International Rice Testing Program for Latin America

Report on the Fourth IRTP Conference for Latin America

August 10-14, 1981

COOPERATION
Centro Internacional
de Agricultura Tropical, CIAT

The International Rice
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IV IRTP CONFERENCE FOR LATIN AMERICA

CIAT, August 10-14, 1981

First row: Elías García, Julio Salvador, Francisco Andrade, Jenny Gaona, Yolanda de Galvis, Rafael Olaya, José Orlando Blanco, Gamaniel Villegas, Walter Ramiro Pazos, José Avila, José Roberto Alvarado, Dorance Muñoz, Benjamín Rivera, Oswaldo García, Eulalio García, Ernesto Andrade, Sang-Won Ahn, Jorge Armenta, Napoleón Reyes, Eric Owen, Manuel Rosero.

Second row: María Teresa de Valenzuela, Alvaro Salive, Lineth Carranza, Hernando Cortina, Alberto Dávalos, Percy Miller, Armengol J. Caballero, Henry Turenne, Leonardo Hernández, José I. Murillo, Paulo Sergio Carmona, Richard Figoni, Luis E. Berrío, Edmundo García, Robert Cheaney, Eliseo Nosa, Ezequiel Espinosa, Rolando González, Wolfgang Jetter, Gloria Gutiérrez, Elcio Perpetuo Guimaraes.

Third row: Dieter Kempf, César Martínez, Marco A. de Oliveira, Patricio Vargas, Maurí O. Machado, Valentín Ezqueda, Peter R. Jennings, Joaquín González, Luis Alberto Guerrero, Alberto Salih, M.J. Idoe, Harold Kauffman, Luis O. Molina, Christian Gartner, Héctor Weeraratne, N.V. Banzatto, Pascual Martínez, Federico Cuevas, Aníbal Rodríguez, Eugenio Tascón, Manuel Decker, Rolando Rubí.

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INTRODUCTION

The International Rice Testing Program (IRTP) for Latin America is sponsored by the Centro Internacional de Agricultura Tropical (CIAT) and the International Rice Research Institute (IRRI) with funds provided by the United Nations Development Program (UNDP).

IRTP activities in Latin America focus on the evaluation and distribution of germplasm by means of several nurseries specifically adjusted to the factors limiting rice production in the region; the Program also gathers information in monitoring tours and individual visits on the problems affecting rice production in the different cropping systems in use, and finally, the Program organizes meetings with collaborating scientists to discuss problems and research developments.

The Fourth IRTP Conference was held from 10-14 August 1981 at CIAT. Thirty-nine delegates from 18 countries attended.

Dr. John L. Nickel, Director General of CIAT, opened the conference by welcoming the participants. He went on to stress the importance of the IRTP cooperation network as an effective means of increasing the production of rice--a staple in the Latin American diet.

The objectives of the Fourth IRTP Conference were:

-- Discuss advances made in the region over the last five years.

-- Report on future IRTP directions and changes in the Eastern Hemisphere.

-- Report to regional participants on CIAT Rice Program achievements in the area of varietal improvement and strategies concerning varietal resistance to disease.

-- Outline CIAT research priorities for upland rice improvement in the region.

-- Discuss advances and problems of the rice crop in the different production systems of the region: irrigated, favored upland, unfavored upland, and semi-deep waters.

-- Discuss future IRTP plans for nurseries in Latin America in terms of changes and operating procedures.

-- Give IRTP collaborators an opportunity to meet, exchange ideas and share experiences.

REVIEW OF IRTP FINDINGS IN LATIN AMERICA, 1976-1980

Dr. Manual J. Rosero, IRTP Coordinator for Latin America, went over IRTP findings for the region for the period of 1976-1980. He referred to the type of nurseries that were organized, regional rice crop problems, performance of the germplasm distributed, and monitoring tours.

Type of nurseries. Information was given on the type of nurseries (Table 1) that have been distributed to 24 countries in the region (Figure 1). These nurseries included improved germplasm for the main constraints of the rice crop.

Crop problems. Dr. Rosero also stated that monitoring tours and individual visits made to participating countries have made it possible to observe the different factors affecting production such as: disease, soil, climate, insects, weeds, and physiological problems (Table 2).

GERMPLASM PERFORMANCE

Yield Nurseries

The performance of the germplasm distributed in yield nurseries varied from country to country. Performance variation is greater when there is a wide variety of climate conditions, temperatures and production systems. Nonetheless, several lines performed well for two or three harvests in the differing ecological environments in the region (Tables 3, 4, and 5).

The VERAL germplasm nursery begun in 1979 comprised 11 lines from the ICA-CIAT breeding program; these lines contained two or three sources of blast resistance. On the basis of findings in several countries, four lines were selected for re-evaluation in the same nursery in 1980. In Table 6 the performance of these four lines is compared with that of CICA 8 and CICA 4. The table shows that the lines performed well both under irrigated and favored upland conditions. The tolerance to disease and yield of these lines are similar to CICA 8.

Distribution of several floating varieties for the semi-deep water system began in 1977 in Brazil, Colombia, Ecuador, and Guyana. Information is available on the 1977 nursery planted in Ecuador and the 1978 one planted in Colombia. Data on yield and days to flowering in the best lines in these nurseries are found in Table 7.

Disease Nurseries

Blast. Distribution of germplasm for blast began in 1978 with IRRI materials which showed resistance to this disease in several Asian countries. Since 1979, CIAT Rice Program materials were included. Table 8 shows the lines that had resistance to leaf and/or neck blast in several countries in the region. All these materials have two or three sources of resistance to blast and were included in the 1981 VIPAL nursery.

Leaf scald. To find resistant improved lines or sources of resistance to leaf scald, a total of 119 lines were distributed in 1979 and 1980 nurseries. Reports indicate that resistance varies from place to place and even from one year to the next in the same locality. Nevertheless, 16 lines of the germplasm distributed for two harvests have shown resistance or tolerance, with infection type lower than 4 on a scale of 1-9. These lines were grown in Villavicencio (Colombia), Tocumen (Panama), Arce (El Salvador) and La Cristina (Guatemala). Disease intensity is higher in natural field conditions in these four locations. Table 9 presents the resistance level in the 16 lines together with the days to flowering and yields reported at the four locations.

Sheath blight. Information has been reported on the germplasm distributed in 1978, 1979, and 1980 regarding the incidence of sheath blight in Tocumen (Panama), Campinas (Brazil), and Araure (Venezuela) in 1980. Tolerant lines found in these locations are presented in Table 10.

Soil and Climate Nurseries

Acid soil. The acid soil problem known as yellowing or oranging leaves that occurs in favored upland and irrigated systems is widely distributed in Central America, Colombia, and Venezuela.

Resistance to yellowing varied in the germplasm of several nurseries distributed to Belize, El Salvador and ICA-La Libertad (Colombia) in 1979. Resistant materials from these nurseries were selected to form the acid soil observational nursery distributed in 1980. Table 11 presents the materials showing resistance in Villavicencio (Colombia) and Araure (Venezuela) in 1980.

Salinity. Germplasm tolerant to salinity and/or alkalinity was distributed in the 1978, 1979, and 1980 nurseries to Brazil, Cuba, Ecuador, Guyana, Mexico, Peru, and the Dominican Republic. Data on the 1978 nursery evaluated in Peru and the Dominican Republic indicated that none of the material in the nursery had survived the high concentrations of salt found in Chiclayo, Peru. The electrical conductivity of the soil extracts taken at this site registered 9.0-42.0 $mmhos/g\text{-}cm^2$, which is an extremely high concentration of salts that no variety of rice can survive in. The selection of salinity-tolerant varieties is geared to soils having a maximum of 10.0 $mmhos/g\text{-}cm^2$. In the Dominican Republic, on the other hand, where salinity conditions are less severe (electrical conductivity is 7.6 $mmhos/g\text{-}cm^2$), several lines showed tolerance and produced satisfactory yields (Table 12).

Low temperature. To evaluate tolerance to cold at seedling or flowering stages, improved germplasm has been included in nurseries distributed in 1979 and 1980 to Belize, Bolivia, Brazil, Cuba, Chile, Mexico, Peru, Uruguay, and the Dominican Republic.

Information received from Chile shows that none of the materials included in the 1980 nursery reached maturity due to lower temperatures during seedling and flowering stages. However, several lines in the 1979 nursery planted in Pelotas (Brazil) were tolerant to low temperatures and were high-yielding (Table 13).

UTILIZATION OF GERMPLASM

The germplasm distributed in IRTP nurseries has been used in hybridization, local yield tests and in seed multiplication for commercial crops (Table 14). Some lines or varieties are being commercially grown in several countries. CICA 8, so named by the Colombian National Program, is being grown under the same name in Panama, Belize, Bolivia, Honduras, and Nicaragua, and is called Adelaida 1 in Paraguay, ICTA Cristina in Guatemala and ISA 40 in the Dominican Republic. The 4440-10 line has been called ICTA Virginia in Guatemala. The IR 1529 line has been given variety status in Cuba and Bolivia.

Monitoring Tours

Monitoring tours were organized so as to coordinate the different IRTP activities with national programs in the best possible way.

Five monitoring tours have been made--two in Central America in 1977 and 1980 and three in South America: in 1978 in the Southern zone (Argentina, Brazil, Paraguay, Bolivia, and Peru); in 1979 in the Northern zone (Ecuador, Colombia, Venezuela, Guyana, and Surinam); and in 1981 to Mato Grosso, Brazil. Making these trips were one or two scientists from the national programs of the countries visited, several members of the IRRI and CIAT staffs and a few special guests from other countries.

These visits have been highly valuable not only for those making them but also for the research and rice production staff from the national programs visited during the monitoring tours. Those participating on the tours had the opportunity to come into contact and share their ideas with researchers from other countries; to become familiar with production systems and the status of program research; and to observe the problems and limiting factors affecting crops in the countries visited that may not exist in their own countries.

The monitoring tour reports published to date are extremely useful since they provide updated information on acreage, production, varieties grown and problems affecting different production systems.

IRTP OUTLOOK FOR THE 80's

Dr. H.E. Kauffman briefly spoke about IRRI activity coordination and outlined changes in IRTP operations in the eighties.

From 1975-1980, the most important IRTP achievement was the establishment of a cooperative network of rice scientists in more than 300 experimental rice stations run by institutes and universities in 75 rice-growing countries. This network has distributed more than 5000 varieties or improved lines evaluated in more than 1000 types of nurseries. Over 2100 trials have been analyzed and described in 100 reports on different nurseries. Hundreds of lines showing good performance have come out of these tests and have been used in hybridization programs, and many of them have been advanced to national and local yield trials. Thirty plus IRTP lines have been made varieties and are currently grown in 20 countries in Asia, Africa, and South America.

The cooperative network has been extremely valuable in terms of identifying parent lines having a broad range of resistance to disease, insects and soil and climate problems. Trials have also served to provide a better understanding of biotype and strain variation in insects and pathogens. The thirty-five monitoring tours and work meetings sponsored by IRTP have contributed to the professional advancement of more than 200 scientists in 40 countries.

IRTP activities in the 80's will focus on giving more effective support to improvement programs to help them achieve yield stability in irrigated and favored upland regions and increase yields in unfavored upland regions.

To better meet network members' needs relating to the evaluation and development of specific local varieties, the trials have been divided into three main types: nurseries, screening tests and tests with resistant donors to specific problems (Table 15). Nurseries will continue to be made up of pure lines and improved varieties that will be evaluated in key problem environments. Yield nurseries will remain much the same as in the past, but will be evaluated in places that are representative of several agro-climatic regions where irrigated rice is grown; evaluation sites will also be chosen on the basis of their suitability for conducting studies on climatological conditions. These studies will provide a better understanding of the influence environmental factors have on yield and will help identify the basic genotypes to be used in breeding programs. Observational nurseries will continue to focus on the most important environments.

The screening sites shall be basically directed towards more specific environments or problems that are important locally but perhaps not widely distributed. These trials will involve a limited number of lines which will be evaluated in "hot spots" that have been identified for the different limiting factors. This work began in 1981 with a series of new screening sets shown in Table 16.

Trials with donor parents will include proven resistant or tolerant varieties to major, and minor, stresses for wide-spread use in breeding programs.

Monitoring tours and workshops will fundamentally focus on furthering varietial improvement activities at the regional level or in certain specific areas.

INNOVATIONS IN BREEDING TECHNIQUES AND RECENT CIAT RESEARCH FINDINGS

Progress made in the ICA-CIAT breeding program for irrigated rice.

Dr. Hector Weeraratne stated that the principal aim of the ICA-CIAT breeding program is to develop improved varieties as a means of stabilizing yield and production in Latin America. In spite of the many limiting factors affecting production in this region, the program's main objective is to improve resistance to blast caused by *Pyricularia oryzae*, planthopper (*Sogatodes oryzicola*), and hoja blanca virus. The program also seeks to improve grain quality and lodging resistance. The following improvement strategies are being used to obtain durable resistance to blast:

Combined crosses. Experience has shown that triple crossing is more productive than double or multiple ones. Backcrossing programs are being conducted to correct defects in existing varieties.

Combined crosses with promising early generations. Single crosses with Camponi x IRAT 8, Camponi x IR 11-452, Ceysvoni x IRAT i, Ceysvoni x IR 11-452, IRAT 13 x Ceysvoni have combined extremely well in triple crosses with several advanced lines.

Single crosses with Camponi x K8, Ceysvoni x K8 combined very well with Bg 90-2 and CICA 4. Several hundred individual plants have been selected from these crosses.

Advanced lines. Several advanced lines having yields 10-20% higher than CICA 8 were obtained from the following crosses BG 90-2//4440/ Colombia 1, CICA 7//4440/Remadja, CICA 7//4440/Colombia 1.

Improvement of Bg 90-2. Four lines were obtained from backcrossing Bg 90-2 (Bg 90-2/3 x Tetep); they showed better grain quality and blast resistance and had the same yield as Bg 90-2.

Improvement for earliness. The demand for early maturing lines is on the rise. More than 60 advanced lines combining early maturing, excellent grain quality and resistance to blast, planthopper and hoja blanca have been evaluated.

Advances in Blast Research

Dr. Sang-Won Ahn stated that pathology work has focused on improving blast evaluation methods, especially for varieties having slow-blasting characteristics. Several new parameters are currently under study, and thus far, results have been satisfactory. These new parameters include infection rate, the severity of panicle blast in segregating generations and individual plant evaluation.

Environmental factors related to the development of blast disease have been analyzed, and this information is being used to maintain suitable and uniform levels of blast in evaluation sites.

Research continues in the chemical control of blast, especifically as regards seed treatment with commercially available fungicides. Preliminary results show that leaf blast is effectively controlled and that effectiveness increases when fungicide action is combined with a moderate level of varietal resistance.

CIAT Research Priorities in Upland Rice Breeding

Dr. C.P. Martínez spoke on the different upland rice ecosystems in Latin America; he also outlined CIAT breeding program priorities for this particular production system.

Variation in productivity, soils, temperature, and rainfall distribution make it difficult to precisely define upland ecosystems. Nonetheless, this production system can be sub-divided into three overall systems: subsistence, mechanized upland (moderate to highly favorable) and unfavored mechanized upland.

The subsistence upland system is characterized by a lack of mechanization and the absence of inputs. It is practiced by outland settlers working 1 ha of land per family; they plant manually varieties of rice for two or three seasons and then move on to new lands. The yields from these crops is about 1 t/ha and is entirely used for family consumption. Since this system is highly complex, the CIAT upland breeding program will not do research on it.

The highly favored mechanized upland system is limited to the flat areas in Central America and Colombia which receive 2000 mm of rainfall over a 6-8 month period. The soils are usually alluvial, fertile, slightly acid, and have good drainage. Several improved dwarf varieties are grown on these lands and inputs are used. The average yield is 2.5 t/ha; however, in Colombia, yields of 4-5 t/ha are not unusual. The main limiting factors affecting this system are weeds, blast and leaf scald.

The moderately favored mechanized upland system is found in most of Central America and in much of the sub-amazonic region of Brazil. It differs from the highly favored system in that it receives less rainfall over a shorter period of time and undergoes periods of drought. The soil in this system is not as fertile as that of the highly favored one and suffers from P, Fe, Zn, and Mn deficiencies. The system is plagued by blast, leaf scald, helminthosporiosis and sheath blight; planthopper (Sogatodes) and weeds also constitute a problem. Dwarf varieties are sown with this system in Central America producing 2.0 t/ha yields, while in Brazil, tall varieties yield 1.5 t/ha.

Research priorities for highly and moderately favored upland systems focus on obtaining dwarf or intermediate varieties with good vigor and having a 110-130 day cycle, strong stems, long grains with good milling and cooking properties and resistance or tolerance to the main limiting factors. The evaluation and selection of material shall take place only in representative areas of the two systems.

The unfavored mechanized upland system is characteristic of Central Brazil where rainfall is scarce and irregular; dry periods can come on at any time and can occur several times. The length of dry periods varies and can last anywhere from 20-30 days. Soils in this system are acid, unfertile, suffer from aluminum toxicity and P and Zn deficiencies and have poor water retention capacity. The use of inputs is limited. Tall varieties susceptible to lodging and diseases are grown. Yields vary widely averaging about 1 t/ha.

A nursery is being developed for this system including traditional upland varieties and improved upland lines from Africa (IRAT, IITA), Asia, Brazil, and Colombia which will be evaluated in the following locations:

-- Colombia: Llanos Orientales in alluvial soils and unfertile savanna lands having heavy rainfall.

-- Brazil: Goiânia, in moderately acid soil where rainfall is low.

-- Peru: in the jungle where the soil is acid and rainfall heavy.

Germplasm evaluation in these locations will make it possible to select the best parents for use in a crossing program and to select materials for different limiting factors.

A Budgetary Approach to Production Systems

Dr. Rafael Posada showed how budgets and budgeting could be used as a tool for identifying, analyzing and evaluating current and future production systems. Drawing up a budget involves calculating income and production costs. It is essential to know the selling price and the average yields for each system in order to estimate income; to estimate costs, one must determine whether a given activity, such as fertilizing, will be done or not; if it is, one must determine how much of this input will be required. Budgeting will make it possible to select the most important parameters that characterize a particular system and differentiate it from others.

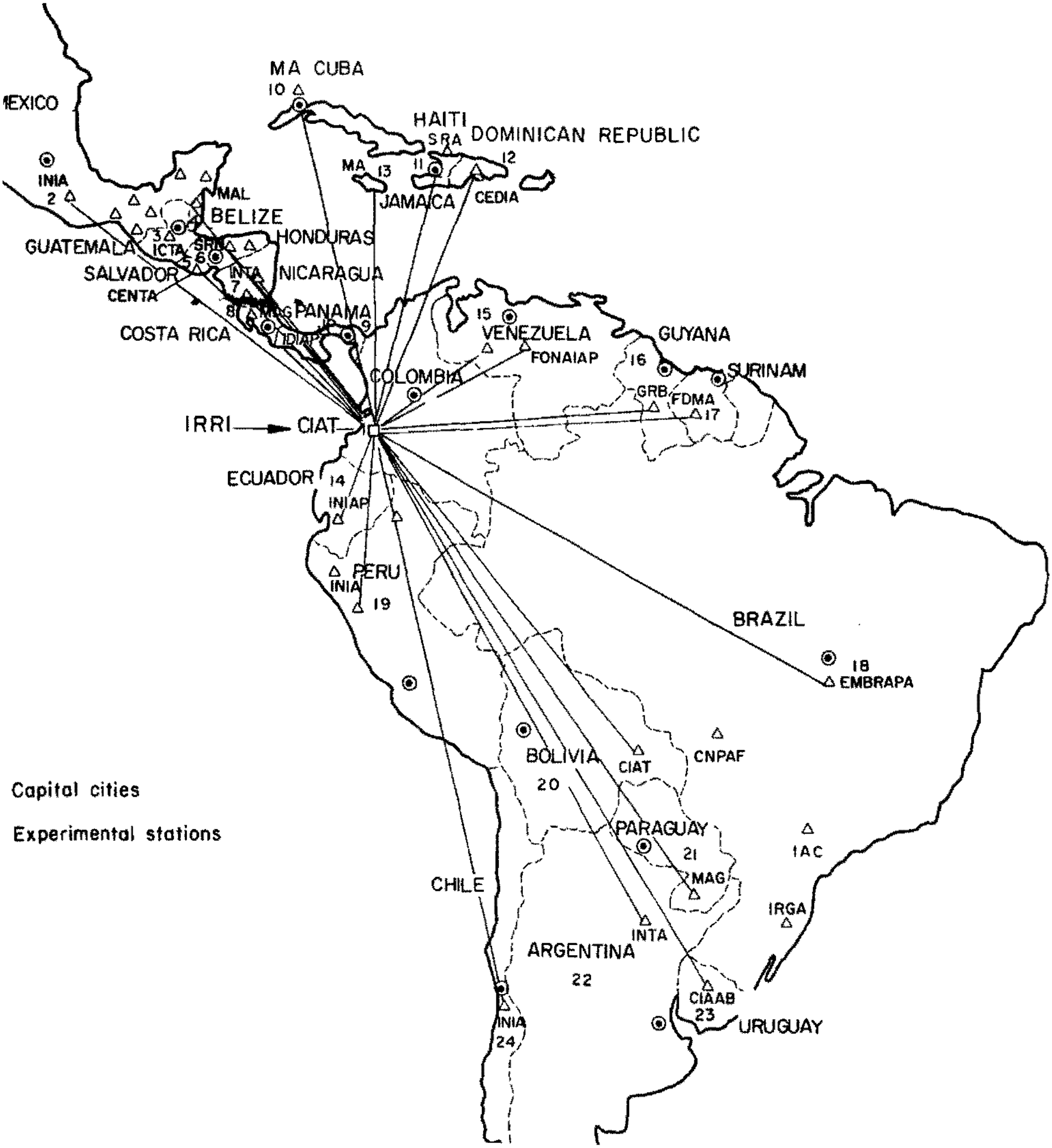

Figure 1. *IRTP cooperation network in Latin America.*

Budgeting and the description of each production system can help set out criteria for resource allotment for research on the different systems. The description of a system will make it possible to establish the conditions in which it functions and the most serious limiting factors affecting it. This information will be useful for increasing system productivity and expansion. Budgeting for each system will indicate system profitability and competitive edge in relation to other systems in terms of cost per unit of land worked and the unit cost of the product itself.

Table 1. IRTP nurseries for Latin America distributed from CIAT.

Nursery type[1]		No. of sets dispatched			
		1977	1978	1979	1980
Yield					
	VIRAL-P	28	-	39	39
	VIRAL-T	28	26	28	29
	VIRAL-Tar	-	-	9	14
	VIRAL-S	22	31	30	36
	VERAL	-	-	22	26
	VIRAL-F	5	5	8	7
Observational					
	VIOAL-R	-	37	14	18
	VIOAL-S	-	-	25	24
Diseases					
	VIPAL	-	31	31	48
	VIOAL-Es	-	-	18	16
	VIAVAL	9	11	12	13
Soil and Climate					
	VIOAL-SA	-	-	-	14
	VIOSAL	4	7	8	10
	VITBAL	-	-	10	7
Total		96	148	254	301

[1] VIRAL = International Rice Yield Nursery for Latin America
P = Early
T = Medium
L = Late
U = Upland
F = Floating

VERAL = Specific Yield Nursery for Latin America

VIOAL = International Rice Observational Nursery for Latin America

VIPAL = International Blast Nursery for Latin America

VIOAL-Es = International Rice Observational Nursery-Leaf Scald

VIAVAL = International Rice Sheath Blight Nursery

VIOAL-SA = International Rice Observation Nursery - Acid Soils

VIOSAL = International Rice Salinity and Alkalinity Observational Nursery

VITBAL = International Rice Low Temperature Nursery

Table 2. Main limiting factors affecting rice in Latin America.

Factor	Region or country
Diseases	
Blast	Entire region except Chile
Sheath rot	Mexico, Central America, the Caribbean
Sheath blight	Colombia, Ecuador, Venezuela, Peru, Brazil
Stem rot	Colombia, Ecuador, Perú
Leaf scald	Mexico, Central America, the Caribbean, Colombia, Venezuela and Brazil
Brown leaf spot	Mexico, Panama, Brazil
Narrow leaf spot	Honduras, Brazil
Hoja blanca	Ecuador, Peru, Colombia
Insects	
Planthopper (*Sogatodes*)	Panama, Ecuador, Nicaragua
Stink bugs	Entire region
Stem stink bugs	Argentina, Bolivia, Brazil
Stemborers (*Elasmopalpus lignosellus*)	Central America and Brazil
Soil and Climate	
Yellowing	Acid soils in Mexico, Central America, Colombia, Guyana, Surinam, Brazil and Peru
Aluminum toxicity	Acid soils in Colombia, Brazil and Peru
Zn deficiency	In neutral or alkaline soils in Cuba, Haiti and Nicaragua and in acid soils in Brazil
Salinity	Cuba, Ecuador, Dominican Republic, Guyana, Mexico, Jamaica and Peru
Drought	Brazil, Central America and Mexico
Low temperatures	Chile, Uruguay, Brazil (RS), Argentina, Mexico, Belize and Cuba
Semi-deep water	Ecuador, Colombia (northern coast), Guyana, Brazil
Weeds	The entire region in upland rice systems
Physiological	
Straighthead	Argentina

Table 3. Days to flowering and yield of the best VIRAL-P lines grown in several Latin American countries.

Designation	Irrigated				Favored upland			
	Days to flowering		Yield (t/ha)		Days to flowering		Yield (t/ha)	
	Range	Average	Range	Average	Range	Average	Range	Average
B 541b-Pn-58-5-3-1[1]	75-124	96	3.0-9.2	6.3	79-115	95	1.4-6.9	4.0
IET 2881[1]	71-130	92	3.1-8.7	6.1	65-119	92	0.2-8.0	3.3
BR 51-46-1-C1[1]	80-137	102	2.5-9.0	5.5	81-133	100	1.7-7.4	4.3
MRC 603/303[2]	79-120	98	3.1-7.3	5.0	80-115	92	2.0-6.5	4.4
UPR 70/30-25[2]	78-122	95	2.1-7.8	4.5	80-114	91	1.4-7.1	3.7
IET 6508[2]	72-119	89	1.9-6.2	4.2	72-104	86	1.5-5.8	3.3
CICA 7 (control)[3]	78-140	92	2.4-8.5	4.5	80-128	94	1.9-5.9	3.8
IR 36 (control)[3]	66-122	91	2.1-79	4.4	75-119	90	1.9-5.7	4.4

[1] Average: irrigated planted in 20 locations: 11 in 1977 and 9 in 1979; upland planted in 12 locations: 4 in 1977 and 8 in 1979.

[2] Average: irrigated planted in 12 locations: 9 in 1979 and 3 in 1980; upland planted in 15 locations: 8 in 1979 and 7 in 1980.

[3] Average: irrigated planted in 23 locations: 11 in 1977, 9 in 1979, and 3 in 1980; upland planted in 19 locations: 4 in 1977, 8 in 1979, and 7 in 1980.

Table 4. Days to flowering and yield of the best VIRAL-T lines grown in several Latin American countries.

Designation	Irrigated				Favored upland			
	Days to flowering		Yield (t/ha)		Days to flowering		Yield (t/ha)	
	Range	Average	Range	Average	Range	Average	Range	Average
BR 51-46-5[1]	85-143	108	1.9- 8.6	5.6	89-105	98	0.9- 7.2	3.7
BG 374-1[1]	83-137	105	3.4- 7.5	5.7	85-101	94	0.3- 5.7	3.3
B 542b-Pn-68-9-2-2[1]	88-139	108	3.7-10.4	6.3	90-106	101	0.1- 7.5	3.8
IET 1785[2]	80-129	104	3.2- 8.9	6.3	85-119	96	0.5-10.1	4.5
Bg 375-1[3]	73-137	99	3.9-10.5	6.6	80-110	97	0.5- 7.6	4.9
Taichung Sen Yu 195[3]	73-124	98	3.1- 9.7	6.1	77-105	94	0.5- 8.4	4.3
IR 4422-98-3-6-1[4]	75-131	110	3.2-10.2	6.1	83-116	99	1.8- 6.8	4.5
CICA 4[4]	75-112	100	3.8- 7.9	5.6	81-98	91	1.1- 7.5	4.1
CICA 8[4]	74-133	106	4.4- 9.3	6.4	80-115	97	1.3- 8.1	5.1

[1] Average: irrigated planted in 15 locations: 9 in 1977 and 6 in 1979; upland planted in 9 locations: 4 in 1977 and 5 in 1979.

[2] Average: irrigated planted in 24 locations: 9 in 1977, 9 in 1978, and 6 in 1979; upland planted in 18 locations: 4 in 1977, 9 in 1978, and 5 in 1979.

[3] Average: irrigated planted in 19 locations: 9 in 1977 and 10 in 1978; upland planted in 10 locations: 4 in 1977 and 6 in 1978.

[4] Average: irrigated planted in 18 locations: 10 in 1978, 6 in 1979, and 2 in 1980; upland planted in 19 locations: 6 in 1978, 5 in 1979, and 8 in 1980.

Table 5. Days to flowering and yield of the best VIRAL-S lines grown in upland conditions in several countries in Latin America.

Designation	Days to flowering		Yield (t/ha)	
	Range	Average	Range[5]	Average
IR 2035-242-1[1]	68-146	104	0.2- 6.3	3.7
CR 1113[1]	68-136	105	0.3- 6.3	3.5
IR 2061-522-6-9[2]	68-122	91	0.2- 6.7	3.4
MRC 172-9[2]	78-134	100	0.5- 4.4	2.9
IR 36[3]	69-127	91	0.2- 7.6	3.4
Kn 361-1-8-6[3]	68-116	84	0.3- 6.7	3.1
IR 43[4]	73-135	101	0.2- 8.6	4.2
BR 51-46-1-C1[4]	82-146	106	0.2-10.4	4.2
CICA 8[4]	72-137	106	0.5- 7.5	4.2

[1] Average of 23 locations: 14 in 1978 and 9 in 1979.
[2] Average of 18 locations: 9 in 1977 and 9 in 1979.
[3] Average of 32 locations: 9 in 1977, 14 in 1978, and 9 in 1979.
[4] Average of 37 locations: 9 in 1977, 14 in 1978, 9 in 1979, and 5 in 1980.
[5] Low yield in unfavored upland in Brazil and high yield in favored upland conditions in Bolivia.

Table 6. Performance of four promising VERAL lines compared to two commercial varieties grown in several countries in Latin America.

Designation	Diseases[1]			Lodging[1]	Irrigated[2]		Upland[3]	
	Bl	LSc	BS		Days to flowering	Yield (t/ha)	Days to flowering	Yield (t/ha)
P 1377-1-15M-4-1M-1	1.2	3.3	5.0	3.1	111	5.6	98	4.4
P 1274-6-8M-1-3M-1	1.2	2.8	5.0	1.8	111	6.1	99	4.7
P 1429-8-9M-2-1M-5	1.6	2.8	4.3	2.1	108	6.0	95	4.4
P 1377-1-15M-1-2M-3	1.2	2.7	4.3	3.1	112	6.5	100	4.5
CICA 8	1.4	3.0	3.3	3.2	113	6.9	103	4.7
CICA 4	2.8	2.3	1.7	1.0	107	5.5	94	3.8

[1] On a scale of 1-9; average of 5 locations for blast (Bl), 6 for leaf scald (LSc), 3 for brown leaf spot (BS), and 9 for lodging.
[2] Average of 10 locations: 9 in 1979 and 1 in 1980.
[3] Average of 14 locations in favored upland conditions: 6 in 1979 and 8 in 1980.

Table 7. Performance of four VIRAL-F lines evaluated in Ecuador and Colombia.

Designation	Ecuador, 1977[1]		Colombia, 1978[2]	
	Days to flowering	Yield (t/ha)	Days to flowering	Yield (t/ha)
BKN 6986-20	115	3.0	117	2.6
BKN 6987-118-3-P	123	4.6	98	2.7
BKN 6987-133-2-P	124	5.2	108	1.4
BKN 6987-233-2-P	121	6.9	109	1.4
RD 1	120	5.2	103	2.5

[1] Planted in Boliche; water depth: 40 cm.
[2] Planted in La Doctrina; water depth: 40 cm.

Table 8. Promising VIPAL lines resistant to leaf and neck blast for two or three harvests grown in several Latin American countries.

Designation[1]	Sources of resistance[2]	Included in 1981 nurseries
IR 2588-2-3-3-1*	Tetep[2], Sigadis	VIPAL
IR 3525-26-1-4*	Tadukan, Dawn	VIPAL
IR 4547-6-2-6*	Tadukan[2], Tetep	VIPAL
IR 8192-166-2-2-3*	Tadukan, Tetep	VIPAL, VERAL
IR 9852-18-1*	Tadukan[2], Tetep	VIPAL, VERAL
P 1277-7-14M-5-1B*	C 46-15, DH, Tetep[2]	VIPAL, VIRAL-Tar
P 1356-1-3M-2-1B*	C 46-15, DH, Tetep[2]	VIPAL, VIRAL-T
P 1409-6-8M-4-1B*	C 46-15[2], Tetep[2]	VIPAL
IR 1416-1-42-2-3-3	Tetep	VIPAL
IR 2058-435-3-2-1-2	Tetep	VIPAL
IR 3464-217-1-3	Zenith, Tadukan	VIPAL, VIOAL-S
IR 5785-188-2-1	CP-SLO, Tetep, Tadukan	VIPAL
IR 5883-115-3-1	Tadukan[2]	VIPAL
P 1293-1-8M-5-1B	C 46-15, DH, Tetep[2]	VIPAL
P 1332-3-8M-1-1B	C 46-15, Tetep[2], DH	VIPAL, VIRAL-T
P 1342-3-8M-2-1B	C 46-15, Tetep[2], Col. 1	VIPAL, VIRAL-Tar
P 1369-4-16M-1B	C 46-15, Tetep[2], Col. 1	VIPAL, VIRAL-T
P 1381-1-8M-2-1B	C 46-15, Tetep[2], DH	VIPAL, VIRAL-S
P 1390-1-1M-2-1B	C 46-15, Tetep[2], Col. 1	VIPAL, VIRAL-T
P 1397-4-9M-3-1B	C 46-15, Tetep[2], Col. 1	VIPAL, VERAL

[1] Lines with an asterisk were resistant to leaf and neck blast for three years; with scale 1-4, based on 17 tests in 1978, 16 in 1979, and 6 in 1980; the other lines showed resistance to leaf and/or neck blast over a two-year period in the same number of tests.

[2] Number 2 indicates that the variety was included twice in the process of multiple crossing.

Table 9. VIOAL-Es lines that have shown resistance to leaf scald in four locations during two years (1979-1980)[1].

Designation	Leaf scald[2]	Days to flowering	Yield (t/ha)
BR 51-26-1	2.4	118	3.5
B 2360-2-3-1-9-5	3.0	114	3.9
B 2360-2-3-1-9-1-MR-1	2.7	113	3.6
B 2362 C/15-SI-8-2	2.9	111	3.7
IET 4693	2.9	102	4.2
IR 42	3.1	113	4.7
RN 305-32-2-3-4	3.5	117	3.6
CR 1002	3.7	110	4.4
IR 4219-35-3-3	3.8	116	4.0
IR 1820-52-2-4-1	3.3	117	4.0
IR 4570-117-2-1-2	3.2	115	4.5
B 1293 B-Pn-24-2-1	2.9	99	4.4
IR 2058-78-1-3-2-3	2.8	105	4.6
IR 4547-14-3-1	2.6	104	3.6
B 295 J-TB-9	3.1	105	3.5
B 5 Bb-Mr-105-2	2.5	102	3.4
Damaris (T.R.)	2.9	111	3.6
Sirandah Silungkang (T.S.)	6.2	127	2.9

[1] Average from Villavicencio (Colombia), Tocumen (Panama), Arce (El Salvador), and La Cristina (Guatemala).

[2] On an international scale of 1-9; 1-3.0 = resistant; 3.1-5.0 = tolerant; 5.1-9 = susceptible.

Table 10. Average days to flowering and yield of germplasm tolerant to sheath blight[1].

Designation	Sheath blight[2]			Yield (t/ha)		
	Tocumen	Campinas	Araure	Tocumen	Campinas	Araure
Chianung Sen Yu 20	4.5	5.2	1.7	2.9	4.4	3.0
IR 2796-44-2	5.1	4.3	2.3	4.3	6.2	3.1
IR 4422-98-3-6	4.9	3.6	1.0	4.5	7.3	2.7
CICA 8	3.9	3.4	2.3	4.4	7.8	4.0
IR 1487-5-3-2 (susceptible check)	7.3	6.0	5.0	3.1	4.3	4.3
Pankaj (resistant check)	3.2	2.9	1.7	3.6	4.9	2.4

[1] Three-year average (1978-1980) in Tocumen (Panama) and Campinas (Brazil) and one-year average (1980) in Araure (Venezuela).

[2] On an international scale of 1-9: 1.0-3.0 = resistant; 3.1-4.0 = moderately resistant; 4.1-5.0 = moderately susceptible; 5.1-9.0 = susceptible.

Table 11. VIOAL-SA promising lines that have shown resistance to yellowing in two plantings in 1979 and 1980.

Designation	Yellowing[1]			Yield[4] (t/ha)	Days to flowering[4]
	1979	1980 [2]	1980 [3]		
IET 6507	3.0	3.0	3.0	3.3	85
IET 2881	2.3	2.0	3.0	2.6	92
CNM 20	1.3	2.0	3.0	3.6	85
CR 261-7039-236	2.3	2.0	1.0	4.6	105
SI-2	2.5	3.0	3.0	4.4	93
B 58 B-Mr-105-2	1.5	2.0	3.0	3.6	99
IR 3262-3-9-4-5	2.5	3.0	1.0	4.1	88
IR 3262-3-338-5	1.5	2.0	1.0	5.0	95
P 1369-4-16M-1-2M-4	2.0	2.0	1.0	5.4	102
P 1264-6-11M-1-3M-4	2.0	3.0	3.0	4.0	89
P 1397-4-9M-3-3M-3	1.0	3.0	1.0	3.5	95
P 1274-6-8M-1-3M-1	3.0	2.0	3.0	3.8	90
P 1277-7-14M-5-1B	2.0	2.0	1.0	3.2	108
P 1342-6-10M-3-1B	2.0	3.0	1.0	3.5	100
P 1356-1-3M-2-1B	1.0	1.0	3.0	2.9	104
P 1383-8-11M-3-1B	1.0	2.0	3.0	4.3	106
P 1391-6-11M-1-1B	2.0	3.0	3.0	2.3	95
Resistant checks					
Damaris	2.5	2.0	1.0	4.7	111
Colombia 1	2.0	2.0	2.0	2.4	89
Tetep	1.2	1.5	1.0	3.2	107
Carreon	1.3	2.0	3.0	3.6	84
CICA 8	2.0	3.0	-	5.6	104
Susceptible checks					
CR 1113	9.0	6.5	8.0	3.5	106
MRC 603/303	8.0	8.0	6.0	2.4	109
IET 6581	9.0	8.5	7.0	1.4	110
IR 1905-81-3-1	9.0	8.5	8.0	2.0	115

[1] On a scale of 1-9: 1 = resistant and 9 = susceptible. In 1979, these were the averages for Colombia, Belize, and El Salvador.
[2] Villavicencio, Colombia.
[3] Araure, Venezuela.
[4] Data from Villavicencio, Colombia, in 1980.

Table 12. Lines of the VIOSAL 78 showing tolerance to salinity in the Dominican Republic[1].

Designation	Salinity[2]		Days to flowering		Yield (t/ha)	
	1	2	1	2	1	2
IR 2153-26-3-5-2	3.6	4.0	95	95	3.6	4.2
IR 2035-290-2-1-1	4.6	4.0	96	97	2.4	3.5
IR 2053-160-1-2-2	5.0	4.0	114	102	2.9	3.9
IR 2053-436-1-2	3.0	5.0	99	100	4.8	4.4
IR 2061-464-2-4-4-6	4.0	5.0	86	84	2.7	4.7
IR 2145-20-4	3.0	5.0	109	104	5.0	2.3
Pokkali (resistant control)	3.3	4.4	94	88	2.2	4.9
MI-48 (susceptible control)	6.0	8.9	95	90	0.8	2.5
Juma 58 (local control)	4.0	5.0	116	110	3.0	5.7
Mingolo (local control)	-	5.5	-	103	-	1.7

[1] Locations: 1 = Juma; 2 = La Laguna.
[2] On a scale of 1-9: 1-3.0 = resistant; 3.1-5.0 = tolerant; 5.1-9.0 = susceptible.

Table 13. VITBAL-79 lines that were tolerant to cold and performed well in Pelotas, Brazil.

Desingation	Tolerance to cold[1]			Days to flowering	Yield (t/ha)
	Tillering	Flowering	Maturing		
IR 394-77	1	1	1	104	5.0
IR 3941-4-PLP 28	1	1	1	108	5.8
IR 5867-45-2-12	1	1	1	107	5.9
IR 7167-7-2-3	1	1	1	113	5.6
IR 5908-89-2-1-3	1	1	1	113	6.5
China 1039 (resistant control)	2	1	1	93	4.7
Bluebelle (local control)	3	1	1	107	4.0

[1] On an international scale of 1-9: 1 = resistant; 9 = susceptible.

Table 14. Utilization of IRTP germplasm in Latin America.

Countries	Number of lines[1]			Total
	Yield trials	Multiplication	Hybridization	
Argentina	2	1	-	3
Belize	-	1	-	1
Bolivia	3	3	-	3
Brazil	7	-	34	41
Chile	-	-	5	5
Colombia	-	-	38	38
Costa Rica	44	-	-	44
Cuba	-	-	-	-
Dominican Republic	13	-	-	13
Ecuador	19	2	-	21
El Salvador	4	-	-	4
Guatemala	9	-	-	9
Guyana	-	-	-	-
Haiti	10	-	-	10
Honduras	50	1	-	51
Jamaica	24	3	-	27
Mexico	5	3	4	12
Nicaragua	2	4	-	6
Panama	6	1	6	13
Paraguay	-	-	-	-
Peru	7	-	2	9
Surinam	-	-	-	-
Uruguay	-	-	8	8
Venezuela	46	-	12	58
Total	251	19	109	376

[1] IR 841-63-5-18 in Argentina; CICA 8 in Belize; CICA 8, CICA 6 and IR 1529 in Bolivia; Pankaj and IR 1545-339-2-2 in Ecuador; INTI in Honduras; CICA 4, CICA 9, IR 930 x IR 665 in Jamaica; P 918-25-1-4-2-3-1B, IR 2053-205-2-6-3 and IR 1529-151-2-2 in Mexico; IR 665, 4422 (Tikal 2), IR 841, CICA 8 in Nicaragua; P 881-19-22-4-1B-1B-2-5 (Tocumen 5430) in Panama.

Table 15. Characteristics of the three types of IRTP trials.

Type of trial	Characteristics
Nurseries	Yield, observational and screening nurseries for major target environments and stresses
	Relatively large numbers of lines per nursery
	Evaluation in representative test sites and hot spots
	In-depth data gathering
	Preparation of detailed reports
Screening sets	For relatively minor target environments
	Limited number of lines involved
	Evaluation in hot spots
	Limited data gathering
	Preparation of simple reports
Stress resistant donor sets	For major and minor stresses
	Few varieties of proven resistance
	For use in hybridizations

Table 16. Special screening sets for 1981.

Soil and climate	Diseases and insects
Arid regions	Leaf scald
Flood tolerant rice	Brown spot
Medium deep water rice	Cercospora
Floating rice	Sheath rot
Tidal swamp	Bacterial blight
Heat tolerance	Tungro virus
Salinity	Ragged stunt virus
Alkalinity	Gall midge
Fe toxicity	Whitebacked planthopper
Acid sulfate	Green leafhopper
Acid upland	Leaf folder
Peat soils	Yellow stemborer

PANEL DISCUSSIONS

1. Advances and Limitations on Improving Irrigated Rice

Four general talks were given as an introduction to this subject. The talks touched on the following topics:

-- The possible existence of planthopper (Sogatodes) biotypes

-- High-yielding varieties using fewer inputs

-- Leaf scald

-- The problem of stem rot in Ecuador.

Possible existence of planthopper (Sogatodes) biotypes. Dr. P.R. Jennings spoke on observations made in Cuba regarding planthopper biotypes. Genetic resistance to planthopper began in 1968 in Colombia with the IR 8 variety. This resistance has proved stable in every country in Latin America except Cuba, where resistant varieties have shown susceptibility. The specific case at hand concerns IR 8, which is resistant in Colombia and susceptible in Cuba. However, CICA 4 is resistant in both countries. No information is available as to whether the source of resistance in CICA 4 is the same as in IR 8. Studies conducted in Cuba using planthopper colonies multiplied in these varieties and tested in these same varieties show that certain colonies vary in terms of aggressiveness. However, it is still too soon to affirm the existence of a new planthopper biotype. This insect is more aggressive in Cuba where it causes more damage in resistant varieties.

High-yielding varieties using fewer inputs. Edmundo Garcia spoke on this topic and mentioned varietal resistance to disease, edaphic problems and climate as a more effective method of decreasing the use of inputs without sacrificing yield potential. As an example, he pointed out that when planted at lower seeding densities and fertilized with reduced doses of nitrogen, CICA 8 yields increase since large amounts of seed and nitrogen considerably raise variety susceptibility to lodging and its grain production falls off.

Leaf scald. Ernesto Andrade discussed leaf scald and spoke on the cultures used for spore production and inoculation methods. High relative humidity exceeding 70% and temperatures ranging from 25-30% are optimal for spore production.

There are three inoculation systems: leaf cutting, spore inoculation and leaf punctions. Using these systems, plants are inoculated when they are 36 days old and then evaluated 20 days after inoculation.

Mr. Andrade also pointed out that potassium and nitrogen do influence disease development. Potassium levels of 15-60 ppm do not affect disease development, while a 120 ppm dose arrests it. However, the more nitrogen used, the greater the development of disease.

Stem rot in Ecuador. Dr. R. Figoni stated that stem rot (*Sclerotium oryzae*) is seriously affecting irrigated rice production in Ecuador, particularly in areas where rice has been grown for several consecutive years. Consecutive rice crops increase fungus inoculum since it is a saprophyte and remains in the soil for several years.

When in an sclerotial state, the fungus causes damage to rice; however, when in the conidial and ascosporial states, the fungus spreads.

The disease is usually secondary, but in some countries such as the United States and India, crop losses of up to 75% have been reported. High levels of this pathogen have been observed in Ecuador, particularly in fields where rice has been sown for several years and where water level is constant. In preliminary trials, losses of 10-30% were reported.

Dr. Figoni stated that to evaluate varietal resistance, one must consider the extent of fungus penetration in the stem and not the infection rate. Several control measures such as destroying crop residues and crop rotation help reduce the level of the fungus but do not eliminate it. The application of the fungicide Duter during the tillering phase has produced satisfactory results. Nevertheless, the most effective and economical form of control is varietal resistance. Thus, efforts must be combined to find resistant parents and to incorporate this resistance into crossing and selection programs.

Discussion

Planthopper (*Sogatodes*)

Q: Why is there incidence of planthopper in Cuba at the commercial level?

A: Because the varieties grown, IR 880-C9 and IR 1529 are slightly susceptible to mechanical damage. The only resistant variety is Naylamp. Furthermore, moderate temperature conditions during the planting seasons in April-May and September-October favor insect growth. This problem will, however, become less serious when the IR 880-C9 variety is replaced by resistant varieties such as J-104 and Caribe 1.

Q: Francisco Andrade of Ecuador. Why are there problems with hoja blanca eventhough planthopper populations are low in the fields?

A: This is possibly due to the fact that infection occurs in the nurseries, and insects have a high rate of virus transmission.

Stem Rot

Mr. Jetter from Argentina said that stem rot does exist in Argentina and has been observed in IRTP materials. He requested that the program evaluate materials for this disease since it can be very dangerous.

Mr. Figoni concurred with Mr. Jetter's statements; since this pathogen is a saprophyte and can live in the soil for six years, a germplasm evaluation program must be started to find resistant materials that can be used as parents or substitutes for susceptible varieties that are commercially grown.

Q: M. Rosero. Stem rot is a disease that affects not only Ecuador and Argentina but countries throughout the region; it can easily be confused with sheath rot and sheath blight. These three diseases have been considered secondary ones because no evaluation has been done on the yield damage they cause. I would like to ask Mr. Figoni if he could tell us about the yield losses caused by stem rot disease.

A: Stem rot has caused losses of up to 65% in California. In preliminary studies conducted in Ecuador, it was found that yield losses ran between 10 and 30%.

2. Varietal Improvement for Lowland Areas Having Water Control Problems (Rainfed, Varzeas)

Production costs and ratoon crop efficiency in the Dominican Republic. Dr. Federico Cuevas stated that ratoon crop is a common practice to produce rice in the Dominican Republic. During the second harvest in 1977, 45% of rice acreage (49,100 ha) was ratoon cropped. An analysis was done on the profitability of ratoon vs. first crop during the two six-month periods (Table 17 and 18). This analysis shows that a kilo of rice grown with ratoon is cheaper (approximately US$0,10 less) than a kilo of rice produced in a first crop. Production efficiency of ratoon in terms of kilograms of rice/day/hectare was 5.1 kg more than the first harvest with Mingolo variety but 2.4 kg less than the first harvest with ISA 21 (CICA 9). There was no difference in terms of production efficiency with Juma 57 variety.

Technology required to increase productivity in "Pozas" (lowland areas). Francisco Andrade described "pozas" as natural depressions in the land that filled with rainwater or flood waters from rivers during the rainy season (January-April). Rice is planted in the "pozas" during the dry season--May-December. Rice grown in "pozas" is typical of the Guayas river basin in Ecuador, where 25,000 ha are planted with rice producing a yield of 3.2 t/ha. This system is primarily used by small farmers who plant native varieties on areas that are usually no larger than 3.1 ha.

The problems affecting "pozas" is floods which occur from January to May; water depth varies up to 2.5 meters in relation to the lowest water level in the "pozas". Water levels fall from May through December, causing droughts that affect production.

Tides give rise to the pressing problem of salinity. The salinity situation can vary according to season and crop distance from the Guayas River. It increases during the dry season (August-December) in crops located up to 30 kilometers from the place where the Babahoyo and Guayas Rivers meet.

The characteristics of the varieties that should be used in pozas-rice production systems are: tall varieties having good initial vigor, tolerant to submersion, good tillering, long grain, early and intermediate cycle, tolerant to salinity and drought, resistant to planthopper (Sogatodes) and borers and moderately resistant to blast and hoja blanca. The Pankaj variety from India (provisionally called INIAP 9 by the program) performed well in "pozas" rice crop conditions during trials conducted on different materials.

Discussion

Q: Is stem rot a problem in ratoon crop?

A: Mingolo is the variety grown in the Dominican Republic. This particular variety shows no problems with stem rot.

Q: What is the "varzeas" rice crop in Brazil?

A: Varzeas is the name for lowland which are flooded during the rainy season. It is estimated that there are some 25-30 million hectares of varzeas land in Brazil; work has been started to adapt this land for rice-growing purposes. There are two types of varzeas: systematic, which are flat lowlands that have already been adapted for growing irrigated rice; and unadapted, which are lowlands that have not yet been made suitable for trapping rainwater for use in rice crops.

The representatives from Mexico, Brazil and Colombia expressed the urgent need to define the different production systems and their main features. They suggested that CIAT undertake studies and sponsor work meetings in order to arrive at a complete definition and thorough description of production systems in Latin America.

3. Advances and Limitations on Breeding Upland Rice

The topic of this panel discussion was the problems and experiences thus far obtained with favored and unfavored upland rice.

Favored Upland

Upland rice improvement problems in Central America. Jose T. Murillo spoke on this topic. He said that upland rice problems in Central America have only been partially solved through varietal improvement. Nonetheless, many problems remain to be solved in order to improve and stabilize rice production. These problems are biotic, technical, political and economic in nature. The most serious biotic problems include blast, leaf scald, stem rot, sheath rot, narrow leaf spot and helmintosporiosis. At the technical level, Mr. Murillo mentioned problems such as the lack of skilled personnel, job instability owing to political and reorganization factors, the lack of government infrastructure for carrying out experiments and the lack of segregating material in early generations for evaluation in regional ecological conditions.

As to the political and economic problems, the speaker stated that research programs are not included in the framework of national policies on crop development. Consequently, programs do not have the political and economic resources they need to enable them to meet their objectives and goals.

How to transfer high upland yields from experimental centers to commercial crops. Anibal Rodríguez talked on this subject. He explained that high yields are the product of several factors: alluvial soils with a pH of 6.0-6.5 and a clay-like soil texture; good rainfall -- 1500 mm over a 6-9 month period; limited temperature variation; good cropping practices employed in preparing fields; weed, insect and disease control; and adequate nitrogen fertilization. The transfer of this technology involves demonstrating high yields to farmers on their own farms through regional trials, semi-commercial crops, field work, information bulletins and continued personal contact.

How to improve technology to increase upland production in the Llanos Orientales. Dr. Eric Owen addressed this subject and explained that there are five soil types in the Llanos Orientales region of Colombia:

Class I & II, fertile alluvial soils

Class III, poor soils found on low terraces where irrigated rice is grown

Class IV, soils found on high and middle terraces; this type of soil predominates

Class V, forest soils

Class VI, soils along river banks; rice is planted here when river waters go down.

Most soil problems affect class IV soils, which are acid, have a high Al content and Low P and K contents, have poor water retention capacity and erode easily. They are affected by a high incidence of blast, helmintosporiosis, leaf scald and narrow brown leaf spot. The most economically significant pest plaguing this crop is the "cucarro" (*Eutheola bidentata*) since it can devastate a crop in six hours.

Other serious problems involve weeds and a lack of communicating roads.

These savannah soils require varieties that are tolerant to disease and, above all, that respond well to Al toxicity and P deficiency.

Discussion

Q: Which area in the Llanos Orientales has higher productivity--the alluvial lands or the high and middle terraces?

A: Rice grown in the alluvial lands is more profitable because there is a reduced number of risks involved and the need for fertilizer is less.

Q: What is the yield potential of high and middle terraces in the Llanos Orientales?

A: Using a good rice variety and good cropping practices, yield potential could reach 4-5 t/ha.

Q: In Guatemala, there are 15,000 ha. along the Atlantic coast that have alluvial soils and 3000mm of rainfall over an eight month period. Rice is grown in rotation with sorghum and corn. Yields come to 6.0 t/ha. Given this situation, what would be the best way to persuade farmers to adopt new techniques?

A: The best way to convince farmers of the goodness of new techniques is to demonstrate it in semi-commercial trials and field days on the farmers' own lands.

Table 17. Production costs and yields at first and ratoon crops in different regions of the Dominican Republic.

Region[1]	Variety	Harvest	Yield (t/ha)	Efficiency[2] (kg/day)	Costs (ha)	(US$) kg
North	Mingolo	First	4.16	26.00	858.98	0.21
		Ratoon	3.35	33.50	505.65	0.15
Northwest (Valverde)	Mingolo	First	5.07	31.68	880.28	0.17
		Ratoon	3.85	38.50	392.20	0.10
Northeast (Monte Cristi)	Mingolo	First	3.96	24.75	1177.74	0.30
		Ratoon	2.58	25.80	287.79	0.10
Northeast	ISA 21 (CICA 9)	First	6.10	43.57	1010.08	0.17
		Ratoon	3.71	41.22	392.79	0.11

[1] Data taken from State Secretary of Agriculture, Banco Agrícola 1981, in production costs of temporal crops 1980 for north and northwest regions. Data for northeast region came from a farm (53.4 ha) of Mr. Luis Guerrero in Fantino, Sánchez Ramírez Province.

[2] The duration cycles in first crops are 160 and 140 days for Mingolo and ISA 21, respectively. While in ratoon crops Mingolo has 100 days and ISA 21, 90 days.

Table 18. Production costs and yields of Juma 57 planted in first and ratoon crops in the Vãsquez Quintero farm (178.3 ha), Jima Abajo, La Vega Province, Dominican Republic.

Year	Harvest[1]	Yield (t/ha)	Efficiency[2] (kg/day)	Costs (ha)	(US$) kg
1979	First	5.01	33.40	791.74	0.15
	Second	4.14	28.55	782.75	0.19
1980	First	3.91	26.06	939.41	0.24
	Ratoon	2.34	26.00	238.05	0.10

[1] First and second harvests refer to plantings of first and second semester.

[2] Juma 57 has a duration of 150 days in the first semester and 145 days in the second; in ratoon crop this variety has a duration of 90 days.

Unfavored Upland Rice

The problems involved in improving unfavored upland rice were discussed in three different talks.

Experiences of the Instituto Agronomico de Campinas (IAC) N.V. Banzatto presented a summary of IAC progress in developing varieties for unfavored upland production in the State of Sao Paulo. He explained that IAC has been doing research on upland rice for 40 years. From 1915-1935, the main varieties planted in Sao Paulo were Agulha peludo, Agulha liso, Cateto, Agulha, Japao, Jaguari, Mattao, Dourado, Douradinho and Agulha dourado.

In 1943, the Institute recommended the Jaguari, Iguape, Cateto and Dourado Agulha varieties for unfavored upland conditions.

In 1925, IAC recommended agulha type varieties such as Dourado Agulha, Iguape Agulha, Perola, Pratao and other like Jaguari, Cuatro meses, Cateto branco and Iguape Cateto. Perola, Pratao and Dourado Precoce (introduced in 1959) were widely used to obtain new varieties. In 1965, IAC 1246 made its appearance and played a key role in upland rice production up to 1973. In that same year, the Institute introduced IAC 47, a variety that was more resistant to narrow brown leaf spot and lodging and more high yielding than IAC 1246. In 1974, the Institute brought out IAC 25, which was the product of a cross between Dourado Precoce and IAC 1246. IAC 25 is early maturing (110-120 days), which makes it possible to plant it after December. This is extremely important for the extensive upland rice crops in Brazil. This new variety replaced other early maturing ones that were not widely grown and had inferior grain types; they include Batatais and Pratao Precoce.

In 1980, IAC introduced the IAC 164 and IAC 165 varieties (a cross between Dourado Precoce x IAC 1246). In production terms they are similar to the parents but yield-wise, they produce up to 25% more than IAC 25 and are more tolerant to drought.

EMBRAPA and its experiences in developing unfavored upland varieties. Elcio P. Guimares spoke on this subject. He explained that upland rice is grown all over Brazil but that production is concentrated in the central-western states of the country in Mato Grosso, Goias and Mato Grosso do Sul. The rice grown in Goias is a transition crop that is playing an important role in the development and adaptation of the land over a three-year period before putting it to use as pasture lands for cattle.

The unfavored upland system is the main system used in this region below parallel 13. Total rainfall is sufficient for crop needs; however, rainfall distribution is irregular, especially in the months of January and February when droughts, regionally known as "veranicos", occur. Depending on their length and the stage of crop development, these droughts can cause losses of up to 100%. Blast is another serious problem affecting this crop, along with a number of deficiencies and nutrient toxicity problems.

The Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA, the Brazilian Institute for Agricultural Research) began research work on upland rice in 1975 at the Centro Nacional de Pesquisa de Arroz, Feijao (CNPAF-the National Rice and Beans Research Center). This research encompasses breeding pathology, agronomy and agro-meteorology. Studies focus on obtaining varieties with resistance to drought and blast that have good grain quality and high yields.

Research findings indicate that: a) the combination of varieties adapting well to unfavored upland conditions with IRTP lines or varieties are not satisfactory; b) combinations of single crosses using national material and African lines show more promising results; c) combinations of national varieties are promising in terms of drought resistance but need a source of resistance to blast; d) in selecting for blast resistance and good plant type, the best results have been obtained with African materials.

Problems in varietal improvement for acid soils in jungles. Cesar P. Martinez discussed this subject and stated that acid soils in jungles represent a potential ecosystem for upland rice. This system includes certain areas of the savannah regions in Colombia, Venezuela, the jungle region in Peru and Northern Brazil, where rainfall is plentiful and acid soils unfertile. Obtaining varieties that do not suffer from hydric deficiency for this type of unfertile soil will depend on the answers provided for the following questions:

-- To that extent could production be increased and stabilized?

-- What is the yield goal? Since there are native varieties that yield 1.5 t/ha, a possible optimal yield goal might be 3 t/ha.

-- Could native varieties maintain their tolerance to soil problems and disease if cropping densities and fertilization practices are increased?

-- What is the ideal type of plant for this ecosystem? One possibility might be a tall plant that has an intermediate tillering capacity, dropping leaves during the vegetative phase but upright ones during the reproductive one.

-- Which production system is the best?

4. Difficulties in Improving High-yield Varieties in Temperate Zones

This panel discussion focused on the problems of straighthead low temperatures, early maturing and grain quality.

The straighthead problem in Argentina. W. Jetter explained that 100,000 ha are planted with irrigated rice in Argentina. Upland rice is not grown. Thirty percent of the rice acreage is sown with the Fortuna variety which is susceptible to straighthead or "vaneo" as it is known in Argentina. Straighthead can cause partial and/or total sterility of panicle grains. This problem becomes worse in light soils where the land is flat, drainage poor and rich in organic matter. The new IR 841 variety was planted on 15% of the total rice acreage; yields of 6-7 ton/ha were estimated but due to straighthead susceptibility, yield averaged only 3 t/ha.

The straighthead problem has existed for many years. Rice farmers have become familiar with the problem and have learned to deal with it by using methods such as draining fields when the crop is 50 days' old until the land is dry and cracked. When this occurs, the soil is oxygenated and the problem then diminishes. However, after CIAT scientists visited this area in March, 1981, the idea arose to eliminate the problem by developing resistant varieties. Varietal resistance was observed in the materials in the IRTP 1980 nurseries. CICA 8 and other lines showed high resistance, while CICA 4, IR 841, Fortuna and others were extremely susceptible.

Breeding problems in Chile. Roberto Alvarado explained that the rice-growing area in Chile is located between 34°10' and 36°36' latitude south. The irrigated production system is used. Pre-germinated seed is directly planted. The rice season runs from October to March. Nitrogen is a limiting factor on this crop, and the most serious weed problems are caused by *E. crusgalli* and *Alisma plantago*. There are no serious pest and disease problems. Short grain varieties that have a large white center are grown; the main variety is Oro. In recent years, as a result of a more liberal import policy, the market for medium and long grain rice has been opened. This forced the Program to release farmers the Diamante variety--a long grain rice having good milling properties.

The most serious factor hindering variety improvement is low temperatures during the initial growth phase (October-November) and during flowering (January-February). During the vegetative phase, the average temperature ranges from 9.5°-13.9°C., while the average minimum temperature runs from 4.4°-7.4°C; at flowering the average temperature fluctuates between 17.6° - 21.0°C, and the average minimum temperature goes from 9.0°-11.0°C. These low temperatures prolong the flowering cycle and cause sterility. One suggested solution to this problem involves introducing germplasm from countries with similar climatic condititions. Another more feasible solution would be to introduce segregating material for selection in Chilean climatic conditions.

The future of dwarf varieties in temperate zones--the case of IRGA 409. Paulo O. Carmona spoke on this topic and said that in the State of Rio Grande do Sul, Brazil, 600,000 ha are planted using the irrigation system with average yields of 3.3-4.0 t/ha. Seventy-five percent of the rice acreage is planted with American varieties including Bluebelle in 60% of the area. 20% of the area is planted with traditional varieties, and 5% is planted with semi-dwarf ones. Rice acreage expansion began in 1972 with good grain quality varieties so as to be able to compete with the varieties produced by the Instituto Agronomico de Campinas (IAC) in Sao Paul. Disease increased with the use of the Bluebelle variety and was only partially controlled through the use of dwarf varieties like CICA 4 and IRGA 408. Due to their inferior grain quality, these varieties were not well accepted although IRGA 408 is still grown in some areas. The IRGA 409 variety was distributed to help solve the problem of grain quality; it had been selected from segregating materials provided by CIAT. IRGA 409 has good grain quality, is tolerant to low temperatures and is 30% higher-yielding than Bluebelle. Reports indicate that IRGA 409 planted in a commercial field of 2500 ha had an average yield of 7.2 t/ha during the 1980-1981 harvest. Although this variety does produce good yields, it also suffers from certain problems such as blast disease. In other states in Brazil that lie to the south of Rio Grande do Sul, this variety has shown very limited tolerance to low temperatures affecting this area, and thus cannot be planted on some 100,000 ha. of rice acreage in this zone. Another limiting factor is IRGA 409 sensitivity to yellowing which has been observed in acid soils in other states. IRGA 409 has just begun to be put on the market and has been well accepted by both farmers and millers. However, certain questions do arise regarding consumer acceptance of this variety: the implications of having only one variety to replace Bluebelle, and the problems that may come up when IRGA 409 is fully marketed. These questions were raised in view of the fact that the program has no new materials over the short term. Several lines having better yields than IRGA 409 but poorer grain quality and later maturing were observed in the germplasm distributed in IRTP nurseries. CIAT support is required in terms of providing new materials having the following characteristics: early maturing, high yielding, good grain quality and tolerant to blast and low temperatures.

Discussion

Q: Why should Chile change from short to long-grain rice?

A: Before, people only ate short-grain rice; however, with the introduction of medium and long-grain rice from international markets, consumers have gotten used to these kinds. This was the reason that the Diamante variety was released, which has long grain and cooking quality. Dr. P. R. Jennings talked about the performance of Japanese and Californian varieties in Chile. The Japanese varieties adapt well to this environment but are susceptible to lodging, while the Californian ones are very late maturing. Climate conditions in Chile are excellent with both considerable solar radiation and a lack of pests and diseases contributing to high yields. Nonetheless, low temperatures in Chile are the major limiting factor on rice growing, and this problem is not easily solved by crossing. The suggestion was made to irradiate current varieties, especially the Oro variety, to obtain short mutants having better grain quality and tolerance to low temperatures. Someone else suggested that Australian varieties might work in Chile. The 1979 IRTP low temperature nursery included the Kulu variety from Australia, which is a long-grain variety that tolerates cold.

Q: What strategies are being applied to the IRGA to obtain varieties with good grain quality?

A: Good quality parent s such as Bluebonnet and Bluebelle are being used in crosses; however, one problem faced when using them is that it is difficult to recombine their characteristics well. One important factor in the selection of introduced segregating materials is grain quality, which is tested in each generation; this was the criteria used in the selection of IRGA 409.

5. Factors Affecting Change in Rice Production Systems and their Research Needs

This panel discussed the factors influencing the change from one production system to another and the need for research on these changes.

The regional factors and needs involved in such changes were discussed and specifically in regard to Mexico and Peru.

Research factors and need in the region. Dr. Rafael Posada stated that there are two main reasons why a rice production system in a country will change: a) because the government of this country feels that change is necessary, and thus takes the necessary steps to bring it about; and b) farmers think that it will be more profitable to grow rice using a different production system. Whether it is the government or farmers who desire change, the underlying reasons for such change are always socio-economic in nature.

During the panel discussion on this point, the following factors were mentioned in relation to the government:

1) The government wishes to accelerate the economic and social development of a region and believes that rice production is a viable alternative for achieving this goal; 2) to better utilize the resources in a given region, the government would like to see a change in the production structure by diversifying production or by concentrating it in one lone product; 3) the government wishes to resolve crop production problems caused by the limited or finite availability of certain key production factors; 4) the government wishes to increase the rice supply to satisfy domestic demand and/or to create surpluses for export; and 5) the government wishes to stabilize the rice supply and protect it from major variations from year to year that might cause price instability.

There are examples in Latin America of these five factors. For instance, in Mexico, the government is furthering the development of upland rice in the southeastern part of the country in order to employ lands currently used to grow irrigated rice for raising other more profitable crops such as vegetables for export. In Peru, the largest rice-growing area is found along the northern coast. Irrigation is the predominant production system used. However, limited water resources are placing serious restrictions on production, which fluctuates from year to year. One possible alternative the Peruvian government has found to this situation is to promote the growing of upland rice in the jungle region in the eastern part of the country where rainfall is sufficient. This alternative has the additional virtue of providing a source of development for an underdeveloped region. In Brazil, most rice is produced using the upland system. Irregular rainfall results in variations in production, making it necessary to import rice in order to meet domestic demand. To solve this problem, the government is promoting the development of irrigated production systems.

Most rice farmers in Latin America live in market economies whose main requirements are productivity and profitability. To remain on the market, farmers must continually find ways to reduce costs. The two highest costs are land and chemical inputs. Thus, farmers are always on the lookout for cheaper land and/or production systems that rely less on these types of inputs. One example of this is found in Colombia, were rice acreage is expanding in the Llanos Orientales region. Land is less expensive in this area than in traditional rice-growing zones while at the same time rainfall is more plentiful and better distributed. As a result, farmers can obtain better harvests in upland conditions using fewer inputs, especially in terms of nitrogen fertilizers.

The next items discussed deals with the implications production system changes have for national rice research programs. There are two main implications. The first concerns the pressing need to develop new technology and the second the type of technology needed. The first implication is conditioned by whether it is the government or the farmers who are interested in the change. If it is the government that is behind moving rice production to a new area and/or adopting a new system, the demand for new technology will be immediate, depending on government plans for implementing change. The greater the difference between new and old production systems, the greater the pressure will be on the national research program to produce new technology. On the other hand, it the move for change comes from the farmers, the need for new technology is not as urgent since current technology will still be applicable.

With regard to the second implication, the type of technology developed will depend on regional characteristics and the limitations they place on crops. To detect these limitations, research programs must: a) determine what type of system to develop in relation to the use of machinery and chemical inputs, field size and land ownership, etc.; and b) determine the agro-ecological and socio-economic characteristics of the new zone. With this information, researchers can design a technological package that is suited to the new zone and proposed system.

Research factors and needs in Mexico. Leonardo Hernandez explained that the factor influencing the change of production systems are related to agro-ecological, technological and socio-economic factors. The biological water-soil-plant systems and climate make up the agro-ecological factors. Researchers can base their studies on change on the features of several biological system components. At the technological level, Mr. Hernãndez mentioned program objectives and the support researchers receive from international centers to generate suitable technologies for production systems. With regard to socio-economic factors the speaker stated that low crop productivity and scarce manpower in certain regions pave the way for a change towards new potential production zones where productivity will increase and available manpower put to better use.

Mr. Hernandez talked about research needs and said that irrigation germplasm must be diversified so that it can be evaluated in different regions suffering from salinity and a lack of water. What is needed is a type of germplasm that responds well when few inputs, fertilizer in particular, are used. Upland rice requires varieties that are tolerant to drought and disease and herbicides to be used before and after emergencies for effective weed control. The speaker felt that it was essential to train personnel to work on research activities and asked the IRRI and CIAT for more assistance in training people in the different crop disciplines.

Research factors and needs in Peru. Rafael Olaya explained that in Perú, some 120,000 to 130,000 hectares were planted with rice--75% in the northern coastal region where irrigated rice is grown and 25% in the jungle region where upland rice is grown. Irrigated rice production is very risky since its productivity mainly depends on the water availability in dams. From 1978-1980, Peru suffered a serious drought that caused rice acreage to be reduced. This, in turn, brought about a production shortage that forced the government to import some 250,000 tons of rice to meet demand. Yields are high on the northern coast when there are no droughts; yields of 11-13 t/ha have been obtained with IR 8 commercial crops in areas receiving 11-12 hours of light. As a rule, yield averages 6-7 t/ha. In the jungle, yields are low--1.5-2.0 t/ha--mainly as the result of the high incidence of disease, the lack of infrastructure and little mechanization. The droughts afflicting the northern coast have moved the government to promote the expansion of upland rice crops in the jungle area.

CICA 8 and PNA 221 have performed well in the jungle due to their resistance to blast. However, more genetic diversity is necessary to obtain more efficient varieties that require little nitrogen. More research is needed on chemical products used to control blast disease and especially on those that have lasting residual action in seed treatment. Nitrogen is a costly input that must be studied to find ways to reduce both its use and cost. Other areas that should be explored are crop rotation, minimal tillage of the crop and legume incorporation.

Discussion

The Llanos Orientales region of Colombia can be divided into two distinct zones: savannah and fertile alluvial zones. Irrigated rice is planted on the former while upland rice is grown on the latter. Upland yields with CICA 8 are more profitable than irrigated ones because the soil is fertile and the variety performs well. Thus, it is more profitable to plant CICA 8 in alluvial soils using upland production methods in this region than to plant it in savanna soils using irrigation systems. This then, is an example of how farmers themselves can bring about changes in an effort to increase the income derived from crops.

6. Need for Agronomical Research on Different Production Systems

Several people on this panel talked about different subjects related to the need for agronomical research on the different production systems used in Latin America.

Need for research on favored upland rice. This subject was analyzed by Rolando Gonzalez, who talked about upland rice in Costa Rica, which can serve as an example of rice for the rest of Central America. Upland ecosystems were defined in the following way:

Highland upland system. This system is located on moderately sloping land that can be worked by mechanical means and has good drainage. There are two basic types of weather: a rainy season that can last up to nine months; and another season that is divided into a 5-6 month dry and hot period and a 6 month hot and rainy one. During July and August rainfall in scarce, and this period is known as "canicula".

Lowland upland system. This system is found in flat areas almost at sea level that have clay-like soil, slow drainage and a fairly high level of fertility. Rainfall is distributed over a rainy season and a stational one. The most serious problem affecting this system is excessive rainfall which makes it impossible to prepare land for planting with conventional equipment and requires the use of heavy machinery.

It was suggested that research done on these upland systems focus on the following areas:

-- Early maturing varieties (100-120 days) that are resistant to blast and tolerant to drought and pests (planthopper (*Sogatodes* and *Elasmopalpus*) and are needed for highland upland system.

-- Varieties having an intermediate cycle (120-135 days) and the same resistance as early maturing varieties; they are needed for the lowland upland system that received just enough rain. Late maturing varieties (150-180 days) that can be harvested after the rainy season are needed for the lowland upland system that receives plentiful rainfall.

-- The effective control of weeds, especially of *Cyperus rotundus*, *Rottboellia exaltata*, *Ixophorus unicetus* and *Echinochloa colona*, which are extremely aggressive weeds that affect all upland systems.

-- Fertilization needs, especially as regards phosphorous and the micro-nutrients Zn, Mn, and Fe for each ecosystem.

-- The most effective control methods for insects: *Spodoptera sp.*, *Blissus sp.* and *Elasmopalpus lignosellus*; and for blast, by combining varietal resistance with fungicide protection.

-- More economical means of preparing very humid soils using agricultural machinery that works faster than the rototiller.

Needs for research on irrigated rice in the tropics. Joaquin Gonzalez discussed this subject. He said that before research needs on irrigated rice in the tropics can be established, it is first necessary to define the agronomical limiting factors affecting this crop and determine if they are local or regional in nature, and second, to determine the location where research will be conducted. Local research needs are great and should be handled by national programs. In some cases, the problem to be studied is common to several countries and thus, should be taken up by international centers with the cooperation of one country where research work can actually be done.

The need for research on unfavored upland rice. Silvio Steinmetz from Brazil talked on this subject. He began by describing the importance of upland rice for Brazil. He explained that from 1975-79, close to 64% of all national production came from upland areas mainly located in the states of Goiás, Minas Gerais, Mato Grosso do Sul, Maranhao, Sao Paulo and Parana. Upland rice from Minas Gerais, Sao Paulo, Mato Grosso do Sul and the southern part of Goias is considered unfavored because of the drought situation that occurs during the rainy season. Over the last 10 years, droughts have reduced rice production by one million tons from one year to another.

There are two well-defined periods of rainfall in the upland rice areas: a rainy period that lasts from October to April when 90% of the annual precipitation falls; and another basically dry season that goes from May through September. Upland rice is planted during the rainy period when droughts (veranicos) occur anywhere from mid-December through mid-February which coincides with the reproductive phase. In addition to drought problems, this rice also suffers from edaphic difficulties such as acid soils with low humidity retention that are poor in the main macro and micro nutrients and are affected by Al toxicity.

The speaker suggested that in-depth studies be done on the different upland regions; then, the appropriate technologies for each region can be defined. The use of some practices like subsolation and laminar compaction, and soil liming help increase crop productivity. Likewise, the use of early maturing varieties that flower before droughts occur offer another alternative for increasing production when planted at proper seeding densities.

The need for research on irrigated rice in temperate zones. Marco A. de Oliveira talked about the need for research on this subject. As an example, he referred to the rice situation in Rio Grande do Sul, where he said that the potential for increasing rice production is good. There are, however, factors limiting production expansion such as the technology currently employed in growing these crops which results in low productivity. Other problems include: land adaptation, weeds (mainly red rice), limited adaptation of high-yield varieties due to their lengthy cycle, poor grain quality and susceptibility to low temperatures and disease (blast). Solutions to these problems were offered but largely depend on CIAT support and assistance. The solutions include:

-- Broadening the genetic selection base with F_2 segregating materials provided by CIAT to obtain early maturing, good grain quality and tolerance to cold and diseases.

-- Broadening the genetic base with advanced lines from CIAT and other sources that have already been evaluated in temperate and sub-tropical environments.

-- Increased cooperation for providing interdisciplinary training for program personnel.

-- Having CIAT technical experts work in close conjunction with programs in temperate zones.

-- Providing appropriate technology to eliminate the red rice problem.

The need for research in low and flood zones. Julio Salvador addressed this subject and described a rural development project in the lower Guayas River Basin, which has been called the Samborondon Project. The government implemented the project through all of the departments and agencies working in the field of agricultural development in Ecuador. The primary project objective was to solve water control problems in the rice-growing area of Samborondon, where rice is grown in "pozas veraneras". The pozas are natural shallow depressions in the land that are flooded during the rainy season (January-May) but also remain filled with water during the dry season (June-December). Rice is sown by means of transplants, which are planted at regular intervals between March and December. The pozas area covers 25,000 ha and has an altitude that ranges from 0.8-2.8 masl. Traditional varieties such as Pico Negro and others which yield 3.2 t/ha are cultivated.

The main problem affecting this crop is salinity and is the product of tidal action, semi-deep waters during the first two months of the year, a shortage of water from September-December and low productivity from traditional varieties. To solve these problems, high-yielding varieties of easy threshability are needed; in addition, they should also have the following characteristics:

-- Tolerance to submersion for low areas

-- Tolerance to drought for highland areas; these varieties should also be early maturing so that the risks of the prolonged drought that comes at the end of the dry season can be reduced.

-- Tolerance to semi-deep waters and good tillering capacity

-- Salinity tolerance.

Discussion

Q: What was behind the policies established to promote growing rice using the "varzeas" system in Brazil?

A: The government implemented this policy to increase rice production by putting unutilized floodable lowlands to use for this purpose. Systematic varzeas systems are trouble-free since existing technology is used for growing rice. However, technology is being developed for undeveloped varzeas.

Q: People have stated that red rice is on the rise and poses a serious problem in many countries. What suggestions could be made to eliminate this problem?

A: Several comments and suggestions were made. Red rice is a serious problem that is not easily solved. To do so would require a number of measures that include:

-- Proper preparation of land and the use of herbicides like Gesaprin as soon as red rice appears.

-- Puddling the land and keep it flooded for 15-20 days. This helps eliminate up to 80% of the red rice population.

These measures, along with the use of certified seeds, are very effective in eliminating this problem.

Q: Someone mentioned the fact that rice losses reach up to 10% in mechanized harvesting in Costa Rica. Since a large number of seeds are left in the fields, it was suggested that CIAT conduct semi-commercial studies on the economic and practical feasibility of using the fallen rice during mechanized harvesting as seed.

FUTURE PLANS FOR IRTP NURSERIES IN LATIN AMERICA

The idea for IRTP nurseries in Latin America came into being because the germplasm distributed by IRRI included widely diverse genetic material that was largely unsuited to regional needs as a result of its susceptibility to planthopper (Sogatodes) its poor cooking quality and its short and medium grain legth. Furthermore, most national rice programs are small and do not have the financial and technical resources needed to evaluate, select and utilize this genetic diversity in crossing programs.

In response to these problems, three types of nurseries were set up for Latin America: a) Yield nurseries for irrigated and upland rice; the irrigated ones included early, intermediate and late maturing varieties or lines; the upland ones included varieties having varying maturing cycles. b) Observational nurseries for upland and irrigated rice. c) Specific nurseries for blast, sheath blight, leaf scald, acid soils, salinity and/or alkalinity, semi-deep waters and low temperatures.

Each yield nursery was made up of ten to twenty-five lines; the nurseries were created to meet the needs of both large and small national programs but were fundamentally aimed at the smaller ones. These nurseries have not been used to any great extent, most likely because they were evaluated in a different production system (upland) than the one for which they were selected (irrigated). On the other hand, observational nurseries were comprised of more lines and were created, for the most part, for use by large national rice programs. These nurseries have been widely used because on the basis of germplasm performance in various ecological environments, the best materials were selected for inclusion in IRTP yield nurseries; national programs have made their own selections for evaluation in local yield tests and regional trials. These nurseries have also been useful in detecting materials that are resistant to limiting factors that do not exist at CIAT.

Specific nurseries were primarily designed to identify parents having resistance to a specific problem; thus, they were of use to programs affected by such problems which had the capability to evaluate and select materials. These nurseries have been useful in detecting materials that are resistant or tolerant to blast, leaf scald, sheath blight, salinity, acid soils and semi-deep waters. They have also been helpful in determining the best sites for testing specific resistances in more effectively evaluating materials. For instance, Tocumen (Panama) is a key place for selecting materials for resistance to sheath blight and leaf scald; ICA-La Libertad (Colombia) is ideal for selecting materials that are resistant to yellowing or oranging of leaves (acid soils problem); La Laguna (Dominican Republica) is the best place to select for salinity-resistant materials.

Changes in Nurseries

IRRI and CIAT have spent a certain amount of resources on the IRTP for Latin America. Their sole aim in doing this has been to help national programs solve problems related to the rice crop and increase production to meet consumption needs. To achieve this goal more quickly, germplasm type and distribution must be in keeping with national program needs.

The cooperation network set up with national programs is a solid one that makes it possible to introduce certain changes designed to improve efficiency. Changes made in nurseries were based on the following considerations:

-- Asian materials have good genetic variability and some have good yield potential; however, their potential in Latin America is confined to a few ecological environments. Nonetheless, these materials will continue to be used but with a more rigorous criteria of selection.

-- The CIAT rice program already has enough advanced materials, that may not cover all, but to cover most of the goals pursued by national programs.

-- Several large national programs also have sufficient materials that enable them to work with the IRTP to help small programs.

The suggestion was made to eliminate the following nurseries: a)

Early maturing (VIRAL-P), late maturing (VIRAL-Tar), upland (VIRAL-S), and specific (VERAL) yield nurseries; b) irrigated (VIOAL) and upland (VIOAL-S) observational nurseries; and c) specific nurseries for blast (VIPAL), leaf scald (VIOAL-Es), sheath blight (VIAVAL) and acid soils (VIOAL-SA).

The following nurseries will be continued:

a) International Rice Yield Nursery for Latin America with medium maturing varieties (VIRAL-T). The best promising materials will be included in these nurseries; this nursery may be planted in irrigated systems in countries where this systems is used and in favored/upland conditions where this production system is used.

b) International Rice Observational Nursery for Latin America (VIOAL). This nursery will include both early and late lines that are resistant to the main diseases in the region and tolerant to acid soils.

   The nursery may be planted in both irrigated and favored upland conditions.

c) International Rice Observational Nursery for Unfavored Upland Conditions (VIOAL-SNF). This nursery will be comprised of materials from CIAT, Asia (IRRI) Africa, Brazil and other countries in the region. It will only be distributed to countries using the upland system where drought and soil fertility are problems.

d) Specific nurseries for Low Temperatures (VITBAL), Salinity (VIOSAL), and Semi Deep Water (VIRAL-F). It was recognized that CIAT does not have facilities to evaluate germplasm for these specific problems. But material can be planted for purification multiplication of seed and determining grain quality and resistance to planthopper (Sogatodes). Thus, in this particular case, national programs may, directly or through CIAT, request germplasm from IRRI.

Nursery Methodology and Handling

Nominating materials for the 1982 nurseries. National programs with promising lines were asked to nominate them for inclusion in the 1982 nurseries. Argentina, Costa Rica, Ecuador, Peru, Surinam, Venezuela and Brazil (IRGA) all responded to this request.

Nursery shipment. No changes were made in shipment dates, which means that nurseries will continue to be sent out at the established times: in March-April for countries that plant from May to June; and in August-September for those planting from October-December.

The delegate from Costa Rica suggested the possibility of sending seed in metal boxes rather than carton ones in order to prevent damage caused by rats in customs zones.

No changes were introduced into data gathering and report sending procedures.

Monitoring Visits

These visits are very valuable both for those making the visit and the technical experts in the countries visited. Visits will continue as far as IRTP budget limitations so permit.

Plans are in the making for a 1982 monitoring visit to the Caribbean region to visit national programs in the Dominican Republic, Haiti, Jamaica and Puerto Rico.

IRTP Conferences

The announcement was made that IRTP conferences will continue to be held every two years at CIAT.

Several conference participants stated that the topic of the next conference should be "The characterization of rice production systems in Latin America."

THE CURRENT RICE PRODUCTION SITUATION IN LATIN AMERICA

National rice program directors were surveyed in an effort to update information on rice acreage and production, the varieties grown, limiting factors, production costs, consumption and marketing, the distribution of the rice-growing area in terms of production systems, the use of IRTP germplasm and training needs.

Survey findings are presented in Tables 19-26.

Table 19. Rice area, production and yield in Latin America, 1979-1980.

Countries	Area (000 ha)[1]			Production (000 t)			Yield (t/ha)		
	Irrigated	Upland	Total	Irrigated	Upland	Total	Irrigated	Upland	Average
Argentina	100.0	-	100.0	300.0	-	300.0	3.0	-	3.0
Belize	4.0	2.5	6.5	10.0	6.0	16.0	2.5	2.4	2.5
Bolivia	-	54.1	54.1	-	92.7	92.7	-	1.7	1.7
Brazil	780.0	5451.0	6231.0	3000.0	5921.0	8921.0	3.8	1.1	1.4
Chile	40.8	-	40.8	95.4	-	95.4	2.3	-	2.3
Colombia	327.6	95.0	422.6	1638.0	152.0	1790.0	5.0	1.6	4.2
Costa Rica	1.5	80.0	81.5	7.5	208.4	215.9	5.0	2.6	2.6
Cuba[2]	151.0	-	151.0	450.0	-	450.0	3.0	-	3.0
Dominican Republic[2]	98.8	-	98.8	299.8	-	299.8	3.0	-	3.0
Ecuador	66.1	68.8	134.9	269.7	110.8	380.5	4.1	1.6	2.8
El Salvador	3.3	11.5	14.8	13.8	43.7	57.5	4.2	3.8	3.9
Guatemala	-	11.5	11.5	-	24.3	24.3	-	2.1	2.1
Guyana[2]	86.4	35.2	121.6	259.2	52.8	312.0	3.0	1.5	2.6
Haiti	31.5	10.6	42.1	169.9	30.4	200.3	5.4	2.9	4.8
Honduras	1.2	18.0	19.2	3.6	32.4	36.0	3.0	1.8	1.9
Jamaica	1.5	-	1.5	4.2	-	4.2	2.8	-	2.8
Mexico	73.5	58.5	132.0	311.0	145.2	456.2	4.2	2.5	3.5
Nicaragua	23.0	19.0	42.0	79.1	28.9	108.0	3.4	1.5	2.6
Panama	1.5	97.0	98.5	5.3	155.6	160.9	3.5	1.6	1.6
Paraguay[2]	20.7	11.1	31.8	43.4	14.8	58.2	2.1	1.3	1.8
Perú	72.0	28.2	100.2	360.0	48.0	408.0	5.0	1.7	4.1
Surinam	35.7	-	35.7	150.0	-	150.0	4.2	-	4.2
Uruguay	62.0	-	62.0	310.0	-	310.0	5.0	-	5.0
Venezuela	125.0	106.4	231.4	500.0	260.0	760.0	4.0	2.4	3.3
Total	2107.1	6158.4	8265.5	8279.9	7327.0	15606.9	3.9	1.2	1.9

1 Blanks indicate that this type of rice is not planted.
2 Data based on the 1977-78 harvest.

Tabla 20. Cultivated Rice Varieties in Latin America, 1979-1980.

Country	Variety name	Variety type[1]	System		Area		
			Irrigated	Upland	Total (000 ha)	Irrigated (%)	Upland (%)
Argentina	Bluebonnet 50	IT	X		100.0	28.0	
	Fortuna	T	X			28.0	
	IR 841, 63, 5, 18	S	X			12.0	
	Bluebelle	IT	X			10.0	
	Itapé	IT	X			7.0	
	Lebonnet	IT	X			6.0	
	Bonnet 73, La Belle						
	Starbonnet	IT	X			5.0	
	Arroyo Grande, Yervá	IT	X			4.0	
Belize	CICA 4, 6, 8, 9	S	X	X	6.5		
	CR 1113	S	X	X			
	Texas Patna	IT		X			
	Belle Patna	IT		X			
	Bluebonnet	IT		X			
Bolivia	Bluebonnet	IT		X	54.1		
	Dourado	T		X			
	90 días colorado	T		X			
	Pico Negro (Bluebelle)	T		X			
	CICA 8	S		X			
	IR 1529	S		X			
	CICA 6	S		X			
Brazil	IAC 47	IT		X	6231.0		
	IAC 25	IT		X			
	IR 841, 63, 5, 2, 9, 33	S	X				
	IR 22	S	X				
	Bluebelle	IT	X			61.5	
	Lebonnet	IT	X			7.6	
	EEA-406	T	X			4.2	
	Bico Torto	T	X			3.9	
	EEA-404	T	X			3.6	
	IRGA-407	T	X			2.3	
	IRGA-408	S	X			2.3	

(continued)

Country	Variety name	Variety type[1]	System		Area		
			Irrigated	Upland	Total (000 ha)	Irrigated (%)	Upland (%)
Chile	Oro	IT	X		40.8	80.0	
	Quella	IT	X			8.0	
	Niquén	IT	X			7.0	
	Diamante	IT	X			5.0	
Colombia	CICA 8	S	X	X	422.6	30.0	10.0
	IR 22	S	X			24.0	
	CICA 4	S	X	X		15.0	7.0
	CICA 9	S	X	X		5.0	1.0
	CICA 7	S	X			4.0	
	CICA 6	S	X	X		3.0	1.0
	Bluebonnet 50, other	IT	X			4.0	
Costa Rica	CR 1113	S	X	X	81.5	2.0	58.5
	CR 5272	S		X			24.6
	CICA 7	S		X			11.0
		T		X			3.9
Ecuador	INIAP 6	S	X	X	134.9		
	INIAP 415	S	X				
	INIAP 7	S		X			
	Donato	T		X			
	Pico Negro	IT		X			
	SML	IT		X			
	Canilla	T		X			
El Salvador	X-10	S	X	X	14.8	2.0	60.0
	Masol 1	S	X	X		2.0	5.0
	CICA 9	IT		X			6.0
	Nilo 1	S		X			6.0
	Nilo 3	S		X			6.0
	CR 1113	S		X			6.0
Guatemala	Tikal 2	S		X	11.5		60.0
	Lebonnet	IT		X			20.0
	Americanito	T		X			10.0
	Bluebelle	IT		X			5.0
		T		X			5.0
Haiti	Dawn	IT	X		42.1		
	Folton	T	X	X			

(continued)

Country	Variety name	Variety type[1]	System		Area		
			Irrigated	Upland	Total (000 ha)	Irrigated (%)	Upland (%)
	Buffalo	T	X	X			
	Ti-Fidele	T	X	X			
	MCI-65	IT	X				
	Starbonnet	IT	X				
	MCI-3	S	X				
Honduras	CICA 6	S	X	X	19.2	1.6	23.0
	CICA 9	S	X	X		0.9	20.0
	CICA 8	S	X	X		1.4	16.0
	CICA 4	S		X			5.8
	Bluebonnet 50	IT		X			7.0
	Criollas	T		X			19.0
	CR 1113, IR 100, Tikal 2	S	X			2.3	3.0
Jamaica	CICA 9	S	X		1.5	30.0	
	CICA 4	S	X			20.0	
	Buffalo	IT	X			15.0	
		T	X			35.0	
Mexico	Navolato A 71	S	X	X	132.0	27.0	23.0
	Bamoa A 75	S	X			2.8	
	Morelos A 70	IT	X			8.4	
	Sinaloa A 68	S	X	X			2.7
	Grijalva A 71	IT		X			4.4
	Macuspana A 75	IT		X			3.6
	Juchitan A 74	S	X			8.4	
	CICA 4 and CICA 6	S	X	X		6.7	6.6
	Morada Criollo	T		X			1.3
	Criollo de Colima	T		X			1.8
	Milagro Filipino (IR 8)	S	X	X		1.6	0.9
Nicaragua	IR-100 d	S	X		42.0	27.3	
	Bluebonnet	IT		X			22.7
	CICA 8	S	X	X		5.5	4.5
	CR 1113	S	X	X		5.5	9.1
	IR 22	S	X			10.9	
	CICA 4	S		X			4.5
	L 9	S	X			5.5	4.5
	Others	T		X			

(continued)

Country	Variety name	Variety type[1]	System		Area		
			Irrigated	Upland	Total (000 ha)	Irrigated (%)	Upland (%)
Panama	CICA 7	S	X	X	98.5	1.1	19.7
	CICA 8	S	X	X		0.4	9.9
	4444 Entry	E		X			4.9
	CR 5272 and CR 1113	S		X			9.9
	Anayansi and Damaris	S		X			4.9
	Eloni, Diwani and Ciwini	S		X			2.0
	Nilo 1 and Nilo 2	IT		X			2.9
	Rexoro, Nira, Chino, Petaca, Seda Blanca, Chela, etc.	T		X			44.3
Peru	INTI	S	X		100.2	28.7	
	Naylamp	S	X			8.0	
	IR 8	S	X			6.0	
	Chancay	S	X			2.0	2.5
	Minabir 2	IT	X			3.8	
	Radin China	T	X			16.0	
	Carolino	T		X			16.0
	Fortuna	T		X			4.5
	Others	T	X	X		7.4	5.1
Surinam	Eloni	S	X		35.7	60.0	
	Diwani	S	X			40.0	
Uruguay	Bluebelle	IT	X		62.0	96.0	
	EEA 404	T	X			2.0	
	Others	T	X			2.0	

[1] S = semidwarf; T = traditional; IT = improved tall.

Table ... Diseases, insects and other problems of rice in Latin America, reported by delegates participating in the Fourth IRTP Conference.

Countries	Diseases[1]													Insects[1]							Others[1]		
	Blast	Sheath blinght	Leaf scald	Brown spot	Narrow leaf spot	Sheath rot	Hoja blanca	Bacterial blight	Straighthead	Stem rot	False smuth	Eye spot	Smuth and/or grain fungi	Plant hopper	Diathraea	Rupella	Stink bugs	Cutworms	Leaf miners	Fall armyworms	Nematodes	Birds	Rodents
Argentina	2								1	3							1	2			3		
Belize	2			1										2	4	3				1		1	2
Bolivia	2		3	1											2		1			3		1	
Brazil	1			3		2											2	1		3			
Chile																						1	
Colombia	2					3	4	5					1	1	2	2	3	1	3	3		2	1
Costa Rica	1		3	2							4			2			3			1			1
Cuba	1						1			2				1					2				
Dominican Republic[2]																							
Ecuador	1						1			2				2		1				3		2	1
El Salvador	1		2	3									4	2			2						1
Guatemala	1		3	2											4	4	1			2		1	
Guyana	1		2	3										2					2				
Haiti				1	2												1		2			1	2
Honduras	1		4	3	2										2	2	3			1		2	4
Jamaica	1			1																			
Mexico	1		3	3									3			2	1			3		1	2
Nicaragua	1		2				2							2									
Panama	1	3	2	5								4		2	4		1			3	3	1	2
Paraguay	1																						
Peru	1					1	1			1		3	3	3	2			1	1			3	
Surinam	3			1	2											4	2		1	3			3
Uruguay	2					2																	
Venezuela	1		2											1									1

1/ 1 = first importance; 2 = 2nd importance; 3 = 3rd importance; 4 = 4th importance; 5 = 5th importance.

2/ Without information.

able 22. Weed, climate and soil problems affecting rice production in Latin America. Data reported by the delegates participating in the Fourth IRTP Conference.

ountries	Weeds[1]			Climate[1]			Soils[1]				
	Narrow leaf[2]	Broad leaf[3]	Red rice	Low temperature	Drought	Deep water	Acid	Salinity	Alkalinity	Toxicity	Deficiency
rgentina	2	2	1	1							
elize	1	2		1		1	1				
olivia	1	2			1						
razil	1		2	2	1		2			Al	P, Zn
hile	1	2		1							
olombia	1	2			2	2	1	3	2	Fe, Al	Zn
osta Rica	1				1					Cu	P, Zn,Fe,Mn
uba	1	2	2	1				1			Fe, Zn
ominican Rep.	1	2	3					1	2		
cuador	1	3	2		2	1		1			
l Salvador	1				2	1	2	2			
uatemala	1	3	2		1		1			Cu, Al	P, S
uyana	1	2				3					
aiti	1				2	1		1	2		Zn
onduras	1	3	2		1			2		Cu	
amaica	2	3						1			
exico	1	2		2	1	2	2	1	1	Al	P
icaragua	1	2									Zn
anama	1	3	2		1		1			Cu	
araguay	1	2	1								
eru	1	2		2	1		1	1		Al	P
urinam	2		1								
ruguay	1			1							
enezuela	1	2			2		2			Fe	P

In order of importance: 1 = very important; 2 = important; 3 = less important.

Narrow leaf weeds (grasses and cyperus); Echinochloa colona, E. crussgalli, Digitaria sanguinalis, Rottboellia exaltata, Ischaemum rugosum, Leptochloa filiformis, Cynodon dactylon, Ixophorus unicetus; Cyperus rotundus, C. difformis, C. esculentus, C. ferax. Not all these species are present in the countries listed.

Broad leaves: Amaranthus sp., Ipomoea sp., Portulaca sp., Heteranthera sp., Aechynomedes sp., Alisma plantago, Heliconia spp., Commelina diffusa, Thrianthema sp.

Table 23. Rice production costs in Latin America, 1979-1980.

Country[1]	Irrigated		Upland		Exchange rate[2]
	US$/ha	US$/t	US$/ha	US$/t	
Argentina	877.05	292.35			1,972.500
Belize					
Bolivia	542.80	301.55			25.000
Brazil	425.83	113.55	98.02	81.69	62.515
Chile	640.25	128.05			39.000
Colombia	1058.98	185.78	713.47	192.83	50.270
Costa Rica			1018.73	339.57	8.570
Cuba					
Dominican Republic					
Ecuador	993.00	248.00	400.00	125.00	25.000
El Salvador			952.00	250.73	2.500
Guatemala			581.00	212.82	1.000
Guyana					
Haiti	563.00	199.63	238.80	170.57	5.000
Honduras			296.50	74.13	2.000
Jamaica	1441.29	436.76			0.561
Mexico	753.39	176.02	445.29	193.60	23.194
Nicaragua	812.10	225.58	523.00	307.75	10.000
Panama	795.00	227.14	700.00	280.00	1.000
Paraguay					
Peru	1217.95	243.59			331.540
Surinam	421.57	100.37			1.785
Uruguay	1217.53	243.51			9.856
Venezuela	794.42	198.61	694.71	277.88	4.293

[1] Blanks indicate that the country sent no information on this topic.
[2] Taken from the International Monetary Fund, January, 1981. <u>International Financial Statistics</u>, Vol. XXXIV, No. 1.

Table 24. Rice consumption and markets in Latin America, 1979-1980.

Country	Per capita[1] consumption	Facilities[2]			
		Drying	Storage	Milling	Transportation
Argentina	5.0	G	F	G	G
Belize	35.0	G	G	F	F
Bolivia	12.3	I	F	G	F
Brazil	56.0	F	I	I	I
Chile	10.0	F	F	F	G
Colombia	36.0	F	G	G	G
Costa Rica	50.0	G	G	G	G
Cuba	-	-	-	-	-
Dominican Republic	-	-	-	-	-
Ecuador	25.0	F	F	G	F
El Salvador	12.4	F	F	F	G
Guatemala	4.5	F	F	G	G
Guyana	-	-	-	-	-
Haiti	33.0	F	I	F	I
Honduras	13.2	S, F	G, F	G, F	G, F, I
Jamaica	23.0	I	I	F	I
Mexico	8.0	G	G	G	G
Nicaragua	23.6	G, I	G, I	G	G, I
Panama	65.0	F	F	G	G
Paraguay	-	-	-	-	-
Peru	25.0	F	F	G	G
Surinam	-	G	F	G	F
Uruguay	10.0	F	G	G	G
Venezuela	20.0	G	G	G	G

[1] White rice, kg/person/year.
[2] G = good; F = fair; I = insufficient; (-) = no information.

Table 25. Area distribution for different rice production systems in Latin America (000 ha), 1979-1980.

Country	Irrigated	Rainfed	Highly favored upland	Moderately favored upland	Unfavored upland	Traditional manual upland	Total area
Argentina	100.00	-	-	-	-	-	100.00
Belize	3.25	0.13	1.30	0.13	0.06	1.63	6.50
Bolivia	-	1.08	1.62	13.53	-	37.87	54.10
Brazil	778.87	124.62	623.10	810.03	3177.81	716.57	6231.00
Chile	40.80	-	-	-	-	-	40.80
Colombia	308.50	-	21.13	-	-	92.97	422.60
Costa Rica	1.63	26.08	28.53	22.00	-	3.26	81.50
Cuba	151.00	-	-	-	-	-	151.00
Dominican Republic[1]	98.80	-	-	-	-	-	98.80
Ecuador	51.26	70.15	-	13.49	-	-	134.90
El Salvador	4.44	-	-	10.36	-	-	14.80
Guatemala	-	1.15	4.60	3.45	1.72	0.58	11.50
Guyana[1]	86.40	-	-	35.20	-	-	121.60
Haiti	31.57	3.37	2.11	1.68	0.84	2.53	42.10
Honduras	1.19	1.73	1.15	2.11	0.96	12.06	19.20
Jamaica	0.97	0.45	-	-	-	0.08	1.50
Mexico	72.60	-	10.56	26.40	15.84	6.60	132.00
Nicaragua	22.26	-	5.46	-	-	14.28	42.00
Panama	1.97	4.93	7.88	19.70	9.85	54.17	98.50
Paraguay[1]	20.70	-	-	11.10	-	-	31.80
Peru	72.14	12.03	-	11.02	-	5.01	100.20
Surinam	33.91	-	-	-	-	1.79	35.70
Uruguay	62.00	-	-	-	-	-	62.00
Venezuela	124.96	9.26	-	97.19	-	-	231.40
Total	2069.22	254.98	707.44	1077.39	3207.08	949.40	8265.50
%	25.03	3.09	8.56	13.03	38.80	11.49	100.00

[1] Data based on 1977-78 harvest.

Table 26. Personnel training needs in Latin America.

Country[1]	Number of technically trained staff		
	Short courses	MS	PhD
Argentina	1		
Belize		1	
Bolivia	3	1	
Brazil	1	3	
Chile			
Colombia		5	2
Costa Rica			
Cuba			
Dominican Republic			
Ecuador	1	4	
El Salvador	2	1	
Guatemala	1	2	
Guyana			
Haiti		4	
Honduras	4	6	
Jamaica			1
Mexico		3	1
Nicaragua	1		
Panama	4	5	2
Paraguay			
Peru	3	4	1
Surinam			
Uruguay		1	
Venezuela			
Total	21	40	7

[1] Blanks indicate that the country sent no information.

PARTICIPANTS IN THE FOURTH IRTP CONFERENCE FOR LATIN AMERICA

Argentina

Wolfgang Jetter
Instituto Nacional de Tecnología Agropecuaria
INTA Casilla de Correo 244
3400 Corrientes, Argentina

Belize

Eulalio García
Ministerio de Recursos Naturales
Belmopan, Belize

Brazil

Nicolau Victorio Banzatto
Instituto Agronómico de Campinas, IAC
Av. Barao de Itapura No. 1481
Caixa Postal 28
13.100 Campinas, Sao Paulo, Brasil

Paulo Sergio Carmona
Instituto Rio Grande do Sul
Caixa Postal 1927
90.000 Porto Alegre, Brasil

Elcio Guimaraes
EMBRAPA/Centro Nacional de Pesquisa em Arroz e Feijao, CNPAF
Caixa Postal 179
74.000 Goiania, Goiás, Brasil

Marco Antonio Oliveira
IRGA
Julio de Castilhos 585, 1P
Caixa Postal 1927
90.000 Porto Alegre, Brasil

Silvio Steinmetz
EMBRAPA/Centro Nacional de Pesquisa em Arroz e Feijao, CNPAF
Caixa pOstal 179
74.000 Goiania, Goiás, Brasil

Colombia

Ernesto Andrande Urresta
Instituto Colombiano Agropecuario, ICA
Apartado 2011
Villavicencio, Colombia

Alberto Dávalos Rojas
Instituto Colombiano Agropecuario, ICA
Apartado 2011

Villavicencio, Colombia

Edmundo García Quiroga
Instituto Colombiano Agropecuario, ICA
Apartado 233
Palmira, Colombia

Alvaro Salive
FEDEARROZ
Villavicencio, Colombia

Dorance Muñoz
Instituto Colombiano Agropecuario, ICA
Apartado 233
Palmira, Colombia

Eric Owen
Instituto Colombiano Agropecuario, ICA
Apartado 2011
Villavicencio, Colombia

Benjamín A. Rivera Calderón
Instituto Colombiano Agropecuario, ICA
Apartado 206
Montería, Colombia

José Patricio Vargas Zárate
FEDEARROZ
Calle 72 No. 13-23, Piso 12
Bogotá, Colombia

<u>Costa Rica</u>

Rolando González Venegas
Ministerio de Agricultura y Ganadería
Apartado 4851
San José, Costa Rica

Jose I. Murillo Vargas
Ministerio de Agricultura y Ganadería
Apartado 10094
San José, Costa Rica

<u>Chile</u>

José Roberto Alvarado Aguila
Instituto de Investigación Agropecuaria
Estación Experimental Quilamapu
Casilla 426
Chillán, Chile

Ecuador

Francisco Andrade
INIAP
Apartado 7069
Guayaquil, Ecuador

Richard Figoni
SIDA/INIAP
Apartado 7069
Guayaquil, Ecuador

Julio César Salvador M.
INIAP
Apartado 7069
Guayaquil, Ecuador

El Salvador

Luis Alberto Guerrero R.
Centro Nacional de Tecnología Agropecuaria, CENTA
Apartado Postal 885
San Salvador, El Salvador

Philippines

Harold Kauffman
IRRI
Box 933
Manila, Filipinas

Guatemala

Osvaldo Rolando García T.
Instituto de Ciencia y Tecnología Agrícolas, ICTA
5a. Avenida 4-36
Zona 3 de Mixco
Residenciales El Castaño
Guatemala, Guatemala

Walter Ramiro Pazos Morales
Instituto de Ciencia y Tecnología Agrícolas, ICTA
Galerías La Reforma, 3er. Nivel
Av. Reforma 8-60, Zona 9
Guatemala, Guatemala

Haití

Robert Cheaney
Texas A&M University/USAID
P. O. Box 1634
Port-au-Prince, Haití

Henry Turenne
Ministerio de Agricultura
P. O. Box 1546
Port-au-Prince, Haití

Honduras

Napoleón Reyes Discua
Recursos Naturales
Dirección Agrícola Regional No. 3
San Pedro Sula, Honduras

Jamaica

Percy Miller
Ministerio de Agricultura
P. O. Box 480
Kingston 6, Jamaica

Mexico

Jorge Luis Armenta Soto
Instituto Nacional de Investigaciones Agrícolas, INIA
CIAPAN
Apartado Postal 356
Culiacán, Sinaloa, México

Leonardo Hernández Aragón
Instituto Nacional de Investigaciones Agrícola, INIA
Apartado Postal 12
Zacatepec, Mor., México

Nicaragua

William Bird Fajardo
ANAR - Empresa Agrícola INRA
Apartado Postal 1688
Managua, Nicaragua

Pablo José Zelaya Medina
Empresa Agrícola MIDINPA II
Edificio Maria Castil
Entrada Centro Comercial
Managua, Nicaragua

Panama

Ezequiel Espinosa Sánchez
Universidad de Panamá
Estafeta Universitaria
Panamá, Rep. de Panamá

Peru

Rafael Olaya Vieira
Centro de Investigación y Promoción Agropecuaria, CIPA
Apartado 116
Chiclayo, Perú

Dominican Republic

Federico Cuevas
Instituto Superior de Agricultura, ISA
Apartado 166
Santiago, Republica Dominicana

Surinam

Mahomed Juesoef Idoe
Rice Research and Breeding Station (S.M.L.)
P. O. Box 26
Nickerie, Surinam

Venezuela

Aníbal Rodríguez
CIARCO-FONAIAP
Extación Experimental Araure
Araure, Portuguesa, Venezuela

Alberto José Salih
CIARLLACEN-FONAIAP
Estación Experimental de Calabozo
Apartado 14
Calabozo, Estado Guárico, Venezuela

Centro Internacional de Agricultura Tropical- CIAT

Rice Program

Sang-Won Ahn, Pathologist
Luis E. Berrio, Agronomist, International Trials
Yolanda Cadavid de Galvis, Agronomist
Jenny Gaona, Agronomist, International Trials
Luis E. García, Agronomist
Joaquín González, Agronomist, Coordinator
Gloria Gutiérrez, Economist
Peter R. Jennings, Plant Breeder
Cesar P. Martínez, Plant Breeder
Luis O. Molina, Agronomist
Eliseo Nossa I. Agronomist
Rafael Posada, Economist

Manuel J. Rosero, Plant Breeder, IRRI Liaison Scientist for Latin America
Rolando Rubí, Visting Researcher
Héctor Weeraratne, Plant Breeder

Training

Elías García, Agronomist
Eugenio Tascon, Agronomist

Biometry

Eduardo Granados, Statistician
María Cristina Amézquita de Quiñones, Math. Stat. Head.