

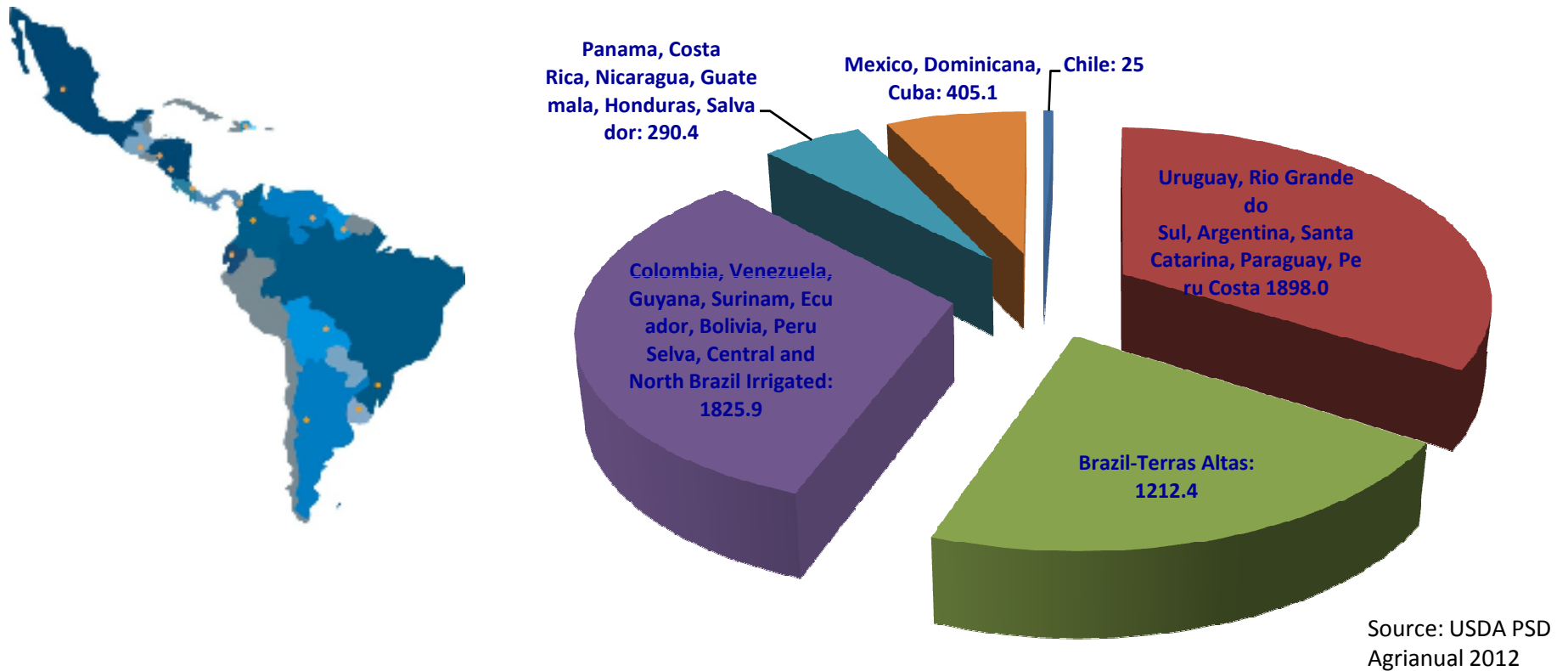
Progress of Hybrid Rice R&D at CIAT

Edgar A. Torres
Breeder CIAT-Rice Program

HRDC Meeting IRRI
2 April 2013

Target environments and cultivated area (by 1000 has)

in Latin America



Total Cultivated Area 5.656 millions has

Market Value 565.670 million US\$

Rice yield growing at the farm level in Latin America 1990-2012

Country	Last Three Years Average Yield Tn ha ⁻¹	Annual Gains kg ha ⁻¹ per year	R ²
Brazil	4.86	123.8	0.96**
Rio Grande do Sul	7.19	124.9	0.73*
Argentina	6.76	118.6	0.71**
Uruguay	8.00	150.3	0.78**
Peru	7.21	115.8	0.78*
Bolivia	3.00	55.2	0.52*
Ecuador	3.06	26.0	0.10
Colombia	4.77	55.8	0.43*
Venezuela	4.27	20.2	0.20
Guyana	4.26	47.9	0.63*
Suriname	3.81	0.0	0.00
Nicaragua	4.36	67.8	0.54**
Dominican Rep.	4.92	4.9	0.00

In South & Central America rice is planted under direct seeding.



	Grano	Blco.					Verde	Mancha
Basura	Entero	Total	Rojos	Yesado	Mezcla	Cargo	Blco.	
1,70	66,60	70,50	0,00	5,40	0,00	9,50	0,06	
1,70	66,60	70,50	0,00	5,40	0,00	9,50	0,06	
1,10	67,80	71,00	0,00	3,00	0,00	8,30	0,02	
1,10	67,80	71,00	0,00	3,00	0,00	8,30	0,02	
1,40	67,20	70,75		4,20		8,90	,04	
1,40								
1,40								



IRGA 427

High yielding, good grain quality and adaptation to warmer regions



Rice quality : High milling recovery > 60%, Long slender grains, L/W ≥ 3.0 , low chalkiness, high amylose, low gelatinization temperature and no aroma.

Red rice is the
major weed
problem under
direct seeding.



Historical development of hybrid rice in Latin America

- Brazil : Embrapa/CNPAF - CIRAD began in 1984. First hybrid BRS CIRAD 302 released in 2010/2011 in association with CIRAD
- Colombia: Fedearroz began in 1983 in collaboration with IRRI some female and restorers lines identified. Aceituno began in 2003. This year one hybrid in commercial testing
- Ecuador: The INIA began in 1995..no hybrids
- Rice Tec. Began in 1992, has release products in Rio Grande do Sul and Central Brazil, Uruguay and Argentina. Avaxi, Inov and Inov CL. INOV better product for the southern cone.
- Irga began in 2003 in collaboration with Ana Paula Farm and Hunan Institute. Two commercial hybrids
- Bayer. Working in Brazil since 2009 in association with Irga and Ana Paula. Arize QM 1010, Arize QM1010CL, Prime.



Area under hybrids in South America

- ✓ Brazil
.- 35000 has
- ✓ Uruguay
.- 6000 has
- ✓ Argentina
.- 13000 has
- ✓ Total
.- 55000 has

The area under commercial production with hybrid seeds is low in LA; less than 1%. In the southern cone less than 4%. However, some information indicates that the area under hybrids is about 70000 has.



Picture by Neil Palmer-CIAT

Limitations to the adoption of hybrid rice technology in the South America

- Grain quality from commercial hybrids below the standards, specially in appearance and milling yield
- Low seed production and long distances between the places for production and the place for use causing high seed price
- In environments with high yield potential, the hybrid yield advantage is not significant.
- Bigger contribution is the herbicide resistance Clearfield® trait that have been very important to face red rice. But, still conventional varieties are by far more planted.



Picture by Neil Palmer-CIAT

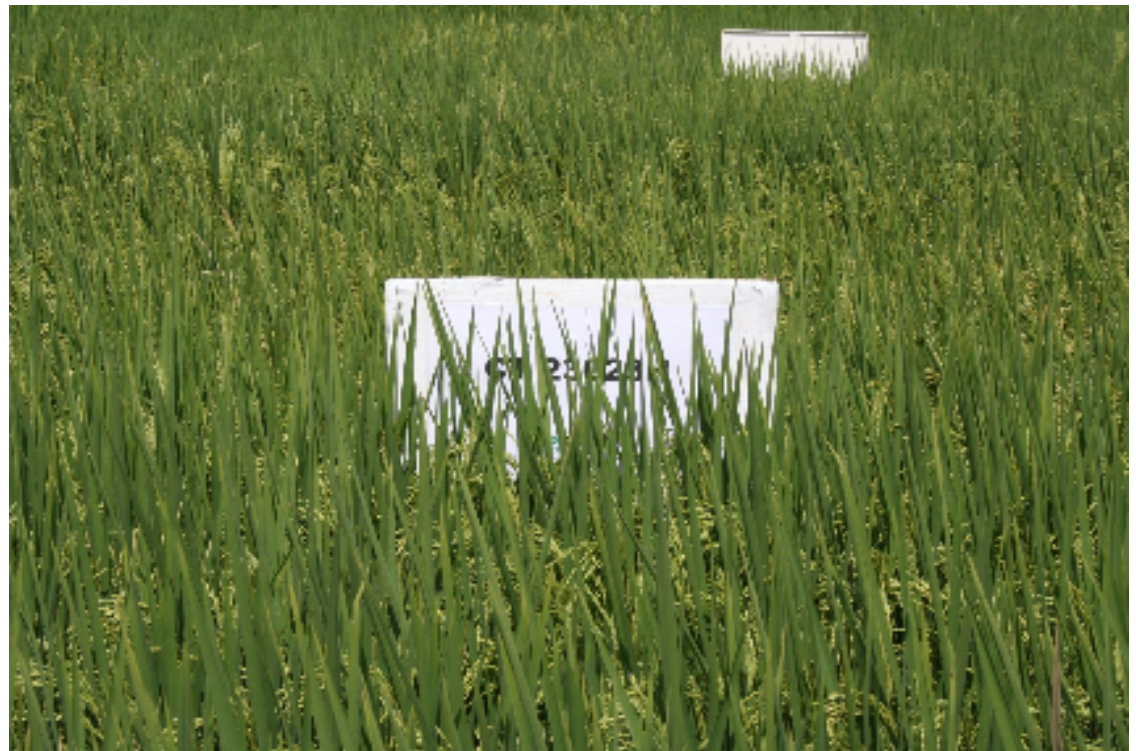
Latin American Germplasm could contribute to global development of hybrid rice

- ✓ Adaptation to direct seeding with good tolerance to lodging
- ✓ Good grain quality for the indica Market
- ✓ Diverse group with long panicles and stay green
- ✓ Innovative breeding methods used like Recurrent Selection that increase the genetic gain s



Hybrid Rice Breeding at CIAT

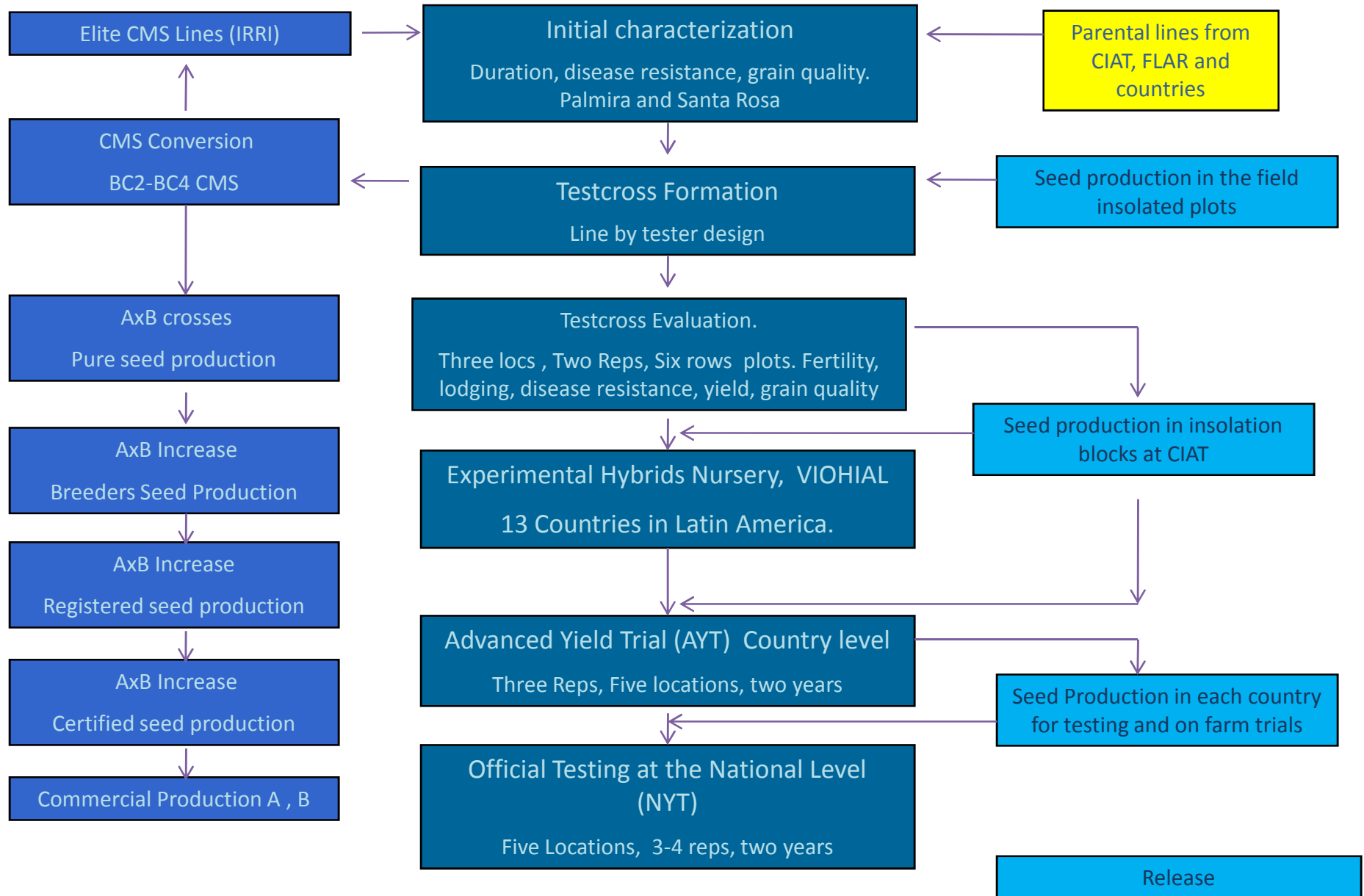
- Heterosis exploitation is an approach that can contribute to increase yield potential in Latin America.
- Hybrids are the ideal vehicle for technologies specially those related to weed control among other traits
- The region needs to learn and manage the use of hybrid rice technology
- Currently the CIAT Rice Program is working in hybrid rice focusing on the quality for the Latin American Market and the direct seeding system



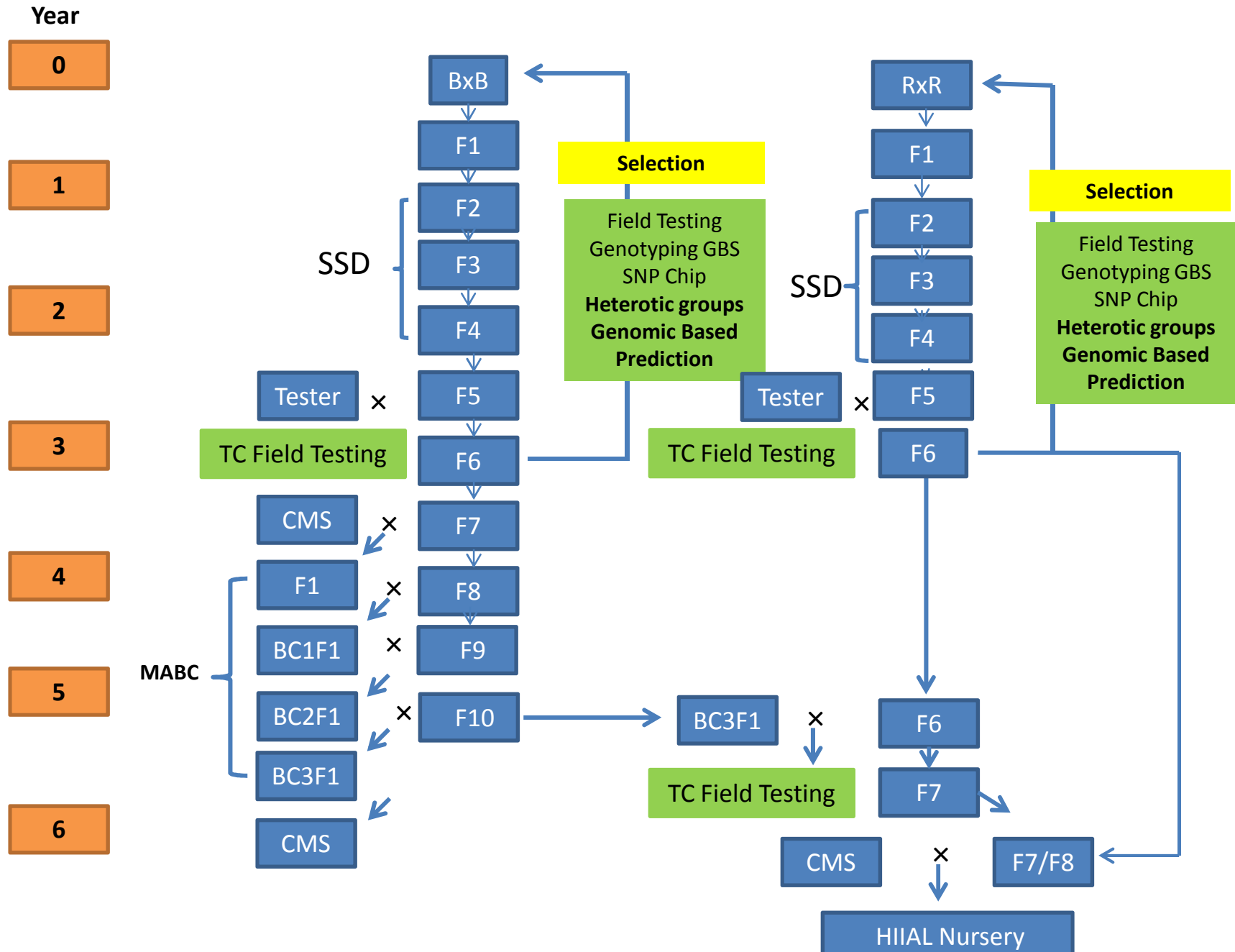
Important Steps on the Development of Hybrid Rice at CIAT

Season	Structure	Germplasm	Testcrosses	Current Situation
2008		Introduction of female lines from IRRI (5 CMS pairs)		Three CMS pairs being used with the CIAT FLAR germplasm
2009-A			96 (Manual)	2 female lines in BC4F1
2009-B			45 (Field)	2 Elite Hybrids for the Tropics 2 Elite Hybrids for the Southern Cone 5 female lines in BC5F1
2010-A	GRiSP Approved; Hybrid Rice for Latin America Product Line			Product line 2.5.3 Hybrid Rice for Latin America
2010-B	CIAT become a HRDC member		378 (Field)	62 Experimental Hybrids being evaluated in the countries... Viohial 012
2011-A		6 CMS pairs, 55 R Lines, 14 Hybrids		Three CMS pairs selected for further testing, R lines susceptible to blast and RHBV, Hybrids better yield but high chalkiness and low amilose
2011-B		2 CMS pairs	248 (Field)	One pair selected.... 37 parents for further testing....250 hybrids being produced for Viohial 013
2012-A	CIAT, FLAR and FLAR Partners created HIAAL			
2012-B	HIAAL Operative	44 F3-F4 R&B progenies	250 (Field)	Harvesting

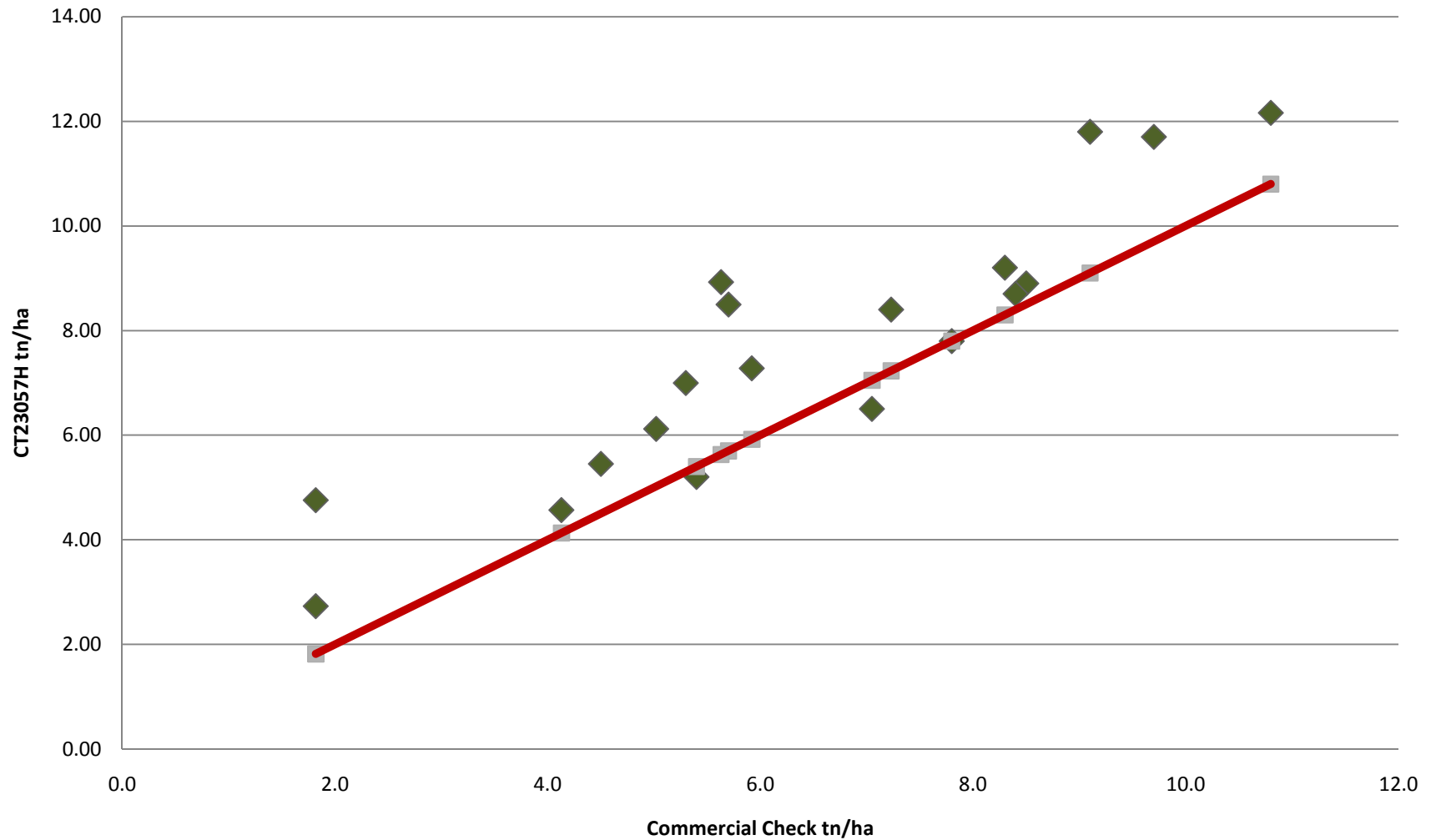
Initial Breeding Scheme



Proposed Breeding Scheme for the Hybrid Breeding at CIAT



**CT23057H 84% of the times won over the best commercial in
2 Seasons at 19 environments in Colombia and Central
America. Advantage (average) 1.24 tn/ha.**



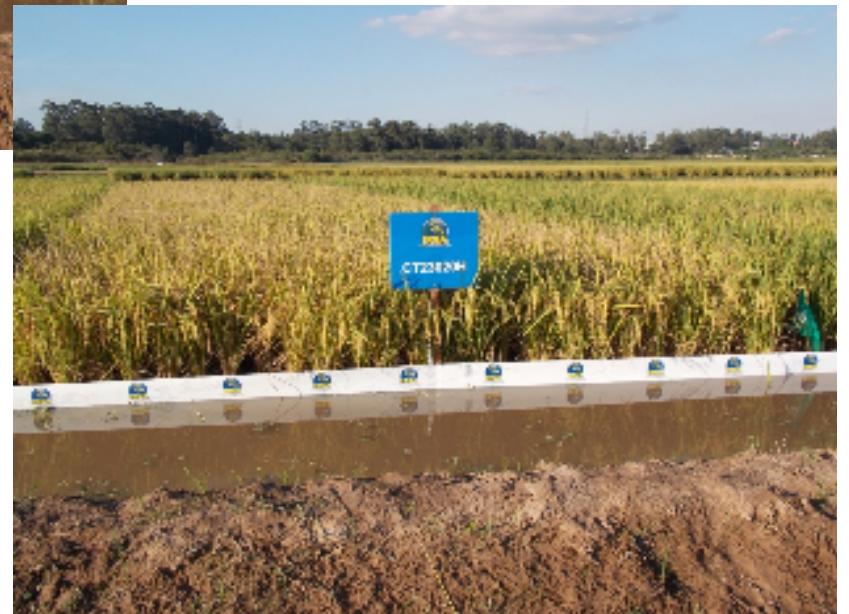
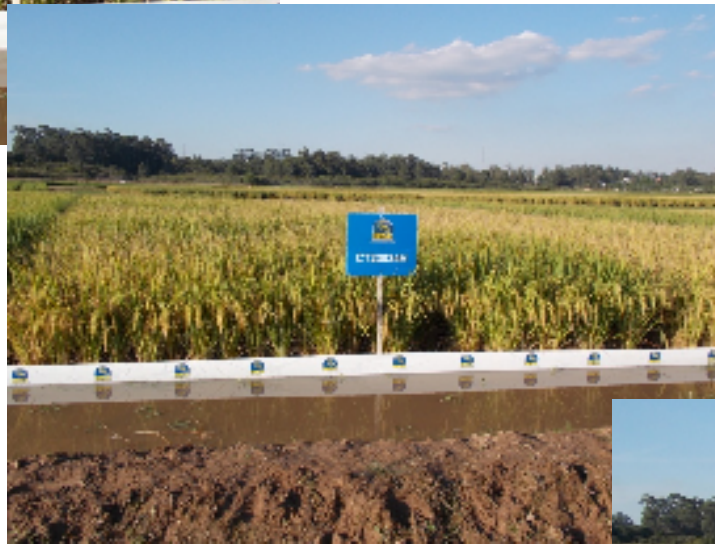
Elite Hybrids Disease Reaction in a Hot Spot for Blast, Santa Rosa 2012A.

PEDIGREE	VG	BL1	BL2	BL3	f150	LSC	BS	NBL	GD
CT 23057H	3	1	1	1	91	3	3	3	3
CT 23021 H	3	3	2	1	84	1	3	3	3
CT 22729 H	3	2	2	1	87	3	3	3	1
CT 23035 H	5	1	1	1	87	3	3	3	3
ORYZICA 1	3	7	7	4	98	1	3	5	5
FL 3174	3	4	5	2	90	5	5	7	5
Cica 8	3	5	5	4	106	3	1	3	3
Ceysvoni	5	6	7	5	81	1	5	5	3
Fanni	9	9	9	9	-	-	-	-	-
Oryzica 1	3	6	6	5	91	1	3	5	3
O. Llanos 5	3	3	3	1	104	3	3	3	5
O. Yacú 9	5	5	6	5	92	5	7	5	5
Fedearroz 733	3	3	3	2	89	1	3	3	3
Fedearroz 50	1	2	3	1	92	1	1	3	3
Fedearroz 60	3	2	2	2	92	1	1	3	3
F. Chicalá	3	2	2	2	89	1	6	3	3
Fedearroz 369	3	3	3	2	88	3	1	3	3
Improarroz 15-50	5	3	4	3	90	3	3	3	3
F. Mocarí	3	5	5	4	86	3	3	5	3

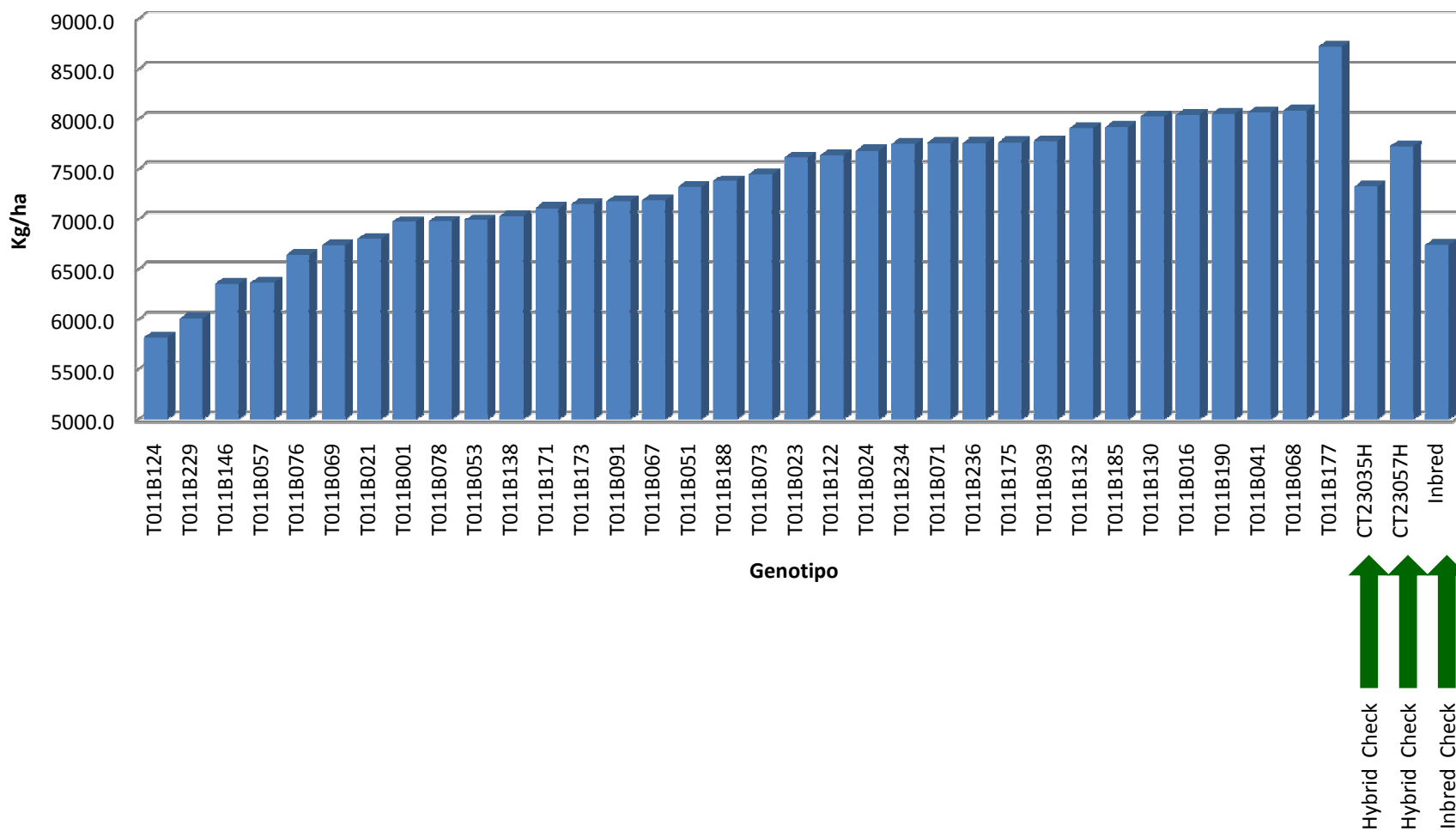
Grain Quality Elite Hybrids in Colombia. Saldaña y Santa Rosa 2012A.

Genotype	Milling W/T	Amilose (%)	White Belly (%)	Trial
CT23957H	59/67		3	AYT
CT23021H	57/68		2	AYT
CT23035H	58/67		5	AYT
Fedearroz 733	47/70		14	AYT
Fedearroz 60	40/68		4	AYT
Fedearroz 473	52/71		6	AYT
CT23057H	58/68		3	Strip Test
CT23021H	53/71		2	Strip Test
CT23035H	57/70		4	Strip Test
Fedearroz 733	58/70		3	Strip Test
Fedearroz 60	55/70		4	Strip Test
Fedearroz 473	57/69		3	Strip Test
CT23057H	60/70	31.0	0.8 (escale)	Santa Rosa
CT23057H	60/70	30.6	0.6	Santa Rosa
CT22729H	55/69	28.2	1.8	Santa Rosa
CT22729H	53/68	28.0	2.0	Santa Rosa
CT23021H	54/71	31.0	1.0	Santa Rosa
CT23021H	54/71	32.0	0.8	Santa Rosa
CT23035H	58/71	32.0	0.8	Santa Rosa
CT23035H	59/71	31.6	0.8	Santa Rosa

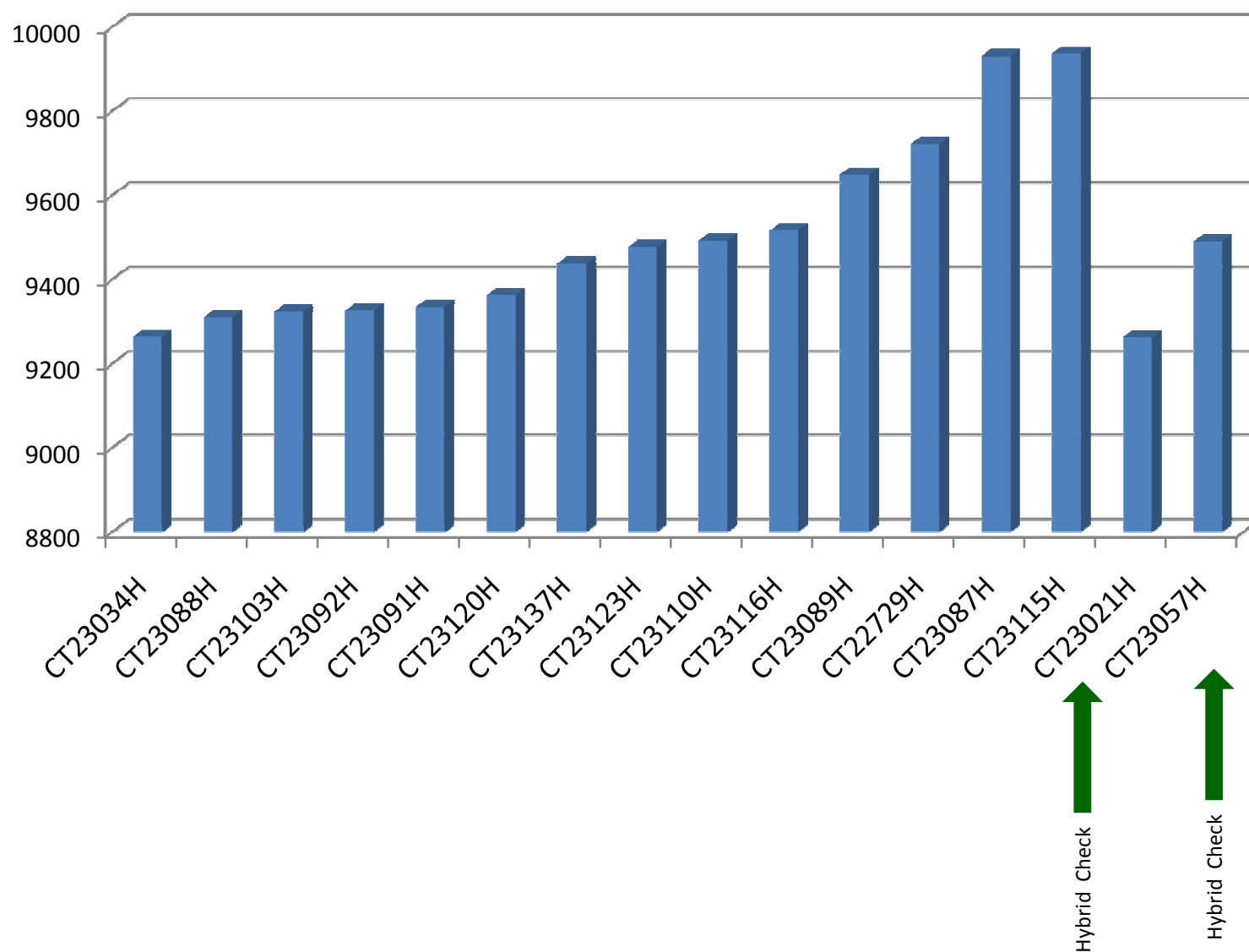
Elite hybrids being shown in IRGA's 2013 Field Day



Average Yield Kg ha⁻¹ of selected Testcrosses on nursery 2011B across three locations. Season 2012A.



Average yield (tn ha⁻¹) across two locations of selected experimental hybrids on VIOHIAL 2012 nursery. Season 2012A



Latin American Hybrid Rice Consortium

- ✓ Thirteen countries from Latin America
- ✓ A five years agreement
- ✓ Each member pays an annual contribution according with the size of the rice sector
- ✓ Each member contribute with elite germplasm
- ✓ Royalties system that rewards the owner of the parent used in the hybrid
- ✓ Products are:
 - Annual hybrid nursery
 - Seed for advanced testing
 - Seeds for parents if released
 - Training in hybrid rice breeding
 - Research on seed production



Conclusions

- ✓ A hybrid breeding program for Latin America have been established trough collaboration with IRRI under GRiSP
- ✓ A network with the 13 partners have been established this network will provide testing capacity, elite adapted germplasm and resources to do the research
- ✓ Interesting products have been developed already and the pipeline has new products coming