Series 09ER-3

International Rice Testing Program

for Latin America

Report of the Monotoring Tour to the Northern Region of South America

June 3-16, 1979

COOPERATION

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CIAT
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SUMMARY

The monitoring tour to Ecuador, Colombia, Venezuela, Guyana and Surinam took place after the conclusion of IRTP's Third Conference for Latin America.

Rice production in these five countries is increasing and there is a good potential for its expansion. The largest regional production comes from direct irrigated plantings or from plantings depending on the rainfall. With the exception of Ecuador, production is mainly from large farms (more than 20 ha), completely mechanized. Ecuador, Guyana and Surinam have active programs dedicated to increasing small farmer production.

The Río Guayas area in Ecuador offers magnificent opportunities for exploiting technology on deep water rice and increasing production in areas where the water is too deep.

The main limiting factors on production are blast (Pyricularia oryzae), high production costs (land, fertilizers, insecticides, fungicides, and gasoline), land leveling, water control, and marketing (rice prices are low and unstable). The hoja blanca virus is still a serious problem in Ecuador, but has been controlled in other countries with the use of varieties resistant to the vector. Sheath blight (Thanatephorus cucumeris) and leaf scald (Rhynchosporium oryzae) have been increasing and may become a serious problem. Among the insects, stink bugs and Sogatodes are the most important.

Research programs in the region are modest but are expanding in most of the countries, and still require more financial support from the government and the private industry. Various countries (Colombia, Guyana and Surinam) have active hybridization programs and the others are evaluating materials coming primarily from CIAT and IRRI. The lack of trained personnel for technology transfer is a limiting factor in most of the countries but mainly in Venezuela and Ecuador.

Various projects for expanding the area cultivated to rice are underway in all of the countries. The majority of them are oriented towards irrigated rice and some to the production of upland rice in the savannas of Guyana and Venezuela.

REPORT OF THE MONITORING TOUR TO THE

NORTHERN REGION OF SOUTH AMERICA

(June 3-16, 1979)

Manuel J. Rosero*

INTRODUCTION

The International Rice Testing Program (IRTP) for Latin America, fulfilling its activities, organized a monitoring tour for 1979 with a group of rice scientists from different countries with the purpose of observing rice research and production activities in the northern region of South America. This observational trip was conducted on June 3-16, 1979 and included Ecuador, Colombia, Venezuela, Guyana and Surinam. Figure 1 and Appendix 1 indicate the places and institutions visited. The observational group was integrated by the following scientists: César P. Martínez and Darío Leal M., National Coordinator and Regional Director for Research, respectively, of the Instituto Colombiano Agropecuario (ICA)'s Rice Program; Francisco Andrade, Rice Program Director for the Instituto Nacional de Investigaciones Agropecuarias (INIAP) of Ecuador; A. Vivian E. Chin, Research Chief for the Guyana Rice Board in Guyana; Aníbal Rodríguez H., Head of the Rice Program of the Fondo Nacional de Investigaciones Agropecuarias (FONAIAP) in Acarigua, Venezuela (accompanied the group in Venezuela, Guyana and Surinam); Mohamed J. Idoe, Breeder of the Mechanized Agricultural Development Foundation (SML) in Surinam (accompanied the group in Surinam); Jean L. Notteghem, Plant pathologist from the Rice Program of the Institute de Recherches Agronomique Tropicales et des Cultures Vivrières (IRAT) in Ivory Coast; B.A.C. Enyi, Director of the West Africa Research Development Association (WARDA) in Monrovia, Liberia; Harold E. Kauffman, IRTP Coordinator and Jerry P. Crill, Plant Pathologist for the International Rice Research Institute (IRRI); Joaquín A. González (accompanied the group in Venezuela, Guyana and Surinam) and Sang-Won Ahn (accompanied the group in Ecuador and Colombia), Coordinator and Plant Pathologist, respectively, of the Rice Program in the Centro Internacional de Agricultura Tropical (CIAT); and Manuel J. Rosero, IRRI Liaison Scientist for Latin America, who acted

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* Ph.D. IRRI Liaison Scientist for Latin America.

Figure 1. Sites and institutions visited by the observational group in five countries of the northern region of South America.

as group leader. Appendix 2 presents a list of all the technical personnel, administrators and rice producers with whom the observational group came in contact.

This report discusses in detail certain aspects of rice related to cultural systems, varieties, problems and research activities observed in the five countries visited.

CULTIVATED AREA AND RICE PRODUCTION IN FIVE COUNTRIES OF THE NORTHERN REGION OF SOUTH AMERICA

In the countries of the northern region of South America were identified:

a) Three irrigation systems: direct planting with dry seed (generalized in Colombia and Venezuela, Estado Portuguesa), direct planting with pregerminated seed in puddled soil (common in Guyana, Surinam and Venezuela, Estados Guárico and Portuguesa) and transplanting (widely used in Ecuador).

b) Two upland systems: mechanized upland, with direct planting broadcasted or in rows (common in Colombia, Ecuador, Venezuela and Guyana) and manual upland, direct planting in cleared land (common in Colombia and Ecuador).

c) Lowland rainfed (common in Ecuador).

Table 1 shows the area cultivated and rice production in 1978. In the irrigated and mechanized upland area, the highest yields were obtained in Colombia primarily due to the fact that 99% of this area is cultivated with semidwarf varieties with high yielding capacity. In Guyana and Venezuela yield under irrigated conditions is still low; in the first because most of the area is planted to low-yielding varieties and due to deficiencies in land preparations; in the second, due to deficiencies in crop management and to damage caused by rats.

Table 1. Area, production and rice yield depending on the cultural system in five countries of the northern region of South America. 1977-1978 growing season.

Country	Area ('000 ha)				Production ('000 t)				Yield (t/ha)			
	Irrig.	Mech. Upland	Manual Upland	Total	Irrig.	Mech. Upland	Manual Upland	Total	Irrig.	Mech. Upland	Manual Upland	National Average
Colombia	259.4	51.7	95.0	406.1	1395.3	176.9	142.5	1714.7	5.4	3.4	1.5	4.2
Ecuador*				79.0				232.9				2.9
Guyana	86.4	35.2	-	121.6	259.2	52.8	-	312.0	3.0	1.5	-	2.6
Surinam	40.0	-	-	40.0	172.9	-	-	172.9	4.3	-	-	4.3
Venezuela	109.3	36.0	-	145.3	364.9	54.0		418.9	3.3	1.5	-	2.9
TOTAL	495.1	122.9	95.0	792.0	2192.3	283.7	142.5	2851.4				

* The exact distribution of the different cropping systems has not been determined.

Yields in Surinam are relatively high, but can be improved through more adequate management practices, especially those regarding land leveling and weed control.

Following is a detailed description of rice production situation in each of the countries visited and the observations made by the group:

COLOMBIA

Status of the Crop

General aspects

Five main producing zones are identified in Colombia, each one represented by different types of soils, climatic conditions and specific problems.

1. The Cauca River Zone, including the Departments of Cauca and Valle del Cauca. The topography is flat, with alluvial soils presenting clayey and loam clayey texture, and a pH ranging from 5.0 to 8.0. The average temperature is 24°C and the annual rainfall is 1200 mm. The zone is located at 1000 masl. Rice is planted under irrigation, planting it directly on dry soil. The puddling system of planting with pregerminated seed is being adopted by various farmers.

2. Upper and Mid Magdalena Zone, including the Departments of Huila, Tolima and Cundinamarca. Most of the soils are alluvial, but a small area (Terraza de Ibagué) has soils of volcanic origin. The texture varies from loam sandy to clay and the soils are rich in P and K but poor in N, with a pH ranging from 5.5 to 6.5. The average temperature ranges from 26-28°C and the annual rainfall is 1500 mm. With the exception of the Terraza de Ibagué, located at 700 and 1200 masl, the rest of the zone is located at 350 masl. Irrigated rice and direct dry seeding are predominant in the zone.

3. Zone of the Llanos Orientales, including the Departments of Meta and Casanare. The soils are flat savanna, with a loam or loam clay texture, defined as ultisols (acid soils) with a pH from 4.0 to 5.5. They have a high content of exchangeable Al, deficient in P and K, poor in organic matter and low in Ca and Mg. This zone is characterized by a high

precipitation (2000-4000 mm/year). The relative humidity is 80-90% and the average temperature is 27° C. Planting under irrigation and mechanized upland is done directly with dry seed in dry soil and broadcasted; in manual upland, planting is done with a stake in new areas. In this area 32,500 ha are cultivated under irrigation; 8600 ha under mechanized upland and about 12,000 ha under manual upland.

4. Atlantic Coast Zone, including the Departments of Antioquia, Córdoba, Sucre, Bolívar, Atlántico and Magdalena. The soils are flat alluvial with a clayey texture and a pH ranging 6.0-6.5. The average temperature is 28° C and the annual rainfall is 1500 mm.

   This zone is at an elevation of 0 and 20 masl. A potential of 2 million ha are estimated to flood during the rainy season, which could be planted with varieties tolerant to semi-deep water levels (1.0-1.5 m). Rice is planted under irrigation, directly with dry seed on dry soil and under manual upland with dry seed in ondulated areas and transplanting in lowland and flooded areas. The puddling system is being promoted.

5. Northeast Zone, including the Departments of Cesar, Guajira, Santander del Norte and Santander del Sur. Soils are flat, with a loam and loam clay texture and pH from 6.0-6.5. The average temperature is 28°C and the precipitation is 1500 mm/year. This zone has an elevation of 20 and 350 masl. Rice is primarily planted under irrigation (direct dry seed planting on dry soil) and partly under manual upland.

Production systems

Three cultural sustems are identified: irrigated, mechanized upland and manual upland. The irrigated system is the traditional one: dry preparation of the land and planting by broadcasting dry seed, using approximately 120-187 kg/ha. This system is completely mechanized, starting from the preparation of the land until the harvest. The application of herbicides, fertilizers, insecticides and fungicides is done by plane. Weed control is done primarily with applications of propanil and 2,4,5-T; at the small scale they use butachlor and bentiocarb. Fertilizers generally include N (80-150 kg N/ha) and in certain zones P and K (20-40 kg P_2O_5 or K2O/ha). Calcium carbonate and basic slag (0.5-1.0 t/ha) are used on the acid soils.

Chlorinated and phosphate insecticides are used to control armyworms, leaf miners, and grain stink bugs. Farmers usually make 2-3 applications.

To prevent severe infections of rice blast, especially in the zone of the Llanos Orientales, the fungicides Kasumin, Hinosan, Bla-S and Dithane M45 are generally used (2-3 applications).

The source of water for irrigation comes from the rivers and in some cases, water from underground sources is utilized. There are various government irrigation districts, but a great percentage are private installations.

The technology for the upland mechanized system is similar to the one for irrigated rice, except that this cropping system depends entirely on the rainfall.

Both systems, irrigated and mechanized upland, are practiced by middle-size farmers (20-100 ha) and by the large ones (100-1000 ha). These crops are partially financed by the government through the Fondo Financiero Agropecuario, which finances up to 40% of the production costs.

The manual upland system consists primarily in slashing and burning the forests and then planting manually 8-10 seed per site (40-60 kg seed/ha), at distances of 0.60 or 1.0 m. There is no control on weeds, insects or diseases and fertilizers are not applied. Harvesting is done manually, cutting with knife or sickle the panicles and then threshing by hitting them against the wall of a vase or against a cement floor. In some parts of the Atlantic Coast, the manual upland system consists of making seedbeds at the beginning of the rainy season, and then transplanting plants of 40-60 days old to the low flooded sites.

Varieties grown

The varieties predominant in the irrigated and mechanized upland areas are CICA 4 (26%), CICA 9 (24%), IR 22 (22%), CICA 7 (16%), CICA 6 (10%), IR 8 (1.5%) and Bluebonnet 50 (0.5%). CICA 8 (a variety released to farmers in 1978) is being extended throughout the region, especially in the zones with problems of blast disease.

Under the manual upland system, Bluebonnet 50 and many native and tall varieties are grown; however, the most important are Costa Rica, Monolaya, Japón and Pablo Montes.

Seed production

Registered and certified seed production of the different varieties grown under irrigated and mechanized upland conditions is the responsibility of the Federación Nacional de Arroceros (FEDEARROZ) and of 24 private enterprises. All these are supervised by the Seed Program of the Instituto Colombiano Agropecuario (ICA). Of the 50,000 tons of seed required in the country, FEDEARROZ supplies 40% and the private enterprises 60%. These organizations produce registered seed from basic seed supplied by ICA's Rice Program and then certified seed.

Limiting factors

Factors limiting rice production in Colombia, by order of importance, are the following:

1. Irregular marketing of the product, characterized by unstable prices; the farmer generally receives low prices during harvest time; these prices many times do not cover production costs.

2. High production costs (US$1,100/ha) and deficient financing from the government.

3. Among the diseases, rice blast (Pyricularia oryzae) continues to have the greatest incidence. Sheath blight (Thanatephorus cucumeris) and leaf scald (Rhynchosporium oryzae) are becoming more important.

4. Few economic resources for research.

5. The use of non-certified seed is increasing the problem of red rice.

6. Lack of high-yielding varieties with excellent grain quality and good adaptability.

7. Among the insects, the armyworms (Spodoptera sp.), the leaf miner (Hydrellia sp.) and stink bugs (Mormidea sp.).

8. Broad-leaved weeds, in areas planted in puddled soils.

Visits and Observations

To provide the monitoring team a general idea on rice production in Colombia, visits were programmed to two areas of major importance and having different characteristics: the Department of Tolima and the Llanos Orientales region.

The Federación Nacional de Arroceros in Ibagué, the Hacienda "El Aceituno" in the Terraza de Ibagué and the Centro Nacional de Investigaciones "Nataima" of ICA in Espinal were the places visited in Tolima.

Visits in the Llanos Orientales included the rice parboiling plant (Soceagro Ltda.) located in Villavicencio and the "La Libertad" Experimental Station of ICA.

Following is a detailed discussion of the different activities during the visit.

Federación Nacional de Arroceros (FEDEARROZ)

The Technical Vice-Manager, Gustavo Villegas, Agr. MS, of FEDEARROZ and the Executive Director of Ibagué's Regional Office, Ing. Agr. Rafael Hernández L., received the group and explained the activities conducted by the institution. FEDEARROZ is a non-profit association of rice producers in charge of all activities related to rice production; its headquarters are in Bogotá and its target area includes all the national territory. It works through 28 regional offices located in the main rice production areas.

The main objective of FEDEARROZ is the improvement of technical, economical, structural and political structures of the rice industry in order to supply the domestic demand and promote an adequate external commercialization of the surplus production. This objective is achieved through the following functions:

- Presentation to the government of the needs and aspirations of its members.

- Transfer of national and international information on scientific, organizational and commerce achievements when it is considered beneficial for the country's rice industry.

- Development of general and specific plans which benefit its members, rendering technical assistance to farmers and millers and through training of personnel in short courses and seminars.

- Cooperation with the ICA-CIAT Rice Program research, in the execution of regional trials and by posting technical personnel in ICA's experimental centers.

- Production and processing of certified seed and distribution of agricultural machinery and inputs (fertilizers, herbicides, insecticides and fungicides) for the rice crop.

Certified seed multiplication and processing is done in five regional offices which have processing plants located in Ibagué, Neiva, Cali, Villavicencio and Valledupar (Figure 2).

Figure 2. A.V. Chin, F. Andrade and S.W. Ahn inspect CICA 9 certified seed processed in FEDEARROZ's seed plant in Ibagué, Colombia.

The group visited the installations and observed the large warehouses, the type of machinery (tractors and implements) and the kind of fertilizers (urea and completes), herbicides (propanil), insecticides (chlorinated) and fungicides (Kasumin), being used. Observed in the seed processing plant was its quality control laboratory with its complete equipment for seed analysis before and after processing (impurities, red rice mixtures, humidity and germination). Also observed were the square concrete-built drying silos, the cleaners, classifiers and seed treating plant. It was possible to observe the process of classifying and treating certified seed of CICA 4 variety which was going to be exported to Venezuela.

Hacienda "El Aceituno"

The Hacienda "El Aceituno" is the center of operations of the Compañía Agrícola El Aceituno Ltda., property of Dr. Benjamín Rocha and Mr. Hans Klotz. It is located on the Terraza de Ibagué, at an elevation of about 700 masl and is considered to be a pilot farm representative of the 10,000 ha of rice grown on the terrace.

Hernán Osorio, IA, technician of the same company, Mr. Ramón Otazua, field administrator, and Mr. Benjamín Rocha, son of the owner, attended the group and supplied ample information on the company's activities.

The company is structured for commercial production of milled rice, and production of certified seed with the official approval of ICA. It has sufficient machinery for land preparation, planting and harvesting, a machinery maintenance operations, a landing strip for the planes used to apply inputs, installments for drying and rice milling, and a plant for processing certified seed.

Each semester, 700 ha of rice are planted, of which 50-60% is for the production of certified seed. Besides rice, sorghum (250 ha) and soybeans (80 ha) are planted as rotation crops.

Rice varieties grown include CICA 4, CICA 6, CICA 7, CICA 9, CICA 8, IR22, Bluebonnet 50 and Starbonnet. IR 22 is the most important, especially for seed. The cultural system utilized is that of direct planting with dry seed on dry land and running water irrigation (semiflooded with water constantly moving), which is typical in the zone. The puddling system is being introduced and there are already 50 ha grown under this sytem. In the commercial production fields, planting is done by broadcasting the seed at densities of 200-250 kg/ha and in the seed production fields, planting is done in rows at a density of 100-120 kg seed/ha.

Fertilization consists in the application, at planting, of 450-700 kg/ha of complete fertilizer 10-20-10 and 130-180 kg N/ha after planting, utilizing urea and ammonium sulfate as sources (Figure 3).

Mentioned among the problems which affect the crop were the fall armyworms and the stink bugs, but these are easily controlled with chlorinated insecticides. Rice blast is severe, especially on CICA 6, CICA 9, and IR 22. CICA 4 has behaved as tolerant and CICA 7 as highly resistant to this disease, but has problems with sheath blight and sterility. To prevent from blast attack, Kasumin and Bla-S (2-3 applications) are applied. Another problem encountered is red rice; in the areas infested, the puddling system is being used to eliminate it.

Production costs in the farm add up to Col. $45,000/ha (US$1100) for the irrigated-direct planting, and Col. $37,000/ha (US$900) for the puddling system (Table 2). Yields obtained with the different varieties are 9.0 t/ha for CICA 4, 8.5 t/ha for CICA 7, 8.0 t/ha for CICA 9, 7.2 t/ha for IR 22 and CICA 6, and 6.0 t/ha for Bluebonnet 50 and Starbonnet.

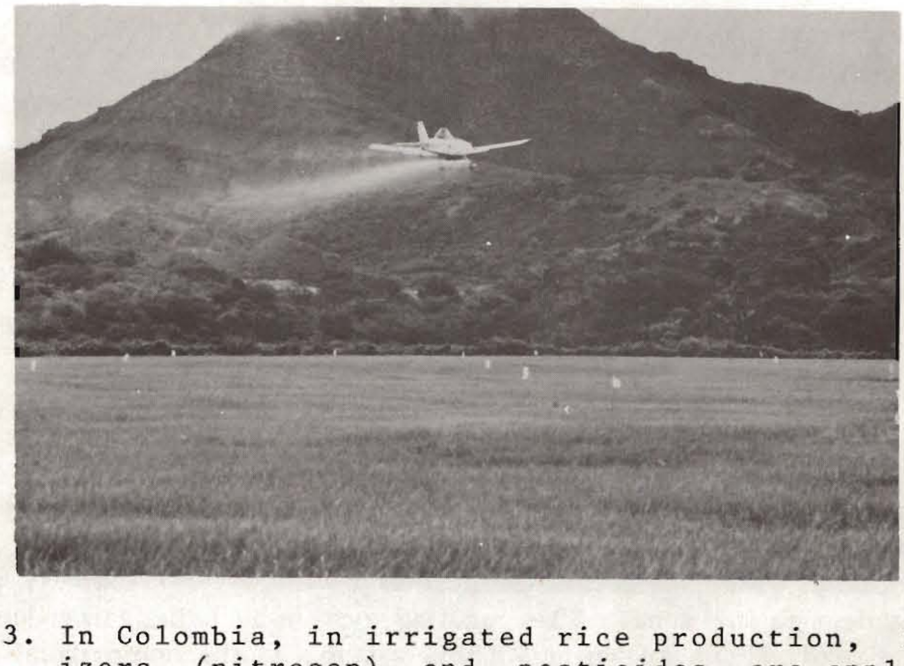

Figure 3. In Colombia, in irrigated rice production, fertilizers (nitrogen) and pesticides are applied by plane. The group observed the aerial application of nitrogen in the "El Aceituno" farm close to Ibagué, Tolima.

Table 2. Production costs, yield and profit under different rice cropping systems in five countries of the northern region of South America. *

Countries	Cropping systems											
	Irrigation direct planting			Irrigation puddling			Intermediate technology			Traditional technology		
	Costs US$/ha	Yield t/ha	Profit US$/t **	Costs US$/ha	Yield t/ha	Profit US$/t **	Costs US$/ha	Yield t/ha	Profit US$/t **	Costs US$/ha	Yield t/ha	Profit US$/t **
Colombia	1100.0	7.0	62.8	900.0	7.0	91.4	-	-	-	-	-	-
Ecuador	575.0	4.5	32.2				430.0	3.8	46.8	370.0	2.8	27.8
Guyana	-	-	-	243.0	3.0	39.0	-	-	-	-	-	-
Surinam	-	-	-	343.0	4.3	40.2	-	-	-	-	-	-
Venezuela	476.0	3.5	74.0	714.0	5.0	67.2	-	-	-	-	-	-

* Data supplied by technicians and farmers in the farms visited by the observational group.

** Paddy rice sale price minus production costs; sale price of 1 ton paddy rice in Colombia is US$220.0, in Ecuador, US$160.0; in Guyana and Surinam US$120.0 and in Venezuela US$210.0.

The seed plant and mill installations were visited. The seed plant has nine silos (each with a capacity of 44 tons), with air and heat drying systems and having various classifiers for processing the different varieties. During the visit, the classification of certified seed of IR 22, was observed; the final production was of excellent quality. The milling installations, independent from the seed plant, have their own drying silos and three processing mills. One of the mills was processing IR 22 and the head rice had an excellent quality.

Afterwards the production fields and installations for pumping irrigation water were visited. Various commercial fields were observed, one for producing seed of Bluebonnet 50 which was close to the harvest and three of IR 22 at the stages of germination, tillering and flowering. The Bluebonnet 50 field showed symptoms of narrow leaf spot, sheath blight and leaf scald. However, the serious problem was lodging. In the plots planted to IR 22, at the tillering stage, areas severely affected by rice blast were observed. Weed control in these plots was excellent (Figure 4).

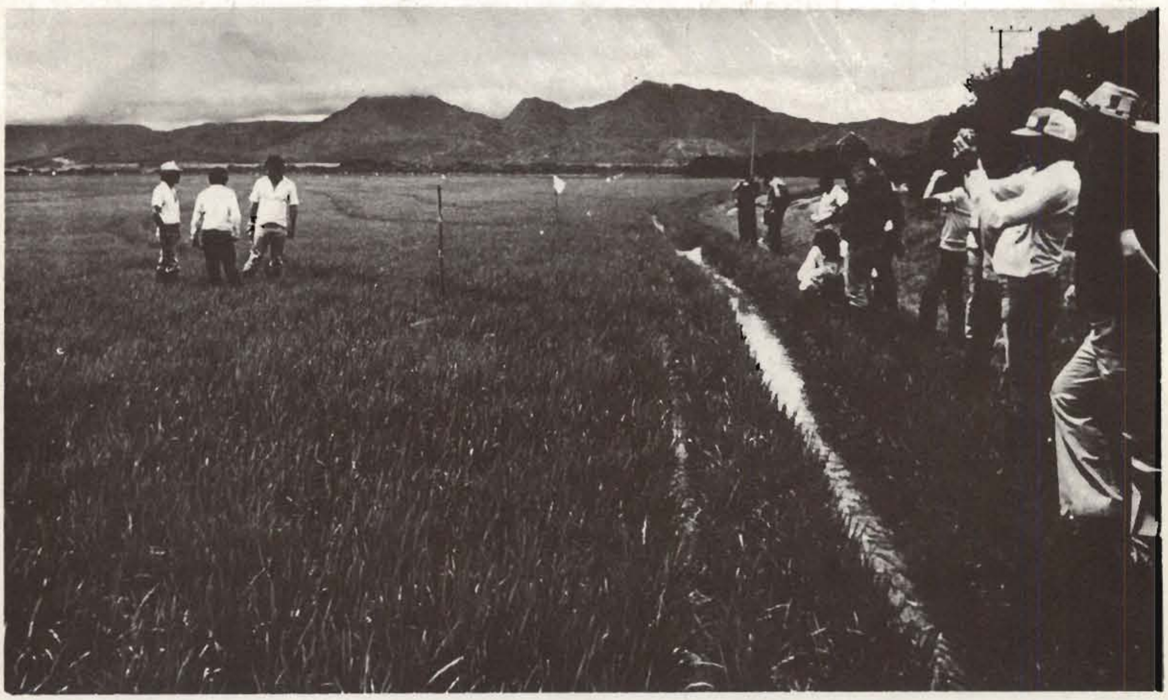

Figure 4. The group observed a severe rice blast infection in a commercial plot planted with IR 22 during the tillering stage, in the "El Aceituno" farm close to Ibagué, Tolima.

The water pumping installations are located in the lowest part of the farm, where leftover water from irrigation and draining is collected. The water is pumped to a height of 24 m (with two pumps installed at two different levels) and is conducted through a concrete canal towards the rice fields. This system allows the recycling of water. These installations have been in operation for nine years and were designed to increase the planting area and to use more efficiently the small amount of water that crosses the farm.

Before finishing the description of this enterprise it is important to mention that the first commercial planting in Colombia of IR 8 was done in the Hacienda "El Aceituno" in 1967.

Centro Nacional de Investigaciones Agrícolas "Nataima"

The Centro Nacional de Investigaciones Agrícolas "Nataima" is an ICA experimental center located in Espinal, Tolima where rice is one of the major research commodities. At this center, ICA's Rice Program conducts yield trials of the promising material, agronomy trials and produces basic seed from the commercial varieties.

The following experiments were observed:

- Yield trials, with 11 promising lines, early maturing and having good grain type.
- IRTP, VIRAL-P and VIRAL-T nurseries from 1979.
- Planting densities vs. nitrogen levels.
- Planting periods using five varieties (CICA 4, CICA 7, CICA 8, CICA 9 and IR 22) and three levels of N (50, 100 and 150 kg/ha).

In all the experiments rice was 40-60 days old, an unappropriate stage for evaluating the materials in yield trials and in the nurseries. In the planting period trial, a minor attack of rice blast and hoja blanca on IR 22 was observed. The *Echinochloa colona* weed showed severe infection of hoja blanca (Figure 5).

Figure 5. C.P. Martínez explains the type of IRTP nurseries planted in ICA's Centro Nacional de Investigaciones Agrícolas "Nataima" located in Espinal, Tolima.

Sociedad Agrícola Ltda., SOCEAGRO

SOCEAGRO is a private enterprise dedicated to commercial rice production, to processing white rice and to parboiling. The processing plant is located in Villavicencio.

The observational group visited the company's installations to get acquainted primarily with the parboiling rice processing plant which is the only one of this nature existing in Colombia.

Mr. Armando Hernández, SOCEAGRO General Administrator, and Ing. Guillermo Espejo, in charge of the processing plant, explained to the group the different stages of the rice parboiling process. The process has two steps, classification and precooking. Classification includes a precleaning of paddy to separate the mixtures, impurities and vain immature grains; then the grain is homogenized. The precooking process has three phases: a) soaking the grain in water, in cylindric tanks during 2 hours at a temperature of 75-80° C until the paddy has a humidity content of 13%; b) cooking the paddy during 15 minutes at a temperature of 92-95° C; c) drying the paddy at 13% humidity, at a temperature of 55°C; and d) the paddy is left to rest in silos during 62 hours. After precooking, the rice enters the milling process.

The parboiling plant has a processing capacity of 6 t/hr. This permit to process 83,000 tons in the drying stage, and 52,000 tons in the precooking stage, to obtain 36,000 tons of final product.

Furthermore, the company has milling and drying installations to process a total of 60,000 tons of paddy rice. The milling installations for precooked and normal rice have a total capacity of 112,000 tons.

Parboiled rice is sold in the main supermarkets of the country, and externally in the European market (France and Italy).

The advantages of parboiled rice indicated were:

- The yield percentage of head rice increases.
- The nutritive value increases. In the precooking process the proteins and vitamins in the aleurone are translocated to the endosperm.
- The white rice has greater resistance during storage to insect and fungi damages.
- When cooked increases the volume in 40% in relation to normal white rice.
- Improves the external appearance of the grain. The white center or chalkness of the grain disappears.
- When cooked, increases the grain size in length and width.

"La Libertad" Experimental Station

The observational group visited the ICA's "La Libertad" Experimental Station in Villavicencio, with the purpose of observing the experiments conducted by the Rice Program.

At the station, Dr. Jairo Sediel, ICA's Regional Manager, welcomed the group and explained the different research activities that ICA is conducting in this region of the country.

Darío Leal, IA, MS, Regional Research Director and part of the group presented a general report on the crop and summarized the rice research activities which are being carried out in the station (Figure 6).

Figure 6. D. Leal (center), Regional Research Director, explains to the participants the rice trials conducted in ICA's "La Libertad" Experimental Station located in Villavicencio, Colombia.

The "La Libertad" Experimental Station is located 25 km east of Villavicencio, at an altitude of 336 masl, 04° 03' north latitude and 73°20' west longitude. The main research activities are concentrated on rice and beef.

Rice research activities concentrate on the following aspects:

- Breeding: selecting varieties with horizontal multiple resistance and multiline resistance to rice blast.

  Evaluation of lines tolerant to acid soil problems and regional trials or varieties.

- Plant Pathology: identification of physiological races of P. oryzae; evaluation of experimental and commercial fungicides for controlling rice blast and leaf scald.

  Determining yield losses caused by leaf rice blast and panicle neck infections.

- Entomology: collection and identification of damaging and benefic insects in rice crop. Evaluation of the simulated damage caused by foliar insects.

- Soils: determining the effect of high dosis and application dates of K and N, on yield and rice blast incidence. Efficiency trials of foliar fertilizer. Effects of dosis and application dates of P and evaluation of promising lines at different fertility levels.

- Weeds and physiology: evaluation of pre and post-emergent herbicides. Biological studies of the "piñita" weed (Leptorreo sp.).

- Management practices: N levels and planting densities with CICA 8. Planting densities with promising lines.

- Evaluation of 1979 IRTP nurseries: VIOAL-R, VIRAL-P, VIRAL-T and VIRAL-S.

Different breeding, plant pathology, and entomology trials, as well as the IRTP nurseries were observed in the field (Appendix 3). The material was between the tillering and flowering stages. Rice blast incidence was minor on the genetic material and from moderate to severe on the plant pathology trials with the varieties IR 22 and CICA 9 (Figure 7). The incidence of "anaranjamiento" was observed, especially on germplasm from the IRTP nurseries, VIOAL-R, VIRAL-P, and VIRAL-T; various lines were severely affected, with the "anaranjamiento" characteristic symptoms (yellowing or oranging of leaves, many

Figure 7. J.L. Notteghem, K. Cardwell (Peace Corp at ICA), B.A.C. Enyi and M.J. Rosero examine the type of rice blast foliar infection at ICA's "La Libertad" Experimental Station in Villavicencio, Colombia.

of them with very small brown spots on the apex and margins). Some lines did not show any symptoms and other showed different degrees of tolerance, indicating the existance of varietal resistance (Figure 8). The germplasm was evaluated and Appendix 4 indicates the resistant lines.

All the experiments showed good management practices, which reflects the excellent work of the technicians who conduct research on this crop. "La Libertad" was considered to be a very appropriate place for germplasm selection having tolerance to acid soil problems.

ECUADOR

Status of the crop

General aspects

Normally in Ecuador, 120,000 ha are planted to rice. During the rainy season 60% is planted, and 40% during the dry season. However, in the 1977-1978 season, the planted area was reduced due to irregular rainfall (Table 1).

Figure 8. Germplasm of IRTP nurseries for Latin America, showing susceptibility (left) and resistance (right) to foliar yellowing (acid soils problem), in ICA's "La Libertad" Experimental Station in Villavicencio.

In the rice producing area, annual rainfall is 1200 mm, distributed between January-May and the rest of the year is dry. The average temperature is 25°C. Ninety percent of the rice growing zone is located in the Guayas and Los Ríos provinces (states). The remaining 10% is located in the Cañar, Manabí and El Oro provinces. Sixty percent of the rice area is cultivated in the province of Guayas.

Production systems

In the two production cycles (rainy and dry season), four production systems can be identified, three upland and one irrigated.

a) Irrigated Rice: approximately 25,500 ha are grown in the rainy season and 11,500 ha in the dry period. The area is concentrated in Daule, Samborondón, Yaguachí and Babahoyo.

   Planting is done directly in the field with dry seed broadcasted or planted in rows on dry soil or by broadcasting on puddled soils.

   Fertilization is done primarily with N, applied after planting, at a rate of 80-100 kg N/ha.

   The use of insecticides for controlling fall armyworms and stink bugs, and of fungicides for controlling rice blast, has been intensified.

   In some cases harvesting is done mechanically with combines, but manual harvesting is predominant.

b) Upland of High Sites: this zone is located mainly in Balzar, Empalme, Vinces and Quevedo and in a lower scale in Baba and Ventanas. 11,500 ha are planted during the rainy season; planting is done manually with dry seed at a distance of 35 x 35 cm or 40 x 40 cm. Land preparation is done mechanically.

   Fertilization is done with N, using as sources urea and ammonium sulfate. Weed control is done with herbicides and manually.

   Harvesting is all done by hand: cutting is done by sickle and the panicles are threshed by hitting them against logs placed on top of canvas. Wet paddy rice is sold directly to the millers; few farmers dry the rice in yards.

c) Upland Low Flooding Zones: these zones cover about 40,500 ha which are planted in the rainy season. They are located primarily in Yaguachí, Babahoyo, Samborondón, Urbina Jado and Pueblo Viejo; and to a minor extent in Daule, Baba and Naranjal. Planting is done directly in the field, with dry seed on dry soils and by transplanting to puddled soils.

Fertilization and weed control are more adequate than in the previous system. Harvesting is done primarily by hand and the use of combines is rapidly becoming common.

d) Upland of "Pozas Veraneras": the "pozas veraneras" are low areas flooded during the rainy season which remain with water during most of the dry season. These "pozas" cover 22,000 ha which are used for rice production during the dry period. They are located in Urbina Jado, Babahoyo, Vinces, Baba, Yaguachí, Daule and Samborondón.

In these "pozas" rice is transplanted and the production system presents special and traditional technologic characteristics. Seedbeds are established in the higher parts which are not flooded. Before transplanting, the farmers hand clean the "pozas" to eliminate aquatic weeds. Before making the final transplanting, the farmers practice what is called "claveteo", this consists in pulling out of the seedbed the seedlings which are 25-30 days old and carrying them to lower places to give them more space and leaving them for 15-30 days before transplanting to the definite site. Transplanting is done stepped (echelon), from the higher to the lower parts, depending on the rhythm in which the water descends in the "pozas". By means of pumps, some farmers handle the water, transporting it from one place to another; in other cases, water movement is achieved through gravity.

Most farmers do not use fertilizers and some use N. Insecticide application is a general practice. Harvesting is done all by hand; cutting is done with sickles and the panicles are threshed by hitting them against logs placed on canvas.

Varieties grown

In the irrigated zones the improved varieties INIAP 6 (CICA 4), INIAP 7, Naylamp and IR 8 are planted.

In upland areas, the native varieties such as Brazilero, Canilla, Donato and Pico Negro are predominant. Among the improved varieties, Tapuripa is the most important.

Seed production

Certified seed production is done by private enterprises supervised by the Department of Seed Certification of the Ministry of Agriculture and Cattle. Certified seed production is done from registered seed supplied to the enterprises by the Seed Production Department of the Instituto Nacional de Investigaciones Agropecuarias (INIAP).

Limiting factors

Crop productivity is affected by the following factors:

1. Deficient water control.
2. Deficiencies in land preparation and leveling.
3. Deficient weed control and inadequate fertilizing.
4. Low-yielding varieties.
5. Diseases, especially rice blast and hoja blanca.
6. Borer insects and Sogatodes.
7. Lack of technical personnel trained in breeding, production, plant pathology and entomology.

Visits and observations

On arriving at Guayaquil, the observational group received a visits program prepared by Agr. Francisco Andrade, Head of INIAP's Rice Research Program. This program included a visit to INIAP's directors in the region; and observation of the rice research activities in the Boliche Experimental Station and in private farms; observation of commercial production systems in the Samborondón zone; and getting acquainted with the activities of the National Rice Program of the Ministry of Agriculture and Cattle, in the Experimental Station of Daule.

INIAP's Regional Offices in Guayaquil

Agr. Carlos Cortaza, Regional Vice-Director, welcomed the observational group and explained the INIAP's activities. He made various comments on the cooperation needs they want to receive from international institutions.

The group leader made a presentation of the scientists integrating the group and briefly explained the visit's objectives.

Dr. Loyd Johnson, presented a series of transparencies and informed the group about the rice production system in the Samborondón zone. He made emphasis on the zone's problems in relation to flooding and to the management of the crop in the "pozas veraneras". He indicated that INIAP started research in 1977 with germplasm for deep water coming from IRRI. From this material, two or three selections survived water levels of 80-90 cm, various lines survived in soils with a water depth of 45-50 cm. Seed from this material showing the major tolerance is being multiplied and one of these lines will be named as variety in 1980 (Figure 9).

Furthermore, he indicated that water control with irrigation and drainage canals would be very expensive and that the most practical and economic solution is selecting a variety having good grain type, well adapted to 30-150 cm water levels and tolerant to the organic toxins in the water. The goal for this zone is achieving two crops per year, with an average yield of 3.0 t/ha per crop.

Figure 9. Three varieties from Thailand, observed by the group, which survived the deep water conditions in Samborondón, Ecuador.

Boliche Experimental Station

This station is located in the county Pedro J. Montero in Yaguachí, Guayas province, at 02°15' south latitude and 79°49' west longitude. At an elevation of 13.8 masl and an annual mean temperature of 24.8°C; this zone has an annual average rainfall of 1300 mm and a relative humidity of 83%.

In Boliche, the group travelled through the experimental field and observed all the major program trials indicated in Appendix 3.

All the material was in the flowering and ripening stages, except the 1979 IRTP nurseries for Latin America, which had 30 days of being transplanted. The management of the experiments was excellent.

In the basic seed multiplication plots, the line INIAP 415 behaved better than INIAP 6 and INIAP 7. Furthermore, it showed resistance to hoja blanca and better tolerance to soil problems, especially to Fe toxicity as was indicated by the Soils Section specialist. INIAP 6 and INIAP 7 showed more susceptibility to this problem. Line INIAP 415 will be named officially in 1979.

The germplasm from 1978 nurseries showed severe hoja blanca incidence. The material was evaluated and the resistant selections are presented in Appendix 4. The field population of rice plant hoppers was minimum, which suggests that the hoja blanca infection occurs in the seedbeds.

It is important to mention the evaluation and seed multiplication trial with 21 native varieties, all resistant to hoja blanca and, according to previous evaluations, tolerant to Fe toxicity.

In general, the rice program at Boliche is using efficiently the introduced germplasm. It has good material, resistant to hoja blanca, and good characteristics of high-yielding capacity.

Samborondón Zone

INIAP trials in this zone were observed in a farm typical of the zone (Pozas Veraneras); here floating varieties trials and demonstrative experiments with nitrogen fertilization were observed; these experiments and trials were conducted with the variety Pico Negro and three promising selections introduced for the zone (Figure 10).

A rice cooperative was observed which had 1160 ha exploited by 68 farmers, with the assistance of extension agents from the Ministry of Agriculture. A field planted with Pico Negro variety was observed at tillering stage which showed no problems.

The Hacienda "Miraflores" was also visited, where plots were being prepared by the puddling system and the group also observed the status of crops with the improved varieties Gloria 3 and IR 6. A total of 450 ha are planted in this farm and two crops are obtained per year. Exploitation is completely mechanized, from the preparation of the land (puddling) (Figure 11) until the harvest. Planting and application of inputs is done by plane. The average yield being obtained with the above mentioned varieties is 7.0 t/ha. Furthermore, the farm has a mill for processing its own rice.

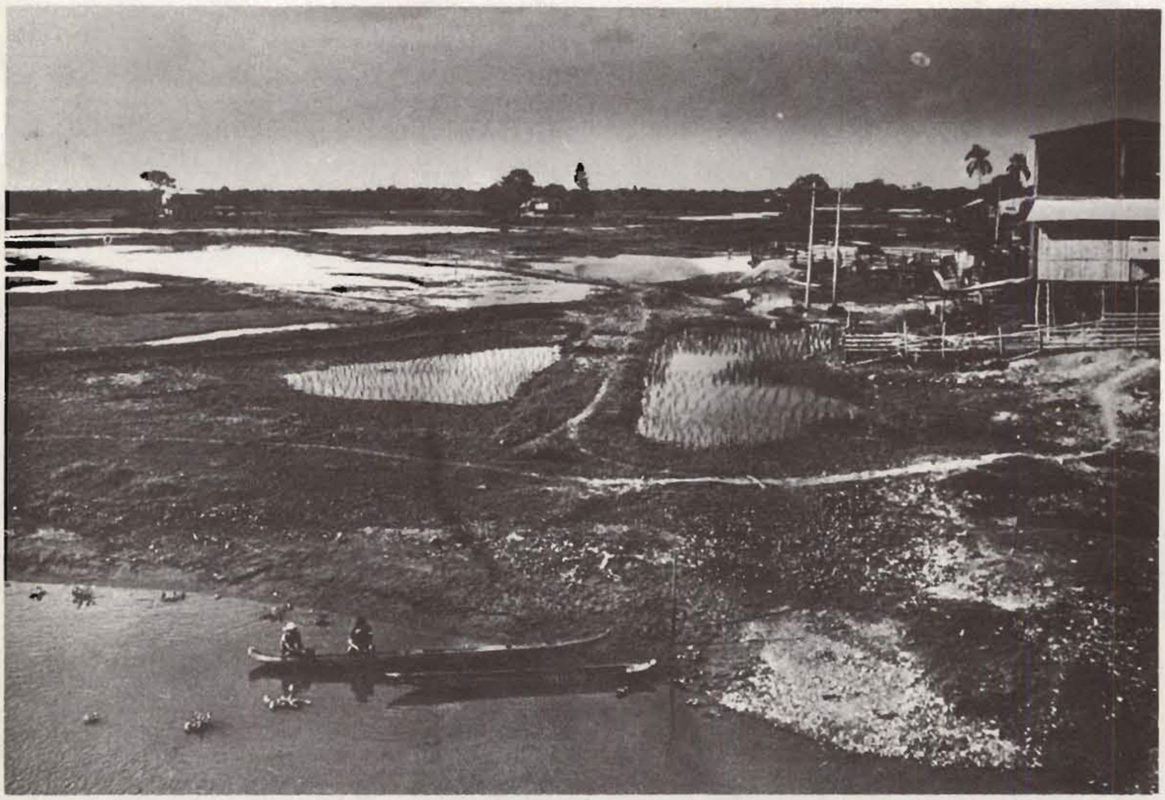

Figure 10. Typical rice farm in "Pozas Veraneras" in the Samborondón region in Ecuador.

Figure 11. Type of tractors used in soil preparation by puddling in commercial farms in Samborondón, Ecuador. This system is widely used in Calabozo, Venezuela.

Experimental Station of the National Rice Program of the Ministry of Agriculture and Cattle in the Daule Zone

Agr. Jorge Gil Chang, Program Director and Agr. Ling, Head of the Chinese Mission, received the group in this station. The main activities in this station are concentrated on the transfer of technology, by means of training farmers and evaluating and multiplying seed of varieties produced by INIAP.

The Chinese Mission is made up of six technicians, who work with the Rice Program as convened in the two-year agreement signed by the government. The Chinese Mission arrived in Ecuador in early 1979.

In the field, the group observed the demonstration plots, transplanted with 12 rice varieties (6 from INIAP and 6 introductions from Taiwan). The varieties were between the stage of flowering and maturity. The material from Taiwan performed well, especially the variety Taichung Siem #3, long grain and intermediate height (Figure 12).

Figure 12. The observational group participants discuss seed production problems with technicians from Ecuador and from the Chinese Mission in the Daule Experimental Station of the Ministry of Agriculture.

Meeting with INIAP's Vice-Director and Technicians

To conclude the group's visit to Ecuador, a meeting was held to discuss various aspects related to the observations the group had made and to determine, with INIAP's administrators in Guayaquil, the type of cooperative activities which could be carried out with CIAT and IRRI.

In relation to rice production costs, it was determined that these vary according to the technological level of the production system applied:

a) In the traditional system, the costs are US$370/ha and farmers obtain yields of 2.8 tons of paddy rice/ha.

b) In the production system with an intermediate technological level, costs are US$430/ha and farmers obtain yields of 3.8 t/ha.

c) In the production system with advanced technology, the costs are US$575/ha and the yields reach 4.5 t/ha.

These costs are considered to be high, since the official price for paddy rice is only US$ 0.16/kg (Table 2). The profit obtained by the farmers, having in mind the high cost of living, does not permit them to invest and improve the technology.

Another aspect discussed was the hoja blanca virus. The opinion of the group, having in mind what was observed in commercial plantings, was that this disease is not presently a limiting factor. However, INIAP's technicians considered it to be a limiting problem; unfortunately due to time limitations, the group was not able to visit the zone where hoja blanca incidence is severe.

This problem will be overcome if production of INIAP 6, INIAP 7 varieties and of line INIAP 415 is intensified; these materials present tolerance to the disease; another solution is eliminating the susceptible varieties, especially IR 6.

INIAP's Vice-Director made the following requests:

1. Training of technical personnel at CIAT in screening techniques for resistance to hoja blanca.

2. Inviting technicians to participate in observational trips focused on upland rice.

3. Technical advising from Thailand scientists who would come to the country to evaluate the area floods and would recommend adequate varieties and management practices.

4. Inviting INIAP's rice technicians to visit Thailand and Bangladesh to observe production of varieties for deep and semi-deep water.

Finally, INIAP's Vice-Director expressed that his institution has its door open to collaborate in any project oriented towards solving this crop's problems, especially those related to hoja blanca.

GUYANA

Status of the Crop

General aspects

In Guyana, approximately 122,000 ha are planted to rice (70% irrigated and 30% favored upland). The area dedicated to irrigated rice is 43,200 ha which are cropped twice a year. The normal upland area is 52,800 ha but in 1978 only 35,200 ha were planted (Table 1).

Present production (Table 1) satisfies domestic needs, and produces a surplus which is exported to the Caribbean region and to various European countries.

Production systems

In the irrigated area, the land is mostly prepared by the puddling system, planting pregerminated seed (80-100 kg/ha); to a minor extent, direct planting is practiced manually by broadcasting dry seed (100-120 kg/ha) on dry soil.

In the favored upland area, production is mechanized in the land preparation and harvest stages. Planting is done by hand, broadcasting dry seed (100-120 kg/ha).

In both cropping systems, fertilizers are not applied before planting. Fertilization is done 20 days after planting, using N and P and later only N, at panicle initiation, and in some cases at flowering stage. Recommended dosis are 58-68 kg N/ha and 29-34 kg P/ha. In clayey soils, K is not recommended. The majority of the farmers fertilize the improved varieties with 58 kg N/ha and 29 kg P/ha. When it is necessary they apply pesticides.

Weeds are controlled with various herbicides but mainly with propanil.

Harvesting in the irrigated and upland areas is completely mechanized, using combines.

Varieties grown

The main commercial varieties are Starbonnet and N, 62 and 17%, respectively, of the irrigated and favored upland areas. Rustic occupies 3% of the irrigated and upland area, and other varieties (Bluebelle, S, T, and Champion) occupy 1%. The traditional varieties, mainly BG 79 and Lodger, are grown in favored upland and cover 17% of the area. Starbonnet, Rustic, Bluebelle and Champion production is sold as normal white rice. Production from the N variety is sold as parboiled and normal white rice. The other varieties are sold as parboiled rice.

Seed production

Certified seed production is under the responsibility of Guyana Rice Board. This entity supplies to the farmers sufficient certified seed of the commercial varieties.

Limiting factors

The main factors which limit rice production in Guyana are the following:

1. Short life of the tractors and combines due to a scarce supply of spare parts.

2. Deficiencies in land preparation.

3. Insufficient irrigation and drainage facilities in the irrigated area.

Visits and observations

During the one-day stay in Guyana, the group had the opportunity of observing the genetic material trials of screening for resistance to rice blast in infection beds; also observed were the different activities conducted by the program's Experimental Rice Station.

Blast infection beds

Blast infection beds are located close to Georgetown on the Caledonia east bank of the Demerara river. The group observed the material being evaluated which included segregating lines from F_4 generations in mass selections and advanced F_8-F_{10} lines. The variety CICA 8 (resistant) and line 52297 (W) (susceptible) were used as checks. A severe initial infection was observed in the susceptible material. In the selection for resistance, the material with an infection grade higher than 6, in the international scale, is discarded. CICA 8 proved to be highly resistant. The group was told that CICA 8 was not planted commercially since its grain type is not ideal for replacing Starbonnet.

Rice Experimental Station

In this Experimental Station the group was received by the Superintendent and other personnel members (Appendix 2).

The entomology lab was visited; here they have a collection of all insects which attack rice in the field and during storage. A total of 48 species of insects have been identified in Guyana attacking rice; among these the most important are water weevils (Helodytes fovedatus (Duval), leaf miners (Hydrellia sp.), armyworms (Spodoptera frugiperda and Mocis puntularis sp.), stemborers (Rupella albinella y Diatraea saccharalis), plant hoppers (Sogatodes oryzicola), leafhoppers (Neoconocephalus spp. and Caulopsis spp.) and stink bugs (Oebalus poecilus). They have produced a publication (Field Pests of Rice in Guyana and their Control) which describes the insects and the damage they cause, including control measures.

The following experiments were observed (Figure 13) in the field:

- Demonstration plots of the commercial varieties Starbonnet, BG 79, T, N, S, Rustic and Champion.
- Demonstration fertilization trials with the variety Rustic.
- Seed multiplication plots with lines resistant to rice blast.
- Basic seed production plots with the varieties N, Rustic, Starbonnet, Bluebelle, Champion, T, S and BG 79.
- Genetic material: F_1 populations, F_2-F_5 segregating populations and advanced material.

All the material, except the genetic material, was in the tillering stage and exhibited good management practices.

Figure 13. The observational group participants, accompanied by technicians from the Guyana Rice Board, observe the varieties and fertilization demonstration trials in the corporation's Rice Experimental Station.

Some of the basic seed production plots had just been transplanted and in others this practice was being done with a demonstration transplanter brought from Korea (Figure 14).

The genetic material was in the flowering-maturity stages. The early generations showed good genetic variability. Rice blast was observed attacking the panicle neck; there were symptoms also of sheath blight and brown leaf spot. Material from advanced lines showed high grain sterility (empty glumes and brown coloring with 80-90% sterility) (Figure 15).

During the tour through Georgetown and to the Rice Experimental Station, the group had the opportunity of observing the land preparation activities (puddling) and various commercial crops 15-40 days old.

Figure 14. Basic seed production plots using the transplanting system by means of transplanters introduced from Korea in the Guyana Rice Board's Experimental Station.

Table 2 indicates production costs and profit for the puddling system.

SURINAM

Status of the Crop

General aspects

In Surinam, rice production is located in lowland areas close to the north coast. Rice is primarily grown under irrigation and in a small area under upland conditions. The most important region is that of the Nickerie District which supplies 95% of the total production. Presently 40,000 ha (Table 1) are cultivated, of which 12,000 ha are in the hands of small farmers, 2,000 ha belong to middle-size farmers and the rest belongs to large commercial farm-

Figure 15. C.P. Martínez, A.V. Chin, D. Leal and a technician from Guyana observe the problem of sterility in genetic material in the Guyana Rice Board Experimental Station.

ers. The area is increasing rapidly, due to its huge interest in the market and because production is completely mechanized (Figure 16). The small farmers do certain practices by hand but when they have the opportunity they plant, fertilize and apply insecticides by plane.

Among large commercial farmers the Mechanized Agricultural Development Foundation in Surinam (SML) is the most important. This company grows 9000 ha of rice and counts with all the facilities for processing and exporting the grain.

Intermediaries purchase small and middle-size farmers production since they have the facilities for drying, processing and exporting the white rice.

In 1978 Surinam exported 61,000 tons of rice, most of this tonnage as brown rice.

The climate in the rice growing zone is classified as humid tropical, with an annual rainfall of 2000 mm during two periods, April-August and December-February, and an annual mean temperature of 27° C. Daylength is approximately 12 hours throughout the year.

Figure 16. Aerial view of the rice growing zone in the Nickerie District in Surinam.

Production systems

95-98% of the production comes from the irrigated area. The water source is the Nanni-Swamp reservoir and various rivers.

The fields are normally prepared on dry conditions and are puddled with metallic wheel tractors and bulldozers two weeks before planting. Pregerminated seed is planted directly by broadcasting. In the areas where planting is done by plane, the fields are flooded, maintaining a 15 cm water depth; after planting is finished the fields are drained as soon as possible.

Weeds are controlled with propanil and 2,4-D amine. Endrin is used to control insects when the crop is still in the seedling stage.

Only N is used as fertilizer, using urea as the source; three applications are used (30, 48 and 65 days after planting) with a total of 100 kg N/ha.

All production tasks are completely mechanized.

In general, two harvests per year are cropped and the average yield is 4.2 t/ha per crop.

Varieties grown

Of the total area, 2% is planted to traditional varieties introduced from Indonesia and India and 98% to varieties developed by the SML Experimental Station.

These varieties were developed for mechanized production and have the following characteristics:

1. Short and stiff straw.
2. Erect plant type.
3. Growth duration of less than 120 days.
4. Extra-long grain and high milling yield.
5. Amylose content from 20-27%.
6. Good response to N and high grain yield.
7. Good tolerance to unfavorable climatic and edaphic conditions.
8. Good resistance to main insects and diseases.

Currently, the varieties Diwani (70% of the area), Camponi and Eloni (10%) are grown by large and medium size farmers, and Pisari (20%) is grown by small farmers.

Seed production

Seed production is one of the main activities conducted by the SML enterprise. This company produces the certified seed required for the irrigated area, especially with new varieties. However, various large and medium-scale farmers also produce seed from the new varieties which have already been delivered for commercial plantings.

Limiting factors

There are various limiting factors, some of them specific to rice production in Surinam:

1. Presence of snails before planting.

2. Armyworms (Spodoptera sp.) and leaf miners (Hydrellia sp.) during the first two weeks after planting.

3. Stemborer (Rupella sp. and Diatraea).

4. Leafhoppers and stink bugs (Oebalus sp.); during some semesters they are serious and must be controlled.

5. Weeds, especially when water is scarce.

6. Red rice, a serious problem for small farmers.

7. Unidentified edaphic problems which produce symptoms such as low vigor of the seedlings and foliar yellowing 30 days after planting.

Diseases such as rice blast, brown leaf spot, narrow brown leaf spot, leaf scald, stem rot and sheath blight are present but are not limiting the production and their control has not been necessary.

Visits and observations

M.J. Idoe made an excellent programming so that the observational group could interview agricultural production administrators and could observe the main rice production activities in Surinam.

Interview with the Minister of Agriculture and the Director of the Experimental Station

The observational group was received in the Ministry of Agriculture in Paramaribo by the Minister of Agriculture and the Director of the Ministry of Agriculture Experimental Station (Figure 17).

Figure 17. Ing. J. Kasantaroeno, Minister of Agriculture (right) and F.W. van Amson, Director of the Agricultural Experimental Station (center) explain to the observational group the rice research activities in Surinam.

The Minister welcomed the group and briefly informed on the rice production policies of the country.

The observational group leader presented the team members and explained to the Minister and the Director of the Experimental Station the objectives of the visit.

The Director of the Experimental Station explained to the group the reasons why rice research had been stopped for two months and mentioned the project for reinitiating these activites in New Nickerie, with the purpose of helping small farmers, especially in the area of crop management.

Mechanized Agricultural Development Foundation (SML) in Wageningen, Nickerie

P.A. Lieuw Song, company Manager received the group and gave ample information on the corporation's activities. Thirty years before the zone where the company is located had been a swamp. Currently, it has good installations for rice processing, houses and recreational facilities for the company's personnel.

A total of 9700 ha are grown, completely developed and counting with a main 15 km irrigation canal and a net of secondary canals that totals 13 km. The source of water is the Nickerie river where a pumping station with a capacity of 21-30 m^3/seg has been installed.

All the company's production in Wageningen is commercial; drying and milling facilities process 100,000 t/year (80,000 are produced by the company and 20,000 by farmers in the zone).

Furthermore, it has an experimental station where genetic breeding and genetic and basic seed production are conducted. In 1972, the average yield was only 3.5 t/ha and in 1978 it increased to 4.3 t/ha with the new short varieties White rice is exported to France and the Antilles and brown rice to Germany.

Rice hulls are used for producing electricity; for this purpose they have complete installations which can generate 900-1200 kw per hour (1 kw energy/2.3 kg hulls). Half of the electricity consumed in the company's housing facilities is generated from combustion of the hulls.

Production costs in the company (Table 2) are 600 gilders/ha (US$ 343/ha).

Another activity of the company is beef production, currently they rise 3000 beef heads and their future goal is increasing their capacity to 6000 heads.

The manager expressed that the company will participate in the IRTP, by nominating various promising lines for the nurseries, as long as the material did not have any direct commercial use.

Various plots were observed planted to Diwani and Eloni, the main varieties of the company's commercial production. The crop was at tillering stage (40 days) and completely free of weeds. The plots were well leveled, with a water depth of 15-20 cm. The only problem observed in one of the plots was leaf yellowing of the seedlings. The cause is unknown, but it is considered to be caused by a soil factor. Soil pH is 6.5 and fertilization is done with urea (100 kg N/ha).

"Prins Bernhard Polder" - SML Breeding Experimental Station

This experimental station is located 30 km from Nickerie towards the farm in Wageningen.

M.J. Idoe introduced Mr. Zalmijn, in charge of transferring technology to the small farmers and Dr. van Dijk, Director of the VANDINI Company. An explanation was given on the program's breeding objectives and on the achievements and methodology for selecting varieties.

Initially (approximately 30 years ago), selection of rice varieties was oriented towards obtaining adequate varieties for mechanization; these efforts resulted in the first variety DIMA and in various lines known as SML. Later. selection was concentrated on obtaining stiff straw varieties, resistant to diseases and insects, adequate for mechanization and tolerant to edaphic problems. The varieties Tapuripa, Galibi and Washabo resulted from these selections.

In 1966, selecting was oriented towards obtaining early-maturing varieties, with stiff straw and good grain quality; this was done by crossing germplasm introduced from IRRI and genetic material from the program. The varieties Apani, Awini and Acorni were obtained from these crosses in 1972; Ceysvoni, Ciwini and Camponi in 1974; Diwani in 1976; and Eloni in 1979 (this is considered to be the best in comparison to the rest of the mentioned varieties).

Currently, the Breeding Program is concentrated on obtaining early-maturing varieties, resistant to lodging, with extra-long grain and good milling and cooking qualities, resistant to diseases and insects and a high yield potential. The methodology applied for selecting materials is indicated on Figure 18.

It is important to mention that selection for resistance to diseases and insects is done directly in the field under natural crop conditions. Naming of a new variety is done after it has been evaluated at least during four harvests in commercial fields and after seed production in Wageningen. The decision to name a variety is taken by the Board of Directors and the breeder of the company.

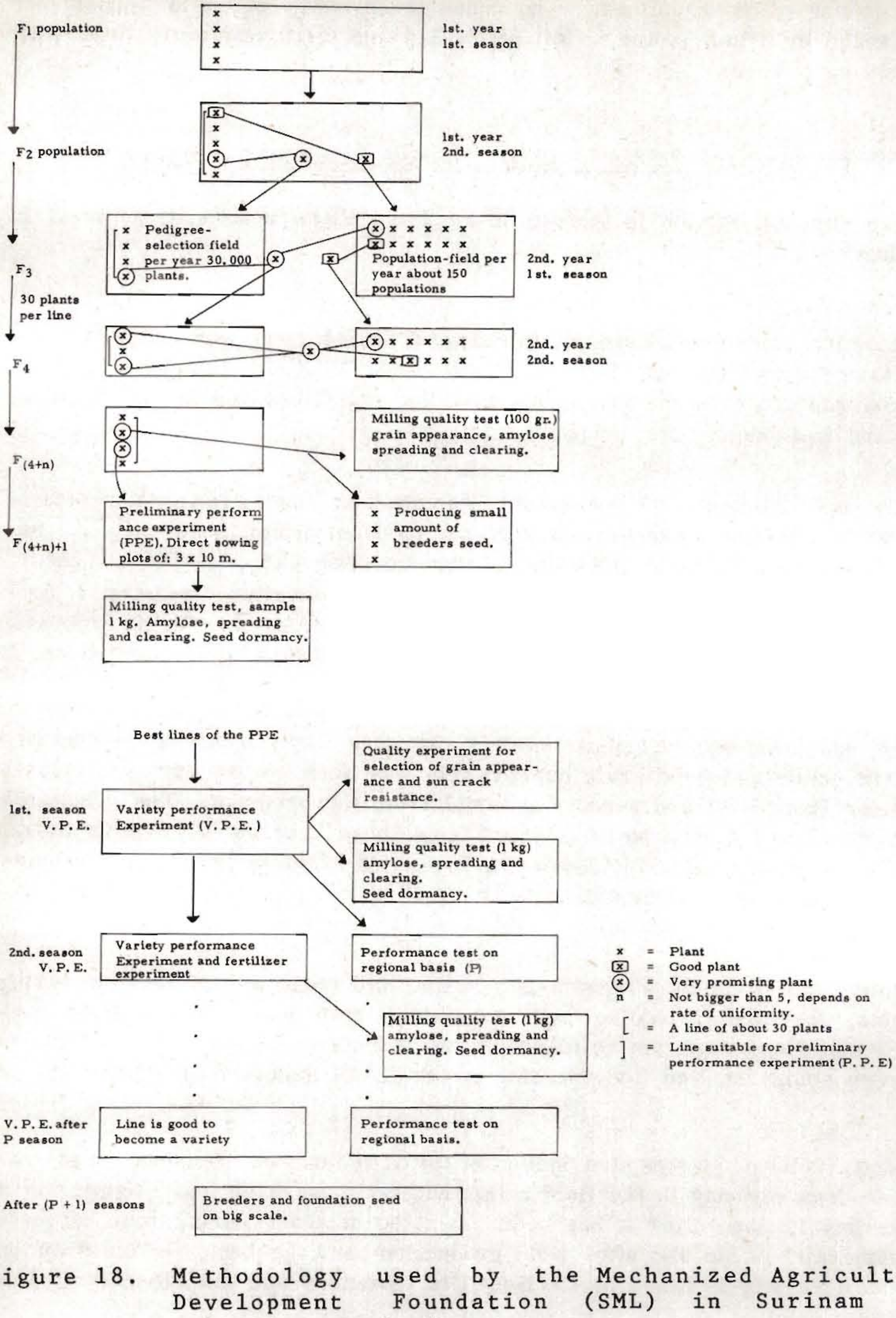

Figure 18. Methodology used by the Mechanized Agricultural Development Foundation (SML) in Surinam for selecting varieties.

Ir. Idoe was requested to name the promising lines for the IRTP nurseries. The following lines were named: 7231/8, 73114/2, and 73151/6.

Mr. Zalmijn, in charge of a development project for small farmers, indicated to the group that in the Nickerie District there are 11,000 ha in hands of 3000 small farmers (3.5-4.0/farmer) whose principal activity is rice production and fishing. The main problems faced by these farmers are lack of water, deficient marketing systems and high production costs (500-600 gilders/ha or US$ 286-343/ha). The yield they obtain (4.2 t/ha) and the price received from intermediaries (210 gilders/t or US$ 120/t) does not permit them to take care of the cost of living, and therefore, they have to look for other employments.

The government, through the Public Works, Forestry and Agriculture Ministries, has begun a land preparation project with irrigation and drainage systems, which will cover approximately 32,000 ha in two phases: 12,000 ha in the first and 20,000 ha in the second phase. The exploitation system will be through cooperatives.

The group made a tour through the soils, quality and seed laboratories. The soil laboratory has the equipment needed for soil and vegetable tissue analyses. The quality lab has all the equipment required for determining the milling and cooking quality of the material. Seedbed utilized for germination and growth of the segregating materials are simple and practical. Seed from each plant selected are placed in small aluminium boxes containing humid soil, in order to assure that germination takes place; transplanted is done when the plants are 10-15 days old. In this way thousands of selected plants are handled in a small space (15 or 20 m^2).

The genetic material was observed in the field; this included segregating F_2-F_4 populations, advanced material in preliminary yield trials, yield trials, genetic and basic seed production plots, and response to N trials. Appendix 3 presents a summary of the different experiments observed. Also visited was the 1979 VIRAL-P, which is located in the middle of a field planted with the variety Eloni (Figure 19). Germplasm was not evaluated since this, and all the genetic material was only 2-4 weeks from planting. The distribution of the plots in the field and the management of the experiments were excellent.

The observational group was very well impressed by the excellent work which M.J. Idoe is carrying out in all his research and production activities within the target area.

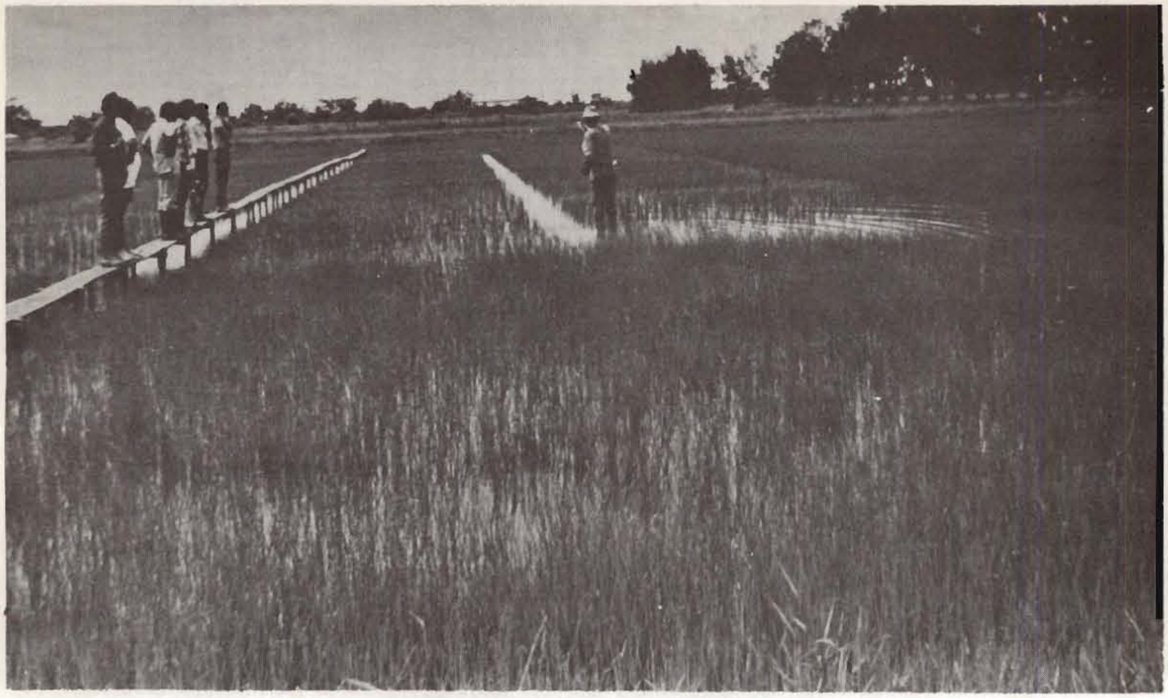

Figure 19. H.E. Kauffman shows to the other group members the VIRAL-P 1979 germplasm planted in the middle of an Eloni commercial plot in the SML "Prins Bernhard Polder" Experimental Station in Nickerie, Surinam.

VENEZUELA

Status of the Crop

General aspects

In Venezuela, rice is produced under irrigated and favored upland conditions. Table 1 shows the area, productivity and yield of rice for the harvest of 1977-1978.

Two zones can be identified in this country:

1. Llanos Centrales Zone, including the Guárico State, where 20,000 ha are grown for rice consumption and 1250 ha for certified seed production, both under irrigated conditions.

   The rice growing zones are at an altitude of 100 masl, with an average temperature of 27°C and an annual mean rainfall of 1200 mm. Two harvests are done per year; the first during the rainy season (May-November) and the second, during the dry season (December-April). The rice growing area has an irrigation district in the Guárico river with irrigation and drainage concrete-lined canals. The source of irrigation is the Guárico reservoir with an impounding capacity of 1840 million m^3, in an area of 23,140 ha.

2. Llanos Centro Occidentales Zone, including the states of Cojedes, Portuguesa and Barinas. Under irrigation 84,000 ha are grown for rice consumption and 4000 ha for certified seed production; under upland conditions 36,000 ha are grown for internal rice consumption. The rice growing zones are at an elevation of 200 masl, with a mean temperature of 26.4°C and an annual rainfall of 1580 mm. Two crops are harvested per year in this zone: the first under both irrigated and upland conditions in the rainy season (May-November) and the second under irrigated conditions during the dry season (December-April).

Production systems

In the Llanos Centrales Zone the land preparation system by puddling and the planting of pregerminated seed are predominant. The exploitation of the land is done by large commercial farmers and small farmer associations. The average size of the former farms is 200 ha and of the latter is 290-480 ha, assigned to groups of 10 to 20 families.

All exploitations are completely mechanized in the stages of land preparation and application of inputs and during harvesting.

From 120-150 kg/ha of pregerminated seed are planted. Fertilization is done with complete fertilizers (200-300 kg/ha) and N (100-120 kg N/ha). Weeds are controlled with propanil and 2,4-D. Sogata and stink bugs are controlled with 1 or 2 applications of chlorinated insecticides.

In the Llanos Centro Occidentales Zone, predominates the irrigated system by direct planting dry seed (120-150 kg/ha broadcasted or in rows) in dry soil. Various farmers are introducing the puddling system. Fertilization is primarily done with N at a rate of 120-150 kg/ha. Weeds are controlled with propanil.

The cropping system under upland is mechanized with seed broadcasted or planted in rows (100-120 kg/ha).

Under both systems, exploitation is completely mechanized from the preparation of the land until the harvest, including the application of inputs with plane, primarily in the irrigated area.

Varieties grown

The main commercial varieties in the irrigated area are CICA 4 (93% of the area) and Araure 1 (17%). Ciarllacen is planted to a small scale in the Guárico State. Under upland conditions CICA 4 (89% of the area) and Llanero 501 (11%) are cultivated.

Seed production

Certified seed production is under the responsibility of the Seed Program of the Fondo Nacional de Investigaciones Agropecuarias (FONAIAP). In the Araure and Calabozo experimental centers, the program produces basic seed and in farmers fields certified seed is produced.

Limiting factors

The main factors limiting production during the dry season in the Llanos Centrales are plant hoppers and rodents and during the rainy season, rice blast and lodging.

In the Llanos Centro Occidentales rodents are a serious problem during the dry season plantings, and rice blast during the rainy season.

Visits and observations

The observation group was received by Agr. Aníbal Rodríguez (member of the group) in Acarigua and by Agronomists Germán Rico and Alberto Salih in Calabozo. In Venezuela, Luis López, MS, joined the group; he is in charge of upland rice research in the Delta.

Acarigua

In Acarigua, the group visited the Araure Experimental Station and two private farms.

Araure Experimental Station. Agr. A. Rodríguez introduced the technical personnel of the Experimental Station (Appendix 2) who in turn informed the group on the different research activities related to rice production.

The Araure Experimental Station is the headquarters of FONAIAP's Centro de Investigaciones Agropecuarias de la Región de los Llanos Centro Occidentales (CIARCO).

The Station is located at 200 masl, at 9°31'34" north latitude and 69°12'33" west longitude. The average temperature is 26.4°C and the mean annual precipitation is 1281 mm.

The group toured various sections and received information on the research activities on rodents, diseases and seed production. In the field, the group observed genetic breeding experiments and cultural practices which were being conducted.

The specialist on rodent control commented on the importance of rats in rice production. In 1978, nearly 5000 ha were lost due to damage caused by rats (Holochides brasiliensis and Sygmonys alotoni). Various control methods have been investigated, but the results have not been satisfactory.

The most common diseases attacking rice are blast, brown leaf spot, sheath blight, narrow leaf spot and leaf scald. The most important is blast, especially during the rainy season on both irrigated and upland systems. Good control results have been obtained experimentally with Kasumin, Hinosan and Antracol fungicides; farmers have also been using them with satisfactory results. All varieties are susceptible but the most affected is Llanero 501.

The seed program activities are concentrated on the multiplication of basic seed in the Experimental Station and on the production of certified seed in farmers fields. In 1978, 6000 ha (3800 ha of CICA 4, 1800 ha of Araure 1 and 400 ha of Llanero 501) were planted, in cooperation with the farmers. The future goal is producing 19,000 tons for irrigated and upland plantings during the rainy season, and 3000 ton for the dry season.

In the field, the group observed the genetic breeding, and agronomy experiments as well as IRTP nurseries for Latin America (Figure 20). Appendix 3 indicates in detail the experiments observed.

Figure 20. Observational group members inpsect IRTP nurseries germplasm planted in the CIARCO/FONAIAP's Araure Experimental Station in Venezuela.

The material of the various experiments was between the flowering and maturity stages; all trials showed good management practices. Among the germplasm from the nurseries, various lines showed to be superior than the regional checks CICA 4, and Araure 1, earlier maturity and better grain type (Appendix 4).

A basic seed multiplication field was observed; it was planted to Juma 57 which had been selected as the best from the First Yield Nursery VIRAL-76. In 1979 it had been the candidate to be delivered to the farmers for commercial production; however, its naming was discarded since it showed symptoms of foliar yellowing in the multiplication plot (Figure 21). Previously, the plot had been planted with grass and this was the first time that it was planted with rice. The plot was prepared by puddling and planting was done by transplanting. Yellowing started when the crop was 60 days old. Several lots were healthy and other were severely affected. The symptoms were not typical of Fe toxicity. From the soil analysis the pH ranged from 5.5 to 5.6.

"La Romaña" Farm. This farm is located in the El Cruce region, in the municipality of Acarigua and is owned by Mr. Domingo Moreli, rice farmer. The farm has 330 ha, all planted with CICA 4 under irrigated conditions.

Figure 21. The observational group and Venezuelan rice technicians observe the foliar yellowing in Juma 57 at CIARCO/FONAIAP's Araure Experimental Station.

Since 1974 the rice program has been planting the breeding trials and conducting cultural practices in this farm. This farm was selected for being representative of the rice growing area in the Portuguesa State and at the same time because of the excellent cooperation of the owner. The experiments planted by the program included segregating material, 1979 international nurseries (VIRAL-P, VIRAL-T, VIRAL-S, VIAVAL, VIOAL-S, VIOAL-Riego, VIOAL-R and VIPAL), and fertility and rice blast chemical control trials. All germplasm was 18 days old (Figure 22).

A commercial field of CICA 4 was observed in excellent conditions; the crop was 30 days old, planted in rows at a rate of 140 kg/ha. Mr. Moreli explained that he liked this variety because it produced better and was more tolerant to diseases during the rainy season, in comparison to other varieties. Its yields range from 3.5 to 4.5 t/ha, with total production costs of 2000 bolívares/ha (US$ 476/ha) and a paddy rice price of 1150 bolívares/ton (US$ 274/ton).

<u>"Santa Rita" Farm.</u> This farm is owned by the Ruffoni brothers and has 400 ha. The land is prepared by the puddling system and pregerminated seed is planted by plane. In this farm, 250 ha are planted to CICA 4, 50 ha to Araure 1 and 100 ha to Llanero 501. The planting density of the three varieties is 120 kg pregerminated seed/ha. Average yields of 3.4, 3.5, and 2.1-

Figure 22. IRTP nurseries planted under upland conditions in the "La Romaña" farm located in Acarigua, Venezuela.

2.4 t/ha are obtained with CICA 4, Araure 1, and Llanero 501, respectively, with production costs of 3000 bolívares/ha (US$ 714/ha).

Various crops with weed problems due to inadequate leveling of the land, were observed.

Calabozo

In Calabozo, the group visited the Experimental Station and various commercial crops of the region.

Calabozo Experimental Station. This station is located at an elevation of 100 masl, 8°45' north latitude and 67'32" west longitude. The mean temperature is 27°C and the annual mean rainfall is 1240 mm.

The Experimental Station is the headquarters of FONAIAP's Centro de Investigaciones Agropecuarias de la Región de los Llanos Centrales (CIARLLACEN).

Dr. Edgardo Ceballos, Center Director, received the group and explained CIARLLACEN's main research activities in the region and the services rendered to the producers.

Agr. Germán Rico indicated that the rice research activities are directed towards obtaining high-yielding varieties, with the international cooperation of IRRI and CIAT, and improving cultural practices (soil management, fertility, irrigation, entomology and planting systems).

The group toured the experimental field (Figure 23) where the following experiments were observed:

1. Segregating F_3-F_4 populations.

2. International 1978 IRTP nurseries for Latin America: VIAVAL, VIOAL, VIRAL-T and VIRAL-P, 1977.

3. International IRTP nurseries distributed from IRRI in 1978: IRON and IURON.

4. Evaluation of commercial varieties from IRRI.

Figure 23. M.J. Rosero, D. Leal, J. Gonzalez, A. Rodríguez and A. Salih observe plants infected by sheath blight in CIARLLACEN/FONAIAP's Calabozo Experimental Station in Venezuela.

5. Basic seed multiplication of Ciarllacen, Araure 1 and CICA 4.

Germplasm was in the stages of flowering and maturity and presented good management. A high degree of lodging was observed in material from IRRI, especially in the IURON, which was planted under irrigated conditions, and in the VIAVAL from CIAT.

Some lines in the VIRAL-P and VIRAL-T, presented lodging but most of them showed good behavior (Appendix 4).

The plot with CICA 4 basic seed production showed a high lodging percentage.

<u>Farm "Parcela #216"</u>. In this farm, owned by Mr. Aníbal Dávila, an 80 ha plot planted to Araure 1 was observed. It was in the harvest period (Figure 24). It showed lodging problems and incidence of sheath blight. Rice production costs in this farm are approximately 3000 bolívares/ha (US$ 714/ha) with an average yield of 5.0 t/ha. With the current sale price (0.90 bolívares/kg paddy rice or US$ 0.21/kg) the profit obtained is US$67.2/ton (Table 2).

Figure 24. Rice harvesting is done with combines in Calabozo, Venezuela, as observed in this figure.

This farm had a plot planted with Ciarllacen; it was at harvest period which showed excellent conditions, another was in the flowering period and presented narrow-leaf weed problems.

DISCUSSION AND RECOMMENDATIONS

The observational group had a special meeting in New Nickerie, at the end of the trip, with the object of discussing the rice production problems in the countries visited and give some recommendations related to the encountered problems as well as to future monitoring tours.

Crop problems

After ample discussion of the problems which this crop presents, it was considered necessary to list them indicating the importance of each in the fields related to genetic breeding, diseases and cultural practices. Table 3 specifies the varietal problems and the importance of them in the different countries visited. Table 4 includes a list of the diseases observed and their importance in each country. Similarly, Table 5 presents the fungicides commonly used for controlling rice blast. Table 6 summarizes the agronomic problems of this crop in the five countries visited.

Recommendations

After the discussions, the observational group established the following recommendations:

Germplasm

a) CIAT's Rice Program must try to identify progenitors for the different crop problems in the region, by collecting and evaluating existing germplasm and making crosses.

b) It is necessary to identify at CIAT new varieties with resistance to lodging, a serious problem in the region; it is requested that the breeding program increases the delivery of genetic material (segregating), especially to Venezuela.

Table 3. Problems observed during the observational trip which may feasibly be solved through genetic breeding of rice germplasm.

Problem	Ecuador	Colombia		Venezuela		Guyana	Surinam
		Tolima	Llanos	Acarigua	Calabozo		
Lodging	1*	1	1	1	1	1	1
Quality	1	1	1	1	1	1	1
Rice blast	1	1	1	1	1	1	1
Early vigor	1	1	1	1	1	1	1
Early maturity	1	1	1	1	1	1	1
Genetic diversity		1	1	1	1	1	1
Sheath rot		1	1	1	1	1	1
Low yield	1			1	1	1	1
Tolerance to drought	1		1	1		1	
Tolerance to soil acidity	1		1	1		1	
Leaf scald		1	1	1			
Brown leaf spot				1		1	1
Hoja blanca	1			1	1		
Tolerance to deep waters	1					1	
Salinity	1					1	1
TOTAL NUMBER OF PROBLEMS	11	8	10	13	9	13	10

* 1 = presence of the problem.

Table 4. Diseases and problems of acid soils observed by the observational group in the five countries visited.

Diseases and problems of acid soils*	Countries/Places										
	Colombia			Ecuador			Guyana		Surinam		Venezuela		
	El Aceituno	ICA Nataima	ICA La Libertad	Boliche	Samborondón	Nat. Rice Pg. Daule	Infection beds	Experimental Station	SML	Exp. Station New Nickerie	Exp. Station Araure	Private farms	Exp. Station Calabozo
Rice blast	XXX	XX	XX	X			XXX	X		X		XXX	X
Brown leaf spot			X					X		X			X
Leaf scald	X		X					X		X			
Sheath blight	X							XX					XX
Stem rot				X				X					
Narrow leaf spot	X												
Hoja blanca		X	X	XXX		X		X				X	X
Foliar yellowing			XXX					X	XX		XXX		
Foliar bronzing			XX										

* X = present; XX = frequent; XXX = important.

Table 5. Fungicides used for controlling rice blast in four countries of Latin America.

Fungicides	Countries/Sites							
	Colombia		Ecuador		Guyana		Venezuela	
	Farm	Station	Farm	Station	Farm	Station	Farm	Station
	*	**						
Hinosan	VF	VE	F	VE		M	R	M
Antracol							VF	VE
Benlate	R		VF	M		L		
BIM (commercial name)	R	VE				L		L
Kasumin	VF	M	VF	M			VF	VE
Blasticidine	F	M	F	L		L	R	L
Kitazin					VF	M		L

* Use: R = rare F = frequent; VF = very frequent.
** Efficiency: L = low; M = moderate; VE = very efficient.

Table 6. Rice agronomy problems observed by the observational group in the five countries visited.

Problem	Countries						
		Colombia		Venezuela			
	Ecuador	Tolima	Llanos	Acarigua	Calabozo	Guyana	Surinam
Weed control	X*	X	X	X	X	X	X
Drainage	X					X	X
Irrigation	X	X			X		
Soil preparation	X		X		X		
Acid soils			X	X			
Planting density		X					
High fertilization		X	X		X		

* X = presence of the problem.

c) Among the germplasm of the IRTP nurseries for Latin America it is necessary to identify material with resistance or tolerance to acid soil problems, and assembling a specific nursery, including material from IRAT, which is considered tolerant to these problems.

d) Collecting and preserving the region's native varieties. To this end, IRRI will send lists of existing materials in the germplasm bank to Dr. Rosero who will in turn circulate these to the national program leaders so that they can determine which materials have not been delivered to IRRI.

e) It is necessary to separate the germplasm of the upland nursery for Latin America in two nurseries, one for favored upland and another for unfavorable upland.

Diseases and insects

a) In relation to rice blast, it is necessary that the international centers (IRRI and CIAT) intensify the genetic breeding projects for resistance to the disease and the fungicide evaluation projects for its chemical control.

b) CIAT's Rice Program could evaluate the climate prediction trials for controlling rice blast, as proposed by Dr. MacKenzie.

c) It is necessary to intensify the selection of resistant varieties to leaf scald, sheath blight and hoja blanca, diseases which represent a serious potential problem.

d) Continue observing resistance to Sogata in the commercial varieties and insure that the new varieties are also resistant.

Monitoring tours

a) This IRTP activity must continue due to its great importance for the region's scientists.

b) In future trip the invitation must be extended to experts representing all the crop's disciplines, assigning each one specific responsibilities during the trip.

c) More time for observation and discussion must be dedicated in each country visited.

Personnel training

a) The personnel training courses of the national programs must continue at CIAT, giving priority to personnel having responsibilities in breeding, plant pathology, entomology, and crop management.

b) In the production courses offered at CIAT, more time should be dedicated to breeding, a critical aspect in most of the countries visited.

Agronomy and soil problems

a) CIAT could determine, in the region visited, the advantages of the land preparation systems (puddling vs. preparation on dry soil).

b) It is necessary to establish trials for better utilization of nitrogen (application forms, water management, sources and dosis), preferably in charge of CIAT. This study is required in view of the fact that the high costs of nitrogen was a general concern in the countries visited.

c) CIAT and IRRI should give priority to the acid soil problems and determine, in the field, the causes of the various problems both in upland and irrigated rice production.

d) CIAT should initiate studies on crop management with varieties for semi-deep water.

Appendix 1. Institutions, enterprises and places visited by the observational group in the five countries of the northern region of South America.

COLOMBIA

- Federación Nacional de Arroceros (FEDEARROZ), Ibagué - Tolima
- "El Aceituno" Farm - Ibagué
- Centro Nacional de Investigaciones Agropecuarias, ICA-Nataima, Espinal, Tolima
- ICA's "La Libertad" Experimental Station in Villavicencio, Meta
- Sociedad Agrícola Ltda. SOCEAGRO in Villavicencio

ECUADOR

- INIAP's regional offices in Guayaquil
- INIAP's Boliche Experimental Station in Guayas
- Samborondón - INIAP's regional trials with floating rice varieties - Rice Cooperative and "Miraflores" Farm
- Experimental Station of the national rice program of the Ministry of Agriculture in Daule - Rice demonstration fields of the Chinese Mission

GUYANA

- Rice Experimental Station of Guyana Rice Board (GRB), Georgetown
- Caledonia East Bank - Demerara River - Georgetown - Rice blast infection beds

SURINAM

- Ministry of Agriculture - Paramaribo
- Mechanized Agricultural Development Foundation (SML) in Wageningen, New Nickerie
- SML "Prins Bernhard Polder" Rice Experimental Station in Nickerie

VENEZUELA

- CIARCO/FONAIAP's Araure Experimental Station in Acarigua, State of Portuguesa
- "La Romaña" farm in Acarigua - Rice experimental fields and CICA 4 commercial plantings
- "Santa Rita" farm in Acarigua - Rice commercial plantings
- CIARLLACEN/FONAIAP's Experimental Station in Calabozo, State of Guárico
- "Parcela #216" in Calabozo - Araure 1 commercial plantings

Appendix 2. Scientists, technical and administrative personnel and rice producers who came in contact with the observational group.

COLOMBIA

Federación Nacional de Arroceros (FEDEARROZ) Ibagué

Gustavo Villegas V.	Technical Vice-Manager
Rafael Hernández	Executive Director
Gentil Vargas	Plant Manager
Guillermo Jaramillo	Technical Assistant
Armando Restrepo	Regional Leader
José Osorio Bedoya	Board of Directors
Pedro Pablo Mendoza	Board of Directors
Jorge Pinzón Quintero	Board of Directors

"El Aceituno" Farm - Ibagué

Hernando Osorio	Technical Director
Ramón Otazua	Administrator
Benjamín Rocha	Supervisor

Centro Nacional de Investigaciones Agropecuarias - ICA in Nataima, Espinal

Daniel Gutiérrez	Director
Alvaro Celis	Rice Section Head

Sociedad Agrícola Ltda. SOCEAGRO - Villavicencio

Armando Hernández	General Administrator
Guillermo Espejo	Plant Engineer

"La Libertad" Experimental Station - ICA, Villavicencio

Jairo Sediel	Regional Manager
Guillermo Chávez	Station Director
Carlos Coral	Production Director
Alberto Dávalos Rojas	Rice Technical Assistant
Alcides Villamil D.	Rice Regional Trials
Kitty F. Cardwell	Plant pathology - Peace Corps
Rhonda D. Oliver	Entomology - Peace Corps

ECUADOR

Instituto Nacional de Investigaciones Agropecuarias (INIAP) Guayaquil

Carlos Cortaza	Regional Sub-Director
Loyd Johnson	Technical Advisor

INIAP's "Boliche" Experimental Station

Hoover Celleri	Director
Julio Delgado	Head Plant Pathology Department
Washington Peñafiel	Breeding - Rice
Sergio Balarezo	Head Seed Production Department
Saúl Mestanza	Head Soils Department
Luis Maldonado	Head Department of Economics
Carlos Montenegro	Breeding - Rice
Santiago Ronquillo	Breeding - Rice
Eduardo Jarrín	Training - Rice
David Alava	Head Entomology Department
Robert Amat	Breeding - Rice
Otto Ordeñana	Head Weeds Department
Segundo Bravo	Head Agricultural Engineering Department
Hugo Martillo	Student of Agronomy
Orlando Calle	Student of Agronomy
Simón Ampuño	Student of Agronomy

National Rice Program of the Ministry of Agriculture - Daule

Jorge Gil Chang	Director
Edmundo Encalada	Production
Milo Rosado	Production
Julio C. Salvador	Production
Edmundo Castro	Production
Hugo Herrera	Production

GUYANA

Research and Extension Division of the Guyana Rice Board

A. Vivian E. Chin	Research Chief
G. Hughes	Regional Manager
B. Maray	Superintendent
L.C. Small	Head - Agronomy
G.C. Shukla	Agronomy
H.J. Fagan	Plant Pathology
I. Rambajan	Entomology
P. Dyal	Field official
D. Persaud	Research Associate
R. Baksh	Research Assistant
R. Samaroo	Research Assistant

SURINAM

Ministry of Agriculture - Paramaribo

J. Kasantaroeno	Minister of Agriculture
H. Lionarons	Director, Ministry of Agriculture
F.W. van Amson	Director, Agricultural Experiment Station

Mechanized Agricultural Development Foundation (SML) - Wageningen

P.A. Lieuw Kie Song	SML Production Manager
D.H. Lion A. Kong	SML Personnel Manager

SML "Prins Bernhard Polder" Rice Experimental Station

Mohamed J. Idoe	Breeder
A.D. van Dijk	VADINI Company Director
A. Zalmijn	Rural Development Head in Nickerie
N. Hardjo	Extension Agent

VENEZUELA

Araure Experimental Station - CIARCO/FONAIAP

Anibal Rodríguez H.	Head Rice Program
Orlando Paéz	Agronomy - Rice
Carlos Barrios	Certified seed production
Humberto Alirio Rodríguez	Plant Pathology
Pedro Castillo	Entomology
Danilo Aguero	Rodents (rats)
Luis López Méndez	Venezuelan Corporation of Guayana

Association of Seed Producers (APROSELLO) - Acarigua

Waldemar Cordero	President
Luis Ramírez	Board of Directors
Guino Merlotii	Board of Directors
Miguel Saldivia	Board of Directors
Rafael Burkes	Board of Directors
Francisco Lanza	Board of Directors
Juán Hernández	Manager

Rice Producers - Acarigua

Domingo Moreli	Owner "La Romaña" farm
Angelo Ruffoni	Owner "Santa Rita" farm
Horacio Ruffoni	Owner "Santa Rita" farm

Calabozo Experimental Station - CIARLLACEN/FONAIAP

Edgardo Ceballos	CIARLLACEN Director
Germán Rico	Head Rice Program
Alberto Salih	Research Assistant
Segundo Rico	Seed Production

Appendix 3. Rice research experiments observed by the observational group.

COLOMBIA

"Nataima"/ICA, Espinal, Tolima

1. Yield trials (11 promising lines, early maturing and good grain type).
2. IRTP nurseries: VIRAL-P and VIRAL-T, 1979.
3. Planting densities versus nitrogen levels in CICA 8.
4. Planting dates versus nitrogen levels (5 varieties: CICA 4, CICA 7, CICA 8, CICA 9 and IR 22; 3 levels of nitrogen: 50-100-1500 kg/ha).

"La Libertad"/ICA, Villavicencio, Meta

1. Breeding: F_2-F_3 segregating populations for horizontal and multiple resistance to rice blast.
2. Varieties regional trial.
3. Evaluation of rice lines tolerant to acid soils.
4. Evaluation of commercial and experimental fungicides for controlling rice blast.
5. Effect of rice blast infection (various infection levels) on the yield of commercial varieties.
6. Effect of two sources and six nitrogen levels on yield and incidence of rice blast.
7. Evaluation of promising lines at different fertility levels.
8. Evaluation of simulated damage on rice caused by leafhopper insects.
9. Evaluation of pre and post-emergent herbicides in rice.
10. Nitrogen levels versus planting densities in CICA 8.
11. IRTP nurseries 1979: VIRAL-P, VIOAL-R and VIRAL-T.

ECUADOR

Boliche/INIAP

1. Basic seed multiplication of INIAP 415, INIAP 6 and INIAP 7.
2. IRTP nurseries, 1978: VIRAL-F, VIRAL-S, VIRAL-T, VIAVAL.
3. IRTP nurseries, 1977: VIRAL-S, VIRAL-P, VIRAL-T, VIAVAL and VIRAL-F.
4. IRTP nurseries, 1979: VIRAL-S, VIRAL-T.
5. IRTP nurseries coming from IRRI: IRDWON-1977, IRYN-L, IRYN-M.

6. Yield trial with promising lines and floating varieties.
7. Preliminary yield trial with 24 promising lines from CIAT.
8. Preliminary yield trial with 35 lines introduced from CIAT.
9. Yield trials with 8 lines from IRRI and 6 from CIAT (direct planting and transplanting).
10. Yield trial with native varieties.
11. Yield trial with extra-long grain varieties introduced from IRRI.

Samborondón/INIAP

1. Observation of germplasm of floating varieties
2. Yield demonstration trials with fertilization

Experimental Station of National Rice Program/Ministry of Agriculture

Chinese Mission - Daule

1. Transplanting demonstration plots with 12 varieties, 6 from INIAP and 6 introduced from Taiwan.

GUYANA

Caledonia Demerara River/GRB

1. Rice blast infection beds
   - Segregating F_4 populations
   - Advanced F_8-F_{10} lines

Rice Experimental Station/GRB

1. VIAVAL nursery 1977.
2. Demonstration plots, different fertilization levels with the variety Rustic.
3. Seed multiplication plots with the commercial varieties Starbonnet, BG 79, T, N, S, Rustic and Champion.
4. Seed multiplication of rice blast resistant varieties.
5. Basic seed multiplication in transplanting with varieties N, Rustic, Starbonnet, Bluebelle, Champion, T, S and BG 79.
6. Genetic material - F_1 populations and segregating F_2-F_5 generations.

SURINAM

"Prins Bernhard Polder" Experimental Station/SML

1. Segregating populations in bulk and pedigree F_2-F_4.
2. Multiplication of genetic and basic seed.
3. Preliminary yield trials - 97 lines.
4. Yield trials - 51 lines.
5. Eloni response to different levels and different application dates of nitrogen.
6. Effect of 150 kg N/ha on the resistance to lodging, milling quality and grain protein content in the variety Eloni.
7. Evaluation of selection from Eloni with dark green leaf.
8. Yield evaluation of various broad leaf lines.

VENEZUELA

Araure Experimental Station/FONAIAP

1. Effect of different nitrogen levels (60-80-100 kg/ha) and irrigation water management on the variety CICA 4.
2. Effect of water management (permanent and intermittent irrigation) on production of Araure 1.
3. Comparison of herbicides alone and mixed for controlling weeds and their effect on CICA 4 yield.
4. Basic seed multiplication of Juma 57.
5. Evaluation of the program's elite lines.
6. IRTP 1978 nurseries: VIRAL-T, VIOAL, VIAVAL, VIRAL-S and VIRAL-P, 1977.

"La Romaña" farm/FONAIAP's Rice Program

1. Fertilization trials.
2. Rice blast chemical control trial.
3. F_3-F_5 segregating populations.
4. IRTP 1978 nurseries: VIRAL-T, VIOAL, VIAVAL, VIPAL and VIRAL-P, 1977.
5. IRTP 1979 nurseries: VIOAL-R, VIRAL-T, VIRAL-P, VIOAL and VIRAL-S.

Calabozo Experimental Station/FONAIAP

1. Segregating lines.
2. IRTP nurseries from IRRI, 1978: IRON, IURON.
3. IRTP, 1978 nurseries from CIAT; VIRAL-T, VIAVAL, VIOAL and VIRAL-P, 1977.
4. Seed multiplication of IRRI varieties.
5. Ciarllacen, CICA 4 and Araure 1 genetic seed production.

Appendix 4. Selections from national programs and IRTP nurseries with resistance to various problems of the crop.

COLOMBIA

"La Libertad"/ICA

Lines resistant to yellowing (acid soil pr[illegible]ems)

VIRAL-P, 1979	3,6,13,16,17,21,22,24.
VIRAL-T, 1979	2,3,9,10,17,20,21,22,24.
VIOAL-R, 1979	1,2,3,4,5,6,7,8,9,11,12,13,14,16,17,19,21,23,24,26,28,29,31,32,33,34,35,39,41,44,45,46,47,48,49,51,52,55,56,58,59,61,63,64,65,67,68,69,70,71,72,73,74 and 7[illegible].

ECUADOR

Boliche/INIAP

L.nes resistant to hoja blanca.

VIRAL-F, 1977	1,2,INIAP 6, INIAP 7, INIAP 415, Pico Negro,
Yield trials	CICA 6, CICA 7, IR 34, IR 36, Bamoa, Inti, 50357, INIAP 2, INIAP 6.
VIRAL-S, 1978	9,10,11,13,14,16,17,20,21.
VIRAL-T, 1978	1,5,12, INIAP 7.

Collection of 21 native varieties.

VENEZUELA

Calabozo Experimental Station/FONAIAP

	Promising lines with resistance to lodging
VIOAL, 1978	3, 33, 42 and 46.
VIRAL-T, 1978	1, 3, 10, 11, 12, 14.
VIRAL-P, 1977	1, 4, 5 and 11.