



Identification of Alien Introgression Lines Resistant to White Backed Planthopper, *Sogatella furcifera* (Horvath) in Rice

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEAI/2022/v44i730835

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/86200>

Original Research Article

Received 01 March 2022

Accepted 02 May 2022

Published 09 May 2022

ABSTRACT

Introgression lines of wide cross derivatives were screened to identify resistant/tolerant entries for WBPH biotypes under artificial condition. The main objective of this study is to provide breeders with more 'attractive' plant genetic resources that are easier to use, i.e. resistance sources in acceptable genetic background; or inbreeding tolerant forms disomic lines for inbred or hybrid rice breeding programme. Forty six pre-breeding lines were evaluated against White Backed Plant Hopper (WBPH) under glasshouse condition over a period of two years (2019 and 2020). Out of these, seven pre-breeding lines are moderately resistant to WBPH having score 5. Three pre-breeding lines are moderately susceptible to WBPH having score 7 and rest thirty four pre-breeding lines are highly susceptible to WBPH with a score of 9.

Keywords: Pre-breeding; screening; *Sogatella furcifera*; resistance; rice.

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1. INTRODUCTION

Rice is the most important food crop of the Asian countries. Rice crop is prone to various insect pests like plant hoppers, leaf hoppers, stem borer, gall midges [1]. Out of one hundred insect pests, Brown Plant Hopper (BPH) (*N. lugens*) and White Backed Plant Hopper (WBPH) (*S. furcifera*) are of most destructive pests and prevalent in India [2]. Lack of donor varieties and landraces tolerant to biotic stress (WBPH) is always a problem and is becoming extremely limited. Therefore, additional genetic resources will help to enrich the germplasm for a successful breeding programme. National Rice Research Institute, Cuttack has already begun to use wild species of rice to find out tolerant pre-breeding donors needed to develop high yielding varieties that are resistant to biotic stress (WBPH). However, hybridization between cultivated and wild species belonging to different genome groups is incompatible due to genomic distance. To overcome this problem, embryo rescue has been carried out successfully to achieve the development of introgressive lines or pre-breeding lines. Cultivated rice has evolved from its wild progenitors through a series of introgressive events, natural selection and ultimately breeding. Utilization of wild species is one of the methods to introduce additional germplasm into cultivated varieties. WBPH, *Sogatella furcifera* (Horvath) is a major pest of rice and cause 30-50% loss in yield. Severe losses were also reported due to transmission of viruses such as rice ragged stunt (RRSV) and rice grassy stunt (RGSV) and WBPH [3, 4]. The use of resistant rice varieties is most economical and efficient method for controlling WBPH [5, 6], therefore, it is necessary to identify WBPH-resistance donors from diverse sources and incorporate them into rice cultivars by the use of modern biotechnological tools. In a view of widening the genetic base to enable the reliable use of BPH resistance breeding, the screening of introgressive lines have been evaluated against WBPH biotype to identify resistant donors to be used in the rice breeding program.

2. MATERIALS AND METHODS

2.1 Insect Rearing

The method described by IRRRI [6] has been used to rear the WBPH. 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 set in water source. Potted plants were changed as needed. Each cage accommodates six pots and each pot contains four hills that could support 3,000 to 4,000 late-instar WBPH nymphs. The original colony per cage was started by 30 to 40 gravid adult female. Eggs of same age group 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 during wet season 2019 and 2020 at National Rice Research Institute, Cuttack and as described by Heinrichs *et al.* [8]. Forty six pre-breeding lines along with one susceptible check TN1 and one resistant check PTB-33 were screened against WBPH. 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 nymphs per seedling. After infestation the wooden seed boxes with seedlings were covered with cages. The plants were daily observed for WBPH damage. After 20 days of infestation, hopper burn symptoms were appeared due to WBPH damage on test lines. When damage rate of 90% was observed in susceptible lines, the test lines were scored on 1-9 scale using SES for rice [9]. 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-six introgression lines including susceptible check TN1 and resistant check PTB-33, none of the lines were having score of 1 and 3. Seven lines were found to be moderately resistant to WBPH having score 5. The resistant lines were EC796762, EC796761, EC796765, EC796764, EC796768, EC796771, EC796772 (Table-1), Fig-1 and Fig-2. Previously, Timmangouda and Mahaswaran [10] evaluated twenty five rice varieties and reported three varieties resistant against this pest. Similarly, Venkatesh *et al.*, [11] also reported three rice varieties (Panorama, Sambha, Karthik sambha), Ali *et al.*, [12] reported 87 genotypes and

Table 1. Screening of introgression lines against WBPH in control condition

SL No.	Damage score	No. of Genotypes	Genotypes
1	0		
2	1	1	PTB-33 (check)
3	3		
4	5	7	EC796762, EC796761, EC796765, EC796764, EC796768, EC796771, EC796772
5	7	3	EC796765, EC796734, EC796760
6	9	35	EC796778, EC796783, EC796759, EC796753, EC796752, EC796746, EC796749, EC796750, EC796736, EC796737, EC796740, EC796741, EC796742, EC796755, EC796757, EC796758, EC796766, EC796767, EC796770, EC796777, EC796743, EC796739, EC796738, EC796756, EC796744, EC796745, EC796751, EC796735, EC796747, EC796769, EC796774, EC796776, EC796779, EC796780, TN-1 (check)
Total		46	

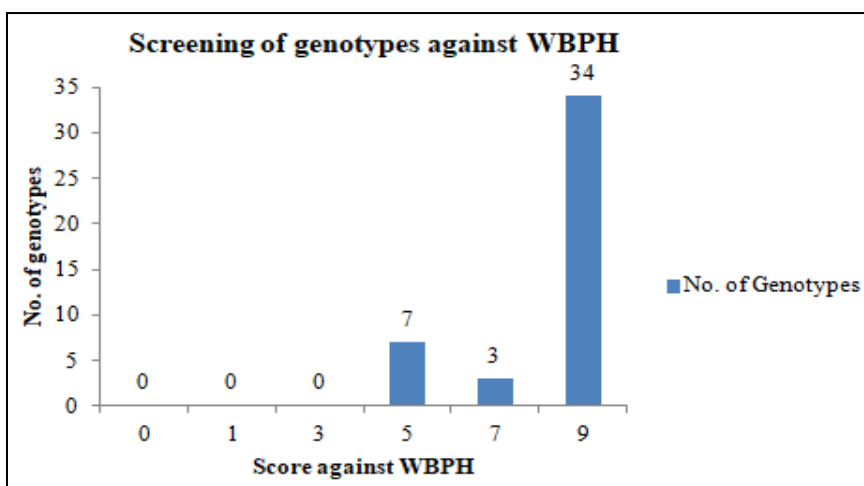


Fig. 1. Screening of genotypes against WBPH

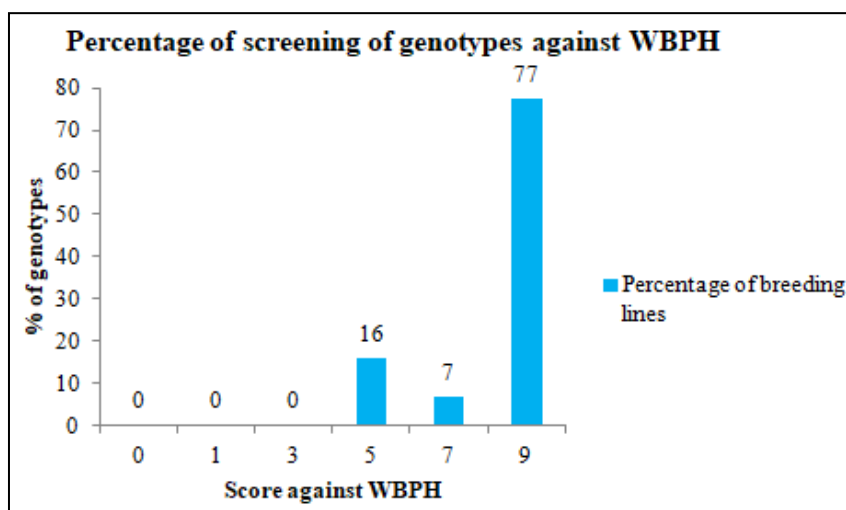


Fig. 2. Percentage of screening of genotypes against WBPH

Bhogadhi et al., [13] reported three varieties resistant against WBPH, Meher et al., [14] reported four varieties (Pathara, Pratap, Tejaswini and Santpheal) moderately resistant to WBPH. During the present study, three lines were found to be moderately susceptible having score 7, thirty four lines were highly susceptible to WBPH having score 9. Score 3 and 5 was reported 4% each of the accessions; 10% of the accessions reported score 5 and score 7 was reported by 80% of the accessions.

4. CONCLUSION

Results indicate that among forty six introgression lines screened EC796762, EC796761, EC796765, EC796764, EC796768, EC796771 and EC796772 were found to be moderately resistant donor against WBPH and those introgression lines could be used in developing resistant varieties against WBPH.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Dupo ALB, Barrion AT. Taxonomy and general biology of delphacid plant hoppers in rice agro ecosystems plant hoppers: New threats to the sustainability of intensive rice production systems in Asia. 2009; 3:155.
- Pathak MD. Ecology of common pests of rice Annual. Review. Entomology. 1968; 13: 257-296.
- Hibino H. Insect-borne viruses in rice. In: Harris KF (ed.) Advances in Disease Vector Research. Springer-Verlag, New York, USA. 1989; 6:209–241.
- Hibino H. Biology and epidemiology of rice viruses. Annu. Rev. Phytopathol. 1996; 34:249–274.
- Alam SN, Cohen MB. Detection and analysis of QTLs for resistance to the brown planthopper, *Nilaparvatalugens*, in a doubled-haploid rice population. Theoretical and Applied Genetics. 1998; 97:1370–1379.
- Renganayaki K, Fritz AK, Sadasivam S, Pammi S, Harrington SE, Mccouch SR, Kumar SM, Reddy AS. Mapping and progress toward map-based cloning of brown planthopper biotype-4 resistance gene introgressed from *Oryza officinalis* into cultivated rice, *O. sativa*. Crop Science. 2002; 42: 2112–2117.
- Pathak MD, Khush GS. Studies of varietal resistance in rice to the brown plant hopper at the International Rice Research Institute. In: Brown Plant hopper: Threat to Rice Production in Asia. IRRI, Los Baños, Philippines. 1977; 285-301.
- Heinrichs EA, Medrano FG, Rapusas HR. Genetic evaluation for insect resistance in rice. IRRI, Los Banos, Philippines. 1985; 356.
- IRRI. Standard Evaluation System for rice (4th Edition) International Rice Research Institute, Los Banos, Philippines; 1996.
- Timmanagouda SP, Maheswaran M. Phenotypic Screening for Brown Planthopper [*Nilaparvatalugens* (Stål)] Resistance in Rice (*Oryza sativa* L.) International Journal of Current Microbiology and Applied Sciences. 2017; 6(12): 858-863.
- Venkatesh K, Soundararajan RP, Muthukrishnan N, Jeyaprakash P. Evaluation of rice landraces for resistances to Plant hoppers and Leafhoppers. Electronic Journal Plant breeding. 2019; 10(1):413-418.
- Ali MP, Salem M, Alghamdi MA, Begum ABM, Anwar U, Alam MZ. Screening of rice genotypes for resistance to the Brown Plant Hopper (*Nilaparvatalugens*Stal) Cereal Research Communication. 2012; 40(4): 502-508.
- Bhogadhi SC, Bentur JS, Durgarani CV, Teppeta G, Yamini K, Arun N. Screening of rice genotypes for resistance to Brown Plant Hopper biotypes -4 detection of BPH resistance gene. Int. Journ. Life Sci. Biotech Pharma. Res. 2015; 4(2): 90-95.
- Meher J, Dash SK, Bose LK, Sarkar S, Rath PC, Subudhi HN. Screening of rice varieties against white backed plant hopper (*Sogatella furcifera* Horvath) in net house condition. Journal of Entomology and Zoology Studies 2020; 8(2): 1044-1046.

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