Report of the monitoring tour to Venezuela, Colombia, Ecuador, Panama and Costa Rica

August 5-19, 1984

Manuel J. Rosero M.
IRRI/CIAT

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INTRODUCTION

The International Rice Testing Program (IRTP) for Latin America is part of the IRTP world network, coordinated by the International Rice Research Institute (IRRI), with funds from the United Nations Development Program (UNDP).

The IRTP for Latin America is auspiced by CIAT and IRRI, and is part of the CIAT rice program.

Monitoring tours are very important activities of the IRTP network and are organized every two years.

A monitoring tour from August 5-19, 1984, was carried out to observe the present situation of rice research activities in the national programs of Venezuela, Colombia, Ecuador, Panama and Costa Rica (Figure 1) and at the same time, to observe problems that are limiting rice production at the commercial level.

This report presents several aspects of rice cultivation in these countries as well as observations and recommendations made by the observation team members.

OBJECTIVES

The following were the objectives of the monitoring tour:

- To gain knowledge on the present situation of rice research in the national programs of Venezuela, Colombia, Ecuador, Panama, and Costa Rica.
- To observe the performance of the IRTP nursery materials distributed in 1984.
- To observe the factors that are limiting rice production at the commercial level under different cropping systems.

PARTICIPANTS

The following rice scientists participated:

VENEZUELA

Ing. Anibal Rodriguez, Coordinator National Rice Program of Fondo Nacional de Investigaciones Agropecuarias (FONAIAP), CIARCO
P. O. Box 102
Araure, Estado Portuguesa

COLOMBIA

Dr. Dorance Muñoz, Director National Rice Program of the Instituto Colombiano Agropecuario (ICA)
P. O. Box 233
Palmira, Valle

Eng.M.Sc. Patricio Vargas Z., Director of Rice Research of Federacion Nacional de Arroceros (FEDEARROZ)
P. O. Box 52772
Bogotá, D. E.

ECUADOR	Eng.M.Sc. Ricardo Guaman, Breeder of Rice Program of the Instituto Nacional de Investigaciones Agropecuarias (INIAP) P. O. Box 7069 Guayaquil
PANAMA	Dr.Rolando Lasso, Breeder of Rice Program of the Instituto de Investigaciones Agropecuarias (IDIAP) of Panama Apartado 6-4391 Panama
COSTA RICA	Eng. Jose I. Murillo, Head of Agronomy Department and Coordinator of Rice Program of the Ministry of Agriculture Apartado 10094 San José
DOMINICAN REPUBLIC	Dr. Federico Cuevas, Coordinator of Rice Program of the Secretary of Agriculture and Instituto Superior de Agricultura P. O. Box 166 Santiago de los Caballeros
IRRI	Dr. Michael Arraudau, Upland Breeder IRAT/IRRI IRRI, P. O. Box 933 Manila, Philippines

Dr. Dennis P. Garrity, Agronomist
IRTP
IRRI, P. O. Box 933
Manila, Philippines

CIAT

Dr. Manuel J. Rosero, Liaison Scientist in Latin America
P. O. Box 6713
Cali, Valle

RICE PRODUCTION IN THE COUNTRIES VISITED

Irrigated and upland rice production systems prevail in the five countries. Under irrigated conditions, dry rice seed is planted directly in dry soil or pregerminated seed in puddled soil. This system is completely mechanized.

In the upland production system mechanization also prevails as well as direct seeding of dry seeds in dry soil or pregerminated seed in moist soil.

Table 1 summarizes the rice area, production and yields that correspond to the 1983 harvest for the irrigated, upland mechanized, and upland manual production systems.

The observation team considered necessary to summarize the present information on production costs for the different ecosystems of the visited countries. This information was obtained from advanced farmers and professionals with wide experience in rice cultivation. This information is summarized in Table 2. The highest costs for the irrigated system were found in Colombia, and the lowest in Ecuador and Venezuela. For the upland mechanized system, the highest costs were found in Costa Rica.

TABLE 1. Rice area, production and yield in five Latin American countries for the 1982-1983 harvest season.

	Area (ha)				Production (,000 t)[b]				Yield (t/ha)		
Irrigated	Irri-gated	Upland Mechan.	Upland Manual	Total	Irri-gated	Upland Mechan.	Upland Manual	Total	Irri-gated	Upland Mechan.	Upland Manual
VENEZUELA	84.000	136.000	-	220.000	336.0	340.0		676.0	4.0	2.5	-
COLOMBIA	224.067	86.423	95.000	425.490	1.342.4	328.7	142.5	1.813.6	5.5	3.8	1.5
ECUADOR[a]	49.030	79.996	-	129.026	196.1	239.5	-	435.6	4.0	2.9	-
PANAMA	-	52.967	46.063	99.030	-	164.2	14.6	178.8	-	3.1	0.3
COSTA RICA	3.092	83.050	2.209	88.351	12.4	265.8	1.9	280.1	4.0	3.2	0.9

a. In upland mechanized 10% of the highland zone, 34% of the floodable low zones and 18% of the Pozas Veraneras are included.

b. Paddy rice dry (14% moisture) and clean.

TABLE 2. Production costs (US$/ha) in the irrigated and upland mechanized systems in five Latin American countries.

Country [a]	Production Systems		Yield (t/ha)		Cost/t (US$)			Profit. (US$/ha)	
	Irrigated	Upland Mechan.	Irri- gated	Upland Mechan.	Irri- gated	Upland Mechan.	Valor US$/t [b]	Irri- gated	Upland Mechan.
VENEZUELA	476.oo	222.oo	4.0	2.5	119.oo	88.80	127.oo	32.oo	95.5
COLOMBIA	1.200.oo	777.oo	5.5	3.8	218.18	204.47	233.oo	81.50	108.40
ECUADOR	450.oo	-	5.0	-	90.oo	-	183.oo	465.oo	-
PANAMA	950.oo	800.oo	5.5	3.1	172.72	258.06	280.oo	590.oo	68.oo
COSTA RICA	-	1.040.oo	-	4.0	-	260.oo	280.oo	-	80.oo

a. Exchange rates in August 15, 1984: Venezuela B.12.oo/US$1; Colombia $105.oo/US$1; Ecuador $93.oo/US$1; Panama $1.oo/US$1; Costa Rica $43.70/US$1.

b. Dry paddy rice (14% moisture) and clean.

RICE IN VENEZUELA

Rice cultivation is a primary agricultural activity in Venezuela. The main rice producers are Portuguesa, Guarico, Barinas y Cojedes states with a total area of 220.000 hectares planted to rice (Table 3). Upland rice occupies 79.5% of this area, while irrigated rice occupies 20.5%. The upland rice producers include the peasant sector with farming units averaging 20 hectares and entrepreneurial farmers with farming units averaging 100 hectares. Irrigated rice is produced by entrepreneurial farmers with farming units ranging between 50-300 hectares.

Soils planted to rice belong to the orders vertisols, ultisols, inceptisols and mollisols, with pH's ranging between 5.5.-6.5.

Rainfall (1,800-2,200 mm) has favored the crop in the last five years (1979-1983); this occurs between April-November which corresponds to the cropping season for both upland and irrigated rice. However, rice production in 1984 was affected by drought which caused losses in the upland sector.

TABLE 3. Rice area and production in Venezuela in 1983.

State	Area (ha)		Yield (t/ha)	
	Irrigated	Upland	Irrigated	Upland
Barinas	-	20.000	-	2.5
Cojedes	-	20.000	-	2.5
Guarico	20.000	-	4.0	-
Portuguesa	25.000	135.000 [a]	4.0	3.5
T O T A L	45.000	175.000		
%	20.5	79.5		

a. It includes 39.000 hectares of upland with supplementary irrigation.

PRODUCTION SYSTEMS

Both irrigated and upland rice production systems are found. Both systems are completely mechanized from planting to harvest. In upland rice, dry seed is broadcast or row-planted at a rate of 120 kg/ha. In irrigated rice, dry seed is broadcast or row-planted in dry soil, or pregerminated seed broadcasted in puddled soil.

CULTIVATED VARIETIES

Until 1979, some traditional varieties such as Llanero 501, Portuguesa 1 and 2, Acarigua, and Cholet, were extensively cultivated. These varieties dissapeared due to their low productivity. The varieties that are currently cultivated in both systems (irrigated and upland) include Araure 1 and CICA 4. In recent years, Araure 1 occupied 90% of the area and CICA 4, 10%. The trend in 1985 is to increase the area planted to CICA 4 and reduce the area planted to Araure 1, by replacing it with the new variety Araure 3 and Araure 4.

PRODUCTION TRENDS

The present national policy is to encourage rice production so that this cereal substitutes other important cereal (wheat and sorghum) partially. Rice consumption will increase in the brewery, panification and feed industries. To reach this goal, the government is providing peasant enterprises and entrepreneurs with adequate credits. The government has also fixed attractive support prices (2,000-2,300 Bs/t paddy rice) for rice producers ant, at the same time, is encouraging more direct (pastry) and indirect (wheat and rice flours for panification, brewery and feeds for poultry) uses. The present per capita consumption is 22 kg white rice/ year.

SEED PRODUCTION

The rice program produces the breeder and basic seeds of commercial and new varieties. Basic seeds are provided to the seed production program that is responsible for producing foundation seed and certifying registered and certified seeds.

The seed program is staffed with three agronomists and four agricultural experts.

In 1983, 6,280 hectares of Araure 1 and 750 hectares of CICA 4 were certified; in total, they produced an average of 3.0 tons of certified seed/ha.

In 1984 the availability of certified seed was 6,309 tons of CICA 4, 1,700 tons of Araure 1, 450 tons of Araure 3, and 450 tons of Araure 4.

The target for 1985 is to certify 30,000 tons of seeds (12,000 tons of CICA 4 and 6,000 tons each of Araure 1, 3 and 4).

The main limiting factors of irrigated rice during the dry season are:

- Rats *Holochilus brasilensis* (palmate feet) and *Sigmomys alstoni*.
- Migratory birds, *Spiza americana*.
- Migratory or temporary birds, *Dendrocygma viduata*, *D. bicolor* and *D. autumnalis* and *Porphyrula martinica*.

The main limiting factors of upland and irrigated rice during the wet season are:

- Weeds, *Echinochloa colona*, *Ischaemum rugosum*, *Rottboellia exaltata* and *Cyerus* sp.
- Insects, *Lissorhoptrus oryzophilus*.
- Diseases, *Pyricularia oryzae*, *Helminthosporium oryzae* and *Acrocylindrum oryzae*.
- Migratory or temporary birds (the same as for the dry season).

OBSERVATIONS

The observation team visited the fields and laboratories of entomology, pathology and vertebrates of the Araure Experimental Station. This station is attached to the Centro de Investigaciones Agropecuarias de la Region Centro-Occidental (CIARCO) in Araure, which depends on the Fondo Nacional de Investigaciones Agropecuarias (FONAIAP).

The Araure Experimental Station was founded in 1953 to promote, plan and conduct the agricultural research activities of the Portuguesa State, in order to generate technology to increase agricultural production. Additionally, it carries out seed production and certification activities, and provides advisory, consultation and laboratory services. Research is carried out in rice, maize, sorghum, sugarcane, cotton, and edible legumes.

The Experimental Station is located in Araure at 200 masl, 9^{o} 33' N latitude, 69^{o} 12' W longitude, with an average temperature of $24^{o}C$, 80% relative humidity, 365 $cal/g/cm^{2}$ solar radiation, and 1,780 mm annual rainfall concentrated mostly between April-October.

The rice program at the Araure Experimental Station concentrates in obtaining high yielding varieties for irrigated and upland conditions, through the screening and selection of introduced germplasm, mainly from the CIAT-IRTP nurseries. Agronomic studies concentrate in irrigated and upland systems, N P K rates and time of applications, planting densities, weed management and control, and disease and insect pest control.

Additionally, the rice program multiplies the breeder and basic seed of commercial varieties.

The experimental fields for varietal improvement included:

- An upland yield trial that included 22 promising lines selected from the IRTP nurseries distributed in 1982 and 1983.

- The IRTP nurseries VIOAL-SNF, VIRAL-T, VIOAL and VIOAL-HB, distributed in 1984.

- Advanced lines for upland conditions (109 F_5 lines) obtained from 10 crosses introduced from IRRI.

- Upland segregating populations (2,081 F_3 populations) obtained from seven crosses introduced from CIAT.

In agronomy, two upland weed control trials were observed: one with pre-emergent herbicides (Machete, Saturno, Ronstar, Avirosan) applied alone or in mixture with post-emergent herbicides (Propanil and Basagran), and another trial with post-emergent herbicides (Propanil, Actril, Saturno Plus and Ronstar PL) applied alone or in mixtures with Propanil and Machete.

Breeding materials were 66 days old and were at maximum tillering. No disease incidence was observed either in irrigated or upland materials, except in CICA 4 upland plots which showed severe leaf blast infection. The "hoja blanca" virus, which showed a high incidence in past years, was found only at low levels in the susceptible varieties Bluebonnet 50 and CICA 8. A high population of Sogatodes cubana was observed in the field and a very low population of S. oryzicola, the main vector of the hoja blanca virus.

The rice program conducts experiments in two private farms: La Toma and La Romaña. In La Toma, Piritu, the program is evaluating the performance of 166 promising lines under irrigated conditions (transplanting); these were selected from the IRTP nurseries distributed in 1982 and 1983. These materials were 15 days old after transplanting. Additionally six promising lines under irrigated conditions and direct seeding are being compared with the new varieties Araure 3 and Araure 4. A high incidence of Lissorhoptus oryzophillus was observed in plots of promising lines, especially in lines located in poorly drained fields affecting the root system and causing poor seedling development or death.

The team had the opportunity here to observe a tractor adapted with metal wheels, which is used to apply agrochemicals (herbicides, insecticies and fungicides) to the commercial fields.

At La Romaña, located in the Payara el Cruce district, 50 km Southeast Araure, the program evaluates promising materials under irrigated and upland conditions, and at the same time conducts weed control trials for upland conditions.

An irrigated yield trial was observed which includes 115 promising lines selected from the 1983 IRTP nurseries. The material were 66 days old and several lines showed susceptibility to hoja blanca.

Germplasm from the 1984 VIOAL-SNF nursery was evaluated under upland conditions. This germplasm was in the flowering stage. Eleven lines were identified as resistant to diseases and showed good performance (Appendix

III). The remaining materials showed susceptibility either to rice blast, hoja blanca or leaf scald. The hoja blanca incidence was not severe (rating 5-6).

COMMERCIAL CROPS

Several irrigated and upland crops were observed in different stages from tillering to maturity.

La Romaña farm belonging to Mr. Domenico Morelli, had 400 hectares planted with Araure 1 and CICA 4 under irrigated conditions. Both varieties were affected by rice blast, but the main problem was that caused by grassy weeds (Echinochloa colona, Leptochloa filiformis) and Cyperus ferax.

The Ruffono brother's farm in the Payara region was visited, which is dedicated to the production of Araure 1 certified seeds. There were 500 hectares under irrigated conditions and in different development stages. A high incidence of rice blast and leaf scald was observed in several fields. Other fields showed severe weed infestation, especially grasses.

Several CICA 4 and Araure 1 crops were observed under upland conditions. The main constraint was that caused by grassy weeds (E. colona, L. filiformis, Ischaemum rugosum, Rottboellia exaltata), Cyperaceae (C. ferax, C. rotundus), and red rice (Figure 2).

According to the farmers, the high weed incidence is attributed to the low quality herbicides available in the domestic market and to a lack of new herbicides due to importation restrictions.

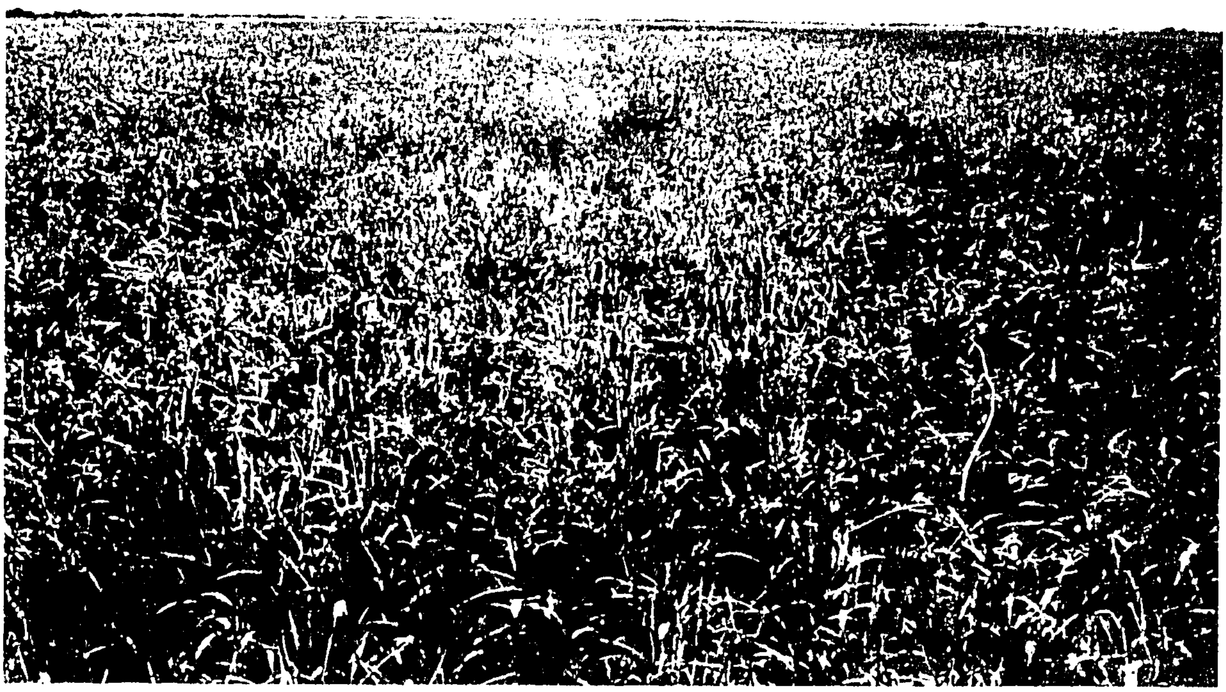

FIGURE 2. Weed problems in upland rice in Araure, Portuguesa, Venezuela.

The observation team also had the opportunity to visit the "Chispa" seed production plant in Acarigua. This plant has the capacity to process 12,000 tons of seed. It processes certified seed of Araure 1 and CICA 4. This plant belongs to 19 rice producers dedicated to certified seed production and rice commercial production.

RECOMMENDATIONS

The team members discussed the problems encountered in rice fields both at the commercial as well as at the research levels, in order to determine production constraints in order to priority and to make suggestions or recommendations to minimize them. It was established that the problems affecting rice production in order of importance for both irrigated and upland conditions are the following:

WEEDS - GRASSES, CYPERACEAE AND RED RICE

To minimize these problems, an integrated control strategy, combining the following factors, was suggested: good soil preparation, good water management (irrigated), good quality seeds (free of red rice), and appropriate and good quality herbicides to be applied at adequate rates and times.

In irrigated crops, the pre-emergent herbicides Ronstar, Machete and Saturno, and the post-emergent herbicide Propanil + 2, 4-D, are used.

In upland crops soil compacting with a roller after planting provides good seed coverage and good soil break up, allowing a uniform rice and weed germination. In these cases, it is suggested to make two herbicide applications, one in pre-emergence (Ronstar or Machete) when good moisture is available and another in post-emergence with Propanil + 2, 4-D.

Crop rotations are suggested for the upland areas: rice in the rainy season and soybeans, sesame or beans in the dry season.

Demonstration trials with promising herbicides should be conducted by the rice program in farmer's fields and field days as an effective means to transfer the new technology.

DISEASES

Mainly leaf scald, rice blast, grain discoloration and hoja blanca.

The recommendation was to diversify the crop with varieties for both irrigated and upland conditions. For irrigated conditions, Araure 1, CICA 4 and Araure 4; for upland conditions, CICA 4 and Araure 3.

SEEDS

CIARCO has a well organized certified seed production program. However, there are quality deficiencies caused by varietal mixtures and red rice and other weeds. The team suggested that this program should revise their certification rules in such a manner that seed fields and processing plants contaminated with red rice are not approved.

It was also suggested to promote certified seed production by private enterprises which would create competition for an increased good quality seed production.

FERTILIZATION

Farmers are fertilizing their irrigated and upland crops with N P K rates similar from one region to another, and the time of application is not adequate (Figure 3).

The rice program should classify the soil series and establish the critical N P K levels and optimum rates for each series and for the different varieties. The program should study, especially for upland conditions, the most adequate N time of application, considering the life cycle of the variety.

INSECTS

The main pest under irrigated conditions is *L. oryzophillus* and its damage to roots is more severe in poorly drained soils, causing seedling death or retarded growth and yellowing.

As a cultural control measure, good soil leveling and good drainage, was recommended.

Regarding chemical control, research should be carried out with new insecticides and the results should be transferred to farmers.

FIGURE 3. Nutritional disorders in upland rice. Araure, Portuguesa, Venezuela.

VERTEBRATES

Among the vertebrates, Porphyrula martinica and the rats are the main pests, the former during the rainy season and the latter during the dry season in irrigated crops.

Eradication campaigns for rat control have been carried out with poor results, especially because of a lack of collaboration by farmers. Some farmers use baits, destroy ratoons, but most of them do not. The problem has persisted for several years and will continue until the eradication campaigns are applied by all farmers in the region.

RESEARCH CONSTRAINTS

The main limiting factors faced by the rice program include the lack of economic resources and trained personnel.

FONAIAP should provide the rice program with sufficient financial resources in order that its activities can be consolidated at the national level and new technology can be transferred to its users on a timely basis.

Personnel training is critical and should be focused to all crop aspects.

To make the best use of the scarce economic resources, it is necessary to integrate the technical staff involved in breeding, agronomy, entomology and pathology.

RICE IN COLOMBIA

In Colombia rice is the main crop after coffee and is basic in the diet of the population. The rice area and productivity have increased during the last 10 years due mainly to a good adoption of varietal improvement and management technique research results by farmers. The area planted to rice in 1971 was 234,591 hectares with an average production of 885,483 tons of paddy rice, and in 1983, 425,490 hectares with an average production of 1,813,534 tons of paddy rice. These figures indicate a 6.7% increase in the area, an 8.7% increase in total production, and a 1.2% increase in yield. These factors have contributed to the fact that the increase in total production has been higher than the population growth. This situation has favored Colombia in terms of self-supply (with an average consumption of 36 kg of white rice per capita) and to export small volumes.

Increases in production and productivity are the results of using high yielding varieties and good crop managment. Eight improved varieties are been planted: CICA 4, CICA 7, CICA 8, CICA 9, IR 22, METICA 1, ORYZICA 1 and ORYZICA 2.

Table 4 shows the cropping systems, area, production and rice yields in 1983.

TABLE 4. Rice area, production and yield in Colombia in 1983.

System	Area (ha)	%	Production (t)	%	Yield (t/ha)
Irrigated	244.067	58.0	1.342.365	74.0	5.5
Upland mechanized	86.423	20.0	328.669	18.0	3.8
Upland manual	95.000	22.0	142.500	8.0	1.5
T O T A L	425.490		1.813.534		4.3

Table 5 shows the rice cropping regions, systems, technology level, varieties and yields.

Table 6 shows the percentage distribution of varieties planted in 1984.

Table 7 shows the main rice production constraints in Colombia.

In general, the main limiting factor for irrigated rice is the inefficient use of water, a resource that each year becomes more limiting. Other limiting factor are diseases: rice blast, grain discoloration and hoja blanca, especially in the Llanos Orientales.

In the favored upland system, the main constraints are the diseases grain discoloration, rice blast and weeds.

In the favored upland system the main production constraints are low fertility soils and the lack of infraestructure.

OBSERVATIONS

The observation team visited the seed processing plants Semillano and Fedearroz, the Centro de Investigaciones Agricolas ICA-La Libertad and CIAT-Santa Rosa in Villavicencio.

SEMILLANO

Semillano is a private company devoted to the production of certified rice and tropical pastures seed. It has a modern processing plant (drying, classification, treat-

TABLE 5. Technology used and varieties planted under irrigated and upland conditions in the different rice production regions of Colombia in 1983.

Region/Sub-region	Cropping Systems	Technology used	Varieties	Yield (t/ha)
CARIBBEAN				
Valle del Cesar and Guajira	Irrigated	Medium	CICA8, CICA7, CICA4	4.5-5.5
Zona bananera	Irrigated	High	CICA8, CICA7, IR22	5.0-6.0
Sinu and Maria La Baja Valleys	Irrigated	Medium-high	CICA7, CICA4	5.5-
South Cesar	Irrigated	Medium	CICA8, CICA7, CICA4, IR22, ORYZICA 1	4.5-5.5
Uraba	Mechanized upland	Low-Medium	CICA8, METICA 1, ORYZICA 1	4.0-5.0
Low Cauca, Magadalena and San Jorge	Mechanized upland	Low-Medium	CICA8, METICA1,ORYZICA1	4.0-5.0
Cordialidad	Mechanized upland	Medium	CICA8, CICA4, IR22	4.0-
Cordoba, Sucre and Bolivar savannas	Mechanized upland	Low	CICA8 + Criolla	2.5-3.5
INTERANDEAN VALLEYS				
Rio del Cauca valley	Irrigated	Medium-high	CICA8, ORYZICA 1	5.5-6.5
Magalena valley high and medium	Irrigated	High	CICA8, IR22, ORYZICA 1 CICA4	5.0-6.5
Meseta Ibague	Irrigated	High	IR22, ORYZICA1, CICA9 CICA8	5.5-6.5
Rio Zulia valley	Irrigated	Medium	CICA7, IR22, ORYZICA	5.0-
Magdalena Medio	Mechanized upland	Low-medium	CICA4, CICA8	3.5-4.5

Continues...

Table 5 (Cont.)

Region/Sub-region	Cropping Systems	Technology used	Varieties	Yield (t/ha)
ORINOQUIA				
Vegas of rivers	Mechanized upland	Medium	METICA1, CICA8	3.5-4.5
Piedemonte	Irrigated	Medium	METICA1, ORYZICA1, CICA8	4.5-5.0
AMAZONIA	Manual upland	Very low	CICA8, METICA1, Criollas	1.5-2.0
PACIFIC				
Nariño, Cauca and Choco Costs	Manual upland	Very low	CICA4, Criollas	1.5-2.0

TABLE 6. Percentage distribution of varieties planted in Colombia in 1984.

VARIETY	PERCENTAGE
ORYZICA 1	26.0
CICA 8	20.0
IR 22	16.0
CICA 4	15.0
METICA 1	12.0
CICA 9	8.0
CICA 7	3.0

TABLE 7. Rice production constraints in Colombia, 1984.

Region	Research Stations ICA	Constrainst
Caribbean	Turipana	Acid soils, diseases (Bl, LSc, ShB), lack or machinery for harvesting
Interandean Valleys	Palmira Nataima El Zulia	P, Zn deficient soils, weeds, diseases (Bl and HB), lack of machinery for harvesting and processing
Orinoquia	La Libertad	Unfertile soils (Al and Fe tox.), diseases (Bl, HB, GID), lack of adequate varieties, weeds, infraestructure
Amazonia	La Libertad	Low fertility soils, infraestructure, diseases (Bl, GID, HB, LSc)
Pacific	Palmira	Low fertility soils, infraestructure, diseases (Bl, GID)

ment and storage); it has 12 slanted silos with a total capacity of 360 tons. It produces 6,000 tons of certified rice seed that cover 20-30% of the area in the Llanos.

Seeds are commercialized between 30 and 60 days. Eighty percent of the seed is sold through distributors and 20% is sold directly.

Seeds are produced in two farms of 7,000 hectares each; 1,000 hectares are planted per farm each year.

Procedure

Semillano buys basic seed from the Instituto Colombiano Agropecuario (ICA). This sed is planted in new fields fertilized with 100 kg P_2O_5/ha, 80 kg K_2O/ha, 100-130 kg N/ha + 8 minor elements/ha + 2 kg Zn/ha.

Production fields are inspected by ICA in 3-4 visits. When ICA approves a field, it is harvested and paddy rice is sent to the seed plant where each sack is sampled for impurities and grain discoloration. If these tests are passed, the material classifies for seed; on the contrary, if it does not pass the tests, the seed is sent to the commercial section for milling.

The paddy seed is first dried; first it goes to precleaning in a storage tower where its moisture is reduced from 23% to 18%; it is left there for 20-24 hours and then passes to the drying silos to lower its moisture content to 13%. The paddy seed with this moisture content then passes to the storage warehouses to break its dormancy and for classification. The classified seed is packed in 60 kg sacks and is stored until ICA provides the approval labels. The seed is then treated with Vitavax and sold when germination is higher than 80%. This process is the same for both registered and certified seeds.

Semillano is presently producing seeds of varieties METICA 1, ORYZICA 1 and ORYZICA 2.

Technical Staff

Semillano is staffed with eight agronomists, one agronomist M.Sc., a supervisor and a agronomist who manages the company.

FEDEARROZ

Fedearroz is a national association of rice producers recognized by the government. Fedearroz looks out for the economic and social welfare of its affiliates. It collaborates in the research and transfer of technology processes. One of its activities is to produce certified seed; for this, Fedearroz has five seed processing plants located in the main rice production regions of the country. The seed plant located in Villavicencio produces rice seed for the Llanos Orientales under contracts with qualified producers under ICA's supervision. Fedearroz processes and distributes the rice seed to the producers. The plant in Villavicencio has a processing capacity of 9,375 tons of seed. Additionally, it provides technical assistance services at the commercial level, it distributes machinary and agricultural inputs to all its affiliates, it collaborates in research and transfer of technology with ICA and CIAT, and it is the entity thar represents rice producers before the government in terms of production, credit and marketing policies within and outside Colombia.

ICA-LA LIBERTAD

The Agricultural Research Center La Libertad depends of ICA and its activities are oriented to research and transfer of technology, promotion and services to crop and cattle producers. Research is carried out on rice, tropical pastures, other six crops of the region, cattle and seed production. Its area of influence is 2 million hectares in the Llanos Orientales of Colombia. La Libertad is located 25 km East of Villavicencio at 336 masl with an average temperature of 26°C, and 2,000 and 3,000 mm annual rainfall. It is located in a humid tropical forest region with soils of pH 4.5 and a loamy to clayed loam texture. The rainy period extends from March to November and the dry period, from December to February.

The experiments observed under irrigated conditions included yield trials, irrigated observation nurseries, hoja blanca, sets of materials tolerant to iron toxicity, and fertilization and planting density trials with a group of promising lines (Figure 4).

The irrigated field in ICA La Libertad is a site with high blast, leaf scald, iron toxicity, and hoja blanca pressures. The hoja blanca incidence this year was cero, while in 1982 and 1983 its incidence was very severe and allowed selecting promising resistant material.

Some promising lines with resistance to blast, leaf scald and iron toxicity were observed in the yield and the observation nursery (VIOAL, 1984).

FIGURE 4. Fertilization trial in irrigated promising lines. Rice program, ICA-La Libertad, Villavicencio.

Materials evaluated for iron toxicity showed a high incidence of this problem, which allowed identifying resistant materials.

The CIAT rice program is evaluating segregating materials in the upland savanna ecosystem with acid infertile soils and high rainfall, in order to select var eties tolerant to aluminium toxicity with a potential yield of 3.0 t/ha. Several populations were observed showing good performance. The germplasm of the 1984 VIOAL-SNF nursery was observed in this ecosystem. All the lines, except the control IAC 25, showed susceptibility to aluminium toxicity, leaf yellowing and stunted growth.

The germplasm from IRRI for upland-acid soils was also observed. These materials were 65 days old and several lines showed a good development, but no differences were observed between materials of plots fertilized with and without 60 kg P/ha.

CIAT-SANTA ROSA

This experimental station is representative of the favored upland ecosystem. Soils here are alluvial, fertile, with a pH 5.5-6.0, and a clay loam texture. The average temperature is 26°C and the average rainfall is 2,000-2,500 mm.

The CIAT rice program evaluates here segregating populations (F_2-F_4), advanced materials in observation plots, yield trials, materials from the IRTP nurseries, and materials from the germplasm bank (Figure 5).

A high disease pressure was observed in all materials, especially blast, leaf scald and grain discoloration.

FIGURE 5. C.P.Martinez explains to the observation team members the rice research activities at CIAT-Santa Rosa, Villavicencio.

This of course allows the selection of resistant material with greater efficiency. Several F_2 populations showed good performance, and others were susceptible to blast and/or leaf scald.

The advanced materials under observation and the yield trials were 96 days old. Leaf scald incidence was severe and several lines were tolerant.

A total of 737 lines and/or varieties from the germplasm bank were observed. These were planted in order to evaluate and identify parents with resistance to blast (leaf and neck), leaf scald and grain discoloration.

The 1984 VIOAL germplasm, which was 119 days old, had several promising lines showing tolerance to blast (neck) and/or grain discoloration (Apendix III).

Agronomy trials established to study weed chemical control under upland conditions, were also observed. Excelent control of grassy and broad-leaf weeds was observed for the following treatments: a) Bentiocarbo 4.0 kg a.i./ha applied to moist soil in pre-emergence followed by Propanil 3.24 kg a.i./ha applied in post-emergence; and b) Oxadiazon 1.12 kg a.i./ha applied to moist soil in pre-emergence, followed by Propanil 3.24 kg a.i./ha applied in post-emergence (Figures 6 and 7).

In another trial to study weed population dynamics, the effectiveness of the following treatments was observed: a split application of Propanil (1.6 + 1.6 kg a.i./ha) in post-emergence; the first application when the grassy weeds are in the 1-2 leaf stage, and the second treatment when the second generation of weeds reaches the 1-2 leaf stage. This treatment has controlled grassy

FIGURE 6. Population dynamics of weeds. Plot planted to rice without weed control (left). Plot with no soil preparation with spontaneous weed populations (right).
CIAT-Santa Rosa, Villavicencio.

FIGURE 7. Chemical control of weeds with the same treatment during three harvests. Plot treated with Bentiocarbo (4 kg a.i/ha) in pre-emergence and Propanil (3.24 kg a.i/ha) in post-emergence.
CIAT-Santa Rosa, Villavicencio.

weeds efficiently during the two years that the experiment has been conducted.

CIAT-PALMIRA

At CIAT-Palmira, the headquarters of the rice program, the team members had the opportunity to talk to the program coordinator, Dr. Peter R. Jennings, who explained the new structure of the program.

The new structure of the program is oriented to select promising materials in ecosystems representative of the rice crop in the Latin American tropics: CIAT-Santa Rosa is a favored upland ecosystem with fertile soils and good rainfall distribution; it is representative of upland rice in Venezuela, Colombia, Ecuador, Bolivia, and several regions in Central America and Mexico.

ICA-La Libertad, irrigated ecosystem in acid soils, to select resistant materials to iron toxicity, needed in Venezuela, Colombia, Brazil (Santa Catarina, Rio Grande do Sul and other states with varzeas system) and Argentina.

ICA-La Libertad in an upland ecosystem in acid soil savannas with good rainfall distribution, is representative of the savannas of Colombia, Venezuela, Peru, and Brazil (the Amazon).

CIAT-IDIAP-Panama, Rio Hato, is an upland ecosystem with moderately fertile soils and an erratic rainfall distribution. This ecosystem is for selecting upland materials with tolerance to drought which are required in Central America and Mexico.

The activities of the program in CIAT-Palmira concentrate in evaluating the IRTP germplasm, multiplying seeds of promising lines to distribute them through the IRTP nursery for Latin America, conducting grain quality tests, and carrying out evaluations for resistance to _Sogatodes_ and hoja blanca. In collaboration with the biotechnology research unit, the program also conducts special studies through anther culture to obtain homozygotic plants tolerant to aluminium toxicity and low temperatures.

The team members also had the opportunity to talk to Dr. Gustavo Nores, Director General of Research (rice and tropical pastures) and International Cooperation of CIAT.

The members observed the different research activities on grain quality, resistance to _Sogatodes_ and hoja blanca, and anther culture. Field observations concentrated on germplasm of the IRTP nurseries from IRRI and materials of the germplasm bank planted for seed renewal and varietal characterization. The new methodology being developed to evaluate large numbers of materials in the seedling stage (15-20 days old) for resistance to hoja blanca, was also observed.

In terms of basic seed production, the team observed on a commercial scale the mechanical transplanting system that field operations is using with very favorable economic results compared to manual transplanting.

RECOMMENDATIONS

The team members discussed the new approach of the CIAT rice program and considered it beneficial for the national programs.

Regarding the IRTP nurseries, the team noted that the low utilization of the germplasm distributed through the IRTP nurseries and the fact that few lines have been released as varieties, is due mainly to the inclusion of materials evaluated in CIAT-Palmira, an ecosystem that is not representative of rice ecosystems in the Latin American tropics. Besides, most of the materials come from Asian programs and from IRRI which lack the grain quality characteristics required in Latin America.

Taking this into consideration, the team suggested that the yield nursery has a low value and that it is reasonable to concentrate in observation nurseries for each program to select materials for further testing in their own yield trials.

IRTP germplasm evaluations in the Llanos Orientales of Colombia are of great value, since this ecosystem allows screening and selecting more efficiently the promising materials for the IRTP network in Latin America.

The team members also consider that several national programs are in the position to evaluate and select segregating materials. Consequently, the team recommends that the CIAT rice program sends segregating materials to these national programs. This would increase the possibility of obtaining in the near future outstanding materials or varieties for their own countries and for other countries through the IRTP network.

Regarding the monitoring tours, the team members considered that these are very important since they allow to gain knowledge on the various problems affecting the crop in each ecosystem, and to observe the performance of IRTP germplasm in several ecosystems that are similar or different to those existing in the countries of each participant. They also allow to learn about the approaches of research activities of the visited programs.

Thus, it was suggested to continue with this activity every two years and to improve its programming in order to allow more time to visit less countries.

The weed problem is critical in upland and irrigated conditions in most of the visited countries. In order to help the national programs minimize this problem, the team member suggested extending the IRTP action to include weed control trials.

RICE IN ECUADOR

Rice is one of the main food staples of the population. In 1982 rice was planted in 152,500 hectares and 129,026 hectares were harvested with an average yield of 2,93 t/ha; 71% of the area corresponded to the rainy season plantings and 29% to the dry season planting.

The main rice producing zones are located in the Guayas and Los Rios provinces, which represent 90% of the total area planted. The rest are located in certain areas of the Manabi, El Oro, Cañar and Loja provinces.

PRODUCTION SYSTEMS

Rice in Ecuador is produced in irrigated and upland ecosystems.

IRRIGATED

The irrigated area concentrates in the regions of Daule, Yaguachi, Samborondon, Balzar and Naranjal (Guayas province), and Baba and Babahoyo (Los Rios province); 38% of the area planted to rice is located in irrigated ecosystems. The average yield is 4.0 t/ha. Most of the irrigated area is planted with high yielding varieties (INIAP 7, INIAP 415 and INIAP 6). Rice is planted directly either with a planter or broadcast with dry or pregerminated seed on puddled soil, and by transplanting.

The soil is prepared under dry conditions when rice is planted directly with a planter or broadcast; the soil is puddled when planting is done by transplanting or with pregerminated seed. Fertilization is based on nitrogen (40-120 kg N/ha). Weeds are controlled with herbicides. In large fields rice is harvested with a combine; in small areas, rice is harvested by hand.

UPLAND

A high percentage of the upland ecosystem is cultivated with traditional tall, late-maturing varieties with low yields and susceptible to lodging, diseases and pests. In small areas of Quevedo and Babahoyo, high yielding varieties (INIAP 7 and INIAP 415) are planted.

Three ecosystems can be differentiated in the upland system:

Highland Zones

These are located mainly in Balzar (Guayas), Vinces, Quevedo, Baba and Ventanas (Los Rios). This ecosystem represents 10% of the total surface area of the country, with an average yield of 2.6 t/ha.

Rice is planted from December 15 to January 15, and is done with a planter, broadcast or by hilling. When machine-planted, the planting distance between rows is 0.18 m; when rice is hill-planted, the planting distances are 0.40 x 0.40 m. The planting density varies from 70 to 90 kg/ha. The traditional varieties predominate in this ecosystem, except in Quevedo where the improved varieties INIAP 7 and INIAP 415 are used. Fertilization ranges between 0-120 kg N/ha. Weeds are manually controlled and sometimes herbicides are used. Manual harvesting prevails over mechanical harvesting.

Floodable Lowland Zones

These are located in Yaguachi, Samborondon, Urbina Jado and Daule (Guayas), and in Babahoyo, Pueblo Viejo and Baba (Los Rios). This ecosystem represent 34% of the total area with an average yield of 3.0 t/ha.

Mechanical planting predominates and is done between December 15 and January 15. Improved varieties occupy 60% of the area in the Los Rios province. Traditional varieties predominate in the rest of the regions.

Rains falling between December 21 and April 21 caused floods one month after the plantings in February and March. The water level covers the rice seedling for several days and then the level decreases. Rains cause two critical situations: in the first place, floods reduce the rice population since the varieties are not tolerant to submersion; and in the second place, the late-maturing traditional varieties are affected by drought after flowering. This ecosystem requires varieties tolerant to submersion and with a short cropping cycle so that they can escape from the dry period.

Fertilization, weed control, and harvesting in this ecosystem are similar to the highland ecosystem.

"Pozas Veraneras" (Low Flooded Areas)

Pozas Veraneras are a particular rice production system in Ecuador. They are natural land depressions where rainfall water accumulates and remains there during most part of the dry season. This ecosystem represents 18% of the total area with an average yield of 3.2 t/ha. It is located in Samborondon, Yaguachi, Daule, Urbina Jado (Guayas) and in Babahoyo, Catarama and Vinces (Los Rios).

Rice is transplanted from March to September. Seed beds are prepared on the higher parts of the field. The first transplanting is done at 25-30 days after planting and is traditionally called "claveteo"; seedlings are pulled out and transplanted to lower sites with a 0.15 m water table providing them with more space for development. The final transplanting to the lowest sites, according to the water level descending rate, is carried out 20-30 days later; in areas with a 0.25-0.35 m water table, 6-8 plants/site are transplanted at 0.40 x 0.40 m.

Farmers plant traditional, late and early varieties. Late varieties are planted between March and April allowing them more time in the nursery until the water level descends. Early varieties are planted in May and June. Water affects production between August and September, but farmers, especially in the Samborondon area, use the water from the Daule and Babahoyo rivers which are salt-contaminated due to tides and cause salinity problems.

This ecosystem requires early and intermediate varieties with tolerance to salinity.

Very few farmers apply fertilizers, but those who practice fertilization (15% of the farmers) obtain yields similar to those who do not fertilize. Weed control and harvesting is done manually.

CULTIVATED VARIETIES

High yielding improved varieties INIAP 6, INIAP 7 and INIAP 415 are planted in irrigated systems.

INIAP recommends varieties INIAP 7 and INIAP 415 for upland farmers in highland and floodable lowland regions. In 1982, 64% of the rice area was planted to these varieties and the rest of the area with the traditional varieties Pico Negro, Brasilero, Donato, Chato Rayado, Papayo, 100 dias, Maravilla, Cafuringa, Dormilon, etc.

PRODUCTION CONSTRAINTS

The following are the main rice production problems in Ecuador:

- A lack of improved varieties for the different upland ecosystems, with tolerance to submergence, salinity and drought.
- Deficient water control in irrigated areas.
- Weed control and fertilization deficiencies.
- A lack of good quality seed.

- Hoja blanca and blast incidence, especially under upland conditions.

- Abnormalities in rice marketing.

OBSERVATIONS

The observation team visited the Boliche Experimental Station of the Instituto Nacional de Investigaciones Agropecuarias (INIAP), the El Rosario Experimental Station of the Ministry of Agriculture Rice Program, the Irrigation Subproject America of the Development Study Comission for the Guayas Basin (CEDEGE) and the Ministry of Agriculture, the Sausalito Farm, and several rice farms in Samborondon.

BOLICHE EXPERIMENTAL STATION

The Boliche Experimental Station is located 26 km Southeast Guayaquil, at 2^{o}, 20'S latitude and 79^{o} 49'W longitude, at an altitude of 17 masl and an average temperature of 25^{o}C. INIAP conducts research on rice, cotton, maize, sorghum, soybeans, sesame, "carcamo", banana and livestock (swine). It has support programs in pathology, weeds, insects and soils, and a seed production unit.

The rice program is staffed with five agronomists devoted to breeding and five in agronomy activities with 50% of their time in rice.

The rice program was initiated in 1969 to obtain high yielding varieties resistant to diseases and with good milling and cooking (long grain, high yield of first quality rice, good white grain appearance, and intermediate-high in amilose). qualities. Variety improvement activities are conducted through hybridizations and introductions. Field observations included introduced materials, the collection of traditional varieties, F_2-F_5 segregating populations, advanced lines in yield trials, and the production of breeder seed.

The 11 materials of the traditional variety collection are used as parents in hybridizations with semi-dwarf lines. These materials are tall with intermediate-long grain, and tolerant to hoja blanca.

Germplasm from the 1984 VIOAL and VIRAL-T nurseries was observed among the introduced materials under irrigated transplanting conditions. This germplasm was 88 days old and showed a severe incidence very similar to zinc deficiency, a problem that has been considered as an iron toxicity by program technicians. However, soil characteristics (clayed texture, pH 6.5-7.0, poor drainage and puddled soil) lead to a zinc deficiency. While zinc deficiency and iron toxicity symptoms can lead to confusions, seedling observations confirm that these symptoms are more typical of zinc deficiency than iron toxicity. In general, iron toxicity occurs in acid soils and iron deficiency in neutral or alkaline soils. Rice germplasm was evaluated for this problem and several lines in adjacent plots showed tolerance (Appendix III) and others susceptibility.

Segregating F_2-F_4 materials were observed under transplanting in irrigated, favored upland and floodable lowland systems.

Fifty promising lines selected from the 1983 VIOAL and VIRAL-T IRTP nurseries are being evaluated in yield trials. These materials were at the flowering stage and several lines performed better than the local checks INIAP 7 and INIAP 415 (Appendix III).

Zinc deficiency was observed again in breeder seed production plots of INIAP 6, 7 and 415 at maximum tillering.

Three fertilization trials with variety INIAP 415 were observed: one to study the effect of P, K and Zn on iron toxicity and to analyze iron tissue levels. N, P and Zn were applied at 120 kg/ha in the following combinations: N + P + S, N + P + K, N + P, N + P + Zn, N + K + Zn, N + Zn, N + K, N, and absolute check. The iron problem did not occur in this experiment. The only difference observed was that N deficiency occurred in the absolute check.

The effect of azolla and duck weed on yield is being evaluated in another experiment. The treatments were 120 kg N/ha, azolla 4 kg/ha, duck weed 4 kg/ha, N + duck weed, and an absolute check. The experiment was at the flowering stage and no differences between treatments were observed.

The effect of organic matter on rice growth is being evaluated under greenhouse conditions. "Crestilla", "mondonguillo", "duck weed" and "lettuce" were used as organic matter sources. Plants fertilized with 40 g organic matter/pot with 2 kg of soil showed good growth compared to the control.

EL ROSARIO FARM

This farm, located in Daule, belongs to the Ministry of Agriculture where the rice national program conducts training, research and certified seed production activities. Training activities are for groups of peasants, intermediate level staff and agronomy students. Research activities are for degree thesis development at their termination of agronomy studies and for yield and hoja blanca and salinity resistant trials with promising rice materials from INIAP.

Thirteen lines were observed under evaluation for hoja blanca resistance. Hoja blanca incidence was moderade, ranking 5 in the severity scale. The most susceptible line (UP 677) showed a 31% incidence of affected plants with grade 5, and the least affected, 8% of affected plants with grade 5. INIAP 6 (CICA 4) and INIAP 415 showed a 12% incidence with grade 5.

In a yield trial with 36 lines selected from the 1983 VIOAL at the maturation stage, which was affected by salts and hoja blanca, the outstanding materials were lines P 3081 F_4-2 and P 3304 F_4-27, which were both tolerant to hoja blanca.

MULTIPLE PURPOSE PROJECT "JAIME ROLDOS AGUILERA": IRRIGATED AMERICA SUB-PROJECT

This irrigated sub-project is part of the Development Study Commission for the Guayas Basin (CEDEGE) and the Ministry of Agriculture. The "Jaime Roldos Aguilera" project is aimed to develop 50,000 hectares in the Daule Valley.

The Irrigated America Sub-project involves infraestructure development (irrigation and drainage canals, land adapting), for a total of 6,000 hectares of clayed alluvial soils that are not being utilized because of their floodable nature by waters from the Daule river. In 1983, floods caused crop losses for up to US$20. millions.

At present there are 80,000 hectares of alluvial plains of which 14,000 hectares are used for rice cultivation. For 1992 the project expects to have 50,000 hectares suitable for rice.

In the Santa Elena region there is a potential of 100,000 hectares. For 1995, 35,000-45,000 hectares of soils for rice production are expected to be fitted and irrigated from the Daule river.

To fit these lands, the Daule-Peripa dam is being constructed with a total capacity of 6,000 million m^3, and will be concluded in 1987. This dam will feed other dams by carrying water through tunnels and generating energy (135 mega-watts) in a hydroelectric plant that is now being constructed. This dam will also allow regulating the Daule river waters and avoiding floods.

The project has a cost of US$137 millions, 25% from national resources and 75% from an IDB loan.

Commercial rice fields of small farmers organized in cooperatives were observed in the area of influence of this project in Daule. These farmers plant rice by transplanting or with pre-germinated seed directly seeded in puddled soil. Four years ago, the most limiting factors in this region were the grassy and red rice.

Now these problems are minimal and the productivity reached with INIAP 415 is 5.0-5.5 t/ha.

SAUSALITO FARM

This farm belongs to Isaias Dasun Hermanos and is managed by the agronomist Jose Maria Lewis.

The total area of the farm is 1,006 hectares with irrigation available for the whole area and the varieties that are planted include INIAP 415, INTI, CICA 9 and Medellin (CICA 8).

Rice problems found here include rats, hoja blanca, the leaf hopper and stem rots.

Rice cultivation is completely mechanized with direct seeding, broadcast by aircraft with dry seed in dry soil at a rate of 150 kg/ha (Figure 8).

Herbicides, fertilizers and fungicides are applied with a lightaircraft.

Weeds are controlled with pre-emergent (Goal, Saturno, Ronstar) and post-emergent (Propanil) herbicides.

Fertilization is based on nitrogen (120-150 kg N/ha) as urea.

Rats are controlled with baits (Racumin) that are distributed in plastic bags on the levees.

The leafhopper is controlled with two applications of sistemic insecticides.

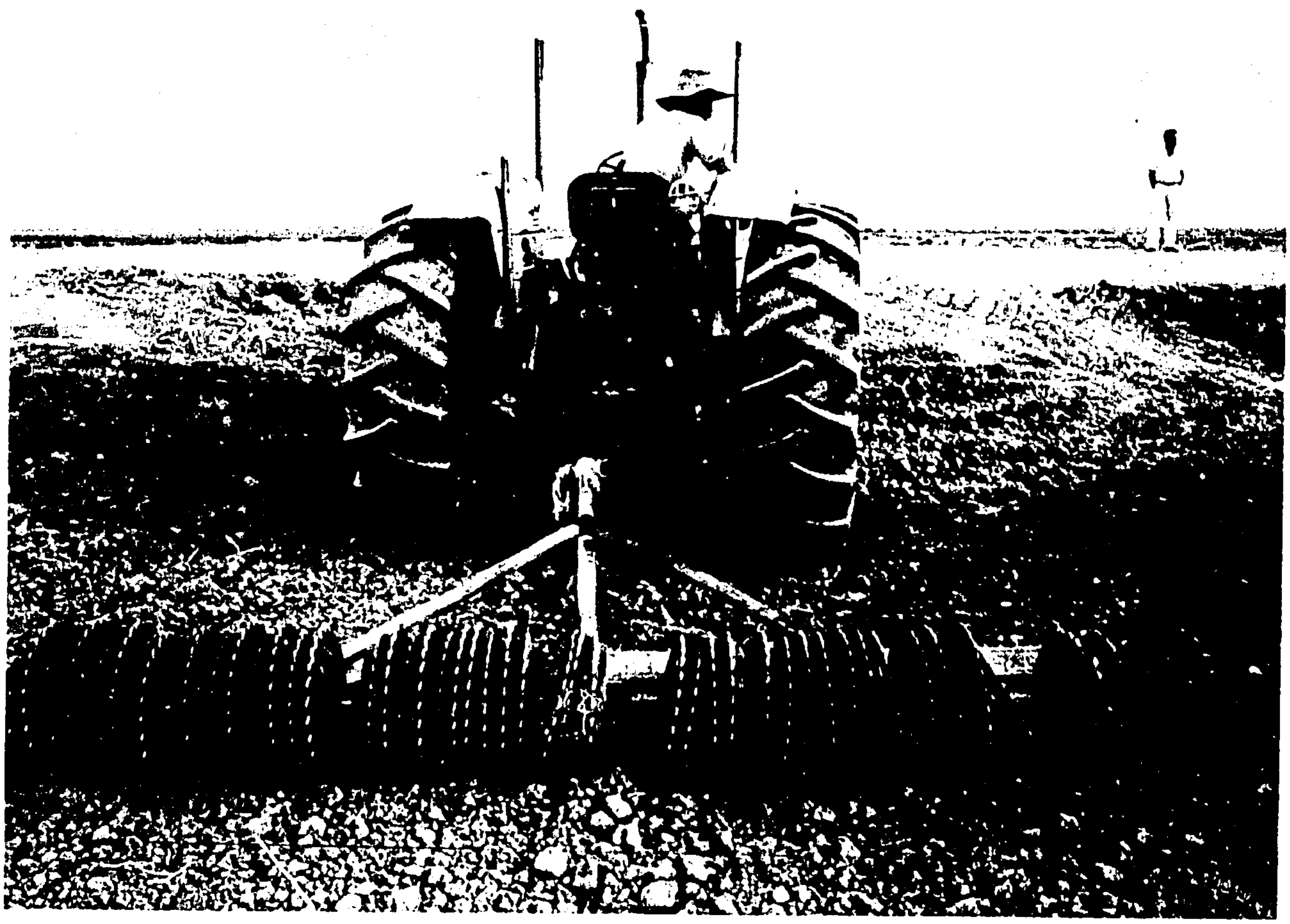

FIGURE 8. Harrow used to cover the rice seed in direct broadcast seeding.
Sausalito farm, Guayaquil, Ecuador.

The incidence of fungi on the rice grain is minimized with two fungicide applications (Kasumin, Hinosan or Bim) after flowering.

The dry paddy rice yields obtained are 5.5-6.0 p/ha with production costs of approximately US$480./ha.

POZAS VERANERAS

This cropping system was observed in several farms in the area of Samborondon (Figure 9). The rice crops observed here were in the tillering stage with early varieties such as 1001 and Brasilero. The rice crop that are planted with late varieties (Pico Negro), which are planted in March and April, were already harvested.

RECOMMENDATIONS

The observation team discussed the problems and made some recommendations.

DISEASES

Hoja blanca is a serious problem, especially in the Daule region. A set of crossing with different resistance sources and evaluations at high pressure sites were suggested. Severity and intensity should be taken into account when evaluating the materials.

While resistant varieties are obtained, it was suggested to determine the percentage of vector insects at the field level; if it is high, it was suggested to recommend the farmers the use of insecticides for their control. Another recommendation was to diversify the crop with

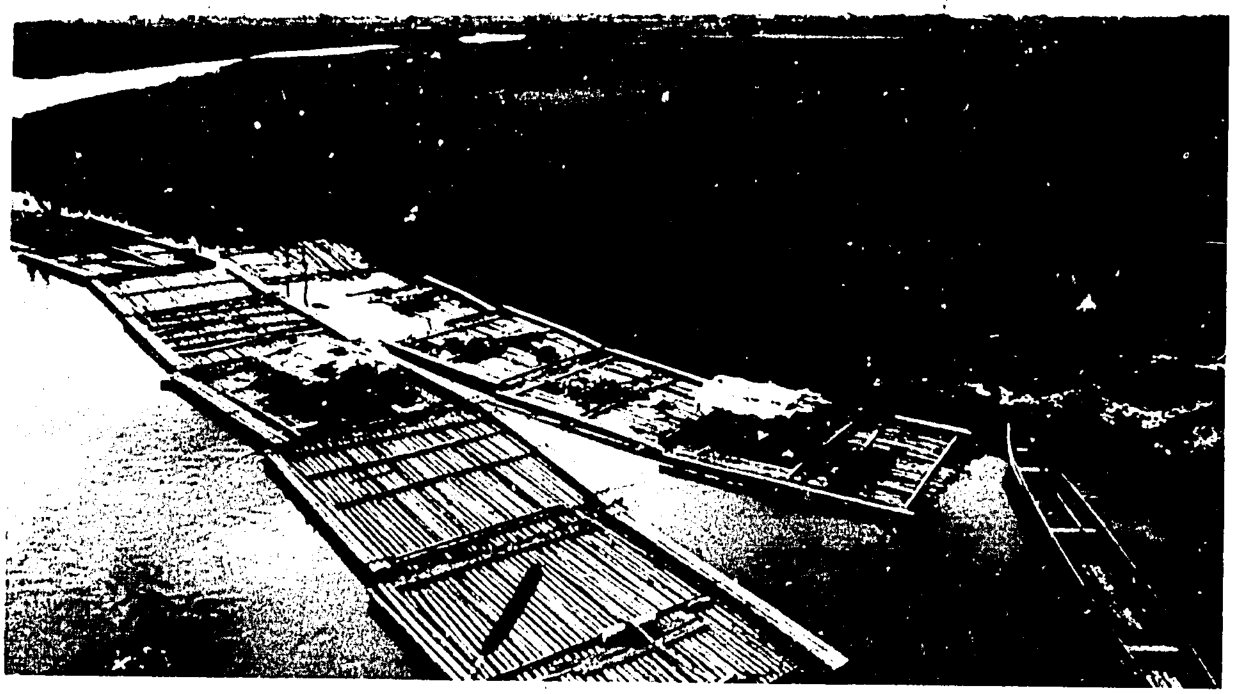

FIGURE 9. Rice crop in "Pozas Veraneras". Samborondon, Guayas, Ecuador.

several genotypes such as INIAP 415, INIAP 7 and INIAP 6.

The rice blast problem is more severe under upland conditions and the program was suggested to evaluate and select resistant materials in the upland regions by using a technology that allows a severe incidence of this disease.

SEED PRODUCTION

Farmers do not have sufficient certified seed available at present and the quality is not adequate.

The national seed program was encouraged to promote the private sector to produce certified seed and control the quality in the already existing enterprises.

Another recommendation was to encourage the farmer to use good quality certified seed.

TECHNOLOGY TRANSFER

The low utilization of herbicides to control weeds and the use of poor quality seed are factors that can be solved through field day demonstrations of the new technology in farmer's fields. These field days should be oriented to large and small rice producers.

FERTILIZATION

Fertilization practices by some farmers are based on nitrogen without taking into account the needs for other elements. The INIAP soils program was suggested to determine the optimum N, P, K and other element levels for the different soil series and varieties. It was also suggested to continue studies in azolla and other acquatic plants as organic matter sources.

Regarding the zinc deficiency problem, it was suggested to make demonstrations with CIAT technics, by applying 25 kg SO_4 Zn/ha before transplanting and with IRRI technics by submerging seedling roots in a 2% ZnO solution before transplanting.

RODENT CONTROL

To minimize the damage caused by rats it was suggested to promote control campaigns by all farmers in the region, by destroying crop ratoons through burnings and soil incorporation.

INSECTS

Regarding the damage caused by *Rupella albinella*, it is suggested to study this damage separately from that caused by sheath rotting and sheath blight. The damage caused by these diseases appears to be more severe than that caused by *Rupella*.

TRAINING

Program staff as well as personnel from other disciplines require updating on different production aspects. The team recommended INIAP to request CIAT's technical collaboration in the organization and presentation of conferences and courses.

It was suggested to include one or two technicians from the INIAP program in the training courses offered by CIAT.

RICE IN PANAMA

Rice in Panama is a main staple with an average consumption of 70 kg of white rice per capita.

In 1982, 106,060 hectares were planted to rice, of which 55.4% correspond to the upland mechanized system, approximately 5,000 hectares of irrigated rice and the rest with an upland of manual system. An average total production of 178,802 tons of paddy rice was harvested from an area of 99,030 hectares (52,967 hectares under upland mechanized and 46,063 under upland manual). 93.3% of the production corresponded to the mechanized upland system with an average yield of 3.1 t/ha. However, the national average was 1.9 t/ha which indicates that the manual upland ecosystem yielded an average of less than 0.5 t/ha. These figures reflect the difficulty in obtaining good statistics for the hilling production system. The main varieties planted were CICA 7 and CICA 8 which represented 53% of the area. Farmers in the manual upland ecosystem plant low yielding native varieties susceptible to diseases.

Rice production in the last two years has been sufficient to meet the domestic demand and to generate some surplus. Taking this into account, the government policy has been focused to self-sufficiency by concentrating rice production in upland mechanized areas, avoiding risks of losses caused by drought, with good technology (high yielding varieties and good crop management).

PRODUCTION CONSTRAINTS

The main rice production constraints are the following:

- Diseases, especially rice blast, leaf scald, brown spot, sheath blight and eyespot.
- Lack of certified seed.
- Inadequate and untimely soil preparation without levelling.
- Inadequate crop management specially related to weed control, fertilization and planting densities.

OBSERVATIONS

The observation team visited IDIAP's Experimental Stations in Rio Hato and Chichebre, and commercial fields in the Bayano region.

RIO HATO EXPERIMENTAL STATION

The research activities of the IDIAP-CIAT Agreement are carried out in this experimental station. This site is characterized by slightly acid soils of pH 5.5-6.0 with a silty loam - clayed loam texture and good internal drainage. The annual rainfall is 1,000 mm with an erratic distribution which varies from one year to another, with short drought periods of up to one week long.

Germplasm bank materials, F_2-F_4 segregating populations, F_5 advanced progenies and IRTP nurseries were observed here (1984 VIRAL-T, VIOAL and VIOAL-SNF). Hoja blanca, rice blast and stemborer incidence was observed in 45 F_2 populations introduced from CIAT that were 69 days old. The rice blast incidence in several populations was severe which allowed to eliminate susceptible materials.

Rice blast incidence was less in F_4 and F_5 populations indicating progress in the selection of resistant materials.

The materials of the VIRAL-T, VIOAL-SNF and germplasm bank were 47 days old. Several lines were observed susceptible to rice blast, similar to CICA 4 with a severity rating of 7-8. The local check Tocumen 5430 showed resistance.

CHICHEBRE EXPERIMENTAL STATION

This station is located in the Bayano region 50 km East of Panama city. The soils here are clayed with a pH 5.5 and low in phosphorus. The average rainfall fluctuates between 1,500-2,000 mm, with an average temperature of 26^{o}C, 90% relative humidity and 300-400 cal/g/cm^2 solar radiation. The station is located at an altitude of 19 masl. The experimental station has a surface area of 20 hectares.

The rice program activities at Chichebre include crossings, the selection of materials in segregating populations (F_2-F_5), the evaluation of materials from the

IRTP nurseries (VIOAL and VIRAL-T) and agronomic trials in weed control, fertilization and rice blast chemical control.

The materials from the 1984 VIOAL and VIRAL-T nurseries were observed. This germplasm was 60 days old. A low pressure by rice blast and other diseases was detected. Most of the materials were resistant and only a few lines were susceptible, in a similar way as CICA 4 with a severity rating of 8.

The local checks Anayansi, T 1-38 and T 1-15 were resistant.

The segregating populations of the program as well as the agronomic trials were recently planted (10 days old) and therefore, it was not the proper time to observe variability.

COMMERCIAL FIELDS

Several commercial fields at maximum tillering and flowering were visited in the Bayano region. Rice crops with varieties Metica 1 and Tocumen 5430 were observed. Both varieties showed a high incidence of leaf scald, varietal mixture, specially red rice in Tocumen 5430. The incidence of narrow leaf weeds was high in most crops.

RECOMMENDATIONS

The observation team discussed rice production and research constraints, and made the following suggestions:

VARIETIES

The lack of varieties resistant to diseases, especially leaf scald, rice blast, and stem rot is a serious constraint. To minimize losses it is necessary to diversify the crop with more tolerant varieties such as CICA 8, Anayansi and Oryzica 1.

To accelerate the selection of varieties tolerant to these problems the IDIAP rice program was suggested to carry out demonstration trials with promising lines and commercial varieties in different rice production areas representative of the country. It was also suggested to carry out field days with the participation of producers in each region.

SEEDS

Commercial seeds observed were varietal mixtures and red rice, indicating that the use of certified seed is deficient. To minimize this problem it is necessary that the seed production enterprises organize an adquate production, so that certified seeds are produced in sufficient amount and with good quality, especially free of red rice.

It is also recommended to promote certified seed production with private enterprises, providing them with the necessary incentives for production to be profitable and quality competitive.

Through government and private credit, to demand from the producers a certified seed purchasing certificate before granting them loans after planting.

SOIL PREPARATION

It was observed that soil preparation in the Bayano region is unsuitable, mainly because it is done when the high moisture conditions do not allow a good soil preparation with the conventional equipment. Studies at the farmer level should be carried out to develop adequate technologies for the Bayano region and other Central America areas with more than 2,000 mm rainfall.

CROP MANAGEMENT

Deficiencies were observed in weed control, fertilization and planting densities.

In order to control weeds properly, it was suggested to develop an integrated methodology including soil preparation and a timely application of good quality pre and post-emergent herbicides.

Regarding fertilization, it was suggested to study the response to different levels of N, P and K and other elements, and to establish the optimum levels for the different soil series and varieties. Similarly, it is essential to study planting densities for each variety and cropping system.

THE NATIONAL PROGRAM

Regarding research, the observation team observed a lack of integration of IDIAP's rice program between

Chichebre and Rio Hato. It was considered that it was due to the lack of a national coordinator, and therefore, IDIAP was suggested to appoint a national coordinator, providing him with all the economical resources to act as such.

Concerning the IDIAP-CIAT collaborative project, the observation team considered that Rio Hato, the main headquarters of the project activities, is not a representative site for Central America and suggested that more emphasis be placed on project activities at David where the ecosystem is more representative for most upland rice in the region.

IDIAP was suggested to strengthen the program with personnel well trained in breeding, pathology and agronomy. IDIAP should facilitate its present staff to study English and to receive training at the post-graduate level.

RICE IN COSTA RICA

Rice is a basic food staple in this country with an annual consumption of 56 kg of white rice per capita.

In 1983, 88,351 hectares were planted to rice, 96.5% under upland conditions and 3.5% under irrigated conditions. Total rice production was 280,084 t of paddy rice with an average yield of 3.2 t/ha. During 1980-1983, the rice production has been sufficient for the domestic demand and has generated a surplus for exportation (94,000 t) and country supply with more than 69,000 t. Most of the rice producing region is concentrated in the coast from the sea level to 500 masl. There are small subsistence units located between 500 and 1,000 masl.

PRODUCTION SYSTEMS

UPLAND MECHANIZED

94.0% of the upland rice crops are completely mechanized and are found in intensive cropping systems. Rice planting and the first fertilizer treatment are done directly and the rest of the cultural practices (weed control, nitrogen fertilization, insecticide and fungicide application) are done with terrestrial equipment or with light aircrafts. When soil moisture conditions do not allow terrestrial equipment for rice seeding, light aircraft are used for broadcast planting using dry seed and, in certain cases, pregerminated seed.

Varieties CR 1113, CR 201 and CR 5272 are planted in this system. In 1983, CR 1113 occupied 89.6% of the total area.

UPLAND MANUAL

This system covers 1-2% of the total area and is represented by small farmers. It is concentrated in sloped areas between 500 and 1,000 masl. These farmers do not use agricultural inputs and it is a subsistence production. Tall varieties Bluebonnet 50 and Carolina are used.

IRRIGATED SYSTEM

This system is completely mechanized in large farms. Planting is done directly with dry seed on dry soil or broadcast with aircrafts using pregerminated seed.

Planting rice by transplanting is only used for basic seed production in the Enrique Jimenez Nuñez Agricultural Experimental Station at Cañas or in demonstration plantings of foreign missions. Soil preparation in this system is by puddling and transplanting is done manually.

The varieties cultivated in this system include CR 1113, CR 5272 and CR 201, with yields that fluctuate between 5.0-6.0 t/ha.

PRODUCTION CONSTRAINTS

- Disease, especially rice blast and leaf scald.
- Weeds
- Seed production
- Soil preparation

OBSERVATIONS

The observation team visited the Enrique Jimenez Nuñez Agricultural Experimental Station in Cañas and the rice production zone of Jaco and Parrita in the Mid Pacific area.

ENRIQUE JIMENEZ NUÑEZ

This station is located 10 km South west of Cañas, Guanascate. The total area is 831 hectares of which 159 hectares are dedicated to research and commercial production.

The soils of the research area are alluvial with a clayed loam and sandy loam texture, and pH 6.2.

The climate here is classified as tropical dry forest with an average annual rainfall of 1,700 mm, characterized by a dry season between December and May and a rainy season between May and November. The average temperature is 27°C. It is located at 10° 20' 48" N latitude and 88° 08' 52" W longitude, at an altitude of 45 masl for the headquarters and 8-12 masl for the fields.

Irrigation and drainage infraestructure are available for 75 hectares, which serve to carry out research and to divulge irrigation technics in different crops. The irrigation and drainage infraestructure includes 15.8 km of coated canals for irrigation and 9.5 km of canals for drainage. This infraestructure was inaugurated in late 1983 and its cost was US$30 million colones with the participation of AID, IDB and the Electricity National Services.

The objectives of agricultural research include:

- Introduction and evaluation of rice, maize, sorghum, grain legumes, sugarcane, cotton, vegetable and fruit varieties.

- Basic seed multiplication of promising varieties.

- Improved use of agricultural chemical inputs for increased productivity.

- Technology transfer to farmers.

- Development of integrated production systems.

- To study different crop production and rotation alternatives.

The 1984 VIOAL, VIOAL-SNF and VIRAL-T nurseries, the national trials and the 1984 IURON from IRRI were observed in the field, as well as materials selected in the Rio Hato and Tocumen at the 1983 Workshop in Panama.

The CIAT germplasm was 50 days old and the rest of the material was 30 days old. Most of CIAT germplasm showed good performance but some lines were susceptible to rice blast except for CR 1113 (local check) which was tolerant.

Basic seed production fields were observed which were prepared by puddling for transplanting variety CR 1113 and two promising lines (CR 1707 and CR 1821), both selected from variety CR 201.

Basic seed harvesting is done with two small Caterpillar Japanese combines (Yanmar TC 1201) with a 0.4-0.8 ha/10 hours efficiency.

THE JACO AND PARRITA RICE GROWING REGION

This rice producing zone represents 15% of the total area and is located in the Mid Pacific Coast. It is characterized by a high rainfall (3,000-3,800 mm/year), alluvial soils with a clayed and sandy clayed texture with pH 6.0-6.2.

La Ligia farm was visited in the Parrita region where 900 hectares are planted with varieties CR 1113, CR 5272 and CR 201. The system is totally mechanized and two harvests per year are obtained (the first under upland conditions during the rainy season and the second under irrigation during the dry period). Rice planting is done directly and broadcast with light aircraft using dry seed or pregerminated seed at a rate of 100-130 kg of seed/ha. Weed control is based on Propanil alone or combined with Prowl (2.5 l/ha) in two applications and, in some cases, in a third application to control

Rottboellia. To prevent neck blast an application of Hinosan (1.5 l/ha) is done at early flowering (10%). After flowering, another Hinosan and Antracol application is done to avoid neck blast, grain discoloration and to control panicle pests. Fertilization is done at planting with 115 kg/ha of the compound 10-30-10 and at tillering and panicle initiation 45 kg N/ha are applied as urea.

Excellent crops were observed at maximum tillering, flowering and maturation with varieties CR 1113 and CR 5272. Yields of over 5.0 t/ha were estimated for fields close to harvesting. CR 5272 fields showed a higher neck blast incidence (5%) compared to CR 1113.

The average annual yield in this farm is 4.0 t/ha with a total cost of approximately US$1,040/ha. At the current prices of US$0.28/1 kg dry paddy rice, the farmer obtained a net profit of US$80/ha.

Another farm called Jaco was visited, where 310 hectares are cultivated under upland conditions with varieties CR 5272 and CR 201. This latter variety is for certified seed production.

Rice planting in this farm is done with a row planter at a rate of 80 kg of seed/ha. Weeds are controlled with herbicides, with a first application of the mixture Propanil + 2-4-5T + Prowll and a second with Propanil alone. Fertilization was based on nitrogen at a rate of 80-120 kg/ha split into four equal applications for CR 5272 at 20, 40, 60 and 80 days after planting, and three applications for CR 201 at 30, 60 and 80 days after planting.

The field of both varieties at the flowering and maturation stages showed a good management and productivity.

A 1-hectare field was observed with the new variety CR 1707, a selection of the variety CR 201. In the 1983 regional trials this new variety yielded up to 10 t/ha under upland conditions and good management. This variety is still under semi-commercial observation and will be officially nominated if its performance merits it.

RECOMMENDATIONS

The observation team discussed the limiting factors detected both at the commercial level as well as in the research program.

The following production constraints were detected at the commercial level:

VARIETIES

There is a narrow genetic base that predominates in 80% of the area planted (CR 1113). This represents a hazard for production stability since in the last years the susceptibility of this variety to rice blast and leaf scald has increased.

To face this problem the program was suggested to monitor the performance of new material already evaluated in the yield trials and to select the best lines with diverse genotypes for their evaluation in regional trials, and select two varieties in a short term. It is also convenient to reduce the area planted to CR 1113 and substitute it with variety CR 201, CR 1707 and CR 5272.

WEEDS

Weeds still pose a serious problem. An integrated control method is suggested to be developed including good soil preparation, optimum fertilization, times of pre and post-emergent herbicide applications and inclusion of new herbicides of prolongued residual effect.

MECHANIZATION AND SOIL PREPARATION METHODS

Deficiencies exist in the use of machinery for soil preparation. Mechanization methods are suggested to be studied in order to obtain an adequate mechanization method for each production system that takes into account soil moisture and other characteristics.

SEED PRODUCTION

The observation team observed varietal mixtures and red rice in several commercial crops indicating that the quality of certified seed is not ideal. The national seed office of the Ministry of Agriculture was suggested to exert increased control on seed quality both at the field level as well as in the processing and laboratory stages to eliminate red rice and other varietal mixtures as possible.

At the research level the following problems were detected:

STAFF

The rice program lacks personnel to execute the different breeding, pathology and agronomic activities. The research division of the Ministry of Agriculture was suggested to increase the personnel to the minimum necessary. To meet the objectives of the rice program, a breeder, a pathologist and a specialist in agronomy are required. All should be full-time staff dedicated to rice research.

FERTILIZATION

The program was suggested to determine the optimum level of the main nutrients for the current varieties and promising lines in the different soil series.

BREEDING

The program was suggested to continue with the present breeding system based on the evaluation of introduced advanced materials and the selection of outstanding lines. However, it is necessary to increase the evaluation of segregating materials introduced from CIAT and other institutions.

APPENDIX I

INSTITUTIONS, ENTERPRISES AND PLACES VISITED BY THE OBSERVATIONAL GROUP

VENEZUELA	Araure Experimental Station of Fondo Nacional de Investigaciones Agropecuarias (FONAIP), for Agricultural Research in the Center-West Region, CIARCO. Araure, Portuguesa.
	Experimental field in farm "La Toma", Piritu county. Araure, Portuguesa.
	Experimental field in farm "La Romaña", Payara, El Cruce. Araure, Portuguesa.
	Hermanos Ruffone Farm, Payara, Araure, Portuguesa.
	Seed plant "Chispa", Acarigua, Portuguesa.

NOTE: The visit of the group was coordinated and attended by Eng. Anibal Rodriguez and rice research collaborators of FONAIAP.

COLOMBIA	Seed plant "Semillano", Villavicencio, Meta.
	Seed plant FEDEARROZ, Villavicencio, Meta.
	Agricultural Research Center "La Libertad", of the Instituto Colombiano Agropecuario (ICA), Villavicencio, Meta.
	Experimental Station CIAT-Santa Rosa, Villavicencio, Meta.
	Centro Internacional de Agricultura Tropical, CIAT-Palmira, Valle.
ECUADOR	Boliche Experimental Station of the Instituto Nacional de Investigaciones Agropecuarias, INIAP. Boliche, Guayas.
	Sausalito farm, Guayas.
	"El Rosario", station of the Ministry of Agriculture, Daule.
	America Irrigation Sub-project "Jaime Roldos Aguilera" of the Commission Studies for Development of the Guayas Basin (CEDEGE), Daule.
	Crops of Pozas Veraneras in Samborondon

NOTE: The visit of the group was coordinated by Eng. Ricardo Guaman and attended by technical personnel of INIAP in Boliche.

APPENDIX II

Scientists, technical and administrative personnel and rice producers who came in contact with the Observational Group

VENEZUELA

Agricultural Research Center-West Region - CIARCO

Araure Experimental Station

Tomas A. Chinchilla	Veterinarian, Head
Anibal Rodriguez	Director Rice Program
Orlando Moreno	Research Assistant, Rice Program
Maria T.Valenzuela	Research Assistant, Rice Program, FUNIAPROT
Mario Gimenez	Expert - Rice Program
Omar Aponte	Entomologist
Humberto Rodriguez	Pathologist
Herman Nass	Pathologist
Danilo Aguero	Biologist
Pedro Romero	Seed production
Jesus Peña	Technology transfer
Franz Kassen	Rice Producer
Manuel Moya	Communications
German Rico	Agronomist, Rice Program Calabozo

PANAMA	Rio Hato Experimental Station of the Instituto Nacional de Investigaciones Agropecuarias (IDIAP), Rio Hato. Chichebre Experimental Station of IDIAP, Chichebre. Rice commercial farms in Bayano zone.

NOTE: The visit of the group was coordinated and attended by Eng. Ezequiel Espinosa, Director of IDIAP and staff of rice program.

COSTA RICA	Experimental Station "Enrique Jimenez Nuñez", of the Ministry of Agriculture. Cañas, Guanacaste. La Ligia farm, Parrita. Jaco farm, Jaco.

NOTE: The visit of the group was coordinated and attended by Eng.Jose I. Murillo and staff of the Experimental Station.

Alberto Salih	Breeder, Rice Program, Calabozo
Pedro Angarita	Seed Production
Ibrain Tobar	Plant Protection, MAG, Acarigua
Efren Diaz	Plant Protection, MAG, Acarigua

PRIVATE ENTERPRISES

Carlos Landaetta	Manager, Seed Plant "Chispa", Acarigua
Luis Ramirez	Seed Producer "Chispa"
Orlando Vasquez	Seed Producer "Chispa"
Filardo Jesus	Manager, FUNIAPROT, Acarigua
Miguel Saldivia	Director, APROSCELLO
Jose Mendoza	Expert, CIBA-GEIGY S.A., Acarigua
Genaro Gomez	Radio Acarigua
Antero Noguera	Expert B.D.Tox,C.A. Acarigua

PRIVATE PRODUCERS - ACARIGUA

Domenico Morelli	"La Romaña" farm
Angelo Ruffoni	"Hermanos Ruffoni" farm
Giacome Cazulane	"La Toma" farm
Guillermo Medina	Producer

COLOMBIA

AGRICULTURAL RESEARCH CENTER ICA-LA LIBERTAD, VILLAVICENCIO.

Ismael Torres	Director
Ernesto Andrade	Head Rice Program
Dario Leal	Agronomist Rice Program

EXPERIMENTAL STATION CIAT-SANTA ROSA, VILLAVICENCIO.

Cesar Martinez	Breeder - Upland
Surapong Sarkarung	Breeder
Marco Perdomo	Research, Agronomy
Eliseo Nossa	Research Assistant
Luis E. Dussan	Research Assistant
Edgar Tulande	Research Assistant
Gonzalo Rodriguez	Administration
Elias Garcia	Training Program

TRAINEES

Jorge O. Miranda B.	Argentina
Pablo Grau	Chile
Orlando Trujillo	Colombia
Robert Amat	Ecuador
Edgar Giron	Guatemala
Tito Guillen	Honduras
Alberto Quintanilla	Nicaragua
Ariel Jaen	Panama
Cesar A. Moquete	República Dominicana

CIAT-PALMIRA

Gustavo Nores	Director Crops
Peter R. Jennings	Coordinator Rice Program
William Roca	Head, Genetic Resources

	Alfonso Diaz	Superintendent
	Luis E. Berrio	Research Assistant IRTP
	Jenny Gaona	Research Assistant IRTP
	Miguel E. Rubiano	Research Assistant, Pathology
	Victor Nuñez	Research Assistant, Anther culture
	Alicia Pineda	Technician
	Victoria de Victoria	Technician Quality Laboratory
	Janeth de Salcedo	Technician Quality Laboratory
	Miralba Agudelo	Technician
	Edgar Quintero	Assistant, Field Operations
	SEED PRODUCERS	
	SEMILLANO-VILLAVICENCIO	
	Nestor Ramos	Technical Director
	FEDEARROZ-VILLAVICENCIO	
	Jairo Diaz	Director
	Carlos Franco	Regional Trials
	Alvaro Salive	Research
ECUADOR	BOLICHE EXPERIMENTAL STATION - INIAP	
	Saul Mestanza	Director
	Francisco Andrade	Head Rice Program
	Orlando Calle	Assistant
	Ricardo Guaman	Breeder
	David Alava	Enthomologist
	Fernando Armijos	Pathologist
	Kleber Medina	Soils

	Santiago Ronquillo	Regional trials
	Washington Peñafiel	Regional trials
	Efrein Frei	Public Relations

"EL ROSARIO" FARM OF THE MINISTRY OF AGRICULTURE, DAULE

Carlos Zambrano	Technical Administrative
Pedro Pantaleon	Technical Director
Carlos Monteverde	Research Coordinator
Victor Mena	Extensionist
Bolivar Ceballos	Extensionist

AMERICA IRRIGATION SUB-PROJECT "JAIME ROLDOS AGUILERA", DAULE

Arturo Ruiz	Director Agricultural Development
Ernesto Cifuentes	Technical Advisor

"SAUSALITO" FARM

Jose Maria Lewis	Technical manager

PANAMA

INSTITUTO DE INVESTIGACONES AGROPECUARIAS IDIAP PANAMA

Ezequiel Espinosa	Director
Alejandro Ferrer	Pathologist
Luis Lopez	Biologist, Rice Agronomy

RIO HATO EXPERIMENTAL STATION - IDIAP

Hernan Gutierrez	Breeder
Claudio Fernandez	Breeder, Assistant

COSTA RICA	"EJN" EXPERIMENTAL STATION - CAÑAS	
	Arnoldo Vargas	Director, Encharged
	Jose I. Murillo	Coordinator Rice Program
	Manuel Carrera	Pathologist
	Manuel Rodriguez	Seed Production
	DIVISION DE INVESTIGACIONES AGRICOLAS DEL MINISTERIO DE AGRICULTURA Y GANADERIA, SAN JOSE	
	Alexis Vasquez	Director
	"LA LIGIA" FARM, PARRITA	
	Jose A. Urgelles	Manager
	"JACO" FARM, JACO	
	Juan Carlos Salas	Administrator

APPENDIX III

PROMISING MATERIALS OF THE IRTP NURSERIES

IDENTIFIED BY THE OBSERVATIONAL TEAM

VENEZUELA LA ROMAÑA

Lines tolerant to rice blast in the 1984 VIOAL-SNF

B 2997C-TB-60-3-3
BR 51-282-8
CR 156-5021-207
IR 5105-156-2-3
P 1386-2-6M-5-1B
P 2030 F4-235-1B-1B
IR 4744-295-2-3

COLOMBIA CIAT-SANTA ROSA

Lines tolerant to grain discoloration in the 1984 VIOAL

IR 9782-111-2-1-2
ECIA 24-107-1
P 3059 F4-79-1
P 2867 F4-31-5
P 3059 F4-25-3

P 3062 F4-170-4
P 3081 F4-24-1
P 3284 F4-5-1

ECUADOR BOLICHE

Lines tolerant to a problem similar to zinc deficiency

VIOAL, 1984

IR 25840-64-1-3
IR 21015-137-3-2-2
P 3284 F4-5-7
Caribe 1-4
P 3293 F4-4B
IR 13146-45-2-3
P 3082 F4-18
P 2030 F4-217-4-1B

VIRAL-T, 1984

P 1358-5-19M-2-1B
P 3062 F4-170-1-1
P 3295 F4-26
P 2189 F4-27-1B-1B-1-1B
IR 25909-11-2-2-3-2
P 2192 F4-39-5-1