

EVALUATION OF RICE VARIETIES FOR RESISTANCE TO BROWN PLANTHOPPER IN THE MEKONG DELTA

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ABSTRACT

The reaction to brown planthopper (BPH) of 299 improved rice varieties, 202 traditional varieties and 88 wild rice accessions was studied. The percentage of resistant varieties (scale 1-3) were high among wild rice group (68.20%) followed by improved variety group (14.67%) and lowest in traditional variety group (2.47%). The test of 30 existing rice varieties in the Mekong Delta and 11 varieties as biotype indicators to the previous and present populations of BPH (1996 vs 1998) showed that there was no new biotype to appear. The test of 30 rice varieties to the populations of BPH collected from 10 provinces in the Mekong Delta showed that the populations of BPH in this region were more or less uniform. The rice varieties showing high resistance to BPH over ecosystems in the Mekong Delta were identified.

Key words: Rice, breeding, brown planthopper, resistance, Mekong Delta

INTRODUCTION

Brown planthopper (BPH) (*Nilaparvata lugens* Stal.) is the most important insect pests in the Mekong Delta of Vietnam. It damages the rice plants by sucking sap causing hopper-burns. It is also a vector causing ragged stunt disease. The utilization of varieties resistant to BPH is the most effective way to control this pest. Resistant varieties have saved thousands of hectares of rice in the Mekong Delta from BPH infestation during the last two decades (Bui, 1998).

Breeding rice varieties for resistance to BPH is given priority for rice improvement in the Mekong Delta- the most important rice-producing region in Vietnam. It is essential to develop resistant varieties possessing divergent genetic background to maintain a durable resistance in the fields. During the last two decades, there were BPH outbreaks in the Mekong Delta from time to time (Luong, 1998); therefore,

the evaluation of rice varieties for resistance to BPH should be done continuously. In the present study, we evaluated hundreds of rice varieties of different origins for resistance to BPH for identifying the resistant donors to be used in the breeding program. We also evaluated most of the existing varieties for resistance to various BPH populations collected from different sites across the region.

MATERIALS AND METHODS

- The materials included 293 high-yielding varieties, 202 traditional varieties, 88 wild rice accessions. These entries were tested for resistance to BPH (population collected at Cantho province).
- Thirty existing rice varieties were selected for testing the resistance to the previous BPH population maintained from 1996 and present BPH population

collected in 1998 from the same location at Cantho province. These varieties were also tested for resistance to 10 present BPH populations collected from 10 provinces in the Mekong Delta: An Giang, Kien Giang, Tien Giang, Vinh Long, Dong Thap, Ca Mau, Soc Trang, Long An, Ben Tre and Can Tho.

- Eleven varieties as biotype indicators were tested for resistance to the previous and present populations.

- In all the test, Tai Nguyen (traditional variety) and PTB33 were used as susceptible and resistant check, respectively. Resistance of the varieties to BPH population(s) was quantified using standard seedbox screening test of 7-old days seedlings (Heinrichs et al., 1985). In this test, scale 0 indicates high resistance (HR); 1 resistance (R); 3 moderate resistance (MR); 5 moderate susceptibility (MS); 7 susceptibility (S); 9 high susceptibility (HS).

RESULTS AND DISCUSSION

Reaction of rice varieties to BPH infestation

The reaction of the rice varieties to BPH infestation was presented in Table 1. The frequency of resistant varieties (scale 1-3) were 13.67% for improved variety group (293 varieties) and 2.47% for traditional variety group (202 varieties). In contrast to the cultivated rice, the wild rice species (*O. rufipogon*, *O. officinalis*, *O. nivara*) possessed a high frequency of resistant accessions (68.2% at scale 1-3) This indicated that wild rice was a good source for resistance to BPH. Almost all the traditional varieties in the Mekong Delta were susceptible to BPH. The incorporation of resistance to the improved rice varieties is essential because our data showed that the frequency of the improved rice varieties resistant to BPH was quite low.

Table 1. Frequency of rice varieties resistant to BPH in the Mekong Delta

Scale (1-9)	No. of varieties	Frequency (%)	Typical resistant varieties
NUMBER OF HIGH-YIELDING VARIETIES TESTED: 293			
1	8	2.73	OMCS97, IR62065T, OM1632, IR59656-5K-1, OM1589-5K-1, OM1589-5K-3
3	35	11.94	NCM16-27, OM1633, OM1271, OM1579-21-4, IR50404-2-14, OM1889, D5, OM2053, OM1643, OM1723-62, IR50404-2-95, IR50404-2-30, IR50404-2-3K, OMCS97-2K, OM1723-62-9K, OMCS97-2K-1, AS1007-1K, IR59656-5K-2, IR50404-2-1K-2, MTL99-8K-3, MTL99-8K-2, MTL99-8K-3, MTL99-8K-4, IR5040--2K-2, OM1630-15, OM1476, OM1493, IR59450, KSB201, IR66707, OM2037, OM2404, OM1493-66
5	123	42.00	
7	93	31.74	
9	34	11.60	

Table 1. (continued)

NUMBER OF TRADITIONAL VARIETIES TESTED: 202			
1	0	0	Tay Lieu, Nang Keo, Di Cu, Doc Phung Lun, Canh Nong My Tho
3	5	2.47	
5	49	24.30	
7	99	49.00	
9	49	24.30	
NUMBER OF WILD RICE ACCESSIONS TESTED: 88			
1	22	25.00	<i>O. rufipogon</i> accessions: 021, 060, 063, 069, 070, 071, 085, 089, 091, 093, 094 <i>O. officinalis</i> accessions: 127, 133, 131, 154 <i>O. nivara</i> accessions: 163, 155, 156, 160
3	38	43.20	
5	24	27.30	
7	4	4.50	
9	0	0	

Reaction of rice varieties to the previous and present BPH populations

In this experiment, we used two BPH populations, one collected in 1996 and the other collected in 1998 from the same location at Omon, Cantho province. Reaction of the rice varieties to these populations was given in Table 2.

The results showed that there was a tendency of resistance in 7 varieties decreasing from the previous BPH population to the present population:

- OM1723-62 decreased from scale 1-3 to 3-5
- IR62032, IR62030 from 3-5 to 5-7

- IR64, OM1706, OM1726, VND95-20 from 5 to 7

The same reaction to the two BPH populations was recorded in 23 varieties:

- OMCS97, NCM-16-27 maintained at scale 1-3
- OM1643, OM1633, OM1271, OM997-6, OM1960, IR50404-5, NCM54 and OM2031 maintained at 3-5
- TN128, OMCS96, OMCS95-5, OM1490, OM1270, OMCS94, OM1308, KDM39, KSB228, OM1704, OM1570, OMF1, NCM64 maintained at 5-7

Table 2. Reaction of existing rice varieties to previous and present BPH populations

S. No.	Variety name	Previous population		Present population	
		Scale (1-9) 3 replications	Reaction	Scale (1-9) 3 replications	Reaction
1	IR62032	3-5-5	MR-MS	7-5-7	S
2	IR64	5-5-5	MS	7-5-7	S
3	OM1706	5-5-5	MS	7-5-7	S
4	IR62030	3-3-5	MR	5-5-7	MS-S
5	OM1960	3-5-5	MR-MS	5-3-5	MR-MS
6	OM1726	5-5-5	MS	5-7-5	MS-S
7	OM1723-62	3-1-3	R-MR	5-3-3	MR-MS
8	VSD95-20	5-5-5	MS	5-5-7	MS-S
9	TS128	5-5-7	MS-S	7-7-7	S
10	OMCS97-0	3-1-3	R-MR	3-3-3	MR
11	OMCS96	7-7-5	S	7-7-7	S
12	OMCS95-5	7-7-5	S	7-7-7	S
13	OM1633	3-3-3	MR	5-3-3	MR-MS
14	OM1271-4	3-3-3	MR	5-3-3	MR-MS
15	OM1490	5-5-5	MS	7-7-5	S
16	SCM-16-27	1-3-1	R-MR	1-3-3	MR
17	OM997-6	3-5-3	MR-MS	5-5-5	MS
18	OM1270-9	5-7-5	MS-S	7-7-7	S
19	IR50404-57	3-5-3	MR-MS	5-3-5	MR-MS
20	OMCS94	5-5-7	MS-S	5-7-5	MS-S
21	OM1643	3-3-3	MR	5-3-3	MR-MS
22	OM1308	7-5-5	MS-S	5-7-7	S
23	RDM-39	7-7-5	S	7-7-7	S
24	RSB228	5-5-5	MS	7-7-5	S
25	OM1704	7-5-5	MS-S	5-7-5	MS-S
26	SCM54	3-3-5	MR-MS	5-3-3	MR-MS
27	OM1570	5-7-5	MS-S	7-7-5	S
28	OMFi 1	7-5-5	MS-S	7-7-5	S
29	OM2031	3-5-5	MR-MS	5-5-3	MR-MS
30	SCM 64	7-7-7	S	7-7-7	S
31	PTB33 (R)	0-0-0	HR	0-0-0	HR
32	TN1 (S)	9-9-9	HS	9-9-9	HS

HR: highly resistant, R: resistant, MR: moderately resistant, MS: moderately susceptible, S: susceptible, HS: highly susceptible.

There was no significant difference in the reaction to the previous and present BPH populations in most varieties; and in a few varieties, there was a tendency in shifting the reaction from moderately susceptibility to susceptibility (from scale 5 to 7). But in no cases, resistant varieties became susceptible or vice

versa. The two varieties namely, OMCS97 and NCM-16-27 showed high resistance to both the populations (scale 1-3). The varieties show scale 7 in the artificial infestation may be safe in the fields when the agro-ecological factors were not favorable to BPH growth, but they will become vulnerable under

adverse conditions (drought, mixed seeds, improper cultural practice, improper pest management, etc.). The results indicated that there was no major change in the virulence of BPH populations in the Mekong Delta. In the past, the outbreaks of BPH in the Mekong Delta was seen in late 70's early 90's. The latest outbreak was in the wet season 1998 but the damage was not severe.

Reaction of varieties as biotype indicators to the previous and present BPH populations

Table 3. Reaction of the varieties as biotype indicators to previous and present BPH populations

S. No.	Variety name	Resistant gene	Previous population (scale 1-9)	Present population (scale 1-9)
1	TN1	None	9 9 9	9 9 9
2	Mudgo	Bph1	5 3 3	5 5 5
3	ASD7	bph2	7 7 7	9 7 7
4	Rathuheenati	Bph3	1 3 3	3 3 3
5	PTB33	bph2, Bph3	0 0 0	0 0 0
6	Babawee	bph4	3 5 3	7 5 5
7	ARC	bph5	9 9 7	9 9 9
8	Swarnalata	Bph6	1 3 3	3 5 3
9	T12	bph7	5 5 7	5 7 7
10	Sinsapa	bph8	5 5 3	5 5 3
11	Pokkali	Bph9	9 7 9	9 9 9

The results indicated that there was no significant change in the biotype of BPH in the Mekong Delta. It was evident that BPH populations in the Mekong Delta were of a mixture of biotype 2 and 3. The same observation was given earlier by Luong (1998). The slow change of BPH biotype in the Mekong Delta may be due to the decreased amount of insecticides applied by farmers in recent years when more resistant varieties were

We also tested the varieties as biotype indicators to the previous and present BPH populations (Table 3). The varieties Mudgo, ASD7, ARC, T12, Chinsapa and Pokkali were susceptible to both the populations. Rathu Heenati showed scale 1-3 to the previous population and scale 3 to the present population. Babawee showed scale varying from 3-5 to 5-7 to the two populations. High resistance was recorded in PTB33 to both the populations.

grown in the fields. The resurgence of BPH was caused by insecticides (Chelliah, 1987).

Reaction of existing rice varieties to different BPH populations

During the outbreak of BPH in 1998, we collected BPH populations from 10 provinces in the Mekong Delta.: An Giang, Kien Giang, Tien Giang, Vinh Long, Dong Thap, Ca Mau, Soc Trang,

Long An, Ben Tre and Can Tho. The reaction of 30 existing rice varieties in the region to these populations is summarized in Table 4

Table 4. Reaction of existing rice varieties to BPH populations collected from 10 different provinces in the Mekong Delta

S. No.	Variety name	Tien Giang	Kien Giang	An Giang	Vinh Long	Can Tho	Dong Thap	Soc Trang	Ca Mau	Ben Tre	Long An
1	IR62032	3	5	7	7	7	5	5	5	5	5
2	IR64	5	5	7	7	7	7	5	7	5	5
3	OM1706	3	5	7	7	7	7	5	5	5	5
4	IR62030	3	5	5	7	5	5	5	5	7	7
5	OM1960	3	3	5	5	3	5	5	5	5	5
6	OM1726	3	5	5	7	5	5	7	5	7	5
7	OM1723-62	1	1	3	3	3	3	3	3	3	3
8	VND95-20	3	5	5	5	5	7	7	7	7	5
9	TN128	5	7	7	7	7	7	7	7	5	7
10	OMCS97	1	1	1	1	3	1	3	3	3	1
11	OMCS96	5	7	7	7	7	7	7	7	5	7
12	OMCS95-5	5	7	7	7	7	5	7	7	7	7
13	OM1633	1	3	3	3	3	3	5	3	3	3
14	OM1271-4	1	3	3	3	3	3	3	3	3	3
15	OM1490	5	5	7	7	7	5	5	5	5	5
16	NCM 16-27	-	3	1	1	1	1	3	1	1	1
17	OM997-6	5	7	5	5	5	5	5	5	5	5
18	OM1270-9	5	7	7	7	7	7	7	7	7	7
19	IR50404-57	1	3	3	3	3	3	3	3	3	3
20	OMCS 94 T	3	3	5	5	5	5	5	5	5	5
21	OM1643	3	3	3	3	3	3	3	3	3	3
22	OM1308	5	7	7	7	7	5	7	7	5	7
23	KDM-39	-	7	7	7	7	7	7	7	7	7
24	KSB228	3	5	5	7	7	5	7	7	7	7
25	OM1704	3	3	5	5	5	5	5	7	5	7
26	NCM54	-	1	3	3	3	5	5	5	3	3
27	OM1570	5	5	7	7	7	7	7	7	5	5
28	OMFi 1	5	7	7	7	7	7	7	7	7	7
29	OM2031	3	3	3	3	3	5	5	3	3	3
30	NCM 64	7	7	7	7	7	7	5	5	5	5
31	PTB33(CK)	0	0	0	0	0	0	0	0	0	0
32	TN1(CN)	9	9	9	9	9	9	9	9	9	9

The results showed that these varieties had almost the same reaction to BPH populations from 7 provinces: An Giang, Can Tho, Dong Thap, Soc Trang, Minh Hai and Vinh Long. Populations from the other 3 provinces: Tien Giang, Ben Tre and Long An seemed to have less virulence than those from other provinces, but the difference was small.

Therefore, it could be concluded that the BPH populations across the Mekong Delta was more or less uniform.

The results revealed the following varieties resistant to BPH populations across 10 provinces in the Mekong Delta: OM1723-62, OMCS97, OM1633, OM1271, IR50404-57, NCM16-27, NCM54, OM2031 and OM1643 (Table

5). These varieties are being grown in large area in the region. Special caution should be made when growing varieties which showed scale 7 to BPH populations from several sites.

Table 5. Popular and promising varieties resistant to BPH

S. No.	Variety name	Scale (1-9)	Reaction
1	OM1723- 62	3-5	MR
2	OMCS97	1-3	R-MR
3	OM1633	3-5	MR-MS
4	OM1271	3-5	MR-MS
5	NCM16-27	1-3	R-MR
6	IR50504-57	3-5	MR-MS
7	OM1643	3	MR
8	NCM54	3-5	MR-MS
9	OM2031	3-5	MR-MS

CONCLUSIONS

Through intensive testing of a large number of varieties for resistance to BPH, resistant varieties were identified among the improved and traditional rice germplasm. Resistant accessions of wild rice species were also identified. Existing varieties being grown in the Mekong Delta including OM1723-62, OMCS97, OM1633, OM1271, NCM16-27, IR50404-57, NCM54, OM1643 and OM2031 possessed resistance to BPH populations from different sites in the Mekong Delta. There was no evidence indicating the shift in virulence of BPH populations, and the populations across the region were more or less uniform.

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TÓM TẮT

Tính kháng rầy nâu của các giống lúa ở đồng bằng sông Cửu long

Thử nghiệm tính kháng rầy nâu đã được thực hiện trên 299 giống lúa cao sản, 202 giống mùa địa phương và 88 mẫu lúa hoang. Tỷ lệ giống kháng cấp 1-3 cao nhất ở nhóm lúa hoang (68,20%), kể đến là nhóm lúa cao sản (14,67%) và thấp nhất ở nhóm lúa mùa (2,47%). Thử nghiệm 30 giống lúa đang trồng ở ĐBSCL và 11 giống trong bộ

chỉ thị biotype với nguồn rầy cũ (1996) và mới (1998) cho thấy chưa có sự biến đổi về nòi của quần thể rầy nâu ở ĐBSCL. Thử nghiệm tính kháng của 30 giống lúa với nguồn rầy thu thập từ 10 tỉnh của ĐBSCL cho thấy quần thể rầy nâu ở ĐBSCL tương đối đồng nhất. Các giống lúa kháng rầy cao, ổn định qua các vùng đã được xác định.