International Rice Testing Program for Latin America

Report on the Fifth Conference of the IRTP for Latin America

9-13 August, 1983

Cooperation:
Centro Internacional
de Agricultura Tropical, CIAT
International Rice Research
Institute, IRRI

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Centro Internacional de Agricultura Tropical (CIAT)
Apartado 6713
Cali, Colombia
April 1984
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V IRTP CONFERENCE FOR LATIN AMERICA

9-13 August, 1983

First row: Rolando Lasso; Derrick Smith; Walter Ramiro Pazos; Carlos Juarez de Souza; Yolanda Cadavid; Roberto Simmonds; Gilberto Magalhaes; Mahomed J. Idoe; Sergio Víctor Santini; Vinicio Castillo; Yin-Tieh Hsieh; James Gibbons.

Second row: Samuel de Almeida C.; Hermes Azevedo C.; Luis Alvarado; Alsonso Mendoza; Eliseo Nossa; Luisa Martínez; Pompilio Gutiérrez; Oromar Bertol; Jorge Luis Armenta; Paulo Sergio Carmona.

Third row: Mario Torres; Eimar Vieira; Luis E. Berrío; Ernesto Andrade; Adinaldo Abrahao; Silvio Steinmentz; Eduardo Marín; Marco Antonio de Oliveira; Luis Antonio Valente; Octacilio Geraldo.

Fourth row: Peter R. Jennings; Luis Eduardo Dussán; Joaquín González; Jorge Jonás; Masaaki Igarashi; Alberto Alves; Vitorio Pereira; Ember Farah; Adalberto Gil.

V IRTP CONFERENCE FOR LATIN AMERICA

9-13 August, 1983

Seated:	Douglas Laing; Luis Alberto Guerrero; Orlando Parada; Francisco Andrade; Manuel J. Rosero; Leonardo Marquez.
First row:	Dennis Garrity; Darío Leal; Héctor Laverde; Ezequiel Espinosa; Janeth Vargas; Jenny Gaona; Roberto Alvarado; Benjamín Rivera; Francisco Paz; Surapong Sarkarung; Dorance Muñoz; Elías García; Guillermo Sánchez.
Second row:	Eugenio Tascón; Samuel de Almeida; Elías García; Pedro Orellana; Maurice Russell; Gustavo Veitia; Jorge Luis Armenta; Omar Aponte; Eson de Melo; Jairo Castaño; Rafael Olaya.
Third row:	Edgar Barrientos; Aníbal Rodríguez; Julio Holguín; Hermes Azevedo; José A. Usberti; Germán Rico; Alberto Salih; Federico Cuevas; Milton C. Rush; Marcos Perdomo; José J. Murillo; Francisco Alvarez.
Fourth row:	Fernando Armijos; Nicolás Chebataroff; Elvis A. Heinrich; Luis Fernándo Meléndez; Miguel Rubiano; Juan Carlos Haure; José Hernández; Patricio Vargas; Homero Quintero.

INTRODUCTION

The International Rice Testing Program (IRTP) for Latin America is supported by the International Rice Research Institute (IRRI), with funds from the United Nations Development Program (UNDP), and by the Centro Internacional de Agricultura Tropical (CIAT). This international effort serves as a research link between the national rice breeding programs, the CIAT Rice Program, and the Genetic Evaluation and Utilization program of IRRI.

IRTP activities in Latin America are focused on germplasm evaluation and distribution to national programs through the various specific nurseries developed for rice production constraints in the region; the collection of information through observation trips with regard to production problems for the different cropping systems; research and training needs; and organization of conferences with collaborating scientists to discuss research problems and progresses.

The Fifth Conference was held between August 9-13, 1983 at CIAT, with the participation of 92 scientists from 23 countries, including 28 professionals from a rice production training course.

The Conference was opened by Dr. Douglas R. Laing, CIAT's Crops Research Director, who welcomed the participants. When referring to the objectives of the Conference, Dr. Laing stressed the importance of the event as an efficient means to discuss the problems that limit rice productivity and to plan research strategies.

The objectives of the Fifth IRTP Conference were discussed by Manuel J. Rosero, who pointed out that the event had various objectives but that the major purpose was to establish direct communication links with the national program representatives and IRTP collaborators in the region. The Conference provided an opportunity for these people to know each other, exchange ideas and share experiences, as well as to discuss the problems that constrain rice production and productivity and to program research needs.

Through this communication effort three basic activities of general concern were carried out: presentation of results, discussion of research problems, and discussion of the needs and programming of future research and collaboration activities.

Regarding the presentation of results, information was exchanged on recent developments in:

- Varietal improvement for irrigated and favored upland ecosystems;
- Performance of germplasm distributed through the IRTP nurseries for Latin America in 1981 and 1982;
- The "hoja blanca" virus and its vector that CIAT and various national programs are studying.

In the discussion and programming sessions, the following topics were dealt with:

- Organization of IRTP activities in the region, germplasm exchange, monitoring tours, and review sessions;

- Upland rice production ecosystems in Latin America; Characterization of the individual ecosystems to define their specific research needs in terms of varieties and/or crop management;
- Needs and limitations to the development of high yielding varieties for temperate regions in Latin America;
- Future research activities on the "hoja blanca" virus and its vector;
- The need to collect rice cultivars (Oryza) and wild species in Latin America.

Another objective of the Conference was to show the rice scientists and IRTP collaborators the upland ecosystems where the CIAT Rice Program is generating new technology. A visit to the Colombian Eastern Plains was scheduled for the participants to observe germplasm performance under high stress conditions that are common to the majority of the national programs.

A summary of the papers discussed in the different working sessions is presented herein, as well as decisions and recommendations arising from the discussion of the various topics.

Irrigated Rice Improvement at CIAT

H. Weeraratne[1]

The main objective of the irrigated rice breeding program is the development of improved varieties to increase rice production in Latin America. Improved varieties should incorporate resistance or tolerance to major production constraints in Latin America together with good grain quality and yield levels similar to those of CICA 8. The basic aim of the program is to stabilize yields and production.

Rice blast continues to be the main biological factor which limits rice production in almost all Latin American countries. To obtain durable resistance to blast, several genetic strategies have been utilized. Sources used as donors with durable resistance to rice blast originated in Africa, Surinam, Brazil, Sri Lanka, the Philippines, Colombia, and Costa Rica (Table 1).

The "hoja blanca" virus, which remained under control for some time, reappeared in 1981. Varieties such as CICA 8, with resistance to the vector, succumbed to "hoja blanca", indicating that a combination of resistances to both the vector and the virus is essential to control the disease.

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1. Breeder, CIAT Rice Program, Palmira.

Rynchosporium oryzae, *Helminthosporium oryzae*, grain discoloration, and Fe toxicity are other factors which affect rice production.

Nine advanced breeding lines were incorporated into regional trials and three of them showed promise. From 40 lines, nine were selected and are being evaluated in yield trials under upland conditions in Santa Rosa. Several lines originating from the cross CICA 7 // 4440/Pelita 1/1 have performed well in a number of plantings. Two other promising lines originated from the cross 4440 // Bg-90-2/S.M.L. 56/7.

More than 180 new lines have advanced to observation plots. Lines from the cross 5738 // 63-83/Camponi show most promise but they still lack the required resistance to "hoja blanca".

Among the segregating generations, the following F_4 populations have been identified as very promising:

5738 // Bg 90-2/Tadukan
5738 // Bg 90-2/Costa Rica
5738 // CICA 8/Bg 90-2
5738 // CICA 8/Camponi
5006 // CICA 8/Costa Rica

The following F_2 populations have been planted in order to obtain materials resistant to "hoja blanca":

7153 // Colombia 1/K 8

5709 // IR 262/Colombia 1

5869 // 4440/Colombia 1

17631 // 4440/Colombia 1

17631 // Colombia 1/IRAT 8

11292 // Colombia 1/IRAT 8

17444 // Colombia 1 /IRAT 8

5869 // CICA 4/Colombia 1

5685 // CICA 4/Colombia 1

10750 // CICA 4/Colombia 1

5715 // CICA 4/Colombia 1

Table 2 lists the sources of resistance to "hoja blanca" used in these crosses.

Highlights in Upland Rice Breeding, C.P. Martínez[1], E. Nossa[2]

The area planted to rice in Latin America is approximately 8.2 million hectares with a total production of 15.6 million tons and an average yield of 1.9 t/ha. Rice in Latin America is mostly produced on intermediate to large farms but under diverse production systems which range from intensive irrigated to extensive upland systems. Average yields for the different production systems vary considerably. Major factors that determine the production systems include rainfall patterns, irrigation costs, soil type, topography, and available infrastructure.

Upland rice continues to occupy the major part (72%) of the total area planted to rice in Latin America, with Brazil accounting for 96.5% of the total upland rice area. Almost all Central American rice, except for Nicaragua, is produced under upland conditions. Mexico recently adopted a policy to increase upland production in the humid south-east. The upland rice production system in Colombia, Venezuela and Ecuador accounts for a significant part of the total rice production area, while Peru is increasing its upland rice production. Rice in Bolivia is mostly produced under upland conditions.

It is a misconception to believe that upland rice in Latin America represents a uniform system in which agronomic practices and production constraints are similar; on the contrary, upland production systems

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1. Breeder, Upland Rice, CIAT-Palmira.

2. Agr. Eng. Research Assistant, Upland Rice, CIAT-Palmira.

represent a continuous succession of ecosystems which range from the lowest to the highest productivity levels. Soils, as well as rains and their distribution, are highly variable.

Recent observations in several countries have identified three major groups of factors that limit increased upland rice production: first are the agronomic factors (drought, weed control, fertilization, planting methods, and soil preparation) followed by a lack of high yielding varieties with stable resistance to rice blast and tolerance to various soil and water stresses. The third group is pests and diseases that are not so disseminated and important as rice blast (the most widespread and important disease) but that, under certain conditions, can cause considerable production losses in specific regions. Included in this group are leaf scald (*R. oryzae*), brown spot (*H. oryzae*), grain discoloration (caused by various pathogens), and the "hoja blanca" virus (HBV). The most important pests are *Sogatodes oryzicola*, stink bugs, and stemborers.

Tables 3, 4, and 5 define the major ecosystems proposed for upland rice in Latin America and indicate the rice improvement objectives for each ecosystem and overall breeding strategies.

Representative sites

It has been mentioned that upland rice in Latin America is produced in different ecosystems with variations in production and distinct technical constraints. This suggests that the evaluation and selection of breeding material at a specific site are not expected to solve all the problems encountered in different ecosystems. For the time being, evaluation and selection work by the breeding program has concentrated on three representative sites in Latin America (two in Colombia and one in Panama). The Santa Rosa site is representative of a highly favored ecosystem. La Libertad (savanna) is favored in terms of rainfall but unfavored in regard to soil fertility. Rio Hato (Panama) is representative of a less favored ecosystem. Table 6 shows the areas of impact of the different selection sites.

These sites differ in soil organic matter content, pH, fertility, texture, water retention capacity, and total rainfall and distribution. Al content is particularly high in La Libertad (Table 7). Disease pressure is high in all sites but is more severe in Santa Rosa and La Libertad where rice blast, "hoja blanca" virus, leaf scald, and grain discoloration predominate. Total rainfall in Santa Rosa and La Libertad is approximately 2800 mm/year and well distributed, while rainfall at Rio Hato is very low and erratic. After several visits to most rice production areas in Latin America, it was concluded that these sites are representative of the majority of the favored, less favored, and unfavored environments in terms of soils.

Evaluation of materials

Santa Rosa. In 1982 disease pressure was high, especially "hoja blanca" virus (HBV) and grain discoloration; neck blast was more severe than leaf blast. Leaf scald incidence was high, especially during flowering and maturity. A total of 2000 F_2, F_3, F_4, and F_5 segregating populations were evaluated and only 37% selected. The high rate of discarded materials was due to disease susceptibility. Most populations originated from crosses by the irrigated improvement program and their susceptibility under upland conditions was expected. This confirms the observation that high levels of resistance to diseases are required for upland conditions and that these should originate from a wide range of donors widely assessed in upland environments.

Of the 66 F_2 populations selected, the following were identified as most outstanding:

5738 // 63-83/Ceysvoni
5006 // Suakoko/Ceysvoni
Línea 8 // IRAT 13/Camponi
8440 // IRAT 13/Camponi
5738 // IRAT 13/Camponi
5010 // Ceysvoni/IRAT 8
5006 // Bg 90-2/Costa Rica
5006 // 5683/Costa Rica
5738 // 2940/Costa Rica

All these populations originate from male donors of Africa and Surinam and are important because of their tolerance to diseases under upland conditions.

Of the 21 F_3 populations evaluated, only eight were selected, and from these 185 individual plants were obtained. The following crosses were found to be promising:

5782 // Camponi/IAC 25

5738 // Camponi/IAC 25.

IAC 25 is an upland variety from Brazil and Camponi is from Surinam.

La Libertad (savanna). The major objective for this ecosystem is to search for improved varieties tolerant to acid soil conditions (Al toxicity and low fertility) and diseases (rice blast, leaf scald, and HBV), as an essential requirement to develop a minimum input, minimum tillage technological package. For this reason low fertilizer levels (500 kg/ha lime, 50 kg/ha nitrogen, 22 kg/ha P, and 25 kg/ha K) were applied in 1982.

HBV and grain discoloration incidences were high, while those of rice blast and leaf scald were low. Most populations showed low tolerant levels to Al toxicity and growth was poor; because of this, 75% of the segregating populations were discarded and only 137 individual plants were selected.

In addition, 117 varieties from the germplasm bank were planted and visually assessed for root type, tolerance to Al toxicity, HBV, and leaf scald. High levels of resistance to HBV and leaf scald were observed in

Paga divida from Brazil, the Japanese varieties Chianung 242, P.I. 215936, Taichung 186, Kaohsiung 139, Kaohsiung 180, Tainung 67, and Tainan 5, and Indica varieties such as Pelita 1/1, Colombia 1, and ICA 10. Foliage of these cultivars remained clean and green. Several cultivars introduced from IITA (Tox-1011-4-1, Tox 1011-4-2, Tox 503-29-3-1, Tox 101-45-1-1, and Tox 1785-19-18), varieties introduced from Brazil (IAC 5544, IAC 164, and IAC 165), and Bluebonnet 50 introduced from U.S., showed thick and deep roots, improved plant type, and tolerance to Al toxicity; yields were good (2-3 t/ha) under these adverse conditions but were reduced because of HBV susceptibility. Also, Tox 1011-4-1, Tox 1011-4-2, IAC 164, and IAC 165 showed short to intermediate statured plants, intermediate tillering, short growth cycle, and long grain. These observations suggest that it is possible to develop improved varieties for this ecosystem combining good yielding potential, thick and deep roots, short to intermediate statured plants, tolerance to diseases (HBV, rice blast, and leaf scald) and, most important, low input requirements.

Rio Hato. A collaborative project was initiated between IDIAP (Panama) and CIAT to utilize the Rio Hato, Tocumen, and Chichebre research stations as representative sites of the moderate to less favored environments found in Central America.

A total of 76 segregating populations (F_2, F_3, and F_4) and 3281 pedigree lines (F_2, F_4, F_5, F_6, and F_7) were evaluated in 1982; 142 F_6 lines were evaluated in Tocumen and 1006 pedigree lines (F_3, F_4) in Chichebre.

Thirty five days of low rainfall occurred in Rio Hato during and after germination; therefore, part of the material was affected by drought and weed competition; leaf blast appeared later. A high incidence of leaf scald and sheath blight was observed in Tocumen, while blast incidence was severe in Chichebre. Many populations and segregating lines discarded because of disease problems (HBV, blast, grain discoloration, and leaf scald) in Santa Rosa, Villavicencio, performed well in Panama, suggesting that different selection pressures exist at each site and, therefore, that germplasm evaluation and screening should continue under different environmental conditions.

Evaluation of advanced lines

In 1982, 59 advanced lines (F_6 and F_7) from the irrigated rice program were evaluated in yield trials at Santa Rosa; CICA 8, CICA 7, and Metica 1 served as controls. Tables 8 and 9 show the genetic background and some agronomic characteristics of nine of the most promising lines. These lines overyielded CICA 7 and CICA 8 and showed good resistance levels to both rice blast and HBV. However, all lines were severely affected by leaf scald, except line 18467, CICA 8 and Metica 1. These materials will continue to be evaluated at Santa Rosa and will also be distributed through the IRTP.

Varietal Improvement for High Yields and Tolerance to Low Temperatures: Limitations and Needs, P.S. Carmona[1]

During the cropping year 1982/83, low temperature conditions gained major importance due to the adverse climatic conditions that prevailed in the State of Rio Grande do Sul (RS) during the whole cropping period and also because of the rapid spreading of the new high yielding varieties BR-IRGA 409 and BR-IRGA 410 which are susceptible to cold.

Irrigated rice crops in RS are located between 29-33° S. Southern zones are obviously more affected by cold.

The adoption of new varieties in the southern region was limited because of the higher risks. Farmers continued planting the early variety Bluebelle, which is lower yielding than the new semi-dwarf varieties. During the 1982/83 growing season, this variety was also affected by untimely low temperatures and by rice blast attacks in late plantings.

Figure 1 shows seasonal variations in temperature in Porto Alegre (30° S) and Santa Victoria del Palmar (33° S).

The rice growing season in RS begins in October and ends in March or April. The recommended time to plant intermediate cycle varieties,

1. Agr. Eng., Head, Plant Improvement Team, IRSA, Porto Alegre, Brazil.

such as the new semi-dwarf materials, is between October 15 and November 10 and between October 15 and November 30 for the rest of the regions in the State.

Before this time, temperatures in the southern regions are very low for germination and initial development of seedlings. On the other hand, late plantings increase the risks of low temperatures occurring in the reproductive stage of the semi-dwarf varieties and rice blast attacks after flowering in susceptible varieties.

In years in which rainfall is normal it is possible to plant practically all the area in the recommended time. The time available for planting is very short in unfavorable years with excess rains in October and November, and farmers are forced to plant out of season. This problem is more accentuated in the south.

Seasonal variations in temperature in the south must also be considered. Sudden temperature falls during January and February can cause considerable damage to crops that are in the stage of growth which is susceptible to cold. However, in contrast to what could be expected, the new varieties of tropical origin were less damaged due to their high tillering capacity and longer flowering period.

There is evidence to indicate that the problem of low temperatures in RS can be overcome, in the short or intermediate term, through varietal improvement. For this it will be necessary to combine earliness and moderate resistance to cold with other desirable agronomic characteristics. Also, the new varieties should perform better than Bluebelle (which occupies 90% of the planted area in the south) in terms of rice blast resistance.

There are two research institutions involved in the development of new varieties that can be used in the southern regions and for late plantings in the remaining rice production regions in RS.

At its Rice Experimental Station in Cachoerinha, IRGA is traying to develop early, high yielding varieties with intermediate tolerance to cold in the reproductive stage. To accomplish this, IRGA is using the genetic variability that exists within the Indica Group.

On the other hand, EMBRAPA, which has a rice research unit in the southern part of the State, has the major objective of identifying sources of resistance to cold (both in the vegetative stage as well as in the reproductive and maturity stages) and incorporating this in commercial varieties. For this purpose EMBRAPA is using germplasm from the Indica and Japonica groups.

There is no need to point to the a difference in the level of priorities that the two programs have in the search for resistance to cold. IRGA intends to obtain widely adapted varieties that can be used throughout RS. On the other hand, EMBRAPA's purpose is to develop varieties resistant to cold, specifically for the southern region of RS.

Achievements of the IRTP in Latin America, 1981-1982, M.J. Rosero[1]

Introduction

IRTP activities in Latin America during 1981-1982 focused on collaborating with the national programs to generate new technology to overcome rice production and productivity constraints.

This collaboration was put into effect by providing improved germplasm through various yield and observation nurseries in order that national programs could evaluate and select promising materials under their own conditions.

National programs are aware that materials selected by them are to be used either directly as varieties after being evaluated in regional trials or indirectly as parents in hybridization and selection projects. The first alternative is a good advantage to national programs that lack hybridization projects, since they save time and resources and can readily release new varieties to farmers.

This report discusses IRTP achievements in 1981 and 1982 in Latin America.

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1. IRRI Liason Scientist for Latin America.

Results of the nurseries distributed in 1981

In 1981 the IRTP for Latin America assembled 14 nurseries, 297 sets of which were distributed to 24 countries in the region (Fig. 2).

The 14 nurseries included 642 lines and/or promising varieties, of which 358 were selected from the 1980 IRTP nurseries from IRRI, 217 from nurseries distributed to collaborators in 1980, and 67 lines nominated by the CIAT Rice Program.

IRTP nurseries distributed in 1981 were of two types: one type for irrigated and upland ecosystems and the other for specific problems such as diseases, soil constraints, and low temperature. The following are the nurseries distributed:

Nurseries for irrigated and upland ecosystems

Yield	- Irrigated	VIRAL-P, VIRAL-T, VIRAL-Tar, VERAL
	- Upland	VIRAL-S
	- Semi-deep water	VIRAL-F
Observation	- Irrigated	VIOAL
	- Upland	VIOAL-S

Specific Nurseries

- Blast	VIPAL
- Leaf scald	VIOAL-Es

- Sheath blight VIAVAL
- Acid soils VIOAL-SA
- Salinity and alkalinity VIOSAL
- Low temperature VITBAL

Data from 139 trials of all nurseries were received except for VIRAL-F.

Results from each nursery were analyzed and published. The final report was sent to all collaborators in early 1983.

Data for yield nurseries were analyzed for each site, as well as for each cropping system; irrigated and upland in tropical regions and irrigated in temperate regions. In this manner, collaborators can readily observe material performance and identify those materials most suitable for the ecosystem prevailing in their country or region.

Tables 10 and 11 show the growth duration and yields of the best lines in yield nurseries for irrigated systems in tropical and temperate regions and for favored upland systems in tropical regions.

In the VIOAL, 1981, composed of 175 lines, 12 lines proved outstanding due to their resistance to blast and lodging and their good yields under irrigated (tropical and temperate region) and favored upland systems (Table 12).

On the 85 lines in VIOAL-S, 1981, planted at eight sites under favored upland conditions, 16 lines were resistant to leaf and neck blast, with similar and/or higher yields than the controls (Table 13).

VIOAL-SA, composed of 42 lines from IRRI, CIAT, IRAT and the national programs of Bangladesh, the Philippines, Indonesia and Sri-Lanka, was planted in acid soils under irrigated conditions in La Libertad, ICA-Villavicencio, Colombia and under upland conditions in Mexico and several Central American countries. Twelve promising lines with resistance to Fe toxicity were identified in the acid soils of La Libertad. These lines were also resistant to Fe toxicity in the 1980 plantings (Table 14).

Materials were evaluated for their reaction to acid soils under upland conditions in Huimanguillo, Mexico; Los Amates, Guatemala; Arce, El Salvador; and Nueva Guinea, Nicaragua. In Los Amates, reactions to acid soils were similar to the controls. However, varietal reaction in other sites was variable compared with resistant and susceptible controls. Eleven lines were found tolerant to acid soils in three sites: Huimanguillo, Arce, and Nueva Guinea (Table 15).

The Third Leaf Scald Observation Nursery was composed of 55 lines selected from 1980 IRTP nurseries: IRON, VIOAL, and VIOAL-Es. Damaris from Panama and IR-4219-113-1-3-2 from IRRI were included as controls. This nursery was planted in 12 sites, but leaf scald was detected at four sites in Central America under favored upland conditions and at one site under irrigated conditions in Venezuela. At the latter site all materials were resistant including the susceptible control. Variations in the reactions from one site to another were observed at the four Central American sites but some lines were identified that had greater or similar resistance to the resistant control (Table 16).

VIPAL 1981 was composed of 110 selections that were resistant to blast in the 1980 IRBN and VIPAL nurseries. Colombia 1, Tetep, and Carreon were included as resistant controls and B 40 and CICA 4 as susceptible controls. This nursery was evaluated at 14 sites, 7 in blast beds and 7 under field conditions. Germplasm was evaluated in the seedling stage at five of the latter sites and panicle neck blast was evaluated at three of these sites; the germplasm was evaluated for panicle neck blast at the other two sites. Table 17 lists the lines that showed resistance to blast in the seedling stage at 13 sites and to panicle neck blast at five sites.

Results of nurseries distributed in 1982

In 1982 germplasm was distributed according to the new approach established in the IV IRTP Conference for Latin America. However, it was necessary to organize a new specific nursery for "hoja blanca" virus, due to its high incidence in CICA 8 and IR 22 in the Colombian Eastern Plains and Tolima, Colombia; in INTI, Peru; in CICA 8 and IR 6 in Ecuador; and in Araure 1 in Venezuela. This new nursery was assembled in order to select resistant material in sites of high disease pressure and, at the same time, to identify the causes of the reappearance of "hoja blanca".

Table 18 indicates the nurseries that were distributed in 1982. VIOAL-HB was distributed to four countries with "hoja blanca" problems.

Data were received from Mexico, Central America, Colombia, Venezuela and Ecuador to which nurseries had been shipped in March-April.

VIRAL-T was planted at 18 sites, 7 under irrigated and 11 under upland favored conditions. Table 19 shows lines that performed well under both agro-ecosystems. These lines were superior or similar in productivity to local controls.

VIOAL 1982 was planted at 15 sites, six under irrigated and nine under favored upland conditions. Among 152 lines included in this nursery, 11 were found outstanding under irrigated conditions and 11 under favored upland conditions, with yields higher or similar to controls (Tables 20 and 21).

VIOAL-SNF 1982 included 94 lines selected from the IURON and VIOAL-S 1981 nurseries. Varieties Salumpikit from the Philippines, IAC 47 from Brazil, Monolaya from Colombia, and Sein Ta Lay from Burma, were included as controls. Table 22 lists lines that showed outstanding performance at four unfavored upland sites: ICA-La Libertad, Colombia; Cuyuta, Guatemala; Santa Cruz, El Salvador; and Tocumen, Panama.

Germplasm utilization

The most important feature of this collaborative network is the utilization of germplasm from the IRTP nurseries by the national programs.

Germplasm introduction and evaluation is a varietal improvement method to which national and international programs should give priority, as it aids the breeders to:

a. readily release new varieties to farmers at low costs, and
b. select parents for hybridization projects.

National programs with hybridization projects such as those in Brazil (Rio Grande do Sul), Mexico, Peru, the Dominican Republic, and Venezuela, selected various lines from germplasm distributed through the nurseries, some to be used as parents and others to be evaluated in yield and regional trials. Countries with small programs and scarce resources selected different lines to evaluate them in yield and regional trials (Table 23).

Nomination of new varieties

Rice programs of seven countries released eight varieties to farmers in 1981 and 1982 (Table 24). Varieties nominated in Brazil are recommended for irrigated systems in Sao Paulo (IAC 1278) and Minas Gerais (INCA 4440).

Oryzica 1, nominated by ICA, is recommended for irrigated systems in Colombia. Varieties nominated in El Salvador, Guatemala, and Panama are recommended for favored upland systems.

In Mexico, Cardenas A 80 is recommended for the lowland regions in the State of Tabasco which are subject to floods during the rainy season. This variety has the ability to tolerate short drought periods and elongate in semi-deep water conditions (1.00 m).

Araure 2 in Venezuela is recommended for irrigated and favored upland ecosystems.

Monitoring tours and individual visits

Monitoring tours. A monitoring tour was made between August 16-22, 1982, to the Caribbean region to familiarize the participants with production systems, problems, and research status in Jamaica, Haiti and the Dominican Republic. Six scientists participated, two from Haiti, one from Jamaica, one from the Dominican Republic, and two from CIAT, including the IRTP Coordinator for Latin America.

A report of this event was published in both English and Spanish and was distributed to all personnel involved in rice research activities in the institutions visited and to all IRTP collaborators in the region.

Individual visits. Individual visits to Bolivia, Paraguay, Peru, Venezuela, Guatemala, and Mexico were made to observe the performance of germplasm from IRTP nurseries and from the national programs and also to become familiar with cropping systems and their problems.

Table 1. Sources of resistance to blast.

Countries	Varieties
Africa	Moroberekan, O.S.6, 63-83, IRAT 8, IRAT 13, Lac 23, Suakoko 8
Brazil	IAC 25, IAC 164, IAC 165
Colombia	Colombia 1, Monolaya
Costa Rica	IR 11-452*
IRRI Philippines	IR 5533-13-1-1, IR 5533-PP-850-1, IR 1416-131-5
Sri-Lanka	H-5, K 8
Surinam	Tapuripa, Costa Rica, Camponi, Ceysvoni, Eloni
Vietnam	Tetep, Tadukan

* Cross made in IRRI; selection in Costa Rica.

Table 2. Sources of resistance to hoja blanca.

Varieties	Origin
Colombia 1	Colombia
IRAT 120	Ivory Coast
IRAT 121	Ivory Coast
IRAT 122	Ivory Coast
IRAT 124	Ivory Coast
Taichung 176	Taiwan
Taipei 309	Taiwan

Table 3. Definition of major ecosystems in Latin America proposed for upland rice by the Upland Rice Improvement Program.

Moderate to highly favored upland	Moderate favored upland	Unfavored upland
- Central America and Colombia	- Central America and Brazil (Amazonia)	- Brazil (Central)
- High rainfall (2000 mm)	_ Shorter rainy season and less rainfall	- Low and irregular total rainfall
- Good rainfall distribution	- Drought periods (veranicos)	- Incidence of veranicos
- Alluvial, moderately acid, well drained, fertile soils	- Less fertile soils	- Flat undulating soils, low water retention
- Improved varieties, utilization, inputs	- Dwarf varieties (Central Africa and tall ones (Brazil)	- Tall varieties, susceptible to lodging and diseases, good quality
- 2,5 t/ha; 4.5 t/ha (highly favored)	- 1.5-2.0 t/ha	- ± 1.2 t/ha, unstable
- Constraints: weeds, blast, lodging.	- Constraints: veranicos, weeds, diseases and nutrient deficiencies.	- Very low planting density. Constraint: drought, blast.

Table 4. Variety requirements for favored and unfavored upland conditions.

Favored upland	Unfavored upland
1. Good vigor; dwarf-intermediate height	1. Intermediate vigorous plant type
2. Lodging resistance	2. Lodging resistante
3. Vegetative cycle from 110-130 days	3. Vegetative cycle from 110-130 days
4. Stable resistance to blast	4. Moderate yield (3-4 t/ha)
5. Tolerance to other diseases	5. Stable blast resistance
6. *Sogatodes* resistance	6. Tolerance to other diseases
7. Long heavy grain, intermediate amilose percentage	7. *Sogatodes* resistance
8. Tolerance to soil problems	8. Tolerance to Al toxicity
9. Good root development	9. Strong and deep roots
	10. Long heavy grain, intermediate amilose percentage.

Table 5. General improvement strategy for upland rice.

- Evaluation of segregating populations
- Evaluation of advanced lines
- Cultivar collection and evaluation
- Crossing program

Table 6. Goals of the upland rice program.

Evaluation and selection	Ecosystem	Regions
Santa Rosa (Colombia)	Favored upland (long favored)	Most of Central America, Colombia, Venezuela, Bolivia, Brazil, (Rondonia, Acre), Ecuador, México, (Campeche, Chiapas, Tabasco)
Rio Hato (Panama)	Less favored upland (short favored)	México (Quintana Roo, Uxpanapa) Guatemala (Cuyuta, Tempisque Valley) Costa Rica (Cañas), Panama (Central Province)
La Libertad (ICA-Colombia)	Savanna (long, unfavored)	Llanos of Colombia, Venezuela and Guyana, Brazil (Matto Grosso North, Porto Velho), Peru (Yurimaguas), México (Balancan zone).

Table 7. Soil analyses in three upland locations.

Location	O.M %	pH	P (ppm) Bray II	Al	Ca	Mg	K	B	Zn	Mn	Cu	Fe
				Meq/100 g soil				p p m				
Santa Rosa (Villavicencio)	2.35	5.1	16.1	0.8	2.88	0.20	0.18	0.20	1.5	30.0	1.86	118
La Libertad (ICA)	4.14	4.4	7.9	3.0	0.28	0.17	0.13	0.32	0.9	12.9	0.44	38
Rio Hato (Panamá)	1.61	5.9	5.5	Tr.	4.67	0.79	0.64	-	0.4	31.0	8.00	12

Table 8. Genetic origins of some promising improved lines for favored upland rice.

Line No.[a]	Origin	Cross	Pedigri
UP 1008	5959	F1P1247xF1 P1256	P1790-5-1M-4-5M-1B-3M-1B
UP 1095	14643	IR 36//5461/CICA 7	P2054F4-26-4
UP 1102	14682	CICA 7//5461/4440	P2056F4-59-2
UP 1104	14697	CICA 7//5461/4440	P2056F4-75-4
UP 1109	14819	CICA 7//5461/IR 22	P2058F4-47-3
UP 1117	14918	CICA 7//IR 36/CICA 9	P2060F4-49-1
UP 1189	18453	CICA 4//CICA 9//CICA 7	P2025F4-93-2-2-1B-1B
UP 1191	18458 [b]	CICA 4//CICA 9/CICA 7	P2025F4-159-3-3-1B-1B
UP 1193	18467 [b]	Bg 90-2//CICA 9/CICA 7	P2026F4-49-5-5-1B-1B

a. UP = upland

b. Evaluated during one season in the year, Santa Rosa, Villavicencio, Meta.

Table 9. Some agronomic characteristics of various promising lines for favored upland, Santa Rosa, Villavicencio, Meta. 1982A.

Line No.	Days to tillering	Height (cm)	Blast: Leaf[a]	Blast: Neck[a]	Hoja blanca[b]	Leaf scald[a]	Grain discoloration[a]	Shedding[b]	Yield (kg/ha) 1982A	Yield (kg/ha) 1981A
5959	104	97	2 (3)	1	MR	8	3	MR	4790	3646
14643	99	91	2 (3)	1	R	8	2	MR	4353	4160
14682	103	89	2 (3)	1	R	7	2	MS	4793	4229
14697	100	93	1 (2)	1	R	7	2	MS	4711	5056
14819	97	89	1 (2)	4	R	8	7	MR	4549	5010
14918	100	80	1 (2)	3	R	7	5	MS	4596	4852
18453	105	91	1, 2 (3)	2	R	8	8	MS	4752	3271
18458	105	93	2, 3	1	R	7	6	MS	4167	c
18467	97	89	2, 3	5	R	2	4	MR	5500	c
CICA 8	106	79	5	9	S	3	6	MR	2308	3313
CICA 7	98	91	2, 3	2	R	9	2	MS	3536	3983
Metica 1	98	102	2, 3	2	R	2	6	MR	4263	3700

a. Relative scale (leaf scale 1-9).
b. R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible.
c. Not evaluted.

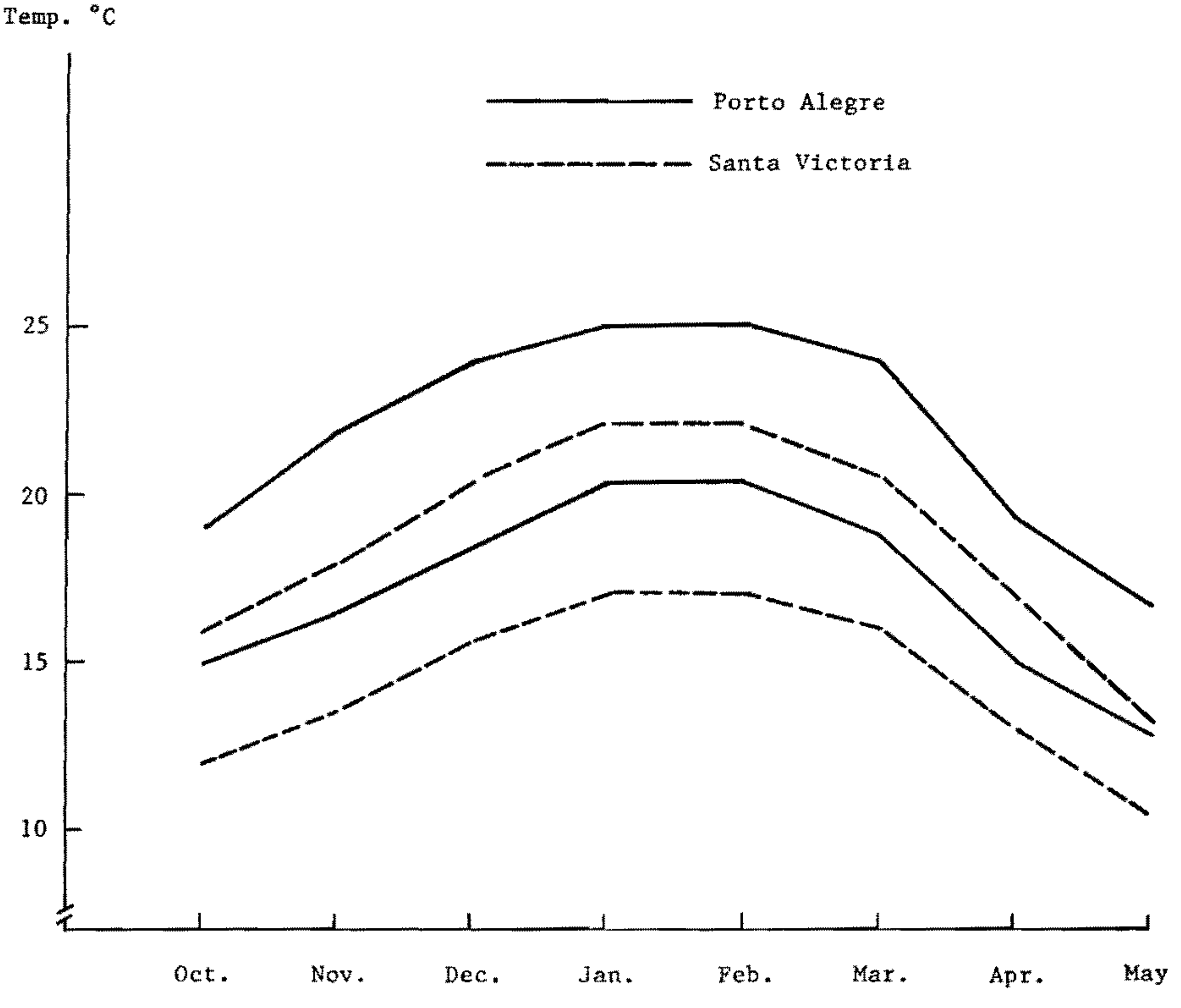

Figure 1. Average minimal and intermediate temperatures in Porto Alegre and Santa Victoria, RS. Brazil.

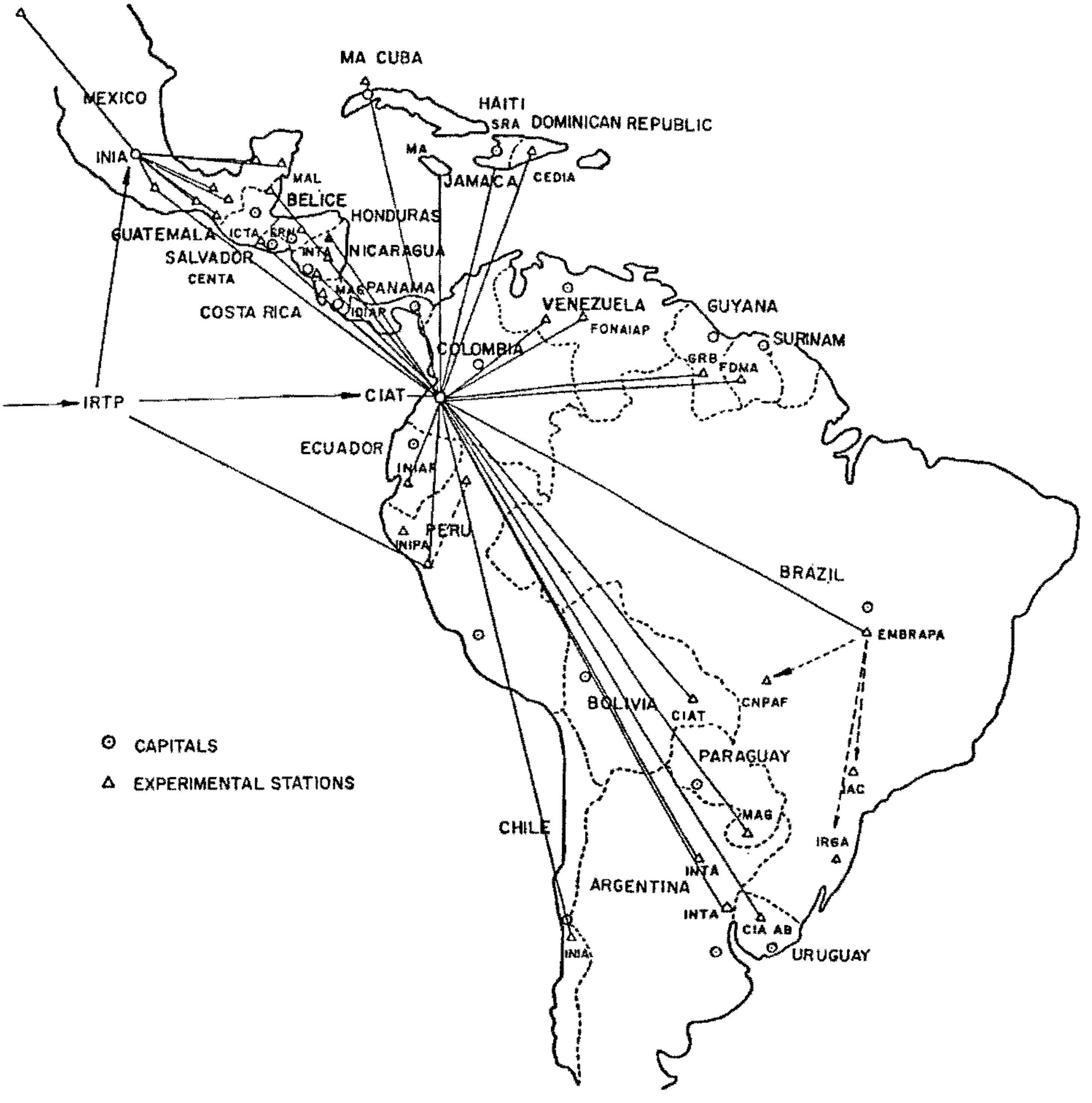

Figure 2. IRTP cooperation network in Latin America.

Table 10. Days to flowering and production under irrigation of the best lines from IRTP yield nurseries distributed in 1981 in Latin America.

Nurseries and selections	Origin	Flowering (days)		Yield (t/ha)	
		Tropics	Temperate	Tropics	Temperate
VIRAL-P [a]					
B 2360-6-7-1-4	Indonesia	100	126	6.2	6.8
IET 4094 (CR 156-5021-207)	India	89	110	6.2	7.4
IR 13540-56-3-2-1	IRRI	95	123	5.8	6.1
IR 9129-209-2-2-2-1	IRRI	87	100	5.5	5.6
UPR 70/30-25	India	92	110	5.5	5.8
MTU 3419	India	103	127	5.1	6.6
IR 9708-51-1-2	IRRI	80	99	3.9	6.4
CICA 7 (check)	Colombia	94	124	4.5	4.8
IR 50 (check)	Philippines	81	99	4.5	5.7
VIRAL-T [b]					
IR 4422-480-2-3-3	IRRI	105	126	6.7	6.9
BR 51-282-8	B'desh	100	113	6.4	7.2
IR 4422-98-3-6-1	IRRI	110	130	6.2	6.6
PAU 41-262-1-5-PR 388	India	105	128	6.2	5.7
PAU 41-306-2-2-PR 406	India	97	119	6.1	6.0
IR 2153-276-1-10-PR 509	India	98	122	6.1	7.2
IET 6496 (R-22-2-10-1)	India	104	126	5.7	7.1
P 1356-1-3M-2-1B	CIAT-ICA	102	113	5.5	6.9
CICA 8 (check)	Colombia	102	125	5.9	6.8
CICA 4 (check)	Colombia	95	110	5.4	5.5
VERAL [c]					
P 1397-4-9M-3-3M-3 (5732)	CIAT-ICA	103	102	6.3	4.8
IR 9852-18-1	IRRI	101	109	6.2	4.9
P 1377-1-15M-1-2M-3 (5854)	CIAT-IRRI	100	104	6.0	2.0
IR 8192-166-2-2-3	IRRI	105	124	5.7	0.8
P 1363-5-13M-3-1B (5366)	CIAT-IRRI	97	122	5.4	0.6
IR 11248-13-2-3	IRRI	99	107	5.3	3.2
CICA 8 (check)	Colombia	101	111	6.4	4.1
CICA 4 (check)	Colombia	97	96	5.6	5.5
CICA 7 (check)	Colombia	95	116	5.2	5.4

a. Planted in 7 localities; 4 in the tropics and 3 in the temperate zones.
b. Planted in 7 localities; 5 in the tropics and 2 in the temperate zones.
c. Planted in 7 localities; 6 in the tropics and 1 in the temperate zones.

Table 11. Average number of days to flowering and yield in favored upland of the best lines from four nurseries distributed in 1981 in Latin America.

Nurseries and selections	Origin	Flowering (days)	Yield (t/ha)
VIRAL-P (planted in 9 localities)			
IET 4094 (CR 156-5021-207)	India	89	4.9
Suweon 287	Corea	80	4.4
B 2360-6-7-1-4	Indonesia	101	4.2
MTU 3419	India	100	4.2
IR 13540-56-3-2-1	IRRI	97	4.1
CICA 7 (check)	Colombia	95	4.3
IR 50 (check)	Philippines	76	3.9
VIRAL-T (planted in 7 localities)			
P 1381-1-8M-2-4M-5	CIAT-ICA	98	5.8
P 1332-3-8M-1-1B	CIAT-ICA	102	5.6
PAU 41-306-2-2-PR 406	India	91	5.6
P 1369-4-16M-1-2M-4	CIAT-ICA	96	5.6
IR 4422-98-3-6-1	IRRI	99	5.4
CICA 8 (check)	Colombia	98	5.5
CICA 4 (check)	Colombia	90	4.2
VERAL (planted in 9 localities)			
P 1397-4-9M-3-3M-3	CIAT-ICA	97	4.5
P 1266-3-6M-1-1B	CIAT-ICA	87	4.2
IR 11248-13-2-3	IRRI	92	4.1
P 1363-5-13M-3-1B	CIAT-ICA	97	4.0
P 13-7-1-15M-1-2M-3	CIAT-ICA	97	4.0
CICA 8 (check)	Colombia	98	4.5
CICA 4 (check)	Colombia	91	3.8
CICA 7 (check)	Colombia	93	4.4
VIRAL-S (planted in 13 localities)			
IET 4094 (CR 156-5021-207)	India	88	4.4
P 1377-1-15M-1-12M-3	CIAT-ICA	98	4.3
TOX 728-2	Nigeria	94	4.3
B 733 C-167-3-2	Indonesia	91	4.2
P 1381-1-8M-2-1B	CIAT-ICA	99	4.1
CICA 8 (check)	Colombia	99	4.2
IR 43 (check)	Philippines	94	4.4

Table 12. Promising lines from VIAOL, 1981, planted in 8 sites of Latin America.

Name	Origin	Flowering (days)[a]			Yield (t/ha)[a]		
		Irrigated		Favored	Irrigated		Favored
		Tropics	Temperate	upland	Tropics	Temperate	upland
P 2019 F4-72-1B-1B	CIAT	108	120	94	7.0	7.4	4.5
Chianung Sen Yu 23	Taiwan	112	116	100	7.5	7.1	4.2
P 2020 F4-5-1B-1B	CIAT	111	122	98	6.6	6.9	4.8
P 2019 F4-24-1B-1B	CIAT	109	120	96	7.0	6.8	4.0
RNR 74823	India	117	125	112	6.8	6.9	3.8
Chinaung Sen Yu 25	Taiwan	113	122	100	6.1	7.3	4.2
P 2030 F4-130-1B-1B	CIAT	114	134	107	6.5	6.8	4.2
P 2015 F4-128-1B-1B	CIAT	109	121	95	5.0	7.4	4.9
IR 14532-22-3	IRRI	115	126	104	6.1	6.4	3.8
IR 8192-31-2-1-2	IRRI	112	125	97	5.5	6.8	4.5
IR 8192-200-3-3-1-1	IRRI	108	119	95	5.4	7.4	4.0
B 2850-B-SI-2-1	Indonesia	117	125	99	5.5	6.5	4.4
Checks							
CICA 8	Colombia	114	123	99	6.1	7.5	3.6
CICA 4	Colombia	105	107	88	5.8	6.4	2.7
IR 43	Philippines	109	116	96	5.9	7.0	5.1
IR 42	Philippines	119	138	110	4.3	5.5	4.1
CR 1113	Costa Rica	112	122	103	5.5	5.9	3.6

a. Average of three sites in the tropics (Palmira, Colombia; Maugé, Haiti, Boliche, Ecuador), three in temperate sites (Cachoeirinha and Itajai, Brazil; Corrientes, Argentina) and two sites in favored upland (Rio Hato, Panama and Guaymas, Honduras).

Table 13. Promising VIOAL-S (1981) lines planted in 8 localities of Latin America under favored upland system.

Name	Origin	Blast[a] BI Rank	Blast[a] NBI Rank	Days to flowering[b]	Yield[b] (t/ha)
P 1035-5-6-1-1-1M	CIAT	0-4	1-1	93	3.5
IRAT 122	Ivory Coast	0-1	1-1	94	3.2
IRAT 127	Ivory Coast	0-4	0-1	96	3.6
MRC 603-383	Philippines	0-4	1-3	91	3.4
IR 4744-295-2-3	IRRI	0-1	0-1	91	3.5
IR 6115-1-1-1	IRRI	0-2	1-3	99	4.0
IR 4427-207-2-2-2	IRRI	0-3	0-1	109	3.4
IR 4723-179-1-2	IRRI	0-3	1-3	93	3.5
IR 9830-26-3-3	IRRI	0-2	1-1	96	3.5
IR 9846-23-2	IRRI	0-1	1-1	99	3.6
IR 13146-45-2	IRRI	0-2	1-1	99	3.2
IR 13420-6-3-3-1	IRRI	0-3	1-1	92	3.4
IR 13240-39-3	IRRI	0-3	1-3	87	4.2
IR 13249-82-2-3-2	IRRI	0-3	1-3	89	3.5
IR 11248-148-3-2-3-3	IRRI	0-3	1-1	96	4.4
IR 13146-23-3	IRRI	0-1	1-3	102	3.4
Checks					
CICA 8	Colombia	0-6	1-9	102	3.7
CICA 4	Colombia	0-7	6-7	94	3.2
IR 42	Philippines	0-3	- -	106	3.2
IR 43	Philippines	1-5	1-3	94	4.0
CR 1113	Costa Rica	0-5	1-3	102	3.1

a. Leaf blast in 5 localities (Chiapas and Cotaxtla, Mexico; Jutiapa, Guatemala, Guaymas, Honduras and Chiriquí, Panama) and panicle blast in two (Jutiapa, Guatemala and Chiriquí, Panama).

b. Average of 8 localities.

Table 14. VIOAL-SA (1981) lines resistant to yellowing under irrigated conditions in La Libertad, ICA-Villavicencio, Colombia.[a]

Name	Origin	Yellowing[b] (1-9)	Flowering (days)	Yield (t/ha)
CR 1002	India	2	106	5.5
P 1409-6-8M-4-1B	CIAT-ICA	2	110	5.4
IR 3273-339-2-5	IRRI	3	97	5.4
BG 374-1	Sri Lanka	2	98	5.2
IR 4568-225-3-2	IRRI	2	93	5.0
IR 4432-52-6-4	IRRI	2	95	4.9
P 1369-4-16M-1-2M-4	CIAT-ICA	2	107	4.7
BR 51-91-6	B'desh	2	110	4.6
IR 4427-315-2-3	IRRI	3	100	4.5
SI-2	Indonesia	3	95	4.4
IR 2058-78-1-3-2-3	IRRI	3	95	4.3
MRC 172-9	Philippines	1	92	3.6
Resistant checks				
CICA 8	Colombia	3	107	4.1
Colombia 1	Colombia	1	95	2.5
Tetep	Vietnam	2	97	3.5
Susceptible checks				
MRC 603/303	Philippines	7	109	1.7
CR 1113	Costa Rica	6	110	2.5
IR 1905-81-3-1	IRRI	7	108	1.8
IET 6581	India	7	101	0.9

a. Averages from planting in 1980 and 1981.
b. International scale 1-9: 1 = resistant, 9 = susceptible.

Table 15. VIOAL-SA (1981) lines tolerant to acid soils in Mexico and Central America.

Name	Reaction to acid soils[a]			Days to flowering[b]		Yield[d] (t/ha)	
	4	6	9	SNF	SF	SNF	SF
P 1264-6-11M-1-3M-4	4	3	4	98	90	0.5	5.9
P 1397-4-9M-3-3M-3	4	4	4	99	92	0.4	5.8
P 1274-6-8M-1-3M-1	4	4	4	94	92	0.3	6.7
P 1278-6-17M-1-1B	4	4	4	91	89	0.7	5.4
P 1356-1-3M-2-1B	3	4	3	101	98	1.2	5.2
P 1358-5-19M-2-1B	4	4	3	99	100	0.8	5.4
P 1383-8-11M-3-1B	3	3	4	104	110	1.2	5.2
CR 261-7039-236	4	4	1	105	100	1.1	5.4
IR 3262-3-9-4-5	4	3	3	95	90	1.2	5.1
IR 4432-52-6-4	4	3	3	98	93	1.2	4.4
IRAT 123	4	-	3	101	102	1.0	2.6
Resistant checks							
CICA 8	5	3	2	100	101	0.7	6.1
Colombia 1	2	2	1	102	89	0.7	3.9
Tetep	4	5	4	104	97	0.5	2.5
Susceptible checks							
CR 1113	7	3	3	98	95	1.0	5.3
MRC 603/303	3	5	4	97	83	0.5	5.1
IR 7149-35-2-3-2	7	4	5	90	85	0.4	4.3
IR 1905-81-3-1	5	5	1	97	100	0.5	5.0
IET 6581	7	3	5	94	90	0.7	4.8

a. International scale 1-9: 1 = resistant; 9 = susceptible; 4 = Huimanguillo (Mexico), 6 = Arce (El Salvador), 9 = Nueva Guinea (Nicaragua).

b. Average of two localities under unfavored upland (Huimanguillo and Nueva Guinea) and 3 favored upland localities (Los Amates, Guatemala, El Salvador and Guaymas, Honduras).

Table 16. Promising VIOAL-Es (1981) lines with tolerance to leaf scald in four localities of Central America[a].

Name	Origin	Leaf scald[b]		Days to flowering[c]	Yield[c] (t/ha)
		Min	Max		
BR 161-2B-58	B'desh	3	5	89	4.8
BR 51-46-1-C1	B'desh	3	5	95	4.7
IET 4693	India	3	5	95	4.0
PAU 41-306-1-4-PR 422	India	3	5	90	4.9
PAU 41-306-2-1-PR 405	India	3	5	90	6.1
PAU 41-306-2-2-PR 406	India	3	5	89	4.8
CR 1009	India	2	5	116	3.2
IET 6058	India	3	5	94	5.3
B 2362-C/15-SI-8-2	Indonesia	2	5	101	4.5
B 295-J-TB-9	Indonesia	3	5	96	5.0
B 2360-6-5-1-10	Indonesia	3	5	88	4.2
IR 2153-276-1-10-PR 509	IRRI	3	5	92	5.9
IR 9846-145-3-3	IRRI	3	5	86	3.5
IR 14753-120-3	IRRI	2	5	96	4.3
IR 2035-117-3	IRRI	2	5	101	4.6
SIPI 671112	Taiwan	3	5	88	4.4
Damaris (T. resistant)	Panamá	3	5	106	3.4
IR 4219-113-1-3 (T.S.)	IRRI	5	6	103	3.9

a. Los Amates; Guatemala; Arce, El Salvador; Cañas, Costa Rica; Tocumen, Panama.
b. International scale 1-9: 1 = resistant; 9 = susceptible.
c. Average of four localities.

Table 17. VIPAL (1981) lines resistant to leaf blast (13 localities) and panicle blast (5 localities).

Name	Resistance sources	Blast[a] Bl Min-Max	Blast[a] NBl Min-Max	Days to flowering	Yield (t/ha)
P 1332-3-8M-1-1B	C 46-15, Tetep, DH	0-3	0-3	113	9.5
P 1390-1-1M-2-1B	C 46-15, Tetep, Col.1	0-4	0-2	111	7.9
P 1329-2-10M-3-1B	C 46-15, Tetep, Col.1	0-4	0-2	117	8.6
P 1381-1-8M-2-4M-5	C 46-15, Tetep, DH	0-4	0-3	107	7.8
P 1383-1-12M-1-1B	C 46-15, Tetep, DH, Col.1	0-4	0-3	117	6.5
P 1264-6-11M-1-1B	C 46-15, Tetep, DH	0-4	0-2	106	7.1
P 1377-1-15M-1-2M-3	C 46-15, Tetep, Col.1	0-3	0-2	107	7.4
P 1384-4-2M-1-1B	C 46-15, Tetep, DH, Col.1	0-4	0-3	117	6.0
IR 343		0-4	1-3	93	5.9
IR 5311-163-3	Tadukan, Tetep, TKM 6	0-4	0-3	113	6.5
IR 2823-271-4	Tetep	0-3	0-2	118	6.3
IR 3464-217-1-3	Tadukan, Zenith	0-3	0-3	115	6.5
IR 5785-188-2-1	Tadukan, Tetep	0-4	1-4	113	7.5
IR 4547-6-2-6	Tadukan, Tetep	0-3	0-2	115	6.6
IR 946-14-3-3-2-3		0-3	0-3	114	8.0
IR 4422-480-2-3-3	Tadukan, TKM 6	0-3	0-3	107	7.9
IR 11248-13-2-3	Tadukan, TKM 6	0-3	0-4	107	8.2
IR 4547-4-1-2	Tadukan, Tetep	0-3	0-2	120	8.8
IR 2071-685-3-5-4-3	Tadukan, TKM 6	0-4	0-1	120	6.4
IR 8192-31-2-1-2	Tadukan, Tetep	0-4	0-3	106	6.9
IR 14753-120-3	Tetep	0-3	0-4	112	8.8
IR 15318-2-2-2-2	Tadukan, TKM 6	0-4	0-3	113	7.4
Janaki		0-4	0-2	117	6.5
P 1381-1-8M-2-1B	C 46-15, Tetep, DH	0-3	0-3	112	6.9
CICA 8	Tetep	0-4	0-3	112	7.9
<u>Resistant checks</u>					
Colombia 1		0-5	0-1	105	4.7
Tetep		0-6	0-4	115	5.4
Carreon		1-4	0-9	95	5.8
<u>Susceptible checks</u>					
CICA 4		0-8	0-8	103	6.5
B-40		2-8	2-8	86	3.5

a. International scale 0-9.

Table 18. IRTP nurseries for Latin America distributed in 1982.

Nurseries[a]	Lines (No.)	Sets (No.)	Ecosystems
Yield			
VIRAL-T	30	60	Irrigated or favored upland
Observation			
VIOAL	160	58	Irrigated or favored upland
VIOAL-SNF	95	27	Unfavored upland
VIOAL-HB	74	5	Irrigated or favored upland
Climate and soil			
VIOSAL	30	13	Irrigated, saline and/or alkaline soils
VITBAL	33	13	Irrigated, low temperatures
VIRAL-F	20	7	Irrigated, semi-deep waters
TOTAL	442 [b]	191	

a. VIRAL-T = International rice yield nursery-early varieties
VIOAL = International rice observation nursery
VIOAL-SNF = International rice observation nursery-unfavored upland
VIOAL-HB = International rice observation nursery for hoja blanca
VIOSAL = International rice observation nursery for salinity and alkalinity
VITBAL = International rice nursery for low temperatures
VIRAL-F = International yield nursery-floating varieties

b. 52% of nurseries from IRRI and 48% from CIAT Rice Program.

Table 19. Days to flowering and yield of the best VIRAL-T 1982 lines in irrigated and favored upland ecosystems.

Name	Days to flowering (No.)	Yield (t/ha)
Irrigated[a]		
P 2034 F4-25-6-1B	91	6.4
P 1897-15-1-4-1-1B-1B	93	6.2
IR 2153-276-1-10-PR 509	91	6.2
SPR 7284-57-5	93	6.2
P 2015 F4-66-1-1B	89	6.2
P 2015 F4-66-5-1B	89	6.1
P 2015 F4-138-3-1B	91	6.0
P 2025 F4-159-3-1B	96	5.9
CICA 8	94	6.0
IR 43	90	6.0
CICA 4	91	6.1
Favored upland[b]		
P 2020 F4-161-5-1B	100	5.6
P 2025 F4-159-3-1B	104	5.5
P 2020 F4-46-2-1B	100	5.2
P 2020 F4-149-1-1B	102	5.2
P 2020 F4-140-3-1B	100	5.1
P 2015 F4-66-5-1B	97	5.1
IR 14753-120-3	101	5.1
P 2030 F4-217-4-1B	107	5.0
CICA 8	100	5.4
IR 43	96	5.0
CICA 4	93	3.4

a. Planted in seven localities: Culiacan and Ebano (Mexico), Punta Gorda (Belize), Bauta (Cuba), Aguachica y CIAT (Colombia), Araure (Venezuela).

b. Planted in 11 localities: San Pedro Colombia (Belize), Cuyuta, La Cristina and Sepu (Guatemala), San Andrés (El Salvador), Guaymas (Honduras), Tocumen, Alanje, Chichebre, David and Rio Hato (Panama).

Table 20. Main characteristics of the best VIOAL 1982 lines planted under irrigation in 6 localities of Latin America.[a]

			Hoja blanca[c]			
Name	Origin	Bl[b]	La Libertad Colombia	Calabozo Venezuela	Days to flowering	Yield (t/ha)
IR 11418-19-2-3	IRRI	1.8	0	1	82	6.2
P 2068 F4-116-2-1B	CIAT	1.3	2	5	90	6.2
IR 13240-108-2-2-3	IRRI	1.2	2	2	84	6.0
P 2053 F4-26-4-1B	CIAT	0.7	0	2	96	5.7
P 2067 F4-85-3-1B	CIAT	0.7	2	3	97	5.5
IR 9093-211-6	IRRI	2.3	1	4	88	5.4
IR 2307-247-2-2-3	IRRI	2.3	1	2	91	5.3
P 1358-5-19M-2-1B	CIAT	0.3	2	3	96	5.2
IR 21931-67	IRRI	1.5	2	2	87	5.1
IR 9846-145-3-3	IRRI	1.0	0	3	85	5.0
IR 9828-91-2-3	IRRI	1.5	3	4	89	5.0
Controls						
CICA 8	Colombia	1.5	6	7	98	6.1
IR 43	Philippines	1.0	4	4	96	5.8
IR 36	Philippines	1.5	1	2	87	5.2
CICA 4	Colombia	2.5	0	3	94	5.2
IR 42	Philippines	1.3	1	5	109	4.6
IR 50	Philippines	0.8	2	2	82	4.5
Chinese	Kenya	1.3	4	7	98	5.5

a. CIAT-Palmira, La Libertad, ICA (Colombia); Cualiacan, (Mexico); Punta Gorda (Belize); Tecolostote (Nicaragua); Araure (Venezuela).

b. Average of 4 localities: La Libertad, Punta Gorda, Tecolostote, Araure, international scale 0-9.

c. International scale 0-9.

Table 21. Main characteristics of the best VIOAL 1982 lines planted under favored upland in 9 localities of Latin America[a].

Name	Origin	Disease reaction[b]					Days to flowering[d]	Yield (t/ha)[d]
		Bl[b]	NBl	Lsc	Hoja blanca 1[c]	Hoja blanca 2[c]		
P 2025 F4-159-1B-1B	CIAT	1.1	0.3	2.6	0	6	102	5.3
IR 1529-ECIA	Cuba	1.9	0.3	3.4	2	6	99	5.2
IR 9846-23-2	IRRI	1.4	0.3	3.4	1	5	99	5.1
P 2053 F4-26-4-1B	CIAT	1.6	0.3	4.2	0	2	103	5.0
IR 11248-148-3-2-3-3	IRRI	1.6	0.3	4.0	2	2	97	4.9
P 1358-5-19M-2-1B	CIAT	1.9	0.5	3.2	2	3	102	4.8
P 2017 F4-18-1B-1B	CIAT	2.1	1.3	3.0	0	6	99	4.8
P 2030 F4-58-1B-1B	CIAT	1.6	0.3	3.4	1	4	102	4.7
IR 13429-299-2-1-3	IRRI	1.0	0.3	3.6	0	2	90	4.5
IR 19058-107-1	IRRI	2.3	0.3	4.6	0	0	91	4.5
P 2030 F4-82-1B-1B	CIAT	1.6	0.3	3.6	1	7	110	4.5
Controls								
CICA 8	Colombia	1.1	0.5	4.1	6	7	102	5.0
IR 43	IRRI	1.4	0.3	5.0	4	4	96	4.8
IR 36	IRRI	1.1	1.3	4.8	1	2	91	3.8
CICA 4	Colombia	3.1	4.5	2.0	0	3	94	4.0
IR 42	IRRI	1.3	0.3	3.2	1	5	110	3.9
IR 50	IRRI	2.6	3.3	4.0	2	2	81	4.0
Chinese	Kenya	2.6	0.7	3.6	4	7	102	4.7

a. Los Amates and Panzos (Guatemala); Arce and Santa Cruz Porrillo (El Salvador); El Progreso (Honduras); Tocumen, Alanje, Chepo and David (Panama).
b. International scale 0-9
Bl = Average of 7 of 9 localities
NBl = Average of 4 of 9 localities
LSc = Average of 5 of 9 localities.
c. 1 = La Libertad, Colombia; 2 = Calabozo, Venezuela
d. Average of 9 localities.

Table 22. Main characteristics of the best VIOAL-SNF 1982 lines planted in four unfavored upland sites.[a]

Name	Origin	Drought[b]	White belly	LSc	Days to flower.[c]	Yield (t/ha)[d]
P 2053 F4-14-2-1B	Colombia	2.5	2.3	2.3	106	3.3
B 2791 B-MR-257-3-2	Indonesia	2.5	3.0	4.0	111	3.0
IRI 356	Corea	2.5	4.0	4.0	100	2.9
IR 13429-196-1	Philippines	3.0	3.7	4.3	107	2.9
IR 13249-108-2-2-3	Philippines	2.5	5.3	4.7	95	2.8
P 2060 F4-2-5-1B	Colombia	3.0	3.7	5.0	117	2.8
IR 9828-91-2-3	Philippines	2.5	5.7	4.0	94	2.7
IR 9761-19-1	Philippines	4.0	3.0	1.7	102	2.7
IR 11418-19-2-3	Philippines	3.0	3.3	2.3	110	2.7
B 2360-6-7-1-4	Indonesia	3.0	3.7	5.0	106	2.7
IR 3262-3-338-5	Philippines	4.0	4.7	4.7	110	2.7
Controls						
Salumpikit	Philippines	3.0	5.3	2.3	92	1.7
IAC 47	Brazil	3.0	4.7	5.0	95	1.7
Monolaya	Colombia	5.0	4.7	4.0	100	1.5
Sein-Ta Lay	Birmania	4.0	2.3	2.7	110	2.0

a. Sites: ICA-La Libertad (Colombia); Cuyuta (Guatemala); Santa Cruz (El Salvador); Tocumen (Panama).
b. Averages from Santa Cruz and Tocumen.
c. Averages from ICA-La Libertad, Cuyuta and Tocumen.
d. Averages from the four sites.

Table 23. Utilization of germplasm from IRTP nurseries distributed in 1981 and 1982 in Latin America.

Country	Parents 1981	Parents 1982	Yield trials 1981	Yield trials 1982	Seed Multiplication[a] 1982
	No. of lines				
Argentina	-	-	44	10	1
Belice	-	-	-	-	2
Bolivia	-	-	4	5	2
Brasil	10	24	3	31	1
Chile	-	8	-	-	-
Colombia	-	8	-	3	-
Costa Rica	-	-	-	-	-
Cuba	-	12	21	10	-
Ecuador	-	8	-	3	-
El Salvador	-	2	-	5	1
Guatemala	-	-	29	23	2
Guyana	-	-	-	-	-
Haiti	-	-	10	-	-
Honduras	-	-	10	6	1
Jamaica	-	-	-	-	-
México	10	23	50	-	-
Nicaragua	-	-	5	20	-
Panamá	-	-	-	-	-
Paraguay	-	-	53	9	-
Perú	2	50	7	11	-
Dominican Rep.	3	3	13	-	-
Surinam	-	-	-	-	-
Uruguay	2	2	-	11	-
Venezuela	12	-	46	-	-
T O T A L	39	140	295	147	10

a. IR 841-63-5-18 in Argentina; CICA 8 and CR 1113 in Belize; CICA 8 and IR 1529 in Bolivia; IAC 1274 in Brazil; Line 5738 in El Salvador; UPR 70/3025 and IR 4427-315-2-3 in Guatemala; line 4444 in Honduras.

Table 24. New varieties nominated by National Programs in Latin America.

Country	Institution[a]	Commercial name[b]	Name	Year
Brazil	IAC	IAC 1278	P 1278-17M-1-1B	1982
	EPAMIG	INCA 4440	CICA 8	1982
Colombia	ICA	ORYZICA 1	P 1429-8-9M-2-1M-5	1982
El Salvador	CENTA	CENTA A 2	P 1008-8-16-6-1B-53	1982
		CENTA A 3	P 1008-8-16-6-1B-52	1982
Guatemala	ICTA	TEMPISQUE	P 1008-8-16-6-1B	1981
México	INIA	CARDENAS A 80	SPR 6726-134-2-26	1981
Panamá	UP	TOCUMEN 5430	P 881-19-22-4-1B-1B-2-1	1982
Venezuela	FONAIAP	ARAURE 2	P 1282-2-4M-2-1B-5-1-2	1982

a. IAC = Instituto Agronômico de Campinas
EPAMIG = Empresa de Pesquisa Agrícola de Minas Gerais
ICA = Instituto Colombiano Agropecuario
CENTA = Centro Nacional de Tecnología Agrícola
ICTA = Instituto de Ciencia y Tecnología Agrícola
INIA = Instituto Nacional de Investigacines Agrícolas
UP = Universidad de Panama
FONAIAP = Fondo Nacional de Investigación Agropecuaria

b. IAC 1278, INCA 4440, CARDENAS A 80 were selected from VIPAL, 1979, VIRAL-T, 1980 and VIRAL-F 1978, respectively. Others originated from materials provided by ICA-CIAT Rice Program.

NEEDS AND FUTURE PLANS OF THE IRTP FOR LATIN AMERICA

Nurseries

Participants were informed of the type of nurseries that are being distributed by CIAT (Table 25) and that will continue to be shipped unless recommendations are to discontinue any of them or to create new ones. There was a consensus to continue receiving germplasm through the already established nurseries which meet the needs of national programs.

Information was given on a blast pathogenicity project initiated in 1983 by the Pathology Section of CIAT's Rice Program in collaboration with some of the national programs through the IRTP network. The objectives of this project are to determine the variability of *Piricularia oryzae* at sites where the disease is very severe, to observe the performance of some commercial varieties in the region, and to collect information on the most reliable screening site to select varieties with slow blasting resistance in the future. This project is independent from the IRTP nurseries and, therefore, it was considered by the participants for inclusion in the collaborative network. After some debate it was suggested that the project should continue as part of the Pathology Section until preliminary results are available that could serve as a basis for discussion and on which a decision could be based.

IRTP nurseries from IRRI

Participants were informed that several national programs received some IRTP nurseries directly from IRRI in addition to nurseries distributed by CIAT.

Leaders from these programs pointed out that they were still interested in receiving various nurseries directly from IRRI. Table 26 shows these programs and types of nurseries desired.

Needs for new nurseries

The need to assemble a new observation nursery for temperate zones in Rio Grande do Sul in Brazil, Uruguay, Argentina and Chile, was discussed. Leaders from these programs indicated their interest in receiving germplasm with the following characteristics: long grain, good milling (high mill recovery, and grain with translucent appearance) and cooking (intermediate to high amilose content) qualities, short duration, and resistance to low temperature during the vegetative and/or reproductive stages.

Also they pointed out that germplasm included in the VITBAL is low in numbers and the majority has a long growth duration.

It was suggested that instead of creating a new nursery, the present VITBAL nursery should continue but increasing the germplasm with long grain and early materials from temperate zones such as California

(U.S.A.), Australia, Taiwan, and Korea, as well as long grain improved materials selected at IRRI for their tolerance to cold, earliness, and good grain quality.

Nursery distribution

Participants were informed that nurseries are being shipped according to the major plating season in the collaborating countries as follows: March-April to countries that plant in May-June, and August-September to countries that plant in October-December.

Leaders from various national programs indicated the need to make some changes in the planting dates. These modifications were made for Peru, Cuba, and Costa Rica. Figure 3 shows the updated planting dates.

Germplasm nomination for 1984 nurseries

It is highly desirable that germplasm distributed through IRTP nurseries has wide genetic variability in terms of growth duration and resistance to diseases, insects, and edaphic and climatic factors. This genetic variability can be obtained through the collaboration of national programs. Some national programs have promising materials that could benefit other programs which lack the necessary resources to generate new technology.

It was reported that in the IV Conference in 1981, several national programs nominated promising materials but very few sent seeds.

At this Conference more collaboration was requested to nominate and ship seed. Some 20 grams of seed are needed and shipping should be done to the following address:

Dr. John L. Nickel
Director General, CIAT
c/o Dr. Manuel J. Rosero
Zona Aduanera CIAT
Cali, Colombia.

National program representatives from Cuba, Guatemala, Mexico, the Dominican Republic, Panama, and Peru and the representative from IITA, nominated several lines for the nurseries that will be distributed in 1984 (Table 27).

Number of nurseries for 1984

Delegates were requested to indicate the number of sets of seven different nurseries that they wish to receive in 1984. Table 28 details the nurseries and number of sets for each one.

Nursery management

There were no changes related to nursery management in the field or to forwarding of data. However, delegates were reminded to send, together with the field evaluations, all information requested in the books for each nursery.

Quarantine Problems

Changes presently being made by governments of some countries related to the introduction of materials and procedures to be followed were discussed in order that collaborators receive germplasm with no problem.

It was stated that until 1981 there were no problems and all collaborators had received germplasm in a timely manner. In 1982, however, problems arose in Brazil and Chile, and in 1983 in Mexico.

The problem in Brazil emerged due to the fact that CENARGEN inspectors found saprophytic nematodes in seeds from IRTP nurseries, and immediately proceeded to destroy the seed. This problem is now being solved and CENARGEN's recommendations will be followed so that EMBRAPA, IRGA and other collaborating institutions receive the rice germplasm.

The problem in Chile is related to a new measure taken by the authorities in the Ministry of Agriculture for the introduction of rice seeds. Besides the Phytosanitary Certificate, the new measure requires a certification stating that seeds were produced in regions free from pathogens *P. oryzae* and *Helminthosporium oryzae*.

The problem in Mexico is related to procedures and not quarantine. To let seed enter the country, Mexican customs asked INIA representatives for an Exportation Certificate from the Colombian Government. This means that they consider nursery seed, which has no commercial value, as a commercial commodity. This problem is being solved through INIA authorities who will report on the procedure to be followed in future germplasm shipments.

To better assure that pathogens, insects, and other organisms will not be introduced through seed in the nurseries, several representatives recommended to fumigate the seed and then treat it with a fungicide and insecticide.

This request was accepted and in future the seed will be treated first with a fumigant and then with Viatavax and Furadan.

Monitoring Tours

Experiences gained in past monitoring tours have been highly beneficial to all rice scientists who have participated. These events have allowed a familiarization with the different ecosystems and their constraints, with research activities by the programs visited and observation of the germplasm performance of nurseries and national programs.

It was reported that a monitoring tour was planned for 1984 to cover part of the northern region of South America (Ecuador, Colombia, and Venezuela) and some Central American countries (Costa Rica, Panama, and Nicaragua). This event will allow observation of rice production problems in irrigated, favored upland, and unfavored upland ecosystems.

Representatives from countries involved in this trip indicated that late August would be the most appropriate time to visit research activities and to see commercial crops in different stages of development.

IRTP Conferences

This type of activity will continue every two years at CIAT.

Some representatives suggested that the next conference should include the following main topics for discussion:

- o Selection methods for durable resistance to diseases, especially blast.
- o Production ecosystems: definition and characterization.
- o Plant physiology related to drought resistance.
- o Economic efficiency in rice production vs. plant architecture.
- o Weed problems with emphasis on upland ecosystems.
- o Efficiency of nitrogen fertilization in upland rice.

Table 25. IRTP nurseries for Latin America distributed in 1982.

Nurseries[a]	Ecosystems
Yield	
VIRAL-T	Irrigated or favored upland
Observation	
VIOAL	Irrigated or favored upland
VIOAL-SNF	Unfavored upland
VIOAL-HB	Irrigated or favored upland
Climate and soil	
VIOSAL	Irrigated saline and/or alkaline soils
VITBAL	Irrigated, low temperatures
VIRAL-F	Irrigated, semi-deep waters

a. VIRAL-T = International Rice Yield Nursery- Early Varieties
VIOAL = International Rice Observation Nursery
VIOAL-SNF = International Rice Observation Nursery-Unfavored Upland
VIOAL-HB = International Observation Nursery for Hoja Blanca
VIOSAL = International Rice Observation Nursery for Salinity and Alkalinity
VITBAL = International Nursery for Low Temperatures in Rice
VIRAL-F = International Yield Nursery-Floating Varieties

Table 26. National programs wanting to receive IRTP nurseries directly from IRRI.

National Program	TYPE OF NURSERY[a]									
	IRYN-VE	IRYN-E	IRYN-M	IURYN	IRON	IURON	IRDWON	IRCTN	IRSATON	IRBN
Brazil	X					X		X		
Chile	X							X		
Costa Rica						X				
Cuba	X	X	X		X				X	X
Ecuador							X			
Mexico	X	X	X	X	X	X	X	X	X	X
Peru	X	X	X		X	X				
Uruguay								X		
Dominican Republic									X	

a. IRYN-VE = International Rice Yield Nursery - Very Early Varieties
IRYN-E = International Rice Yield Nursery - Early Varieties
IRYN-M = International Rice Yield Nursery - Early Maturing Varieties
IURYN = International Upland Rice Yield Nursery
IRON = International Rice Observation Nursery
IURON = International Upland Rice Observation Nursery
IRDWON = International Rice Deep Water Observation Nursery
IRCTN = International Rice Cold Tolerant Nursery
IRSATON = International Rice Salinity Alkalinity Tolerant Observation Nursery
IRBN = International Rice Blast Nursery

Figure 3. Rice planting seasons in Latin American countries.

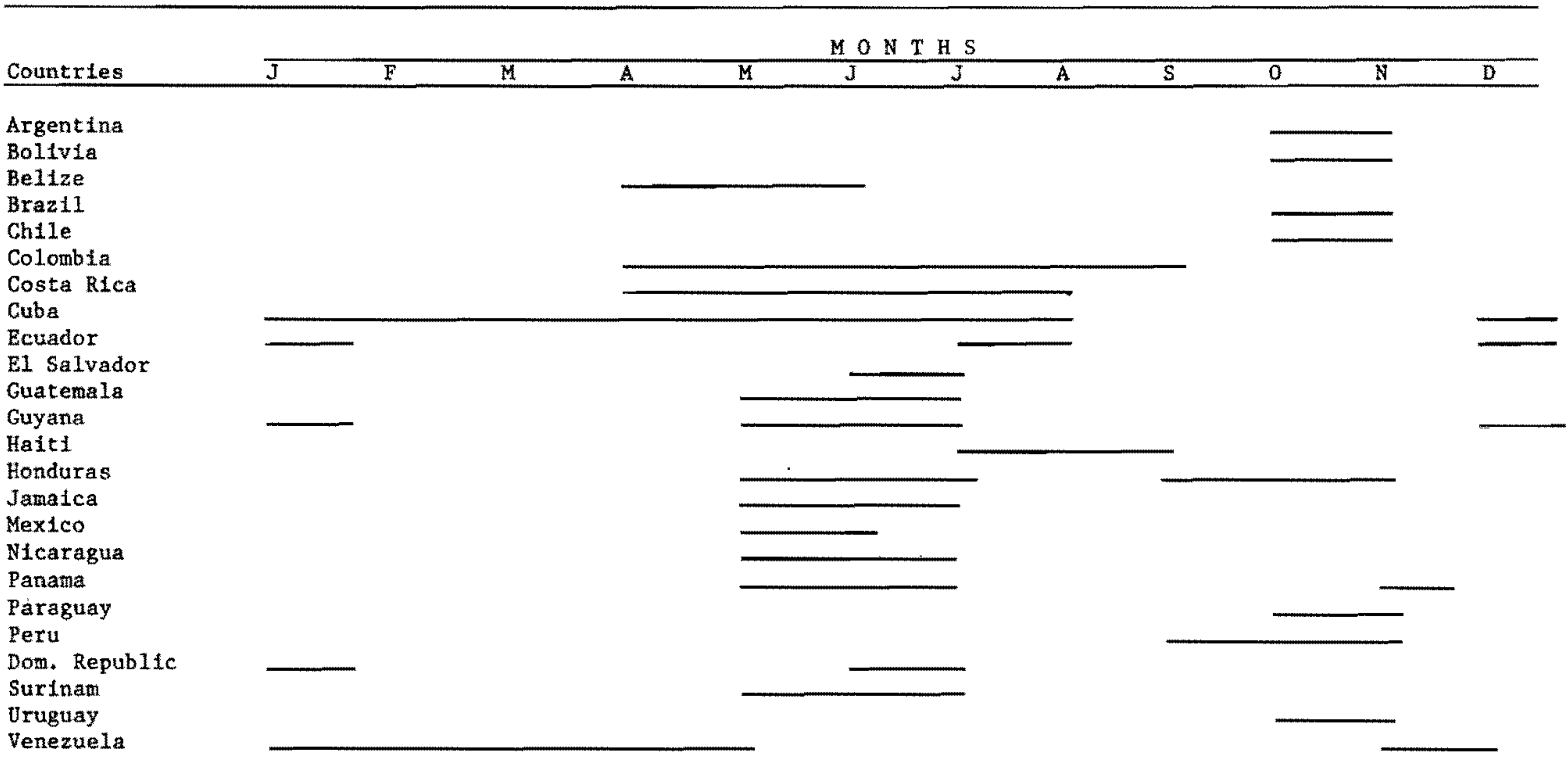

Table 27. Number of lines nominated for 1984 IRTP nurseries in Latin America.

Nat. Program	No. of lines	Type of nursery
Cuba	10	VIOAL
Guatemala	3	VIOAL-SNF
IITA	10	VIOAL-SNF
IITA	5	VIOAL
Mexico	3	VIOAL-SNF
Dom. Republic	3	VIOAL
Panamá	5	VIOAL-SNF
Perú	17	VIOAL-HB

Table 28. IRTP nurseries for Latin America to be distributed from CIAT in 1984.

IRTP Nurseries		Argentina	Belice	Bolivia	Brazil	Colombia	Costa Rica	Cuba	Chile	Ecuador	El Salvador	Guatemala	Guyana	Haiti	Honduras	Jamaica	México	Nicaragua	Panamá	Paraguay	Perú	Dom. Republic	Surinam	Uruguay	Venezuela	Total
Yield	VIRAL-T Early	1		1	1		1	1		1	1	2				1	9	4	6				1	1	2	34
Observación	VIOAL				2	2	2	1		2	2	2				1	6	2	5		3	1		1	2	34
	VIOAL-SNF *						1				1	2					6	2	4						2	18
	VIOAL-HB **					2	1	1		1	1										3		1		2	11
Problemas de clima y suelo	VIOSAL Salinity							1		1							2				1	1				6
	VITBAL Low Temp.	1			2				1								2				1			1		8
	VIRAL-F Floating				2					1							2									5
T O T A L		2		1	7	4	5	4	1	6	4	6				2	27	8	15		8	2	2	3	8	115

* Observation Nursery - Unfavored Upland
** Observation Nursery - Hoja Blanca

RICE LEAFHOPPERS IN ASIA AND HOJA BLANCA PROBLEMS IN LATIN AMERICA

The incidence of rice leafhoppers in Asia and problems with hoja blanca and its vector in Cuba, Venezuela, Ecuador, Peru, Costa Rica, and Colombia, were discussed in this session. The following is a summary of each of the papers discussed.

Biotypes of Rice Leafhoppers in Asia, E.A. Heinrichs[1]

The main irrigated rice pests in south and southeast Asia, are the brown planthopper (BPH), *Nilaparvata lugens* (Homoptera: Delphacidae) and the green leafhopper (GLH), *Nephotettix virescens* (Homoptera: Cicadellidae). The BPH causes mechanical or direct damage with yellowing of the plant and also transmits races 1 and 2 of the grassy stunt virus and the ragged stunt virus. The GLH causes no mechanical damage but is an efficient vector of the tungro virus.

Only recently has the BPH become a major pest in tropical Asia where the insect's population is favored by cultural practices (i.e. high fertilization levels, continuous cropping with permanent irrigation) used to produce high yielding varieties. The uncontrolled application of various insecticides has also resulted in a high incidence of the problem.

1. Entomologist, IRRI.

When IR 26 (the first variety resistant to BPH) was released, it was found susceptible in India. This was the first indication of the existence of "biotypes", populations which differ in their feeding habits in various differential varieties. The IRTP nursery for BPHs and collaborative projects were used to characterize biotypes present in Asia. The population found in south Asia was different to that in southeast Asia.

Greenhouse screening studies were carried out at IRRI and biotypes selected that could kill varieties having resistance genes Bph 1 (Mudgo and IR 26) and bph 2 (ASD 7 and IR 32). Wild populations not killing varieties with resistance genes were named "biotype 1", while populations killing varieties with resistance genes Bph 1 and bph 2 were named "biotypes 2 and 3" respectively. These three BPH populations are being used to evaluate improved materials at IRRI.

After planting IR 26 in Indonesia and the Philippines for 2-3 years (4-6 harvests), there was a change in the biotype 2 population which destroyed IR 26. IR 36 was released in 1976 and this variety is still effectively controlling the BPH. Laboratory studies are being conducted to understand the mechanism involved in the stability of IR 36. To overcome the problem of the biotypes, four breeding strategies have been followed:

1. Continuous release of resistant varieties
2. Accumulation of major genes
3. Combination of major and minor genes
4. Incorporation of tolerance with antibiosis and non-preference

GLH-resistant varieties have been produced in Asia since IR 8 was released in 1966. There is no evidence of the existence of biotypes under field conditions. However, the occurrence of biotypes under laboratory conditions is rapid and in some varieties it occurs in approximately five generations. With selection, the insect changes its feeding pattern; from feeding on the xylem it changes to feeding on the phloem of the resistant variety. As a result, the GLH increases its survival rate from one generation to another. The percentage infection of tungro virus increases if the variety has no genetic resistance to the disease. It is therefore important that rice varieties have resistance to both the GLH and the tungro virus, so that when biotypes of the pest occur, virus infection remains low.

Research Achievements with Hoja Blanca in Cuba, P.A. Orellana[1]

Breeding for Resistance

Research to create the necessary conditions to evaluate genetic materials for hoja blanca resistance was initiated in 1973. The method used to rear insect colonies with high infection percentages was that proposed by Hendrich *et al*. (1965) and Galvez (1967).

The first infected colonies were developed from field populations with 3% infected insects; 94% infected insects were obtained in the

1. Head, Varietal Improvement Dept., Ministry of Agriculture, (ECIA), Cuba.

first generation with small variations in the following six generations (Table 29).

In later studies colonies were replaced each year, and evaluations for resistance to the disease done using colonies having infective insect percentages higher than 80%. The inoculation period is 2-4 days with 2 or 3 insects per plant. Plant age for inoculation has varied between 12 and 30 days.

Table 30 shows the performance of some lines and varieties that have shown resistance to hoja blanca and that have been used as parents in the breeding program or as commercial varieties in Cuba.

Naylamp has been outstanding for its resistance to hoja blanca and, in some trials, it has shown resistance from 12 days of age; this has also been observed in lines PNA from Peru, CICA 4, IR 1857-69-1, and IR 1300-72-2-3.

This varietal resistance of materials inoculated at less than 20 days of age is very important considering that plants in rice fields are exposed to the vector from the time that the first leaf appears. These results are also encouraging as several authors have reported that resistant varieties are not considerably different from varieties susceptible to hoja blanca until they reach, at least, the third leaf stage.

Some indication of what has been proposed by several authors can be obtained by making a comparative analysis by Orellana and Gavidia of hoja blanca evaluations in eight varieties at two different ages and in different countries (Table 31).

However, it must be emphasized that resistance to hoja blanca should be achieved at early growth stages and that it is therefore necessary to evaluate parent varieties from the seedling stage (12 day old plants).

During the last few years the program has concentrated on the development of varieties resistant to the vector and having at least a moderate resistance to hoja blanca. In addition, special emphasis has been placed on prophylactic measures.

Percentage of Infected Insects in Field Colonies

Studies to determine the percentage of infective insects in field colonies were carried out during years of high hoja blanca incidence. Results from different trials showed percentages of infective insects ranging from 7-35%, with a 19.2% average for the most eastern region of the country where more than 500 adults and 3-5 instar nymphs of Sogatodes oryzicola (Muir) were tested.

These results show higher indices than those found by other authors who have reported percentages ranging from 5-15% of infective vectors. However, tests to determine the percentages of active vectors during these periods have not been carried out in Cuba.

Identity of the Hoja Blanca Causal Agent

Isolation studies and electron microscopy by Quintero and Cañet during 1974-1980 in the Academia de Ciencias de Cuba show the occurrence of mycoplasma-like particles.

These researchers worked with healthy and diseased plants of rice varieties IR 8 and Bluebonnet, as well as with *Echinochloa colona* (L.) plants. They used the immersion method proposed by Brandes *et al.* (1965) and negative staining contrast with 2% PTNa (sodium phosphotungstate).

Particles encountered had the type "L" cell characteristics and pleomorphic shape with size ranging from 180 to 240 nm.

Other studies conducted by these researchers involved the application of tetracycline to plants infected by hoja blanca in order to evaluate their recovery, as some mycoplasma react to this antibiotic. Results up to now show that plants with hoja blanca symptoms recover, which is another evidence of the possible reaction of hoja blanca with microorganisms susceptible to mycoplasma.

Future Research Activities

Since hoja blanca is present in varieties resistant to the vector, varieties resistant to both factors should be developed.

Large numbers of varieties should be evaluated to search for resistance to hoja blanca at early growth stages.

Hoja blanca evaluations should be carried out in collaboration with other countries, especially those that can conduct field trials.

Research Achievements with Hoja Blanca in Rice in Ecuador, F. Armijos, F. Sánchez, J.C. Delgado, A. Espinoza[1]

Hoja blanca is present throughout all the rice producing regions in the country and its incidence varies from year to year and from one production zone to another. Hoja blanca is considered as a potential hazard for irrigated rice. Fortunately, an outbreak of the disease has not been observed in commercial fields planted to varieties developed for the country. It is known that INIAP-2 is highly susceptible to hoja blanca as has been observed in experimental trials.

The introduction and continuous planting of varieties not developed for the specific conditions of Ecuador favors hoja blanca incidence and severity. Varieties introduced from Surinam and Peru have in fact demonstrated their high susceptibility to hoja blanca. Yield reductions in commercial crops of the variety Naylamp have ranged from 30-40%. The recently introduced Jequetepeque variety was affected by more than 50% hoja blanca incidence.

In late 1982, the introduced variety Peruano 1001 was severely and directly affected by the rice leafhopper at Cantón Yaguachi, Province of Guayas, in what seems to be the first report of an event of this nature in Ecuador; yields were reduced by approximately 60%. Rice growers generally do not apply chemical control measures for leafhoppers.

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1. Researchers, INIA Rice Program, Guayaquil, Ecuador.

INIAP's Rice Program (Instituto Nacional de Investigaciones Agropecuarias del Ecuador) has two main research objectives for dealing with resistance to hoja blanca and its vector.

- o Identification of sources of resistance to hoja blanca and leafhoppers, in both native and introduced materials, for their utilization in crossing programs.
- o Development of high yielding varieties with desirable characteristics for cropping systems and resistance to hoja blanca and the leafhopper.

Research Highlights

Hoja blanca

The main source of rice materials for INIAP has been cultivars introduced from CIAT and IRRI. It was only in 1981 that a crossing program was initiated to develop varieties with agronomical characteristics appropriate for the different production systems.

Screening for resistance to hoja blanca was initiated in 1978 with the evaluation of 12 rice cultivars selected from 231 F_4 lines introduced from CIAT in 1974. These evaluations were carried out in Arenillas, Hacienda Plantaciones Tropicales, and Samborondón. Line 50415, later nominated as INIAP-415, showed the lowest level of incidence of hoja blanca at all sites. In general, hoja blanca incidence in Plantaciones Tropicales was approximately 2 times higher and in Arenillas 3 times higher than that observed in Samborondón (Table 32).

More than 1200 lines introduced from CIAT and IRRI have been evaluated up to 1981 and many have exhibited low incidence levels (Table 33).

The 21 native varieties that have been studied show high to intermediate resistance reaction; variety Chato with awns showed the highest hoja blanca incidence level (22%) (Table 34). Twenty two improved varieties were also studied for their reaction to the disease; IR 6, IR 8 and INIAP 2 showed the highest incidence levels (38, 43 and 45%, respectively). IR 46 showed the lowest susceptibility with a 1% incidence level (Table 35).

Seventy four lines from the first Hoja Blanca Nursery (VIOAL-HB 1982), including 24 lines selected by INIAP for irrigated and upland conditions, were evaluated in Hacienda Sausalito (Provincia del Guayas) in 1982.

All lines in the VIOAL-HB 1982, showed an overall average of hoja blanca incidence higher than 40%. CICA 8 and, to a lesser extent, CICA 7 were as susceptible to the disease as Bluebonnet 50. ICA 10 remained resistant in all trials (Table 36).

In contrast, lines selected by INIAP performed better, in that they were less susceptible and selections 14 (VIRAL-S, 1978), 12 (VIRAL-S, 1979), and 9 (VIRAL-T, 1978) had 8, 26, and 31% average incidences, respectively (Table 37).

Table 38 shows the reaction of the three most cultivated varieties in Ecuador during 1978-1982. The highest incidence of the disease was observed in 1978 and 1982, with INIAP 415 showing the lowest infection percentage.

Sogatodes

Work was initiated by INIAP in 1982 to study Sogatodes resistance in the most promising materials. Selection 14 (VIRAL-S, 1978) showed the lowest level of dead seedlings (8%) among the five lines that had less than 10% seedling mortality (Table 39); in hoja blanca resistance studies this variety also had the lowest infection percentage (Table 37).

Among the most cultivated varieties, INIAP 7 showed a higher mortality percentage than INIAP 6 and INIAP 415. The native variety Pico Negro was as susceptible as the control, Bluebonnet 50 (Table 40) and equally susceptible to hoja blanca (Table 38).

Present Situation and Recent Studies of Hoja Blanca and its Vector in Peru, R. Olaya Viera[1]

A report was presented on the incidence of hoja blanca in commercial varieties as well as on evaluations of introduced and promising materials from the national programs.

Table 41 shows the reaction to hoja blanca of commercial varieties in Bagua, Peru.

Tables 42 and 43 show the reaction to hoja blanca of promising lines and commercial varieties evaluated in Huarangopampa, Bagua, Peru.

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1. Pathologist, CIPA, Chiclayo, Peru.

Table 44 shows the reaction to hoja blanca of promising materials from the Rice National Program compared to the reaction of control varieties.

Table 45 shows the commercial duration of varieties in Peru from 1968 to 1982.

Varietal Reaction to Hoja Blanca, M.J. Rosero

Rice hoja blanca is a viral disease transmitted by *Sogatodes oryzicola* (Muir). The disease is restricted to the western hemisphere and its presence was reported in Colombia in 1935. However, it was only in the 50's that the disease became economically important.

In Cuba, Venezuela, Panama, Costa Rica, and U.S.A., hoja blanca was reported in 1956-1957. Yield losses in Cuba and Venezuela in some cases reached 75%.

In 1957-1958 yield losses due to hoja blanca in Colombia were 100% in several Bluebonnet 50 fields in the Cauca Valley. The disease caused severe damage until 1967, but from 1965 to 1967 the direct damage caused by the vector was more severe than that caused by hoja blanca. From 1967 to 1980 hoja blanca resistance stopped being a breeding objective because of the absence of the virus, and plant breeders concentrated on resistance to *Sogatodes*. Damage by hoja blanca in Colombia was again reported in IR 22 crops in Tolima in 1981. The incidence of the disease was attributed, however, to the relative susceptibility of IR 22 to the virus. Considerable damage by the virus to CICA 8 in Meta was observed this same year and was even more severe in the 1982 plantings.

In Peru, Ecuador and Venezuela hoja blanca has been affecting yields of varieties INTI, CICA 8, IR 6, and Araure 1, since 1980.

Since hoja blanca is a destructive disease, a nursery was assembled in 1982 to select resistant materials at sites with a high incidence of the disease and also to determine varietal resistance variation in countries where hoja blanca is presently a production constraint.

This paper reports on observations of the hoja blanca nursery (VIOAL-HB, 1982) planted at La Libertad-ICA, Colombia; Calabozo, Venezuela; Guayas, Ecuador; and Bagua, Peru.

Materials and methods

VIOAL-HB 1982 included 74 lines from CIAT's Rice Program, having at least one source of resistance to hoja blanca in their genealogy: CICA 7, Colombia 1, CICA 4, and Pelita 1. All lines are resistant to mechanical damage by *Sogatodes*. ICA 10 and ICA 7 were included as resistant controls and Bluebonnet 50, CICA 8 and Bg 90-2, as susceptible controls.

The nursery was planted at La Libertad-ICA, Villavicencio (Colombia), Bagua (Peru), Guayas (Ecuador), and Calabozo (Venezuela). Three plantings were done at 20-day intervals; each time one 5 m long row was planted with 0.3 m spacings between the rows. Controls were planted every 10 rows.

Hoja blanca readings were made twice using the international scale from 0-9 from the *Standard Evaluation System for Rice* manual; one was made 40 days after planting and the other at flowering.

Results and discussion

Hoja blanca incidence was severe in Bagua, Peru and in Guayas, Ecuador, in the three planting dates, especially at flowering. At ICA-La Libertad, Colombia, hoja blanca incidence was low and the other two plantings were not carried out. Data recorded for the first planting were not taken into account for this report. Instead, data that are reported here were taken from nursery lines that were planted in new trials which showed highly severe hoja blanca incidence.

The nursery was planted twice in Calabozo: the first one with two replications and the second with one. Hoja blanca incidence in both plantings was moderate. Data reported here were taken from the two replications of the first planting when plants were 103 days old.

All lines, including the resistant control CICA 7, were susceptible to hoja blanca in Guayas. Similar results were obtained in Bagua, except in the case of four lines (39, 78, 80, and 83) which showed a moderate resistance reaction. ICA 10 was highly resistant at both sites.

In ICA-La Libertad, Colombia, lines were observed that were highly resistant (severity reaction from 0-2), moderately resistant (3-4), and susceptible (5-9). The resistant controls ICA 10 and CICA 7 had no plants affected by hoja blanca. Bluebonnet 50, CICA 8 and Bg 90-2 were susceptible with a reaction from 5-6.

Resistant (2 in the severity scale), moderately resistant (3-4), and susceptible (5-7) lines were also observed in Calabozo, Venezuela. ICA 10 was highly resistant, while CICA 7 (resistant control) was susceptible (5 in the severity scale). In contrast, Bg 90-2

In Peru, Ecuador and Venezuela hoja blanca has been affecting yields of varieties INTI, CICA 8, IR 6, and Araure 1, since 1980.

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The nursery was planted at La Libertad-ICA, Villavicencio (Colombia), Bagua (Peru), Guayas (Ecuador), and Calabozo (Venezuela). Three plantings were done at 20-day intervals; each time one 5 m long row was planted with 0.3 m spacings between the rows. Controls were planted every 10 rows.

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Resistant (2 in the severity scale), moderately resistant (3-4), and susceptible (5-7) lines were also observed in Calabozo, Venezuela. ICA 10 was highly resistant, while CICA 7 (resistant control) was susceptible (5 in the severity scale). In contrast, Bg 90-2 (susceptible control) showed moderate resistance (3-4), while Bluebonnet 50 and CICA 8 were susceptible.

An analysis of the reaction of the materials to hoja blanca in the four countries leads to the following cases:

- o Lines resistant in Colombia and susceptible in Ecuador, Peru, and Venezuela (Table 46). This case apparently indicates the presence of a new race of the virus, but at the same time the resistance could be the result of an escape of the materials from the insect vector or a low concentration of the virus. Therefore, it is necessary to validate the resistance of these materials under conditions with a high concentration of the virus. Lines which received a high concentration of the virus performed similarily to the susceptible checks Bluebonnet 50, CICA 8, and Bg 90-2 in the four sites (Table 47).
- o Lines with different reaction to hoja blanca. These materials are shown in Table 48. There are lines resistant in Venezuela and susceptible in other countries; lines resistant in Venezuela and Colombia and susceptible in Ecuador and Peru; lines resistant in Colombia and moderately in Peru; and lines susceptible in Ecuador and Venezuela. These differences are probably due to a low concentration of the virus.

CICA 7's susceptibility in Ecuador, Peru, and Venezuela was expected as this variety is susceptible under laboratory conditions when exposed to high concentrations of the virus or under field conditions with high disease pressure. The only source of resistance in all four locations was ICA 10.

If resistance in La Libertad is the result of a low concentration of the virus, this would indicate that hoja blanca evaluations under field conditions at La Libertad are not reliable. Therefore, there is a critical need to develop a methodology to efficiently evaluate resistance to the virus under laboratory conditions or to develop the methodology to obtain a high disease pressure under field conditions.

It is also critical to search for other resistant sources, similar to ICA 10, in order to incorporate them into the program's promising materials.

Recent Studies of Hoja Blanca and its Vector, P.R. Jennings[1]

Introduction

Hoja blanca was reported for the first time in Colombia in 1935. The problem lasted some years and disappeared around 1940. Some 15 years later hoja blanca reappeared in several countries causing great losses. This epidemic lasted approximately 10 years and disappeared as an economic problem around 1965.

During the second semester of 1981, hoja blanca reappeared severely in the Eastern Plains of Colombia and in Calabozo, Venezuela. Varieties CICA 8 and CICA 4 were severely affected. That year the disease was reported in commercial plantings in coastal Ecuador and in Jaen-Bagua, Peru.

In view of the reappearance of hoja blanca, studies were initiated in 1982 to clarify this situation. The following are the results that have been obtained.

Hoja Blanca Virus (HBV) Studies

Studies which were conducted previously were repeated and the following are the results:

1. There is no HBV transmission through rice or weed seeds.

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1. Breeder, CIAT Rice Program, Palmira, Colombia.

2. There is no evidence that insects or mites different from the genus Sogatodes are vectors of the virus.

3. *S. oryzicola* survives well on rice but not so well in weeds and is the main vector of rice HBV. *S. cubanus* survives well on weeds and not on rice; it is the main vector of HBV in weeds.

The species are biologically different. Females of one species confined with males of the other do not produce progeny.

4. Both species transmitted the virus from weeds to rice and vice versa. However, the very low transmission percentages under forced conditions with proved vectors indicates that transmission from one host to another is insignificant under field conditions. Additionally, it is frequently observed that rice plants in the field are free of the disease while neighboring weeds are affected by HBV.

For this reason it has been concluded that HBV in weeds is not epidemiologically significant to rice and, consequently, weed control to control HBV is not justified.

5. In relation to the percentage of vectors in the field, ICA found 12.8% vectors in Meta, Colombia, a level similar to that encountered during the first epidemics 20 years ago. This high percentage of vectors explains the presence of the epidemic in Meta.

Only 0.12% vectors were found in the Cauca Valley (Table 49); there is no HBV in the Cauca Valley. However, 19% potential vectors were found. The presence of many potential vectors suggests that, to initiate an HBV epidemic in the Cauca Valley, only a source of the virus is lacking.

6. The incubation period of the virus in the insect was estimated using potential vectors. This period ranged from 12 to 44 days in 364 insects which does not agree with previous reports and makes it difficult to obtain pure colonies of vectors, non vectors, and potential vectors.

7. Previous work showed a high level of transmission of the virus from eggs to nymphs. Now it has been demonstrated that transmission also occurs through spermatozoids; female non-vectors x male vectors resulted in 6% of the nymphs receiving the virus from the males (Table 50).

Resistance to HBV

1. Plants are not protected against HBV through their resistance to the insect vector; for example, CICA 8, which is resistant to *Sogatodes*, is highly susceptible to the virus under field conditions.

2. Varietal reaction to the virus

With high concentrations of the virus (5 vectors/plant during 5 days), Bluebonnet and CICA 8 were susceptible at all ages.

Metica and Mudgo (low HBV incidence in Metica) are susceptible between 10-30 days of age and then become more resistant.

Colombia 1 was resistant at all ages with a minimum infection percentage. This is the first case of resistance to HBV in the seedling stage (Table 51).

3. Resistance of parents and lines

Many varieties in the seedling stage have been evaluated for HBV resistance following the methodology of a high concentration of virus during a 5-day period. All advanced lines and almost all parents were susceptible.

4. Sources of resistance

Eight varieties have been identified as highly resistant to HBV in the seedling stage using high concentrations of virus. All are of the Japonica type or have Japonica genes in their genetic background (Table 52).

5. Inheritance of resistance to HBV

Results of previous work using adult plants indicate that resistance to HBV is dominant over susceptibility and is controlled by one or two pairs of genes.

Preliminary results this year (1983) using seedlings (10 days of age) and high concentration of the virus indicate that the F_1 of a simple cross (resistant x susceptible) is resistant and that the F_1 of a triple cross (resistant x susceptible x susceptible) segregates 1:1, which confirms that resistance is dominant and controlled by one pair of genes.

6. Reaction of lines under field conditions

Several lines from CIAT's Rice Program have reacted as resistant in Meta where CICA 8, Bluebonnet 50, and other varieties are highly susceptible.

However, those lines resistant in Meta are all highly susceptible in Ecuador and Peru (most are lines that have CICA 7 in their genetic background).

While differences in reactions from one country to another appeared to be due to a new race of the virus, there is another factor that better explains this difference; i.e. different concentrations of the virus.

Four varieties were evaluated under greenhouse and field conditions for their reaction to five different virus concentrations which were obtained by changing the number of vectors (Table 53). HBV severity increased in CICA 7 and Metica 1 as the concentration of the virus increased, while Colombia 1 remained resistant. These results indicate that the lowest concentration is representative of Meta, Colombia, and the highest concentration is representative of Ecuador and Peru, and that differences in virus concentration among countries is a function of differential reaction of commercial varieties to the insect vector.

Studies on Sogatodes

Biotypes of Sogatodes oryzicola

Varietal resistance to Sogatodes has remained stable in commercial varieties for more than 15 years. The only exception is the susceptibility of IR 8 reported from Cuba. In Colombia, IR 8 was considered as resistant.

Resistance to the vector is evaluated in CIAT cages when the control, Bluebonnet, dies. IR 8 is resistant at this time. The methodology used in Cuba was followed; there, materials are evaluated when IR 8 starts suffering damage. Varieties were infested with the vector and two evaluations were conducted: the first one when Bluebonnet died and the second one a week latter when IR 8 showed damage. Resistant varieties (CICA 8, Mudgo, Nylamp, etc.) were found during the second evaluation, while IR 8 was susceptible. It was concluded that the differential reaction of IR 8 is a consequence of the methodology and not a different biotype present in Cuba.

Other lines also reacted as IR 8; Araure 1 from Venezuela, for example, was initially resistant but became susceptible in time.

It is, therefore, recommended to evaluate Sogatodes resistance when IR 8, Araure 1 or other similar varieties show direct damage.

Differential varieties for resistance to Sogatodes

In order to standardize studies on Sogatodes in different countries, numerous varieties were evaluated by infesting them four times. Fifteen varieties were selected that exhibited uniform reactions. This group is recommended to be used as differential varieties (Table 54).

Studies on the mechanism of resistance to Sogatodes

CICA varieties are resistant to Sogatodes because of their high level of antibiosis which negatively affects the whole life cycle of the insect.

Studies were initiated on non-preference as another resistant component. Table 55 shows data on non-preference for oviposition.

CICA 8 and CICA 4 have two types of resistance: antibiosis and non-preference. Metica 1 has antibiosis only and Bluebonnet (susceptible) has neither antibiosis nor non-preference. The relevance of this study is that it has demonstrated the existence of a new resistance component, non-preference. As a consequence, resistant promising lines should be evaluated for both components before releasing them as varieties.

Conclusions

1. There are no epidemiological or transmissibility differences of the HBV between the present epidemic and the one which occurred 20 years ago.
2. Weeds do not play an important role in rice HBV.
3. Resistance to the insect vector *Sogatodes* does not render protection against HBV.
4. All commercial varieties in Colombia are susceptible to HBV.
5. There are excellent sources of resistance to the virus; these sources of resistance should be incorporated into susceptible promising lines, through backcrossing to susceptible lines.
6. *Sogatodes* remains stable. There are no biotypes and varietal resistance is still working.

Future Research on Hoja Blanca

Francisco Morales, Virologist with CIAT's Bean Program, who acted as Chairman, stated that a nucleo-protein with viral characteristics was isolated from materials with hoja blanca symptoms in recent research conducted at CIAT. He indicated that this virus has not been classified and that it is similar to the rice striped virus present in Japan and to the maize striped virus present in USA.

He also pointed out that an anti-serum has been developed which allows hoja blanca detection in affected material and insect vectors, using the Elisa technique.

The possible existence of HBV races was discussed on the basis of differential field reactions of some varieties that show resistance in Colombia and susceptibility in Peru, Ecuador, and Venezuela. However, results from recent studies conducted under laboratory conditions at CIAT demonstrated that some resistant varieties, such as CICA 7, become susceptible when exposed to a high concentration of the virus, while varieties highly resistant, such as Colombia 1, remain resistant. This would partially explain the difference in varietal reactions from one site to another. However, to confirm that the virus has no races, it was suggested that groups of differential varieties for hoja blanca, including highly resistant, intermediate and susceptible materials be established. If HBV is observed in highly resistant varieties, samples of diseased tissue should be sent to CIAT for serological tests and to determine if it is a new race of the virus. These differential varieties would be included in the 1984 VIOAL-HB.

Regarding the methodology to evaluate HBV resistance, it was suggested that the system be standardized, using the method developed by CIAT to evaluate materials in the seedling stage. The method is efficient to evaluate small populations, but it demands much time for larger populations.

To determine the percentage of insect vectors in a field population, it was suggested that samples of death insects be sent to CIAT for their identification using the Elisa serological test. Samples of 300-500 insects are required for this test.

The identification of HBV races can also be accomplished by analyzing infected leaf tissues using Elisa serology. In this case, collaborators should send 3-4 cm^2 dry leaf tissues affected by hoja blanca.

Table 29. Performance of HB vectors <u>S. oryzicola</u> throughout seven generations.

Insects	Total insects tested	Generations						
		F_1	F_2	F_3	F_4	F_5	F_6	F_7
Infective/ inoculated	1303/1432	216/229	629/ 751	239/ 248	102/ 115	24/ 29	53/ 66	40/ 44
% transmitters	91	94,3	90.0	96.3	88.7	82.7	80.3	91.0
% mortality	18	6	16	13	23	24	24	20

Table 30. Main lines or varieties with HB resistance in Cuba.

No. record	Pedigri	Name or origin	HB reaction[a]	Age at inoculation (days)
1566	IR 1905-81-3-2	IRRI	R	17
1571	IR 2091-21-3-3	IRRI	R	17
1814	IR 1542-51-2-6-3	IRRI	R	18
1956	Naylamp	Perú	R	12-30
2097	IR 1544-284-3	IRRI	R	12-25
2131	IR 1300-72-2-3	IRRI	R	14
2279	PNA 12-24-1-2-5	Perú	R	13
2280	PNA 12-24-1-2-6	Perú	R	13
2281	PNA 12-24-2-1-2	Perú	R	13
2282	PNA 12-24-2-1-3	Perú	R	13
2283	PNA 12-24-2-2-24	Perú	R	13
2332	Thailand 3-2-3-1	Thailand	R	25
1264	IR 5	IRRI	R	18
1305	CICA 4	Colombia	R	14
1564	IR 1905-72-3-3	IRRI	R	25
1565	IR 1905-81-3-2	IRRI	R	25
1602	IR 1857-69-1	IRRI	R	14
1604	IR 1857-84-2	IRRI	R	17
1716	IR 1529-430-3-1	IRRI	R	24
1812	IR 1542-30-2-4	IRRI	R	18
1813	IR 1542-30-24-3	IRRI	R	18
1815	IR 1542-15-2-2-1	IRRI	R	18
2098	IR 1544-340-6-1	IRRI	R	18
2131	IR 1300-7-2-3	IRRI	R	13
2284	PNA 12-24-2-3-2	Perú	R	25
2331	Thailand Kn-1-3	Thailand	R	25

a. 0- 10% R (resistant)
11- 20% I (intermediate)
21-100% S (susceptible)

SOURCE: Orellana y Ginarte, 1977 and Orellana, 1981.

Table 31. Comparison of reaction of eight varieties tested for HB with highly infective colonies, Gavidia (1979) and Orellana and Ginarte (1977).

					Orellana and Ginarte (1977)			
Varieties	Age inoc.	Days under inoc.	% diseased plants	HB reaction[a]	Age inoc.	Days under inoc.	% diseased plants	HB reaction[a]
IR 5	30	3	4.66	R	20	8	13	I
ICA 10	30	3	0.66	R	18	4	40	S
MUDGO	30	3	3.33	R	14	3	36	S
TKM-6	30	3	24.66	S	18	6	60	S
Taichung-Native 1	30	3	30.00	S	24	2	100	S
IR 8	30	3	34.00	S	15	7	98	S
Dawn	30	3	37.3	S	20	8	100	S
Bluebonnet	30	3	59.3	S	14	3	100	S

a. resistant (R)
intermediate (I)
susceptible (S)

Table 32. Reaction to HB in rice lines and varieties under natural infection conditions (Ecuador, 1978).

Select. No.	Name/Cross	Localities Arenillas	Hda. P. Tropicales	Samborondón
50357	P 941-1-1-2-3-B-1B F1 (IR 930-147-8xIR 579-48-1-2) x Tetep	82 [a]	36 [a]	20 [a]
50402	P 1038-13-3-1B F1 (P 761xP 880 x F1 (P 761xP 881)	72	40	17
50405	P 1039-19-2-1B F1 (P 761xP 881) x F1 (P 761xP 881)	62	29	16
50415	P 1042-2-2-3-1B F1 (IR 930xIR 579) x F1 (IR 930xIR 22)	32	25	13
50417	P 1042-6-7-1B F1 (IR 930xIR 579) x F1 (IR 930xIR 22)	40	27	14
50431	P 1048-17-6-1B P 780xF1 (758xTetep)	73	55	30
IR 6		62	24	18
IR 8		69	39	17
SML		73	30	18
INIAP 6		47	19	16
INIAP 7		45	31	17
$\bar{X}$		50.7	32.3	17.8

a. Average (%) diseased plants at flowering in three replications.

Table 33. Evaluation of rice HB under natural infection conditions (Ecuador,1978-1981).

Line No.	Origin	Nursery	Scale[a] 1-3	4-5	6-9
114	CIAT	Observation lines	60 [b]	49 [b]	5 [b]
143	CIAT	Observation lines	113	27	3
249	IRRI	IRLRON-1979	165	62	22
9	IRRI	Extra large grain	6	3	0
22	CIAT	VIRAL-S, 1979	20	2	0
22	CIAT	VIAVAL-77-78-79	11	10	1
24	CIAT	VIRAL-P Y T 77-78-79	8	8	8
12	IRRI	CM-T- 1977	8	2	2

a. Standar evaluation scale 1-9
b. No. of lines.

Table 34. HB evaluation in 21 "criollo" varieties under natural infection conditions in Ecuador, 1980.

Scale[a]	Cultivars
1 - 3	Nilo, Chato Rayado, Pancho Vera, Canilla, Chileno, Brasilero, Cafuriga-2, 7 Canuto, Pico Negro, Rabo de Yegua, Papayo, Donato
4 - 5	Piedad, Fama, Cafuringa-1, Ayora, Cenit, Congoneño, Chato, Chato con Arista

a. Standard evaluation scale 1-9.

Table 35. HB evaluation of 22 rice varieties under natural infection conditions in Ecuador, 1980.

Scale[a]	Cultivars
1 - 3	IR 46, CICA 9, IR 36, IR 32, IR 34, CICA 6, Ciwini, Juma 57, Ceysvoni, CICA 7, INTI
4 - 5	INIAP 415, INIAP 7, CR 1113, Gloria-3, INIAP 6, Camponi, Bamoa, CICA 8
6 - 9	IR 8, IR 6, INIAP 2

a. Standard evaluation scale 1-9.

Table 36. HB reaction in some VIOAL-HB lines (Ecuador, 1982).

Selection No.	Planting season [a]			$\bar{X}$
	I	II	III	
17	80 [b]	9	40	43
19	79	20	23	41
39	89	21	40	50
1	94	22	38	51
46	75	25	20	40
52	88	25	73	62
77	100	26	83	70
64	100	27	76	68
32	100	29	68	66
31	95	63	15	58
5	91	79	25	65
3	85	32	27	48
23	100	70	27	66
40	100	41	30	57
Bluebonnet 50	85	97	73	85
CICA 7	99	64	42	68
CICA 8	93	90	91	91
Bg 90-2	95	71	65	77
ICA 10	0	0	0	0

a. Planting season 20 days apart.
b. Percentage of diseased plants at flowering.

Table 37. Percent reaction to HB in some rice lines under natural infection conditions (Ecuador, 1982).

Selection No.	Name/Cross	Incidence (%)	Severity (1-9)
14 (VIRAL-S, 1978)	IR 2058-78-1-3-2-3 IR 1416-131/IR 1364-37/IR 1366-120/IR 1539-111	8 [a]	2 [a]
12 (VIRAL-S, 1979)	MRC 172-9	26	4
9 (VIRAL-T, 1978)	IR 4422-98-3-6-1 IR 2049-134-2/IR 2061-125-37	31	5
CICA 7		68	7
CICA 8		91	7
Bluebonnet 50		85	7
ICA 10		0	1

a. Average of three replications evaluated at flowering.

Table 38. Percent reaction to HB in three INIAP rice varieties in Ecuador, 1978-1982.

Varieties	Year and localities [a]				
	1978 (Arenillas)	1979 (Arenillas)	1980 (Arenillas)	1981 (Daule)	1982 (Sausalito)
INIAP 6	47 (73) [b]	14 (31)	0.5 (3)	3 (3)	50 (100)
INIAP 7	45 (48)	9 (19)	0 (0)	9 (31)	55 (77)
INIAP 415	32 (40)	16 (19)	1 (3)	2 (3)	36 (56)
IR 8	69 (80)	7 (16)	5 (13)	15 (25)	97 (100)
BLUEBONNET 50	-	-	-	-	73 (100)
PICO NEGRO	-	-	-	-	73 (100)

a. Average of two replications, except for 1978 and 1982 when there were three.

b. Number in parentheses indicates highest percentage observed in evaluated replications at flowering.

Table 39. Reaction of rice crops to mechanical damage by S. oryzicola under greenhouse conditions (Ecuador, 1982).

Selection No.	Name/Cross	Mortality %	Severity (1-9)
18 (VIRAL-S, 1979)	Gama 318	0 [a]	1
12 (VIRAL-S, 1979)	MRC 172-9	3	3
1 (VIRAL-T, 1979)	BR 51-46-5	5	5
	IR 20/IR 5-114-3-1		
14 (VIRAL-S, 1978)	IR 2058-78-1-3-2-3 IR 1416-131/IR 1364-37/IR 1366-120/IR 1539-111	8	4
127 (VIOAL-S, 1980)	KMP 34	10	3
BLUEBONNET 50		100	9
MUDGO		8	2

a. Average of two evaluations.

Table 40. Reaction of some rice varieties to mechanical damage by *S. oryzicola* under green house conditions.

Varieties	Mortality (%)	
	1st. evaluation	2nd. evaluation
INIAP 6	75	0
INIAP 7	50	0
INIAP 415	85	15
IR 6	100	15
IR 8	88	58
MUDGO	0	15
ICA 10	- [a]	68
PICO NEGRO	100	100
BLUEBONNET 50	100	100

a. Non evaluated.

Table 41. HB incidence in commercial rice varieties in the field in Bagua (Peru).

Variety	% diseased seedlings 1981	1982	Average
1 - Inti	2.0	6.4	4.20
2 - CICA 7	2.0	8.0	5.00
3 - Chancay	2.4	8.4	5.40
4 - Radin China	4.0	9.0	6.50
5 - Huarangopampa	2.5	11.0	6.75
6 - Naylamp	8.4	6.0	7.20
7 - CICA 8	7.2	11.6	9.40
8 - IR 8	6.4	15.6	11.00
9 - Bg 90-2	8.4	14.8	11.60
10- Colombia I (T)	0.0	0.0	0.00
11- Blue bonnet 50 (T)	15.5	20.5	18.00

Table 42. Evaluation of promising varieties and lines under HB attack in Huarangopampa, Bagua, Peru, 1978-1982.

Cultivar	HB % diseased seedlings	Yield (kg/ha)
Colombia 1	1.9	5.123
Raminad Str. 3	2.9	3.462
Ram Tulasi (Sel)	3.0	2.326
Dissi Hatif	5.8	4.480
IR 1544-238-2-3	6.7	5.094
IR 9550-PP 889-1	7.5	3.488
IR 480-5-9-2	8.5	5.987
IR 9667-PP 836-1	8.9	4.636
Tadukan	9.0	2.234
Tetep	10.0	2.689
Mamoriaka	11.0	2.426
Carreon	11.9	3.368
P 881-19-24-9-4	12.1	3.832
IR 1416-1-42-2-3-3	12.3	4.431
IR 5533-PP 850-1	14.1	3.946
C 46-15	16.6	4.370
IR 1905-81-3-1	18.6	3.740
CICA 8 (T)	18.3	2.336

Table 43. Promising material noted for less HB incidence in Huarangopampa, Bagua, Peru, 1982.

Line	HB[a]
IR 4422-143-2-1	.0
IR 48	0.2
IR 3351-38-3-1	0.2
IR 48	0.3
PNA 314-F4-140-1	0.3
PNA 314-F4-202-1	0.4
P 1577-1-23M-5-1M-4	0.5
IR 4422-98-3-6-1	0.5
UPR 7030-25	0.1
IR 9802-31-2	0.2
IR 13415-9-3	0.3
B 2850-B-ST-2-1	1.4
Bg 90-2	1.6
IR 8 (T)	4.4
CICA 8 (T)	10.6
INIT (T)	2.0

a. Percentage of diseased seedlings.

Table 44. HB nursery material (109) and national rice program promising lines (125) noted for less HB incidence in three plantings in Huarangopampa, Bagua, Peru, 1982.

Name	Planting seasons [a]			Average
	1°	2°	3°	
	% diseased seedlings			
PNA 343-F4-446-2-1	0	2.4	0.8	1.07
PNA 343-F4-440-1	1.2	0.8	1.2	1.07
PNA 314-F4-201-1	0.8	0.6	2.0	1.13
PNA 343-F4-446-2-3	0.4	1.2	2.2	1.26
PNA 343-F4-446-2-4	0	0.4	3.6	1.33
PNA 343-F4-372-1	0.6	0.6	2.8	1.35
PNA 314-F4-51-1-3	0	1.6	2.6	1.40
PNA 343-F4-446-1-3	0.2	1.8	2.4	1.47
PNA 372-F4-5-1-3	0	2.0	2.6	1.52
PNA 314-F4-41-1	0.8	0.6	3.4	1.60
PNA 372-F4-2-1-5	0.2	4.6	0.4	1.73
PNA 314-F4-202-1	1.6	0.8	3.0	1.80
PNA 343-F4-346-1	1.6	0.8	3.0	1.80
PNA 343-F4-134-1-2	0.8	3.4	1.4	1.86
PNA 372-F4-3-1-1	2.0	1.8	2.0	1.93
PNA 343-F4-232-1	1.2	3.6	1.4	2.07
PNA 314-F4-85-1	1.0	2.4	2.8	2.05
PNA 343-F4-517-1-2	2.4	2.9	2.1	2.45
P 2 189-F4-64-1B-1B-3-1B	3.2	2.6	2.6	2.80
Colombia I (T)	0	0.40	0.46	0.29
ICA 10 (T)	0	0	0	0
Blue bonnet 50 (T)	6.20	8.62	8.66	7.83
Bg 90-2 (T)	10.86	17.60	14.80	14.42
CICA 7 (T)	6.91	9.31	12.62	9.61
CICA 8 (T)	10.86	18.34	20.60	16.60

a. Planting every 20 days.

Table 45. Commercial duration of rice varieties in Peru.

Variety	Name	Duration	Cause
IR 8	1968	8 years	HB
Chancay	1972	Continuous	—
Naylamp	1972	9 years	M. Ojival Blast
Huallaga	1973	2 years	Blast
Inti	1975	continuous	—
Viflor	1982	—	—
Tallan	1982	—	—
Huarangopampa	1982	—	—

Table 46. VIOAL-HB 1982 lines resistant to HB in La Libertad (Colombia) and susceptible in Guayas (Ecuador), Bagua (Peru) and Calabozo (Venezuela).

Line No.	Name	Resistance sources	HB reaction[a]			
			La Libertad Colombia	Guayas Ecuador[b]	Bagua Peru[b]	Calabozo Venezuela[c]
1	P 2023 F4-74-2-1B	CICA 7	1	6.3	4.0	4.5
2	P 2030 F4-217-4-1B	CICA 7, CICA 4	2	5.6	4.0	5.0
3	P 2030 F4-222-1-1B	CICA 7, CICA 4	0	5.0	4.3	4.0
4	P 2030 F4-222-2-1B	CICA 7, CICA 4	0	5.0	5.6	5.0
5	P 2030 F4-243-4-1B	CICA 7, CICA 4	0	5.0	6.3	5.0
6	P 2025 F4-159-3-1B	CICA 7, CICA 4	0	5.6	6.3	4.0
8	P 2030 F4-226-1-1B	CICA 7, CICA 4	0	7.0	6.3	4.0
10	P 2180 F4-82-5-1B	SML 56/7	2	7.0	5.3	5.0
18	P 2189 F4-64-1-1B	Bahagia ?	1	6.3	5.6	4.0
31	P 2217 F4-30-4-1B	CICA 7, Remadja ?	2	6.3	4.3	4.0
32	P 2217 F4-45-7-1B	CICA 7, Remadja ?	2	6.3	5.0	4.5
35	P 2231 F4-4-7-1B	CICA 7, Pelita 1/1	2	7.0	6.3	4.5
36	P 2231 F4-13-2-1B	CICA 7, Pelita 1/1	1	7.0	4.3	4.5
37	P 2231 F4-45-6-1B	CICA 7, Pelita 1/1	1	6.3	4.3	4.0
38	P 2231 F4-45-8-1B	CICA 7, Pelita 1/1	1	6.3	5.6	4.5
40	P 2231 F4-138-2-1B	CICA 7, Pelita 1/1	0	6.3	4.0	4.0
47	P 2015 F4-128-5-4-1B	CICA 7	1	8.3	7.6	6.5
48	P 2016 F4-87-5-5-1B	CICA 7	0	6.3	5.0	5.5
50	P 2025 F4-93-1-5-1B	CICA 7, CICA 4	1	6.3	5.6	5.0
51	P 2025 F4-93-2-2-1B	CICA 7, CICA 4	0	7.0	5.6	5.0
52	P 2025 F4-93-2-5-1B	CICA 7, CICA 4	1	5.6	5.6	5.5
54	P 2026 F4-49-5-5-1B	CICA 7	1	7.6	7.0	6.0
55	P 2030 F4-88-1-2-1B	CICA 7, CICA 4	0	7.0	5.6	4.5
62	P 2180 F4-7-5-1B	SML 56/7	3	7.0	5.6	5.5
68	P 2180 F4-55-1B-1B-4-1B	SML 56/7	0	8.0	5.0	7.0
70	P 2182 F4-39-1B-1B-4-1B	Pelita 1/1	0	7.0	5.0	6.5
76	P 2182 F4-39-1B-1B-6-1B	Pelita 1/1	0	7.0	4.3	4.0
77	P 2182 F4-49-1B-1B-1-1B	Pelita 1/1	0	7.0	4.3	6.0
95	P 2195 F4-107-1B-1B-1-1B	K 8	0	9.0	5.6	4.0
97	P 2017 F4-140-3-1B	CICA 7, CICA 4	0	7.6	5.0	4.0
106	P 2023 F4-20-9-1B	CICA 7	3	8.3	5.0	5.0
107	P 2023 F4-53-1-1B	CICA 7	0	7.0	7.0	5.5
108	P 2023 F4-53-4-1B	CICA 7	0	7.0	7.0	6.0
	Checks[d]					
	Bluebonnet 50 (S)		6.1	7.3	5.6	6.0
	CICA 8 (S)		4.7	7.4	6.5	4.4
	CICA 7 (R)		0.0	7.4	6.0	4.5
	Bg 90-2 (S)		5.0	7.6	6.3	3.4
	ICA-10 (R)		0.0	1.3	0.1	0.0

a. International scale 0-9; 0 = resistant, 9 = susceptible.
b. Average of three planting seasons, observations taken at flowering.
c. Average of two replications, observatins taken at 103 days of age.
d. Average of seven replications, observations taken at flowering.

Table 47. VIOAL-HB lines susceptible to HB in La Libertad (Colombia), Guayas (Ecuador), Bagua (Peru), and Calabozo (Venezuela).

			HB reaction [a]			
Line No.	Name	Resistance sources	La Libertad Colombia	Guayas [b] Ecuador	Bagua [b] Perú	Calabozo [c] Venezuela
7	P 2034 F4-25-6-1B	CICA 4	7	7.0	7.0	4.0
9	P 2177 F4-44-5-1B	K8, Bahagia ?	4	7.0	7.0	5.0
16	P 2181 F4-75-6-1B		7	7.0	7.6	6.0
17	P 2186 F4-54-1-1B	Colombia 1	6	5.6	5.6	5.0
20	P 2192 F4-37-1-1B	CICA 7, K8 ?	8	6.3	6.3	4.0
21	P 2192 F4-37-3-1B	CICA 7, K8 ?	9	7.0	7.0	5.0
22	P 2192 F4-46-8-1B	CICA 7, K8 ?	7	7.0	5.0	4.0
23	P 2201 F4-63-3-1B	CICA 4, SML 56/7	6	6.3	5.0	4.0
25	P 2216 F4-12-4-1B	Remadja ?	8	7.0	7.0	5.0
33	P 2217 F4-2-1-1B	CICA 7, Remadja ?	7	7.6	7.6	4.0
53	P 2026 F4-49-2-1-1B	CICA 7	7	7.6	5.6	6.0
61	P 2034 F4-65-2-4-1B	CICA 7	7	7.0	7.0	6.0
63	P 2186 F4-2-2-1B	Colombia 1	6	6.3	8.3	4.0
64	P 2186 F4-19-2-1B	Colombia 1	5	7.0	7.0	5.0
65	F4-1-1B-1B-5-1B		4	7.0	7.6	5.0
66	P 2177-F4-48-1B-1B-1-1B	K8, Bahagia ?	7	6.3	6.3	6.0
67	P 2177 F4-48-1B-1B-7-1B	K8, Bahagia ?	7	7.0	5.6	6.0
69	P 2181 F4-40-1B-1B-1-1B		6	7.0	7.0	4.0
82	P 2192 F4-30-1B-1B-4-1B	CICA 7, K8 ?	8	7.0	5.0	4.0
85	P 2192 F4-37-1B-1B-11-1B	CICA 7, K8 ?	9	7.0	5.6	6.0
91	P 2192 F4-37-1B-1B-13-1B	CICA 7, K8 ?	7	8.3	5.6	5.0
92	P 2193 F4-10-1B-1B-3-1B	K8	8	9.0	5.6	6.0
93	P 2193 F4-22-1B-1B-5-1B	K8	8	9.0	5.6	6.0
94	P 2193 F4-158-1B-1B-7-1B	K8	8	8.3	6.3	6.0
96	P 2015 F4-108-4-1B	CICA 7	6	8.3	5.0	5.0
98	P 2019 F4-24-7-1B		6	8.3	5.6	4.0
99	P 2019 F4-72-3-1B		6	7.6	5.6	4.0
100	P 2023 F4-20-2-1B	CICA 7	6	7.0	5.0	6.0
	Checks [d]					
	Bluebonnet 50		6.1	7.3	5.6	6.0
	CICA 8		4.7	7.4	6.5	4.4
	Bg 90-2		5.0	7.6	6.3	3.4
	CICA 7		0.0	7.4	6.0	4.5
	ICA 10		0.0	1.3	0.1	0.0

a. International scale 0-9: 0 = resistant, 9 = susceptible.
b. Average of three planting seasons, observation at flowering.
c. Average of two replications, observations at 103 days of age.
d. Average of seven replications.

Table 48. VIOAL-HB-1982 lines with different HB reaction in Calabozo (Venezuela), La Libertad (Colombia), Guayas, (Ecuador), and Bagua, (Peru).

Line No.	Name	Resistance sources	HB reaction[a] Calabozo Venezuela	La Libertad Colombia	Guayas Ecuador	Bagua Peru
19	P 2192 F4-30-2-1B	CICA 7, K8	2.0	5	5.6	4.0
24	P 2201 F4-78-6-1B	CICA 4, SML 56/7	3.0	4	7.0	5.0
34	P 2217 F4-44-7-1B	CICA 7, Remadja ?	3.0	5	7.0	6.3
49	P 2023 F4-16-5-1-1B	CICA 7	2.0	6	7.6	5.0
81	P 2192 F4-30-1B-1B-1-1B	CICA 7, K8 ?	2.0	6	7.6	4.3
83	P 2192 F4-30-1B-1B-5-1B	CICA 7, K8 ?	2.0	8	7.0	3.6
84	P 2192 F4-37-1B-1B-7-1B	CICA 7, K8 ?	2.0	9	7.6	5.6
46	P 2231 F4-138-6-1B	CICA 7, Pelita 1/1	2.0	0	5.0	3.6
79	P 2189 F4-27-1B-1B-1-1B	Bahagia ?	3.0	0	7.6	4.3
109	P 2023 F4-53-8-1B	CICA 7	3.0	0	8.3	6.3
39	P 2231 F4-138-1-1B	CICA 7, Pelita 1/1	4.0	0	6.3	3.3
78	P 2182 F4-49-1B-1B-8-1B	Pelita 1/1	7.0	2	7.0	3.6
80	P 2189 Fr-64-1B-1B-3-1B	Bahagia ?	6.0	0	7.0	3.0

a. International scale 0-9; 0-2 = resistant; 2-1 - 3.0 = moderately resistant; 3.1 - 4.0 = moderately susceptible; 4.1 - 9.0 = susceptible.

Table 49. Percentage of active HB vectors in Sogatodes species collected in the field.

Insect and host	Sampled area: Meta [a] No. tested insects	Transmission (%)	Valle del Cauca No. tested insects	Transmission (%)
S. oryzicola (rice)	235	12.77	807	0.12
S. cubanus (*E. colona*)	-	-	1132	4.95

a. Data provided by Agr. Eng. Orlando Jiménez, La Libertad-ICA.

Table 50. Transovaric transmission of rice HBV.

Cross			No. evaluated nymphs	Transmitting nymphs (%)
Female		Male		
Vector	x	vector	356	89.60
Vector	x	non-vector	138	75.40
non-vector	x	vector	272	6.25

Table 51. Reaction of five rice varieties to HBV in four stages of development.

Varieties	Age of plants (days)							
	10		20		30		40	
	Infection (%)	Inoculation (days)	Infection (%)	Inoculation (days)	Infection (%)	Inoculation (days)	Infection (%)	Inoculation (days)
Bluebonnet 50	100	6.8	100	7.0	100	10.4	94	9.9
CICA 8	100	6.5	100	8.1	88	9.7	81	10.6
Metica 1	100	7.3	100	8.9	94	10.4	25	16.3
Mudgo	100	7.3	88	7.2	44	9.9	13	15.5
Colombia 1	13	16.0	6	21.0	0	-	0	-

Table 52. Rice varieties highly resistant to HBV.

Variety	Country of origin
Colombia 1	Colombia
ICA 10	Colombia
Taichung 176	Taiwan
Taipei 309	Taiwan
IRAT 120	Ivory Coast
IRAT 121	Ivory Coast
IRAT 122	Ivory Coast
IRAT 124	Ivory Coast

Table 53. Effect of HBV dose on varietal reaction.

Variety	Dose (hours/vector/seedling)				
	7.2	14.4	28.8	57.6	115.2
	% affect. plants		-	Greenhouse	
Bluebonnet 50	28	45	65	90	100
Colombia 1	0	0	0	0	0
CICA 7	13	28	30	45	73
Metica 1	10	35	38	55	48
	% affect. plants		-	Field	
Bluebonnet 50	27	30	46	80	71
Colombia 1	0	5	0	3	1
CICA 7	18	18	30	34	48
Metica 1	9	10	24	46	58

Table 54. Varietal differences in evaluating reaction to *Sogatodes oryzicola*.

Variety	Origin	Reaction
H 5	Sri-Lanka	Highly resistant
Mudgo	India	Highly resistant
Rustic	Guyana	Highly resistant
Pelita 1/1	Indonesia	Resistant
Carreon	Philippines	Resistant
C 115	India	Resistant
IRAT 8	Costa de Marfil	Intermediate
Costa Rica	Surinam	Intermediate
IR 8	Filipinas	Intermediate
Mashuri	Malaysia	Intermediate
Colombia 1	Colombia	Highly susceptible
Bluebonnet 50	U.S.A.	Highly resistant
Moroberekan	Ivory Coast	Highly resistant
Azucena	Philippines	Highly resistant

Table 55. Number of eggs oviposited by *Sogatodes oryzicola* in paired resistant and susceptible varieties.

Variety	Reaction	No. of oviposited eggs		
		$\bar{X}$/plant	total 5 plants	Varietal non-preference (%)
CICA 4	R	127.6	638	55
Bluebonnet 50	S	230.2	1151	100
CICA 8	R	133.4	667	52
Bluebonnet 50	S	256.4	1282	100
Metica 1	R	606.4	3032	102
Bluebonnet 50	S	592.6	2963	100
CICA 8	R	64.2	321	53
Metica 1	R	120.2	601	100

COLLECTION OF RICE GERMPLASM IN LATIN AMERICA

During the discussion of the collection of germplasm in Latin America, emphasis was placed on the importance of the collection, characterization, and preservation of cultivars of the genus *Oryza* and wild species in the region.

Most national programs have no collections of their own varieties, many of which are genetically valuable for plant breeders; these materials are being eroded and it is urgent to collect them to preserve what is still available.

Representatives of national programs of countries such as Brazil, Cuba, Peru, the Dominican Republic, and Ecuador, pointed out that they have collected part of their improved and native varieties and that seeds of these materials were sent to IRRI's germplasm bank for their characterization and preservation. They also indicated that the collection had no continuity because of a lack of personnel and financial resources.

National program leaders recognized the importance of collecting rice cultivars and indicated that they would collaborate by sending seed of their available cultivars. They suggested also that CIAT assume leadership for this project and act as a depositary of cultivars for their classification and characterization; CIAT should also send duplicate samples of these cultivars to IRRI's International Rice

Germplasm Center for their complete characterization and long term preservation.

The following countries should receive priority for germplasm collection:

Central America and the Caribbean: Panama and the Dominican Republic

South America: Colombia (north coast), Ecuador, Peru (jungle), Brazil and Surinam.

CLASSIFICATION OF UPLAND RICE PRODUCTION ECOSYSTEMS, VARZEAS, ETC. IN LATIN AMERICA AND ASIA

The purpose of this section is to gather information on the different ecosystems for upland rice production in Latin America. This information will serve as a basis to standardize ecosystems and also to define and program future research needs concerning varieties and/or crop management for each ecosystem.

Five scientists were invited to discuss the main upland production ecosystems in Asia and Latin America including Mexico, Central America, the Andean region (Colombia, Ecuador, Bolivia, Peru and Venezuela), and Brazil.

The following is a summary of the papers discussed by these scientists.

Upland Rice Production Systems and Varzeas in Brazil, S.Steinmetz[1]

In this paper, the definition of upland rice will be that given in the meeting on this crop held in Bouake, Ivory Coast: "rice that depends upon rains and is cultivated on well drained soils with no water accumulation on the surface, with no influence from the phreatic levels and no dams to retain rain water."

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1. Agronomist, MS, Researcher, EMBRAPA/CNPAF, Goiania, Goiás, Brasil.

Upland rice has major economic and social importance for Brazil. Rice occupies the third place in surface area, fourth in production value, and fifth in tonnage. Its social importance is related to the fact that it is a basic staple for Brazil's population where per capita consumption is approximately 45 kg/year.

Upland rice accounts for approximately 60% of Brazil's total rice production. For the cropping year 1980-81, upland rice comprised approximately 84% of the 6.6 million/ha planted to rice (Table 56).

The most important problem for upland rice production is the occurrence of drought periods (veranicos) in some regions, which causes unstable rice productivity affecting national production.

Some aspects of upland rice production in Brazil, especially those related to the different ecosystems, are discussed in this paper.

Characteristics of upland rice production systems

There are considerable differences in purpose of production and technological levels between regions where upland rice is produced. Upland rice is produced for three main purposes: (1) as a subsistence crop, frequently in association with other staples. This system is more common in the north and northeastern regions; (2) as a transition crop, to clear the area for other purposes. This system prevails in agricultural frontier regions in which "cerrado" or forest areas are cleared for pastures as occurs in the centralwestern region; (3) as a commercial crop in lands already cultivated. This type of system is very important in the southeastern and southern regions.

1. Subsistence crop. Subsistence crops generally occur in small areas (less than 5 ha) where the producer is the tenant, not the owner, of the land. Farmers use family labor with no soil preparation (just clearing and burning), input use or appropriate seed. Rice is generally intercropped with maize, cassava and other crops. Most of the production is used for family consumption, and some is kept for seed and the rest, if any, is sold. This system, which prevails in several regions of the country, is most representative of the state of Maranhao, especially in the pre-Amazon region.

2. Transition crop. This system is representative of regions where there is animal production; rice is used for land colonization for two to three years, the land later being planted to pastures. Most of these rice crops in the central-western region are totally mechanized, from land clearing, planting and harvesting, to pasture establishment. Input use in this system is low. In some areas, where producers are more concerned with lowering pasture establishment costs, rice is cultivated in association with pastures. Rice and pasture planting is done in one sole operation. As rice develops more rapidly than pastures, there are possibilities of obtaining some productivity, although less than with monoculture rice. However, this practice lowers pasture establishment costs. Land renting is common in this region. The tenant has the right to cultivate rice during two to three years but in exchange he must establish pastures.

3. Commercial crops. In this cropping system rice is a component of the production system, generally in rotation with other crops. The

level of technology employed is relatively high with input use including chemical fertilizers, insecticides, fungicides, improved seed, and mechanization. The productivity of this system is higher than the national average for upland rice. However, the use of this system in the total area cultivated is relatively low.

Climatological risk

According to data obtained from PROAGRO in collaboration with the Banco Central do Brasil, upland rice is the second most risky crop after wheat in Brazil. The main cause of this risk is the occurrence of long dry periods (veranicos) in the main production regions although there are regions where these dry periods are less frequent or do not occur.

The CNPAF adopted a provisional nomenclature with 5 classes ranging from "highly favored" to "highly unfavored", indicating regions with no or very low risk to regions with very high risk of occurrence of dry periods. This classification is being improved in order to better characterize climatological risks to which the various upland rice production regions are exposed.

Planting dates

Table 57 shows the planting dates for the main rice production regions in Brazil. October and November are the most common planting dates in states where upland rice is produced. Plantings are earlier (September) in states located more to the south (Parana and Sao Paulo) and later (December and January) in northern states (Maranhao).

Rice production systems in varzeas

Varzeas are composed of alluvial or hydromorfic soils which are generally flat and rich in organic matter. In many cases they can be irrigated by gravity, they are highly fertile and can be temporarily flooded.

However, in many cases, they have excessive moisture content and, therefore, require adequate drainage for their appropriate use.

Area, types, and utilization of varzeas for rice production

According to data from PROVARZEAS, Brazil has a potential of approximately 30 million ha of irrigable varzeas. In 1979, a census was taken of approximately 24.155.103 ha.

There is great variability in the types of varzeas existing in Brazil, ranging from areas which are temporarily flooded to those in which the phreatic level just rises.

Due to its particular characteristics, rice is one of the main crops used in varzeas, either in a systematic manner (adapted and irrigated through immersion) or under humid lowland conditions (partially adapted or with no adaptation). Some aspects related to rice production in humid varzeas will be mentioned.

Humid varzeas rice cultivation in the southeast (Minas Gerais) and central-west (Goiãs and southern Mato Grosso) regions is done mainly during the rainy season when the phreatic level rises as a function of the increase of river water levels. During the dry season there are two main problems. The first one is the occurrence of low temperatures which affect rice development in some regions. The second is related to water supply as, in the majority of varzeas, there is a considerable decrease in the phreatic level which makes it difficult to produce rice without having some irrigation.

Compared to upland rice production, humid varzeas rice cultivation has some advantages, especially as water deficiency is eliminated or minimized as a problem. However, this type of production has some specific problems, such as the lack of improved varieties and weeds.

Most of the traditional varieties used in humid varzeas have undesirable characteristics such as excessively high stature and weak stems which account for their susceptibility to lodging; also, some varieties have relatively long growth cycles.

The CNPAF has been conducting research since 1980 to obtain specific varieties for this cropping system. The program is basically searching for the following characteristics:

a. resistance to lodging;

b. vegetative vigor so that the plant can compete with weeds;

c. early to intermediate growth cycle (120-130 days);

d. plant height of approximately 1 m;

e. tolerance to Fe toxicity;

f. resistance to blast (*Piricularia oryzae*), brown spot (*Helminthosporium oryzae*), and leaf scald (*Rynchosporium oryzae*);

g. good grain quality; and

h. good yielding capacity with few or no modern inputs, especially fertilizers.

Among varieties and lines evaluated, as of July 1982, the following are considered promising: BR 51-282-8; B 2039 G-KN-7-2-5-3-1, CNA 810078, Ninacao and CNA 810130.

Weeds are considered the major problem in rice production in humid varzeas. Weed growth is considerably high during the first or second production year. The Cyperaceae Cyperus spp. and Fimbustylis littoralis are the most widely distributed and agressive weed species in the humid varzeas of the experimental area of CNPAF, in Goiania. Broad leaf species include Ludwigia spp., Aeschynomene rudis, Caperonia palustris, and others of minor importance.

CNPAF's activities related to this problem focus on the classification and identification of weeds and ways to control them economically through chemical control or integrated control (chemical, mechanical, and cultural).

Upland Rice Production Systems in Central America, E. Espinosa[1]

Introduction

Central America is politically divided into seven countries: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, and Belize. Central America is located in the tropics between latitudes 7 and 18° north. Geographically it is an insthmus characterized by intense seismic and volcanic activity. Its height ranges from sea level to 2000

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masl in the mountainous zone. Volcanic ash, alluvial and residual soils are abundant in the area, some of which have low fertility problems, excess acidity, and high phosphorus fixation.

In general, rice is a relatively important staple crop in all countries of the region in terms of area planted, production and per capita consumption. Rice is the most important staple in Panama and Costa Rica; in El Salvador and Guatemala it ranks third after maize and beans; and in Nicaragua and Honduras it ranks fourth after maize, beans, and sorghum.

Production zones

Of the total upland rice area in Central America (250.000 ha), it is estimated that 87% is planted to upland rice. Upland rice is planted directly and its growth depends upon rains. Only Belize and Nicaragua have more surface area planted to irrigated rice (60 and 65%, respectively). The rest of the countries employ irrigation but on a small scale. Upland rice accounts for 80% of the total production in the area.

Upland rice is mostly concentrated in high rainfall regions with flat topography and developed infrastructure. The main rice production regions are the coastal plains of Belize, the valleys of Motagua and Polochic on the northern coast of Guatemala, the state of Cortes, Atlantida and Colon on the northern coast of Honduras, the Pacific coasts of Guatemala and El Salvador, the states of Matagalpa, Boaco and Carazo in Nicaragua, north and south Pacific Costa Rica, and the Pacific coastal plains of Panama.

Production systems

Within the regions upland production systems which can be distinguished include the traditional or manual system, the semi-mechanized system and the fully mechanized system.

a. Traditional or manual upland production system. This system is found in more than half the area planted to upland rice in most Central American countries. The first step is land clearing with ax and machete and the burning. This is done during the dry season in 1-3 ha plots with no tilling. Sowing is done when rains begin in April or May, at a rate of 15-20 kg of seed/ha. Seeding is done in hills by placing several seeds in holes spaced approximately 40 cm apart. These planting distances allow weed control with a machete and hoe. Rice varieties are tall statured with long grain (Nira, Fortuna, Rexoro, Bluebonnet, etc.) and, although considered as local materials, they were probably introduced many years ago. Yields range from 1-1.5 t/ha.

In this system it is customary to interplant rice with other crops, especially corn and edible roots (cassava, ñame and others).

b. Semi-mechanized upland rice production system. This system is practiced in 1-5 ha plots that have been already cleared and cropped for several years; soils are mechanically prepared (plowing and disking). Sowing is done manually in hills or broadcast and in some cases is done with mechanical planters. In some regions manual sowing is done at regular intervals or in rows spaced at 50 cm, which allows mechanical weeding or intercropping between the rows. Rice growers use some agricultural inputs (fertilizers and pesticides) and rice is harvested manually.

c. Fully mechanized upland rice production system. This system prevails in all countries of the region in relatively large fields and flat lands with intermediate to high fertility soils, and in regions where rainfall is abundant during the cropping cycle.

New lands are cleared and soils are broken up with heavy machinery. Lands previously planted are prepared before planting using conventional equipment; i.e., heavy plowing and disking in well drained soils and using a rotovator in more humid and heavy soils. When soil conditions allow, sowing is done in rows with mechanical planters, otherwise the seeds are broadcast. Herbicides, insecticides, fungicides, and nitrogen fertilizers are applied by means of light aircraft, helicopters or by appropriate equipment attached to the tractor. Harvesting is done with combines and the product is handled in bulk.

Rice growers use high level technology with intensive application of inputs (fertilizers, herbicides, insecticides and fungicides). Production costs vary from one country to the other, but in Panama and Costa Rica they fluctuate between US$800-1000/ha. Fifty percent of the upland rice in these two countries is mechanized and accounts for approximately 80% of the total production.

Upland rice production constraints in Central America

There are a number of environmental factors that affect upland rice production in the region but the most important is low rainfall and its unfavorable distribution. In the last few years, prolonged dry periods have negatively affected production in the main rice growing areas. In the future, production will be promoted in areas with more favorable climatic conditions and an irrigation infrastructure will be developed to solve this problem.

Other upland rice production constraints in the region include weeds, diseases, pests and soil problems.

Upland Rice Production Systems in Mexico, L. Hernández, L. Tavitas, H. Quintero[1]

Introduction

Rice in Mexico is presently produced under three cropping systems: irrigated with direct sowing, irrigated with transplanting, and upland. Semi-deep water rice production is a fourth system which has great future potential for the south-east regions of the country and INIA is presently developing preliminary production technologies.

Profitability and production areas

Direct seeding with irrigation is the most profitable of the three commercial systems because of its high technology level; it is found mostly in the states of Sinaloa, Nayarit, Tamaulipas, Jalisco, San Luis Potosí, part of Colima and the Istmo de Tehuantepec, Oax. Studies conducted at Sinaloa in 1981 indicated that the benefit/cost ratio for this system in 5.84.

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1. INIA Rice Program Researchers.

Transplanted rice is found principally in central Mexico in the states of Morelos, Guerrero, Puebla, and Mexico. Other states where this cropping system is used, although less frequently, are Veracruz (central area) and Michoacan. The benefit/cost ratio of this system based on studies conducted at Morelos in 1981 is 0.45.

Upland rice is cultivated from the Papaloapan river basin, in Veracruz and Oxaca, to Quintana Roo, including Chiapas, Tabasco, and Campeche; other areas or minor importance are located in the states of Nayarit and Colima. In a socio-economic study carried out in 1981 in the state of Veracruz, the benefit/cost ratio for this system was estimated at 0.27.

Figure 4 shows the evolution of rice cropping systems in Mexico.

Upland rice

Upland rice depends on rainfall from seed germination through vegetative growth to the reproductive stages. From the beginning of their growth cycle, plants have no defense and consequently are exposed to attacks by pests and diseases and to high weed infestation. They can also suffer the effects of dry periods due to erratic or scarce rainfall. This results in partial or total crop losses. Additionally, due to the aerobic conditions in which plants develop, different soil chemical reactions can occur, depending on soil pH. If the soil is acid, minor element toxicities (for example Fe) can occur, and if it is alkaline minor element deficiencies (Fe and Mn) are possible, the effects of which can cause seedling death and, consequently, lower yields. Figure 5 shows upland rice production variations during the period 1973-1982.

Upland rice production systems in Mexico

Upland rice is presently cultivated under three production systems: rustic, traditional and mechanized.

Rustic system of "clearing and burning". Around 1600 the Spaniards first introduced this system into forest areas with irregular topography in the region that is presently part of the states of Veracruz and Oaxaca. At present, this system is still used in some areas of both states as well as in some places in Chiapas, Tabasco, and Quintana Roo.

The bushes are cleared with a machete. Then forest trees are cut down; if they are tall (from 20 to 50 years old) felling is done from August to December; if the trees are from 8 to 18 years old felling is done from December to March; and if the forest is young (from 4 to 6 years old) it is cut down from March to April. Burning is carried out during the second half of April following the direction of the wind and controlling the fire by means of a 2-3 m wide boundary line. Sowing is done using the "hand spike" system which consist of making 5-7 cm deep holes in the ground 20-30 cm apart and placing in each one the amount of seeds that can be grasped with the index and middle fingers and the thumb; the planting density is around 30 kg/ha. This cropping system is generally found on the hillsides and is typical of a subsistence agriculture.

Traditional system or cropping in rows. Soils are prepared when the rainy season begins; first they are plowed and harrowed to a depth of 20-30 cm and then they are levelled off with a board or a rail. Sowing is done in rows spaced 60 cm apart which allows machinery or animal-pulled implements to enter the field for cultivation and weed control. Planting density is 60 kg/ha and sowing is done with a mechanical planter or by hand. This system is used in flat areas with soils that are not hydromorphic. This system has probably been used since the early 40's, mainly in the Cuxtepeques River region in central Chiapas, close to the frontier with Guatemala.

Mechanized system. It is a government policy to take advantage of the infrastructure available in irrigated areas in order to produce more profitable or export crops. Considering this and the background of upland rice production in the humid tropics, by the end of the 60's, the Secretaría de Agricultura y Ganadería planned upland rice mechanization in the flat parts of these areas. Upland rice could then be produced intensively and in a similar way to irrigated rice with direct seeding, except that plants would depend on rains.

During the first years many problems were faced since technology generated for irrigated conditions in the dry tropics was extrapolated for this system. Most of the varieties planted were severely affected by diseases _(Pyricularia oryzae)_ and pests, and rice crops were also infested by various weed species including grasses (zacates), broadleaf weeds, and Cyperaceae. To overcome these and other limiting factors the Centro de Investigación y Extensión Agrícola de la Chontalpa (CIEACH), that later became the Colegio Superior de Agricultura Tropical (CSAT) with headquarters in Cardenas, Tabasco, initiated in 1970 the first studies to mechanize upland rice in Tabasco.

Later in 1973, the Instituto Nacional de Investigaciones Agrícolas (INIA) promoted the use of this production system in the rest of the country by evaluating production problems and assigning them priorities and restructuring research programs. New research programs initiated their activities that year. A breeding program, to develop new and improved varieties appropriate for upland cultivation and complementary production technologies, was organized that year in Veracruz (CAECOT), Campeche (CAECAM), Chetumal (CACHET), Centro de Chiapas (CAECECH), and coastal Chiapas (CAECOCH). New technology is being utilized in areas with hydromorphic Vertisols in most of Veracruz, Oaxaca, Tabasco, coastal Chiapas, Quintana Roo, and all Campeche; in 1980, this cropping system was starting to be used in Ultisols of savanna areas around the boundaries of Tabasco and Campeche. Presently, new technologies are being developed for complete mechanization of the system; planting will be possible with row or broadcast planters or with aircraft at rates of 100-110 kg/ha.

Upland rice technologies in Mexico

Table 58 shows the varieties that are now cultivated in the three production systems, the states where these systems are prevalent, and production technologies.

Figure 6 shows the distribution of upland rice areas in Mexico.

Upland rice problems in the humid tropics

Although, in little more than a decade advances have been achieved in research on upland rice for the humid tropics of Mexico, there are still some severe constraints limiting production:

- *Pyricularia oryzae*, the causal agent of rice blast, has different pathogenic races; sometimes it causes epiphitics, especially when the disease occurs together with dry periods.

- Weeds (including grasses, broadleaf weeds, and Cyperaceae) that cannot yet be controlled efficiently and that, because of their adaptation, have multiplied extensively in various tropical areas.

- Dry periods in various production regions due to scarce and erratic rainfall.

- Pests, especially stink bugs, army worms and others no less important.

- Soil acidity, especially in savanna areas, including regions in the states of Tabasco and Campeche; soils are characterized by low pH and high Fe and Al toxicities.

- Low adoption of new technologies by rice growers especially in regions where the rustic and traditional cropping systems prevail.

Objectives of the upland rice breeding program in the humid tropics

INIA's upland rice breeding program is developing and selecting new varieties with the following characteristics:

- Intermediate stature plants (100-110 cm) with compact or semi-compact architecture and acceptable yield stability.
- Wide level or resistance to leafblast, node, and panicle neck blast.
- Deep and functional roots with plants having the characteristic of leaf rolling for improved tolerance to drought.
- Early (110-120 days) to intermediate (125-135 days) growth cycle.
- Resistance to lodging and grain shattering.
- Tolerance to aluminum toxicity in acid soils and iron toxicity when acid soils are heavy and poorly drained.
- Long grain with good milling and cooking qualities.

Upland Rice Ecosystems in Asia, D. Garrity[1]

Summary

In Asia upland rice is an important production system but it does not predominate. Most of the 11.6 million ha (Table 59) are cultivated continuously with no ridges or dams. However, upland rice is the main

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1. Associate Agronomist, IRTP-IRRI, Philippines.

staple in the traditional subsistence systems throughout the region. Production is highly variable and subject to an extremely diverse range of climatic, edaphic, biological, and socioeconomic conditions.

In order to effectively focus upland rice breeding efforts, a more specific understanding of the environmental complex is required.

The information available on the physical limiting factors of upland rice ecosystems in Asia was reviewed; rainfall during the cropping season and duration of the latter; soil type, texture, and fertility and types of topography. The range, spatial variability and distribution of these limiting factors were analized.

Interaction among the various factors should be taken into account in order that characterization of upland ecosystems be useful.

A preliminary effort to divide Asian upland rice into four main ecosystems, based on the duration of the cropping season and soil fertility, was described (Table 60).

Upland Rice in the Andean Region: A Preliminary Agroecological Inventory, P.G. Jones[1]

Abstract

A study was presented on upland rice regions in the Andean countries (Venezuela, Colombia, Ecuador, Peru, and Bolivia). Cultivated areas were identified using the available statistical data and satellite imagery.

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1. Agrometeorologist and Systems Scientist, CIAT.

Table 61 shows upland rice areas classified according to FAO soil maps.

Table 62 presents a description of the types of soils and their fertility status.

Upland rice in the Andean region is cultivated in highly fertile Fluvisols (Je) to unfertile Fluvisols. Upland rice production in highly unfertile Ferrasols is low (Table 63).

Upland rice areas in the Andean regions were classified according to the duration of the rainy period during the cropping cycle (Table 64). This classification shows that most of the upland rice in the Andean region is planted in areas with adequate moisture supply for more than 100 days. Only 12% of the area is subject to water deficiency during crop growth.

In a second analysis (Table 65) the probability of dry period occurrence during crop growth was investigated.

Based on these data, it can be concluded that most rice planted in the Andean region can suffer water stress. Less fertile soils are found in areas where drought is less feasible.

PRESENT SITUATION OF RICE PRODUCTION IN LATIN AMERICA

A survey was carried out among national program leaders to update the information on cultivated area and production, varieties, production systems, production constraints, production costs, rice consumption and marketing, and training needs.

Results of this survey are summarized in Tables 66-74.

Table 56. Planted area (1000 ha) in the main rice production systems in Brazil; 1980-1981 harvest.

State	Irrig. rice (1)	(1)/(4) %	Varzeas (2)	(2)/(4) %	Upland (3)	(3)/(4)	Total rice (1+2+3) = (4)
MA	1.2	0	5.8	1	1.093.0	99	1.100.0
MG	16.1	2	161.0	25	476.9	73	654.0
SP	20.9	7	-	-	296.1	93	317.0
PR	0.3	0	19.9	6	322.8	94	343.0
MT	0.9	9	-	-	909.1	100	910.0
MS	2.1	1	34.0	8	379.9	91	416.0
GO	18.0	1	9.8	1	1.299.2	98	1.327.0
SC	83.7	54	-	-	70.3	46	154.0
RS	566.3	89	-	-	71 .7	11	638.0
Other	31.1	4	97.4	12	650.9	84	779.4
Brazil	740.6	11	327.9	5	5.569.9	84	6.638.4

Table 57. Rice planting seasons in the main producing states of Brazil.

State	Percentage area covered by planting season												Total (%)
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
Rio Grande do Sul	-	-	-	-	-	-	-	1	12	67	19	1	100
Goias	-	-	-	-	-	-	-	-	-	15	79	5	100
Mato Grosso	-	-	-	-	-	-	-	-	3	50	39	5	100
Maranhao	46	4	1	-	-	-	-	-	-	-	3	45	100
Minas Gerais	-	-	-	-	-	-	-	-	6	37	52	3	100
Sao Paulo	-	-	-	-	-	-	-	1	8	52	36	2	100
Paraná	-	-	-	-	-	-	-	4	52	36	6	1	100
Santa Catarina	-	-	-	-	-	-	-	7	35	31	21	5	100
Brazil	9	1	-	-	-	-	-	1	10	31	37	9	100

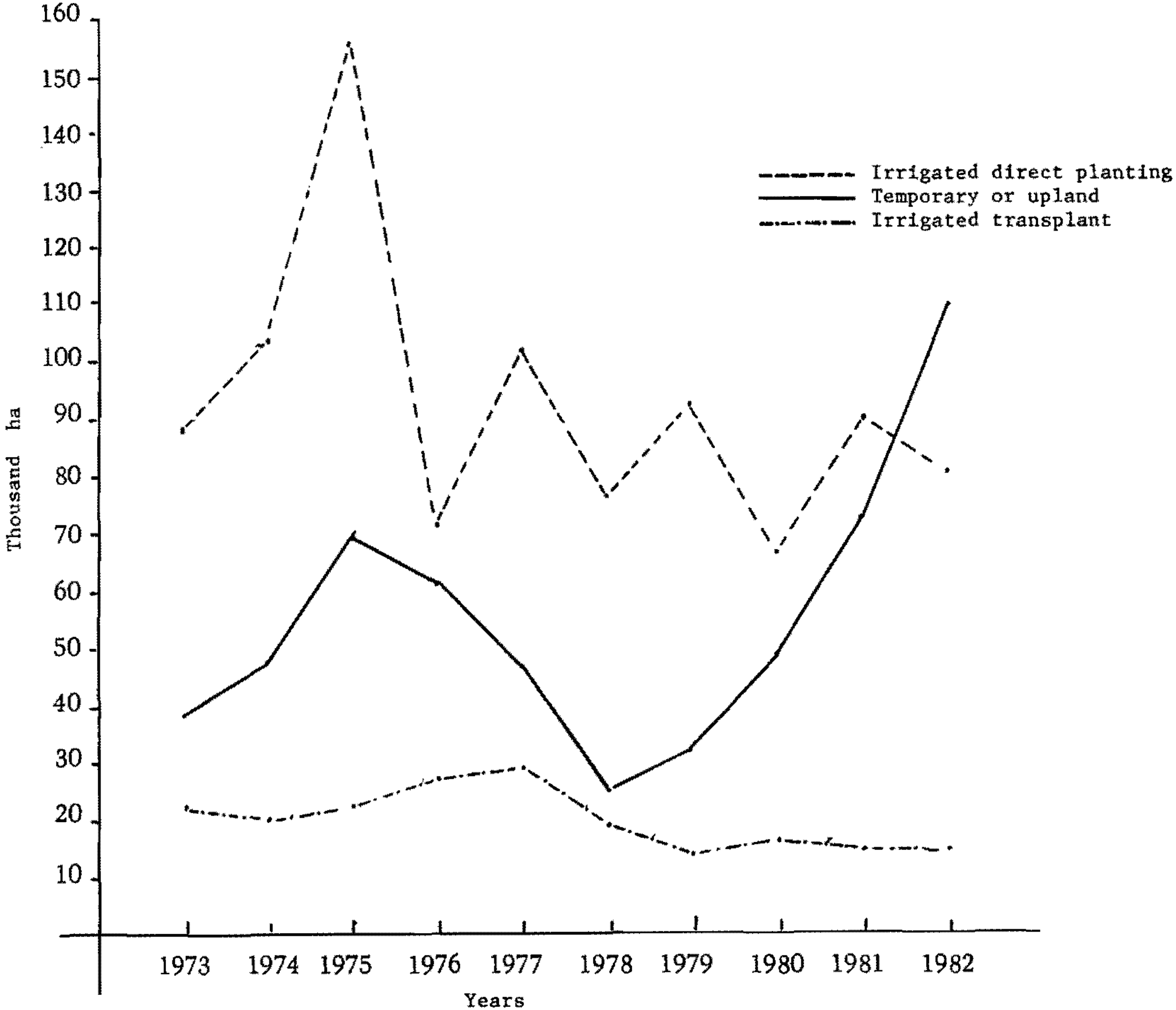

Figure 4. Development of rice cropping systems in Mexico, INIA, 1973-1982.

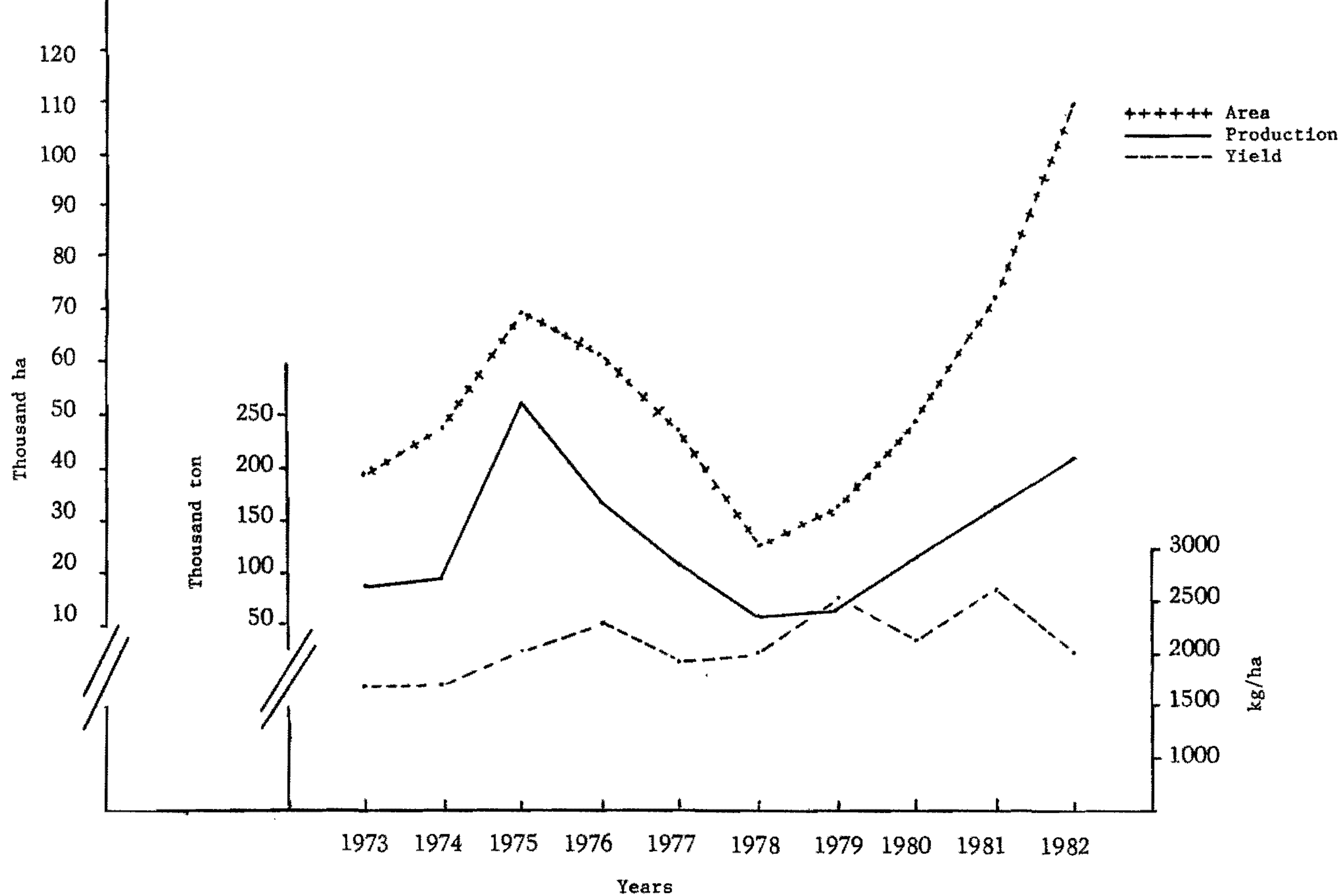

Figure 5. Area, production and yield of upland rice in Mexico, INIA, 1973-1982.

Table 58. Technologies used in the three upland rice crop systems in Mexico, INIA, 1983.

Cropping system	Varieties	States	Production technologies
Rustic	Lira Sinaloa A64 Morado criollo	Veracruz Oaxaca Chiapas Tabasco Q. Roo	Manual planting, weeding, fertilization and harvest; low fertilization; insecticides and fungidides applied with manual sprinklers.
Traditional	Bluebonnet 50 Tres mesinos OS 6	Chiapas (Centro)	Manual and seeder planting; weeding with cultivator and chemical products; fertilization with fertilizers, parasiticides applied with tractor equipment or manual sprinklers; harvest with conventional combine.
Mechanized	CICA 4 Grijalva A71 Macuspana CICA 6 Navolato A71 CICA 8 Campeche A80 Cárdenas A80 Champotón	Veracruz Oaxaca Tabasco Costa de Chiapas Campeche Quintana Roo Nayarit Colima	Planting with seeders or aerial equipment; fertilization and parasiticide application by plane; harvest with caterpillar combines in heavy, slow drainage soils.

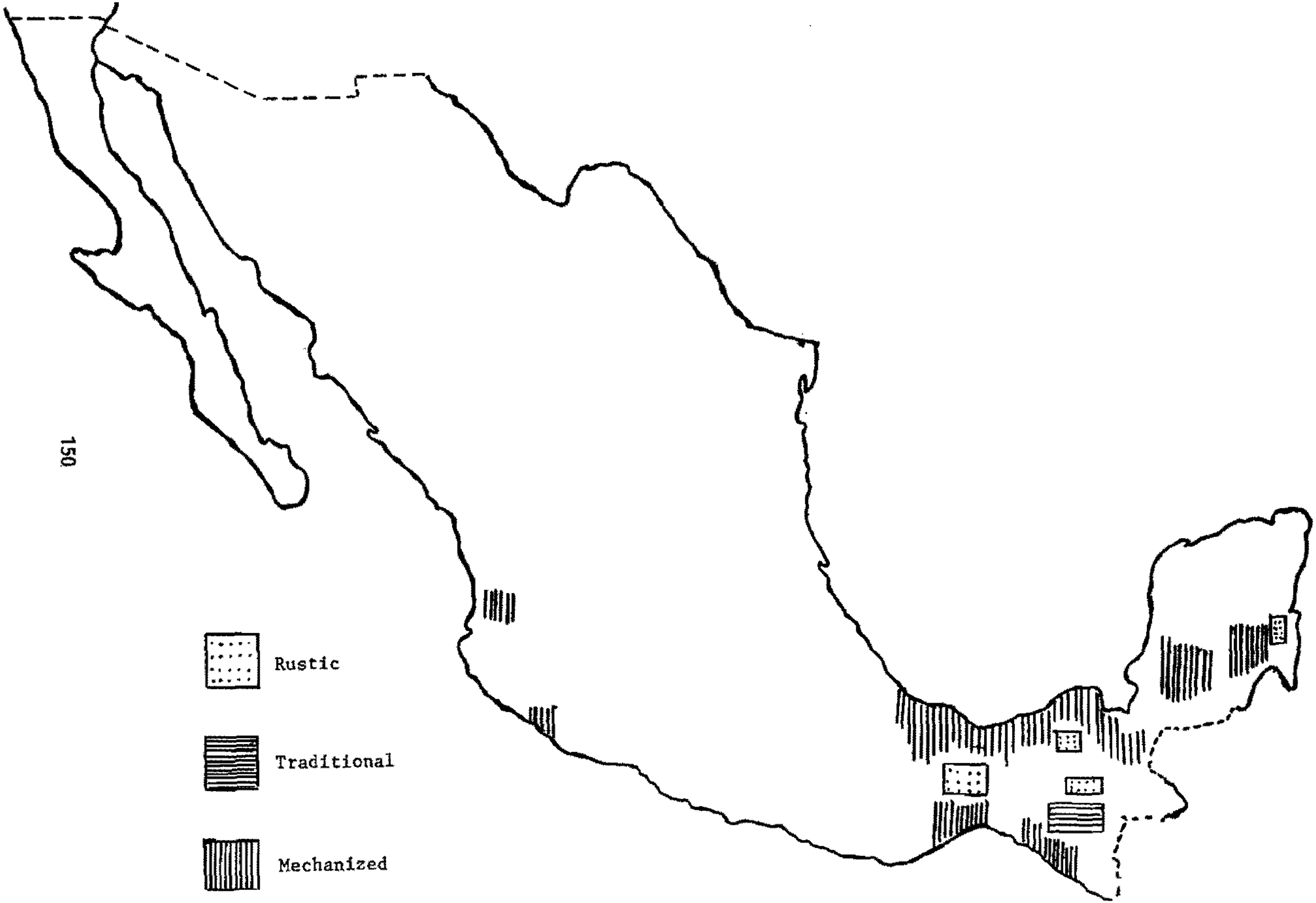

Figure 6. Upland rice cropping systems in Mexico.

Table 59. Estimated rice area under main cropping system of southern and southeastern countries of Asia.[a]

		Area (1000 ha)					
			Irrigated[b]		Rainfed		
Country	upland	Floating (> 100 cm)	Rainy season	Dry season	Shallow (0-30 cm)	Deep (30-100cm)	Total
Southern Asia							
India	5973	2434	11134	2344	12677	4470	
Bangladesh	858	1117	170	987	4293	2587	
Paquistán	-	-	1710	-	-	-	
Sri-Lanka	52	-	294	182	210	22	
Nepal	40	53	261	-	678	230	
Butan	28	-	-	-	121	40	
TOTAL	6951	3604	13569	3513	17979	7349	52965
Southeastern Asia							
Burma	793	173	780	115	2291	1165	
Tailandia	961	400	866	320	5128	1002	
Vietnam	407	420	1326	894	1549	977	
Campuchea	499	435	214	-	713	170	
Laos	342	-	67	9	277	-	
Malasia	91	-	266	220	147	11	
Indonesia	1134	258	3274	1920	1084	534	
Filipinas	415	-	892	622	1207	379	
TOTAL	4642	1686	7685	4100	12396	4238	34747
Grand total	11593	5290	21254	7613	30375	11587	87712
%	13	6	24	9	35	13	

a. SOURCE:
b. Areas with double crop are counted twice.

Table 60. Distribution of upland rice area into different environments in southern and southeastern Asian countries. Values in million ha.

Country	Classif. area	Long duration (5-12 months) Fertile soils[a]	Long duration (5-12 months) Unfertile soils[b]	Short duration (0-4 months) Fertile soils	Short duration (0-4 months) Unfertile soils
Southern Asia					
India	5.97	0.57	0.84	2.80	1.76
Bangladesh	0.85	0.52	0.11	0.22	-
Sri-Lanka	0.05	0.01	-	-	-
Nepal	0.04	-	0.04	-	-
Bhutan	0.03	-	0.03	-	-
TOTAL	6.94	1.10	1.02	3.07	1.76
%	100	16	15	44	25
Southeastern Asia					
Burma	0.79	0.12	0.56	0.02	0.10
Thailand	0.96	-	0.29	0.01	0.66
Vietnam	0.41	0.01	0.38	-	0.01
Campuchea	0.50	0.01	0.20	0.01	0.29
Laos	0.34	-	0.28	-	0.06
Malaysia	0.09	-	0.09	-	-
Indonesia	1.14	0.27	0.80	0.05	0.04
Philippines	0.41	0.22	0.19	-	-
TOTAL	4.64	0.63	2.79	0.09	1.16
%	100	13	60	2	25
Grand total	11.58	1.73	3.81	3.16	2.92
%	100	15	33	27	25

A. Fertility scale
b. Unfertility scale

Table 61. Areas[a] sown to upland rice in the Andean region.

FAO Soil[b] Mapping Unit	Country / HA[a]				
	Bolivia	Colombia	Ecuador	Peru	Venezuela
Ao	7060	-	100	-	6080
Bd	21800	-	100	-	-
Be					20
Fo					75
Fx					110
Ge	12340	15030	360	4770	50
Gh	500			7120	
Gm					50
J	12240			7730	430
Je	7320	36460			1090
Lf	6880				62700
Lo		522			
Lp	11040				
Nd		1250	1270		2050
Ne				1100	
Vc				6870	2580
Vp			10940		
We	3900	2500			1000
Vm	1000				

a. Estimates are not necessarily contemporaneous although every effort has been made at standardization.
b. For full names of the mapping units see Table 62.

Table 62. Area sown to upland rice in the Andean region grouped by inherent fertility status[a].

Inherent fertility status rating		Soil mapping unit	Area sown (ha)
2	Be	Eutric Cambisols	20
3	Je	Eutric Fluvisols	44900
	Lo	Orthic Luvisols	520
	Vp	Pellic Vertisols	10940
	Vc	Chromic Vertisols	9450
4	Ne	Eutric Nitosols	1100
	J	unspecified Fluvisols ıdo	20400
5	Gm	Mollic Gleysols	50
	Ge	Eutric Gleysols	39600
	We	Eutric Planosols	8400
6	Bd	Dystric Cambisols	21800
	Ao	Orthic Acrisols	13240
7	Lf	Ferric Luvisols	69580
	Nd	Dystric Nitosols	4570
	Lp	Phinthic Luvisols	11040
	Gh	Humic Gleysols	7620
8	Fo	Orthic Ferralsols	75
	Fx	Xanthic Ferralsols	110

a. Modified after Garrity (1982).

Table 63. Area sown to upland rice in the Andean region classified by inherent fertility class and by country.

Inherent fertility class	Country/ (ha)					Total (ha)
	Bolivia	Colombia	Ecuador	Peru	Venezuela	
2					20	20
3	18360	37000	10900	6900	3700	76860
4	12200			8800	400	21400
5	16900	17500	260	4800	1100	40560
6	28900				6080	34980
7	7400	1200	1300	7100	64700	81700
8					200	200
TOTAL	83760	55700	12460	27600	76200	255720

Table 64. Areas of upland rice in Andean region classified by growing season length.

Humid days[a]	ha	Percentage
Less than 50	21900	9
50-100	8090	3
100-150	136900	57
150-200	44700	19
200 plus	29600	12

a. Number of consecutive days on which precipitation exceeds potential evapotranspiration.

Table 65. Areas sown to upland rice in the Andean zone classified by fertility class and probability of 7 dry days in the second month of the cropping season.

Inherent fertility class	Probability				
	0-.4	.4-.6	.6-.8	.8-1.0	TOTAL
	ha				
2 + 3	8820	16100	20000	20300	65300
4	3000	9400	5900	3300	21500
5	3000	10100	28000	4300	45000
6	0	10500	7200	17400	35100
7	58000	7500	27000	800	93000
8	200				
	Percentage				
2 + 3	13	25	31	31	100
4	14	44	27	15	100
5	7	22	62	9	100
6	0	30	20	50	100
7	62	8	29	1	100
8	100	0	0	0	100

Table 66. Area, production and yield of rice in Latin America, 1980-81 harvest.

Country	Area (00 ha)[a]			Production (000 ton)			Yield (t/ha)		
	Irrig.	Upland	Total	Irrig.	Upland	Total	Irrig.	Upland	Average
Argentina	90.0	-	90.0	300.0	-	300.0	3.3	-	3.3
Belice	1.8	2.2	4.0	5.8	4.9	10.7	3.2	2.2	2.7
Bolivia	0.4	65.4	65.8	1.0	111.7	112.7	2.5	1.7	1.7
Brazil	740.6	5897.8	6638.4	2747.6	5890.4	8638.0	3.7	1.0	1.3
Chile	31.4	-	31.4	99.7	-	99.7	3.2	-	3.2
Colombia	305.2	95.0	400.2	1628.6	142.5	1771.1	5.3	1.5	4.4
Costa Rica	1.7	82.9	84.6	10.2	233.4	243.6	6.0	2.8	2.9
Cuba	135.0	-	135.0	455.5	-	455.5	3.4	-	3.4
Ecuador	71.2	62.6	133.8	289.8	145.1	434.9	4.1	2.3	3.3
El Salvador	-	16.8	16.8	-	60.7	60.7	-	3.6	3.6
Guatemala	-	12.6	12.6	-	27.2	27.2	-	2.2	2.2
Guyana [b]	86.4	35.2	121.6	259.2	52.8	312.0	3.0	1.5	2.6
Haiti	31.7	10.7	42.4	186.0	30.2	216.2	5.9	2.8	5.1
Honduras	5.0	25.4	30.4	22.3	62.6	84.9	4.5	2.5	2.8
Jamaica	1.0	-	1.0	3.0	-	3.0	3.0	-	3.0
Mexico	107.4	72.3	179.7	473.4	170.1	643.5	4.4	2.4	3.6
Nicaragua	24.4	19.2	43.6	87.0	29.3	116.3	3.6	1.5	2.7
Panama	5.0	95.7	100.7	20.5	169.0	189.5	4.1	1.8	1.9
Paraguay	19.8	12.0	31.8	57.4	19.2	76.6	2.9	1.6	2.4
Perú	111.8	42.6	154.4	581.7	82.3	664.0	5.2	1.9	4.3
Dom. Republic	108.0	3.3	111.3	255.5	3.9	259.4	2.4	1.2	2.3
Surinam [b]	35.7	-	35.7	150.0	-	150.0	4.2	-	4.2
Uruguay	68.0	-	68.0	381.0	-	381.0	5.6	-	5.6
Venezuela	50.0	150.0	200.0	200.0	375.0	575.0	4.0	2.5	2.9
TOTAL	2031.5	6701.7	8733.2	8215.2	7610.3	15825.5	4.0	1.1	1.8

a. Blank space indicates no planting.
b. Data from Guyana (77/78) and Surinam (79/80) harvest.

Table 67. Area, production and yield of rice in Latin America, 1981-82 harvest.

Country	Area (000 ha)[a]			Production (000 ton)			Yield (t/ha)		
	Irrig.	Upland	Total	Irrig.	Upland	Total	Irrig.	Upland	Average
Argentina	110.0	-	110.0	400.0	-	400.0	3.6	-	3.6
Belice	1.2	2.2	3.4	3.5	4.3	7.8	2.9	2.0	2.3
Bolivia	0.5	58.2	58.7	1.3	91.4	92.7	2.6	1.6	1.6
Brazil[b]	740.6	5897.8	6638.4	2747.6	5890.4	8638.0	3.7	1.0	1.3
Chile	37.0	-	37.0	131.2	-	131.2	3.5	-	3.5
Colombia	345.9	107.4	453.3	1754.9	161.0	1915.9	5.1	1.5	4.2
Costa Rica	2.0	70.3	72.3	12.2	189.8	202.0	6.1	2.7	2.8
Cuba	130.0	-	130.0	496.9	-	496.9	3.8	-	3.8
Ecuador	72.4	62.8	135.2	282.5	127.2	409.7	3.9	2.0	3.0
El Salvador	-	13.9	13.9	-	50.1	50.1	-	3.6	3.6
Guatemala	-	15.4	15.4	-	33.3	33.3	-	2.2	2.2
Guyana[b]	86.4	35.2	121.6	259.2	52.8	312.0	3.0	1.5	2.6
Haiti	31.7	10.5	42.2	190.0	30.1	220.1	6.0	2.9	5.2
Honduras	6.0	28.1	34.1	27.0	75.2	102.2	4.5	2.7	3.0
Jamaica	1.5	-	1.5	4.5	-	4.5	3.0	-	3.0
Mexico	96.4	110.6	207.0	366.9	219.7	586.6	3.8	2.0	2.8
Nicaragua	22.3	19.5	41.8	90.5	48.1	138.6	4.1	2.5	3.3
Panama	6.0	98.2	104.2	24.5	193.1	217.6	4.1	2.0	2.1
Paraguay	21.3	11.0	32.3	61.8	19.8	81.6	2.9	1.8	2.5
Peru	120.2	40.3	160.5	595.6	80.6	686.2	5.0	2.0	4.3
Dom. Republic	100.0	3.1	103.1	258.1	4.0	262.1	2.6	1.3	2.5
Surinam[b]	35.7	-	35.7	150.0	-	150.0	4.2	-	4.2
Uruguay[b]	68.0	-	68.0	381.0	-	381.0	5.6	-	5.6
Venezuela	60.0	140.0	200.0	240.0	350.0	590.0	4.0	2.5	3.0
TOTAL	2095.1	6724.5	8819.6	8479.2	7620.9	16100.1	4.0	1.1	1.8

a. Blank space indicates no planting.
b. Data from Brazil and Uruguay (80/81), Guyana (77/78) and Surinam (79/80).

Table 68. Rice varieties planted in Latin America in the 1981/82 harvest.

Country	Variety	Variety type[a]	Cropping system: Irrig.	Cropping system: Upland	Area: Total (000 ha)	Area: Irrig. (%)	Area: Upland (%)
ARGENTINA	Fortuna	T	X		110.0	25.0	
	IR 841-63-5-18	E	X			25.0	
	Bluebonnet 50	AM	X			15.0	
	Bluebelle	AM	X			15.0	
	Lebonnet	AM	X			6.0	
	Bonnet 73	AM	X			6.0	
	Itapé, Cala	AM	X			5.0	
	Arroyo Grande, Yervá	AM	X			3.0	
BELICE	CICA 8	E	X	X	3.4	20.0	30.0
	CR 1113	E	X	X		20.0	20.0
	CICA 4	E		X			5.0
	Bluebelle, Texas Patna, UPL, Berley Rice, Belle Patna	AM		X			5.0
BOLIVIA	Bluebelle	AM		X	58.7		12.5
	Dourado	T		X			12.5
	Pico Negro	T		X			12.5
	CICA 8	E	X	X		0.2	12.3
	Bluebonnet	AM		X			12.5
	IR 1529	E		X			12.5
	IR Dominicana	E		X			12.5
	CICA 9	E	X	X		0.2	12.3
BRAZIL	Bluebelle	AM	X		6638.4		
	BR IRGA 409	E	X				
	BR IRGA 410	E	X				
	IAC 47	T		X			
	IAC 165	T		X			
	IAC 164	T		X			
	IAC 25	T		X			

Continued ...

Table 68 (continued).

Country	Variety	Variety type[a]	Cropping system		Area		
			Irrig.	Upland	Total (000 ha)	Irrig. (%)	Upland (%)
CHILE	Oro	AM	X		37.0	65.0	
	Diamante	AM	X			10.0	
	Quella	AM	X			25.0	
COLOMBIA	CICA 9	E	X		453.3	1.5	
	CICA 8	E	X	X		38.2	16.6
	CICA 7	E	X			7.6	
	CICA 4	E	X			9.9	
	IR 22	E	X			15.3	
	Metica 1	E	X			3.8	5.9
	Monolaya	T	X	X			1.2
COSTA RICA	CR 1113	E	X	X	72.3	2.8	82.6
	CR 5272	E		X			9.7
	CR 201	E		X			4.9
CUBA	J-104	E	X		130.0	31.0	
	IR 880	E	X			43.0	
	Naylame	E	X			7.0	
	Caribe	E	X			4.0	
	IR 1529	E	X			15.0	
ECUADOR	INIAP 7	E	X	X	135.2		
	INIAP 415	E	X	X			
	INIAP 6	E	X	X			
	Donato	T		X			
	Canilla	T		X			
	SML	AM		X			
	Pico Negro	T		X			
	Brasilero	T		X			

Continued ...

Table 68 (continued).

Country	Variety	Variety type[a]	Cropping system		Area		
			Irrig.	Upland	Total (000 ha)	Irrig. (%)	Upland (%)
EL SALVADOR	X-10	E		X	13.9		
	CENTA A-1	E		X			
	CR 113	E		X			
	CENTA A-2	E		X			
GUATEMALA	Lebonnet	AM		X	15.4		40.0
	New Rex	AM		X			30.0
	ICTA-Virginia	E		X			10.0
	Tikal 2	E		X			10.0
	Starbonnet	AM		X			5.0
	Otras	T		X			5.0
HAITI	Dawn	AM	X		42.2		
	Folton	T	X	X			
	Buffalo	T	X	X			
	Ti Fidele	T	X	X			
	Starbonnet	AM	X				
	MCI-65	AM	X				
	MCI-3	E	X				
	Caro-Pangnol	T	X	X			
	Neg-Pap Di'ou	E	X	X			
HONDURAS	CICA 8	E	X	X	34.1		
	CICA 6	E	X	X			
	CICA 4	E		X			
	CICA 9	E	X				
	Bluebonnet 50	AM		X			
	Starbonnet	AM		X			
JAMAICA	CICA 9	E	X		1.5		
	CICA 8	E	X				
	Buffalo	T	X				

Continued ...

Table 68 (continued).

Country	Variety	Variety type[a]	Cropping system: Irrig.	Cropping system: Upland	Area: Total (000 ha)	Area: Irrig. (%)	Area: Upland (%)
MEXICO	Navolato A-71	E	X	X	207.0		
	CICA 4	E	X				
	CICA 6	E	X				
	Culiacán A 82	E	X				
	Huastecas A 80						
	Campeche A 80	E		X			
	Morelos A 70	AM	X	X			
	Champotón A 80	E		X			
	Cardenas A 80	E		X			
	Grijalva A 71	AM		X			
	Macuspana A 75	AM		X			
	Juchitán A 74	E	X				
	Sinaloa A 68	E	X				
	Milagro Filipino	E	X	X			
	Morado Criollo	AM		X			
	Lira	AM		X			
	CICA 4	E		X			
NICARAGUA	CICA 8	E	X	X	41.8		
	IR 100	E	X				
	J-104	E	X				
	IR 22	E	X				
	CR 1113	E	X				
	CICA 7	E	X				
	Línea 9	E	X				
	Bluebonnet 50	T		X			
PANAMA	CICA 7	E	X	X	104.2	2.9	18.8
	CICA 8	E	X	X		2.3	11.3
	CR 1113	E		X			2.8
	CR 5272	E		X			1.9
	Eloni (Surinam 70)	E		X			4.7
	Anayansi	E	X	X		0.7	4.7

Continued....

Table 66 (continued).

Country	Variety	Variety type[a]	Cropping system		Area		
			Irrig.	Upland	Total (000 ha)	Irrig. (%)	Upland (%)
PANAMA	Toc. 5430	E		X			1.9
	4444	E		X			0.9
	Criollas	T		X			47.1
PARAGUAY	CICA 9	E	X		32.3	23.5	
	CICA 8	E	X			17.3	
	CICA 7	E	X			16.8	
	Vista	T	X			16.4	
	Fortuna	T	X			10.5	
	CICA 6	E	X			5.3	
	Wilcke II	E	X			1.2	
	Otros		X			9.0	
PERU	INTI	E	X		160.5	52.4	
	Naylamp	E	X			5.2	
	IR 8	E	X			2.2	
	BG 90-2	E	X			3.8	
	Chancay	E	X			0.8	5.0
	Minabir 2	AM	X			6.0	
	Radin China	AM	X	X		1.5	0.5
	Fortuna, Carolino	T		X			15.1
	Peru 65	T	X	X		0.8	2.0
	Otros	T	X	X		2.2	2.5
DOM. REPUBLIC	Juma 58	E	X		103.1	28.0	
	Juma 57	E	X			23.0	
	Tanioka	E	X			15.0	
	ISA 40	E	X			12.0	
	IR 6	E	X			2.0	
	Juma 51	E	X			0.5	
	Mingolo	T	X			11.0	
	Toño Brea 439	AM	X			1.5	
	Inglés Largo	AM	X			4.0	
	Otros	T	X	X			3.0

Continued ...

Table 68 (continued).

Country	Variety	Variety type[a]	Cropping system		Area		
			Irrig.	Upland	Total (000 ha)	Irrig. (%)	Upland (%)
SURINAM	Diwani	E	X		39.7	50.0	
	Eloni	E	X			45.0	
	Camponi	E	X			5.0	
URUGUAY	Bluebelle	AM	X		68.0	95.0	
	EEA 404	T	X			3.0	
	976	AM	X			2.0	
VENEZUELA	Araure 1	AM	X	X	200.0	24.0	56.0
	CICA 4	E	X	X		6.0	14.0

a. E = dwarf; AM = improved tall; T = Traditional.

Table 69. Distribution of area among different production systems in Latin America (00ha) in the 1981/82. harvest.

Country	Irrig.	Low fload zones	Highly favored upland	Moderately favored upland	Unfavored upland	Traditional manual upland	total area
Argentina	110.00	-	-	-	-	-	110.00
Belice	1.20	-	-	-	-	2.20	3.40
Bolivia	0.50	-	-	34.68	-	23.52	58.70
Brazil [a]	740.60	327.90	650.63	849.80	3319.27	750.20	6638.40
Chile	37.00	-	-	-	-	-	37.00
Colombia	345.90	-	64.44	-	-	42.96	453.30
Costa Rica	2.00	1.00	26.30	35.00	7.00	1.00	72.30
Cuba	130.0	-	-	-	-	-	130.00
Ecuador	60.08	37.56	-	30.05	-	7.51	135.20
El Salvador	1.39	-	-	12.51	-	-	13.90
Guatemala	-	0.77	5.39	6.16	2.31	0.77	15.40
Guyana [a]	86.40	-	-	35.20	-	-	121.60
Haiti	31.70	3.31	2.11	1.70	1.27	2.11	42.20
Honduras	6.00	3.00	15.00	4.98	2.05	3.07	34.10
Jamaica	1.50	-	-	-	-	-	1.50
Mexico	96.37	2.68	20.22	60.67	20.22	6.74	206.90
Nicaragua	22.15	-	3.35	5.85	5.85	4.60	41.80
Panamá	5.21	8.34	12.50	10.42	8.34	59.39	104.20
Paraguay	21.30	-	-	11.00	-	-	32.30
Perú	120.37	9.63	8.03	6.42	16.05	-	160.50
Dom. Republic	100.00	-	-	3.10	-	-	103.10
Surinam	39.70	-	-	-	-	-	39.70
Uruguay	68.00	-	-	-	-	-	68.00
Venezuela	60.00	-	140.00	-	-	-	200.00
T O T A L	2087.37	394.19	947.97	1107.54	3382.36	904.07	8823.50
%	23.66	4.47	10.74	12.55	38.33	10.25	100.00

Data from harvest in Brazil (80/81) and Guyana (77/78).

Table 70. Predominant diseases and pests in rice crops in Latin America, 1981/1982 harvest.

Country	Diseases[a]													Pests[a]								Other[a]		
	Blast	Sheath blight	Leaf scald	Helminthosporiosis	Cercosporiosis	Sheath rot	Hoja Blanca	Bacterial blight	Straighthead	Stem rot	False smut	Eye spot	Smut and/or grain fungi complex	Sogata	Diatrea	Rupella	Stink bugs	Cutworms	Hydrellia	Spodoptera	Other	Nematodes	Birds	Rodents
Argentina	2	5						4	1	3							1	3	4	2	5	1	2	2
Belice[b]	2			1										2	4	3				1			1	2
Bolivia	3		1	2											1		3			2	4		1	
Brazil	1		2			2									3		2	1			4		1	
Chile													1										1	
Colombia	1						2						3	1	2		4	3					2	1
Costa Rica[b]	1		3	2							4			2			3			1				1
Cuba[c]																								
Ecuador	1						1							3		1				2			3	3
El Salvador	1		2										3	1			2			3	3		2	1
Guatemala	1		3	2		5				5			4	4	5	5	1			2	3		1	
Guyana[c]																								
Haiti				1	2												1		2				1	2
Honduras	1		2														2			3	1		1	2
Jamaica[c]																								
Mexico	1		2	2													1			2	3		1	2
Nicaragua																								
Panamá	1	4	2	3								5		4	1	1	3				2	1	2	3
Paraguay	1			3		2											1			2			1	
Perú	1		4	3			2							1	2	3		5	5		4		1	2
Dom. Rep.	1		3			2	4							1			2	3						1
Surinam	4			1	2	3								4		3			2	1				
Uruguay[c]																								
Venezuela	1		3				2							3		2		1					1	2

a. 1 = first priority; 2 = second priority; 3 = third priority; 4 = fourth priority; 5 = fifth priority

Table 71. Predominant weed, climate and soil problems in rice crops in Latin America, 1981/82 harvest.

Country	Weeds[a]			Climate[a]			Soils[a]				
	Narrow leaf[b]	Red rice[c]	Broad leaf	Low temperatures	Drought	Deep waters	Acidity	Salinity	Alkalinity	Toxicity	Deficiency
Argentina	2	3	1	2	1				1	Fe	
Belice[d]	1	2		1		1	1				
Bolivia	1						4				
Brazil	2	3	1	1	1					Fe,Mn,Al	P
Chile	1	2		1							
Colombia	1		2		2	2	1			Al,Fe	
Costa Rica[d]	1				1					Cu	P,Zn,Fe,Mn
Cuba[e]											
Ecuador	1		2		2	1		1			
El Salvador	1				1						
Guatemala	1	2	3		1		1	2		Al,Cu	P,S
Guyana[e]											
Haiti	1				2	1		1	2		Zn
Honduras	1		2	4	1	2	3		3		
Jamaica[d]								1			
México	1	2			1		1	2	1		
Nicaragua[e]											
Panamá	1		2		1		1	2			
Paraguay	1	2		1	2		1				
Perú	1	2		2	1		2	1		Al	
Dom. Rep.	1	2		1				1			
Surinam	2		1								
Uruguay[d]	1			1							
Venezuela	1	2			1		1				

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

b. Narrow leaf weeds (Gramineae and Ciperaceae): Not all species are present in countries listed.

c. Broad leaf weeds:

d. Data from 79/80 harvest in Belize, Costa Rica, Jamaica, and Uruguay.

e. No data.

Table 72. Rice production costs in Latin America in the 1981/1982 harvest.

Country[a]	Irrigated		Upland		Exchange rates[b]
	US$/ha	US$/ton	US$/ha	US$/ton	
Argentina [c]	442.86	171.43	-	-	70,000.oo
Belice					
Bolivia	-	227.27	307.50	227.27	200.oo
Brazil	688.18	242.90	299.75	245.70	179.38
Chile	781.08	166.67	-	-	39.oo
Colombia	1352.oo	260.87	1001.38	260.87	69.oo
Costa Rica [c]	-	-	1018.73	339.57	8.57
Cuba					
Ecuador	859.26	217.57	325.04	217.57	35.oo
El Salvador	1048.04	290.74	868.15	290.74	2.50
Guatemala	-	-	837.78	297.oo	1.oo
Guyana					
Haiti	792.03	200.oo	285.53	160.oo	5.oo
Honduras	609.14	265.oo	493.60	265.oo	2.oo
Jamaica [c]	1441.29	436.76	-	-	0.56
México	532.oo	137.14	349.93	137.14	70.oo
Nicaragua	1527.86	409.20	1140.92	409.20	10.oo
Panamá [c]	795.oo	227.14	700.oo	280.oo	1.oo
Paraguay	791.88	218.75	-	-	160.oo
Perú	832.09	199.50	-	-	1,000.oo
Dom. Rep. [c]	1018.16	255.oo	-	-	1.oo
Surinam	546.03	166.67	-	-	1.80
Uruguay [c]	1217.53	243.51	-	-	9.86
Venezuela	666.71	372.09	561.77	372.09	4.30

a. Blanks indicate the countries did not send information. (-) indicates no planting.
b. Data sent by collaborators as of Dec. 1982.
c. Data from harvest in Argentina (82/83), Costa Rica, Jamaica, Panama, Uruguay (79/80), Dom. Republic (80/81).

Table 73. Consumption and marketing of rice in Latin America, 1981-1982.

Country	Per capita consumption [a]	Facilities [b]			
		Drying	Storage	Milling	Transportation
Argentina	5.0	R	R	B	B
Belice	35.0	R	R	R	R, I
Bolivia	13.5	I	R	R	I
Brazil	45.0	I	B, R, I	B	B, R, I
Chile	10.0	R	B	B	B
Colombia	32.0	R	R	B	R
Costa Rica	50.0	B	B	B	B
Cuba	41.7	B	B	B	B
Ecuador	26.7	R	R	R	R, I
El Salvador	7.7	I	R	B	B
Guatemala	6.0	R	B	B	B
Guyana	-	-	-	-	-
Haiti	34.0	R	I	R	I
Honduras	16.0	R	R	R	R
Jamaica	25.0	I	I	I	R
México	9.0	B	B	B	B
Nicaragua	23.6	R	R	R	R
Panamá	65.0	R	R	B	B
Paraguay	12.0	R	R	B	B
Perú	27.0	I	R	B	B
Dom. Republic	45.2	R	B	B	R
Surinam	-	B	R	B	B
Uruguay	10.0	B	B	B	B
Venezuela	20.0	R	B	B	B

a. Milled rice (kg/person/year)
b. B = good, R = fair, I = inadequate, (-) no information.

Table 74. Training needs in Latin America.

Country[a]	No. of technicians		
	Short courses	MS	PhD
Argentina		1	
Belice	3		
Bolivia	2	2	1
Brazil		1	
Chile		1	
Colombia	3	5	2
Costa Rica			
Cuba			
Ecuador	4	2	
El Salvador	2	1	
Guatemala	1	2	
Guyana			
Haiti		4	
Honduras	5	2	
Jamaica	3		
Mexico	5	8	6
Nicaragua		4	
Panamá	2	2	
Paraguay	-	-	-
Perú	1	5	
Dom. Rep.	1	1	
Surinam			
Uruguay	3		
Venezuela		4	
TOTAL	35	45	9

a. Blanks indicate countries did not send information. Paraguay has no candidate.

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