International Rice Testing Program for Latin America

Rice
Report on the monitoring tour to Central America 1980

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COOPERATION
Centro Internacional
de Agricultura Tropical, CIAT

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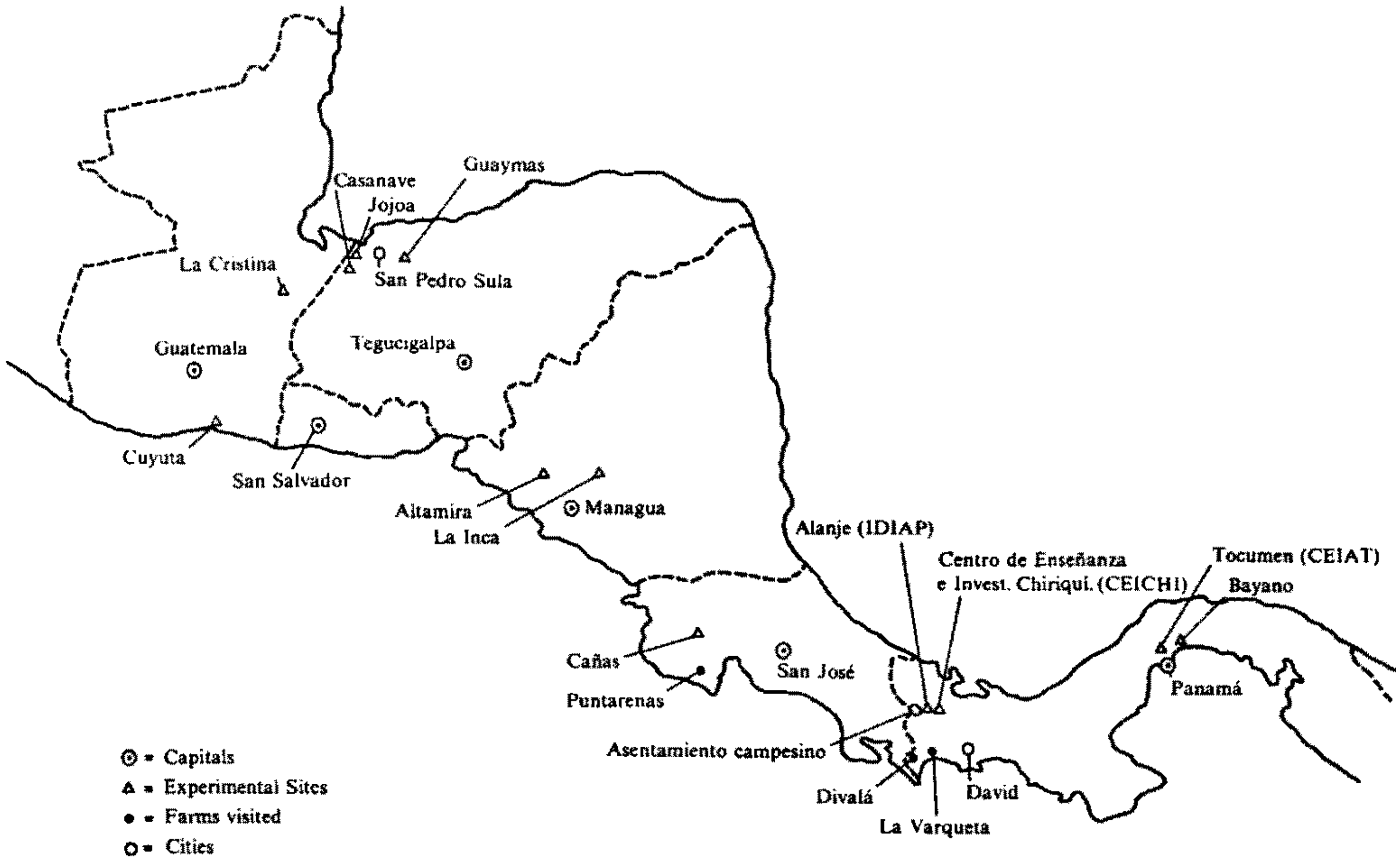

Figure 1. *Locations and institutions visited by the monitoring team in five Central American countries.*

REPORT ON THE 1980 MONITORING TOUR TO CENTRAL AMERICA

As part of the International Rice Testing Program (IRTP) for Latin America, a group of rice scientists from several different countries made a monitoring tour to Central America in September 1980 to become familiar with the research activities and rice production problems in this area.

This report presents several of the visiting team's observations and comments on rice production areas, cropping systems, varieties, problems and research work in Guatemala, Honduras, Nicaragua, Costa Rica and Panama.

Appendices 1, 2 and 3 list the institutions and individual farms that were visited, the scientists, technical experts and growers the team had contact with, and the research work on rice currently under way in experimental centers that were observed.

MONITORING TEAM

- *Walter Ramiro Pazos*, Head of the National Rice Program of the Instituto de Ciencia y Tecnología Agrícolas(ICTA) in Guatemala.
- *Napoleón Reyes Discua*, Director of the Rice Program of Secretaría de Recursos Naturales in Honduras.
- *William Bird*, Ex-official of the Banco Nacional de Desarrollo in Nicaragua.
- *José I. Murillo* and *Rolando González*, National Director and Researcher of the Rice Program of the Ministry of Agriculture and Livestock in Costa Rica.
- *Ezequiel Espinosa*, Dean of the School of Agronomy, University of Panama.
- *Alejandro Ferrer*, Plant pathologist from the Instituto de Investigaciones Agropecuarias de Panama (IDIAP).
- *Milton C. Rush*, Plant pathologist/Professor at the Louisiana State University in Baton Rouge, USA.
- *George Ghobrial*, Head of the Rice Program, Ministry of Agriculture, Wad Medani, Sudan.
- *Francisco Andrade*, Director of the Rice Program of Instituto Nacional de Investigaciones Agropecuarias (INIAP) in Ecuador.
- *Harold E. Kauffman*, IRTP Coordinator of the International Rice Research Institute (IRRI), Philippines.
- *Joaquín González*, Rice Program Coordinator for the Centro Internacional de Agricultura Tropical (CIAT).
- *Manuel J. Rosero*, IRRI Liaison scientist for Latin America; acted as monitoring team leader.

RICE ACREAGE AND PRODUCTION IN THE COUNTRIES VISITED

Table 1 shows rice acreage and production for the 1979 harvest. Except in Nicaragua, the manual and mechanized upland systems are the most widely used; rain distribution in both systems is good during the whole growing cycle although occasional droughts do occur during the germination and tillering stages.

Sixty-five percent of the rice acreage in Nicaragua is cropped using the irrigated system and dry and pregerminated seeds in fields that have been prepared by puddling; the technology used in this system is good, and yields are high. However, the yields from upland systems are low mainly due to disease and little rainfall. This does not happen in other countries.

Yields in the region are low mainly due to improper agronomical practices, high disease rates and problems with the soil. Tables 2, 3 and 4 summarize the main disease and insect problems, cultural methods (fertilization, weed control) and soils.

The following sections of this report give in-depth descriptions of the rice situation in each of the countries visited and the team's recommendations for these countries.

Table 1. **Rice area, production and yield in five Central American countries, under irrigated, mechanized upland (Mech. Up.) and manual upland (Man. Up.) systems during 1979-80 harvests.**

	Area (thousand ha)				Production (thousand t)				Mean yield (t/ha)			
	Irrig.	Mech.Up.	Man Up.	Total	Irrig.	Mech.Up.	Man.Up.	Total	Irrig.	Mech.Up.	Man.Up.	Nat.
Guatemala		11.5	-	11.5	-	24.2	-	24.2	-	2.1	-	2.1
Honduras	0.9	17.2	-	18.1	1.5	28.0	-	29.5	1.7	1.6	-	1.6
Nicaragua	18.2	9.8	-	28.0	87.4	13.7	-	101.1	4.8	1.4	-	3.6
Costa Rica	1.8	71.2	7.0	80.0	10.8	166.0	11.2	188.0	6.0	2.3	1.6	2.3
Panama	1.5	56.7	56.7	114.9	6.8	121.5	56.7	185.0	4.5	2.1	1.0	1.6
Total	22.4	166.4	63.7	252.5	106.5	353.4	67.9	527.8	4.7	2.1	1.1	2.1

Table 2. **Rice diseases observed in various locations in Central America in 1980**[1].

Diseases	Countries and localities														
	Guatemala		Honduras			Nicaragua		Costa Rica		Panamá					
	Cristina	Cuyuta	Casanave	Yoró	Guaymas	La Inca	RLP	Puntarenas	EJN	Tocumen	David		IDIAP	Baru	Bayano
											Univ.	Agric.	Alanje		
Fungi															
Leaves															
Blast	++	+			+++	++		+	+++		+++			+	++
Brown leaf spot	+	+++				++			+			+++	+++	+	++
Leaf scald	+++	+	++	+++	+++			++	++	+++	+	+++	++	++	+++
Narrow leaf spot	+			+++											
Leaf smut								+				+			
Eyespot					+++					+++		+++	++	+	+
Sheath and stem															
Sheath blight	+	+					+	+	+	+++	+	++		++	
Sheath rot	++	++			+	++	++					+		+	++
Stem rot	+	+	+		+	++						+		+++	
Narrow leaf spot					+										
Panicle															
Blast	++				++									++	
Brown leaf spot	+	+++					++					+	+++		
Narrow leaf spot				++											
False smut														+	
Virus															
Hoja blanca						+	+	+	+	+		+		+	

[1] + Mild incidence; ++ moderate incidence; +++ severe incidence

Table 3. **Rice insect pests observed in various Central American locations in 1980**[1]

Insects	Countries and localities														
	Guatemala		Honduras			Nicaragua		Costa Rica		Panamá					
	Cristina	Cuyuta	Casanave	Yoró	Guaymas	La Inca	RLP	Puntarenas	EJN	Tocumen	David		IDIAP	Barú	Bayano
											Univ.	Agric.	Alanje		
Stemborers	+	+			+	+			+	+	+	+		+	
Sting bugs	++	++	++	++	++	+++	+		+	+	+	+			+++
Sogatodes						++	++	+	+			+			++
Cutworms												+		++	
Elasmopalpus									+						
Mocis						+	+		+						
Grasshoppers		+				+	+		+			+			
Aphids					+++	++	++								
Water weevil						+	+								
Leaf miners			++												

[1] + Mild incidence; ++ moderate incidence; +++ severe incidence

Table 4. **Soils, weeds, rats and birds problems in various Central American locations in 1980[1]**

Problems	Countries and localities														
	Guatemala		Honduras			Nicaragua		Costa Rica		Panamá					
	Cristina	Cuyuta	Casanave	Yoró	Guaymas	La Inca	RLP	Puntarenas	EJN	Tocumen	David		IDIAP	Baru	Bayano
											Univ.	Agric.	Alanje		
Soils															
Yellowing	+++								+			+++	++	++	
Cu toxicity			+	+										+++	
Zn deficiency						++	++					++			
P deficiency	+++		+	+	+	+	+	++	++	+	+	+++	++	+++	+++
Weeds															
Narrow leaf	++	++	++	+++	++	++	++	++		++	++	+++	++	++	+
Red rice				++	+++		++					+++		+++	
Wild rice					+++							++		++	
Rats						++	++	+	+						
Birds						++	++								

[1] + Mild incidence; ++ moderate incidence; +++ severe incidence

RICE IN GUATEMALA

In Guatemala, the upland production system is used to grow rice; this crop is dependent on the rainy season. Three variations of the system are in use:

a) Totally mechanized upland: used only by a few producers.

b) Partially mechanized upland: tractors are used to prepare land and machines are sometimes used for sowing; other practices, such as weed control and harvesting, are done manually.

c) Manual upland: land preparation, sowing, weed control and harvesting are performed manually using different types of rustic tools; used by small producers.

Rice Areas

Table 1 shows that total rice acreage in Guatemala is small compared to acreage in other Central American countries. The reason behind this is that beans and corn make up the mainstay of the rural Guatemalan diet. Even though <u>per capita</u> rice consumption is low (4.5 kg), rice does occupy a third place and together with beans makes up the main national dish.

There are three rice-growing areas in the country that differ in terms of soil and climatic conditions. They are:

The Atlantic Coast

Ecologically, this is a humid tropical zone; there are two important rice-growing areas here: the Motagua Valley in the Department of Izabal and the Polochic Valley in the Department of Alta Verapaz.

Rainfall in the Motagua Valley is 3000-3500 mm annually; approximately 1920 mm fall during the rice-growing cicle (May-

October). The average temperature is 28°C and the relative humidity 80%. In many parts of the Valley, the soils have a clayed texture, are low in organic matter, poor in phosphorus and with a pH of 4.5-5.5. The manual upland production system is frequently used in this type of soil.

This Valley also contains large extensions of alluvial soils that have a high level of organic matter, phosphorus and potassium; the pH is 6.5-7.0. Rice production on this type of land is entirely mechanized and other commercially important crops like bananas are also grown.

The Polochic Valley is located along the Polochic River and encompasses more than 80,000 ha of fertile land suitable for growing rice, corn and sorghum. The climate is hot with a six-year average of 27°C. Rainfall is well distributed and shows one of the highest levels in tropical Central America, at times reaching more than 4000 mm annually; during the rice-growing cycle (May-October), there are 2000 mm of rainfall; the relative humidity is 80%.

The soil in the Polochic Valley is basically alluvial and loamy although there are areas that have loamy-silty and clayed texture; this soil is rich in organic matter, phosphorus and potassium, and its pH oscillates between 5.5-7.0.

Rice growing in this Valley is fully mechanized in upland systems having excellent rainfall. Generally speaking, rice farmers use the most advanced technology available, accounting, in part, for the region's obtaining the highest per unit yields in the country: an average of 6.5 t/ha especially with Tikal 2 and other similar varieties.

The Motagua and Polochic Valleys and small areas of the Department of El Peten, which includes the Atlantic Coast zone, account for 50% of the country's total rice production.

The Pacific Coast

In ecological terms, the Pacific Coast is a dry tropical area that takes in the Departments of Escuintila, Suchitepequez, Retalhuleu and the lower part of Quetzaltenango.

Average annual rainfall is 1600 mm, and approximately 950-1000 mm of rain falls during the rice-growing cycle (June-October). The average temperature is 28°C and the relative humidity, 70%. The soil is volcanic and has a silty-loamy and loamy-sandy texture although some clayed soil is also found. The level of organic matter is low but phosphorus and potassium levels are usually high; the pH runs between 6.0 and 8.5.

This area grows some 30% of the country's total rice output. Cropping systems are semi- and completely mechanized; however, on some farms, efforts are being made to change over to the irrigated production system. Some areas have been leveled and supplied with the infrastructure necessary to grow rice using this new system.

Eastern Zone

The Eastern Zone includes the Department of Jutiapa and small sections of Santa Rosa, Jalapa, and Chiquimula; this area is dry and subtropical.

Annual rainfall reaches 956-1120 mm, with some 1000 mm falling during the rice-growing cycle (May-October). Average temperature is 24°C and the relative humidity, 60-63%. The area's dark gray soil has a clayed texture and becomes very hard and forms broad, deep cracks when dry. Natural fertility is moderate, organic matter and phosphorus levels are low and potassium levels are medium; soil pH is 5.5-6.5. Of all the rice-growing zones in the country, this one is the least important and produces about 20% of total rice output.

Varieties

The Lebonnet, Starbonnet and Bluebonnet 50 varieties (introduced from the United States) are grown on the Atlantic Coast zone along with Lira Blanco (traditional) and improved high-yield varieties like Tikal 2, Virginia and Cristina (4440-10).

Lebonnet, Starbonnet and Tikal 2 varieties are grown on more than 700 hectares; the others are grown on a smaller scale.

In the Pacific Coast zone, Lebonnet is grown on more than 700 hectares; in the Eastern zone, Tikal 2 is the most widely grown variety; traditional Americanito and Lirita are grown to a lesser extent.

Seed Production

The ICTA Rice Program produces the basic seed for improved varieties which is supplied to the Seed Program; this Program, with the help of the private sector, produces certified seeds.

Constraints

The principal constraints affecting rice production in Guatemala are listed in their order of importance:

1. Diseases: primarily rice blast (*Pyricularia oryzae*), leaf scald (*Rhynchosporium oryzae*), brown leaf spot (*Helminthosporium oryzae*), sheath rot (*Acrocylindrium oryzae*) and stem rot (*Sclerotium oryzae*).

2. Insects: stink bugs (*Blissus* sp.), grain stink bugs (*Tibraca* sp. and *Solubea* sp.), stem borers (*Rupella albinella* and *Diatraea* sp.), fall armyworm (*Spodoptera* sp.), grass leafhopper (*Hortensia similis*).

3. Weeds: grasses mainly, such as barnyardgrass (*Echinochloa* sp.), raygrass (*Leptochloa filiformis*), corngrass (*Rottboellia exaltata*), bermuda grass (*Cynodon dactylon*), red rice and Cyperus (*Cyperus rotundus*). Other main weeds are related to broad leaves such as: spiny amaranth (*Amaranthus* sp.), *Portulaca oleracea*, *Trianthema portulacastrum*.

4. Problems with acid soils, especially in the Atlantic Coast zone.

5. Improper cropping and harvesting methods, especially as regards fertilization, weed control and pre- and post-harvesting practices.

6. Inadequate milling equipment and deficient marketing techniques.

Monitoring Team Observations

The monitoring team had the opportunity to visit the Cristina and Cuyuta production centers, where the Rice Program of the Instituto de Ciencias y Tecnología Agrícolas (ICTA) conducts research activities.

Created in 1972, ICTA is a government agency attached to the Ministry of Agriculture that operates independently and autonomously. Its principal function is to generate and promote agricultural research.

Rice research began in 1949. At present, the ICTA Rice Production Program is responsible for variety and agronomical improvement; to this end, it has four full-time agronomists and three middle level agronomy experts; for field evaluations at the farm level, the rice technicians receive support from agronomists in technology validation, soils and socioeconomics.

The Cristina Production Center

Located in the humid tropical zone along the Atlantic Coast, the Cristina Production Center lies some 211 km northeast of Guatemala City. It covers 45 ha, and the soil has a clayed texture with a pH that runs from 4.5-5.5; levels of phosphorus and organic matter are low. Annual rainfall is 3500 mm, the average temperature is 28°C and relative humidity is 80%.

The monitoring team observed the trials under way on varietal breeding improvement, cropping practices and basic seed multiplication; all of these experiments were running well.

Evaluations were made of the VIOAL-Es, VIRAL-P, VIRAL-T and VERAL nurseries; this germplasm was 90-103 days old,that is, at the flowering-maturity stage — an ideal one for evaluating performance in terms of diseases and other agronomical characteristics. Furthermore, the existing conditions at the Cristina Center are perfect for developing leaf scald, blast and acid-soil related problems.

Leaf scald-resistant materials having good phenotypes included:

VIOAL-Es, 80:	Lines Nos. 801-806, 811, 812, 824, 827, 828 830, 831, 837, 843-845, 850, 852, 855, 856, 862-864.
VIRAL-P, 80:	Lines Nos. 2, 3, 4, 6, 9, 10 and 11.
VIRAL-T, 80:	Lines Nos. 2, 3, 4, 5, 6, 16, 21 and 22.
VERAL, 80:	Lines Nos. 6, 7, 8 and 9.

As to blast, the VIOAL-Es line 854(IR 7149-35-2-3-2) showed a rate of 95% panicle neck infection, while line 857 (B 541 b-Pn-58-5-3-1) showed a rate of 40%.

The germplasm in the observational nursery for acid soil (VIOAL-SA) was not evaluated since the soil had been fertilized with a high dose of phosphorus and check varieties showed no differences.

The Cuyuta Production Center

This center is 220 ha large and is located 84 km to the southwest of Guatemala City in the Department of Escuintla. Its climate and soil conditions are representative of conditions in the Pacific Coastal zone: volcanic soil with a silty-loamy texture; soil pH, 7.0-8.2; annual rainfall, 1600 mm; average temperature, 28°C; relative humidity, 65%.

The Center's irrigation system makes it possible to conduct year-round research, and, in particular, to multiply the basic seed of promising lines and varieties.

Program activities are oriented, in part, towards evaluating and selecting germplasm supplied by CIAT-ICA and IRTP nurseries for Latin America in upland conditions; other activities involve the multiplication of basic seed of promising material in irrigated systems. Appendix 3 gives a list of the experiments currently in progress.

The germplasm used in the different experiments was very well handled; at the time of the monitoring visit, it was at the flowering-maturity stage. Evaluation was based on phenotype acceptability and resistance to brown leaf spot; a high incidence of this disease was observed on the leaves and panicle neck, especially in highly susceptible germplasm.

Observation showed the following material to be resistant to brown leaf spot; it had a reading under 3 on the international scale of 1-9.

VERAL, 80: Lines Nos. 1, 2, 3, 4, 6, 7, 8 and 9.

VIRAL-P,80: Lines Nos. 3, 4, 9, 10, 11.

VIRAL-T,80: Lines Nos. 2, 3, 4, 5, 6, 8, 9, 14 and 16.

VIOAL-S,80: Lines Nos. 704, 706, 713, 715, 718, 723, 727, 729, 736, 741, 742, 744, 746, 747, 749, 752, 755-757, 762.

Program Regional Trial: Lines Nos. 103, 105, 109, 110 and 117.

The promising lines from this trial were highly resistant to this disease.

The VERAL 1980 germplasm was notable in terms of agronomical performance and tolerance (lines 6, 7, 8 and 9) to brown leaf spot; line No.8 (P 1429-8-9M-2-1M-5) was especially notable for its good plant type, earliness and grain type. This line was selected by the program from the VERAL, 1979, and is in the basic seed multiplication phase.

VIRAL-P, 1980 lines 2, 5, 6 and 7 were highly susceptible to brown leaf spot and showed severe infection at the base of the flag leaf and on the panicle neck.

Recommendations

On the basis of team observation and discussion of the problems found in Guatemala, the following recommendations were made:

Varietal Improvement

Since the climatic and soil conditions at the Cristina and Cuyuta Production Centers are suitable for evaluating germplasm tolerance to blast, leaf scald, brown leaf spot and acid soil problems, the monitoring team makes the following suggestions:

- Continue evaluating germplasm from the national program and IRTP nurseries: the Cristina Center should concentrate on blast resistance and leaf scald and the Cuyuta Center should focus on brown leaf spot resistance.

- Plant the VIPAL nursery at La Cristina Center in infection beds and in the field. The IRTP coordinator in Latin America shall send to the Center enough germplasm seed for this purpose.

- In the Cuyuta Center, continue to multiply the basic seed of line 8 (P 1429-8-9M-2-1M5) selected from the VERAL 1979 nursery, which has shown itself to be very promising and should be evaluated in regional trials.

Plant Pathology

- Begin research on the chemical control of brown leaf spot and leaf scald.

- With CIAT and IRRI help, find a suitable inoculation technique for leaf scald in field conditions.

Agronomy

- Revise insect constraints on this crop.

- Begin research work on the chemical control of insects. While research is in progress, make minimal use of insecticides in experimental fields.

- Expand chemical weed control trials, especially for weeds such as purple nutsedge (*Cyperus rotundus*), barnyardgrass (*Echinochloa* sp.), corngrass (*Rottboellia exaltata*).

- Rotate rice fields in Cuyuta with other crops as a means of minimizing cyperaceous infestations.

- Determine when and how much N, P and K should be applied to promising lines.

Training of Personnel

- Make it possible for Rice Program personnel to receive training at CIAT.

- Have a plant pathologist from the CIAT Rice Program visit the Guatemala Program more frequently and give talks and lectures on new rice cropping technology.

- Have technical experts who have already received CIAT training take refresher courses or participate in evaluation work on genetic materials.

Ninety-five percent of the rice acreage in Honduras uses the upland system in its manual and semimechanized forms; 5% of this acreage is cultivated with the irrigated system using direct sowing and dried or pregerminated seeds.

For the most part, rice is grown on small farms on areas under 5 ha; the use of technology, especially as regards cropping practices, is limited. Weed control is performed manually with machetes or pickaxes; though some growers use propanil and 2,4-D herbicides, this practice is not widespread due to a lack of equipment. Insect control and fertilization are not widely practiced.

Current production (30,000 tons of unmilled rice) does not satisfy demand; annual consumption is 13 kilograms of white rice *per capita*; to meet demand, the government imports between 30-40% of the amount of rice the country needs.

Rice Growing Areas

The most productive upland rice-growing zones are found along the country's Northern coast, which includes the Departments of Cortés, Atlántida, Yoró and Colón. Both upland and irrigated production systems are used to grow rice in the Department of Choluteca (Southern zone).

Varieties

CICA 6 is the main variety grown on 70% of the total rice acreage. CICA 8 is being introduced commercially under the official name 4440. Bluebonnet 50, IR 100 and Tikal 2 are grown on a lesser scale.

Seed Production

The Ministry of Natural Resources is responsible for the production of certified rice seed in Honduras; it uses the basic seed provided by the Rice Program. Production is concentrated at the Casanave Experimental Station nearby San Pedro Sula. The Chinese Technical Mission is working with the Honduran government on this project.

Current certified seed demand is 300 tons, although current needs are for some 1600 tons to cover 20,000 ha with a density of 80 kg/ha of seed.

Constraints

The chief constraints limiting rice production in Honduras are the following in order of importance:

1. A lack of certified seeds, especially of high-yielding improved varieties.

2. Diseases, especially blast disease (*Pyricularia oryzae*), brown leaf spot (*Helminthosporium oryzae*), leaf scald (*Rhynchosporium oryzae*), and narrow leaf spot (*Cercospora oryzae*).

3. Weeds, especially grasses such as barnyardgrass (*E. colona*), corngras (*R. exaltata*) and red rice (*O. sativa*).

4. Inadequate fertilization, dose and timing of application of N, P, K and other elements.

5. Lack of machinery and equipment for small growers.

6. Insufficient infrastructure in support of production, such as roads, technical assistance, credit, availability of inputs, storage facilities and marketing.

Monitoring Team Observations

During the short monitoring visit, the team observed the seed production work being done by the Casanave Project, technology validation work on growers' farms, and rice research at the Guaymas Experimental Station. Several small growers' crops were also observed.

Casanave Project

The focus of the Casanave Project is seed production; it is attached to the Secretariat of Natural Resources, in cooperation with the Chinese Mission. The Station is located 30 km to the north of San Pedro Sula in an area that will eventually be turned into an Experimental Station. Seed production will use the irrigated system.

At present, 13 ha are planted with CICA 8 (line 4440), and in the future, this acreage will be increased to 40 ha. At the time of the monitoring visit, the CICA 8 crop was close to harvesting and it was 112 days old. Its condition was good although it showed some lodging in small areas where there was some incidence of stem rot. The estimated production was 6.0 t/ha.

VIRAL-S, VIRAL-P, VERAL and VIOAL-S nurseries were observed in upland conditions. The germplasm was 40 days old.

Commercial Crops

The team observed a commercial upland crop worked by small growers; it was planted with Tikal 2 which had been sown by hand using stakes and placing seeds at a distance of 40-50 cm between hills. A severe narrow brown leaf spot infection was found on the leaves, stems and neck of the panicle; furthermore, the plants were seriously covered with weeds. Estimated production was 1.0 t/ha.

Sites of technology testing

These sites refer to regional trials being conducted on growers' farms. This year, twenty farms are involved in this work. The testing site located in the Yoró zone was visited; three trials were under way there: demonstrative trials, fertilization levels and varieties.

a) The demonstrative trial is simple; it attempts to show the grower the goodness of an improved variety (4440) compared with the variety growers are currently sowing (CICA 6) using three technologies:

   Complete: optimal doses of fertilizer — 100 kg/ha of N, 22 kg/ha of P (50 kg of P_2O_5), 20 kg/ha of K (24 kg of K_2O); also chemical weed control (propanil + 2,4-D).

   Intermediate: using half of fertilizer dose — 50 kg/ha of M, 11 kg/ha of P (25 kg of P_2O_5) and 10 kg/ha of K (12.5 kg of K_2O).

   Grower: no fertilizer used; chemical control of weeds (propanil + 2,4-D).

b) The trial on fertilizer levels seeks to establish the optimal doses of N, P and K in the improved line 4440 using the following levels: 0, 40, 80, 120 kg/ha of N; 0, 8.80 and 17.60 kg/ha of P (0, 20 and 40 of P_2O_5), and 0, 16.60 and 32.20 kg/ha of K (0, 20 and 40 of K_2O).

c) The variety trial attempts to establish the performance of the promising lines selected from the IRTP nurseries. The lines or varieties being tested were: Taichung Sen Yu 195, P 1429-8-9M-2-1M-5, 4444, IR 661-140-3-2-Cu5, INTI, IR 1093, Juma 57, Juma 58 and 4440.

At the time of the monitoring visit, the varieties were 120 days old and showed good performance; the INTI variety from Peru and the CICA 8 variety from Colombia were the outstanding ones.

Guaymas Experimental Station

At the experimental station located in Guaymas, research is done on breeding improvement, yield trials and planting of IRTP nurseries. Commercial crops are also grown using CICA 6 (see Appendix 3).

The climatic conditions (high temperature and relative humidity) at this experimental station are appropriate for developing blast, leaf scald and stem rot diseases, making it possible to select effectively the resistant materials.

a) CICA 6 commercial crop

A commercial crop of 20 hectares of CICA 6 was observed at the flowering-maturity stage; variety mixtures and weed infestation, including the wild rice *Oryza latifolia* were found. Panicle neck blast was the prevailing disease affecting the crop, together with leaf scald, stem rot and sheath rot.

b) IRTP 1980 Nurseries

The VIRAL-S, VIRAL-T, VIRAL-P, VIOAL-Es nurseries were observed in the field and the VIPAL nursery in infection beds. Most of the VIPAL lines showed resistance to blast disease while the susceptible checks were dead or had degrees of infection from 7 to 8 in the scale.

The VIRAL-S lines 1 and 19, VIRAL-T lines 6, 16, 20 and 25 and VIRAL-P lines 2, 5, 9, 10 and 16 were highly susceptible to blast. The promising blast resistant material from these nurseries included:

VIRAL-S, 80: Lines Nos. 2, 3, 5, 9, 10, 11 and 12.
VIRAL-T, 80: Lines Nos. 2, 3, 4, 5, 9, 13, 14, 18 and 19.

Recommendations

Varietal Improvement

- Of all the IRTP nurseries the Program has received, VIRAL-T, VERAL, VIRAL-S, VIOAL-Es and VIPAL are thought to be the best for evaluating germplasm at the Guaymas Experimental Station in upland conditions; the VIRAL-P nursery, since it includes irrigated varieties, should not be sown in upland conditions.

- To begin the multiplication of basic seed using the INTI, Juma 57, 4440 and 4444 varieties. These materials have shown themselves to be very promising in upland conditions in the country.

- The Guaymas Station is a good place for selecting material resistant to blast disease, leaf scald, stem rot and narrow brown leaf spot. So when the station is taken over by the Small Farmers' Association, the Secretariat of Natural Resources should keep between 10 and 15 ha for rice trials since it would be hard to find another place with such favorable conditions for the development of these diseases.

- To plant the blast nursery both in beds and the field. IRTP will send enough seed from this nursery for both types of plantings.

Plant Pathology

- Since disease constitutes the principal constraint on production and there is no plant pathologist working with the Rice Program, a full-time pathologist should be hired to direct research work towards evaluation of planting material and to conduct chemical control trials for the different diseases.

- To treat seed chemically to eliminate pathogens it could transmit.

Agronomy

- To conduct fertilization trials with N, P and K to determine optimal doses of these nutrients in different types of soils.

- To take advantage of the strategic location of the Casanave Experimental Station and maintain it as a demonstration site. For this purpose, part of the land must be leveled and dikes dug in a rectangle; the traditional system should be used on the rest of the land, that is, follow the natural terraces along the contour lines and level within the terraces themselves. In both systems, seed production should continue using the best available technology for the irrigated system.

- Narrow-leaf weeds, especially gramineous ones, are a serious problem. Chemical control trials should be conducted using commercial and other herbicides that have not been tried in the country but that have been found satisfactory in other countries. Optimal doses recommended by manufacturers should be used.

Training of Personnel

- Continue the short courses given in conjunction with CIAT.

- Give priority to training staff in plant pathology and seed production under irrigation.

RICE IN NICARAGUA

Rice is the third most important cereal in Nicaragua after corn and beans. Per capita white rice consumption is 24 kg/yr. There are 28,000 hectares of rice, 18,200 ha under irrigation, and 9800 ha under upland system (Table 1). The National Development Bank provides 60% financing to cover production costs for rice grown with the irrigated system. This is used on large, high technology mechanized farms; the land is prepared by puddling, and seeding is done directly by broadcasting dry or pregerminated seeds. Average yield is 4.8 t/ha of paddy rice with 14% humidity.

The upland production system is semimechanized and used by small growers. Sowing is done manually or mechanically; in manual sowing, seed is broadcasted using 100 kg/seed/ha or by digging small holes in which 6-8 seed are planted 40 cm apart in a square formation; mechanized sowing is performed with a driller machine in rows some 18-23 cm apart using 65-100 kg/ha of seed.

Upland yields are low (1.0-1.9 t/ha) as a result of pathological problems, weeds and low rainfall.

Rice Growing Areas

The irrigated system is concentrated in the Departments of Matajalpa, Boaco and Carazo, using water from lakes,rivers and deep wells. Intermediate cycle rice varieties are sown from January-March and late-maturing ones are planted from March to May.

The upland system is used in the lower zones of the Pacific Coast where there is little rainfall and on the Atlantic Coast where rainfall is plentiful. Planting is done in June on the Pacific Coast and in September on the Atlantic Coast.

Varieties

The IR 22, IR 100d, CICA 4, CR 1113, CR 5272, Nilo 2 and Line 9 varieties are planted in irrigated systems.

CICA 4 is the main variety used in upland systems although recently CICA 8 has been recommended for them. The use of IR 841, IR 655, IR 1529-3-2 and IR 1529-163-3-2 and Tikal 2 is spreading.

Seed Production

The National Development Bank monitors seed production on large rice farms. The "Rigoberto López Pérez" farm is the main producer of certified seed.

Constraints

The main constraints to rice production in Nicaragua are listed below in order of importance:

1. Diseases: primarily blast, brown leaf spot, sheath rot, leaf scald and hoja blanca.

2. Insects: especially planthoppers and stink bugs.

3. Weeds: mainly *E. colona*, *C. rotundus*, red rice (*O. sativa*) and wild rice (*O. latifolia*).

4. Birds and rats: migratory birds from Canada cause severe damage as do rats which are a constant problem and must be controlled in every harvest.

5. Nutritional deficiencies: mainly Zn in irrigated areas having a soil pH of over 6.0.

6. Lack of personnel trained in plant breeding, production and plant pathology.

Monitoring Team Observations

The Rice Program has two technical experts working with it. At present, one is doing advanced specialization work in the United States and the other is heading the Program.

Research work on breeding and crop management is being conducted on the commercial farms Sebaco, Santa Teresa and Rigoberto López Pérez.

The aim of the Rice Program is to select high yielding varieties, resistant to lodging and diseases, with good milling and cooking properties and a short or intermediate growing cycle. To accomplish this, materials introduced by the IRTP or directly from Central American countries are being evaluated.

The Monitoring Team concentrated its observations on two large rice farms, La Inca and Rigoberto López Pérez, which use irrigated systems.

La Inca

Amin Hanon owns this farm which is located 30 km south of Managua. Its 175 hectares are planted with irrigated rice. The farm's infrastructure is good: irrigation ditches, drainage, access roads to the fields, an airstrip for small planes and four deep wells having a capacity of 1200 gallons per well per minute.

Cropping methods used on the farm are entirely mechanized. Fields are prepared by puddling and all sowing, fertilizing, weeding, insect and disease control are done by plane.

Sowing is direct and staggered using dry or pregerminated seeds. IR 22 and IR 100 varieties are planted at densities fluctuating between 300 and 400 kg/ha. Crops are fertilized with 144 kg/ha of complete 11-28-15 and 100 kg of Zn sulfate; 100 kg N (urea)/ha are applied at postplanting.

Weeds are controlled with propanil (16 lt/ha); rats are controlled with bait made of broken rice (40 kg) and Racumin (4 kg), which is spread along the ditches and ridges between furrows; a compound made of methyl parathion (2 lt), molasses (125 gal) and endrin (25 lt) per hectare is also used for rat extermination. Planthoppers and stink bugs are controlled by applying Lorsban, methyl parathion and Tamaron in commercial doses. Blast and brown leaf spot diseases are kept under control by using Hinosan and Anthracol.

Three lots of rice were observed on this farm: One lot of IR 100 in the process of being harvested; plant leaves had entirely dried up, but the cause of this problem was not established. Brown leaf spot, narrow brown leaf spot; stem rot and sheath rot were observed on leaves, stems and sheaths.

Hoja blanca virus was found on another lot of IR 100 which was at the flowering stage.

A 3-5 degree blast infection was found on the third lot of IR 22, which was at the seedling stage (30 days old).

Production costs on this farm ranged between US$200-1300/ha, while yields fluctuated between 5.5-6.5 t/ha of paddy rice. The paddy sale price runs between US$245-254/ton.

Rigoberto López Pérez

Formerly known as Altamira, this farm is now government-run; a general manager handles farm administration and two agronomists manage technical aspects; one of them is responsible for equipment and machinery, and the other one is in charge of rice processing. The farm employs 350 regular laborers and 100 other workers who do irrigation and milling work and operate the machinery.

The farm grows IR 22, CR 1113,Línea 9, and more recently CICA 8 varieties; Nilo 1 is still planted but on a small scale.

The farm's 905 hectares are planted with rice; 515 hectares are planted during the dry season (November-March) using the traditional irrigated system (the land is prepared dry and directly sown with dry seed; tractors are used); 390 hectares are planted during the rainy season (May-October) using the puddling system and seeding pregerminated seed by plane. Three hundred hectares of the land planted during the dry season are used for seed production.

Lake Managua provides the farm with water which is pumped to the main irrigation ditches and then distributed by gravity to the fields.

A basic application of 200 kg/ha of complete 10-30-10 is used for fertilization; after planting, 130 kg/ha of N split into 3 parts of 32, 32 and 65 kg each are applied at 25, 35 and 55 days, respectively.

Insecticide is applied three times to control pests. Lorsban (1.5 lt/ha) is used 8-10 days after germination to control armyworms and cutworms; Metasistox-R (1.5 lt/ha) is applied 30 days after germination to control sogatodes; and methyl parathion or Tamaron (1.5 lt/ha) are used after flowering has occurred to control stink bugs.

Rats are controlled by spreading plastic bags filled with zinc phosphide and molasses in the fields. Blast and brown leaf spot are kept under control through the use of Hinosan (1.5 lt/ha) and Anthracol (4.6 lb/ha).

The farm processes and mills marketable rice and sells white rice to the National Enterprise of Agricultural Products.

The Rice Program evaluates improved breeding materials on this farm, performs multiplication trials on promising lines, and does fertilization tests. The Team observed the germplasm of IRON, IRRI 1978, 24 entries introduced from Cuba and three Mexican varieties (Campeche A 79, Cárdenas and Champoton A 79).

Lines 4440, 4422 of CIAT and IR 665, IR 841 and IR 1529 of IRRI were also observed in multiplication plots. The 4440 and IR 1529 lines showed the best performance. Lines 4422 and IR 665 were highly susceptible to lodging and sheath blight, and IR 841 had a high rate of sterility.

Recommendations

Varietal Improvement

- In view of the shortage of program staff and financial resources for evaluating germplasm in irrigated conditions, efforts should be concentrated on CIAT nurseries, especially on early and medium yielding nurseries (VIRAL-P and VIRAL-T), and the leaf scald observational nursery (VIOAL-Es). The Program should focus on the VIRAL-S yield nursery and on blast nursery (VIPAL) in order to evaluate germplasm in upland conditions. CIAT will send these nurseries in 1981.

- Continue seed multiplication of IR 1529 and 4440 lines and expand their evaluation under both irrigated and upland systems.

- Eliminate most of the IRON 1978 material. Select the 10 or 20 best lines and continue evaluating them in yield trials.

- Eliminate IR 665 and 4422 lines due to their lodging susceptibility and also the IR 841 line, which shows a high rate of sterility.

Plant Pathology

All of the diseases that commonly affect rice production in Guatemala and Honduras were found in Nicaragua, in addition to hoja blanca virus found on IR 22 commercial crops; this disease had not been observed in other countries. Consequently, the team made the following suggestions:

- Hire a plant pathologist to study the chemical control of the diseases affecting commercial production and seed quality.

- Treat seeds in order to partially decrease disease spread.

Agronomy

Although high quality technology is used, high sowing densities and high P levels raise production costs. Thus, the team made these suggestions:

- Establish optimal sowing densities with good quality seeds.

- Conduct trials using different levels of phosphorus to determine the optimal level in vertisol soils.

- Control weeds in irrigation ditches and dikes or ridges which are the focal points of weed infestation in rice fields.

- Try Mesurol as a bird repellent and as an insecticide for stink bugs and mites.

Training of Personnel

- Further training of Rice Program and National Development Bank staff; short courses should be given on breeding, plant pathology and seed production.

Rice is a basic component of the Costa Rican diet; annual *per capita* white rice consumption reaches 50 kg. In the 1979-1980 harvest, 188,000 tons of paddy rice were produced on 80,000 hectares (Table 1). Forty percent of the total upland area considered favorable has good rain distribution, while the other 60% is not favorable since rainfall is limited.

Good technology is used in all phases of the mechanized upland system from land preparation to harvesting; weed and insect control methods are very good, and appropriate fertilization practices help make production excellent.

Fertilization involves a basal application of 144 kg of the complete 10-30-10; a total of 64 kg/ha of N are applied after seeding — 32 kg 30 days after sowing and the other 32 kg, 60 days after germination (46% urea is used as a source of N). A few growers use ammonium sulfate (92 kg/ha) and apply all of it 30 days after planting.

Several growers control weeds in pre- and postemergence. In preemergence, they use 3 lt/ha of Prowl and in postemergence they use 2.5-3.0 gal/ha of propanil, 12-15 days after germination.

Other growers control weeds in postemergence only by applying a mixture of propanil and 2,4,5-T herbicides combined with endrin to control armyworms; the commercial doses per hectare of these three products are, in their respective order: 2.5-3.0 gallons, 300-400 cc, and 1.5 liters; they may be applied by plane or other means. Most growers use 3 or 4 applications of insecticides to control armyworms, planthoppers and stink bugs. They also use one application of fungicides to control blast; the products Hinosan and Kitazin are applied at flowering.

Rice Growing Areas

The rice-growing zones in Costa Rica are located along the Northern and Southern Pacific Coast. The most important area in terms of acreage and favorable climate conditions is the North Coast. In both areas, rice is grown between April and December and is dependent on the rainy season.

Varieties

Three high production varieties are grown: CR 1113, in 1979 it constituted 67% of total rice acreage; CR 5272, 27% of total rice acreage; and CICA 7, 6% of total rice acreage.

Seed Production

The National Seed Office is in charge of seed production in Costa Rica; it coordinates production between the private sector and the National Production Council, which has a processing plant in Barrancas.

The National Rice Program produces basic seed for commercial varieties and then gives it to the National Seed Office which, in turn, distributes it to the National Production Council and private growers for the production of registered certified and authorized seed.

Seed availability in 1980 was: 7630 tons of CR 1113; 1530 tons of CR 5272 and 312 tons of CICA 7.

Constraints

1. Diseases: primarily blast, leaf scald and brown leaf spot.

2. Insects: the armyworm attacks during the first 30 days; *Blissus* and *Elasmopalpus* attack, especially during prolonged periods of drought and sogatodes damage. After flowering, stink bugs and stemborers attack.

3. High production costs and difficulties in marketing rice surpluses are problems that affect production stability.

4. Nutritional deficiencies, especially P, Zn, S, Mn and Fe.

5. Gramineous weeds such as *Rottboellia exaltata*, *Echinochloa* spp. and *Ixophorus unicetus* and the Cyperaceous *C. rotundus*; these weeds present serious problems, especially in crops grown using traditional methods.

Monitoring Team Observations

While in Costa Rica, the Monitoring Team was only able to visit the National Production Council's seed production facilities in Barrancas, the Enrique Jiménez Nuñez Experimental Center in Cañas and several typical commercial upland rice crops.

Seed Processing Plant

The National Production Council's Seed Processing Plant (NPC) is located in Barrancas, Puntarenas.

The Seed Program began in 1957 under the auspices of the NPC and the Ministry of Agriculture; after 1965, it passed entirely into the hands of the NPC. The Seed Law was passed in 1972 when the private sector started to produce seeds.

Designed by technical experts from the University of Mississippi, the plant opened operations in 1977; it was competing with three other privately owned plants. It only processes 2300 tons of rice seed, 230 tons of corn seed and 230 tons of bean seed; it also handles 690 tons of imported sorghum seed and 92 tons of imported hybrid corn seed.

Plant processing capacity is 4.5 t/hr; it has both room temperature and refrigerated storage rooms. Seeds can be kept for three months in the room temperature storage areas where the temperature ranges from 30-32°C with 80-88% relative humidity. Seeds can be kept up to five months in the cold refrigerated storage rooms where temperatures are maintained at 20°C with 50% relative humidity.

The plant has eight drying silos, each having a 160 ton capacity; the silos are run with two dryers. There are also eight flat-bottom storage silos that have a 101 ton capacity each. They can handle two types of seed at once and are operated by two panel computers; one computer controls cleaning and drying and the other controls classifying and treating.

The NPC produces seed through contracts made with growers. Technicians from the National Seed Office supervise the production fields, accept or reject seeds and subject them to laboratory analysis before they are precleaned, dried and classified.

Seeds are sold directly to growers and farming associations upon demand at government established prices for the different types of seed. The per kilogram prices for the 1980 harvest were: authorized seed, US$0.57, certified seed, US$0.59, registered seed, US$0.68.

Enrique Jiménez Nuñez Experimental Station

Founded in 1964, this Experimental Station is located in Cañas, Guanacaste Province and is part of the Ministry of Agriculture and Livestock. Forty of its one thousand hectares are devoted to research on upland rice.

The station is the headquarters for the Rice Program which employs two agronomical engineers who are specialists in plant pathology and agronomy; they are assisted by a plant pathologist and an entomologist.

The Program's main aim is to evaluate materials from IRTP nurseries and early generations of segregating populations introduced from CIAT. The Program conducts trials on cropping practices, fertilization and weed and disease control. It also carries out regional trials on different varieties in the country's main rice-growing areas.

The Monitoring Team made field observations of the different materials in the trials and evaluated germplasm in terms of its resistance and susceptibility to blast and leaf scald.

The different experiments were at the maximum tillering and flowering stages and had been well handled. Appendix 3 lists the different experiments in progress.

Commercial Crops

Three commercial upland crops sown with CR 1113 were observed. One of them on three hectares, located in Puntarenas, was at the maximum tillering stage and showed the presence of sheath blight, leaf scald and hoja blanca virus; it was also moderately infested with weeds.

The other crops had been sown in furrows at 30 cm and 17 cm apart; both weed control and crop fertility were very good.

Recommendations

Varietal Improvement

- The Enrique Jiménez Nuñez Experimental Station is a good place for selecting leaf scald and blast resistant materials. The recommendation was made to evaluate the germplasm of all observational nurseries at the station and to report on resistant lines so that they would be included in 1981 yield nurseries.

- The program has selected several materials from the 1978 and 1979 nurseries and is currently evaluating them in yield trials. The recommendation was made to report on their performance in order to select the best lines and include them in 1981 VERAL.

- The program has chosen the CR 0202, CR 0203 and CR 0204 lines from its own materials. The Program head was asked to nominate them for inclusion in the VIRAL-S and VIRAL-T 1981 yield nurseries.

- To obtain the best results from the VIOAL-SA germplasm, a suggestion was made to plant it in an acid soil site and not to apply phosphorus to it.

Plant Pathology

- It was recommended to intensify experiments on the chemical control of diseases and to determine the losses caused by them in upland conditions, especially as regards losses caused by leaf scald and blast. It is also important to establish the best times for applying fungicides.

Agronomy

- Increase the use of certified seed. The NPC has the capacity to process the amount of certified seed the country needs.

- Step up research on weed control and extend information on technology to all producers by means of regional trials conducted by agricultural extension agents.

Training of Personnel

- Further extension staff training by means of short courses on production and the transfer of technology.

Rice growing in Panama is fundamentally upland in nature; it takes place during the rainy season from May through November when rainfall is about 2000 mm. Between 100,000 and 115,000 hectares are cultivated using this system which produces yields ranging from 1.5-1.7 t/ha (Table 1). Approximately 1500 hectares are planted using irrigated systems which give yields fluctuating between 4-5 t/ha.

Rice is a basic component of the Panamanian diet; rice consumption in Panama is the highest in Latin America with _per capita_ consumption of white rice reaching 65 kg a year.

About 50% of the upland area is mechanized from the preparation to the harvesting stages. The rest is manual and is worked with machetes and coas (a type of primitive hoe used to till the land). Growers in mechanized upland areas must produce yields higher than 3.0 t/ha in order to cover production costs; some producers obtain up to 5.0 t/ha.

In 1980, production costs per hectare fluctuated between US$600-800, and the support price was US$311 per ton of paddy rice, dry and clean.

In 1980 the government established a rice insurance policy that covers up to 80% of production costs, depending on the crop stage, in the event of loss. Farmers pay US$23/ha for this insurance.

Rice Growing Areas

Rice is grown all along the Pacific Coast of Panama. The Province of Chiriquí, known as Panama's breadbasket, is the outstanding rice-growing area in the country in terms of acreage and production.

Varieties

Sixty percent of the mechanized upland area is planted with CICA 7, CICA 8 and line 4444. Surinam, Nilo 1, Nilo 2, Diwani and Eloni varieties are grown on another 20% of this area; and Costa Rica, CR 1113, and CR 5272 are planted, along with the Panamanian varieties Damaris and Anayansi, on the reamining 20%.

Seed Production

Seed production in Panama is at the organizational stage with both the government and the private sector participating in it. The Ministry of Agricultural Development (MIDA) and the Department of Agronomy of the University of Panama represent the government in seed production; a private company has exclusive rights on the production of the Surinam seed varieties.

The Instituto de Investigaciones Agrícolas y Pecuarias (IDIAP) and the Department of Agronomy of the University of Panama head the Rice Program and are responsible for the production of all basic rice seed, except for the Surinam varieties.

Constraints

1. Diseases: mainly blast, leaf scald, brown leaf spot and sheath blight.

2. Insects: major problems are caused by sogatodes and stink bugs.

3. Weeds are a serious problem in rice production, especially red rice crops of small growers.

4. Lack of certified seeds; most commercial crops use a mixture of seeds.

5. Nutritional problems in acid soils.

6. High production costs.

Monitoring Team Observations

In Panama, the Monitoring Team visited the Centros de Enseñanza e Investigación Agrícola of the University of Panama, which is located in Tocumen and David. Both large and small commercial crops were visited in the Province of Chiriquí, along with IDIAP regional trials in this same area, and the IDIAP experimental sites in Bayano.

Centro de Enseñanza e Investigación Agrícola Tocumen (CEIAT)

At this center, the Monitoring Team observed the germplasm of IRTP 1980 nurseries, the segregating F_2 - F_4 populations introduced from CIAT, yield trials on lines selected from 1979 nurseries and CIAT advanced lines and a commercial crop of CICA 7 (Appendix 3).

The materials observed were at the maximum tillering and flowering stages. There was a high incidence of leaf scald and sheath blight on susceptible material in the different trials.

In the commercial crop of CICA 7, which was at the tillering stage, the team noted the presence of eyespot (*Dreschslera gigantea*) in areas where soil had been removed during leveling.

Promising materials resistant to leaf scald and sheath blight included:

VIRAL-P, 80:	Lines Nos. 1, 2, 4 and 9.
VIRAL-T, 80:	Lines Nos. 2, 3, 4, 5, 11, 12, 13, 19, 21, 22 and 23.
VIAVAL, 80:	Lines Nos. 1, 5 and 7.
VIOAL, 80:	Lines Nos. 618, 619, 633, 634, 635 and 642.
VIOAL-Es,80:	Lines Nos. 801, 802, 808, 810, 812, 814, 830, 833, 851, 853-856, 858, 859, 862, 865-868.

Centro de Enseñanza e Investigación de Chiriquí (CEICHI)

This center is located in David, Chiriquí Province. It has an area of 830 hectares with acid soil of classes 2 and 5. At present it is dedicated to experimentation and production.

This center will house the Faculty of Agronomy of the University of Panama. Buildings and greenhouses are under construction.

The Monitoring Team visited experimental and commercial crops at this Center. They observed the commercial upland crops of CICA 7 and CICA 8 (100 ha each). Rice had been planted at staggered intervals and the different lots were between 35 and 70 days old.

The youngest lots of CICA 8 showed a severe blast infection that was evenly distributed over the plants; the infection scale was between 5-7. The CICA 7 lots had a minor 3-4 scale blast infection. Both CICA 7 and CICA 8 lots had been sprayed aerially with Hinosan (1.5 lt/ha).

The incidence of blast disease in CICA 8 was the only one observed during the entire trip through Central America; it was also the first time that the disease was confirmed on CICA 8 at the commercial level in Panama.

The experiments observed at this Center are listed in Appendix 3.

Rice Farms

The Team visited the Los Olivos and La Barqueta rice farms in the David zone, the Los Números farm and several small farms in the Divalá area and the San Antonio Cooperative in the Barú zone.

Five fields of CICA 8 and one field of 4444 were observed on the Los Olivos farm. The CICA 8 fields had sandy soil with a pH of 5.0-5.5. Yellowing was found in the plants located in the sandiest soil; they were 40-70 days old. Weeds were a serious problem; fields showed a mixture of several varieties, including red rice. Blast disease was not observed in these lots.

There was a high rate of brown leaf spot and blast disease on the leaf and panicle neck of the 4444 lot.

Five lots of CICA 8 at the flowering-harvesting stage were observed on the La Barqueta farm. A Zn deficiency was found in soils having a 6.0-7.0 pH, and sheath blight was present in all fields. There was also a 10-20% lodging in lots ready for harvesting. Red rice was one of the main weeds. Generally speaking, the fields were well managed; estimated production was 5-6 t/ha.

A lot of CICA 7 that was susceptible to sheath blight, leaf scald and eyespot was also observed on this farm.

Two lots of CICA 8 at the initial flowering-stage were observed on 60 hectares on the Los Números farm. The crops were in excellent condition; no fungicides had been used on them.

CR 1113 and CR 5272 crops were observed as well on this farm. Leaf and panicle blast were found on both varieties but especially on CR 5272; the crops also showed symptoms of sheath blight and stem rot. A mixture of weed varieties on CR 1113 was very high, especially red rice (*O. sativa*) and wild rice (*O. latifolia*). Other important weeds affecting this variety were *Echinochloa* sp. and *R. exaltata*.

The San Antonio Cooperative brings together some 100-120 small growers who have between 5-10 hectares of land each and whose major agricultural activity is rice-growing. The Cooperative seeks out credit, lends technical assistance and markets the rice. The main varieties planted are CR 1113 and CICA 7; the Damaris variety is not sown because of its poor milling quality.

Three crops of CR 1113 from this cooperative were observed. Two of them, between 35-45 days old, showed clear symptoms of chlorosis possibly due to copper toxicity. The presence of copper can be explained by the fact that this was formerly a banana zone where copper-based compounds were used to control banana diseases. Thus, the soil still contains copper residues.

The other crop of CR 1113 which was close to maturity, presented both leaf and panicle blast.

The Monitoring Team visited the IDIAP Rice Program experimental trials in the Alanje zone and a seed multiplication lot of the VIRAL-T,77 line No. 13. The appearance of the lot was good, and it was resistant to brown leaf spot.

The 1980 VERAL and VIOAL-Es nurseries were observed in the experimental trials. The germplasm of these nurseries showed a severe brown leaf spot infection, with few lines showing tolerance. This site is excellent for evaluating germplasm resistance to brown leaf spot. Resistant lines included:

VERAL, 80:	Lines Nos. 2, 4, 5, 7, 8 and 9.
VIOAL-Es,80:	Lines Nos. 810, 814, 833, 835, 839, 843, 844, 858, 863, 866 and 868.

IDIAP Experimental Farm at Bayano

At this experimental farm, the Monitoring Team observed rice program materials in upland conditions having limited humidity. Flowering materials showed severe grain damage from stink bugs.

Germplasm from 1980 VIOAL-S and VIPAL nurseries were also observed. Very few VIRAL-S lines were tolerant to drought and most VIPAL,80 germplasm was affected by it. The incidence of blast was not high since susceptible checks had an infection type of 4, 5 or 6; the resistant check Tetep had a 3 and 4 level infection.

Recommendations

Varietal Improvement

- On the basis of observations of the seedling of CICA 8 susceptibility to blast, the recommendation was made to study this variety's ability to recover, and to establish the incidence of this disease in the panicle neck. This study should be conducted on plots treated and nontreated with fungicides.

- The Department of Agronomy, the IDIAP and the MIDA should strengthen certified seed production and distribution in order to reduce varietal mixtures and red rice infestations in commercial crops.

- Step up observation of national and international nurseries to establish the most promising lines and conduct regional trials with them with a view to selecting possible substitutes for CICA 8 and CICA 7.

- Put VIOAL-SA germplasm in acid soils that are most representative of soils in the Chiriquí Province to be able to better evaluate the material's tolerance to acid soils.

- Include line 13 of the VIRAL-T, 1977 nursery in international 1981 yield nurseries since it has shown to be promising in the conditions found in the Chiriquí Province.

Plant Pathology

- Government organizations must work closely with other agencies in evaluating disease resistant material. These evaluations should be done by both plant breeders and pathologists.

- Begin studies in Panama on sogatodes and hoja blanca resistance in order to establish the possible presence of insect biotypes since this insect has caused severe damage to commercial crops.

- Establish trials on the chemical control of blast, brown leaf spot, sheath blight and eyespot in order to determine when and how much fungicide should be used.

Agronomy

- Set up demonstration lots at the University of Panama site at David; some lots should use the traditional irrigated system, that is, in ditches along contour lines, and the other lots the irrigated system using puddling with rectangular ditches.

- Begin fertilization studies that include complete soil analysis of the different rice-growing areas in the Province of Chiriquí. These studies will make it possible to establish different fertilization patterns and do away with the only pattern currently recommended.

- Set up regional weed control trials. In this way, the correct doses of herbicides can be established and information on their use can be disseminated.

- Begin studies to determine critical levels of phosphorus using several sources and periods of application on upland rice.

Training of Personnel

- Further the training of rice program staff from the University of Panama and IDIAP through CIAT rice production and improvement courses.

- Continue the training courses sponsored by IDIAP and the University of Panama for agricultural extension personnel. In these courses, the management of irrigated rice crops should be stressed.

DISCUSSION AND GENERAL RECOMMENDATIONS

At the end of the monitoring tour, the team held a special meeting in Panama to discuss rice crop problems and their possible solutions. These problems in Central America are diseases, weeds, lack of certified seed and nutritional deficiencies. On such basis the following recommendations were made:

- Rice Programs must continue to evaluate the disease resistance of germplasm provided by CIAT in international nurseries and segregating populations. The evaluations should include soil and climatic factors affecting disease development.

- To make disease resistant selection more effective, evaluation work must be concentrated in areas most affected by disease (see Table 5).

- Varietal resistance in itself will not solve the complex problem of disease in upland rice crops. Therefore, research must be done on chemical control; both international rice centers and private industry must cooperate in this work.

- While much is known about chemical weed control in irrigated rice crops, little is known about chemical control with herbicides in upland crops; it is essential that national programs, with the help of international rice centers, design a plan of action to establish the doses, times and right herbicides to be used on these crops. A regional herbicide trial could be an initial step to focus on this problem.

- Good seed quality is an important factor in rice production; except for Costa Rica and Guatemala, the use of certified seed is limited in the other countries visited. Official entities must establish certification guidelines for each country and must themselves produce certified seeds or promote their production by private industry using the basic seed produced by rice programs; only in this way can varietal mixture and red rice problems be eliminated and the spread of damaging weeds be checked.

- The nutritional problems of upland rice are complex and have not been studied to any great extent. There are many different types of soils used for growing rice in Central America, and little is known about their physical and chemical characterization. National rice programs must broaden regional fertilization trials to include complete soil analyses so that proper levels of fertilizer and periods of application can be established.

- A CIAT-coordinated regional trial on phosphorus (dose, sources and application times) would be extremely beneficial for upland rice production in Central America.

Table 5. **Places with highest disease incidence for evaluation of rice germplasm in Central America.**

Diseases	Countries and localities							
	Guatemala		Honduras		Costa Rica	Panamá		
	Cristina	Cuyuta	Yoró	Guaymas	EJN (Cañas)	Tocumen	David.	
							Universidad	Alanje
Blast (leaf and panicle)	X			X	X		X	
Brown leaf spot (leaf and panicle)		X						X
Leaf scald	X			X	X	X		
Scheath blight						X		
Sheath rot	X					X		
Narrow leaf spot			X					
Eyespot				X		X		X

APPENDIX 1

Institutes, companies and sites visited by the Monitoring Team during the visit to five Central American countries

GUATEMALA

- Instituto de Ciencia y Tecnología Agrícolas(ICTA), Guatemala City

- ICTA Cristina Production Center, La Cristina

- ICTA Cuyuta Production Center, Cuyuta

Note: The tour visit was coordinated and lead by ICTA Rice Program officials.

HONDURAS

- Department of Natural Resources, Northern Region, San Pedro Sula

- Casanave Project, Northern Region

- Guaymas Experimental Station, Northern Region

- Sites of Technology Testing in Yoró.

Note: In San Pedro Sula, the visit was coordinated and lead by officials from the Department of Natural Resources' Rice Program, Northern Region.

NICARAGUA

- La Inca Farm

- Rigoberto López Pérez Farm, formerly called Altamira.

Note: The visit was coordinated and lead by officials from the National Development Bank and a technical expert from the Ministry of Agriculture's Rice Program.

COSTA RICA

- National Production Council's Seed Production Plant, Puntarenas

- Enrique Jiménez Nuñez Experimental Station, Ministry of Agriculture and Livestock.

PANAMA

- Centro de Enseñanza e Investigación Agrícola Tocumen (CEIAT), University of Panama, Tocumen campus

- Centro de Enseñanza e Investigaciones Agrícolas de Chiriquí (CEICHI), University of Panama, David campus in Chiriquí

- Instituto de Investigaciones Agropecuarias (IDIAP) Experimental Farm, Alanje, Chiriquí

- Los Olivos and La Barqueta Farms, David, Chiriquí

- Los Números farm in Divala, Chiriquí

- San Antonio Cooperative in Barú, Chiriquí

- IDIAP Experimental Station in Bayano.

APPENDIX 2

Scientific, technical, administrative and rice production personnel contacted by the Monitoring Team.

GUATEMALA

Instituto de Ciencias y Tecnología Agrícolas (ICTA)

Vladimiro Villeda	General Manager
Bruno Busto Brol	Assistant Manager
Orlando Arjona M.	Technical Director
Luis Manlio Castillo	Public Relations
W. Ramiro Pazos	Rice Program Coordinator

Cristina Production Center

Carlos F. Alburez O.	Research Assistant
Carlos Román Chon	Technical Researcher
J. Alberto Valenzuela	Technical Assistant

Cuyuta Production Center

Osvaldo R. García	Assistant Researcher
Roberto Carcuz Díaz	Technical Researcher
Noé Crecencio de León	Technical Assistant

HONDURAS

Natural Resources Secretariat

José María Torres	Regional Assistant Director

Napoleón Reyes D.	Rice Project Coordinator
Juan J. Osorio	Regional Coordinator-Agric. Res.
Leopoldo Crivelli	Rice Project Assistant
Alfredo Escoto	Rice Project Assistant
Roberto Bonilla	Research Assistant - Farm
Omar Hernández	Research Assistant - Farm

Technical Experts from the Chinese Mission

Química Integrada S. de R.L. de C.V.

Mario Morán	Manager

NICARAGUA

Germán Hernández G.	Head, Rice Improvement Project, Ministry of Agricultural Development
Mario Castillo C.	Development Bank
William Bird F.	Ex-official, National Development Bank
César Sequeira	
Joaquín Peña	La Inca Farm manager
Luis Arauz Castilla	Technical Director, Rigoberto López Pérez Farm

COSTA RICA

National Production Council

Raúl Gillot	Head Seed Plant, Barranca, Puntarenas

Ministry of Agriculture and Livestock

Alberto Vargas	Head of Research, San José
Manuel Rodríguez	Head of rice seed production, San José

Germán Quezada	Director, Enrique Jiménez Nuñez Experimental Station, Cañas
José I. Murillo	Director, Rice Program
Rolando González	Researcher, Rice Program, Cañas
Manuel H. Carrera	Plant Pathologist, Rice Program

University of Costa Rica, Department of Agronomy, San José

Ronald Echandi	Director, Grain and Seed Research Center

National Seed Office, San José

Carlos Molina Guzmán	Executive Director
Alin Araya Calvo	

PANAMA

University of Panama, Department of Agronomy

Ezequiel Espinosa	Dean
Aldemar Sequeira	Professor of Soils
Luis Alvarado	CEIAT-Tocumen, Supervisor
Claudio Fernández	Assistant Researcher
Hernán Gutiérrez	Assistant Researcher, Tocumen
Luis O. López	Researcher, Tocumen
José C. Cedeño	Agronomist, Tocumen
Diego Navas	Professor of Entomology, David
Alfonso Morales	Technical Administrator, David
Ismael Camargo	Assistant Researcher, David

Agricultural Research Institute, Panama (IDIAP)

Carmen Damaris Chea	Director
Rolando Lasso	Plant Breeder at Bayano
Alejandro Ferrer	Plant Pathologist
Delia Jiménez	Researcher, David
Marco Torres	Researcher, David

Private Farms

Olmedo Miró	Owner, Los Olivos farm
Pastor Muñoz	Administrator, Los Olivos farm, David, Chiriquí
Fernando Aguizola	Los Números farm, Divalá, Chiriquí La Barqueta farm, David, Chiriquí

APPENDIX 3

Research work in progress at the experimental centers visited by the Monitoring Team.

GUATEMALA

Cristina Production Center

1. Varietal improvement
   - Evaluation of germplasm for blast resistance in infection beds
   - Evaluation and selection of segregating populations F_2-F_3
   - Observational trials with promising materials selected from international yield nurseries
   - Special yield trials
   - Observation of advanced F_6 lines introduced from the CIAT-ICA improvement project
   - Purification of 77 F_8 lines
   - IRTP nurseries for Latin America, 1980: VIOAL-Es, VIPAL, VIOAL-SA, VIRAL-P, VIRAL-T and VERAL.

2. Agronomy

   - Chemical control of weeds

3. Basic seed production of ICTA-Virginia variety on 5.6 hectares.

Cuyuta Production Center

1. Varietal improvement
   - Evaluation and selection of F_3 segregating populations
   - Exploratory yield trial on advanced lines
   - Comparative trial of 15 promising lines and 3 varieties currently being disseminated (farm trial)

- Evaluation of lines and varieties selected in upland unfavorable conditions
- Purification of F_6 lines in panicle plots by row
- IRTP nurseries for Latin America, 1980: VIRAL-P, VIRAL-T, VIRAL-S, VIOAL-S and VERAL.

2. Agronomy
   - Study of nitrogen and sulphur levels
   - Chemical control of *Cyperus rotundus*

3. Multiplication of basic seed by transplanting promising lines and varieties:

   P968-1-4-1B-2-3-2I
   P975-6-1-1B-4-4-SC
   P1429-8-9M-2-1M-5
   B541b-kn-7-1-2-3
   Taichung Sen Yu 195

HONDURAS

Casanave Project

- Multiplication of basic CICA 8 seed
- Evaluation of 1980 IRTP nurseries for Latin America: VIRAL-S, VIRAL-P, VIRAL-T, VIOAL-S and VERAL.

Sites of Technology Testing in Yoró

- Demonstrative trials with two varieties and three technologies
- Fertilization levels with improved variety 4440
- Varietal trial with 9 promising varieties.

Guaymas Experimental Station

- 1980 IRTP nurseries for Latin America planted in upland conditions: VIRAL-P, VIRAL-T, VIRAL-S, VIOAL-Es and VIPAL in infection beds
- Commercial fields of CICA 6.

NICARAGUA

Rigoberto López Pérez Farm

- Evaluation of observational nursery IRON of 1978 from IRRI
- Evaluation of 24 lines introduced from Cuba and 3 varieties from Mexico (Campeche A79, Cárdenas and Champotón A79)
- Basic seed multiplication of promising lines: 4440 and 4422 from CIAT and IR 665, IR 841 and IR 1529 from IRRI
- Fertilization trials with four levels of N, five levels of P and four of K.

COSTA RICA

Enrique Jiménez Nuñez Experimental Station

- 1980 IRTP nurseries for Latin America: VIRAL-P, VIRAL-T, VIRAL-S, VERAL, VIOAL-Es, VIPAL and VIOAL-SA
- 1980 IRTP nurseries (IRRI): IURON
- Program observational lines
- Regional varietal trial
- Herbicides evaluation.

PANAMA

Centro de Enseñanza e Investigación Agrícola Tocumen (CEIAT)

- 1980 IRTP nurseries for Latin America: VIRAL-P, VIRAL-T, VERAL, VIAVAL, VIOAL, VIOAL-Es and VIPAL
- 1980 IRTP (IRRI) nurseries: IRON and IURON
- Central American nursery with 20 promising lines
- Yield trials with: commercial varieties, promising lines selected from 1979 IRTP nurseries, F_5 and F_6 CIAT advanced lines
- Observational trial with CIAT F_6 advanced lines
- CIAT F_2-F_4 segregating populations
- Herbicide evaluation
- CICA 7 commercial production.

Centro de Enseñanza e Investigaciones Agrícolas de Chiriquí (CEICHI)

- 1980 IRTP nurseries for Latin America: VIRAL-S, VIOAL-S
- Central American nursery
- Yield trials with commercial varieties and promising lines
- Regional trial with 5 promising lines and 5 commercial varieties
- Observation of promising lines selected from 1978 and 1979 IRTP nurseries
- Herbicide evaluation
- Upland commercial crops CICA 8 (110 ha), CICA 7 (100 ha)
- Irrigated commercial crop of CICA 7; 10 ha prepared by the puddling system.

IDIAP's Experimental Farm in Alanje, Chiriquí

- 1980 IRTP nurseries for Latin America: VERAL and VIOAL-Es.

IDIAP's Experimental Farm in Bayano

- 1980 IRTP nurseries for Latin America: VIPAL, VIRAL-S and VIOAL-S
- Evaluation of advanced material from the program.

Pictorial Supplement

Two ICTA officials in Guatemala, Luis M, Castillo (Public Relations) and W.R. Pazos (leader of the Rice Program) in the multiplication plot of a rice line selected from the IRTP nurseries for Latin America.

Blast incidence in the germplasm planted in La Cristina Experimental Station of ICTA in Guatemala being observed by the monitoring team. From left to right: A. Ferrer (Panama), M.C. Rush (U.S.), M.J. Rosero (IRRI representative) and W.M. Pazos (Guatemala).

The monitoring team and Honduras technicians examine VIRAL-S germplasm planted in Casanave, San Pedro Sula, Honduras.

Nicaraguan technicians discuss hoja blanca symptoms in IR 100 rice leaves shown by Manuel Rosero (IRRI) in a commercial field at La Inca farm.

José I. Murillo (second from left) explains to the group the upland system in Costa Rica.

The monitoring team listens to José I. Murillo (center) explaining planting dates and cultural practices used with the VIPAL blast germplasm planted in the Enrique Jiménez Nuñez Experimental Station, Cañas, Costa Rica.

Germplasm evaluation of the IRTP nurseries from CIAT in the Enrique Jiménez Nuñez Experimental Station, Cañas, Costa Rica. From left to right: Ezequiel Espinosa (Panama), José I. Murillo (Costa Rica), M.J. Rosero (IRRI-CIAT), W.R. Pazos (Guatemala) and F. Andrade (Ecuador).

Ezequiel Espinosa (center) explains to G. Ghobriol from Sudan and M.C. Rush from the U.S. the agronomy trials (weed control) being carried out in CEIAT, Tocumen, Panama.

The monitoring team and technicians from the Agronomy Faculty of the University of Panama observing the IRTP nursery for Latin America, planted in CEICHI, David, Panama.

Olmedo Miró (center) owner of Los Olivos farm in David, Chiriquí, Panama, shares with the group his experiences as a rice farmer.