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Screening of Rice Cultivars Against the Emerging Disease Bacterial Panicle Blight under Odisha Condition

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ABSTRACT: A total of 25 popular rice genotypes were screened against bacterial panicle blight disease caused by *Burkholderia glumae* under artificial inoculation conditions. Among these twenty five genotypes only one genotype Hasanta was found to be moderately resistant against bacterial panicle blight and other were found to be susceptible, moderately susceptiple and highly susceptible. The highest disease index (84%) and disease severity (77.74) was recorded in the genotype Swarna.

Keywords: Bacterial Panicle Blight, *Burkholderia glumae*, artificial inoculation, disease incidence, disease severity.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important staple food for a large part of world's population (Qudsia *et al.*, 2017). The rice production in world is 787 million tons in an area of 165.25 million ha with productivity of about 3.69 tons/ha and in India it is 145.92 million tons in an area of 46.37 million ha with productivity of about 3.69 tons/ha (FAO, 2022). But the yield of rice is mostly affected by the different biotic stresses like fungal, bacterial, viral diseases and insect pest damage. Among different diseases in rice now-a-days a new disease bacterial panicle blight caused by *Burkholderia glumae* is causing 60-70 yield loss (Chien *et al.*, 1983; Trung *et al.*, 1993; Nandakumar *et al.*, 2007). In bacterial panicle blight disease, the diseased panicle bears light to dark brown, partially or fully discoloured glumes. Under severe conditions, grain filling in the diseased panicles is affected, subsequent resulting in chaffy grains (Mondal *et al.*, 2015; Singh and Vishunavat 2015; Zhou-qi *et al.*, 2016; Gowda *et al.*, 2022). The use of chemicals to control this disease is effective but still expensive and overuse of pesticide causes severe environmental pollution and health hazards. Thus the use of resistant variety is one of the most effective and economic way to minimize the losses from this disease. Though, there are so many varieties available in rice but only some popular varieties among farmers were selected for the present study with an aim of identifying the genotypes which can be used as donors for incorporating resistance against the devastating bacterial panicle blight disease.

MATERIALS AND METHODS

For screening of rice germplasm against bacterial panicle blight, artificial inoculation was preferred over natural infection as it ensures the rice plants are properly exposed to right amount of inoculums for cause of the disease. Screening for rice germplasm against bacterial panicle blight was carried out at Instructional farm, O.U.A.T., Bhubaneswar, Odisha (20.264796° North, 85.806927° East and at an altitude of 45m above mean sea level) in 2021 and 2022 *Kharif*. All the 25 genotypes with different durations were planted in different sub plots of 3 × 2 m plot size with three replications adopting a spacing of 20 × 15 cm for screening against bacterial panicle blight. For artificial inoculation, the inoculum was prepared by suspending 24 hours old *Burkholderia glumae* culture in sterile distilled water. The concentration was adjusted to approximately 10^8cfu/ml. The inoculum was immediately used within two hours. Plants were inoculated artificially by spaying at 45 days after transplanting. The data was recorded three weeks after inoculation. Observation on reaction to bacterial panicle blight was recorded by visually examining the blighted panicles and categorized based on 0-9 scale (Echeverri-Rico *et al.*, 2021). As this disease is mainly affecting the panicles, so the grain yield was also recorded. The details of the scale are as follows:

Table 1: Disease scale for bacterial panicle blight of rice.

Disease	Scale	Area infection
Bacterial Panicle Blight	0	No symptom
	1	0.1 to 10% of panicle affected
	3	11 to 20 % of panicle affected
	5	21 to 30% of panicle affected
	7	31 to 60% of panicle affected
	9	>61% of panicle affected

Data on disease incidence, percent disease index and yield/ m^2 were calculated. The disease severity index was calculated by using the following formula:

$$PDI = \frac{\text{Sum of all the numerical ratings}}{\text{Total number of samples scored} \times \text{maximum disease grade}} \times 100$$

The disease incidence was examined by using formula:
Disease incidence = Number of infected plants/Total number of plants × 100
The numbers of infected plants were recorded and the disease reaction of the variety was recorded following the scale given by Groth *et al.* (1991). The detail of scale is given in Table 2.

Table 2: Disease reaction scale for bacterial panicle blight of rice.

Disease incidence (%)	Reaction
0	Immune
1- 20	Resistant
21 -30	Moderately resistant
31 -50	Moderately susceptible
51 -60	Susceptible
61 -100	Highly susceptible

RESULT AND DISCUSSION

Twenty five different rice varieties were inoculated on varying dates coinciding with their panicle emergence stage. The disease symptoms were developed within two weeks of artificial inoculation. Observation was recorded by visually examining the blighted panicles and categorized based on 0-9 scale. The data revealed that none of the variety was showing immune reaction to *Burkholderia glumae*. Among twenty five varieties only Hasanta variety exhibited moderately resistance reaction towards the pathogen while thirteen varieties were found to be highly susceptible, four are susceptible and seven varieties were moderately susceptible. Among thirteen highly susceptible varieties Swarna had recorded the highest disease incidence *i.e.* 84%. The lowest disease incidence was in Hasanta *i.e.* 24.3% (Table 3). From the present disease severity and yield data it was observed that the highest PDI (77.78) was in variety Swarna which is at par with Surendra (73.33) and Tejaswini (71.11). The lowest PDI (19.26) was recorded in variety Hasanta followed by variety Kalachampa *i.e.* 33.33 which is at par with variety Indrabati (37.78). The highest yield was recorded in variety Hasanta *i.e.* 521.3 g/m^2 and the lowest yield was found in variety Khandagiri *i.e.* 218.7 g/m^2. The screening of 25 rice varieties for resistance and susceptibility against *Burkholderia glumae* classified the varieties into different groups *i.e.* resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible (Groth *et al.*, 1991). Among the twenty five rice varieties none of the variety was found to be resistant against *Burkholderia glumae* but only Hasanta variety exhibited moderately resistance having 24.3% disease incidence. Out of twenty five varieties, thirteen varieties were found to be highly susceptible *viz.* Mandakini, Ajay, Ghanteswari, Pratikhya, Nabeen, Swarna, Padmini, Lalat, Prativa, Khandagiri, Mrunalini, Manaswini and Indrabati. Among these highly susceptible varieties, Swarna exhibited highest disease incidence 84%. The study revealed that most of the medium duration and long duration varieties exhibited the moderately susceptible to highly susceptible reaction against *Burkholderia glumae*. The longer incubation period seen in these kinds can be attributable to the incubation that occurred during the booting stage leading to panicle emergence during the heading stage. This suggests that the duration of maturity in paddy varieties influences the manifestation of panicle blight symptoms. However it is also possible that the genetic makeup of the variety contributes to this phenomenon as certain long duration variety like Hasanta displayed a moderate resistance to this disease. Mizobuchi *et al*. (2013) ; Wahidah *et al*. (2019) screened some widely cultivated paddy varieties against bacterial grain rot disease and the result indicated that none of the cultivar had a resistance against bacterial grain rot disease caused by *Burkholderia glumae*.

Table 3: Varietal screening of different genotype against *Burkholderia glumae.*

Sr. No.	Variety	Durations	Disease incidence (%)	Disease Reaction	PDI	Yield (g/m^2)
1.	Ranidhan	145	48.3 (44.04)	MS	40.00 (50.79)	384.1
2.	Mandakini	120	75.3 (60.28)	HS	51.11 (45.64)	405.5
3.	Ajay	135	65.0 (53.74)	HS	55.56 (48.22)	356.3
4.	Ghanteswari	90-95	61.3 (51.58)	HS	31.11 (33.90)	228.4
5.	Kalachampa	150-160	38.0 (38.05)	MS	33.33 (35.26)	402.1
6.	Upahar	162	49.0 (44.42)	MS	37.78 (37.91)	358.0
7.	Hasanta	145-150	24.3 (29.52)	MR	19.26 (26.03)	521.3
8.	Pratikhya	140-145	67.3 (55.13)	HS	55.56 (48.22)	460.5
9.	Nabeen	115-120	71.3 (57.63)	HS	46.67 (43.09)	397.7
10.	Swarna	120-125	84.0 (66.43)	HS	77.78 (62.08)	320.6
11.	Gobinda	95-100	39.3 (38.79)	MS	40.00 (39.20)	500.5
12.	Padmini	140-145	65.3 (53.94)	HS	46.67 (43.09)	297.8
13.	Lalat	125-130	78.0 (62.03)	HS	62.22 (52.41)	224.5
14.	Asutosh	150	40.0 (39.23)	MS	40.00 (39.23)	327.5
15.	Prativa	125	63.0 (52.54)	HS	44.44 (41.80)	378.8
16.	Heera	65-68	58.3 (49.78)	S	42.22 (40.50)	246.2
17.	Khandagiri	90-95	65.0 (53.73)	HS	55.56 (48.19)	218.7
18.	Mrunalini	145	73.3 (58.90)	HS	46.67 (43.09)	382.9
19.	Manaswini	132	62.0 (51.94)	HS	41.34 (40.01)	372.5
20.	Hiranmayee	135	42.3 (40.59)	MS	51.11 (45.64)	435.1
21.	Surendra	135	40.3 (39.40)	MS	73.33 (58.91)	345.6
22.	Indravati	150	77.66 (61.86)	HS	37.78 (37.93)	312.4
23.	Tejaswini	135	54.3 (47.47)	S	71.11 (57.49)	315.8
24.	Sidhanta	120	58.3 (49.79)	S	57.78 (49.48)	274.1
25.	Bhubana	135-140	55.0 (47.87)	S	48.89 (44.36)	308.7
	SE(m) ±		1.29		2.32	15.308
	CD (5%)		4.24		7.60	50.15

*Figures inside parentheses indicate corresponding angular transformed values
Note: DI 0-20 : R, 21-30 : MR, 31-50 : MS, 51-60 : S, 61-100 : HS (Groth *et al.*, 1991)

CONCLUSIONS

Twenty five rice varieties were screened against *Burkholderia glumae* and classified into different groups *i.e.* resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible. Out of twenty five rice varieties none of the variety was found to be resistant against *Burkholderia glumae*. Only Hasanta variety was found to have moderate resistance against *Burkholderia glumae* exhibiting disease incidence 24.3%. Among the highly susceptible varieties, Swarna variety exhibited highest disease incidence 84%. So it can be concluded that medium duration and long duration varieties exhibited the moderately susceptible to highly susceptible reaction against *Burkholderia glumae* as longer incubation period during the booting stage leading to panicle emergence during the heading stage. This suggests that the duration of maturity in paddy varieties influences the manifestation of panicle blight symptoms. However the genetic makeup of the variety is also contributing to this phenomenon as the long duration variety like Hasanta showed a moderate resistance to this bacterial panicle blight disease.

FUTURE SCOPE

Planting with cultivars having a resistant level as high as possible can be an effective way to reduce the damage caused by this bacterial panicle blight disease. Recent progresses in rice genomics and newly developed genome editing tools may provide powerful tools to better understanding the mechanisms associated with bacterial panicle blight resistance and develop the new rice cultivars with higher level of resistance to bacterial panicle blight in future.

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Conflict of Interest. None.

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