

Short Research Article

PHENOTYPIC SCREENING OF F₄ BREEDING LINES AGAINST BACTERIAL BLIGHT DISEASE IN RICE

Abstract

Biotic stresses are major threat to rice production. Among biotic stresses, bacterial leaf blight is one of the major diseases affecting rice grain production in rice growing areas. Present investigation was conducted to evaluate phenotypic effect of 50 breeding lines from a cross (Pranahitha//ISM/MTU1010). 50 breeding lines were evaluated in glass house at RARS, Jagtial by inoculating BB culture (DX-020) by leaf clipping method. Out of these 50 F₄ lines evaluated against BB, twenty nine breeding lines showed resistant reaction with disease score of 1. Eleven lines were shown moderately resistant reaction with disease score 3. Susceptible check, MTU1010 NIL showed highly susceptible reaction with disease score of 9. Resistant check, Improved Samba Mahsuri showed highly resistant reaction with disease score of 1. Twenty nine breeding lines that were found to be resistant with disease score 1 have shown excellent grain yield. Hence, these lines can be advanced to further generations. Thus the present study has proven that phenotypic selection is successful as these breeding lines with higher yield levels could perform better in the farmer's field having good level of bacterial blight resistance.

Key words: Rice, Bacterial blight, Leaf clipping method and Phenotypic screening

INTRODUCTION

Rice is one of the major food crops of the world and forms the staple diet of about half of the world's population. Approximately 90.4% of the world's rice is grown in the Asian continent. It constitutes a staple food crop (up to 60% of energy intake) for 2.7 billion people worldwide (Salim *et al.*, 2003). The demand for rice is boosting up further in the view of expected increase in population. Biotic and abiotic stresses are major constraints for rigorous yield loss affecting rice cultivation. Among biotic stresses, bacteria leaf blight (BB) is one of the serious disease caused by the pathogen *Xanthomonas oryzae pv. oryzae* (Xoo) which is responsible for significant yield reduction in rice. Bacterial blight can cause yield loss upto 50 % (Ou 1985) and in severally infected field, the losses reach upto 59-90%, 80 %, 80 %

and even 100% under very severe conditions (Singh *et al.*, 2013b and Agarwal *et al.*, 2005). In India, it was first reported in 1951 (Srinivasan *et al.*, 1959 and Bhapkar *et al.*, 1960) and it has been commonly occurring in India since the introduction of the semi-dwarf high yielding varieties (HYV) of rice from the Philippines during mid 1960's and increased applications of nitrogen fertilizer in these rice varieties to encourages its occurrence. Several tested chemicals or antibiotics could not control the BB infestation completely. Bacterial blight reduces rice yield drastically by declining photosynthetic area (Pradhan *et al.*, 2015). The persistent, injudicious use of chemicals has toxic effects on non-target organisms and can cause undesirable changes in the environment. Most of these chemicals are too expensive for the resource poor farmers of Asia, where 90% of the world's rice is grown. Consequently, most effective and sustainable approach is development and deployment of BB resistant rice varieties introgressed with resistant genes. In this process, phenotypic screening of bacterial blight disease would be of great use for evaluation of breeding lines. This work is carried out to evaluate bacterial blight resistance at phenotypic level.

MATERIAL AND METHODS

The material of present study includes 50 genotypes derived from a three way cross (Pranahitha//ISM/MTU1010 NIL) and two checks *viz.*, ISM (Improved samba mahsuri) and MTU1010 (Cotton Dora Sannalu).

The experiment was carried out in glass house at Regional Agricultural Research Station, Polasa, Jagtial during *Rabi* 2020-21, where the artificial inoculation was done. The research station is located at Northern Telangana zone, Telangana, India. Experiment plot was laid out in Randomised Block Design (RBD) with two replications for the evaluation of yield and other agromorphological parameters.

Bacterial leaf blight screening and evaluation

The selected target F₄ plants along with the parents were screened in the glass house at RARS, Jagtial. The bacterial cultures of virulent isolate, DX- 020 of *Xanthomonas oryzae* pv. *oryzae* (collected from IIRR, Hyderabad, Telangana) were maintained on Hayward's agar media at 28⁰C for 96 hours. After incubation period, the bacterial cells were harvested and diluted with 10ml of sterile distilled water to get a final concentration of approximately 10⁸cfu/ml (Preece, 1982). Homozygous F₄ lines were inoculated with bacterial culture at maximum tillering and flag leaf stages by following leaf clipping method described by Kauffman *et al.* (1973). Plant inoculation was carried out by clipping the tip (about 1 to 2

cm) of the fully expanded uppermost leaf with scissors that had been dipped into the inoculum. The lesion length on leaves was measured at 15 days after inoculation. Scoring was done as per SES, IRRI, 2013.

The disease was scored on 1 to 9 scale as per the IRRI Standard evaluation system given below:

Table. 1. Standard Evaluation System, IRRI scale (2013) for bacterial leaf blight

Scale	Rating	% leaf area diseased
1	Highly resistant	1-5
3	Resistant	6-12
5	Moderately resistant	13-25
7	Susceptible	26-50
9	Highly susceptible	51-100

RESULTS AND DISCUSSIONS

Phenotypic evaluation of improved breeding lines for BB

Out of the 50 F₄ breeding lines evaluated against BB, twenty-nine breeding lines *viz.*, KAL1, KAL-2, KAL-3, KAL-4, KAL-5, KAL-6, KAL-7, KAL-8, KAL-9, KAL-11, KAL-18, KAL-19, KAL-21, KAL-22, KAL-23, KAL-24, KAL-25, KAL-26, KAL-27, KAL-28, KAL-29, KAL-31, KAL-32, KAL-33, KAL-34, KAL-42, KAL-43, KAL-45 and KAL-46 showed resistant reaction with disease score of 3. Ten lines *viz.*, KAL-10, KAL-12, KAL-14, KAL-17, KAL-20, KAL-30, KAL-36, KAL-47, KAL-48 and KAL-49 were shown moderately resistant reaction with disease score 5. Seven breeding lines *viz.*, KAL-15, KAL-16, KAL-35, KAL-37, KAL-38, KAL-41 and KAL-44 were shown susceptible reaction and remaining four lines *viz.*, KAL-13, KAL-39, KAL-40 and KAL-50 were shown highly susceptible reaction. Susceptible check, MTU1010 showed highly susceptible reaction with disease score of 9. Resistant check, Improved Samba Mahsuri showed highly resistant reaction with disease score of 1 (Table 2) There are many studies shown excellent resistance of cultivars using gene pyramiding with two or more genes (Sundaram *et al.*, 2008), single

gene like *Xa21* conferring durable resistance against BB (Balachiranjeevi *et al.*, 2015, Arunakumari *et al.*, 2016 and Laxmi Prasanna *et al.*, 2018) were shown good level of resistance to known races.

Table. 2. Screening details of Improved F₄ breeding lines for BB resistance and scoring details as per IRRI-SES scale (IRRI 2013)

S. No	Parents and Checks	Reaction against BB	
		DX020	
		Score	HR/R/MR/S/HS
1	MTU1010	9	HS
2	ISM	1	HR
3	Pranahitha	5	MR
	Improved breeding lines (F ₄)	Score	HR/R/MR/S/HS
1	KAL1	3	R
2	KAL 2	3	R
3	KAL 3	3	R
4	KAL 4	3	R
5	KAL 5	3	R
6	KAL 6	3	R
7	KAL 7	3	R
8	KAL 8	3	R
9	KAL 9	3	R
10	KAL 10	5	MR
11	KAL 11	3	R
12	KAL 12	5	MR
13	KAL 13	9	HS
14	KAL 14	5	MR
15	KAL 15	7	S
16	KAL 16	7	S
17	KAL 17	5	MR
18	KAL 18	3	R
19	KAL 19	3	R
20	KAL 20	5	MR
21	KAL 21	3	R
22	KAL22	3	R
23	KAL 23	3	R
24	KAL 24	3	R
25	KAL 25	3	R

S. No	Parents and Checks	Reaction against BB	
		DX020	
		Score	HR/R/MR/S/HS
26	KAL 26	3	R
27	KAL 27	3	R
28	KAL 28	3	R
29	KAL 29	3	R
30	KAL 30	5	MR
31	KAL 31	3	R
32	KAL 32	3	R
33	KAL 33	3	R
34	KAL 34	3	R
35	KAL 35	7	S
36	KAL 36	5	MR
37	KAL 37	7	S
38	KAL 38	7	S
39	KAL 39	9	HS
40	KAL 40	9	HS
41	KAL 41	7	S
42	KAL 42	3	R
43	KAL 43	3	R
44	KAL 44	7	S
45	KAL 45	3	R
46	KAL 46	3	R
47	KAL 47	5	MR
48	KAL 48	5	MR
49	KAL 49	5	MR
50	KAL 50	9	HS



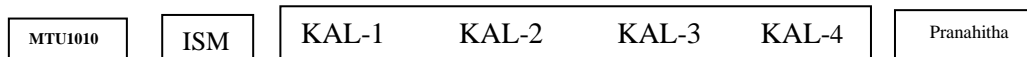


Figure 1: Phenotypic screening for bacterial blight resistance using *Xoo* (DX020) culture. ISM- Resistant check; MTU1010 - Susceptible check; Improved breeding lines possessing *Xa21* and *Gn1a* (F₄ Generation)

Conclusion

In this study, phenotypic screening of Bacterial leaf blight (BB) (leaf clipping method) of 50 F₄ breeding lines identified 29 resistant lines, 10 moderately resistant lines, seven susceptible lines and four highly susceptible lines. Hence these 29 resistant lines can be further advanced to next generations for screening. The breeding lines possessing BB resistance along with good yield levels can serve as good donors for targeted transfer of the major gene to other elite rice varieties cultivated in Telangana state. Also these breeding lines having excellent grain yield coupled with bacterial blight resistance could perform better in farmer's field. The breeding lines developed in the study will be of great use in the future rice breeding programmes and breeders can use them customizing their deployment according to the needs of the farmers in various rice growing areas of the country. The superior breeding lines developed in the present study will be advanced through pedigree method of breeding for possible multiplication and evaluation through multilocation trials in the state of Telangana and also across the country through All Indian Coordinated Research Improvement Project (AICRIP).

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