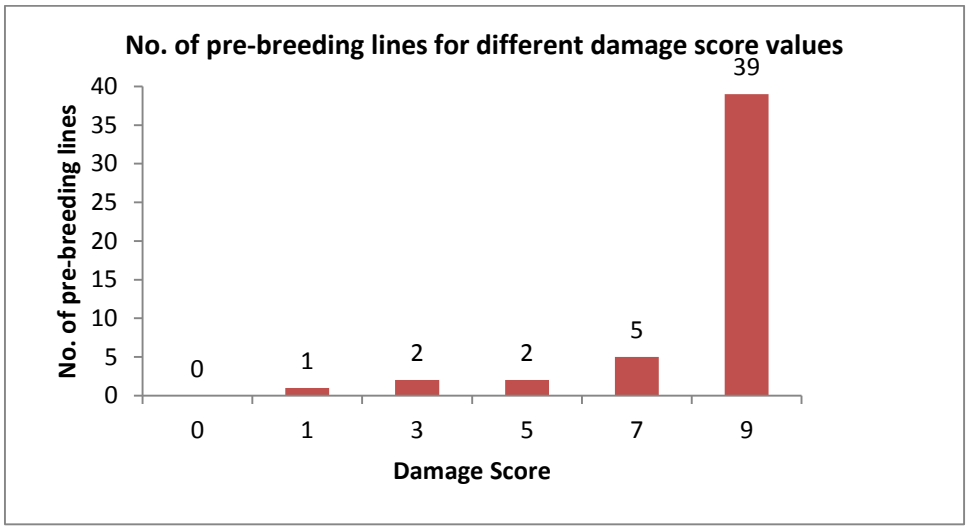


**Fig. 1. Number of pre-breeding lines for different damage score values**

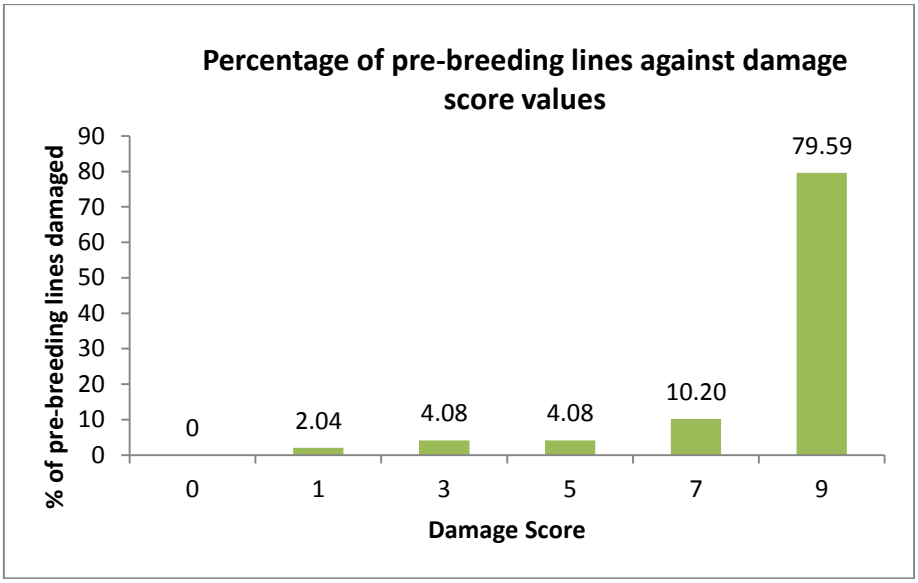


**Fig. 2. Percentage of pre-breeding lines against damage score value**

## 4. CONCLUSION

Results indicate that among forty seven pre-breeding lines screened, EC796771, EC796772 and EC796762, EC796750 were found to be promising resistant donor against brown plant hopper and could be used in developing resistant varieties against BPH.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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