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Field screening of rice germplasm for resistance to bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*)

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Abstract
Rice yield is affected by a number of diseases among which bacterial leaf blight (BLB) caused by *Xanthomonas oryzae* pv *oryzae* is one of the oldest and most severe. The introduction and widespread cultivation of high yielding cultivars having narrow genetic base was led to increased susceptibility to the diseases such as bacterial blight. The most effective method against the control of this deadly disease is the improvement and utilization of the host plant resistance. Hence the present study was undertaken with the aim of evaluating the 25 breeding lines of the popular Kerala rice variety Prathyasa along the resistant and susceptible checks to find out the resistant plants which can be utilized in further breeding programs as sources of resistance. Among the 25 lines screened two (Pr-446-5 and Pr-446-19) were identified as resistant and rest were classified to different resistance and susceptibility classes.

Keywords: Rice, bacterial leaf blight, clipping, breeding lines, *Xanthomonas*

Introduction
Rice, major food grain for more than half of the world's population, provides daily calories for rural and urban people (Khush 2005) [6]. Rice yield is affected by a number of diseases among which bacterial leaf blight (BLB) caused by *Xanthomonas oryzae* pv. *oryzae* is one of the oldest and most severe (Mew 1987) [8]. Bacterial leaf blight is a significant vascular disease of irrigated and rainfed rice and severe infestations may leads to substantial yield losses. Since the introduction and widespread cultivation of high yielding but susceptible rice cultivars, bacterial blight has become one of the most serious diseases of rice in Asia. Chemical methods are found to be ineffective against BLB, the only feasible and economical way of controlling disease is the use of resistant rice cultivars. In view of the importance of genetic resistance for disease control, this study was undertaken to evaluate the rice genotypes against bacterial leaf blight.

Material and Methods
The experiment was conducted at the research farm of Rice research station Moncompu, Alappuzha during late *Puncha* (Jan 2022 to April 2022). 25 back crossed lines derived from the cross between Improved Samba Mahsuri and Prathyasa were used as the experimental material and assessed for resistance to BLB. They were planted at a spacing of 20 x 20 cm and essential agronomic practices were implemented according to Kerala POP. The pathogen *Xanthomonas oryzae* pv. *oryzae* was isolated from the collected symptoms (Fig 1) and cultured in nutrient agar media (Fig 2). They were inoculated in broth and 72 hours old media was used for the artificial inoculation. The inoculation was done using clipping method (Kauffman *et al*. 1973) [3] by dipping a clean sharp scissor in the prepared broth and leaf tip of around 2 to 3 cm were clipped (Fig 3). The inoculation was done during seedling and maximum tillering stage and done either at early morning or in the late evening. Observations were taken after 14 days of inoculation and plants were assigned scores according to BLB score chart published by IRRI in 2013 (Anonymous 2013) [1] (Table 1). The percentage of the incidence of the disease was calculated by the following formula (Gnanamanickam *et al*. 1999) [2].

$$\text{Diseased leaf area percentage (\%)} = \frac{\text{Lesion length}}{\text{Total leaf area}} \times 100$$

Fig 1: Symptoms of BLB collected from the research field

Fig 2: *Xanthomonas oryzae* pv *oryzae* cultured in Nutrient agar

Table 1: IRRI Score chart for Bacterial leaf blight

Disease score	Lesion area percentage (%)	Disease reaction
1	1-5%	Resistant (R)
3	6-12%	Moderately resistant (MR)
5	13-25%	Moderately susceptible (MS)
7	26-50%	Susceptible (S)
9	51-100%	Highly susceptible (HS)

Results and Discussion

As the population under the evaluation was segregating population, each plant was clip inoculated along with the resistant (Improved samba mahsuri) and susceptible checks (Prathyasa) in both seedling and maximum tillering stage. Symptoms were first appeared after 10 days of inoculation. Among the twenty-five, 2 plants were severely affected and dried in the seedling stage itself. They showed severe symptoms of the *kresek* phase and categorized as highly susceptible. Two plants named Pr-446-5 and Pr-446-19 among the 50 were identified as resistant and 5 were moderately resistant (Pr-446-2, Pr-446-7, Pr-446-18, Pr-446-21, Pr-446-22). Among the remaining plants more than half of the plants were susceptible (Pr-446-3, Pr-446-4, Pr-446-8, Pr-446-9, Pr-446-10, Pr-446-15, Pr-446-16, Pr-446-23, Pr-446-24) and 4 plants were highly susceptible (Pr-446-6, Pr-446-11, Pr-446-14, Pr-446-25). Also 5 plants were found as moderately susceptible (Pr-446-1, Pr-446-12, Pr-446-13, Pr-446-17, Pr-446-20) (Table 2)

These results are comparable with the findings of Kaushal *et al.* (1998) [5], who screened 167 wild rice accessions in which nine accessions were identified with resistance against bacterial blight. Latif and co-workers evaluated a total of 35 inbred and 13 hybrid varieties including susceptible checks and all were showed moderately susceptible response. Pha and Lang (2004) [9] screened 166 local accessions and 25 lines of hybrid rice against 10 international bacterial races. Some of the local accessions showed resistant response against all the races.

Fig 3: Artificially inoculated panicles by clipping

Fig 4: Appearance of the symptoms after inoculation

Table 2: Scoring and classification of the lines into different classes for resistance to bacterial leaf blight

Sl. No	Sample No	Incidence Percentage (%)	Score	Host Response
1	Pr-446-1	20.2	5	MS
2	Pr-446-2	9.0	3	MR
3	Pr-446-3	33.0	7	S
4	Pr-446-4	28.0	7	S
5	Pr-446-5	3.0	1	R
6	Pr-446-6	71.0	9	HS

7	Pr-446-7	9.0	3	MR
8	Pr-446-8	35.0	7	S
9	Pr-446-9	41.0	7	S
10	Pr-446-10	40.5	7	S
11	Pr-446-11	75.0	9	HS
12	Pr-446-12	16.0	5	MS
13	Pr-446-13	18.0	5	MS
14	Pr-446-14	74.0	9	HS
15	Pr-446-15	37.0	7	S
16	Pr-446-16	41.0	7	S
17	Pr-446-17	21.4	5	MS
18	Pr-446-18	10.0	3	MR
19	Pr-446-19	3.80	1	R
20	Pr-446-20	22.0	5	MS
21	Pr-446-21	8.00	3	MR
22	Pr-446-22	9.80	3	MR
23	Pr-446-23	37.0	7	S
24	Pr-446-24	41.0	7	S
25	Pr-446-25	65.0	9	HS
26	Prathyasa	78.0	9	HS
27	Improved samba Mahsuri	2.00	1	R

All the 25 breeding lines were evaluated for their agronomic performances also (Table 3). Morphological observations such as plant height, days to maturity, number of productive tillers per plant, panicle length were noted and compared with the resistant and susceptible check varieties. Significant differences were obtained for quantitative traits such as number of productive tillers per plant and panicle length among the resistant and susceptible lines. Large reduction in the number of productive tillers per plant and panicle length were observed in the highly susceptible and susceptible plants. The maximum value of number of productive tillers per plant was 13, while in susceptible and highly susceptible class it was only 8. While the traits such as plant height and days to maturity were unaffected due to BLB. Panicle length in susceptible plants were notably reduced due to the incidence of BLB and showed huge loss in yield as compared to resistant plants.

Similar results were also presented by Samiullah and co-workers (2015) [10]. The highly susceptible varieties among the 23 indigenous germplasm screened showed considerable reduction in panicle length and other quantitative traits.

Table 3: Morphological observations of the lines screened for resistance to bacterial leaf blight (Blank columns indicate the plants who Dried during the seedling stage itself)

Sl. No	Sample No	Plant height (cm)	Days to maturity	No of productive tillers/ plant	Panicle length (cm)
1	Pr-446-1	104.0	118	11	24.20
2	Pr-446-2	108.0	117	12	23.71
3	Pr-446-3	102.5	114	10	23.81
4	Pr-446-4	106.0	118	9	20.21
5	Pr-446-5	105.4	118	11	22.89
6	Pr-446-6	108.0	117	8	19.99
7	Pr-446-7	105.3	116	12	23.00
8	Pr-446-8	108.0	117	11	22.90
9	Pr-446-9	109.0	118	10	24.00
10	Pr-446-10	107.5	117	10	23.87
11	Pr-446-11	-	-	-	-
12	Pr-446-12	107.0	116	12	22.67
13	Pr-446-13	105.8	117	13	23.12
14	Pr-446-14	-	-	-	-
15	Pr-446-15	109.0	117	11	23.12
16	Pr-446-16	108.2	116	10	23.76
17	Pr-446-17	104.8	115	11	24.32
18	Pr-446-18	103.0	118	12	22.98
19	Pr-446-19	107.2	118	12	23.12
20	Pr-446-20	105.0	117	11	24.21
21	Pr-446-21	104.0	114	10	22.88
22	Pr-446-22	107.4	116	12	21.87
23	Pr-446-23	104.9	116	11	22.32
24	Pr-446-24	106.0	115	10	22.78
25	Pr-446-25	106.0	117	8	21.21
Prathyasa	P	98.0	108	8	20.08
Improved samba mahsuri	ISM	118.0	146	14	21.60

Conclusion

Bacterial leaf blight is one of the most devastating diseases of rice and causes the severe yield losses during epidemics. Utilization of the host plant resistance is the most appropriate strategy to mitigate this disease. In the present study out of the 25 lines screened two lines Pr-446-5 and Pr-446-19 were identified as resistant. These lines can be used as the resistant source in further breeding programmes for the development of resistant varieties against BLB. Moreover, incorporation of these varieties may reduce the linkage drag which is common with the land races and wild relatives.

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