

Consuitative Group on International Agricultural Research



Hybrid Rice in Latin America A country report

Edgar A. Torres Breeder CIAT-Rice Program





Latin America:

Population: 577 millions

Area under cultivation: 5,2 Million has

Annual Consumption : 27 kg/person year

Central America& Caribean Imports: 2-2.3 mt tons

South America Imports: 1.1 mt

Rice is the staple food of poor people

Potential to become an important rice producer



Trends on Harvested Area, Rough Production and Yield in South America, 1960-2012.

Source: USDA-PSD

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





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

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. INOV better product for the southern cone.
- Irga began in 2003 in collaboration with Ana Paula Farm and Hunan Institute
- Bayer. Working in Brazil since 2009 in association with Irga and Ana Paula. Arize QM 1010



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

Seed Production

≻ Irga

.- AxB: Pairs 2,3 to 3,0 tn/ha

.-AxR: 1,0 to 1,5 tn/ha



Limitations to the adoption of hybrid rice technology

 Grain quality 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, there is not an important advantage on yield between the inbreds and the hybrids.

 Bigger contribution is the herbicide resistance 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 by EMBRAPA-CIRAD and Aceituno.
 Reciprocal Recurrent Selection that ensures the genetic gain and improvement of outcrossing capacity



Hybrid Rice Breeding at CIAT

- Heterosis exploitation is an approach that can contribute to increase yield potential in Latin America.
- Currently the CIAT Rice Program is working in hybrid rice focusing on the quality for the Latin American Market and the direct seeding system



Hybrid growing in Palmira.

Any advance on inbreds can be maximized by using them as parents for Hybrids

Historical Development of Hybrid Rice at CIAT

Year	Organization	Germplasm	Testcrosses	Current Situation
2008		Introduction of female lines from IRRI (5 CMS pairs)		3 females being used with the CIAT FLAR germplasm
2009-A			96 (Manual); tropical japonica	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 BC4F1
2010-A	GRiSP Approved; Hybrid Rice for Latin America Product Line			
2010-В	CIAT become a HRDC member		378 (Field)	62 Experimental Hybrids VIOHIAL ready to be distributed
2011-A		6 CMS pairs, 55 R Lines, 14 Hybrids		
2011-В		2 CMS pairs	248 (Field)	Planted in Pal, SR and Mont
2012-A	CIAT, FLAR and FLAR Partners created HIAAL			



CT23057H 86% of the times won over the best commercial check in 2 seasons at 15 environments in Argentina, Colombia and Central America.

Genotypes	Cachoeirinha	Cach. do Sul	Camaquã	Dom Pedrito	Santa Vitória	Uruguaiana			
Experimental 1	10.4 ^{bc}	14.9 ^{ab}	8.8 ^{ab}	10.6 ^{bc}	8.7 bcd	12.6 ^{abc}			
Experimental 2	10.2 ^{bcd}	15.6 ^{ab}	8.5 ^{abc}	10.2 ^{bc}	9.6 ^{ab}	13.6 ^{ab}			
Experimental 3	11.1 ^{ab}	16.6 ^a	8.7 ^{ab}	9.8 ^{bc}	10.5 ^a	15.0 ^a			
Commercial 1	10.9 ^{ab}	15.1 ^{ab}		13.2 ^a	9.6 ^{ab}	13.8 ^{ab}			
Commercial 2	9.8 ^{cd}	14.3 ^{bc}	7.2 ^c	9.9 ^{bc}	9.7 ^{ab}	12.3 ^{abc}			
Commercial 3	9.8 ^{cd}	12.2 ^d	8.3 ^{abc}	10.4 ^{bc}	7.5 ^{de}	12.0 ^{bc}			
Commercial 4	9.8 ^{cd}	14.5 ^{bc}	7.5 ^{bc}		8.8 ^{a-d}	13.1 ^{abc}			
Experimental 4	11.7 ^a	16.2 ^{ab}	9.5 ^a	11.1 ^b	9.6 ^{ab}	15.0ª			
Experimental 5	9.8 ^{cd}	16.7 ^a	8.4 ^{abc}	10.4 ^{bc}	9.5 ^{ab}	10.7 ^{cde}			
CT 23020H					9.2 ^{abc}	14.0 ^{ab}			
CT 23034H					7.6 ^{cd}	15.1 ^a			
BR-IRGA 410	9.4 ^{cd}	12.9 ^{cd}	7.5 ^{bc}	9.6 bc	8.0 bcd	13.2 ^{abc}			
IRGA 417(424)	9.5 ^{cd}	15.3 ^{ab}	7.5 ^{bc}	9.7 bc	8.1 bcd	10.8 ^{cd}			
IRGA 424	9.3 ^d	15.2 ^{ab}	7.8 ^{bc}	9.0 ^c	8.2 bcd	12.9 ^{abc}			
Means	10.2 ^c	14.9 [°]	8.3 ^d	10.5 ^c	8.5 ^d	12.0 ^b			
CV %	5,0	8,3	6,8	8,8	8,3	8,6			

Yield (t ha-¹) hybrid rice genotypes, Rio Grande do Sul, Season 2011/12. IRGA / EEA, Cachoeirinha 2012.

Data from Sergio Lopes-IRGA

Grain quality of hybrid rice genotypes in Rio Grande do Sul, season 2011/12. IRGA / EEA, Cachoeirinha 2012.

Canatura	SITE																			
Genotype	Cachoeirinha				Camaquã			Dom Pedrito			Sta. Vitória				Uruguaiana					
	СВ	ΤG	AMY	WG	СВ	ΤG	AMY	WG	СВ	ΤG	AMY	WG	СВ	TG	ΑΜΥ	WG	СВ	ΤG	ΑΜΥ	' WG
Experimental 1	0,7	A/B	29	58.9	1,1	Μ	29	64.1	0,6	Μ	29	48.4	1,2	В	30	52.2	1,5	Μ	30	64.7
Experimental 2	1,2	MA	27	64.6	1,4	B/A	30	64.2	1,0	A/B	25	58.7	1,9	В	27	63.0	1,6	Μ	28	66.7
Experimental 3	1,2	А	27	63.6	1,3	А	22	65.0	1,3	А	27	58.0	2,2	M/A	27	60.9	1,5	А	26	66.7
Commercial 1	1,2	M/A	24	59.8	•				1,3	A/B	24	56.9	2,0	В	27	60.9	2,0	B/M	26	65.1
Commercial 2	1,0	В	31	60.3	0,9	В	32	60.2	0,4	В	31	55.3	0,4	В	31	64.1	0,7	В	30	65.9
Commercial 3	0,3	BA	30	63.5	0,5	Μ	33	64.6	0,2	Μ	29	62.0	0,3	В	31	59.9	0,6	Μ	31	63.2
Commercial 4	1,4	A/B	27	57.3	1,3	Μ	29	58.4					1,2	Μ	27	61.7	1,2	В	30	61.2
Experimental 4	1,3	A/B	26	58.4	1,2	B/M	29	60.1	1,2	М	27	48.0	1,9	В	32	50.8	1,7	Μ	27	55.5
Experimental 5	1,9	В	30	57.2	1,9	В	32	59.7	1,1	В	29	50.9	1,0	В	30	57.9	2,3	В	29	57.0
CT 23057H					•					•			0,6	В	29	59.3	0,4	В	29	66.5
CT 23020H													0,4	В	30	63.3	0,6	В	31	65.5
CT 23034H													0,6	В	29	62.8	0,9	В	29	65.7
BR-IRGA 410	1,4	В	29	61.7	1,3	В	30	62.2	1,0	В	30	56.3	0,6	В	29	64.5	2,3	В	28	65.2
IRGA 417(424)	0,4	В	29	65.0	0,8	В	32	64.2	0,8	В	29	56.7	0,3	В	30	62.7	1,6	В	30	64.9
IRGA 424	0,4	В	30	64.7	0,8	В	32	62.0	0,6	В	30	59.4	0,2	В	29	61.5	1,4	В	29	66.4

Data from Sergio Lopes-IRGA

Strong collaboration with IRRI-HRDC

IRRI to CIAT

- ✓ .- Original females
- ✓ .- Five new CMS pairs received during 2011 and evaluated
- ✓ .- 57 R Lines
- ✓ .- 12 Experimental hybrids
- ✓ .- Two new CMS pairs

CIAT to IRRI

- ✓ .- 23 Elite Lines for testing... several for re-testing
- ✓ .- Two R lines
- ✓ .- 15 Experimental Hybrids
- \checkmark .- 165 new lines for testing.





Latin American Consortium -Products

- .- Two elites hybrids for the tropics
- .- Two elite hybrids for the temperate region
- .- 13 Countries in the Hybrid Rice Consortium for
- Latin America HIAAL
- .- VIOHIAAL Nursery with new 62 Hybrids ready to be distributed
- .- 260 testcrosses being evaluated in three locations
 .- New R lines and A&B pairs introduced from IRRI being characterized
- .- Six CIAT females lines in BC4 and testcross formation.
- .- Markers for restoring ability under study



Collaborators

- Antonio Folgiarini Rosso IRGA-Brazil
- Johana Dossman Aceituno-Colombia
- Pedro Blanco y Federico Molina-INIA Uruguay
- Alfredo Marin Inta Argentina