The Pharma Innovation Journal 2022; 11(1): 1001-1004

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(1): 1001-1004

www.thepharmajournal.com
Received: 14-11-2021
Accepted: 27-12-2021

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Screening of rice germplasm for identification of BPH resistant genes

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Abstract
The present investigation was at The University Research Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *Kharif* season of 2016. The experimental material comprised of A set of 24 rice germplasm lines including three varieties. Out of 24 rice germplasm lines and varieties, 13 germplasm lines *viz*. IC75889, IC75767, IC217492, IC216609, IC217509, IC216606, IC75829, IC216579, IC216612, T-12, IC216563, IC 218607 and ARC 10550 showed the resistant reaction. Heritability governs the resemblance between parents and their progeny whereas; the genetic advance provides the knowledge about expected gain for a particular character after selection. Heritability suggests the relative role of genetic factors in expression of phenotypes and also acts as an index of transmissibility of a particular trait to its offspring. However, the knowledge of heritability alone does not help in formulating concrete breeding programme, genetic advance along with heritability helps to ascertain the possible genetic control for any particular trait. The nature and extent of the inherent ability of a genotype for a character is an important parameter determining the extent of improvement of any crop species. The parameter, genetic advance as per cent of mean (GA) % as mean is more reliable index for understanding the effectiveness of selection in improving the traits because its estimates is derived by involvement of heritability, phenotypic standard deviation and intensity of selection.

Keywords: Rice, BPH, germplasm, resistance, susceptible, hopperburn

Introduction
Rice (*Oryza sativa* L.), the world's most important cereal crop, is the primary source of food and calories for about half of the human population. Taxonomically, rice is classified in the family *Poaceae* and subfamily *Oryzoideae*. Due to the importance of rice as a major food crop, its origin and diversity of has attracted greater interest. The genus *Oryza*, to which cultivated rice belongs, probably originated at least 130 million years ago and spread as a wild grass in Gondwana land which eventually broke up and drifted apart to Asia, Africa and Australia (Chang, 1976) [2]. Today's species of *Oryza* is distributed in all of these continents except Antarctica. There are 21 wild species and two cultivated species of *Oryza*. The cultivated species has about 11,500 years of domestication in the river valleys of South and Southeast Asia and China (Normile, 1997) [5]. The Asian cultivated rice, *Oryza sativa*, is grown worldwide and the African rice, *Oryza glaberrima* is grown on a limited scale in West Africa. The genetic diversity of *indica* sub species is thought to be more than that of *japonica* subspecies. The brown planthopper (BPH), *Nilaparvata lugens* (Stål) (Homoptera: Delphacidae), is a typical phloem sap feeder that has remerged as the treat to rice production in Asia (Chen and Chang, 1971) [3]. The plant would suffer 40% to 70% yield loss if attacked by 100–200 first instar nymphs of BPH at 25 day after rice seedling transplanting (Bae and Pathak, 1970) [1]. In HPR programmes, screening diverse germplasm and identification of tightly linked markers is more important, as pest populations continue to change their virulence pattern and new genes for resistance must be constantly identified (Panda and Khush, 1995) [6].

Material and Methods
The Screening for BPH resistance in germplasm of rice (*Oryza sativa* L.)" was carried out in the Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India. Generation and maintenance of rice brown plant hopper breeding materials along with molecular work were done at the research farm and molecular biology laboratory of Department of Genetics and Plant Breeding.

The studies extended over a period of one cropping wet seasons (*Kharif*) 2016-2017.

Plant material

The experimental material consisted of 24 elite rice genotypes are IC75889, IC75844, IC75767, IC217492, IC75964, IC76046, IC216609, IC75832, IC217509, IC216606, IC75845, IC75829, IC 540584, IC 216579, IC75795, IC75839, IC218650, IC75874, IC216612, T-12, IC216563, Swarna, ARC-10550 and IC218607, where T-12 and ARC 10550 were used as resistant check and Swarna used as susceptible check, respectively.

Standard seed box screening technique

The experiment was conducted at a temperature of 28 to 30°C and relative humidity of 70 to 80%. The seeds were presoaked and sown in rows in 60 x 45 x 10 cm seed boxes along with resistant and susceptible checks. 25 to 30 seedlings per row were maintained per genotype. Ten (10) day old seedlings were infested with first instar nymphs at the rate of eight to 10 per seedling. Approximately one week after infestation "hopperburn" symptom was observed. When more than 90% of susceptible check shows wilting, the plants were scored individually based on scoring system proposed by the International Rice Research Institute (IRRI, 1996) and each seedling was scored as 0 = no visible damage, 1 = partial yellowing of first leaf, 3 = first and second leaves partially yellowing, 5 = pronounced yellowing or some stunting, 7 = mostly wilted plant but still alive, 9 = the plant completely wilted or dead (Figure 1). Interpretation of results was based on standard evaluation system where the families with a mean rating of 0 to 3, 3.1 to 6.9 and 7 to 9 are designated as resistant, moderately resistant and susceptible, respectively (IRRI, 1996). This method is used by me for screening of BPH.

Recording of Observation

Observations were recorded 7-10 days after releasing insects, when 90% of the plants in the susceptible check line TN1 were killed. The entries were scored for damage following the criteria for scoring the damage of individual plants. The observations were recorded on the basis of 0-9 scale as per the International Standard Procedure (IRRI, 1996). (Table 1).

Table 1: Scoring of seedling was done on the basis of visual plant damage symptoms (0-9 scale) which are as follows:

Score	Rating	Symptoms
0	Highly resistant	No visible damage
1	Resistant	First leaf is yellow
3	Moderately resistant	One or two leaves are yellow or one leaf shrank
5	Moderately susceptible	One or two leaves shrank or one leaf shriveled
7	Susceptible	3-4 leaves shrank or 2-4 leaves shrivel and the plant is still alive
9	Highly susceptible	The plant is dead

Analysis and interpretation of results

Fixed genotypes showing score of 0 were rated as highly resistant (HR), 1 as resistant (R), 3 as moderately resistant (MR), 5 as moderately susceptible (MS), 7 as susceptible (S) and 9 as highly susceptible (HS), (IRRI, 1996). For the genetic studies plants with score 0-3 (0, 1, 3) were pooled as resistant and those with scores 5-9 (5, 7, 9) were pooled as susceptible.

Heritability (broad sense)

It is the ratio of genotypic variance to the phenotypic variance (total variance).

$$h^2 (bs) \% = (\sigma g / \sigma p)^2 X 100$$

Where,
h2 (bs) % = heritability in broad sense,
$^2\sigma$g = Genotypic variance,
σp2= Phenotypic variance

As suggested by Burton (1952) heritability values are categorized as low (<50%), moderate (50 - 70%), and high (>70%).

Genetic advance

Improvement in the mean genotypic value of selected plants over the parental population is known as genetic advance.

G A = K.h2. σp

Where,
GA= Genetic advance
K = Constant (Standardized selection differential) having the value of 2.06 at 5 per cent level of selection intensity.
h2 = Heritability of the character
σp= Phenotypic standard deviation

Genetic advance as percentage of mean

It was calculated by the following formula

$$\text{GA as percentage of mean} = \frac{\text{Genetic Advance}}{\text{Mean}} X 100 \text{ General}$$

GA > 20 per cent High
GA = 10 – 20 per cent Moderate
GA < 10 per cent Low

Results and Discussion

Screening of the rice germplasm lines including varieties

A set of 24 rice germplasm lines (Table 2) including three varieties were screened for their reaction against BPH infestation. Screening was done as per the methodology suggested by Kalode *et al*., (1979) [4]. The test and check varieties were pre-germinated and transferred to wooden boxes containing well mixed homogeneous soil. Each seed box contain twenty four test lines with 20 seedlings of each including two middle rows of resistant check (T-12 and ARC 10550) and susceptible check (Swarna) and four border rows of susceptible check (Swarna).

The boxes were covered so as to enhance seedling growth. After sowing the seed boxes were placed on cemented platform with 6-8 cm border and 3-4 inches water level to provide adequate humidity for the insect and protection against ants. When the seedlings were 8-10 days old with 2 to 3 leaves in the screening trays so that each seedlings has reared with 6-8 nymphs.

Observation was recorded 7-10 days after releasing insects, when 90% of the plants in the susceptible check line Swarna were killed. The observation was recorded on the basis of 0-9 scale.

Table 2: Reaction of 24 rice germplasm lines including three varieties against BPH

Sr. No.	Rice germplasm lines/ varieties	Average damage score	Reaction
1	IC75889	1.5	Resistant
2	IC75844	9	Susceptible
3	IC75767	3	Resistant
4	IC217492	0.41	Resistant
5	IC75964	9	Susceptible
6	IC76046	9	Susceptible
7	IC216609	0.71	Resistant
8	IC75832	9	Susceptible
9	IC217509	0.45	Resistant
10	IC216606	1.36	Resistant
11	IC75845	9	Susceptible
12	IC75829	1.68	Resistant
13	IC540584	6.52	Susceptible
14	IC216579	0.63	Resistant
15	IC75795	9	Susceptible
16	IC75839	9	Susceptible
17	IC218650	6.89	Susceptible
18	IC75874	9	Susceptible
19	IC216612	1.22	Resistant
20	T-12 (Check)	0	Resistant
21	IC216563	1	Resistant
22	Swarna (Check)	9	Susceptible
23	ARC 10550 (Check)	0	Resistant
24	IC218607	1	Resistant

Out of 24 rice germplasm lines and varieties, 14 germplasm lines *viz*. IC75889, IC75767, IC217492, IC216609, IC217509, IC216606, IC75829, IC540584, IC216579, IC216612, T-12, IC216563, IC 218607 and ARC 10550 showed the average plant damage score of (0-5) 1.5, 3, 0.41, 0.71, 0.45, 1.36, 1.68, 0.63, 1.22, 0, 1, 1 and 0 respectively i.e. resistant. 10 rice germplasm lines and varieties *viz*. IC75844, IC75964, IC76046, IC75832, IC75845, IC540584, IC75795, IC75839, IC218650, IC75874 and Swarna showed the average plant damage score of (6-9) 9, 9, 9, 9, 9, 6.52, 9, 9, 6.89, 9 and 9 i.e. susceptible.

600 resistant donors have also been identified by Kalode *et al.*, 1979 and 1983 [4]. Major genes Bph 1 and Bph 2 were identified by Pathak and Khush (1979) [7]. Velusamy *et al*., 1984 [9] reported that one hundred ninety-five breeding lines received from *Oryza officinalis* against BPH, 54 lines were exhibited high level of resistant to BPH with score 1. Pophaly and Rana (1993) [8] observed that only, IR 62 and IR 64 were resistant and IR 34, IR 36 and IR 56 showed moderately resistant reaction against BPH at Raipur.

Table 3: Summery of BPH reaction of 24 rice germplasm lines including three varieties

Average plant damage score (Range)	Rice germplasm lines and varieties	Reaction
0-5	12 germplasm and 2 varieties	Resistant
6-9	9 germplasm and 1 variety	Susceptible

Thus 24 rice germplasm and varieties were categorized into 2 major categories based on their reaction against brown plant hopper. (Table 3)

Susceptible category of rice germplasm lines and varieties included important germplasm lines of Chhattisgarh like IC75844, IC75964, IC76046, IC75832, IC75845, IC540584, IC75795, IC75839, IC218650, IC75874 and Swarna recorded damage score between 6-9. These findings indicate that their is need for improvement of these lines for BPH resistance.

Only 13 germplasm rice lines and 1 variety of the collection namely IC75889, IC75767, IC217492, IC216609, IC217509, IC216606, IC75829, IC540584, IC216579, IC216612, IC216563, IC 218607, ARC 10550 and T-12 fell under the category of resistant to BPH. These varieties can serve as donors for the BPH resistance trait for the improvement of other elite and popular varieties of interest.

Heritability and genetic advance as per cent of mean were estimated for 24 genotypes. The results are presented below:-

An attempt has been made in the present investigation to estimate heritability in broad sense and categorized as low (<50%), moderate (50%-70%) and high (>70%). High magnitude of heritability (>70%) was obtained for most of the characters. The highest heritability was recorded for100 grain weight (98.723%) followed by unfilled grain (98.347%), grain length (98.331%),biological yield (97.411%), plant height (96.923%), economic yield (95.739%), harvesting index (94.109%), filled grains (92.978%), grain width (91.63%), effective tiller (83.355%), total tiller (80.412%), coleoptiles

length (78.621%), seedling length (74.744%) and leaf length (70.906%) exhibited high heritability. The magnitude of genetic advance as percentage of mean was categorized as high (> 30%), moderate (30% - 10%) and low (< 10%). The highest genetic advance as percentage of mean was found in unfilled grains (84.896%), filled grains (77.355%) and plant height (52.556%). This indicates that the character primary branches per plant are governed by additive gene and selection will be rewarded. Moderate magnitude of genetic advance was obtained for effective tiller (26.512%) followed by total tiller (26.441%), harvesting index (21.482%), leaf length (16.476%). This showed the existence of additive as well as non-additive gene action. Whereas, low magnitude of genetic advance was obtain for panicle length (3.175%), seedling length (2.722%), grain length (1.653%), 100 grains weight (0.697%), grain width (0.598%), leaf width (0.391%), coleoptile length (0.233%), biological yield (0.12%) and economic yield (0.041%). suggesting that the character is governed by nonadditive genes and heterosis breeding may be exploited for the above traits.

Heritability and genetic advance are the important parameters for selecting genotypes that permits greater effectiveness of selection by separating out environmental influence from the total variability. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. However, it is not necessary that a character showing high heritability will exhibit high genetic advance. Estimates of heritability also give some idea about the gene action involved in the expression of various polygenic traits.

The characters representing high values of heritability and genetic advance emerge as ideal traits for improvement through selection due to high variability and transmissibility. Thus, the characters mentioned above are likely to show very high response to selection practiced in breeding population.

References

1. Bae SH, Pathak MD. Life history of *Nilaparvata lugens* (Stal.) (Homoptera: Delphacidae) and susceptibility of rice varieties to its attacks. Ann. Entom. Soc. Amer. 1970;63:149-155.
2. Chang TT. The origin, evolution, cultivation, dissemination and diversification of Asian and African rice. *Euphytica*. 1976;25:435-444.
3. Chen LL, Chang WL. Inheritance of resistance to brown plant hopper in rice variety Mudgo. J Taiwan Agric. Res. 1971;20:57-60.
4. Kalode MB, Krishna TS, Gour TB. Studies on pattern of resistance to brown planthopper (*Nilaparvata lugens*) in some rice varieties. *In*: Proc. Ind. Nat. Sc. Acad, 1979;B-44:43-48.
5. Normile D. Archeology: Yangtze seen as earliest rice site. Science. 1997;275:309.
6. Panda N, Khush GS. Host plant resistance to insects. CAB International. IRRI, 1995, 273-276.
7. Pathak MD, Khush GS. Studies of varietal resistance in rice to the brown planthopper at the IRRI. *In*: Brown Planthopper: Threat to Rice Production in Asia. Los Banos. Philippines, 1979, 369.
8. Pophaly DJ, Rana DK. Reaction of IR varieties to the brown planthopper (BPH) population in Raipur, Madhya Pradesh, India. Int. Rice Res. Newsl. 1993;18(1):27-28.
9. Velusamy R, Chelliah S, Heinrichs EA, Medrano F. Brown planthopper biotypes in India. Internat Rice Res Notes. 1984;9:19.