

PRELIMINARY EVALUATION ON RESISTANCE GENES AGAINST RICE BACTERIAL LEAF BLIGHT IN CAN THO PROVINCE - VIETNAM

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ABSTRACT

The reactions of 10 near-isogenic lines and 13 pyramiding lines against bacterial leaf blight were evaluated under natural infection in the field. IRBL13 and IRBL14 carrying resistance gene *xa13* and *Xa14* were susceptible, IRBB4 and IRBB5 having resistance gene *Xa4* and *xa5* were moderately susceptible, the remaining was moderately resistant to bacterial leaf blight. The level of infection was not so clear among 2-gene, 3-gene, 4-gene and 5-gene pyramiding lines. IRBB60, IRBB62, and IRBB63 with respectively resistance gene combination *Xa4+xa5+xa13+Xa21*, *Xa4+Xa7+Xa21* and *xa5+Xa7+xa13* had short lesion length and low diseased leaf area (%). Due to environmental influence, additional experiments should be done by artificial inoculation to confirm the above results.

Key words: Bacterial leaf blight, resistance gene, *Xanthomonas oryzae* pv. *oryzae*

INTRODUCTION

In the Mekong Delta the bacterial leaf blight (BLB) caused by *Xanthomonas oryzae* pv. *oryzae* was not serious from 1980 - 1995. Recently, severity has increased gradually over the years. Most of leading varieties become susceptible, especially Jasmine 85, OMCS 2000, OM2490, OM2492, OM2517, OM4498 and OM4656 that are grown in large-scale area. Efficacy of chemical on this disease is not significant. Therefore, planting resistant varieties provides an effective control and up to the present most breeders concentrate on the development of highly resistant varieties.

In Vietnam, previous results on BLB showed that there were 14 bacterial leaf blight races in Northern Vietnam. Most of races were incompatible to resistance genes *Xa-7* and *xa-5*, the next was *Xa-21* and *Xa-4* (Phan Huu Ton and Bui Trong Thuy, 2003). Noda et al. (1999) were classified 52 isolates -collected in Southern, Central, and Northern- into 6 races (A, B, C, D, E, F), race A was prevalent in the Mekong Delta area and was incompatible to resistance genes *Xa-3*, *xa-5*, *Xa-7*, *Xa-17* and *Xa-21*.

Xa 4 gene was not durable as a major gene for high level of resistance but possibly durable as a minor gene for partial resistance (Koch and Parlevliet, 1991). *Xa 21* gene was identified in the wide species, *Oryza*

longistaminata (Khush et al., 1990). It is resistant to all Philippine and Indian races of *Xanthomonas oryzae*. There were large residual effect in *Xa 21* and *Xa 4* genes, *xa 5* had smaller and *xa 13* had no residual effect (Li et al., 2001).

This evaluation was done to preliminarily assess resistance genes that are still effective and can be used in bacterial leaf blight resistance breeding program.

MATERIALS AND METHODS

Ten near-isogenic lines IRBB 1 (carrying *Xa-1*), IRBB 3 (*Xa-3*), IRBB 4 (*Xa-4*), IRBB 5 (*xa-5*), IRBB 7 (*Xa-7*), IRBB 10 (*Xa-10*), IRBB 11 (*Xa-11*), IRBB 13 (*xa-13*), IRBB 14 (*Xa-14*), and IRBB 21 (*Xa-21*).

And thirteen pyramiding lines involving IRBB 51 (carrying *Xa-4*, *xa-13*), IRBB 52 (*Xa-4,Xa-21*), IRBB 54 (*xa-5,Xa-21*), IRBB 55 (*xa-13, Xa-21*), IRBB 57 (*Xa-4,xa-5, Xa-21*), IRBB 59 (*xa-5, xa-13, Xa-21*), IRBB 60 (*Xa-14, xa-5, xa-13, Xa-21*), IRBB 61 (*Xa-4,xa-5,Xa-7*), IRBB 62 (*Xa-4,Xa-7,Xa-21*), IRBB 63 (*xa-5,Xa-7,xa-13*), IRBB 64 (*Xa-4,xa-5,Xa-7,Xa-21*), IRBB 65 (*Xa-4, Xa-7,xa-13, Xa-21*), and IRBB 66 (*Xa-4, xa-5, Xa-7,xa-13, Xa-21*) that have combination of 2-5 resistance genes.

These lines were provided by Drs. H Leung and CM Vera Cruz from International Rice Research Institute (IRRI).

Under field condition, the reactions of these lines were evaluated in natural infection in wet season 2005. Each line was planted in a 10-row plot with 20 plants in each row, and spacing of 15x20 cm. Fertilizer dose was 100-40-30 (N-P₂O₅-K₂O) kg/ha. At the dough stage, the diseased leaf area (DLA) (%) and lesion length (LL) (cm) were measured on first three leaves of each tiller. The data were recorded for all tillers of four plants randomly selected in each plot. The DLA was evaluated using Standard Evaluation System (IRRI, 1996) and plants with LL < 1 cm were classified as highly resistant, ~1-3 cm as resistant, ~3.1 - 6 cm as moderately resistant,

~6.1-10 cm as moderately susceptible, and > 10 cm as susceptible.

RESULTS AND DISCUSSION

As shown in table 1, the difference of lesion length and diseased leaf area showed clearly between NILs and susceptible variety Jasmine 85 (27.87 cm and 42.94%, respectively). IRBB 1, IRBB 3, IRBB 4, IRBB 10, IRBB 11 and IRBB 21, carrying resistance genes *Xa 1*, *Xa 3*, *Xa 4*, *Xa 10*, *Xa 11*, *Xa 21*, respectively, were moderately resistant to *Xoo*. None of NILs were highly resistant or resistant to *Xoo* in Can Tho province.

Table 1. Reaction of Near-Isogenic Lines carrying different resistance genes against rice bacterial leaf blight.

NILs*	Resistance genes	Diseased Leaf Area (%)	Lesion Length (cm)	Reaction
IRBB 1	<i>Xa 1</i>	7.85	3.96	MR
IRBB 3	<i>Xa 3</i>	7.57	3.84	MR
IRBB 4	<i>Xa 4</i>	8.85	5.82	MR
IRBB 5	<i>xa 5</i>	12.36	9.57	MS
IRBB 7	<i>Xa 7</i>	15.40	9.77	MS
IRBB 10	<i>Xa 10</i>	8.95	5.89	MR
IRBB 11	<i>Xa 11</i>	6.65	4.69	MR
IRBB 13	<i>xa 13</i>	16.07	10.30	S
IRBB 14	<i>Xa 14</i>	21.39	11.81	S
IRBB 21	<i>Xa 21</i>	9.42	6.01	MR
Jasmine 85	?	42.94	27.87	S

* NILs: near-isogenic lines

The diseased leaf area and lesion length of pyramiding lines having 2-5 genes were seen in table 2. When in pair, the DLA and LL were increased in the case where one of resistance gene was compatible to *Xoo* and were decreased when both dominant resistance genes were incompatible to *Xoo*, for instance, *xa13* + *Xa21* (IRBB 55) and *Xa4* + *Xa21* (IRBB 52), respectively.

High level of resistance was observed in combination of three dominant resistance genes *Xa4*+*Xa7*+*Xa21* (IRBB 62), the next was *Xa4*+*xa5*+*xa13*+*Xa21* (IRBB 60).

Especially, IRBB 63 having three genes *xa5*+*Xa7*+*xa13* were resistant in combination but one-gene NILs were moderately susceptible to *Xoo*. Residual effect and quantitative complementation should be mentioned in this case. According to Li et al. (2001), high level of resistance against virulent pathogen races resulted from the defeated gene pairs such as *xa13/xa5*, *xa13/Xa4*, *xa13/Xa21*, *xa5/Xa4* and *xa5/Xa21*. This has been referred to as quantitative complementation (Ogawa and Khush 1988, Yoshimura et al. 1996; Huang et al. 1997).

Table 2. Reactions of the pyramiding lines carrying 2-5 resistance genes against bacterial leaf blight.

NILs/PLs	Resistance Genes	DLA (%)	LL (cm)	Reaction
IRBB 4	<i>Xa 4</i>	8.85	5.82	MR
IRBB 5	<i>xa 5</i>	12.36	9.57	MS
IRBB 7	<i>Xa 7</i>	15.40	9.77	MS
IRBB 13	<i>xa 13</i>	16.07	10.30	S
IRBB 21	<i>Xa 21</i>	9.42	6.01	MR
IRBB 51	<i>Xa 4, xa 13</i>	9.04	6.01	MR
IRBB 52	<i>Xa 4, Xa 21</i>	4.86	4.60	MR
IRBB 54	<i>xa 5, Xa 21</i>	—	—	—
IRBB 55	<i>xa 13, Xa 21</i>	12.36	7.43	MS
IRBB 57	<i>Xa 4, xa 5, Xa 21</i>	10.67	9.54	MS
IRBB 61	<i>Xa 4, xa 5, Xa 7</i>	7.90	4.76	MR
IRBB 62	<i>Xa 4, Xa 7, Xa 21</i>	2.69	1.50	R
IRBB 63	<i>xa 5, Xa 7, xa 13</i>	5.32	3.09	R
IRBB 59	<i>xa 5, xa 13, Xa 21</i>	5.60	4.33	MR
IRBB 60	<i>Xa 4, xa 5, xa 13, Xa 21</i>	4.37	3.34	R
IRBB 64	<i>Xa 4, xa 5, Xa 7, Xa 21</i>	13.95	6.10	MS
IRBB 65	<i>Xa 4, Xa 7, xa 13, Xa 21</i>	5.61	3.36	MR
IRBB 66	<i>Xa 4, xa 5, Xa 7, xa 13, Xa 21</i>	8.22	4.13	MR
Jasmine 85	?	42.94	27.87	S

DLA: Diseased leaf area, LL: Lesion length, NILs: near-isogenic lines, PLs: pyramiding lines

Generally, in comparison between two-gene pyramiding lines, three-gene pyramiding lines, four-gene pyramiding lines and five-gene pyramiding lines, not-obvious difference was addressed in terms of diseased leaf area and lesion length except IRBB60, IRBB62 and IRBB63. Field-testing of rice with bacterial blight was strongly influenced by environment on development of this pathogen. Additional experiment should be done in artificial inoculation to confirm the above observation and using the different races prevalent in Mekong Delta area is necessary in determining which resistance genes against bacterial leaf blight are still effective in the Mekong Delta area. The result of additional

study will be useful in breeding program for bacterial leaf blight resistance.

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Đánh giá sơ khởi hiệu lực của gen kháng bệnh bạc lá lúa ở tỉnh Cần Thơ vùng đồng bằng sông Cửu Long

Phản ứng của 10 dòng đơn gen và 13 dòng mang từ 2-5 gen kháng bệnh bạc lá đã được đánh giá trong điều kiện lây nhiễm tự nhiên ngoài đồng ruộng. Phản ứng nhiễm được ghi nhận trên hai giống IRBB13 và IRBB14 mang gen kháng *xa13* và *Xa14*, IRBB 4 và IRBB 5 mang gen kháng *Xa 4* và *xa5* hơi nhiễm, các dòng còn lại có phản ứng hơi kháng đối với bệnh bạc lá. Chiều dài vết bệnh và diện tích lá bị bệnh giữa các dòng mang 2, 3, 4 và 5 gen kháng không khác biệt rõ. Mức độ kháng của IRBB60 (mang các gen *Xa4+xa5+xa13+Xa21*), IRBB62 (*Xa4+Xa7+Xa21*) và IRBB63 (*xa5+Xa7+xa13*) thể hiện tốt trong điều kiện đồng ruộng.