

GENETIC STUDY ON BLAST RESISTANCE IN RICE (*Oryza sativa* L.)

Bui Thi Duong Khuyeu¹, Nguyen thi Lang¹, Pham thi Thu Ha,
Tran Binh Tan¹, Bui Chi Buu²

¹ Cuu Long Delta Rice Research Institute, Can Tho, Viet Nam (CLRRI)

² Institute of Agricultural Sciences for Southern Vietnam (IAS)

ABSTRACT

Leaf blast samples with typical lesions were collected from farmer's fields of irrigated regions in four provinces (Hung Yen, Bac Ninh, Vinh Phuc, Ha Tay) in 2008 dry season. All monocultures were maintained in a long-term storage medium at CLRRI Genebank. The reaction of 31 monogenic lines (from IRRI) was confirmed using the 16 blast isolates from Northern in Vietnam. The reaction of 341 landraces evaluated to blast isolates was confirmed using three races as OM 001, OM 002, and OM 003.

Reactions of susceptible, moderate resistant and resistant rice genotypes were recognized with IRRI's protocol, using 16 races. Materials included 32 genotypes from IRRI and 11 ones from CLRRI. Almost of these resistance genes were confirmed to be different. Almost races were compatible to the monogenic lines carrying the resistance genes as *Pi-a*, *Pik-s*, *IRBLta-CT2*, *Pi-12 (t)* and *Pi(t)*. Almost genotypes were compatible to two races collected in the Central Vietnam as OMP 0015. Other *Pi-b* was incompatible to all races except OM P003, OMP 008, OMP 0014, OMP 0015 and OMP 0016. The results obtained 17 varieties susceptible to new races in Vietnam. *IRBL11-Zh* exhibited its resistance only to race OMP 0014; 21 genotypes expressed their resistance to race OMP 002.

Keywords: Magnaporthe grisea Sacc., rice blast

INTRODUCTION

Blast caused by *Magnaporthe grisea* Sacc. This is one of major rice disease in Vietnam and the most destructive diseases of rice throughout the world. In some areas of Vietnam, the potential is to reduce yield by more than 20%. The first gene for resistance to blast, *Pi-a*, was identified by Shinoda et al. (1971). Since then, 25 genes for resistance to blast have been identified. The work by Kiyosawa (1981) established the basis for genetic studies of blast resistance genes in japonica rice using Japanese blast strains. Development of near isogenic lines improved the situation (Bonman and Mackill 1988). So far blast disease was evaluated with 922 rice varieties, which collected from many countries and these were classified into six variety groups (Fukuta et al. 2007). Various races or clusters of races of blast have been identified through classical genetic analysis. The existence of many different races of *Magnaporthe grisea* has been making it difficult to develop

durable and long-lasting resistant varieties. The relationships between resistance genes in rice and virulence gene in blast pathogen have not been clarified yet, due to the lack of universal differential varieties, which could identify the true reactions of pathogen without the influences of genetic backgrounds of rice. Moreover, the research on diversity of blast races and resistance genes has been carried out on relatively small area or country basis, without global view.

MATERIALS AND METHODS

Collection of the diseased rice samples

Blast leaves with typical lesions were collected from farmer's fields of irrigated regions in 9 provinces (Hung Yen, Bac Ninh, Vinh Phuc, Ha Tay, Ninh Thuan, Binh Thuan, Binh Dinh, Lam Dong). All of 29 races were collected in upland rice cultivation areas (Central Vietnam and Northern n Vietnam) in 2008 dry season. All

monocultures were maintained in a long-term storage medium at CLRRRI Genebank.

Preparation of plant materials

The seeds were placed in petri dishes on wet blotting paper for two days under 30°C condition. The testing lines were transplanted in the green

house. Three weeks after transplanting, rice plants would be ready for inoculation (5-6 leaf stage = 21 days)

Inoculums' production

Ten seeds of each rice varieties were sown in a plastic tray (30 x 20 x 20 cm)

Table 1. Race of *Magnaporthe grisea* detected among isolates from seven province of Northern and Center regions

No	Accession	Site	
1	001	Luu Trung Village, Luu Xa Commune, Yen My district, Hung Yen province	Northern in Vietnam
2	002	Neu Thuong village, Cam Xa Commune, Yen My district, Hung Yen province	Northern in Vietnam
3	003	Khuc Long village, Vinh Phuc Commune, VanGiang district, BacNinh province	Northern in Vietnam
4	004	KhucLong village, VinhPhuc Commune, VanGiang district, BacNinh province	Northern in Vietnam
5	005	TienDu commune, ThuanThanh district, BacNinh province	Northern in Vietnam
6	006	PhuChan commune, TuSon district, BacNinh Province	Northern in Vietnam
7	007	ChiDong village, Quang Minh Commune, MeLinh district, VinhPhuc province	Northern in Vietnam
8	008	ChiSon village, Quang Minh Commune, MeLinh district, VinhPhuc province	Northern in Vietnam
9	009	ThangLoi village, HungCanh Commune, BinhXuyen district, VinhPhuc province	Northern in Vietnam
10	010	Xom Village, PhuNam Commune, ThanhOai district, HaTay province	Northern in Vietnam
11	011	NinhSon District NinhThuan province	Central Vietnam
12	012	Ninh Hai district NinhThuan province	Central Vietnam
13	013	LuongSon commune, BacBinh district, BinhThuan provine	Central Vietnam
14	014	TuSon commune, ĐucTrong district, LamDong provine	Upland
15	015	ĐucTrong district, DaLat city, LamDong provine	Upland
16	016	NamSon field, Lien Nghia, DucTrong district, Lam Dong province	2 km from LD 1

The youngest leaf that was at least half expanded was selected for inoculation.

Disease assessment

Seven days after inoculation, infection is rated as:

0= No evidence of infection

1= tiny brown pinpoint lesion, smaller than 0.5 mm in diameter, no sporulation

2= brown specks about 0.5-1 mm in diameter, no sporulation

3= roundish, lesions with dark margin about 1-3 mm in diameter with gray center

4= Typical spindle shaped blast lesion capable of sporulation 3 mm or longer with necrotic gray center

5= lesion as in 4 but about half of one or two leaves were considered susceptible.

RESULTS AND DISCUSSION

Collected of race

16 race from 100 samples were isolated and selected differential blast isolates

The reaction of 31 monogenic lines (from IRRI) were confirmed using the 16 blast isolates from Northern Vietnam

The reaction of 341 landraces was evaluated with blast isolates. It was confirmed as three races: OM 001, OM 002, and OM 003

Reaction to rice blast

Reactions of susceptible, moderate resistant and resistant rice genotypes were recognized with IRRI's protocol, using 16 races for 32 genotypes from IRRI and 11 from CLRRI.

In table 2, almost of these resistance genes were confirmed to be differentiated by them. Almost races were compatible to the monogenic lines carrying the resistance genes *Pi-a*, *Pik-s*, *IRBLta-CT2*, *Pi-12 (t)* and *Pi(t)*. Almost lines compatible to two races at Central Vietnam (OMP 0015). Other *Pi-b* was incompatible to all races except OM P003, OMP 008, OMP 0014, OMP 0015 and OMP 0016.

The results obtained 17 varieties susceptible to new races in Vietnam. *IRBL11-Zh* exhibited its resistance only to race OMP 0014; 21 genotypes expressed their resistance to race OMP 002.

The 43 kinds of resistance genes were different using the 16 isolates.

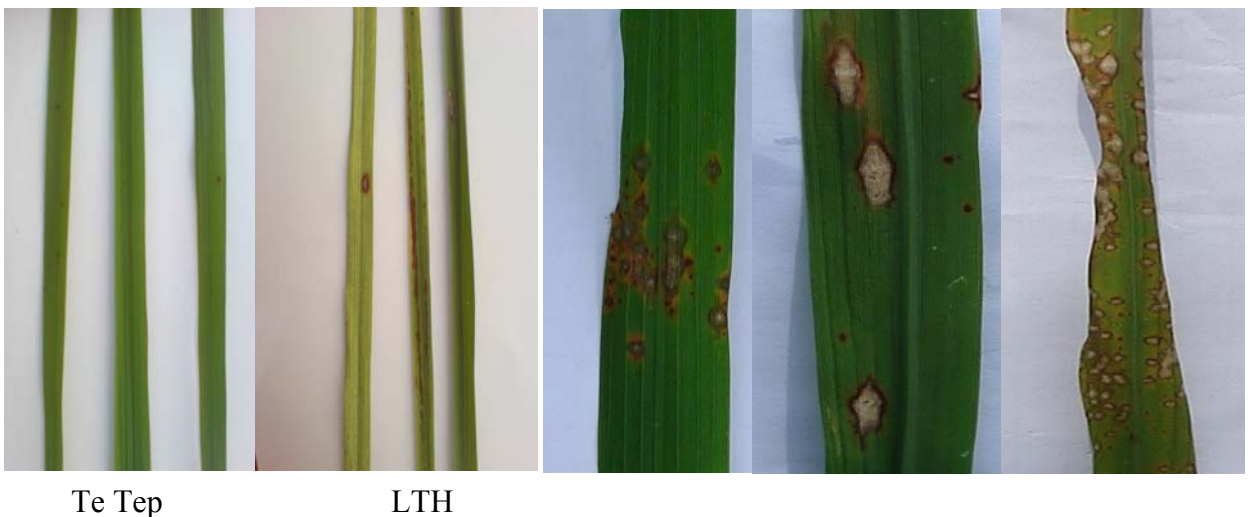


Figure 1: Reaction of Blast among given varieties

Table 2. Reactions of monogenic lines developed by IRRI and CLRRRI to 16 Vietnam blast fungus isolates at seedling

Gene	Designation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<i>Pi-a</i>	IRBLa-A	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
	IRBLa-C	R	M	S	S	M	S	S	S	R	S	S	M	S	S	S	S
<i>Pii</i>	IRBLi-F5	S	M	M	S	S	M	M	S	S	R	S	S	S	S	S	S
<i>Pik-s</i>	IRBLks-F5	S	S	S	S	R	S	S	S	S	S	S	S	S	S	S	S
	IRBLks-S	S	R	S	R	R	R	R	S	S	S	R	R	S	S	S	S
<i>Pik</i>	IRBLk-Ka	S	R	S	S	R	R	R	S	S	S	R	R	S	S	S	S
<i>Pik-p</i>	IRBLkp-K60	S	R	S	S	M	R	R	S	S	S	R	R	S	S	S	S
<i>Pik-h</i>	IRBLkh-K3	S	R	S	M	R	R	R	S	S	S	R	R	S	S	S	S
<i>piz</i>	IRBLz-Fu	S	R	S	R	R	R	R	S	S	S	R	R	S	S	S	S
<i>Piz-5</i>	IRBLz5-CA	S	R	S	M	S	R	R	S	S	S	R	R	S	S	S	S
<i>Piz-t</i>	IRBLzt-T	R	S	R	S	R	S	S	S	S	S	S	S	S	S	S	S
<i>Pita</i>	IRBLta-K1	S	S	S	S	S	S	S	S	S	S	R	M	R	S	S	S
13	IRBLta-CT2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
<i>pib</i>	IRBLb-B	R	R	S	R	S	S	R	S	S	R	R	S	S	S	S	S
<i>Pit</i>	IRBLt-K59	R	R	S	R	S	S	R	S	S	R	R	S	S	S	S	S
<i>Pish</i>	IRBLsh-S	R	R	S	R	R	R	S	R	R	R	S	R	R	S	S	S
	IRBLsh-B	S	S	S	S	R	R	S	R	R	S	S	S	S	S	S	S
	IRBL1-CL	S	S	S	S	S	S	R	R	R	R	R	S	S	S	S	S
<i>Pi 3</i>	IRBL3-CP4	S	M	M	S	S	S	R	R	S	R	R	S	S	S	S	S
<i>Pi(t)</i>	IRBL5-M	S	S	S	S	S	S	R	R	S	R	R	S	S	S	S	S
	IRBL9-M	S	M	S	S	R	R	R	S	M	S	S	R	R	S	S	S
<i>Pi 9(t)</i>	IRBL9-W	S	S	S	S	M	S	S	S	S	S	S	R	R	S	S	S
<i>Pi(12)</i>	IRBL12-M	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
<i>Pil9(t)</i>	IRBL19-A	S	R	R	R	S	S	S	S	S	S	S	S	S	S	S	R
-	IRBLkm-Ts	R	R	R	R	S	S	S	S	R	R	R	R	S	S	S	S
<i>Pi(t)</i>	IRBL20-IR24	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
	IRBLta2-Pi	R	R	R	R	R	R	R	S	M	S	S	S	S	S	S	S
<i>Pita-2</i>	IRBLta2-Re	R	S	S	S	S	S	S	S	R	R	R	S	S	S	M	S
29	IRBLta-CP1	S	S	S	S	S	S	S	R	R	S	R	R	M	M	M	M
<i>pil(11)</i>	IRBL11-Zh	R	M	S	S	S	M	M	S	S	S	M	S	S	R	S	S
	IRBLz5-CA(R)	R	R	R	R	R	R	R	S	R	S	S	S	M	S	S	S
	LTH	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
	Te tep	R	R	R	R	R	R	R	R	R	R	R	R	M	M	M	M
	OM6840	R	R	R	R	R	R	R	S	R	R	R	R	R	S	S	S
	OM6856	S	S	R	S	S	S	S	S	S	S	S	R	S	S	S	S
	OM6859	R	R	R	R	R	S	S	S	M	S	S	S	S	S	S	S
	OM6860	R	R	S	R	R	R	R	S	S	S	S	S	S	S	S	S
	OM6861	R	R	M	M	M	S	S	S	S	S	S	M	S	S	S	S
	OM6868	R	R	M	M	M	M	M	S	S	S	S	M	M	S	S	S
	OM6869	S	S	S	S	S	S	S	R	S	S	S	S	S	S	S	S
	OM6862	R	R	R	M	R	R	S	S	S	R	R	R	S	S	S	S
	OM6867	R	R	R	R	S	S	S	S	R	R	S	S	S	S	S	S
	OM6872	S	S	S	S	S	S	S	S	R	R	R	S	S	S	S	S
	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	S	25	17	28	24	21	24	23	35	27	29	23	23	33	40	40	40
	R	18	21	11	14	17	16	17	8	13	14	19	16	6	1	0	1
	M	0	5	4	5	5	3	3	0	3	0	1	4	4	2	3	2

R: Resistant; S: Susceptible; M: moderately resistant

The Te Tep expressed its resistance to 10 races one race at Binh Thuan (Central Vietnam). from Northern Vietnam, and became susceptible to

Table 3. Varieties resistant, susceptible, and moderately resistant to 16 blast races (percentage %)

isolate	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
S	58.0	40.0	65.1	56.0	49.0	56.0	53.0	81.0	62.7	67.4	53.4	53.4	76.7	93.0	90.6	90.6
R	42.0	49.0	25.6	33.0	40.0	37.0	40.0	19.0	30.2	32.6	44.1	37.2	13.9	2.3	0.0	2.3
M	0.0	12.0	9.3	12.0	12.0	7.0	7.0	0.0	6.9	0.0	2.3	9.3	9.3	4.6	9.3	6.9

S: susceptible; R: resistant; M: moderately resistant

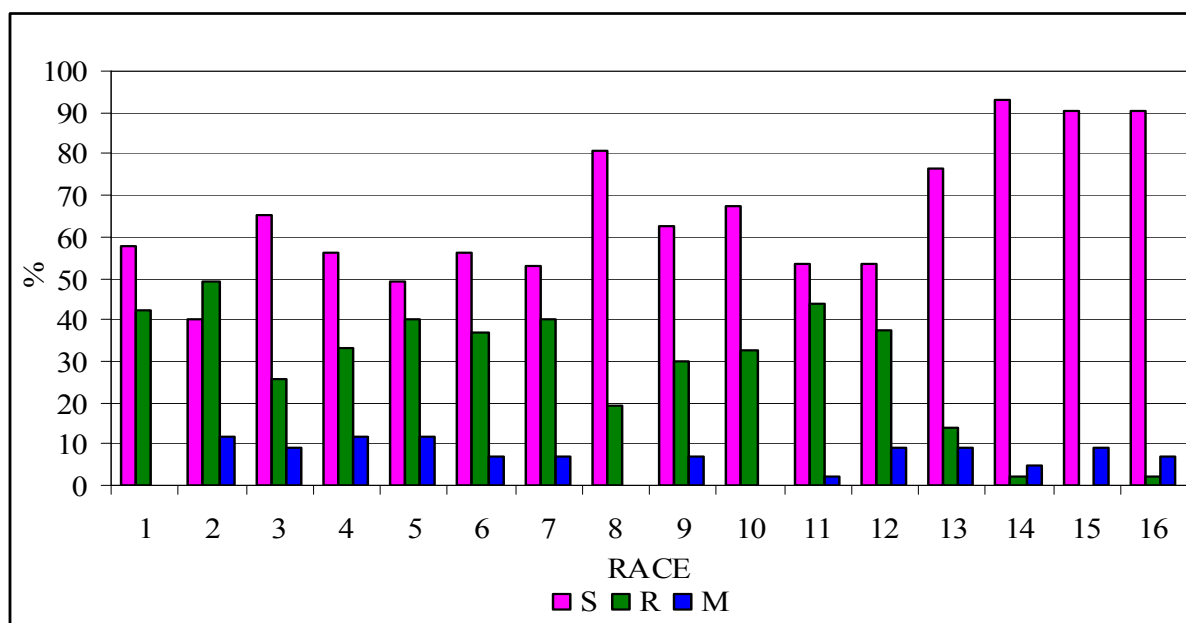


Figure 2. Frequency of individuals resistant to 16 given races

Table 4. The reaction of 341 genotypes to 3 blast isolates OMP 001, OMP002, OMP 003 from Northern Vietnam

No.	Acc. No	Designation	Scale (mm)			No.	Acc. No	Designation	Scale (mm)		
			OMP 001	OMP 002	OMP 003				OMP 001	OMP 002	OMP 003
1	1551	Nep tuong	0.4	1	1.2	172	294	Nep da	3.1	3.6	2.3
2		Nang loan	0.8	1.2	0.8	173	274	Ba bo ti	3.2	2.8	3.1
3	1537	Gang xe mua	0.8	1.4	0.9	174	650	Tra bieu thach	2.2	5.3	1.5
4		Vang lua	1.4	1.1	0.7	175	556	Nep than	2.1	5	1.9
5		Lun do	1.2	0.7	1.7	176	438	Do sao muon	2.7	4.4	2
6	1716	Nang thom oc	2.1	1	0.7	177	303	Trang tep	3.1	3.1	2.9
7		Ut Luom	0.2	2.6	1	178	1338	Tai nguyen	3.6	2.4	3.1
8	541	Nang huong	1.7	1.6	0.6	179	588	Nang thom thanh tra	3	3.5	2.6
9	1614	Nep ao vang	1	1.3	1.7	180	327	Mong chim roi	3.6	3.1	2.4
10	1563	Mot bui	0.7	1.1	2.3	181	288	Thanh nien	5.3	1.8	2
11	1717	Nang thom doc	1.2	1.5	1.6	182	543	Hoa lai	3.6	2.9	2.7
12		Nang thom muon	1.2	1.3	1.8	183	539	Nang thom giua	4.5	2.3	2.3

No.	Acc. No	Designation	Scale (mm)			No.	Acc. No	Designation	Scale (mm)		
			OMP 001	OMP 002	OMP 003				OMP 001	OMP 002	OMP 003
13		Nang thom CD	2	0.7	1.7	184	669	Gie đong	1.7	4.2	3.3
14	1720	Nang loan doc	1.8	1.3	1.3	185	553	Men nhen	3.2	3.3	2.7
15	1725	Trang tep doc	1.8	2.2	0.5	186	378	Thang coi	3.9	4	1.3
16	1686	Nep nghe	1.4	2.1	0.9	187	437	Ba thiet xanh	4.5	1.4	3.3
17	653	Tieu so da	1.7	1.7	1	188	513	Lua lun	2.4	2.1	4.8
18		Re hanh vang	2.2	0.7	1.6	189	616	Tau huong	4	2.7	2.6
19	1655	So ri do	1.6	1.4	1.5	190	608	Tau huong	4	2.4	2.9
20	1587	KT15	1.7	1.2	1.6	191	611	Tai nguyen	2.3	4.2	2.8
21	1536	Trang tep	0.7	1.6	2.2	192	619	Nang thom thanh tra	3.3	2.7	3.3
22	1712	Nong nghiep chum doc	1.4	1.6	1.8	193	483	Gie noi 1035	2.8	3.8	2.8
23	1691	Lem bui	1.9	1	1.8	194	663	Chet ran	2.7	2.7	4.1
24	1569	Nang gao	2	0.8	2	195	635	Nanh chon	3.5	3	3
25	1648	Nang huong	2	1.7	1.1	196	594	Mot bui	3.8	3.7	2
26	1730	Nang huong doc	0.8	3.2	0.9	197	446	Trang thuoc 2	4.4	3.1	2
27	1713	Nep ruoi xanh doc	1.5	1.3	2.1	198	1345	Chau pha soc	3.1	4.3	2.1
28	1721	Nang loan doc	1.2	1.9	1.9	199	585	Nang thom thanh tra	4.5	2.7	2.3
29	1580	Ba co	1.9	1.6	1.5	200	1398	Barvul runtai	3	3.3	3.3
30	1728	NTCĐ doc	0.8	0.7	3.5	201	1387	Tay do	4.2	3.2	2.2
31	415	Gia lu	1.5	1.7	2	202	554	Trang hoa binh	3.2	1.8	4.6
32	591	Nang thom	1.5	2.8	1	203	343	Tien mo	2.2	4.4	3.1
33	1578	Nep phu	2	1.5	1.8	204	599	Tau huong	1.8	5	2.9
34	533	Lua thom	1.9	2	1.4	205	530	Nang huong	2.5	4.7	2.5
35	1557	Lun thong	1.9	2.2	1.3	206	618	Nang thom muon	2.4	4.1	3.3
36		C10	1.8	1.9	1.7	207	439	Mua so 5	4	3.4	2.4
37	1544	Nang huong	0.8	2.1	2.5	208	424	Thang con	5	3.1	1.8
38	673	Biet ca tron	1.5	1.3	2.6	209	1384	Nang tuong	3.8	2.7	3.3
39	1715	Soi da doc	1.8	1.7	1.8	210	398	Nanh chon	1.6	3	5.3
40	1591	504 mua	1.5	2.3	1.6	211	396	Bang minh coc	1.9	2.8	5.2
41	1650	Mot bui lun	1	1.6	2.8	212	1382	Bay ba hai ruong LA	2.1	5.2	2.7
42	561	Nep tau huong	1.6	1.7	2.2	213	1394	K457	3.3	3.5	3.1
43	1727	Nep mu u doc	2.7	1.3	1.4	214	1706	Nang thom cho dao	3.6	2.5	3.8
44	1576	Lun Kien Giang 1	1.9	1.8	1.8	215	1585	Troi cho	3.8	3.2	3
45	1635	Ba thiet	1.3	2.3	1.9	216	316	Mong chim lun	2.8	3.5	3.7
46	667	Ba bui	2.4	1.3	1.9	217	591	Nang thom	3.8	2.8	3.3
47	1533	Trang tep	2	1	2.7	218	405	Song doi	2.6	5.5	2
48	788	PCR 92111-B-2	1.7	1.4	2.6	219	417	Vang duoi trau	3.5	1.6	4.9
49	1542	Nang huong	2.1	2	1.7	220	1310	Sarkping	4.2	4.4	1.4
50	544	Hoa lai	2.7	1.8	1.3	221	1346	Hoa lai	4.7	2.6	2.8
51	402	Trang lon	1.1	1.8	2.9	222	532	Nep mong ngua	2.8	1.9	5.4
52	604	Thanh tra	2	1.2	2.7	223	503	Nha giao	4.6	2.3	3.3
53	808	Mao chao	1.7	2.5	1.6	224	432	Mua so 16	7.2	1.4	1.6
54	1625	Nep mong chim	1.9	2.3	1.7	225	499	Nep doi dahuri	4.9	1.8	3.5
55	813	Ba ruong gam	2.5	2.1	1.4	226	1348	Mashuri	4.5	3.5	2.2
56	570	Chet xanh	2.6	1.3	2.2	227	565	Nep nhung	4	1.9	4.3
57	636	Nep nhung	1.9	2.1	2	228	1393	Lua men	3	3.6	3.7
58	648	Tra bieu thach	2.5	1.6	1.9	229	595	Nang thom hat luu	2.8	3.8	3.6
59	1315	Nang nhen	2.4	1.9	1.8	230	658	Ba bui	3.3	2.9	4.1
60	572	Nang huong cho dao	2.8	1.8	1.4	231	447	Cong ca	2.7	2.1	5.4
61	639	Bong sen	1.8	2.7	1.6	232	325	Khome do	3.2	5.3	1.9

No.	Acc. No	Designation	Scale (mm)			No.	Acc. No	Designation	Scale (mm)		
			OMP 001	OMP 002	OMP 003				OMP 001	OMP 002	OMP 003
62	811	Chiple	2.6	2	1.7	233	641	TK red 35-729	2	7	1.3
63	1707	Nang quot	2.5	1.3	2.4	234	662	Ba bong	5.3	3	2.1
64	551	Nang huong	1.6	2.3	2.3	235	620	Nang thom thanh tra	3.2	3.5	3.7
65	1581	Duoi chau	2.9	2.1	1.3	236	610	Ta huo	2.8	5.1	2.5
66		Lun can	1.3	2.7	2.3	237	631	Nep mong chim	2.8	4.8	2.8
67	426	Tam vuot	1.4	2	3	238	1336	Tai nguyen	3.1	1.9	5.4
68	630	Nho thom	3.4	1.2	1.8	239	482	Gie noi 1035	4.2	3.7	2.6
69	429	Tieu chum	1	2.6	2.8	240	508	Mua so 25	2.9	3.2	4.4
70	555	Nanh chon	1.2	2.4	2.8	241	1319	Nhen thom	4.2	2.7	3.6
71	280	Tam cao 9A	1.4	1.7	3.3	242	614	Tieu chet	2.2	3.9	4.5
72	603	Nep mong ngua	2.1	1.7	2.7	243	536	Nho thom	4.5	3.6	2.5
73	528	Nang huong	2.4	2.3	1.8	244	456	Chet ran	2.8	2.7	5.1
74	625	Mong chim roi	1.5	3.1	1.9	245	1333	Nep chuot che	3.4	3.1	4.1
75	628	Nho thom	1.6	4.2	0.8	246	275	Koi tap	5.4	3.1	2.2
76	282	Nang tay	1.5	3.9	1.3	247	1392	Cach met	4.6	3.1	3
77	640	Cu luu	2.1	1.3	3.3	248	436	Trang lun	3.9	2.7	4.2
78	1584	Trang bo cau	1.9	3.3	1.5	249	1335	Mot bui bo dia	2.6	4	4.2
79	455	Nop rum	2.7	1.8	2.2	250	569	Thom som	6.2	1.6	3
80	403	Nang thom	1.5	2.1	3.2	251	444	Mua so 23	2.9	3.8	4.1
81		Hanh lua	2.5	2.2	2.2	252	1678	Khau hang moony	1.9	3.8	5.2
82	605	Tau huong	1.1	2.7	3	253	1331	Hai sung	3.7	3.9	3.3
83	576	Bang nu	2.7	1.8	2.3	254	1314	Ba thiet	6	3	1.9
84	1396	Nep mo	1.9	2.3	2.6	255	534	Nanh chon	5	1.7	4.2
85	552	Tau huong	2.9	2.3	1.6	256	670	Bat ngat	3.9	3.9	3.2
86	1588	Nep chuot che	2.7	3.1	1.2	257	568	Tau le huong	2.8	4.8	3.5
87	644	Trang nho	2.5	2.7	1.7	258	573	Nang huong	3.4	2.4	5.3
88	1708	Nang den	2	1.6	3.3	259	638	Base	3.6	3.7	3.8
89	1634	Tai nguyen	2.7	1.6	2.7	260	380	Mbakit	3.2	4.4	3.5
90	376	Mua so 43	3.3	1.5	2.2	261	1375	Lua den mua 98	2.6	4.2	4.4
91	587	Nang thom thanh tra	2.7	2	2.3	262	535	Nang thom thanh tra	4.3	3.8	3.1
92	1574	Than nong lun	1.1	2.7	3.3	263	589	Nang thom muon	3.2	4.8	3.2
93	1700	Nep ruoi xanh	1.7	1.6	3.8	264	457	Chet ran	2.7	4.2	4.3
94	557	Nang thom	1.9	2.3	2.8	265	506	An ngoc hoang	2.9	3.4	4.9
95	423	Mua so 62	2.8	2.6	1.7	266	621	Nang huong cho dao	2.2	5.5	3.5
96	571	Ngoc nu	3	1.4	2.7	267	305	Mua so 19	4.8	1.8	4.7
97	278	Ven trang	3.1	1.7	2.3	268	1379	Do mo coi	1.8	3.1	6.5
98	664	Ba ren	2.2	2.8	2.1	269	671	Bat ngat	4.4	6.1	0.9
99	297	Trang lun	2.9	2.4	1.9	270	624	Nho thom	3	4.8	3.5
100	607	Tieu chet	2.9	2.1	2.2	271	397	Bang minh coc	3.5	4.3	3.7
101	441	Thang ngoc do	2.1	2.4	2.7	272	558	Mot bui lun	4	4.3	3.2
102	615	Tieu chet	1.9	2.7	2.7	273	1330	Nep mo	3.9	4.5	3.1
103	416	Vang duoi trau	2.7	2.4	2.2	274	474	Tieu cham	3.5	3.4	4.7
104	656	Doc phung	2.9	2.2	2.3	275	537	Nep sap	4.4	4.8	2.5
105	292	Ven nai Vg	2.2	1	4.2	276	1357	Lua soi vang	6.3	2.4	3
106	526	Nhen thom	3.5	1.3	2.6	277	418	Thom som	3.6	5.3	2.9
107	300	Trang cut	2.4	1.7	3.4	278	564	Mong chim	3.2	2	6.7
108	600	Lua huong	2	2	3.5	279	559	Nang loan	3.7	4.3	3.8
109	538	Nang thom cho dao	1.7	3.5	2.3	280	1395	K339	3	3.2	5.8
110	406	Mua so 54	1.7	2	3.8	281	567	Nep phung tien	4.2	2.3	5.5

No.	Acc. No	Designation	Scale (mm)			No.	Acc. No	Designation	Scale (mm)		
			OMP 001	OMP 002	OMP 003				OMP 001	OMP 002	OMP 003
111	430	Mua so 24	3	2.3	2.2	282	627	Nho thom	4.1	6	2
112	395	Nong nghiep	3	2.1	2.5	283	1312	Mashuri phi	3.3	5	3.8
113	1391	Den vo do ruot	2.1	3.7	1.8	284	577	Nho thom	3.5	4.2	4.5
114	272	Cun lac	2.1	2.1	3.5	285	338	Nep tra nho	3.1	5.6	3.6
115	388	Mbakit	2.8	1.7	3.1	286	306	Trang quang	6.4	3.6	2.4
116	529	Nang huong	2.1	2.6	3	287	419	Do sao muon	4.8	4.9	2.8
117	665	Ba bui	2.7	2.8	2.1	288	505	Trang luc	3.3	4.5	4.8
118	381	Mbakit	2	3.8	1.9	289	500	Trang lun trang 2	3.9	3.7	4.9
119	649	Tra bieu thach	3.1	2.4	2.3	290	575	Trang hoa binh	1.9	8	2.6
120	584	Nang huong cho dao	1.7	2.9	3.2	291	1340	Cuong trau	4.8	4.1	3.7
121	414	Nha giau	3.1	3.1	1.6	292	609	Mong chim lun	4.7	5	2.9
122	1325	Pakadon	2.9	1.5	3.4	293	454	Nop rum	4.2	5.1	3.3
123	1390	Truong hung	4.3	1.7	1.9	294	1323	Ca tut	6.3	4	2.5
124	1534	Trang lua	3.8	1.9	2.2	295	546	Mong chim	4	3	5.8
125	687	Gia den	2.8	3.9	1.3	296	1389	Nep nhung	3.8	5.9	3.3
126	1324	Ba thiet	2.6	2.1	3.2	297	1351	Trang lun	2.8	3.7	6.6
127	593	Chet xanh	2.2	2.4	3.3	298	527	Nep thom	2.5	6.1	4.5
128	597	Nho thom	2.6	3.4	2	299	1364	Hue ky Bd	4.7	2.8	5.5
129	679	Chanh hung	2.8	2.8	2.4	300	545	Bang thai	3.6	5.4	4.2
130	586	Nang thom thanh tra	3	3.7	1.3	301	475	Trang 7 tan	3.8	4.5	4.9
131	643	Tam xoan ht	2.8	2.3	2.9	302	269	Nep lem	4	4.8	4.5
132	452	Nep ao gia	3.2	2.9	2	303	270	Ba reo	3.5	5	4.9
133	289	Thanh nien	2.4	2.9	2.9	304	268	Ca don	4	4.8	4.7
134	601	Lua mong chim	2.3	2.1	3.7	305	467	Nang cua	4.3	5	4.1
135	560	Nang huong	3	2.8	2.3	306	459	Duoi trau	4.4	3.6	5.5
136	1349	Tep trang	3.5	3	1.7	307	1328	Nep than nong	4.8	4.6	4.2
137	1683	Nong nghiep chum	2	3.7	2.6	308	576	Bang nu	4.1	6.3	3.1
138	646	Tau phuoc	2.1	2.7	3.5	309	598	Lua thom	4.7	3.6	5.3
139	583	Nang huong cho dao	1.3	2.8	4.2	310	623	Nho thom	3.6	4	6.1
140	415	Gia lu	4.1	2	2.2	311	581	Nang huong cho dao	5.5	4.1	4.1
141	458	Lua cay lay	2.2	3.3	2.8	312	502	Trang thanh	7.1	3.2	3.4
142	582	Nang huong cho dao	3.2	3.2	2.1	313	1334	Nep chuot che	4.2	4.8	4.8
143	596	Nho thom	3.5	2.7	2.2	314	1362	Nang me	5.6	3.7	4.7
144	617	Nang thom muon	3.2	2.3	2.9	315	1339	Tai nguyen	4.2	4.3	5.6
145	652	Tau huong	2.2	3.4	2.8	316	1317	Pkaanpa	5.3	5.6	3.3
146	613	Tau huong	4.2	1.9	2.3	317	1352	Kien Giang lon	4.6	3.7	6
147	342	Ngoc mi	5.5	0.9	2.1	318	443	Trang ong 7	3.6	4.1	6.7
148	666	Ba bui	2.2	3.3	2.9	319	580	Nho thom	2.7	7	4.7
149	626	Nho thom	1.9	1.9	4.7	320	629	Nho thom	8	4.3	2.2
150	592	Thom lua mua	3.2	1.5	3.8	321	612	Nang thom cho dao	6.2	4.3	4
151	431	Mua so 55	2.1	2.8	3.7	322	484	Mua so 39	4.7	4	5.9
152	562	Nep tau huong	2.5	2.6	3.5	323	1381	Mot bui lun	2.8	6.5	5.3
153	659	Ba thiet	3.9	2.1	2.6	324	1354	Radin dai	6.2	4.5	4
154	647	Trang quang	3.4	3.7	1.5	325	507	Nep trui	4	7.5	3.2
155	540	Nang thom cho dao	2.7	4.1	1.8	326	1397	Nang co	6.5	4.2	4.1
156	1407	Do lun	2.1	4.1	2.6	327	453	Nep ao gia	5.5	4.8	4.4
157	1341	Bac ri	3.3	2.3	3.2	328	493	Nang tay	6.4	4.1	4.3
158	651	Tau huong	1.2	3.6	4	329	1359	Chiem do	4.8	5.2	5.1
159	1570	Tec hanh	4.2	2.8	1.8	330	1360	Nang thiet	5.1	3.9	6.3

No.	Acc. No	Designation	Scale (mm)			No.	Acc. No	Designation	Scale (mm)		
			OMP 001	OMP 002	OMP 003				OMP 001	OMP 002	OMP 003
160	494	Mua so 5	3.2	3.2	2.4	331	495	Mua so 5	4	6.8	4.7
161	660	Huyet rong	2.8	3.9	2	332	271	Lua thuoc co	7.1	4.6	3.9
162	632	Nep suong gang	3.2	2.8	2.8	333	445	Khong ten	6.3	3.6	5.7
163	1321	Con tray	3.3	2.3	3.2	334	1309	Nang nhen	5.3	3.5	7.2
164	281	Nang sau	4.1	2.2	2.6	335	642	Nanh chon	7	6.8	3.1
165	336	Gie dong	2.2	1.3	5.3	336	496	Chet cut	11.3	4	2.4
166	384	Nang tay	3.1	3.4	2.3	337	563	Nanh chon	6.5	7.1	4.2
167	462	Ba tuc	2.8	3.7	2.3	338	590	Nang thom muon	4.2	8	6.2
168	332	Nep ao gia nau	3.9	1.9	3.1	339	1380	Nep ba dong	6.3	6	7.2
169	422	Chau ram	2.7	3.3	2.9	340	550	Nang huong	6.2	8.3	5
170	448	Mua so 47	3.5	2.4	3.1	341	1374	Lua trung cut	11.5	5.2	3.7
171	578	Nho thom	4.7	1.9	2.3						

REFERENCES

Bonma JM, DJ MacKill. 1988. Durable resistance to rice blast disease. *Oryza* 25: 103-110.

Mackill DJ, JM Boonman. 1992. Inheritance of blast resistance in near- isogenic lines of rice. *Phytopathology* 82: 746-749

Kiyosawa S. 1981. Gene analysis for blast resistance. *Oryza* 18: 196-203.

Shinoda H, K Toriyama, T Yunoki, A Ezuka, Y Sakurai. 1971. Studies on the varieties resistance of rice to blast. Linkage relationships of blast resistance genes. *Bull. Chugoku Agric. Exp. Stn, Ser. A* 20: 1-25.

Fukuta Y, M Jeanie, T Yanoria, S Senoo, N Kobayashi. 2007. Diversity of blast resistance in rice (*Oryza sativa* L.) varieties. JIRCAS working report No. 53: 31-41.

Nghiên cứu di truyền tính kháng bệnh cháy lá trên lúa

Những mẫu bệnh đạo ôn trên lá có các vết bệnh điển hình được thu thập trên các ruộng lúa nông dân ở 4 tỉnh khu vực phía Bắc (Hưng Yên, Bắc Ninh, Vĩnh Phúc và Hà Tây) vào vụ Đông Xuân năm 2008. Tất cả các nòi bệnh được này phân lập và duy trì tại ngân hàng gen của Viện Lúa. Phản ứng bệnh của 31 dòng đơn gen (nguồn gốc IRRI) được xác định đối với 16 nòi phân lập được từ khu vực phía Bắc. Phản ứng bệnh của 341 dòng lúa mùa địa phương đối với các nòi bệnh đạo được đánh giá và xác định qua 3 nòi đạo ôn OM 001, OM 002, và OM 003. Phản ứng của các kiểu gen nhiễm, kháng trung bình, rất kháng đã được ghi nhận sử dụng phương pháp chủng của IRRI với 16 nòi bệnh. Các kiểu gen được đánh giá bao gồm 32 giống du nhập từ IRRI và 11 giống lúa của Viện Lúa. Các gen kháng được ghi nhận có tính chất khác nhau. Hầu hết các nòi bệnh tương hợp với các dòng lúa đơn gen mang các gen kháng như *Pi-a*, *Pik-s*, *IRBLta-CT2*, *Pi-12 (t)* và *Pi(t)*. Các giống có sự tương hợp với 2 nòi thu thập tại miền Trung Việt Nam như OMP 0015. Mặt khác, gen *Pi-b* không tương hợp với tất cả các nòi trừ OMP 003, OMP 008, OMP 0014, OMP 0015 và OMP 0016. Kết quả thu được 17 giống nhiễm với các nòi mới ở Việt Nam. *IRBL11-Zh* biểu hiện tính kháng duy nhất đối với OMP 0014; 21 giống biểu hiện tính kháng đối với nòi OMP 002