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SCREENING GERMPLASM FOR RESISTANCE TO BACTERIAL BLIGHT OF RICE CAUSED BY *Xanthomonas oryzae* pv. *oryzae*

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ABSTRACT
The bacterial blight of rice caused by *Xanthomonas oryzae* pv. *oryzae* (*Xoo*) (Ishiyama, 1922) is an economically important and is one of the most destructive disease of rice in both irrigated and rainfed environments in Asia. The disease can cause 30 to 50 Per cent yield loss. Host Plant resistance is an important component of an integrated management program for this disease. So, in this investigation effort has been made to screen the germplasm against the pathogen under natural condition. Among the seventy one rice genotypes screened under natural epiphytotic condition at Agriculture Research Station, Siruguppa, none of them were found immune against bacterial leaf blight. However, three genotypes *viz.*, Ajaya, TKM-6 and IR-8 were found resistant. Six genotypes *viz*., IR-72, Tetep, PR-111, Zenith, CRMAS-2231-23 and Govind were moderately resistant, twenty three were moderately susceptible, twenty four susceptible and fifteen were highly susceptible. Virulence reaction of the five isolates was varied on different cultivars some are more virulent and some are less virulent. Cultivar IET-8320 and TN-1 showed highly susceptible reaction to all the isolates and IR - 20 also showed highly susceptible reaction to all the isolates except Xoo 2 and IR – 72 showed susceptible reaction against Xoo 1, Xoo 4 and Xoo 5 and highly susceptible for Xoo 3, whereas IR-8 was moderately resistant against Xoo 1, Xoo 2, Xoo 3 and moderately susceptible for Xoo 4 and Xoo 5.

KEY WORDS: Rice, bacterial blight, *Xanthomonas oryzae* pv. *oryzae*, Screening germplasm

INTRODUCTION

The bacterial blight of rice caused by *Xanthomonas oryzae* pv. *oryzae* (*Xoo*) (Ishiyama, 1922) Swings *et al*. (1990) is an economically important (Mew, 1987) and is one of most destructive disease of rice in both irrigated and rainfed environments in Asia (Mew, 1987). The disease can cause 30 to 50 Per cent yield loss (Reddy, 1989 and Adhikari *et al*., 1994). Host Plant resistance is an important component of an integrated management program for this disease. To minimize the risk of attack by bacterial blight, evolving resistant cultivars against the pathogen is the best non chemical method for management of the disease. To develop high yielding varieties with durable resistance to bacterial blight, it is necessary to understand the pathogen population structure. Following the breakdown of resistance in cultivar Asakaze, the studies on host pathogen interaction were carried out in different countries. The existing population of the bacterium was classified into virulence groups/races based on their interaction with differential cultuvars by various workers (Das, *et al*. 1994; Ou, 1985). Rehman *et al*. (1993) Identified five races viz. Ia, Ib, II, III and IV from India and Nepal. Hence, in this investigation effort has been made to screen the germplasm against the pathogen under natural condition. Apart from this differential reaction of the *Xoo* isolates was made to find out the virulent isolate.

MATERIAL AND METHODS

Germplasm screening

Seventy-three different entries/ genotypes were tested at Agricultural Research Station (ARS), Siruguppa during *kharif* 2005-06 against *Xoo* under natural epiphytotic condition.

Each entry was planted in rows, each of three meter length with an inter row spacing of 30 cm. Two replications were maintained in a randomized block design. Each of the plots consisting of a minimum four rows of test genotypes was flanked on either side with a single row of susceptible check TN1. Basal application of NPK at 40:40:30 Kg/ha was applied and incorporated prior to planting 21 days old seedlings. Top dressing was given with urea @ 40 kg N/ha once at 25 days after planting, and again at panicle initiation stage. The experimental field was kept free from weeds by adopting manual weeding. Plant protection measures adopted only when absolutely needed to prevent insect pest damage to the crop. Plants were exposed to natural infection by *Xanthomonas oryzae pv. oryzae*. Observations were recorded at the milky stage on the severity of bacterial leaf blight reaction on a 0-9 scale (Anon., 1996).

0 = immune
1 = Resistant (1 – 5% area affected)
3 = Moderately resistant (6 – 12% area affected)
5 = Moderately susceptible (13 – 25% area affected)
7 = Susceptible (26 – 50% area affected)
9 = Highly susceptible (51 – 100% area affected)

Differential reaction of cultivars to *Xanthomonas oryzae* pv. *oryzae* under *in vitro* condition

Bacterial leaf blight disease of rice caused by *Xanthomonas oryzae* pv. *oryzae* occurs on most cultivars of rice. Attempts have been made in the present

investigation to differentiate the isolates of *Xoo* collected and isolated from different location. Isolates showed differences in characters such as morphology, physiology and biochemical properties. An *in vitro* inoculation technique was used to measure the virulence of isolates. The purpose of this study was to determine the differential virulence of isolates of *Xoo* to different rice cultivars.

Five isolates of *Xanthomonas oryzae* pv. *oryzae* were grown on Potato Sucrose Agar (PSA) at 27^0 C. inoculum suspension (10^9 cfu/ml) were prepared by using sterile distilled water from 48 hr old cultures on PSA. Cultivars of rice IR-8, IR-72, IET-8585, IET-8320, IR-20 and TN_1 were used in the study. The cultivars were raised in pots and 45 days old plants were kept under controlled condition (27^0 C temperature and 95% RH) and the cultivars were clip inoculated with the bacterial suspension and PDI was recorded 14 days after inoculation.

RESULTS AND DISCUSSION

Seventy one rice genotypes were screened against *Xanthomonas oryzae* pv. *oryzae* under natural epiphytotic condition at Agricultural Research Station, Siruguppa. Genotypes were classified into six classes based on degree of reaction and genotypes falling in particular class are presented in table 1.

TABLE 1. Reaction of rice genotypes against *Xanthomonas oryzae* pv. *oryzae* under natural epiphytotic condition

Grade	Per cent area affected	Resistance grade	Genotypes
1	1-5	Resistant	Ajaya, TKM-6, IR-8
3	6 -12	Moderately resistant	IR-72, Tetep, PR-111, Zenith, CRMAS 2231-23, Govind
5	13 -25	Moderately susceptible	CRMAS 2231-4, CRMAS 2231-6, CRMAS 2231-8, CRMAS 2231-12, CRMAS 2231-13, CRMAS 2231-14, CRMAS 2231-19, CRMAS 2231-22, CRMAS 2231- 28, CRMAS 2231-29, CRMAS 2231-32, CRMAS 2231-35, CRMAS 2231-36, CRMAS 2231-37, CRMAS 2231-42, CRMAS 2231-45, CRMAS 2231-48, CRMAS 2231-49, K-20, DV-85, IET 8585, IRBB 21, IET 8320
7	26 -50	Susceptible	CRMAS 2231-2, CRMAS 2231-3, CRMAS 2231-5, CRMAS 2231-10, CRMAS 2231-15, CRMAS 2231-17, CRMAS 2231-18, CRMAS 2231-21, CRMAS 2231-24, CRMAS 2231-25, CRMAS 2231-30, CRMAS 2231-34, CRMAS 2231-38, CRMAS 2231-41, CRMAS 2231-43, CRMAS 2231-44, CRMAS 2231-47, CRMAS 2231-50, IR-64, Hashikalni, Chegoku-45, Java-14, Cemposelak, IR- 20
9	51-100	Highly susceptible	CRMAS 2231-7, CRMAS 2231-9, CRMAS 2231-11, CRMAS 2231-16, CRMAS 2231-20, CRMAS 2231-26, CRMAS 2231-27, CRMAS 2231-31, CRMAS 2231-33, CRMAS 2231-40, CRMAS 2231-46, IR- 24, BJ-1, IRBB 13, TN 1

TABLE 2. Reaction of six rice cultivars to five isolates of *Xanthomonas oryzae* pv. *Oryzae*

Cultivars	Reaction				
	Isolates				
	Xoo1	Xoo2	Xoo3	Xoo4	Xoo5
IR-8	MR	MR	MR	MS	MS
IR -72	S	S	HS	S	S
IET - 8585	HS	S	HS	HS	S
IET-8320	HS	HS	HS	HS	HS
IR-20	HS	S	HS	HS	HS
TN-1	HS	HS	HS	HS	HS

MR = Moderately resistant
MS = Moderately susceptible
S = Susceptible
HS = Highly susceptible

None of them were found to immune against *Xanthomonas oryzae* pv. *oryzae*. However, 3 genotypesAjaya, TKM-6 and IR-8 were found to be resistant with grade 1. Where as six genotypes *viz*, IR- 72, Tetep, PR-111, Zenith, and CRMAS – 2231-23 and Govind were moderately resistant with each scoring grade 3. Twenty three were moderately susceptible with grade 5, Twenty four genotypes found susceptible and fifteen were highly susceptible against the disease. Wide response of genotype against the *Xanthomonas oryzae* pv. *oryzae* has been earlier observed by various workers (Khan *et al*, 2000; Ram singh, 2000).

Reaction of five isolates of the bacteria on rice cultivars/ differentials

Symptoms on leaves were characterized by water soaked lesion in the early stages and started extending along the

margin as a wavy necrotic lesion. Reaction of six rice differentials *viz.* IR-8, IR –72, IET – 8585, IET-8320, IR-20 and TN-1 to five isolates of Xoo is presented in table 2. Differences in resistance and susceptibility of six differentials were observed by using pot culture technique.

Cultivar IR-8 showed moderate resistance reaction against isolate Xoo 1, Xoo 2 and Xoo 3, while moderately susceptible reaction for Xoo 4 and Xoo 5. Susceptible reaction was exhibited by IR-72 against Xoo 1, Xoo 2, Xoo 4 and Xoo 5, whereas highly susceptible reaction was shown for Xoo3.

Isolates Xoo 2 and Xoo 5 produced susceptible reaction on cultivars IET – 8585 and Xoo 1, Xoo 3 and Xoo 4 exhibited highly susceptible reaction. Cultivar IET–8320 and TN 1 showed highly susceptible reaction for all the five isolates. Whereas IR-20 also exhibited highly susceptible reaction against all the isolates except isolate Xoo2.

Isolate Xoo 3 was found to be the highly virulent as it produced the highly susceptible reaction on five cultivars and Xoo 2 was found to be the least virulent since it produced highly susceptible reaction on only two cultivars rest of the isolates were found to be the intermitants. However, variation in virulence was well demonstrated by Priyadarsini *et al*. (1999).

Kiryu and Mizuta (1955) found that cultivars with few, short, narrow and erect leaves have low infection than those having luxuriant growth and spreading leaves. Cultivars with hairy leaves showed maximum disease while the disease was very low in cultivars with glabrous leaves due to retention of more inoculum by the hairy cultivars (Raju and Devadath, 1980). Resistant cultivars have a higher ratio of reducing sugar to total nitrogen, higher content of polyphenols, lower contents of some free amino acids and production of a non specific phytoalexin (Mahto, *et al*., 1987: Ou, 1985). Purushothaman (1974) noticed a high phenylalanine ammonia lyase activity in resistant cultivars due to synthesis of more phenyls than susceptible ones. In IR 28 or Te-tep, the bacterial cells became irregular in shape and were immobilized by fimbrillar material induced from the cell wall of host. The development of such fibrillar material has been reported to be a defense mechanism associated with incompatible reaction (Horino, 1981).

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