Rice unit

1977/CIAT

02E18 - 77
September 1978

Rice Unit
1977 Report

This publication is a reprint of the Rice Unit Section, 1977 CIAT Annual Report

Centro Internacional de Agricultura Tropical (CIAT)
Apartado Aéreo 6713, Cali, Colombia, S.A.

PERSONNEL OF THE RICE UNIT

(as of 31 December 1977)

CIAT General Direction

Senior staff

John L. Nickel, PhD, Director General

Alexander Grobman, PhD, Associate Director General, International Cooperation

Kenneth O. Rachie, PhD, Associate Director General, Research

Other professional staff

Cecilia Acosta, Administrative Assistant

Rice Unit

Senior staff

Manuel Rosero, PhD, IRRI Liaison Scientist (Acting Coordinator)

Peter Jennings, PhD, Regional Coordinator for Central America (stationed in San Jose, Costa Rica)

***Loyd Johnson**, MS, PE Agricultural Engineer

Hector Weeraratne, PhD, Plant Breeder

Research associates

***Rodrigo López**, Ing. Agr.

***Rafael Posada**, MS

Research assistants

Gustavo Benavides, Ing. Agr.

Marino Caicedo, Ing. Agr.

Luis García, Ing. Agr.

Camilo Jaramillo, Ing. Agr.

***Raúl Valderrutén**, MS

CONTENTS

INTERNATIONAL COOPERATION	D- 1
First International Rice Yield Nursery for Latin America (VIRAL-76)	D- 1
Nurseries from IRRI	D- 3
Second Conference on International Rice Testing Program for Latin America (IRTP)	D- 3
Distribution of Varieties and Promising Lines	D- 7
BREEDING	D-10
Earliness	D-10
Disease and Pest Resistance	D-10
Evaluation of Promising Materials	D-12
Mechanical Damage in Rice Paddies	D-14
TRAINING	D-15
Rice Production Courses	D-15
Intensive Courses	D-16
RICE TECHNOLOGY ADOPTION	D-17

Rice Unit

Rice is basic in the nutrition of the Latin American people, particularly in the lowland tropics where per capita consumption is above 50 kilograms.

While production has been increasing in some countries, in the majority, yields and productivity are still low and insufficient to meet the demand. Insufficiency is primarily due to the lack of appropriate varieties with tolerance to adverse climatic and soil conditions and with tolerance or resistance to pests and diseases. Moreover, the lack of properly trained technicians prevents the transference of farming technology to farmers in those regions where suitable varieties are available and where conditions are favorable for increased production.

In 1977, CIAT's Rice Unit continued to develop its projects in international cooperation, varietal improvement and training, to help fulfill the primary objective of contributing to increasing national yields per surface unit in Latin America.

International Cooperation

Results were compiled this year for the First International Rice Yield Nursery for Latin America (VIRAL-76). Additionally, the following International Rice Research Institute (IRRI) nurseries received in mid-1976 were evaluated at CIAT: two yield nurseries of early- and medium-maturing varieties; two for evaluation in upland conditions; one for sheath blight; one of floating varieties; and another for soil salinity and alkalinity problems. These nurseries were planted at CIAT between July and November 1976 and the material evaluated, the seed multiplied and the most promising varieties or lines for Latin America selected. Particular emphasis was placed on plant type, grain quality, resistance to *Sogatodes* and good yield.

FIRST INTERNATIONAL RICE YIELD NURSERY FOR LATIN AMERICA (VIRAL-76)

In 1976, the First International Rice Yield Nursery for Latin America (VIRAL-76) was formed with 24 varieties from Colombia, Costa Rica, the Dominican Republic, Ecuador, Guatemala, Mexico, Peru, the Philippines, Sri-Lanka and Surinam. Twenty-eight sets were distributed to 17 countries. Yields obtained in several countries are shown in Table 1. Some varieties in this nursery outyielded the local varieties, e.g., Juma 57 and 58 from the Dominican Republic, yielded more than the Peruvian local variety, INTI. Similarly, IR2863-38-1-2 from the

Table 1. **Yield of the varieties from the International Rice Yield Nursery (VIRAL-76) in several countries in Latin America.**

Variety	Country of origin	Countries and yield (t/ha)[1] Colombia	Costa Rica[2] (2)	Ecuador	Guyana	México[3] (3)		Peru	Venezuela[4] (4)
CICA 4	Colombia	3.3	4.5	6.1	2.9	6.4	1.7	8.1	5.4
CICA 6	Colombia	3.9	5.3	5.5	2.7	6.7	2.5	7.2	4.8
CICA 7	Colombia	3.1	4.5	5.6	3.0	5.1	2.6	7.5	4.3
CICA 9	Colombia	4.6	5.3	6.8	2.8	5.5	2.6	8.8	5.0
P918-25-1-4-2-3-1B	Colombia	4.9	3.5	6.2	2.8	9.7	3.3	8.1	5.8
P918-25-15-2-3-2-1B	Colombia	4.6	3.4	6.1	2.9	9.5	3.6	7.7	6.4
CR 1113	Costa Rica	4.3	4.0	5.7	3.1	6.6	2.2	8.7	6.1
Juma 57	Dom. Republic	3.8	-(5)	6.9	1.8	-	2.6	9.4	5.6
Juma 58	Dom. Republic	2.5	-	6.1	-	-	3.0	9.4	7.2
118	Ecuador	4.5	3.6	6.3	2.1	4.9	2.8	7.2	5.2
Tikal	Guatemala	4.9	4.9	3.7	2.9	4.1	2.6	8.4	5.2
N (IR1055)	Guyana	3.9	-	-	4.3	8.6	-	7.0	-
77916(GR22-10-6-10)	Guyana	3.7	-	-	4.6	6.6	-	6.2	-
Macuspana A 75	Mexico	-	2.5	3.2	2.9	4.5	2.9	5.7	3.9
Bamoa A 75	Mexico	-	4.1	5.4	3.8	7.2	2.8	8.2	5.3
Inti	Peru	3.0	3.1	5.9	3.5	7.2	2.7	8.4	6.1
IR2058-78-1-3-2-3	IRRI	3.5	-	-	-	8.4	-	-	-
IR2823-399-5-6	IRRI	4.1	-	-	-	-	-	-	-
IR2863-38-1-2	IRRI	4.3	-	-	-	10.8	-	-	-
IR1529-430-3	IRRI	4.4	-	-	-	-	-	-	-
Bg 90-2	Sri Lanka	4.4	2.6	5.1	4.6	1.0	2.0	9.0	6.0
Ciwini SML	Surinam	4.3	3.3	5.2	3.1	1.9	2.2	6.9	3.4
Camponi SML	Surinam	4.6	5.6	4.1	3.7	-	2.0	6.8	5.1
Ceysvoni SML	Surinam	4.3	3.8	4.2	3.5	-	2.3	6.3	4.2

1 Under irrigated conditions, except in Costa Rica and in two sites in Mexico.
2 Under upland conditions with good rainfall distribution.

IRRI and the two lines from the cooperative Instituto Colombiano Agropecuario (ICA)-CIAT project from Colombia (P918-25-1-4-2-3-1B and P918-25-15-2-3-2-1B) yielded 2 to 3 t/ha more than Bamoa A75 and 4 t/ha more than Macuspana A75 in Mexico.

NURSERIES FROM IRRI

In 1977 IRRI nurseries received in mid-1976 were evaluated at CIAT. The International Rice Yield Nursery for Latin America for Early-maturing Varieties (VIRAL-P) contained 10 varieties with good grain quality and yield potential; yields fluctuated between 6.5 and 8.6 t/ha. Under CIAT conditions (1000 meters asl and 24ºC) maturity varied between 121 and 129 days. At lower altitudes, time to maturity would be reduced by 10 to 15 days (Table 2). In the nursery of medium-maturing varieties (VIRAL-T) 14 lines or varieties were included with yields that fluctuated between 6.5 and 9.9 t/ha; time to maturity was 130 to 143 days (Table 3). The nursery for deep-water varieties (VIRAL-F), initially had 50 lines of which 10 were selected by the CIAT Rice Unit for plant type, grain quality and tolerance to deep waters (80 cm) and were distributed to the countries which solicited this material. This nursery was also planted at CIAT in early 1977 to multiply seed and determine potential yields of the entries under normal irrigation conditions. Table 4 shows the principal characteristics and yields of entries in VIRAL-F. In the International Sheath Blight Tolerance Nursery (VIAVAL), some lines were discarded due to unacceptable grain type, late maturity or susceptibility to lodging. From this, a small nursery more appropriate for Latin America was distributed. However, no material was eliminated from an International Observational Nursery for Salinity (VIOSAL) since only a few lines were included for specific countries.

The upland nurseries, composed of 200 lines or varieties, were planted at CIAT under upland conditions. (A drought lasted from December 1976 through February 1977). Several lines showed drought tolerance in the vegetative and reproductive stages. However, a low tolerance to iron deficiency was found in the majority of the lines, which interfered with the reliability of yield data. Fourteen varieties tolerant to drought and iron deficiency were selected —seven with medium size grains, three with short grains, and four with long grains. With this material, the International Rice Upland Yield Nursery (VIRAL-S) was formed and distributed.

Table 5 shows the nurseries and the number of sets dispatched to Latin American countries in 1977.

SECOND CONFERENCE ON INTERNATIONAL RICE TESTING PROGRAM FOR LATIN AMERICA (IRTP)

This year, the second conference on the International Rice Testing Program for Latin America was conducted at CIAT on November 4-5. Leaders and other professionals of national rice programs attended the conference whose purpose was to strengthen international cooperation within the IRTP; correct procedural problems; define the need for more nurseries; interchange ideas on current rice problems; and develop a schedule of activities to more rapidly disseminate the IRTP results to the farmers. Table 6 shows the number of participating delegates from each country represented.

When delegates were asked if they preferred to receive the nurseries directly from IRRI or after evaluation and further selection by CIAT, all the delegates except those from Mexico and Costa Rica requested the nurseries from CIAT. Mexico requested nurseries from both IRRI and CIAT and Costa Rica requested the observation nurseries directly from IRRI, and the yield nurseries from CIAT. The

Table 2. **Principal characteristics of the germplasm in the 1977 International Yield Nursery for Early-maturing Varieties for Latin America (VIRAL-P) observed at CIAT.**[1]

		Agronomy		Diseases[2]			Insects[2]	Quality		
Identification	Country of origin	Height (cm)	Maturation (days)	Blast	Bacterial Blight	Sheath Blight	Sogatodes	Grain Length[3]	Gelatinization Temperature[4]	Yield (t/ha)
BR51-46-1-Cl IR20/IR5-114-3-1	B'desh	107	129	7	3	1	4	5	I	8.0
IET2881(RP319-34-9-1-3 T141/IR661-1-175-3	India	86	123	9	5	3	4	3	IL	8.1
IET3262(RP633-95-8-1 IR8/PJ1-43/IR22	India	91	125	8	3	2	7	3	I	8.5
IET3127(RP6-516-31-4) TKM6/IR8	India	85	122	8	5	2	7	3	L	7.2
B541B-Pn-58-5-31 Pelita I-1/IP1108-2	Indonesia	103	128	7	2	2	3	3	I	8.6
IR2070-414-3-9(IR40) IR20*2/0.nivara//CP94-13	IRRI	96	125	4	4	2	6	5	I	7.3
IR2071-625-1-252(IR36) IR1561-228//IR24*4/0.n.///CR94-13	IRRI	80	124	2	6	3	3	3	I	7.7
IR2307-84-2-1-2 CR94-13/IR1561-228	IRRI	89	127	4	4	2	3	3	L	6.5
IR1561-228-3-3(check) IR8/Tadukan//TKM6*2/TN1	IRRI	83	121	7	5	2	8	3	L	8.0
CICA 7	Colombia	99	125	3	3	2	4	3	L	8.0

1 Average of two semesters
2 International resistance scale of 1-9: 1-2.9 = resistant; 3.0-3.9 = moderately resistant; 4.0-5.9 = moderately susceptible or intermediate, 6.0-9.0 = susceptible.
3 Scale for length of grain: 3 = long grain (6.61-7.50mm); 5 = medium length grain (5.51-6.60mm)
4 Gelatinization temperature scale: I = intermediate; L = low.

observed at CIAT.[1]

Identification	Country of origin	Agronomy: Height (cm)	Agronomy: Maturation (days)	Diseases[2]: Blast	Diseases[2]: Bacterial Blight	Diseases[2]: Sheath Blight	Insects[2]: Sogatodes	Quality: Grain Length[3]	Quality: Gelatinization Temperature[4]	Yield (t/ha)
BR51-46-5 IR20/IR5-114-3-1	B'desh	122	134	8	4	3	4	5	I	7.8
BR51-74-6 IR20/IR5-114-3-1	B'desh	120	133	8	4	3	4	5	IL	6.8
BR 4 (BR51-91-6) IR20/IR5-114-31	B'desh	129	137	8	3	3	3	5	I	7.5
IET1785(RP84-39-1)	India	95	132	9	6	4	4	3	L	7.2
B541b-Kn-58-5-3 Pelita 1/1/IR532E576-4	Indon.	110	130	8	4	3	4	3	I	7.0
B542b-Pn-9-2-2 Pelita 1/1/IR532E576-4	Indon.	117	134	9	3	2	6	3	I	9.9
IR2070-423-2-5-6(IR38) IR20*2/0.n//CR94-13	IRRI	91	134	4	5	3	3	3	IL	7.3
IR2071-586-5-6-3(IR42) IR1561-228/IR24*6/0.n//CR94-13	IRRI	103	143	0	3	3	8	5	L	7.9
IR2323-399-5-6 CR94-13/IR1529-680///IR24*3/0.n//IR14-16	IRRI	103	137	2	4	4	4	3	IL	7.1
IR2863-38-1-2 IR1529-680-3/CR94-13//IR480-5-9-3	IRRI	88	136	4	4	3	3	3	L	6.5
Bg 374-1 (75-311) Bg 66-1/IR20	Sri-Lanka	103	132	8	3	2	3	3	I	8.2
Bg 375-1 (75-404)	Sri-Lanka	98	132	8	3	2	3	3	I	9.1
IR2588-19-19-1-2-2 IR1544-238/IR1529-680-3	IRRI	92	139	4	2	2	3	3	L	8.5
Taichung Sen-yu 195 Bin-tang-Chien/IR661	Taiwan	89	132	6	4	3	3	3	L	8.1
CICA 9	Colombia	110	133	4	3	3	3	3	L	8.0

[1] Average of two semesters
[2] International resistance scale of 1-9: 1-2.9 = resistant; 3.0-3.9 = moderately resistant, 4.0-5.9 = moderately susceptible or intermediate; 6.0-9.0 = susceptible
[3] Scale for length of grain: 3 = long grain (6.61-7.50mm); 5 = medium length grain (5.51-6.60mm)
[4] Gelatinization temperature scale: I = intermediate; L = low.

Table 4. **Results of promising rice lines with the characteristics of floating rice under normal irrigated conditions at CIAT.**

Identification	Country of Origin	Days to Flowering	Height (cm)	Lodging %	Yield (t/ha)
BKN 6986-147-2 IR 262/Pin Gaew 56	Thailand	168	112	10	6.7
BKN 6986-81 IR 262/Pin Gaew 56	Thailand	156	150	85	4.4
BKN 6986-20 IR 262/Pin Gaew 56	Thailand	146	111	0	6.5
BKN 6987-105-4 IR 262/Khao Nahng Nuey 11	Thailand	128	109	0	8.9
BKN 6990-63 IR 262/TPG 161	Thailand	129	172	100	5.4
C 4-63	Philippines	119	115	0	6.9
R D 1	Thailand	123	113	0	6.4
BKN 6987-118-3-P IR 262/Khao Nahng Nuey 11	Thailand	123	107	0	8.2
BKN 6981-133-2-P IR 262/Khao Nahng Nuey 11	Thailand	126	111	0	5.8
BKN 6987-233-2-P IR262/Khao Nahng Nuey 11	Thailand	125	107	0	8.7

Table 5. **Number of nurseries from the International Rice Testing Program for Latin America distributed in 1977.**

	No. of nurseries[1]						
Country	VIRAL-P	VIRAL-T	VIRAL-S	VIRAL-F	VIAVAL	VIOSAL	Total
Argentina	1	1			1		3
Bolivia	1	1	2				4
Brazil	5	5	3	1	2		16
Colombia	1	1	1				3
Costa Rica	1	1	1				3
Ecuador	2	2	1	1	1	1	8
El Salvador	1	1	1				3
Guatemala	1	1	2				4
Guyana	1	1	1	1	1	1	6
Honduras	2	2	2				6
Jamaica				1			1
Mexico	4	4	2				10
Nicaragua	2	2					4
Panama	2	2	2				6
Paraguay			1				1

continued on page -7

Table 5. (continued)

Country	No. of nurseries[1]						
	VIRAL-P	VIRAL-T	VIRAL-S	VIRAL-F	VIAVAL	VIOSAL	Total
Peru			2		2	1	5
Dom. Republic	1	1	1	1	1	1	6
Surinam	1	1			1		3
Venezuela	2	2					4
Total	28	28	22	5	9	4	96

[1] VIRAL International Rice Yield Nursery for Latin America
-P Early maturing varieties
-T Medium maturing varieties
-S Upland rice varieties
-F Floating varieties
VIAVAL International Sheath Blight Tolerance Nursery for Latin America.
VIOSAL International Rice Salinity Observational Nursery for Latin America.

Table 6. **Number of delegates who participated in the second conference on the International Rice Testing Program for Latin America for 1977**

Countries	No. of Delegates
Argentina	1
Belize	1
Bolivia	2
Brazil	3
Colombia	6
Costa Rica	2
Dom. Republic	1
Ecuador	2
El Salvador	1
Guatemala	1
Guyana	1
Honduras	2
Mexico	3
Panama	3
Paraguay	1
Surinam	2
Venezuela	2
Uruguay	1
Philippines (IRRI)	3
Total	38

delegates from Brazil and Uruguay stated that they would request directly from IRRI the following specific nurseries: for resistance to low temperatures, drought, and aluminum toxicity.

The following nurseries were of interest to the delegates of several countries: yield nurseries of early- and medium-maturing varieties for upland and irrigated conditions; observational nurseries of early- and medium-maturing varieties for upland and irrigated conditions; rice blast and sheath blight nurseries; and nurseries for salinity, low temperatures and deep water. There was also a consensus of a need for future nurseries on brown leaf spot *(Helminthosporium oryzae)* and leaf scald *(Rhynchosporium oryzae)* and soil problems such as aluminum toxicity and alkalinity. Table 7 shows the types of nurseries established for 1978 and the number of sets requested.

DISTRIBUTION OF VARIETIES AND PROMISING LINES

The CIAT Rice Unit collaborated with institutions of several countries by sending seed of varieties and promising lines. Table 8 shows the quantity of seed from varieties and promising lines dispatched in 1977.

Table 7. **International Rice Testing Program for Latin America planned for 1978.**

IRTP Nurseries	Type[1]	Argentina	Belize	Bolivia	Brazil	Colombia	Costa Rica	Cuba	Ecuador	El Salvador	Guatemala	Guyana	Honduras	Mexico	Nicaragua	Panama	Paraguay	Peru	Dom. Republic	Surinam	Uruguay	Venezuela	Total
	VIRAL-P	1	1	1	6	2	1	1	1	1	1	1	2	3	1	2	1	1	1	1	1	2	32
Yield	VIRAL-T Temparano	1			4	3	1	1	1	1	1	1	2		1	2	1	1	1			2	24
	VIRAL-S		1	2	2	2	1		1	1	1	1	2	6	1	2	1	2				2	28
Observational	VIOAL Riego	1	2		3			1				1	2		1	1		1				2	15
	VIOAL Secano		2	2	5		1				1	1	2	6		2		1				2	25
Diseases	VIPAL		2	1	6	1	2	1	1	1	1	1	2	6	1	1		1	2		1	2	33
	VIAVAL				1		2	1	1			1			1	1		1				2	11
Environmental and Soil Problems	VIOSAL				1			1	1			1		1				1	1				7
	Low Temperatures Nursery				2			1										1			1		5
	VIRAL-F				1	2	1		1			1											6
TOTAL		3	8	6	31	10	9	7	7	4	5	9	12	22	6	11	3	10	5	1	3	14	186

VIRAL-P International Rice Yield Nursery for Latin America - Early-maturing varieties.
VIRAL-T - International Rice Yield Nursery for Latin America - Medium-maturing varieties.
VIRAL-S International Rice Yield Upland Nursery for Latin America
VIOAL International Rice Observational Nursery for L.A.
VIPAL International Rice Blast Nursery for Latin America
VIAVAL International Sheath Blight Tolerance Nursery for Latin America
VIOSAL International Rice Salinity Observational Nursery for Latin America
International Rice Observational Nursery for Low Temperatures in Latin America
VIRAL-F International Yield Nursery for Floating Varieties for Latin America.

Country	Varieties and lines distributed (kg)													
	CICA 4	CICA 6	CICA 7	CICA 9	IR 8	IR 22	Line 4422	Line 4420	Line 4444	Line 4462	Line 4440	Colombia[1]	ICA 10	Bluebonnet 50
Argentina	0.2	0.2	0.2	0.2										
Australia		0.1	0.1	0.1										
Germ. Fed. Rep.	1.0	1.0	1.0	1.0	1.0	1.0								
Brazil	3.0	1.0	51.0	51.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5
Bolivia			150.0	200.0					100.0		200.0			
Belgium		1.0												
Costa Rica											50.0			
Colombia				2.0							100.0			
Ecuador											10.0			
France			0.2	0.2										
Philippines			0.4	0.4					0.4		0.4			0.4
Guyana			50.0	50.0							50.0			
Kenya			0.1	0.1							0.1			
Liberia		0.02	0.02	0.02					0.02		0.02			
Mexico			1.0	1.0							1.0			
Nicaragua											50.0			
Panama											50.0			
Peru		5.0	7.0	57.0					2.0		57.0			
Venezuela				50.0							80.0			
Uruguay				1.0										
Total	4.20	5.32	211.52	414.02	1.5	2.0	1.0	1.0	103.42	1.0	658.52	1.0	0.5	0.9

Breeding

This year ICA and CIAT continued breeding rice varieties with high yields for production stability, reduced dependency on agricultural inputs and to overcome major production constraints such as rice blast *(Pyricularia oryzae)*, hoja blanca virus, the leaf-hopper *(Sogatodes oryzicola)* and minor constraints such as sheath blight *(Corticum sasakii)* and salinity.

EARLINESS

The fermers in the important Colombian rice zones of Tolima and on the North Coast prefer rice varieties which are early-maturing (100-110 days). Four early-maturing varieties—IR36, 74-5461 (blast resistant Bg 34-8), CICA 7 and IR22—were combined in 13 different simple crosses for early maturity with blast resistance from Tetep, Colombia 1 and C46-15. The simple crosses were subsequently top crossed and intercrossed to produce eight triple and five double crosses. The F_2 population of these crosses will be evaluated for earliness at the ICA Nataima and Turipana stations, in Tolima and the North Coast rice growing zones, respectively.

DISEASE AND PEST RESISTANCE

Resistance to Rice Blast

Selection for resistance to rice blast, *P. oryzae*, is one of the basic objectives of the breeding program. The achievement of stable resistance to rice blast is being pursued through multiple resistance and multiline approaches.

Multiple Resistance. Some 36,000 F_2 progeny were selected from multiple crosses with 10 improved parent lines carrying resistance factors from Tetep, Colombia 1, Dissi Hatiff, C46-15 and Carreon. The F_3 progeny combining resistance factors from three or four sources were evaluated in single row progeny trials. Some 11,000 selections combining resistance to blast, the plant hopper *(Sogatodes)*, acceptable grain quality and good plant type were derived from the promising F_3 progenies. All 11,000 selections were planted as F_4 progenies at Villavicencio and exposed to natural neck blast infection. Of 3,400 F_4 progenies that matured during the year, 330 promising lines were selected and planted at the ICA-Palmira station in unreplicated plots for yield evaluation; 1,000 selections were advanced to F_5 progenies.

Multiline Varieties. The third and final backcross for a five component multiline with five sources of resistance (Tetep, Colombia 1, Carreon, Dissi Hatiff, and C46-15) and two recurrent parents (4414, and CICA 9) was completed and their respective B_1F_3 populations were planted.

With the third backcross, the recurrent parent phenotype was fully recaptured as evidenced by the uniformity of the lines. The B_3F_1 populations were intercrossed to combine resistance factors from three different sources (Tetep with two others) as shown in Table 9 to develop a multiple resistant multiline.

Table .9. Crossing combinations with different resistance sources for rice blast.

1.	Tetep x (Carreon x Colombia 1)
2.	Tetep x (Carreon x Dissi Hatiff)
3.	Tetep x (Carreon x C46-15)
4.	Tetep x (Colombia[1] x Dissi Hatiff)
5.	Tetep x (Colombia[1] x C-46-15)
6.	Tetep x (Dissi Hatiff x C46-15)

Table 10. **Sources of resistance to blast from geographically diverse origins.**

Recurrent Parents	Sources of Resistance	Country of Origin
4440	Tetep	Vietnam
4414	Tapoo-cho-z	China
4468	Ca 902/b/3/3	Chad
CICA 4	P.I. 184675-2	Iran
CICA 9	Colombia 1	Colombia
Linea 8	S.M.L. 56/7	Surinam
Bg 90-2	Ramind Str 3	Thailand

In addition, an expanded multiline project was initiated with seven different recurrent parents and seven different sources of resistance from geographically diverse origins (Table 10). The first backcross to each of the recurrent parents was completed this year.

Five new, widely adapted, high-yielding varieties with good combining ability and resistance to several production constraints were incorporated as parents into the breeding program. Table 11 lists the parents and their desirable characteristics. The five parents were crossed in 152 triple cross combinations to combine factors for blast resistance from two different sources.

Tolerance to Sheath Blight

Presently, only tolerance has been found to sheath blight *(C. sasakii)*. Of the three tolerant varieties selected — Bahagia, Tapoo-cho-z and K8 — Bahagia and Tapoo-cho-z have been widely used in multiple crosses as tolerant sources to sheath blight. Crosses were made between the three tolerant varieties Bahagia x Tapoo-cho-z; Bahagia x K8; and K8 x Tapoo-cho-z such that each combination would have tolerance factors from the two parents. Each single cross was top-crossed to CICA 4, CICA 7, CICA 9 and 4440. The F_2 progenies will be observed under field conditions and evaluated. CICA 4, CICA 7, CICA 9 and 4440 were also crossed and backcrossed to each of the three donors for upgrading the recurrent parents with tolerance to sheath blight. Rapid seedling screening techniques for tolerant materials have not yet been developed.

Resistance to Bacterial Leaf Blight

Eleven varieties resistant to bacterial leaf blight in Asia were inoculated using isolates of *Xanthomonas oryzae* obtained in Latin America. From varietal reactions presented in Table 12, it appears that the isolates from Latin America behave similarly to those obtained in Asia.

Table 11. **Desirable traits of five parents incorporated into the CIAT/ICA breeding program in 1977.**

Parent	Plant Type	Reaction[1]				
		Bacterial Blight	Sheath Blight	Salinity	Phosphate Deficiency	Low Temperature
Remajda	Tall	HR	S	S	S	T
Bahagia	Intermediate	T	T	S	S	S
Pelita I/1	Intermediate	MR	S	HR	T	S
Bg 66-1	Dwarf	HR	S	S	S	S
Bg 90-2	Dwarf	R	S	S	S	T

Resistance scale: HR= highly resistant; MR = moderately resistant, T = tolerant, S = susceptible.

Table 12. **Reaction of several varieties to bacterial leaf blight (*Xanthomonas oryzae*).**

	Reaction[1]	
Variety	Colombia	Asia
Remajda	HR	HR
Pelita I/I	R	R
Tadudakan	R	R
Bg 90-2	R	R
Bg 66-1	R	R
Bg 97-2	MR	R/MR
Bg 97-3	R	R
K 8 (mutant)	MR	MR
IR 22	R	R
IR 2035-290	MR	R/MR
IR 8	SS	SS
Bluebonnet 50	SS	SS

Resistance scale: HR = Highly resistant; R = Resistant; MR = Moderately resistant, SS = Highly susceptible.

Some 832 advanced lines selected at the ICA-Palmira station from F_2 and F_4 populations (brought from Sri-Lanka) were tested under greenhouse conditions for resistance to bacterial leaf blight. Fifty-nine percent were resistant; 20 percent tolerant; and 21 percent, susceptible.

Identification of Genes for Resistance to Plant Hopper

There is a possibility of a physiological specialization of *Sogatodes* and therefore, the identification of resistant genes should be undertaken. Ten different resistant varieties are currently being researched to identify their corresponding genes.

EVALUATION OF PROMISING MATERIALS

Advanced Lines and Segregating Populations from Sri-Lanka

A total of 934 advanced lines (in the F_5 and F_6 generations) derived from 22 different crosses brought from Sri-Lanka were evaluated and 44 were selected as promising. These were tested for yield potential in two experiments both using CICA 9 as the control. Table 13 shows the results of the best eight lines in each trial.

Bulk F_4 populations from eight multiple crosses brought from Sri-Lanka (Table 14) were evaluated. From this material, 768 individual selections were made and evaluated in progeny row trials in the F_5 generation. Of these, 90 promising lines were selected for high yield potential, acceptable grain quality, plant type and resistance to hoja blanca and bacterial leaf blight and plant hopper.

Four F_2 populations from Sri-Lanka were observed and of this material 166 F_3 selections were evaluated in progeny row trials. Some 30 promising lines were obtained.

Evaluation of Introductions

Some 461 advanced lines from IRRI and Indonesia were evaluated and three lines were found to have a resistance factor for rice blast derived from the wild rice, *Oryza nivara*. These lines will be used as parents in the breeding program.

Purification and Multiplication of Line 4440

Line 4440 originated from a cross between CICA 4 and F_1 (IR665-23-3-1 x Tetep) and was selected as a pure line, with the geneology P918-25-1-4-2-3-1B. Along with CICA 7 and CICA 9, it was included in the 1976 regional trials, and the First International Yield Nursery for Latin America.

Segregation for grain type, plant height and maturity was observed in a seed multiplication lot with 4440 at CIAT. From this lot, 1600 plants were selected for purification, which were evaluated for

Table 13. **Performance of the 16 advanced lines from 22 crosses brought from Sri-Lanka.**

Lines	Crosses	Yield (t/ha)	% of Control
Trial 1			
1170	Bg 90-2 x [IR 1541 x ob678]	8.5	125
1156	Bg 90-2 x [IR 1541 x ob673]	7.8	115
1279	Bg 90-2 x [IR 1541 x ob 678]	7.7	113
1313	Pelita I/I x [IR 1702 x IR 1529]	7.6	111
1394	Pelita I/I x [IR 1702 x IR 1529]	7.5	110
1188	Bg 90-2 x [IR 1541 x ob678]	7.5	110
1348	Pelita I/I x [IR 1702 x IR 1529]	7.4	109
1332	Pelita I/I x [IR 1702 x IR 1529]	7.3	106
Trial 2			
Bg 90-2	IR 262 x Remajda	9.3	129
1724	Pelita I/I x [ob678 x T.K.M-6]	9.3	128
1884	IR 22 x Bg 90-2	8.5	117
1843	[IR8 x T.K.M-6] x [IR665 x Bg90-2]	7.8	108
1883	IR 22 x Bg 90-2	7.7	107
1893	IR 22 x Bg 90-2	7.7	107
1895	Bg 66-1 x IR 20	7.7	107
1854	[IR8 x T.K.M-6] x [Bg66-1 x IR22]	7.7	107

grain quality and maturity. Ten improved plants were selected to continue evaluation and seed multiplication in individually seeded 200 m² plots with three replications, transplanting one seedling/site at a distance of 50 x 50 centimeters. Tables 15 and 16 present the principal agronomic characteristics and grain quality of these 10 selections. From these observations, it was decided to continue multiplication of basic seed from selections 1 and 10, transplanted in 4.5 hectares. In early 1978, one of these will be named as a variety in Colombia by the ICA Rice Program. Additionally, one kilogram of seed/selection was delivered to the heads of national rice programs who attended the second conference of the Internation Rice Testing Program for Latin America.

Table 14. **Eight multiple crosses brought from Sri-Lanka.**

IR 2042-101	x	[IR 262 x Pelita I/I]
IR 2035-290	x	[Bg 90-2 x Pelita I/I]
IR 2035-290	x	[IR 262 x Pelita I/I]
IR 2035-290	x	[IR 1529 x Pelita I/I]
Pelita I/I	x	[IR 26 x ob678]
73-797	x	[Bkn 6809 x IR 1529]
73-669	x	[Bkn 6809 x IR 1529]
IR 262	x	[Bkn 6809 x IR 1529]

Table 15. **Principal agronomic characteristics of 10 selections from Line 4440 at CIAT.**[1]

Selection	Days to Flowering	Days to Maturity	Height (cm)	Reaction[2] Sogatodes	Reaction[2] Blast	Yield (t/ha)
1	106	143	96	2	1	7.8
2	106	144	96	2	1	7.4
3	111	146	99	3	1	7.7
4	112	147	96	2	1	7.4
5	114	148	99	3	1	7.8
6	107	145	98	3	1	7.6
7	106	143	96	2	1	7.1
8	108	145	98	2	1	7.9
9	110	142	97	2	1	7.1
10	109	146	98	2	1	7.6

1 Average of three replications.
2 According to the international resistance scale of 1-9: 1-2.9 = resistant; 2.9-3.9 = moderately resistant; 4.0-5.9 = moderately susceptible or intermediate; 6.0-9.0 = susceptible.

MECHANICAL DAMAGE IN RICE PADDIES

A duck, *Porphyla martinica,* has caused lodging and impeded the flowering of rice plants where these birds make their nests. In late 1976, when the rice planting area at CIAT was reduced, the population of *P. martinica* concentrated in a one hectare plot planted with 4440, where it

Table 16. **Grain quality of 10 selections of Line 4440 at CIAT.**

Selection No.	% Total Yield of White Rice[1]	% Head Rice[2]	Grain Length (mm)	White Center[3]	Gelatinization Temperature[4]
1	71.8	59.9	6.9	0.6	I,L
2	71.3	58.8	6.9	0.7	I
3	70.8	58.3	6.9	0.8	I
4	70.9	58.0	6.9	0.7	I
5	71.4	59.4	6.8	0.7	I
6	70.5	52.9	7.1	0.7	I
7	69.3	51.5	7.0	0.7	I
8	68.7	45.0	7.2	0.7	I
9	68.3	46.2	7.1	0.5	I
10	69.1	48.3	7.2	0.6	I

1 Based on 15 kg of paddy rice.
2 Whole white rice and 3/4 of whole grain.
3 Appearance of the white rice based on a scale of 0-5: 0 = absence of the white center; 5 = white center which fills the whole grain.
4 I = intermediate; L = low; the rice is dry and non-sticky after cooking.

caused severe damage from eating the 30-day-old seedlings down to the ground (Fig. 1). The damage affected 10 to 15 percent of the area. This observation confirms the fact that birds can, for lack of feedstuffs, significantly limit production. This is the first time this type of damage was noted in the rice paddies and its magnitude is of economic importance.

Figure 1. Severe damage caused by *Porphyla martinica* after feeding on foliage of 30-day-old rice at CIAT.

Training

RICE PRODUCTION COURSES

Fifteen Latin American rice professionals from Bolivia, Brazil, Ecuador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, and Panama were trained in rice production and breeding in four to six-month courses. The trainees received practical orientation in: soil preparation; planting; cultural practices; harvesting and processing; and planning and economic evaluation (Fig. 2). This was reinforced with classroom instruction and periodic conferences on economic and administrative aspects of production.

An important phase of training was the planning and execution by the trainees, of experiments to study the principal agronomic problems of the crop which are present in their own countries. The trainees planned eight experiments in which the following were evaluated: planting density and nitrogenous fertilization on direct-seeded and transplanted rice; the appearance of volunteer rice and its control; the effect of the rice leaf miner, *Hydrellia* spp. on the production of transplanted rice and on direct-seeded rice; and finally, the chemical control of weeds in direct-seeded and transplanted rice.

Experiments comparing yields of semi-commercial planting systems in one-hectare plots were also planned and conducted by the trainees. While there were no significant yield differences, the experiment is being continued with another group of trainees to evaluate production costs of these two planting systems.

Training was complemented by observation trips to rice zones in the Cauca Valley, Tolima and Huila, in Colombia, and the Guayas River Basin in Ecuador. Trainees then compared different cultural techniques in distinct ecological media and evaluated and integrated their own knowledge and experiences with other technicians.

Figure 2. As part of their field experience, trainees study the condition of transplanting beds at CIAT.

Special training was provided for professionals interested in plant breeding. Training included the basics of selection of genetic material, the establishment and evaluation of regional trials, and planning and evaluation of International Rice Yield Nurseries for Latin America (Fig. 3).

INTENSIVE COURSES

In late 1977, a short course for 20 agronomists working in technical assistance programs with ICA, Federación de Arroceros de Colombia

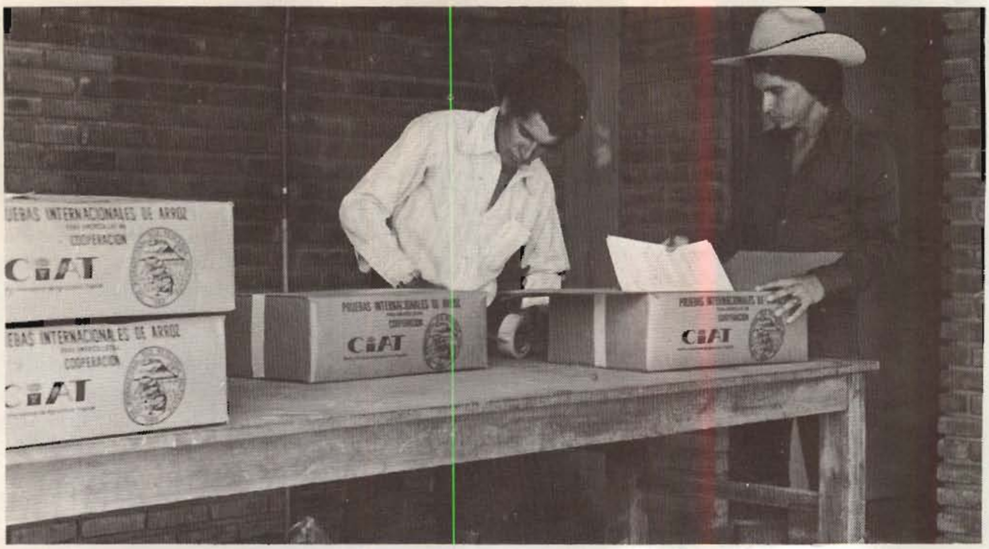

Figure 3 Ecuadorian and Mexican trainees assist in the assembly and packaging of International Rice Yield Trial Nurseries for distribution to Latin American countries.

(FEDEARROZ) and CARE provided instruction on new technology on rice production such as leveling of land underwater and transplanting.

Rice Technology Adoption

This year, a special studies project was continued on the socioeconomic effects of improved rice varieties and their associated technology on farmers in villages and farms of the North Coast of Colombia, an important rice cultivation region. The economics of upland, rainfed and irrigated rice production were analyzed to establish CIAT/IRRI research priorities for small rice producers in Latin America; and, to detail the socioeconomic adaptations of a rice farming society in transition (CIAT, Annual Report, 1976).

Two neighboring rice-growing communities were studied. In the control only traditional rice varieties and technologies were used for subsistence cultivation. Both upland and rainfed rice cultivation in the traditional community are non-irrigated. In the upland cultivation system, rice is direct-seeded in higher areas with relatively poor soil. No dikes are constructed to retain rainwater. In rainfed cultivation, rice is generally transplanted in good soils in shallow naturally flooded fields which are sometimes bounded by dikes to retain water. Most farmers in the traditional community use both rice cultivation methods, and average rice plots were 0.8 and 0.9 hectares per farmer for the two cultivation methods, respectively. Most farmers use both systems; then the average rice area per farmer is 1.26 hectares.

In the modern farming community, the majority of the farmers use the improved variety, CICA 4, on irrigated land with fertilizers, insecticides, fungicides, and chemical weed control. These inputs were supplied by credits from the Caja Agraria. (However, some farmers did not manage their credit well, became indebted, and lost their credit rating.)

Rice yields differed substantially between modern and traditional farmers (see Table 17). Modern farmers had higher net incomes due to higher yields of the improved variety, CICA 4, which also has

Table 17. **Estimated yield and breakdown of profitability of rice production in three different rice growing systems in two communities.**

	Modern	Traditional	
	Mechanized Irrigated	Manual Upland	Manual Transplanted
Yield (kg/ha)[1]	3,510	972	984
Value of production (Col.$/ha)	12,285	3,402	3,444
Total costs (Col.$/ha)	12,078	6,486	4,322
Net profit (Col$/ha)[2]	207	-3,084	-878
Net profit[3]		-1,501	315

1. Yield estimates based on questioning 100% of farmers in modern community, 25% of traditional community.
2. Family labor included as a cost.
3. Family labor not included as a cost.

Table 18. **Yield and breakdown of profit of mechanized rice production by a cooperative, per member, as compared with averages of co-villagers for 1976.**

	Cooperative	Village Average
Yield (kg/ha)	5,140	3,510
Value of yield (Col.$/ha)	18,258	12,285
Total costs (Col.$/ha)	15,819	12,078
Net profit (Col.+/ha)	2,439	207

a shorter growing period permitting two harvests per year. (One farmer produced eight tons of rice on a one hectare plot.)

It should be noted that at the time of the surveys, rice prices were low, wet season rains were late and precipitation low, adversely affecting transplants. As a result, real profits were negative for the traditional farmer and only slightly greater than zero for the modern farmers. However, farmers in a cooperative in the modern community achieve higher yields and incomes than the average (see Table 18).

Table 19 shows estimated production costs for the two communities. Of the variable costs, labor in the traditional system was very high as compared with mechanized production — 74 and 87 percent for upland and rainfed rice, respectively, as compared with 17 percent for the modern farmer. *It should* be noted that subsistence farmers use family labor on their farms but do not consider it a cost. However, when family labor is deducted from total production costs, only rainfed rice farmers made a profit in 1976.

Since upland farmers rentland on which other crops can be grown such as beans, maize, and cassava, the rental fees of the upland farmers are higher. At the same time, rainfed rice farmers do not compete for land with other crops and therefore have lower production costs and produce higher yields. New technology for these farmers would have a bigger pay-off.

Table 19. **Estimated costs of rice production/ha in three different rice growing systems, North Coast region, Colombia, 1976. (in Col. $).**

	Modern	Traditional	
	Mechanized, irrigated (n = 72)	Upland (n = 23)	Rainfed (n = 43)
Land rent	1,585	1,943	1,039
Land preparation	1,800	-	-
Water	526	-	-
Seed	1,242	478	255
Inputs	1,912	176	95
Input application	156	10	5
Harvesting	1,800	-	-
Technical assistance and interests	901	80	43
Transport	300	53	28
Manual labor	1,856	3,746	2,857
Total	12,078	6,486	4,322

It is evident that the modern rice-farming community is changing from a commodity-based economy into a cash based one. This has adversely affected landless, sharecropping farmers in this community for whom rice is a staple whose availability is limited in a commodity-oriented economy of scarcity. Sharecroppers, who are 50 percent of the subsistence farmers in this community generally require one-fifth of the crop to pay harvest labor, and one-third for the landowner. This indicates that subsistence farmers cannot contribute significantly to the external market or retain much of their crop for family consumption. Until recently, they supplemented rice for family consumption by working as laborers for modern rice farmers who paid them in rice shares.

When the combine harvestor was first introduced by modern families poor families in the community were allowed to recover shattered grains left by the machine, partially offsetting the reduction in rice availability. However, modern farmers now argue that 3-15 percent of the grains remain in the rice stalks and leaves cut by the machine and this rice can be consumed by the owner's family.

The reduced rice circulation in the local economy forces the subsistence farmers to buy more rice during the greater part of the year (Fig. 4). However, these cash payments buy less rice than the quantity normally paid to laborers since purchased rice passes through middlemen who raise the price.

The fact that the modern community is making an economic transition from a subsistence commodity to a cash based economy is also reflected in changing social customs. Formerly, farmers in both communities gave of rice to families and friends. Currently, 85 percent of the traditional farmers surveyed made gifts of rice, while only 65 percent of the modern farmers still continued this practice. These

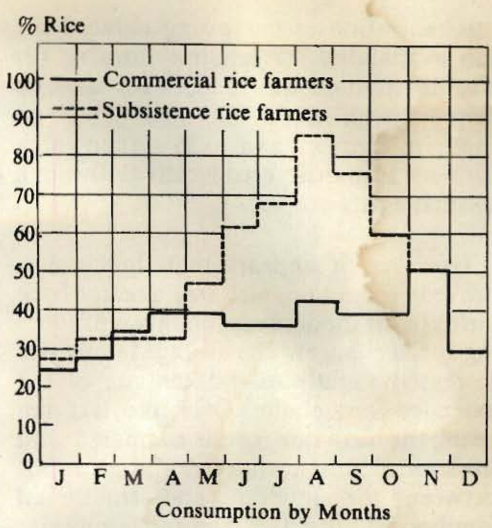

Figure 4. Comparison of percentage of commercial farmers in the modern community and subsistence farmers in the traditional community who buy rice for family consumption during the year.

quantities constitute 3.4 and 0.9 percent of the farmers production, respectively. The poorest farmers, the sharecroppers, may have distributed similar quantities of rice as the modern farmers, however, they had the lowest yields and net incomes therefore distributing a higher proportion of their rice than the landowning farmers. While the quantities were small and probably more significant as tokens of social commitment than of economic importance, when these gifts were given prior to harvest, they may have been important for non-landowning farmers.

This change to a cash-based economy is also polarizing the modern farmers from the traditional ones and the farm laborers. This is expressed in such visible items as television sets, radios, bicycles, improved housing quality and by less tangible factors as different work habits and different cosmopolitan levels.

These economic pressures are also creating a migration of less favored persons from the modern community. Preliminary analysis indicates that there are three contributing factors: (1)

mechanization of harvesting reduced the job availability for landless farmers; (2) rice distribution was reduced for landless farmers who work for wage labor on modern farms; and, (3) landowning farmers lost their credit ratings through mismanagement.

However, it appears that due to improved economic welfare, greater rice yields in the modern community is producing social changes. The average family size increased slightly as did the size of the extended household. Over the last ten years, the birth rate rose as compared with the control group, while age and sex ratios between the modern and traditional families did not differ. Desired family size of the modern farmers was also bigger. Although changes in family size were not statistically significant, these changes were directly attributed to higher yields producing higher net incomes and improved family nutrition.

Increased rice production with improved varieties and associated technologies have also produced a reversal of the economic decision-making role in the modern farmer's family. In the traditional community, the woman is the principal decision-maker as she is responsible for the family garden which is an important subsistence base. However, as the economic situation becomes more lucrative due to improved rice yields, the father who is responsible for rice cultivation assumes a more important decision-making role.

When traditional and modern farmers were asked their opinion of their future vocational expectations of their children, 30 percent of the traditional farmers wanted their children to be farmers while only 8 percent in the modern community wanted their children to continue that profession. In view of the higher profitability of farming for the modern farmers, this surprisingly low desire for their children to be farmers was interpreted as a change in perception of farming from a way of life to a means of investment. This was accompanied by the expressed desire to move to the cities. Apparently, improved yields and net profitability of improved rice cultivation is viewed as a stepping stone for social mobility.