STUDY ON DURABLE RESISTANCE OF RICE VARIETIES TO BLAST DISEASE IN THE MEKONG DELTA OF VIETNAM

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ABSTRACT

Results of testing 500 rice varieties for blast resistance over 7 locations in 4 provinces in the Mekong Delta showed that 23 varieties were highly resistant, 80 were moderately resistant, and the rest were susceptible or unstable for resistance. Based on the disease severity index, the varieties OMCS94, OM1706, IR64, IR62032, OM1570, OM723-11, OMCS5, NCM10-20, OM1726, TEP HANH and BONG DUA were considered to possess durable resistance. The varieties with high and moderate resistance to leaf blast normally maintained the resistance to panicle blast also. However, most of the varieties with unstable resistance to leaf blast were found to be susceptible to panicle blast. It is recommended to use the varieties with durable resistance for large-scale production. Evaluation for resistance to blast disease should be done continuously over locations and cropping seasons.

Key words: Rice, *Pyricularia grisea,* blast, durable resistance

INTRODUCTION

The blast disease caused by *Pyricularia grisea* is the most important disease on rice in the Mekong Delta. The climatic conditions and intensive rice cropping in the region make this disease most severe. It causes lesions on leaves of the young plants or "rotten neck" on the panicles leading to substantial yield loss. The control of this disease is difficult because of the high variation in the races of the fungus over locations and years. (Zeigler et al., 1997). It is common that resistant varieties became susceptible after a short time in production (Wang et al., 1989). Therefore, it is essential to study the durability in resistance of rice varieties to blast disease to help in identifying the varieties which could sustain from the disease pressure in various ecosystems.

MATERIALS AND METHODS

Materials

The material included 500 rice varieties of different origins. OM269 and Te Tep were the susceptible and resistant check, respectively.

Methods

The method of uniform blast nurseries was followed (Ahn, 1994). Evaluation of blast resistance was based on score 0-9 (IRRI, 1988). The nurseries were conducted at 7 locations in the provinces Can Tho, Ca Mau, Tien Giang and An Giang during 1996-97.

Panicle blast disease was evaluated in the fields in the provinces Ben Tre, Soc Trang and Tien Giang during 1999 when blast disease occurred severely. The percentage of panicles infected were recorded and converted to score 0-9.

Durable resistance was evaluated based disease severity index (DSI) as defined by Ahn (1994)

$$DSI = \frac{\text{Sum of compatible reaction scores (4-9)}}{\text{Total number of trials showing compatible reaction}}$$

DSI ≤ 5: indicates durable resistance
DSI >5: indicates unstable resistance or susceptibility

RESULTS AND DISCUSSION

Reaction of rice varieties to blast in different locations in the Mekong Delta

Based on the scores of each variety obtained from 7 testing locations in the Mekong Delta, the varieties were divided into 4 groups:

Group I: resistance with 23 varieties (5.26%) with score from 0-3
Group II: moderate resistance with 80 varieties (18.31%) with score from 0 to 5
Group III: unstable resistance with 205 varieties (46.91%) with reaction to vary widely from resistance in one location to susceptibility in another
Goup IV: susceptibility with 192 varieties (29.52%) showing susceptible score 7-9 in all the locations.

It was noted that the percentage of highly resistant varieties were very low. A high number of varieties were susceptible or unstable for resistance. Typical varieties in each group are given in Table 1.

Durable resistance of the rice varieties

Rice varieties showing high frequency of incompatible reaction across many locations and years are considered to possess broad spectrum resistance. This type of resistance is generally quantitative and controlled by major gene(s) (Ahn and Ou, 1982). Ahn (1994) called this type of resistance as durable resistance which had the same meaning of field resistance, partial resistance or quantitative resistance and proposed to use the disease severity index (DSI) as a criterion for evaluating durable resistance to blast disease. Varieties showing DSI below 5 after testing over years and locations were considered durably resistant. Varieties with DSI above 5 were unstable for resistance. We calculated DSI for 500 varieties from the experiments at 7 locations. Table 2 shows the rice varieties to have DSI below 5. They included OMCS94, OM1706, IR64, IR62032, OM1570, OM723-11, OMCS5, NCM10-20, OM1726, TEP HANH and BONG DUA. These varieties had score normally varying from 0-4. It was proved practically that the varieties IR64, OM1706, OM723-11 sustained in production for a long time in the Mekong Delta. The susceptible check OM269 had score 8-9 and DSI= 9. The resistant check Te Tep in our study showing DSI= 6. Data from the international testing program for blast resistance of IRRI showed DSI of Te Tep= 5.3 (Ahn, 1998).

Table 1. Reaction of rice varieties to blast disease in the Mekong Delta

Variety group	Range of score (0-9)	Number of varieties	% total varieties tested	Typical varieties
Resistance	0-3	23	5.26	IR59656**,** WAB32-80, B7291-SM-12, W7-1, 0M1704, OM90-9, OM2031, TA-POO-CHOZ, NCM4-12-1**,** NCM16-27, K984**,** BA XE GIAI, BONG DUA, K314
Moderate resistance	0-5	80	18.31	IR64, OM1270, OM1570, OMCS5, IR36. TEP HANH, NGOC NU, DU THOM THAI BINH, IR62032, MTL14, ARO37, NCM10-20, NCM42-94, SA MO VAN, K861, IR50, C22
Unstable resistance	0-9	205	46.91	IR62030, IR62164, IR62126-59, OM1633**,** OM1723, OM1490, S40, IR42, OM1271, OM997-6, MRC123**,** OM1314, OM1726 ,OM1493, OMCS6, C15173
Suscepti-bility	7-9	192	29.52	TN1228, PSBR20, VN95-40, IR50404, OM1632, MTL145, IR62, IR40, IR44, PUSA, LUN CAN, BA NGUON, TN1, MOT BUI, OM1666, OM850, OM1250

Table 2. Disease severity index of popular varieties in the Mekong Delta

Variety name	Frequency of disease scale (%)							DSI
	0-2	3	4	5	6	7	8-9	
DSI <5								
OMCS94	71.4	0	14.3	0	14.3	0	0	5.0
OM1706	51.7	14.3	28.6	0	0	0	0	4.0
IR64	42.8	28.6	28.6	0	0	0	0	4.0
IR62032	42.8	0	24.6	0	0	0	0	4.5
OM1570	42.8	14.3	14.3	14.3	14.3	0	0	5.0
OM723-11	42.8	28.6	14.3	14.3	0	0	0	4.5
OMCS5	71.4	14.3	0	14.3	0	0	0	5.0
NCM10-20	71.4	0	28.6	0	0	0	0	4.0
OM1726	57.1	14.3	14.3	0	14.3	0	0	5.0
TEP HANH	28.3	28.6	14.3	0	14.3	0	0	4.7
BONG DUA	85.7	14.3	0	0	0	0	0	-

Table 2. (continued)

Variety name	Frequency of disease scale (%)							DSI
	0-2	3	4	5	6	7	8-9	
DSI >5								
OM1633	28.5	28.5	14.3	0	14.3	14.3	0	5.6
OMFi1	28.5	14.3	14.3	14.3	14.3	14.3	0	5.5
OM997	14.3	14.3	0	42.8	28.6	0	0	5.4
IR50404-57	0	0	28.6	14.3	7.0	0	0	5.8
OM1271	0	0	28.5	28.5	14.3	28.5	0	6.4
IR62030	28.6	28.6	14.3	14.3	0	14.3	0	5.6
OM1490	28.6	28.6	0	58.6	0	0	14.3	6.3
TN128	14.3	0	0	0	14.3	0	71.4	8.3
TE TEP*	28.6	14.3	0	0	66.6	0	0	6.0
OM269**	0	0	0	0	0	0	100	9.0

**Resistant check ** Susceptible check*

Panicle blast disease of the varieties

The occurrence of rotten neck on the panicles at the flowering stage (panicle blast) causes empty spikelets resulting in yield loss directly. The correlation between leaf blast resistance at the early stage and panicle blast resistance at the flowering stage of the same variety is not always positive. Therefore, it is essential to evaluate the resistance of rice varieties to panicle blast also. We carried out the evaluation on the varieties grown in the farmers' field in three provinces: Ben Tre, Soc Trang and Tien Giang where blast disease was severe in 1998.

The results showed that IR59656, OM1704, OM2031, NCM16-27 had low percentage of panicles infected (1.77-4.47%). These varieties were also resistant to leaf blast.

The varieties with moderate resistance to leaf blast- IR64, OM1570, NCM10-20, OMCS5 had low percentage of panicles infected, except OM1570 had 8.93% of panicles infected (this variety was resistant to panicle blast in Ben Tre and Soc Trang but susceptible in Tien Giang).

The varieties with unstable resistance to leaf blast- OM62030, OM1633, OM1490, OMCS6, OM1726, OM1723-62, OM1271 showed varying degrees of panicle blast infection. Susceptible scores were recorded in most of the cases, except the two varieties, OM1490 and OMCS6 which were found to be resistant to panicle blast.

Table 3. Panicle blast (% panicles infected) of popular varieties in the Mekong Delta

Variety group to leaf blast resistance	Variety name	% Panicles infected			Average	
		Ben Tre	Soc Trang	Tien Giang	% panicles infected *	Score
High Resistance	IR59656	3.4	5.2	2.5	3.70ab	1
	OM1704	0	0	6.2	2.07a	1
	OM2031	1.3	3.3	0.7	1.77a	1
	NCM16-27	13.2	0	0.2	4.47ab	1
Moderate Resistance	OM1570	1.2	3.3	22.3	8.93a-d	3
	NCM10-20	2.1	0.8	1.1	1.33a	1
	OMCS5	0.9	3.1	0.8	1.60a	1
Unstable Resistance	IR62030	11.4	37.5	25.8	24.90b-g	5-7
	OM1633	30.8	22.7	35.7	29.73d-h	5-7
	OM1490	4.5	5.2	2.5	4.07ab	1
	OMCS6	2.5	0	3.2	1.90a	1
	OM1726	10.1	26.4	20.6	19.03a-e	5
	OM1314	7.1	27.2	6.6	13.63a-d	3-7
	OM1723-62	12.7	13.7	10.1	12.17a-d	5
	OM1271	9.0	12.0	10.1	10.37a-d	3

**for each group separately*

CONCLUSIONS

The highly resistant varieties identified in this study could be utilized in the breeding program. It is recommended to introduce to production the varieties with durable resistance (DSI $\leq$ 5) plus resistance to panicle blast. Some varieties meeting this requirement are being grown on large area in the Mekong Delta such as OMCS94, OM1706, IR64, IR62032 and OM1706. The new varieties showing resistance to both leaf blast and panicle blast include NCM16-27, NCM10-20 and OM2031.

In the Mekong Delta, farmers still grow some varieties with unstable resistance or susceptibility to blast disease. These varieties should be used only with high caution in pest management.

Due to the high variability of the fungus races, the evaluation of rice varieties for blast resistance should be done continuously over time and place in the Mekong Delta.

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TÓM TẮT

Nghiên cứu tính kháng bền vững của các giống lúa đối với bệnh đạo ôn ở đồng bằng sông Cửu Long

Kết quả thử nghiệm 500 giống lúa bằng phương pháp nương mạ đạo ôn qua 7 địa điểm của 4 tỉnh ĐBSCL cho thấy có 23 giống kháng cao, 80 giống kháng trung bình, 205 giống kháng không ổn định và 192 giống nhiễm. Các giống có chỉ số bệnh nhỏ hơn 5 được xem là giống kháng bền, điển hình như IR64, OM1706, OM1570, OM723-11, OMCS5, BASMATI 370, TÉP HÀNH, NCM10-20. Các giống kháng cháy lá cao và kháng trung bình duy trì tính kháng đối với bệnh thối cổ gie giai đoạn sau trổ, nhưng nhóm giống kháng không ổn định thường có tỷ lệ thối cổ gié cao, tuy nhiên sự tương quan giữa mức nhiễm cháy lá và nhiễm thối cổ gié trong nhóm này không chặt. Cần phát triển các giống kháng bền đối với bệnh đạo ôn cho sản xuất. Công tác đánh giá tính kháng bệnh đạo ôn của các giống lúa qua các vùng sinh thái, các mùa vụ cần được thực hiện liên tục.