

IRRI

New Resistance genes, BPH, Blast and Bacterial blight, and Marker-assisted breeding in rice

K. K. Jena

International Rice Research Institute
www.irri.org

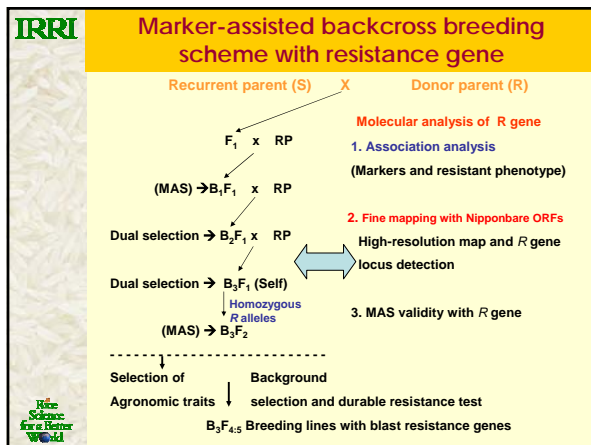
Rice Science for a Better World

IRRI

Outline

- ❖ Sources of new resistance genes for BPH, blast and BB
- ❖ New resistance genes and their associated DNA markers
- ❖ Marker-assisted selection (MAS) for BPH, blast and BB resistance breeding
- ❖ Application of new resistance genes for hybrid rice breeding
- ❖ Conclusions

Rice Science for a Better World

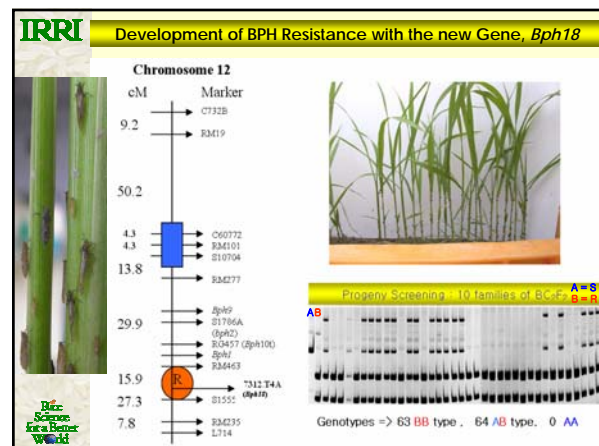


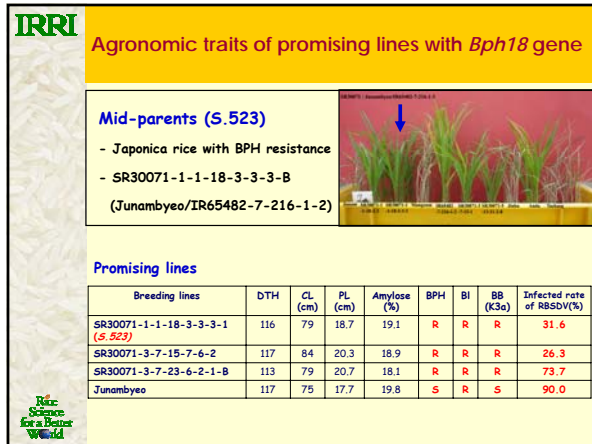
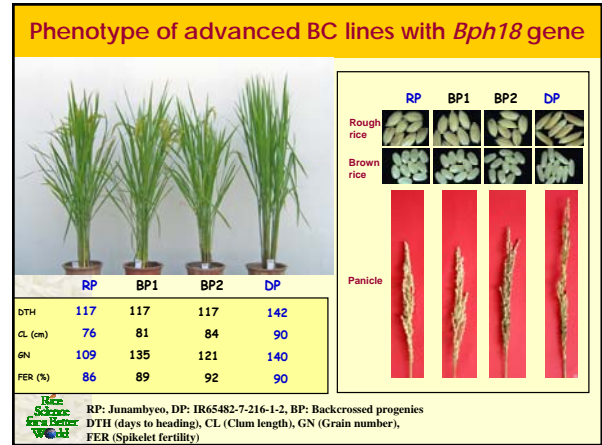
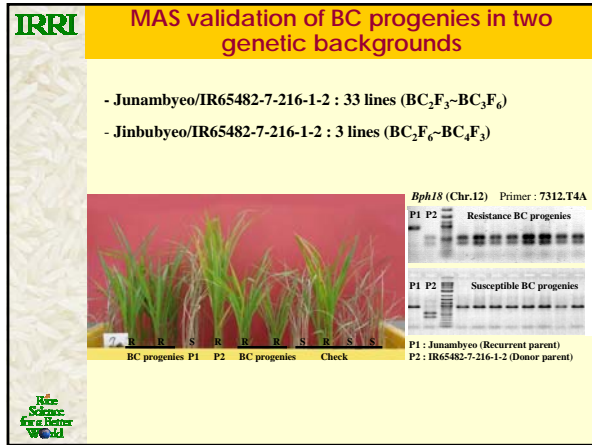
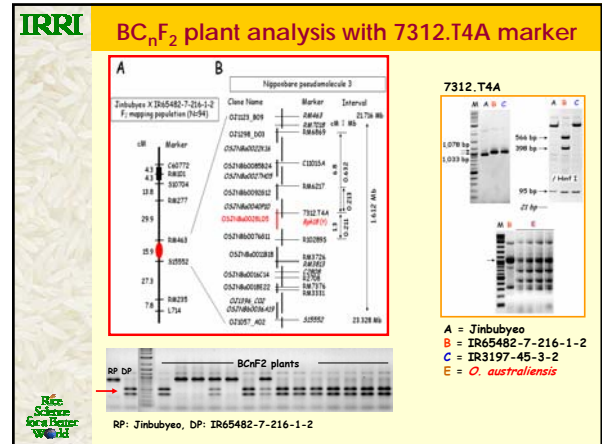
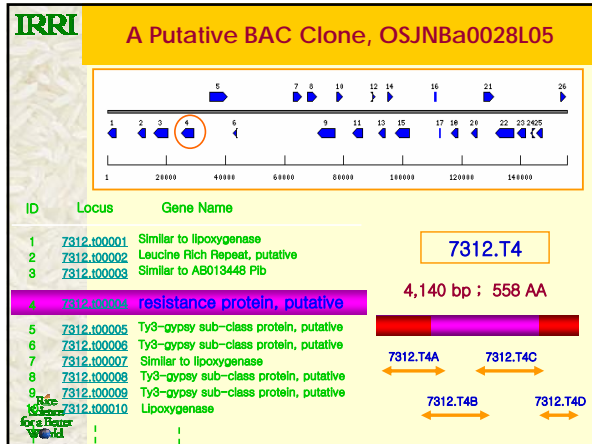
IRRI

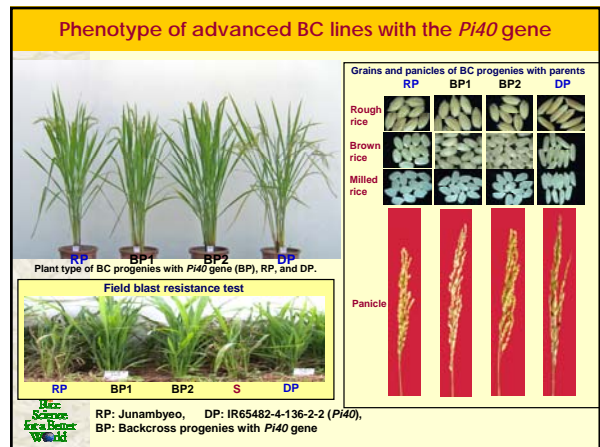
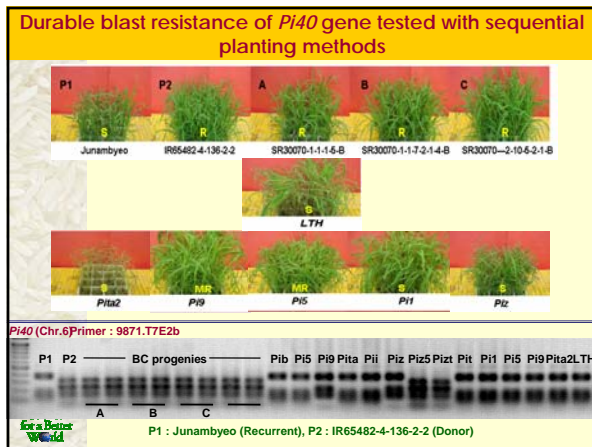
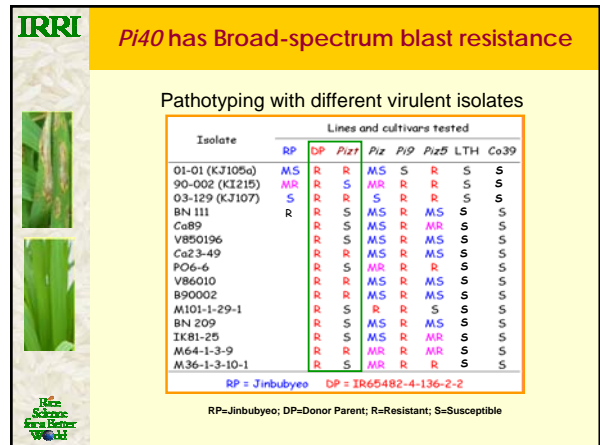
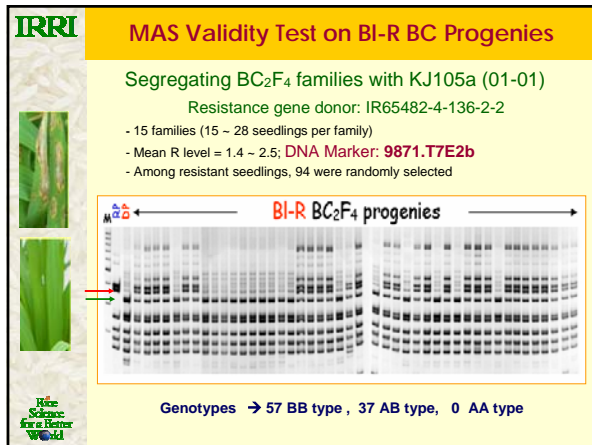
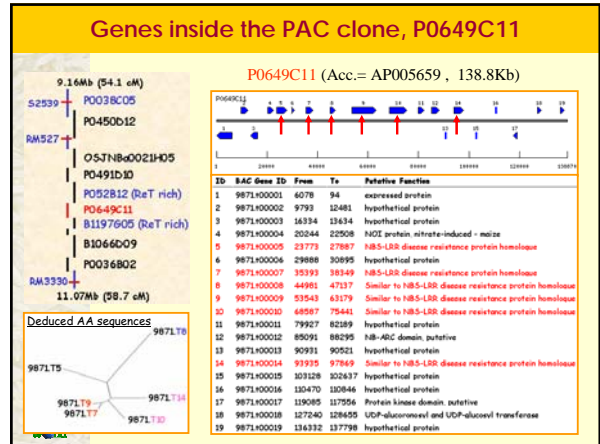
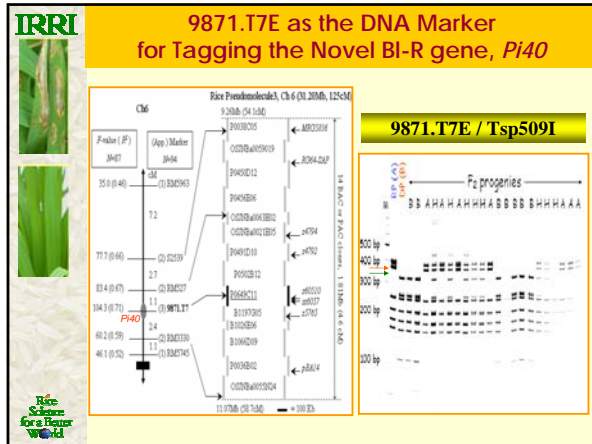
Genetic Sources of new resistance genes

Genotype	Gene	Nature of Gene
IR65482-7-216-1-2	<i>Bph18</i>	Dominant
IR65482-4-136-2-2	<i>Pi40</i>	Dominant
IRBB57	<i>Xa4+xa5+Xa21</i>	Dominant + Recessive

Rice Science for a Better World







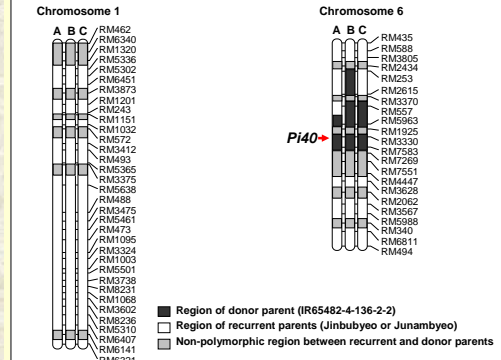
Major agronomic traits of advanced BC lines

Variety/line*	R gene	DTH* (days)	CL* (cm)	PL* (cm)	PN*	1,000 grain wt. (g)
Jinbubyeo (RP)	<i>Piz</i> (S)	95	85±3.3	21±0.3	13±1.4	21±0.2
SR30062-2-1-12-1	<i>PI40</i> (R)	97	81±4.1	20±0.8	13±1.9	22±0.4
Junambyeo (RP)	<i>Piz</i> (S)	117	72±3.3	20±0.3	12±1.2	23±0.9
SR30070-1-1-1-2	<i>PI40</i> (R)	100	65±2.1	23±0.8	11±1.8	23±0.4
SR30070-1-1-1-3	<i>PI40</i> (R)	113	72±3.4	23±0.5	11±1.1	22±0.6
SR30070-1-1-12-1	<i>PI40</i> (R)	116	80±2.6	19±0.6	12±1.8	21±1.0

*RP= Recurrent parent; DTH= Days to heading; CL= Culm length; PN= Panicle number; R= Resistant; S= Susceptible



IRRI Genotyping of BC Progenies with *Pi40* gene



IRRI Blast Reaction of BC lines in Northeastern China

Nampyong

Limgang



IRRI Reaction of IRBL9-W (*Pi-9*) monogenic rice line to Korean blast isolates

LTH

IRBL9-W



Field damage of Japonica rice cultivars due to outbreak of new *Xoo* race, K3a in Southwestern part of Korea (2003)



IRRI Reactions of genotypes with different R genes against Korean BB isolates

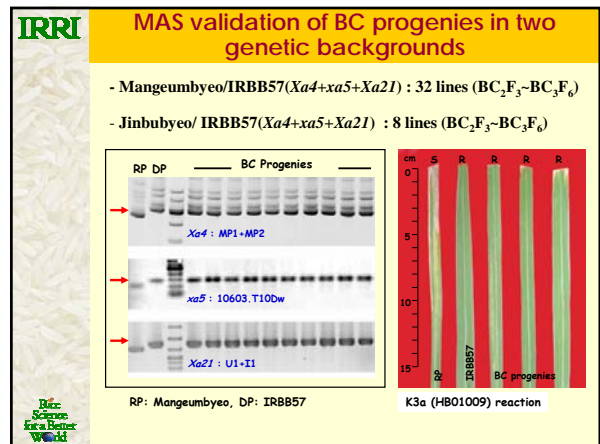
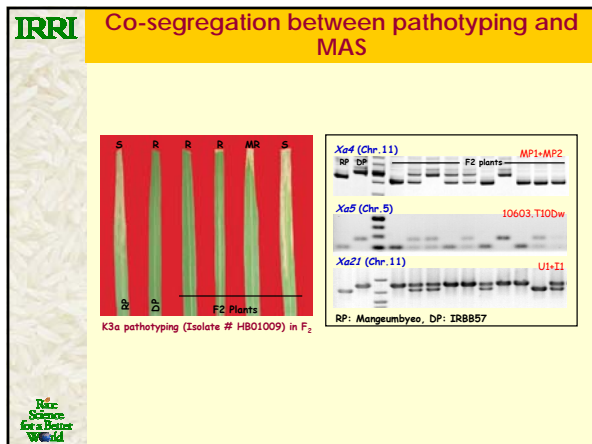
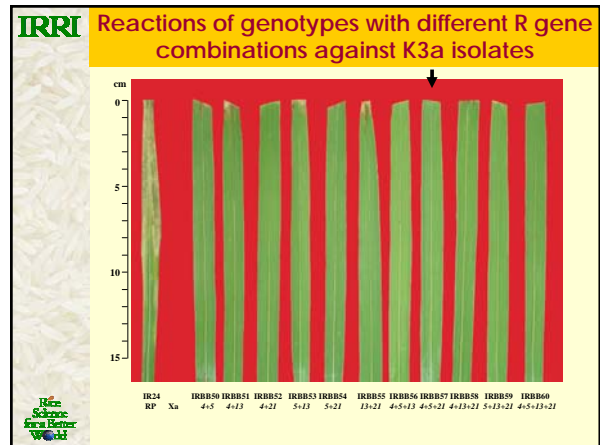
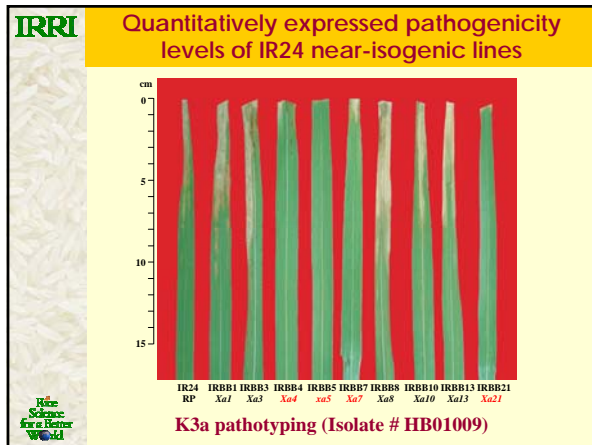
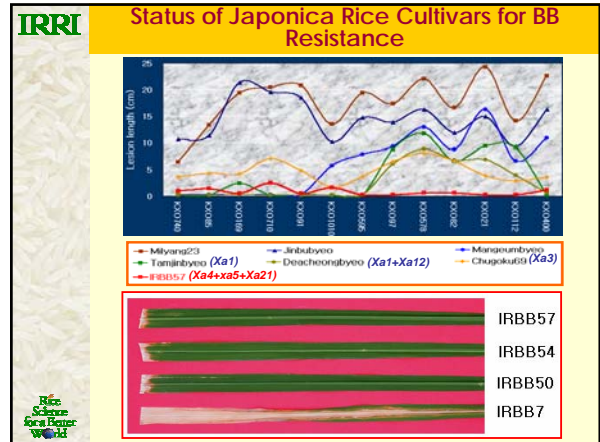
Cultivar	Gene	Isolates (KXO-)						
		21	82	97	400	578	595	605
IRBB 1	<i>Xa</i> 1	S	S	S	MR	S	S	MR
IRBB 4	<i>Xa</i> 4	MR	S	MR	S	S	S	S
IRBB 5	<i>Xa</i> 5	R	MR	R	MR	MR	R	R
IRBB 50	<i>Xa</i> 4 + <i>xa</i> 5	R	R	R	MR	R	R	R
IRBB 7	<i>Xa</i> 7	R	R	R	MR	MR	R	R
IRBB 21	<i>Xa</i> 21	R	R	MR	S	R	S	S
IRBB 54	<i>Xa</i> 5 + <i>Xa</i> 21	R	R	R	MR	R	R	R
IRBB 57	<i>Xa</i> 4 + <i>xa</i> 5 + <i>Xa</i> 21	R	R	R	MR	R	R	R
Mangeumbyeo	-	S	S	S	S	S	S	S

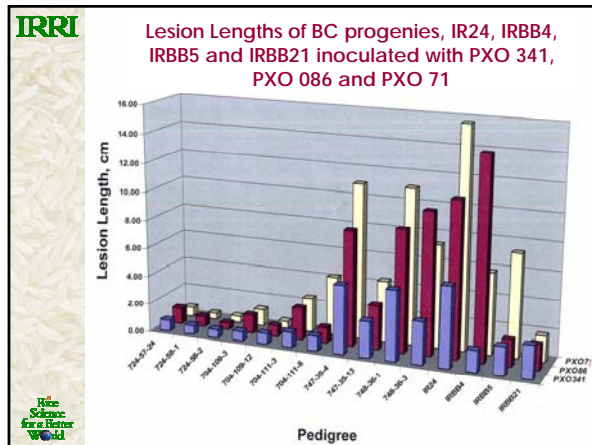
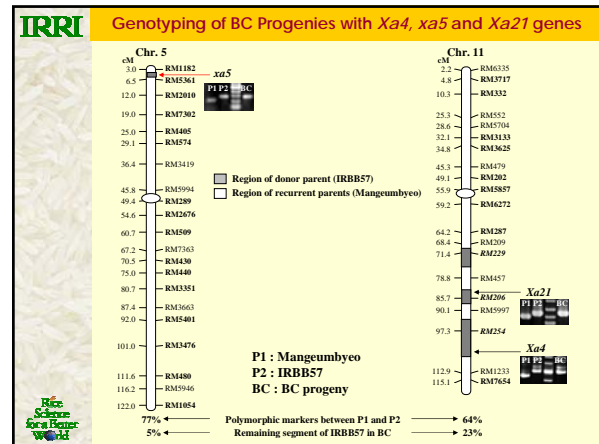
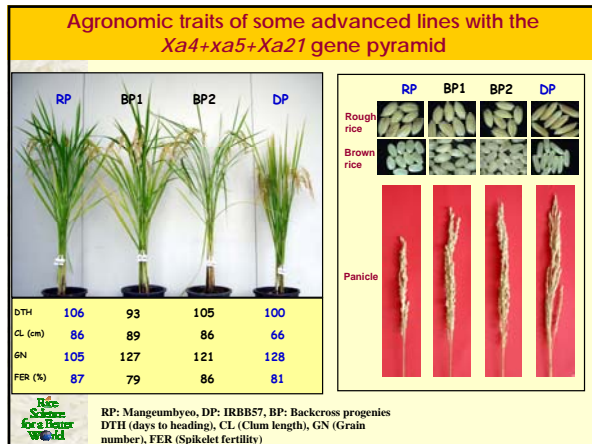


IRRI Features of cloned BB resistance genes and their products

Gene	Ch.	Product	Expression
<i>Xa1</i>	4	encodes NBS-LRR type	non-constitutive
<i>xa5</i>	5	encodes TFIIA gamma subunit (differ by 1 codon)	anti-repressor
<i>xa13</i>	8	homologous with MIN3 gene with LRR protein	constitutive
<i>Xa21</i>	11	receptor-like kinase protein with LRR domain	constitutive
<i>Xa26</i>	11	receptor-like kinase protein large LRR domain	constitutive
<i>Xa27</i>	6	no informative sequence similarity	-

Rice Science for a Better World





DNA markers, primer sequences and band sizes of new resistance genes

Sl. No.	R genes	Chromosome location	Markers	Primer sequences (5'→3')	Band size (bp)
1	<i>Bph18</i>	12	7312.T4A	F: acggcggtgagcatgg R: tacgcganaagcataaagatic	1,078
2	<i>Pi40</i>	6	9871.T7E2b	F: caacaacgggtcgacaaagg R: cccccaggctgataaccttc	642
3	<i>Xa4</i>	11	MP1+MP2	F: gatgatgatcttcacagg R: tctgtataaaaggctcgg	175
4	<i>xa5</i>	5	10603.T10Dw	F: gcactgcaacctaatgaatc R: cctagggaactagccgtcca	300
5	<i>Xa21</i>	11	U1+11	F: cagatcgtataaacgcaaaac R: atagcaactgattcttg	1300

Conclusions

- ❖ The new gene *Bph18* confers resistance to BPH biotypes of Korea, China and Vietnam. Breeding lines with *Bph18* gene can provide effective protection against new biotypes of BPH in Asia. The DNA marker, 7312.T4A can be used for marker-assisted introduction of *Bph18* gene into hybrid rice for BPH resistance.
- ❖ The *Pi40* gene conferred resistance to blast races of Korea, Philippines, China, and Vietnam. The *Pi40* gene in Japonica genetic background expressed broad-spectrum durable blast resistance under greenhouse bioassay and has potential for blast resistant hybrid development.
- ❖ Advanced BC breeding lines with BB resistance gene pyramids (*Xa4+xa5+Xa21*) expressed resistance reaction to the new BB race, K3a and are potential source for hybrid rice development.

