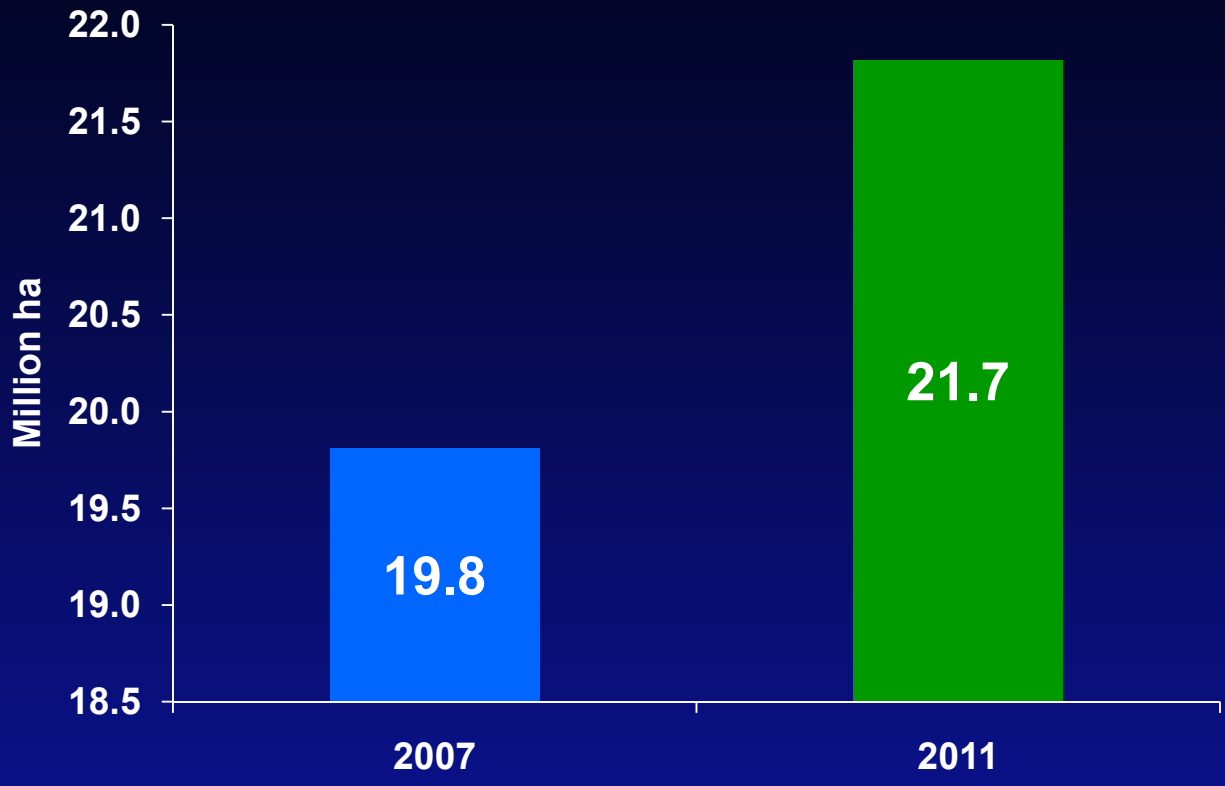
Hybrid Rice Research and Development at IRRI

6th International Hybrid Rice Symposium
Hyderabad, India
Sept. 10-12, 2012

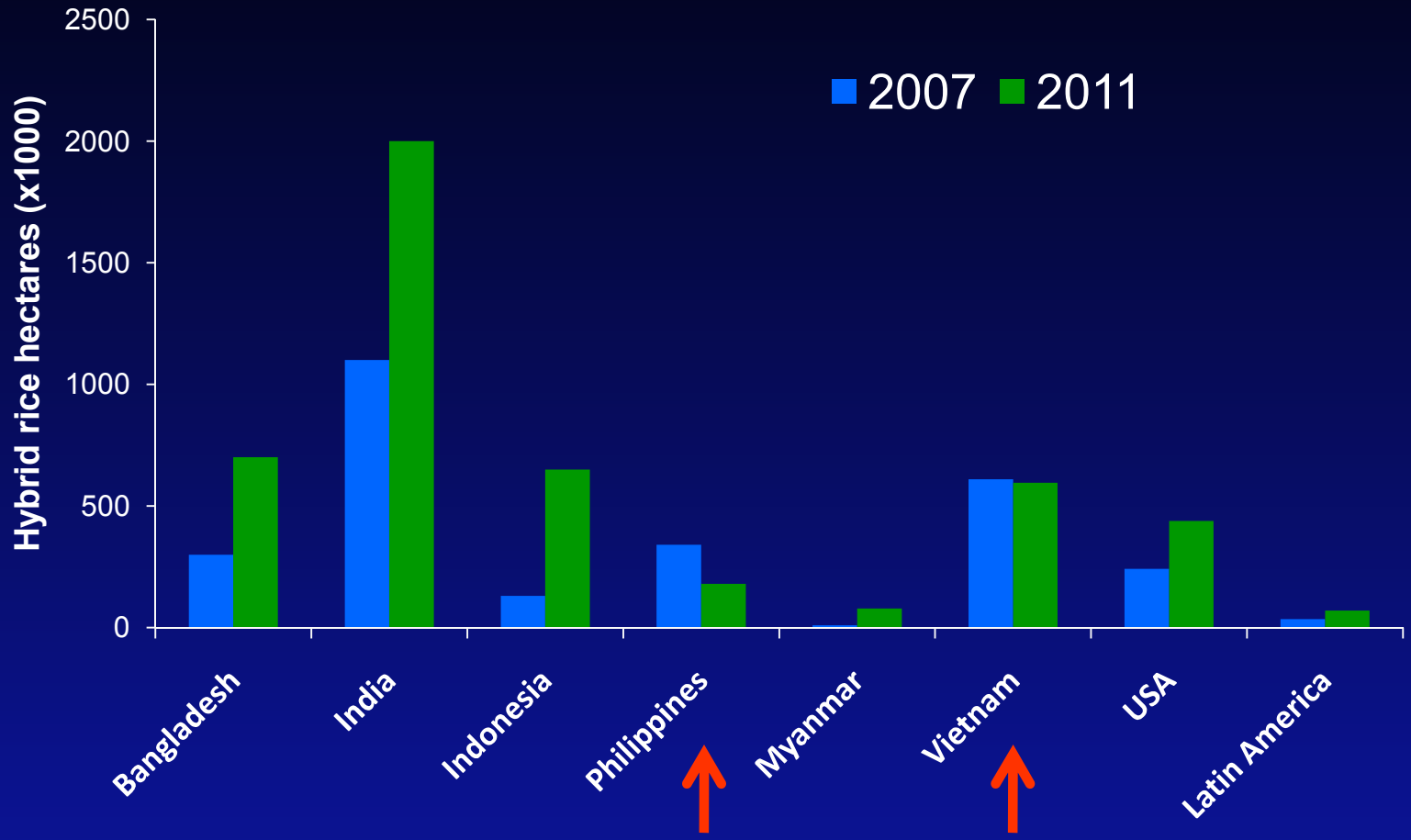
Fangming Xie
IRRI

Hybrid Rice is Growing Globally



2 million ha of hybrid rice added in rice production in the last 4 years (10.2% increase), outside China

Changes of Hybrid Rice Area in Countries outside China



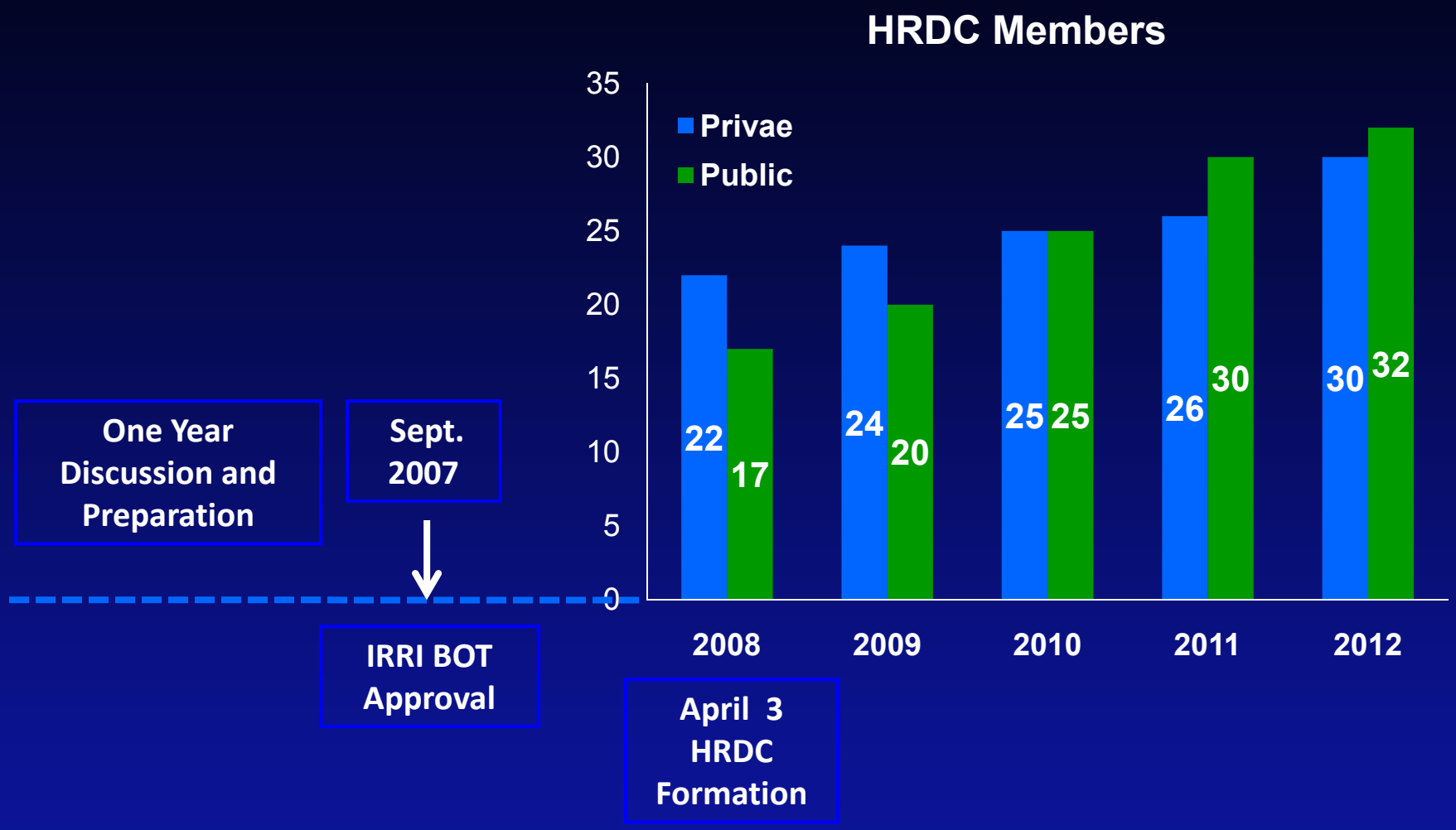
Hybrid rice area increased in the major hybrid rice countries/regions

IRRI organized HRDC in 2008

Objectives:

- Support research for parent and hybrid development
  - Hybrid rice research (heterosis & other traits);
  - Develop hybrids & parents and share w/ partners
- Provide information on the performance of hybrids & develop best management practices
- Support information sharing, public awareness & capacity building

HRDC Members Increased



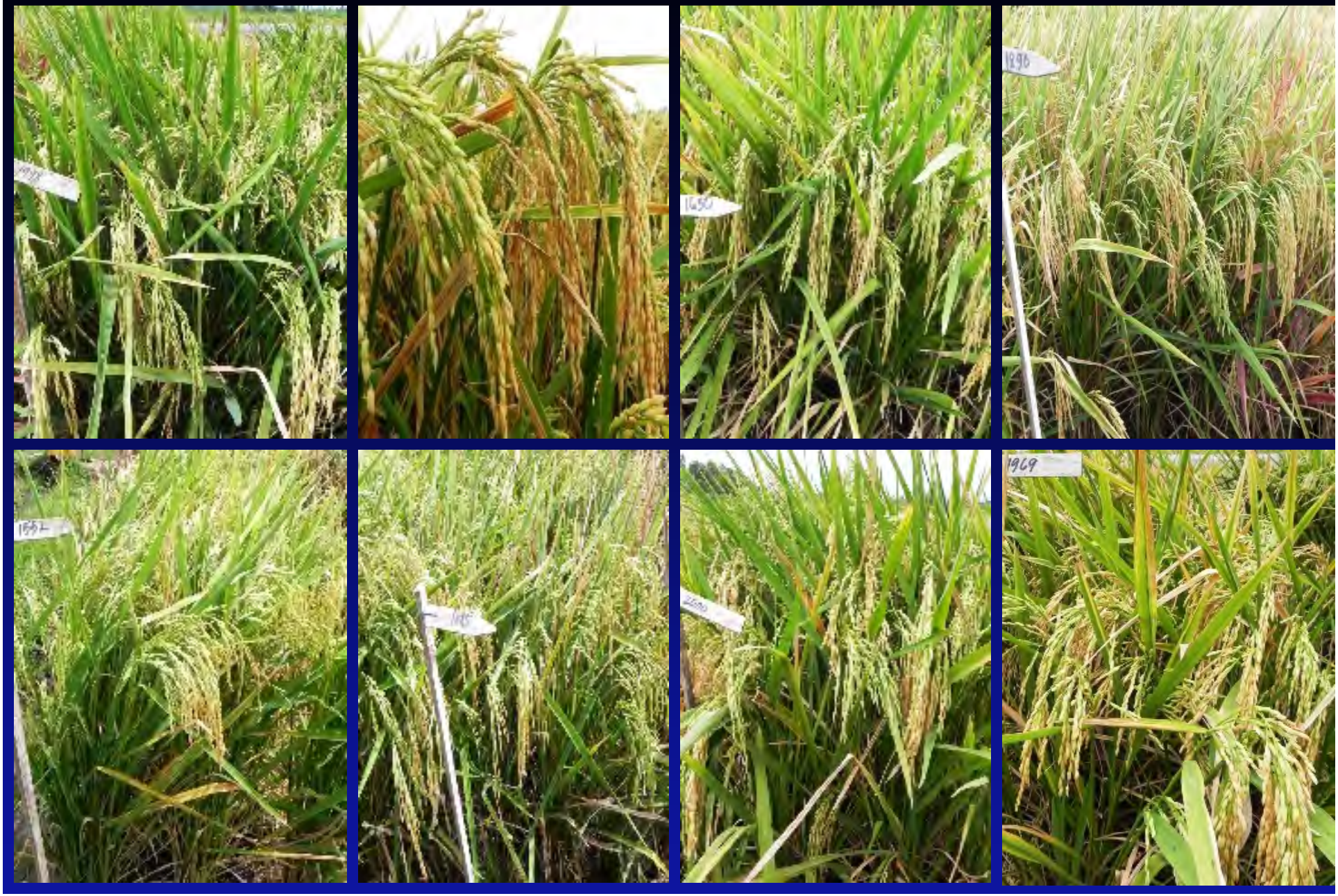
Research Priorities defined by HRDC members

Traits	Trait Detail
Yield Heterosis	• High yielding > 20% heterosis in the tropical • Heterotic pools – concept and parental grouping • Stable yielding over environments
Seed Production	• High-yielding • Stable sterility & high-outcrossing females • Elite male parents • Stable yielding
Resistance & Tolerance	• Diseases – BLB, Blast, Sheath Blight, False smut • Insects - Stem Borer, BPH & WBPH; • Drought, Salinity & Submergence
Quality	• Less chalk, non sticky • Long grain or Medium grain with specific amylose
Maturity	• 115 – 120 days, 120- 125 days
Others	• Wide adaption – parents & hybrids • Plant architecture for high-yielding

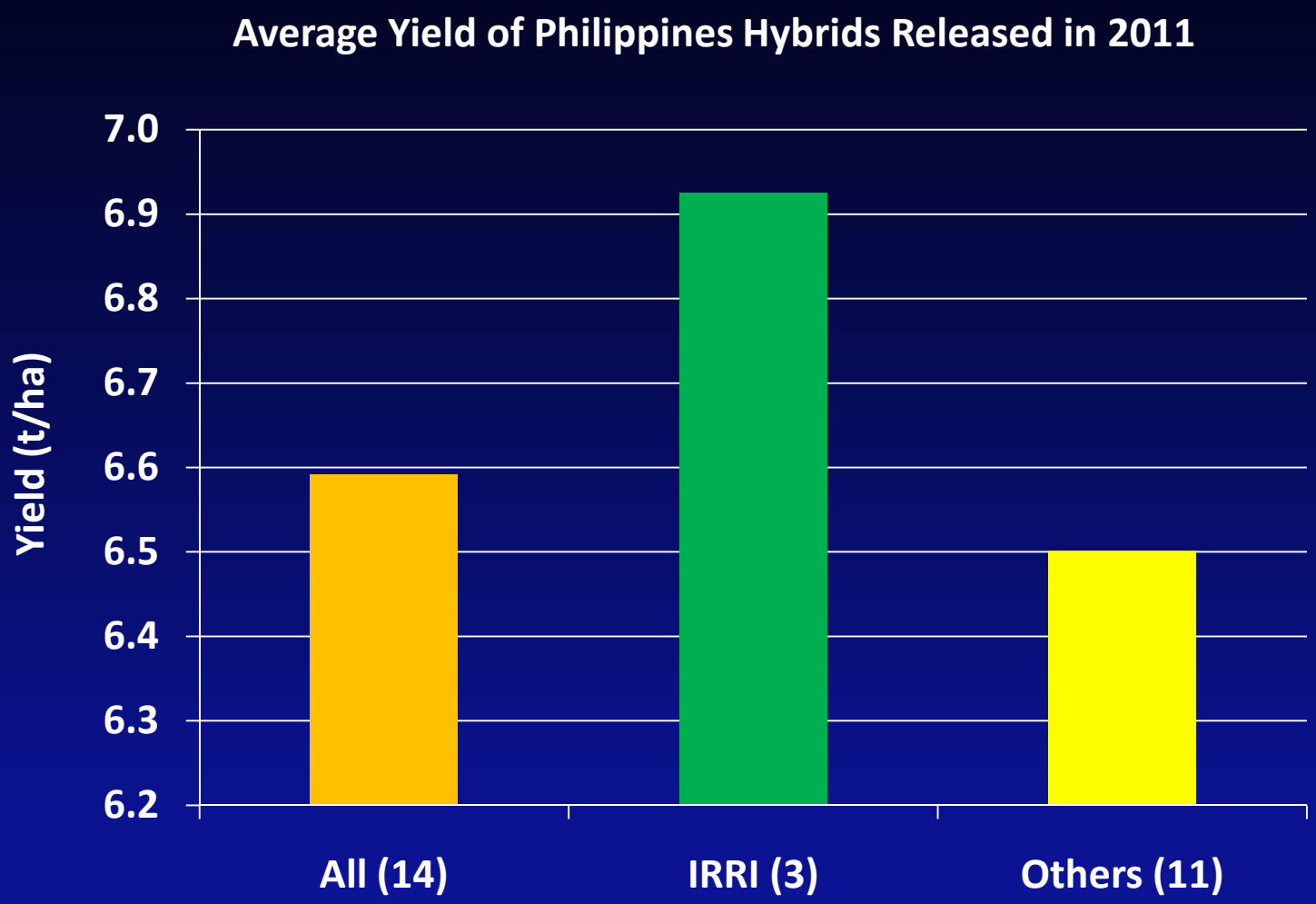
Hybrid Rice Breeding

- 15 ha/season for hybrid rice breeding
- 12,000 breeding lines & populations/year
- 2,700 new hybrids/year

New Hybrids in the Pipeline



IRRI Rice Hybrids Show Yield Advantage over Other Hybrids



Develop new CMS lines with high outcrossing

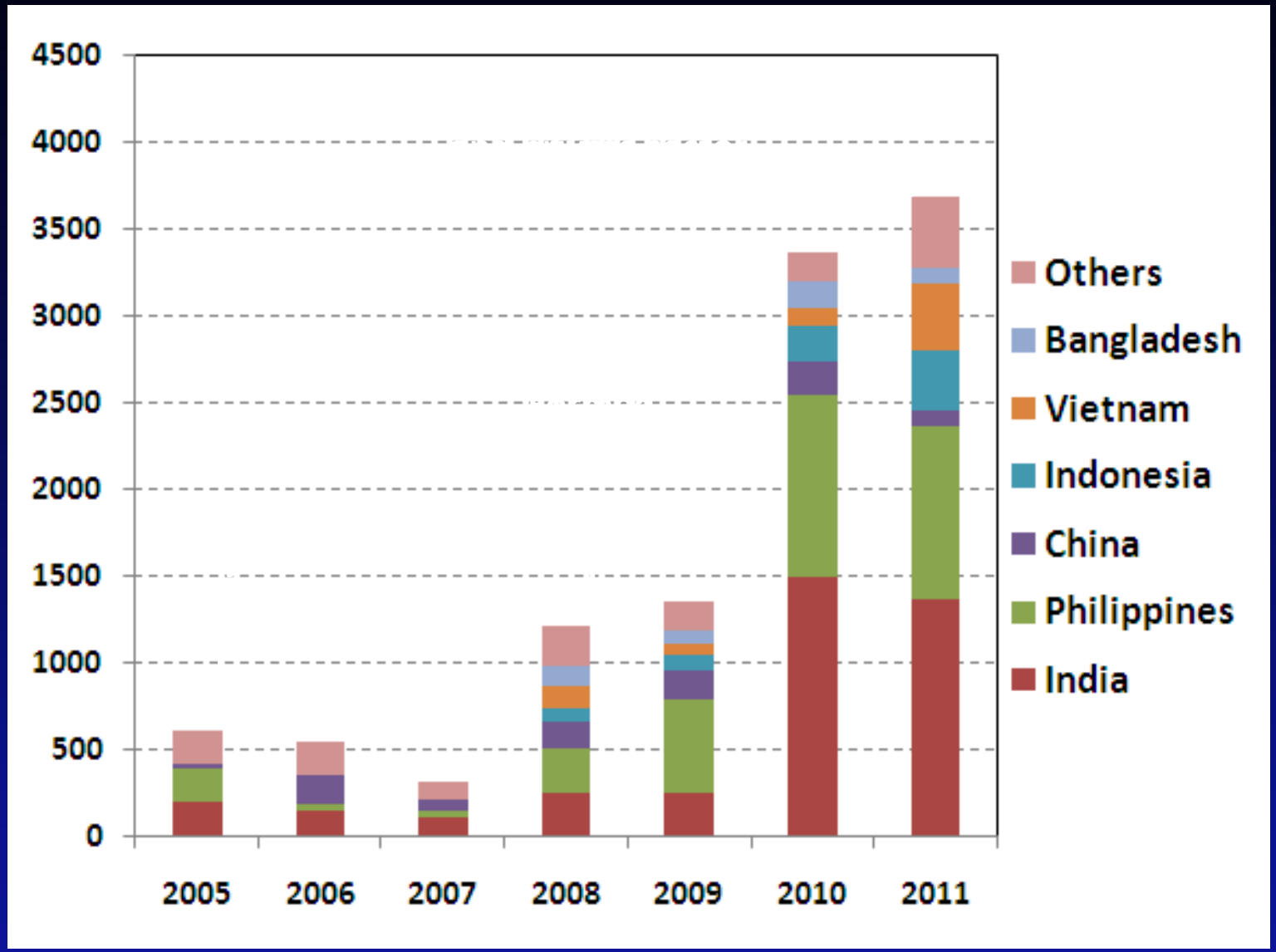
IR58025A

New CMS A

New CMS A New CMS B

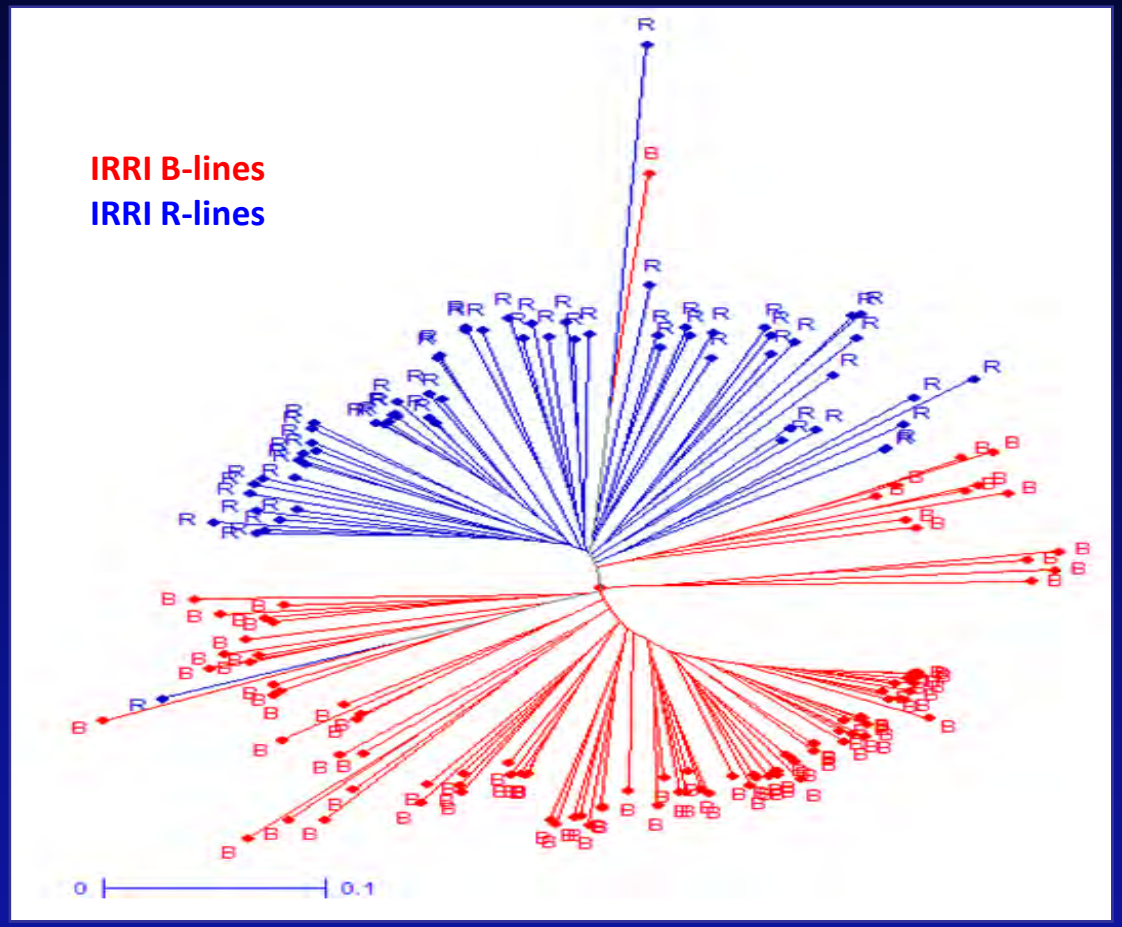
High Seed Set of New CMS line

IRRI hybrid rice germplasm shared with partners

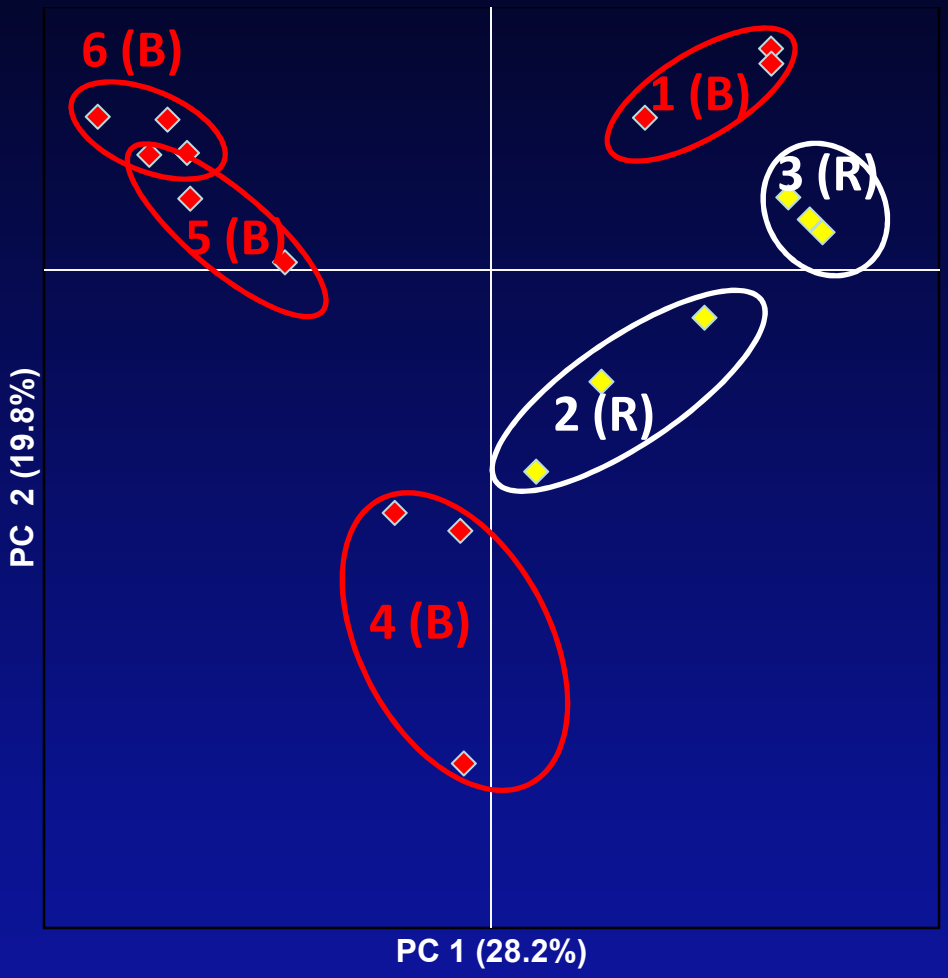


Studies of heterotic groups – Molecular markers + field evaluation

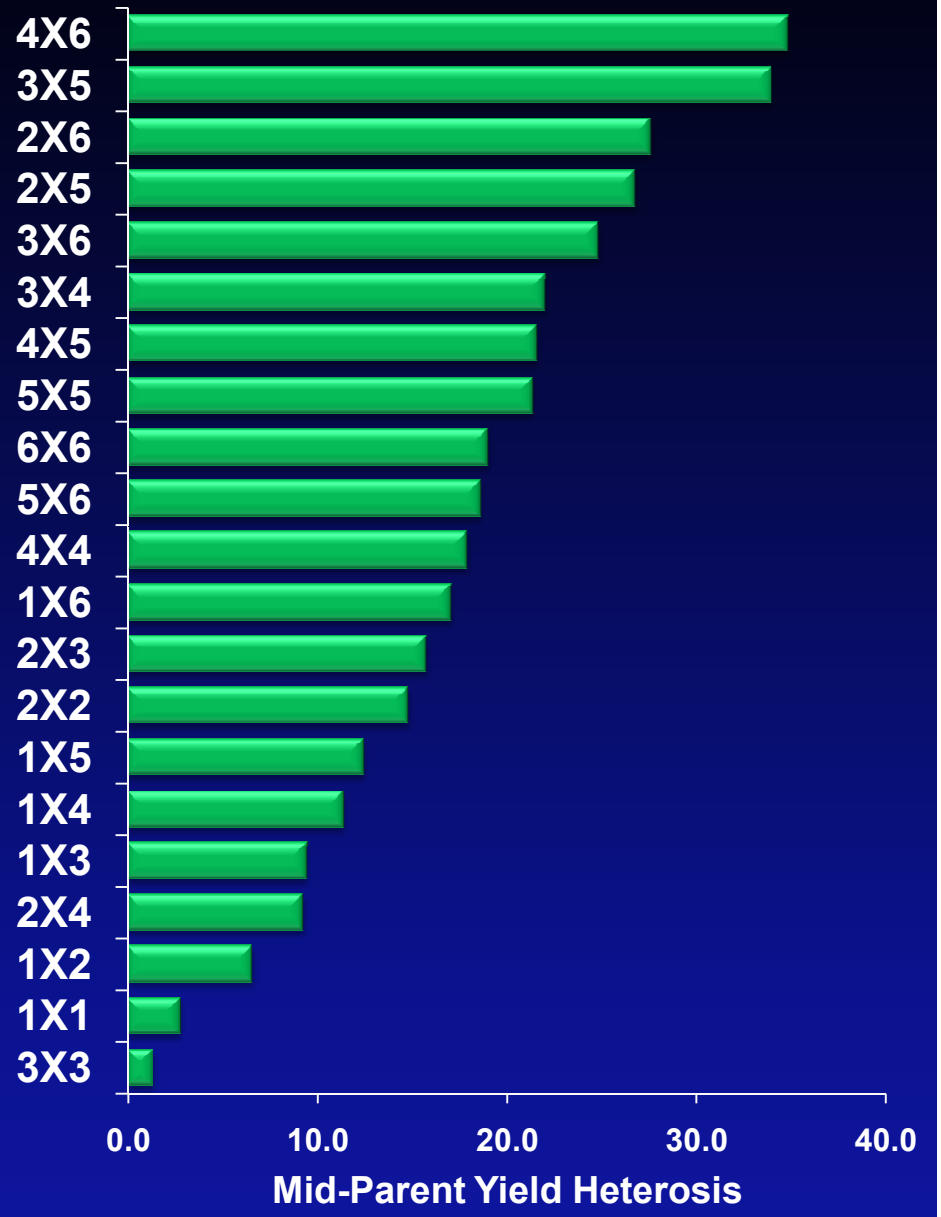
- Heterotic groups of IRRI hybrid rice parents (168)
  - Parents grouped by SSR & SNP markers
  - Hybrids between & within groups made and evaluated in multi-location
  - Heterosis: Between groups > within group
  - Strong yield heterosis was observed between specific groups



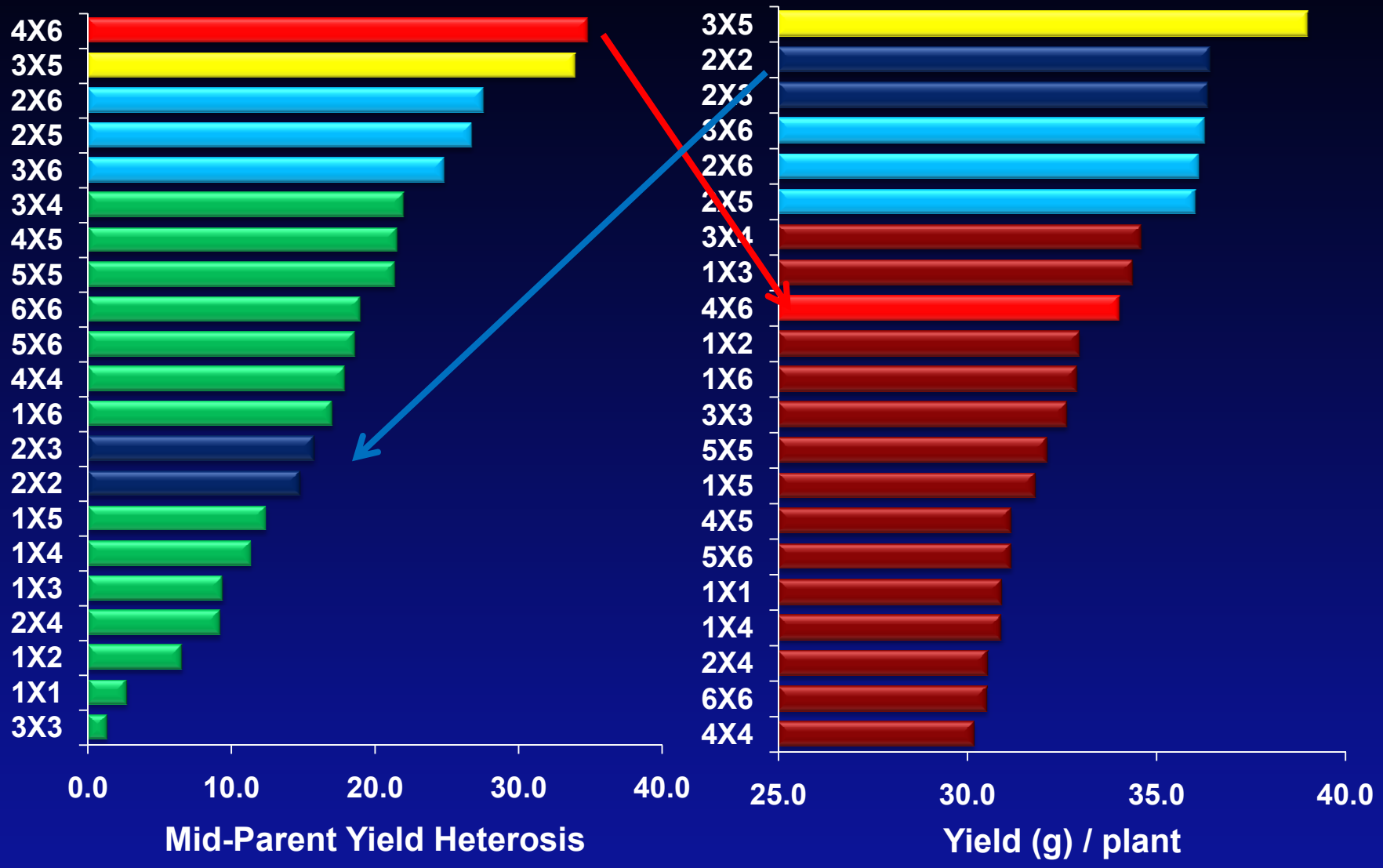
Parents grouped by markers



Hybrids between & within groups



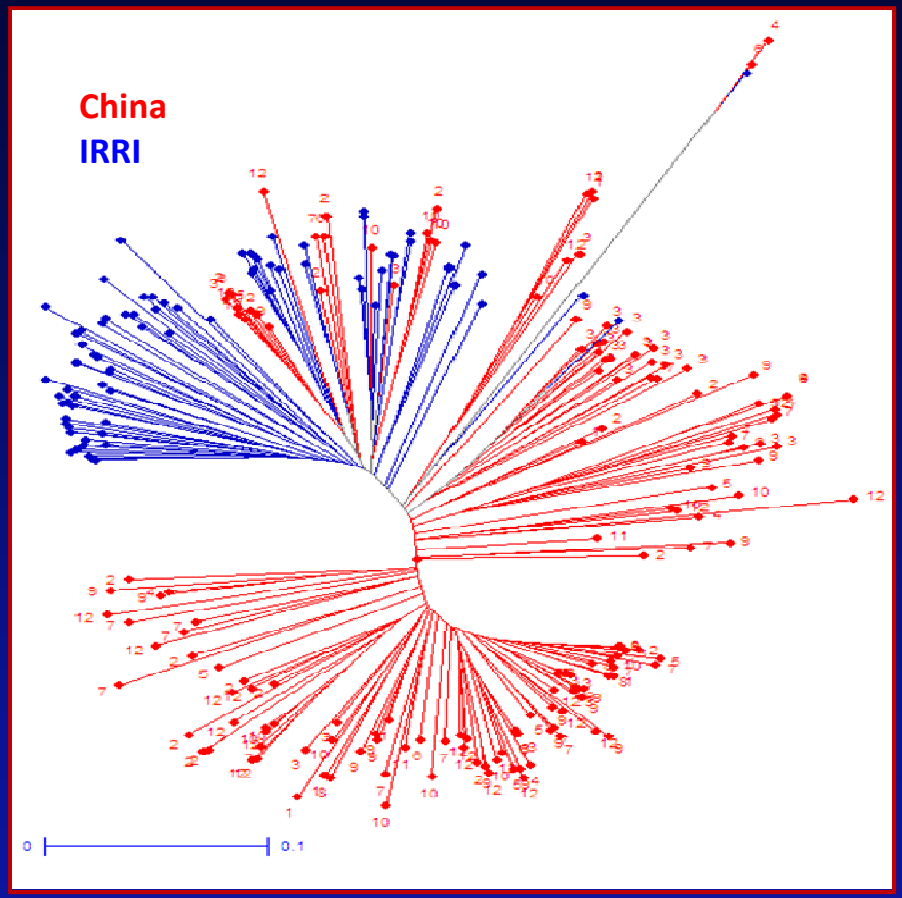
Hybrid yield performance and heterosis

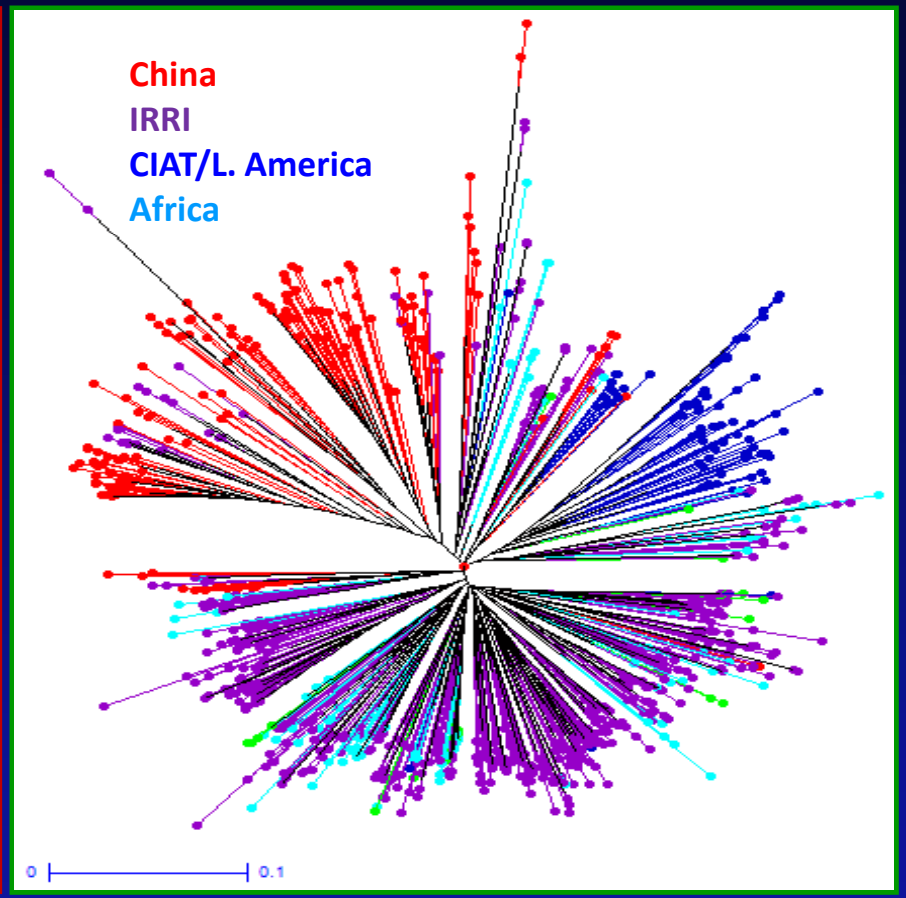


Hybrids from G5 (B) x G3 (R) Yielded highest with Best Heterosis

Studies of heterotic groups – Molecular markers + field evaluation

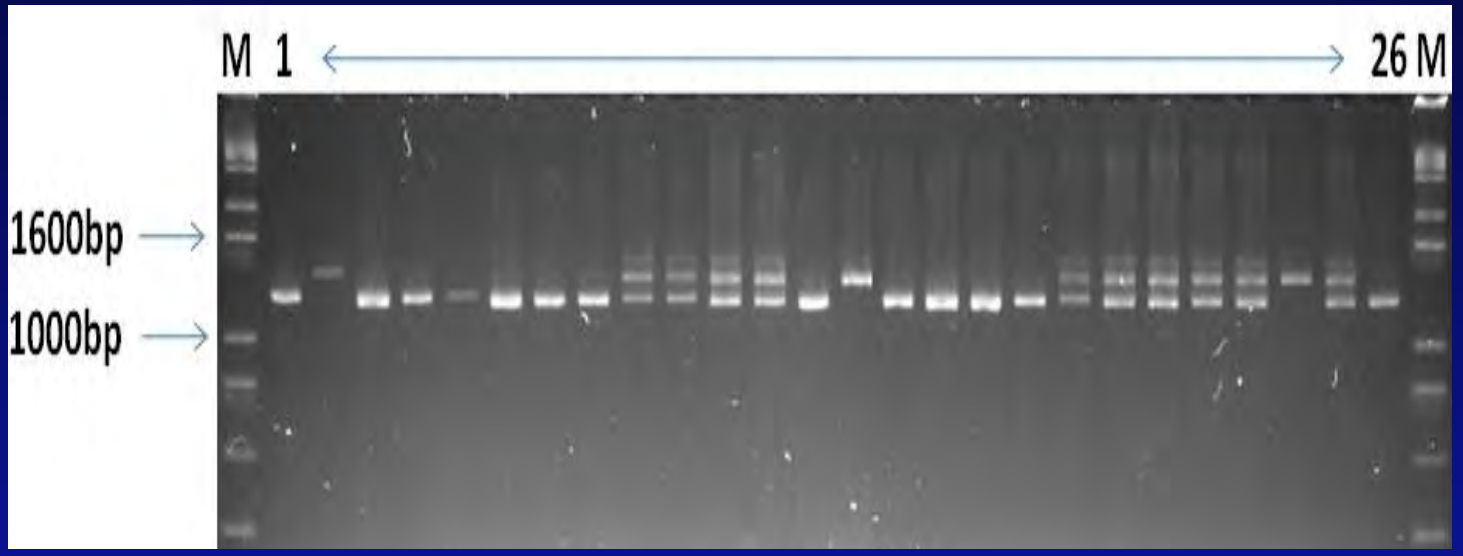
- Heterotic groups of IRRI hybrid rice parents (168)
- Variety groups of IRRI and southern China *indica* (215)
- Variety groups of IRRI, China, some Asian and L. America countries (736)





Other on-going Hybrid Rice R & D at IRRI

- Bacterial blight resistance
  - Xa4, xa5, Xa7, xa13, Xa21, and Xa23
  - IR68897B, IR58025B, IR 93559B, IR93560B, IR93561B
  - Inoculums + Field screen + MAS
  - BC3F1 (2012DS)



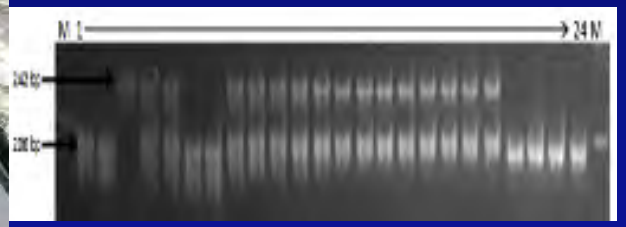
PCR product Bandings using Xa21 marker, a 1400 bp band (R) for IRBB21 & a 1200 bp band (S) for IR24
M: DNA size standard; Lane 1–7: IR24, IRBB66, IR93561B, IR93560B, IR93559B, IR58025B, IR68897B; Lanes 8–26: BC1F1's

Pther on-going Hybrid Rice R & D at IRRI

- Submergence tolerance
  - Submergence + MAS
  - IR68897B & SRT3R, and other B/R lines
  - BC3F1 (2012DS)



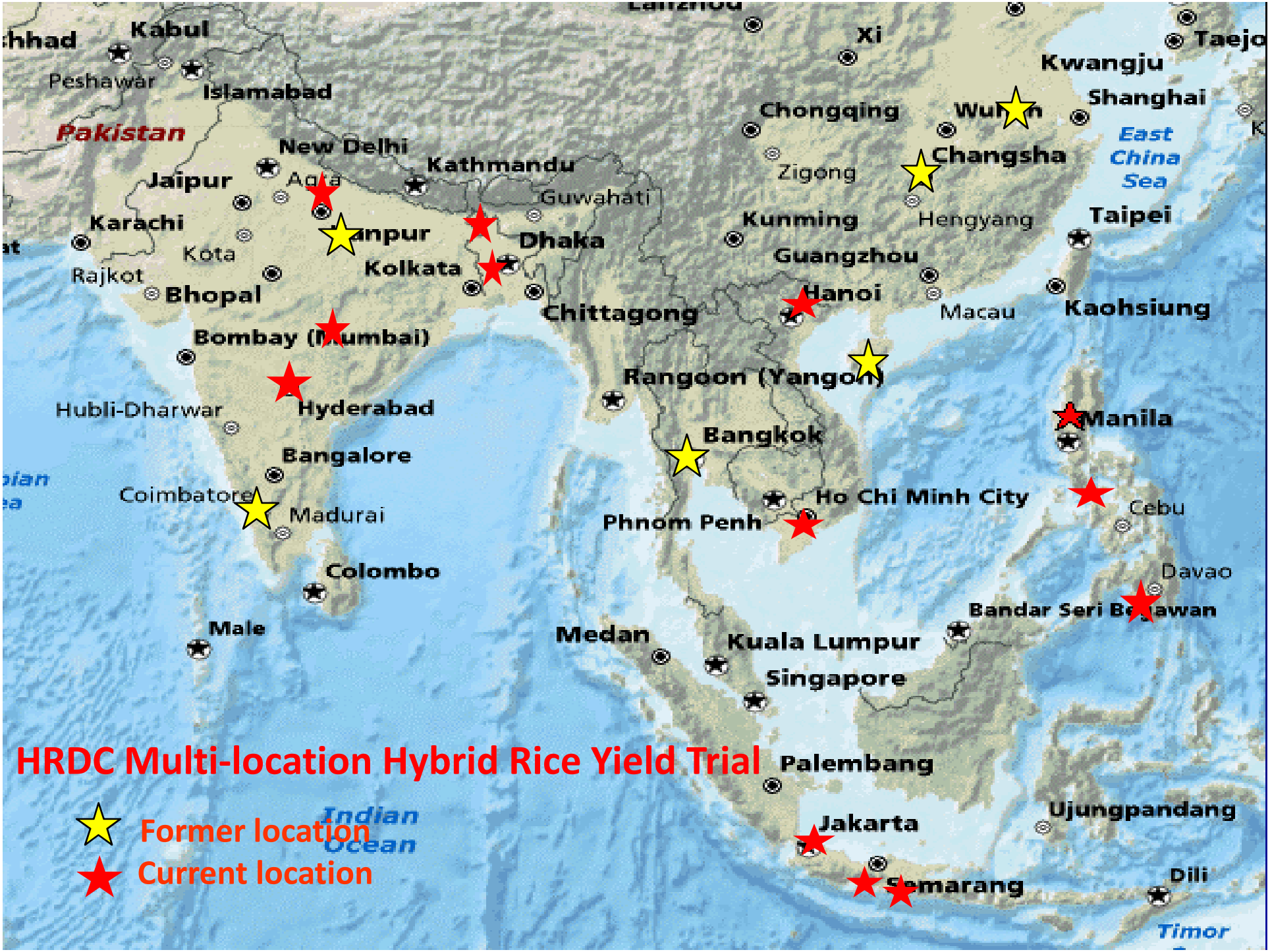


Other on-going Hybrid Rice R & D at IRRI

- Drought tolerance: Transfer drought-tolerant QTLs to hybrid parents using conventional and MAS
- Low chalk: Low chalk QTLs + MAS to improve parents
- TGMS: Line selection and breeding
- Outcrossing: Conventional screening + traits from wild rice
- SNP markers: Convert and confirm SNP markers for *Rf*, sub-1, BLB, Blast, Amylose genes

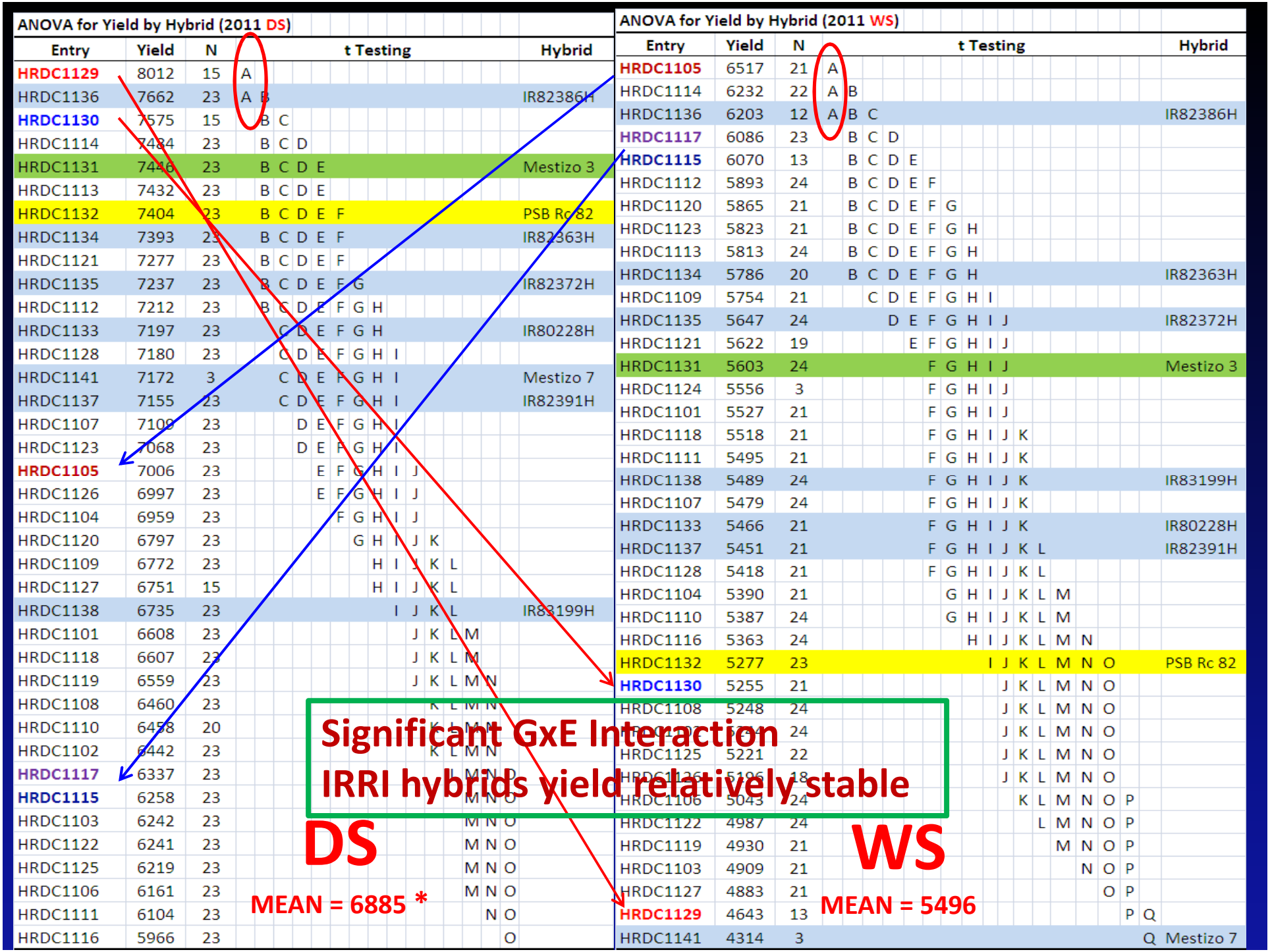
JAAS-HRDC Hybrid Rice Training


HRDC Multi-location Hybrid Rice Yield Trial
Former location
Current location
Kabul
Peshawar
Islamabad
Pakistan
New Delhi
Kathmandu
Jaipur
Agra
Karachi
Kota
Rajkot
Bhopal
Dhaka
Kolkata
Guwahati
Chittagong
Bombay (Mumbai)
Hyderabad
Hubli-Dharwar
Bangalore
Coimbatore
Madurai
Colombo
Male
Indian Ocean
Rangoon (Yangon)
Bangkok
Phnom Penh
Ho Chi Minh City
Hanoi
Chongqing
Zigong
Kunming
Guangzhou
Macau
Changsha
Hengyang
Wuhan
Xi
Kwangju
Shanghai
East China Sea
Taipei
Kaohsiung
Manila
Cebu
Davao
Bandar Seri Begawan
Medan
Kuala Lumpur
Singapore
Palembang
Jakarta
Semarang
Ujungpandang
Dili
Timor

2012 DS HRDC MRYT at IRRI

Objectives:

1. Assist HRDC members in assessing the performance of hybrids
2. To enable HRDC members to generate reliable performance data across a set of marketing locations


ANOVA for Yield by Hybrid (2011 DS)
Entry Yield N t Testing Hybrid
HRDC1129 8012 15 A
HRDC1136 7662 23 A B IR82386H
HRDC1130 7575 15 B C
HRDC1114 7484 23 B C D
HRDC1131 7446 23 B C D E Mestizo 3
HRDC1113 7432 23 B C D E
HRDC1132 7404 23 B C D E F PSB Rc 82
HRDC1134 7393 23 B C D E F IR82363H
HRDC1121 7277 23 B C D E F
HRDC1135 7237 23 B C D E F G IR82372H
HRDC1112 7212 23 B C D E F G H
HRDC1133 7197 23 C D E F G H IR80228H
HRDC1128 7180 23 C D E F G H I
HRDC1141 7172 3 C D E F G H I Mestizo 7
HRDC1137 7155 23 C D E F G H I IR82391H
HRDC1107 7109 23 D E F G H I
HRDC1123 7068 23 D E F G H I
HRDC1105 7006 23 E F G H I J
HRDC1126 6997 23 E F G H I J
HRDC1104 6959 23 F G H I J
HRDC1120 6797 23 G H I J K
HRDC1109 6772 23 H I J K L
HRDC1127 6751 15 H I J K L
HRDC1138 6735 23 I J K L IR83199H
HRDC1101 6608 23 J K L M
HRDC1118 6607 23 J K L M
HRDC1119 6559 23 J K L M N
HRDC1108 6460 23 K L M N
HRDC1110 6458 20 K L M N
HRDC1102 6442 23 K L M N
HRDC1117 6337 23 L M N O
HRDC1115 6258 23 M N O
HRDC1103 6242 23 M N O
HRDC1122 6241 23 M N O
HRDC1125 6219 23 M N O
HRDC1106 6161 23 M N O
HRDC1111 6104 23 N O
HRDC1116 5966 23 O
DS
MEAN = 6885 *
ANOVA for Yield by Hybrid (2011 WS)
Entry Yield N t Testing Hybrid
HRDC1105 6517 21 A
HRDC1114 6232 22 A B
HRDC1136 6203 12 A B C IR82386H
HRDC1117 6086 23 B C D
HRDC1115 6070 13 B C D E
HRDC1112 5893 24 B C D E F
HRDC1120 5865 21 B C D E F G
HRDC1123 5823 21 B C D E F G H
HRDC1113 5813 24 B C D E F G H
HRDC1134 5786 20 B C D E F G H IR82363H
HRDC1109 5754 21 C D E F G H I
HRDC1135 5647 24 D E F G H I J IR82372H
HRDC1121 5622 19 E F G H I J
HRDC1131 5603 24 F G H I J Mestizo 3
HRDC1124 5556 3 F G H I J
HRDC1101 5527 21 F G H I J
HRDC1118 5518 21 F G H I J K
HRDC1111 5495 21 F G H I J K
HRDC1138 5489 24 F G H I J K IR83199H
HRDC1107 5479 24 F G H I J K
HRDC1133 5466 21 F G H I J K IR80228H
HRDC1137 5451 21 F G H I J K L IR82391H
HRDC1128 5418 21 F G H I J K L
HRDC1104 5390 21 G H I J K L M
HRDC1110 5387 24 G H I J K L M
HRDC1116 5363 24 H I J K L M N
HRDC1132 5277 23 I J K L M N O PSB Rc 82
HRDC1130 5255 21 J K L M N O
HRDC1108 5248 24 J K L M N O
[illegible] 24 J K L M N O
HRDC1125 5221 22 J K L M N O
[illegible] 18 J K L M N O
HRDC1106 5043 24 K L M N O P
HRDC1122 4987 24 L M N O P
HRDC1119 4930 21 M N O P
HRDC1103 4909 21 N O P
HRDC1127 4883 21 O P
HRDC1129 4643 13 P Q
HRDC1141 4314 3 Q Mestizo 7
WS
MEAN = 5496
Significant GxE Interaction
IRRI hybrids yield relatively stable

Low head rice yield and high chalk are the two challenges for improving hybrid rice grain quality

Average head rice yield and chalk percentage of hybrid rice

Season	Quality	Hybrid	Inbred	Hybrid vs Inbred	
				Value	%
Dry	Head Rice	42.7	47.3	-4.60	-9.7
	Chalk	15.9	11.1	4.87	43.9
	N	371	50		
Wet	Head Rice	45.7	50.6	-4.93	-9.7
	Chalk	18.7	14.3	4.36	30.4
	N	398	50		

Source: National Cooperative Testing, Philippines, 1997 - 2011


THANKS