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1979

RICE

CIAT CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL

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INTRODUCTION

Rice is a basic food crop for the Latin American population, supplying one third of the energy requirements. Rice consumption in tropical Latin America increased from 41 kg per capita in 1973-75 to 45 kg per capita in 1975-77. However, in a few countries production is not sufficient to meet their internal demand and in others self-supply is erratic.

The main objective of CIAT's Rice Program is to develop readily adopted technology to decrease production costs and increase yields in Latin America, in order to meet the rice demand both quantitatively and qualitatively. This is being attained through the collaborative team work of the Rice Program focused towards the development of high yielding varieties with good agronomic and processing characteristics, and resistance to the main diseases (blast, hoja blanca, etc.) and insect pests (leafhoppers), complemented by cultural practices which will require minimal inputs. The improved technology is transferred to the national rice programs of Latin America through the already established international trials network and the training of professionals.

BREEDING

The development of high yielding varieties combining acceptable grain quality continues to be the main objective of the ICA/CIAT cooperative rice breeding program. High yields, production stability and reduction of cost inputs are being envisaged through breeding for resistance or tolerance to the major common biological production constraints such as rice blast *(Pyricularia oryzae)*, "hoja blanca" virus disease, and the planthopper *(Sogatodes oryzicola)*, all widely prevalent constraints to rice production in Latin America.

Disease and Pest Resistance

Resistance to blast

The breeding program concentrates most of its efforts on stabilizing the resistance to *Pyricularia oryzae*, the causal agent of the rice blast disease. Both major and minor genes are being exploited through pyramiding of major genes, multilines, concentration of minor genes, and the combination of major and minor genes.

The exposure of early segregating populations (F_2 and F_3) to the Villavicencio environment in Colombia, ensures a dependable simultaneous field screening against blast, leaf scald, P deficiency, Fe toxicity, and elimination of excessive white belly, thus facilitating early discarding of undesirable populations and concentration of efforts and available facilities only on preliminarily screened promising populations.

Pyramiding of major genes

Based on three seasons of evaluation and yield testing in CIAT-Palmira, 11 pyramided lines derived from multiple crosses between improved breeding lines carrying resistant factors from Tetep, Carreon, Dissi Hatiff, Colombia 1, and C 46-15, were advanced to regional trials at 11 locations in Colombia. The 11 lines represent short to intermediate plant types with resistance to blast, planthopper *(Sogatodes* sp.), tolerance to leaf scald, good grain quality and high milling recovery. These lines are also being evaluated under different environmental conditions all over Latin America in a special nursery distributed through the International Rice Testing Program for Latin America (IRTP). Five additional pyramided lines tested under CIAT-Palmira conditions will be advanced to regional evaluations next year. The outstanding characteristics of the 11 lines are presented in Table I.

In addition, 218 F_2 populations originating from crosses involving different sources of resistance to blast (e.g., Tapuripa, Camponi, Tetep, Colombia 1, P.I. 184675, Ca 902/b/3/3, S.M.L. 56/7, Tapoo-cho-z, and K 8) were planted—138 in Villavicencio, the rest in CIAT-Palmira. Severe natural field infection of blast and leaf scald in La Libertad, Villavicencio, facilitated the identification and selection of the most promising crosses. Of the 138 populations planted in Villavicencio, only 50 were mass selected. Forty-three of the populations planted in CIAT-Palmira were also mass selected and advanced to the F_3 generation in Villavicencio.

Sixteen mass selected F_2 populations originating from threeway crosses designed to combine the yield potential and the plant type of Bg 90-2 with blast resistant factors from Tetep, Colombia 1, and C 46-15, were advanced through F_3 and single plant selected in the F_4 generation. The 2300 single plant selections made were quality evaluated and 1400 of them were planted in F_5 pedigree rows. A range of good plant types combining good grain quality and stiff straw were identified.

Multiline varieties

The final backcrosses for an expanded multiline project with seven geographically diverse sources of resistance to blast with seven genetically distinct recurrent parents (CIAT Annual Report, 1977) were completed. The resulting B_3F_1 populations were planted and harvested to be advanced to the B_3F_2 generation in Villavicencio.

Two of the non-recurrent tall donor parents, P.I. 184675 and Ca 902/b/3/3, combined poorly as the complete recapture of the recurrent parent phenotype has not been accomplished even with three backcrosses.

Utilization and concentration of minor genes

A resistant reaction with a few restricted types of susceptible or moderately resistant lesions is believed to characterize the rate-reducing (horizontal) type of resistance. Twelve varieties reported as having this type of resistance to blast and obtained from four different countries (CIAT Annual Report, 1978) were combined into simple crosses between varieties among countries (Africa, Japan, Philippines, and Surinam in all possible combinations) as a precaution against duplication, in view

Table 1. Agronomic and quality characteristics of promising pyramided rice lines advanced to regional trials. (Mean yield of three seasons at CIAT-Palmira.)

Line No.	Maturity (days)	White belly	Milling out-turn (%) Whole grain	Milling out-turn (%) Total	Reaction to Rhynchosporium[1]	Yield (kg/ha)	% of control
5732	140	0.6	65	70	R	7404	112
5709	135	0.6	60	69	R	7039	106
5832	127	0.4	64	71	MS	6815	103[2]
5738	127	0.4	66	71	R	6608	100
5715	129	0.8	65	71	R	6617	100
5685	131	0.8	64	70	R	6452	98
5684	128	0.6	68	72	R	6305	96
5728	131	0.2	60	69	R	6339	96
5734	140	0.2	68	71	R	6062	92
5698	131	0.4	55	67	MS	5921	90
5854	136	0.4	56	70	R	4723	72
IR 22	122	0.2	55	72	S	3102	47
CICA 8	136	0.6	56	68	MR	6609	100 control
CICA 4	120	0.6	61	70	R	5984	91

1 R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible.
2 Figures underlined are yields of one season only.

of the fact that varieties originating in a given country may carry similar genes.

The resulting F_1 was top-crossed to widely adapted susceptible varieties and 207 F_1 populations were planted.

Over 90% sterility was observed in cross combinations with the Japanese upland variety Sensho and the West African variety IRAT 10, thus only 152 out of the 207 F_1 populations were advanced to the F_2 generation in La Libertad, Villavicencio.

Contrary to the expected results, the two Surinam varieties combined well with most of the parents. The cross IRAT 8 x Camponi combined very well with most of the top crossed parents.

Crossing of susceptible varieties

Gradual accumulation and build up of minor gene resistance (rate reducing type) through recurrent selection from an entirely susceptible base has been advocated as a means of stabilizing resistance to pathogens. F_1 generations of 66 single crosses between 12 adapted susceptible varieties were planted and harvested (CIAT Annual Report, 1978).

The F_2 populations will be exposed to natural infection of blast in Villavicencio to select plants even with very low levels of resistance for a second cycle of crossing.

Combination of major and minor genes

A combination of major and minor genes is believed to increase their effectiveness. Breeding projects initiated so far envisage a concentration of major or minor genes but not a combination of both. A combination of the two types in all probability may impart better stability and increased longevity.

Seven single crosses made for the breeding project for horizontal resistance (crosses among African, Surinam, Japanese, and Philippines varieties) were selected and three additional single crosses involving two new parents were included (Table 2).

The ten single crosses were top-crossed to six advanced breeding lines with major genes of resistance to blast (Table 3).

In the selection of parents for top crossing, resistance or tolerance to leaf scald was taken into consideration in view of the widespread occurrence of the disease in Central America and some locations of Colombia.

Table 2. List of single crosses used for the combination of major and minor genes for resistance to blast.

Single cross		
IRAT 8	x	Camponi
IRAT 8	x	Costa Rica
IRAT 13	x	Camponi
IR 11-452	x	Camponi
IR 11-452	x	Costa Rica
3250[1]	x	Camponi
3250	x	Costa Rica
3250	x	IRAT 8
O.S. 6	x	Camponi
68.83	x	Ceysvoni

1 A line with genes for blast resistance from Dawn.

Tolerance to sheath blight

Sheath blight *(Thanatephorus cucumeris)*, though not a major production constraint, is prevalent in Central America and some locations in South America. Erratic natural field infections seriously hamper evaluations due to the absence of dependable screening techniques.

F_2 populations from 16 cross combinations involving K 8 and Topoo-cho-z as donor parents for resistance were planted in Monteria and CIAT-Palmira. Six of the populations planted at CIAT-Palmira were mass selected for plant type, grain type, and maturity duration, to be advanced to the F_3 generation. The planting at Monteria had not been harvested.

F_3 populations from four backcrosses, 4440/2 x Tapoo-cho-z and 4440/2 x K 8, were planted in Panama. The natural infection was poor, so a realistic field evaluation was not possible. F_3 pedigree rows of the last backcross (3330/2 x K 8) were single-plant selected.

One hundred-fifteen B_1F_2 populations from the same crosses with CICA 9/2 x K 8, an additional backcross, were planted in CIAT-Palmira and 111 selections were derived from two of the backcrosses involving K 8 as the non-recurrent parent.

Poor combining ability characterizes Tapoo-cho-z, in addition to high sterility encountered in crosses done with it. Almost all of these were discarded.

Table 3. Characteristics of the six lines used as top-cross parents for the combination of major and minor genes of resistance to blast.

Line No.	Donor for resistant genes	Grain quality[2]	Reaction to Rhynchosporium[3]
5685	Pyramided	VG	R
5732	Pyramided	VG	R
5738	Pyramided	VG	R
5002	Colombia 1	VG	R
6843[1]	Tetep	G	MS
6839[1]	Tetep	G	MS

1 Lines derived from the cross Bg 90-2/3 x Tetep.
2 Grain quality: G = good; VG = very good.
3 Disease reaction: R = resistant; MS = moderately susceptible.

Earliness

Early maturity (100-110 days) is preferred by farmers. Sixteen mass-selected F_2 populations of threeway crosses with Tetep, CICA 7, and CICA 9 used as donors of resistance to blast and with CICA 4 as the donor of early maturity, were advanced through the F_3 generation and single-plant selected in the F_4 generation in Nataima, Tolima in Colombia. One thousand-seventy selections made from 14 of the populations were evaluated for quality characteristics and 696 of them were advanced to F_5 pedigree rows in Nataima.

Climatic conditions in Nataima favor better white belly expression, an undesirable quality trait. The selection pressure under the climatic conditions prevailing in Nataima facilitates the detection and elimination of undesirable individuals with low grain quality.

A further 13 mass selected F_2 populations originating from crosses involving four early maturing varieties—IR 36, 5461, IR 22, and CICA 7—with three different sources of blast resistance— Tetep, Colombia 1, and C 46-15— were advanced through the F_3 generation and single-plant selected in the F_4 . Plants maturing 10-15 days earlier than CICA 9 were selected at CIAT-Palmira. These were evaluated for quality and advanced to F_3 pedigree rows.

Selection combining excellent plant type, good grain quality and earliness were identified both at Nataima and at CIAT-Palmira.

Dual Purpose Crosses

Nearly 70% of the total rice area in Latin America is cropped under rainfed or upland conditions with varying environmental stresses. During the year, a new project was initiated with a set of dual purpose crosses to breed for adaptation to irrigated as well as rainfed conditions.

Five upland varieties of different geographic origins were mated with two varieties from Surinam and one IRRI breeding line, to produce single crosses. These are being top crossed to nine varieties adapted to irrigated as well as rainfed conditions. The agronomic characteristics of the varieties involved in dual purpose crosses are presented in Table 4.

The selection of parents and the cross combinations were planned for dwarf and intermediate plant types with tolerance to water stress, adaptation to upland, rainfed, and irrigated cropping systems, good grain quality, and resistance to blast and leaf scald.

F_2 seed of the dual purpose crosses was proposed to be supplied to all Latin American countries interested in upland or rainfed rice. In this way, early screening could identify stress tolerant segregates by their exposure to the environmental stresses specific to each country. Such early screening should enable the participating countries to select and breed for their own local conditions.

Improvement of Bg 90-2

Bg 90-2 combines high yield, wide adaptability, an excellent plant type and very good early vigor. However, its susceptibility to blast and poor grain quality preclude its commercial acceptability.

The incorporation of blast resistance and improvement of its grain quality while retaining its desirable characteristics was attempted through backcrossing. Bg 90-2 was backcrossed twice and three times to Tetep(Bg90-2/3 x Tetep) (Bg 90-2/4 x Tetep). Over 325 selections from the two backcrosses were evaluated through the F_3 and F_4 generations in Villavicencio and CIAT-Palmira. Forty-three B_2F_4 and 18 B_3F_4 lines were finally selected and advanced to preliminary yield trials.

Although the white belly rating of the recurrent parent Bg 90-2 exceeded 3.0 (very high), the ratings of the lines advanced to yield trials ranged from 0.4-0.8, combining also a long slender grain which is a desirable quality characteristic.

Several progenies combining blast resistance, improved grain quality,and the plant type of Bg 90-2,were identified.

The improvement of grain quality of Bg 90-2 was also attempted with one backcross to CICA 7. A B_1F_3 progeny was identified combining blast resistance, with a 0.2 rating for white belly. Selections from this progeny were advanced to the F_4 generation.

Rectification of the Defects of CICA 8

Wide adaptability, high yield, acceptable grain quality, and blast resistance characterize CICA 8. However, moderate to severe lodging, particularly under upland and rainfed conditions, has been observed as a noteworthy defect.

Table 4. Agronomic characteristics of the varieties involved in dual purpose crosses for irrigated, rainfed and upland conditions.

Variety or line No.	Plant type[1]	Cropping system	Grain quality[2]	Reaction to blast[3]	Reaction to leaf scald[3]
Azucena	I	Upland	VG	R	-
M.I. 48	I	Upland	VG	R	R - MR
IAC 25	I	Upland	VG	R	-
Costa Rica	I	Rainfed	VG	R	R - MR
IRAT 8	I	Upland	VG	R - MR	-
Camponi	D	Irrigated	VG	R	R - MR
Ceysvoni	D	Irrigated	VG	R	R - MR
5002	D	Irrigated	VG	R	R
5732	D	Irrigated	VG	R	R
5738	D	Irrigated	VG	R	R
Taichung S195	D	Irrigated-rainfed	G	S	MR
IR 4422	I	Irrigated-rainfed	G	MR	R
IR 4744	I	Irrigated-rainfed	G	MR	R
2476	D	Irrigated	G	S	-
2135	D	Irrigated	G	S	-
3224	D	Irrigated-rainfed	G	R	-
3250	D	Irrigated	F	R	-

1 Plant type: I = intermediate; D = dwarf
2 Grain quality: G = good; VG = very good
3 Reaction to blast and leaf scald: R = resistant; MR = moderately resistant; S = susceptible.

Bg 90-2 is characterized by a stronger culm. F_2 progenies of the first backcross of CICA 8 to Bg 90-2 and of Bg 90-2 to CICA 8 were evaluated, selected and advanced through the B_1F_3 generation. One hundred twenty-six single plants selected for superior straw strength were planted in B_1F_4 progeny rows for further evaluation.

Mutation Breeding

Breakdown of varietal resistance to blast is a very frequent phenomenon even though the varieties were derived from crosses involving parental sources for broad-spectrum resistance. Such a breakdown of resistance attributed to the dilution of genetic factors, as a cross combination of broad-spectrum parental sources does not ensure that the progeny will recapture the entire complement of resistant factors of the donor. Backcrossing to the broad-spectrum donor parent, though an effective safeguard against dilution, would lead to an undesirable, low productive plant type as all the broad-spectrum donor sources for blast resistance are tall statured with weak straw, thus susceptible to lodging.

Dwarfing such broad-spectrum tall donor parents through induced mutations is being attempted, to render them as suitable recurrent parents. Fourteen varieties were irradiated at the laboratories of the International Atomic Energy Commission in Vienna, and their X_1 generations were planted. These included Tetep, Tapoo-cho-z, Tapuripa, Ca 902/b/3/3, P.I. 184675-2, Carreon, Tadukan, O.S. 6, Moroberekan, M.I. 48, IAC 25, Colombia I, CICA 4, and Bg 90-2.

Evaluation of Selections Derived from Segregating Populations Brought from Sri-Lanka

A total of 768 single plant selections derived from 8 F_4 populations of multiple crosses brought from Sri-Lanka (CIAT Annual Report, 1977) were observed and evaluated. Seventeen final selections were yield tested and the performances of the first six highest yielders are presented in Table 5. Five of these have already been used in the breeding program as donors for yield, plant type, and lodging resistance. Lines 5062 and 5209 were identified as tolerant to sheath blight and leaf scald. Additionally, line 5209 is being extensively crossed for its excellent early vigor, high tillering capacity, and good plant type.

Evaluation of Introductions

A total of 108 advanced breeding lines, 81 from the International Institute of Tropical Agriculture, IITA, Africa, and 27 from IRRI, the Philippines, were planted in observation plots in CIAT-Palmira and evaluated for early vigor, plant type, grain type, and tillering capacity.

The majority of the African lines were tall with low tillering capacity, large panicles and large flat grains. These are typical upland plant types. Twelve of the intermediate type African lines combining early vigor, profuse tillering and stiff straw were selected.

Almost all the IRRI lines were dwarf types but lacked early vigor. Ten of the IRRI lines combining stiff straw, profuse tillering and dwarf stature, were selected. IR 2058-1-3-2-3, IR 1416-131-5-10-2, IR 1416-142-2-3-3, IR 1820-52-2-4-1 and IR 3259-11-182-4 were identified for very high tillering ability, excellent straw strength, and dwarf plant type with medium maturity duration.

The selected lines will be further field evaluated for blast and leaf scald under natural field infections in Villavicencio.

Male Sterility

Genetic sterility

The availability of male sterile stock would greatly facilitate recurrent selection programs for the concentration of genes. Genetic male sterile stock in IR 36 background, crossed to Tetep, Carreon, and IET 1444 were obtained from IRRI. The recessive male sterile character is being transferred to CICA 4 and Bg 90-2 through backcrossing.

Table 5. Yields of six rice lines derived from segregating populations brought from Sri-Lanka.

Line No.	Cross	Plant type	Yield (kg/ha)	% of control
2485	IR 2035-290 x (Bg 90-2 x Pelita 1/1)	Dwarf	8637	112
5062	Bahagia x 73-805	Intermediate	8635	112
3555	IR 2035-290 x (IR 262 x Pelita 1/1)	Dwarf	8442	109
2135	Bg 90-2 x (IR 1541 x Ob 678)	Dwarf	8437	109
2698	IR 262 x (BKN 6809 x IR 1529)	Dwarf	8368	108
5209	Bahagia x IR 262	Dwarf	8203	106
CICA 8	(control)		7710	100
Bg 90-2	(control)		8005	103

Chemical sterility

Studies with the chemical induction of male sterility were continued with Ethrel (2-chloroethylephosphonic acid) (CIAT Annual Report, 1978).

Four concentrations of Ethrel (2000, 3000, 400, and 5000 ppm) were applied to CICA 8 at the booting stage followed by a second application three days after the first. Compared to 16% sterility of the untreated control 52, 58, and 73% male sterility was produced by the four concentrations, respectively. A concentration higher than 4000 ppm failed to be effective in increasing sterility.

The investigation is being repeated with 3 ml of 10% HCl added to 1000 ml of the Ethrel mixture, as this acid is reported to enhance the effectiveness of Ethrel.

PATHOLOGY

The Plant Pathology section of the Rice Program was initiated in January, 1979. As a preparation period, a survey and exploratory experiments were carried out to establish the future working plan. Training of personnel, multiplication, and cataloguing of various test materials, and the establishment of experimental plots are in the final stages.

Evaluation of Disease Resistance

The identification of various sources of resistance to major rice diseases and the evaluation of breeding materials constitute the key components of the multidisciplinary team approach of developing new disease resistant varieties.

Without a proper management scheme, it is often difficult to obtain reliable and consistent results under natural field conditions. Accordingly, main emphasis is on developing an efficient disease evaluation method.

Evaluation scheme for rice blast resistance

The breeding scheme in the CIAT/ICA rice program is adopting various approaches to achieve stable resistance which include pyramiding major genes, multiline varieties, pyramided multilines, and concentration and utilization of minor genes. Each approach requires quite different evaluation methods and a different management for the pathogens.

An efficient working scheme has been developed to integrate all the different steps of evaluation (Figure 1). Also, several new plot designs and working procedures were devised and their efficiencies are being tested in pilot plots established in CIAT-Palmira. The promising method will be further tested in several locations.

Blast nursery test

As illustrated in Figure 1, testing in the blast nursery is an important and informative beginning towards a further detailed evaluation.

A total of 678 breeding lines and pathology accessions from various origins have been evaluated in a newly established CIAT blast nursery (Table 6). More than 38% of the entries showed highly resistant reactions. These will

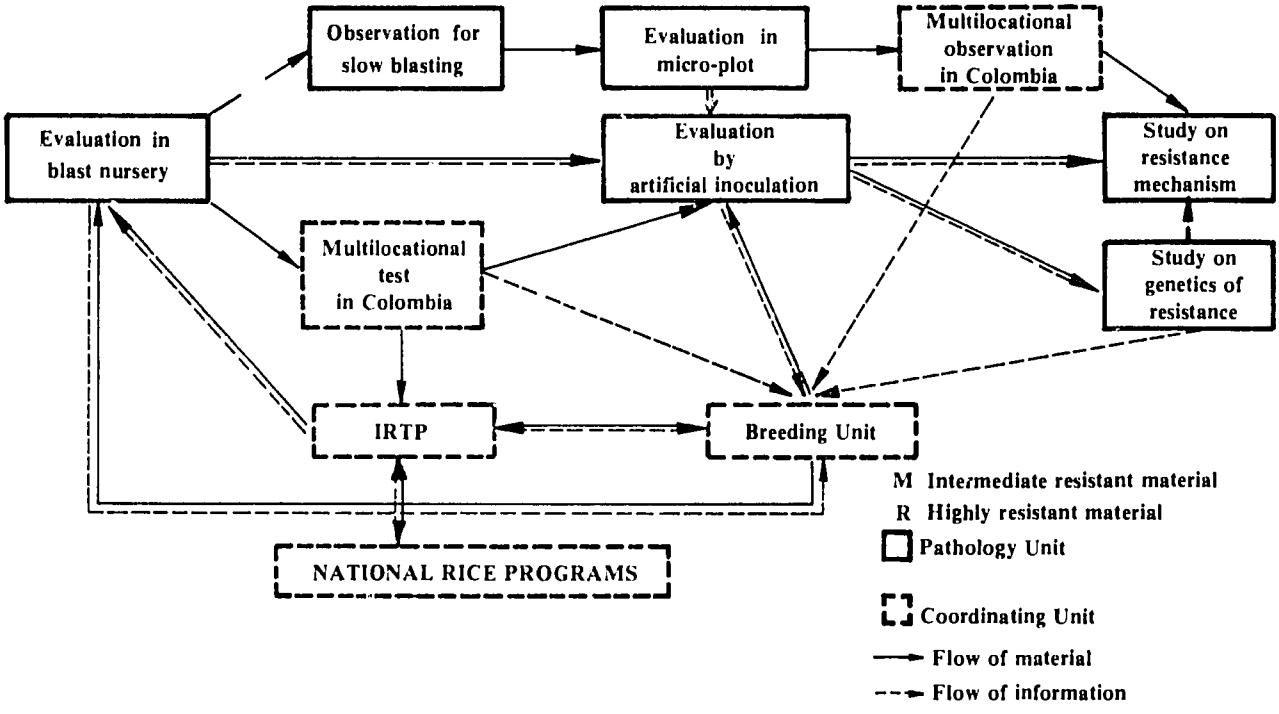

Figure 1. Working scheme for the evaluation of blast resistance in the CIAT Rice Program.

Table 6. Summary of evaluation for blast resistance in the blast nursery planted at CIAT-Palmira, 1979.

Group	Number of entries			Total
	Resistant	Intermediate	Susceptible	
Regional trial	4	6	1	11
CIAT/ICA line	84	98	1	183
IRRI line	14	15	0	29
African line	2	20	0	22
USA line	79	95	96	200
Commercial variety	3	1	4	8
Pathology accession	72	133	20	225
TOTAL	258	368	52	678
%	38	54	8	100

be further subjected to multilocational blast nursery tests and finally in the International Rice Blast Nursery (IRBN) to find out its spectrum of resistance. Entries exhibiting a moderate level of resistance will also be further evaluated for the possible presence of a slow blasting characteristic.

To observe any recovering ability two readings at 30 and 40 days after sowing were made. Several entries have recovered remarkably in spite of the considerable initial level of infection (Table 7).

The reaction of Japanese race differential varieties in the blast nursery of CIAT indicates that the population of *P. oryzae* present in the nursery has virulence to many of the known genes except Pi-z, ta^2 and z^t, with varying frequency (Table 8). However, it is not certain whether the resistance of the remaining is due to a known gene or not.

Favorable microclimatic conditions, especially a prolonged period of leaf humidity, are essential for good blast development. For this purpose, maize was planted surrounding the blast nursery as a temporary wind barrier, which will be later replaced by trees. Also, the bamboo frames to support plastic covers during the night have been substituted with PVC frames which are more durable and easy to manage (Figure 2).

Table 7. Ability of several rice lines to recover from blast in the blast nursery planted at CIAT-Palmira, 1979.

Entry	Rating[1] at days after sowing	
	30	40
IR 13396-7-2	3 (4)	1 (3)
IR 1416-131-5-10-2	3 (4)	0 (3, 4)
STBN/9837	4 (5)	1 (3, 4)
M 101	7	4
BB50/M341//OS 57	5	3
BN73/984/BBLE//BLPT/ Dawn/3/IR8/4/ BBLE BLPT/Dawn	4 (5)	0 (3)
NTAI//9545/Nova	0 (3)	3 - 4
9881/331581	4 (5)	7

1 Standard evaluation scale: 0-2 = resistant; 3-5 = intermediate; 6-9 = susceptible. Scale in parenthesis indicates the presence of few number of plants showing different reaction. 0 = absence of brown speck. (In the second evaluation, the reaction observed was that of the upper two thirds of the plant.)

Table 8. Reaction of race differential varieties in the blast nursery, CIAT-Palmira, 1979.

Variety	Resistance gene involved	Reaction
Group A[1]		
Shin 2	Pi - k^s	Susceptible
Aichi asahi	Pi - a	Susceptible
Ishikari shiroke	Pi - i	Susceptible
Kanto 51	Pi - k	Susceptible
Tsuyuake	Pi - m, k	Susceptible
Fukunishiki	Pi - z	Resistant
Yashiro mochi	Pi - ta	Susceptible
Pi No. 4	Pi - ta^2	Resistant
Toride 1	Pi - z^t	Resistant
Group B		
IR 1905-81-3-1		Resistant
IR 2588-2-3-3		Resistant
IR 34		Resistant
IR 1529-680-3		Susceptible
IR 26		Susceptible

1 Group A = Japanese differentials; Group B = Tentative differentials in IRRI (information on resistance gene involved is not available).

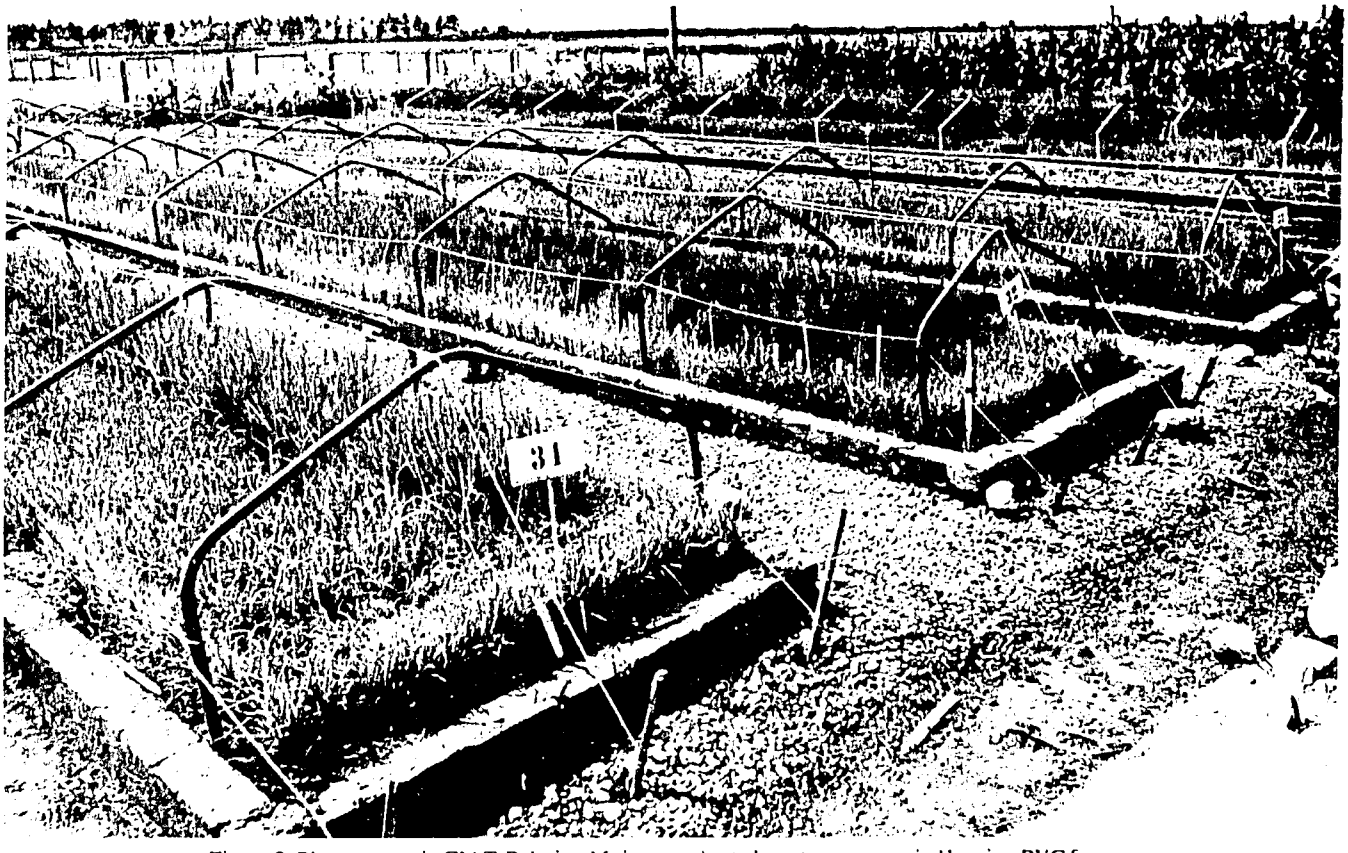

Figure 2. Blast nursery in CIAT-Palmira. Maize was planted as a temporary wind barrier. PVC frames are to support plastic covering during the night to prolong leaf wetness.

New plot design for the evaluation of the slow blasting character

Several resistant mechanisms such as a lower efficiency of infection, a longer incubation period, a small size of lesion, and less spore production have been known to contribute to a slow progress of blast. In general, the individual component may not be readily detected in a conventional way due to its relatively small effect in each cycle of infection. However, the repeated cycles over a prolonged period result in the magnification of effects of these components of resistance.

To evaluate the relatively large number of materials, a new plot design was made (Figure 3). Entries showing a 3-5 rating in the evaluation scale in the blast nursery are evaluated for the intensity of disease in each row at given intervals. Promising entries will be further evaluated in detail under different conditions utilizing the terrace nursery which consists of long strips of lowland, semiupland and upland (Figure 4).

Field evaluation of regional test materials

Eleven elite lines from the CIAT/ICA rice program together with several commercial varieties were evaluated in Jamundi, Colombia, during 1979B (Table 9). Several elite lines showed a high level of resistance to leaf scald although none of them were completely free of the disease. Four lines showed the zonate eyespot symptom but in much lower levels compared to CICA 6 which was heavily affected.

Pathogenic diversity of Pyricularia oryzae

It is a well known fact that the diversity and the rate of change in the pathogenicity of *P. oryzae* have dictated the nature of the resistance and its utilization. Information on both pathogenic diversity of the pathogen and its change in prevalence has served to establish the proper strategy.

It is quite clear that the pathogenicity of the rice blast agent varies from country to country and from location to location within a country (Table 10).

After the first testing in the ICA nursery at Palmira, the same material was again tested in CIAT-Palmira using the same inoculum obtained in the ICA nursery. Several entries showed a remarkable change in their reaction, while others remained stable (Table 11). This again demonstrates that the kind and frequency of race constitution is changing continuously even in the same location.

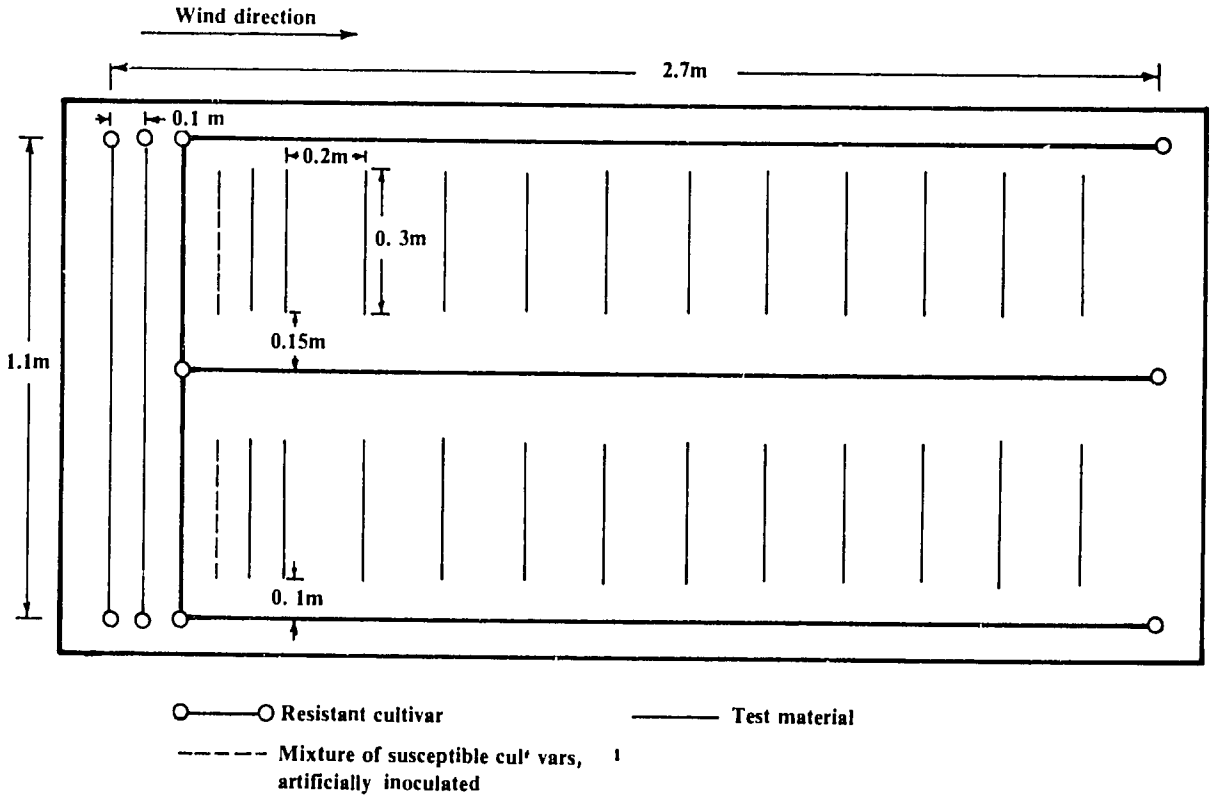

Figure 3. New design of the evaluation plot for rice blast development.

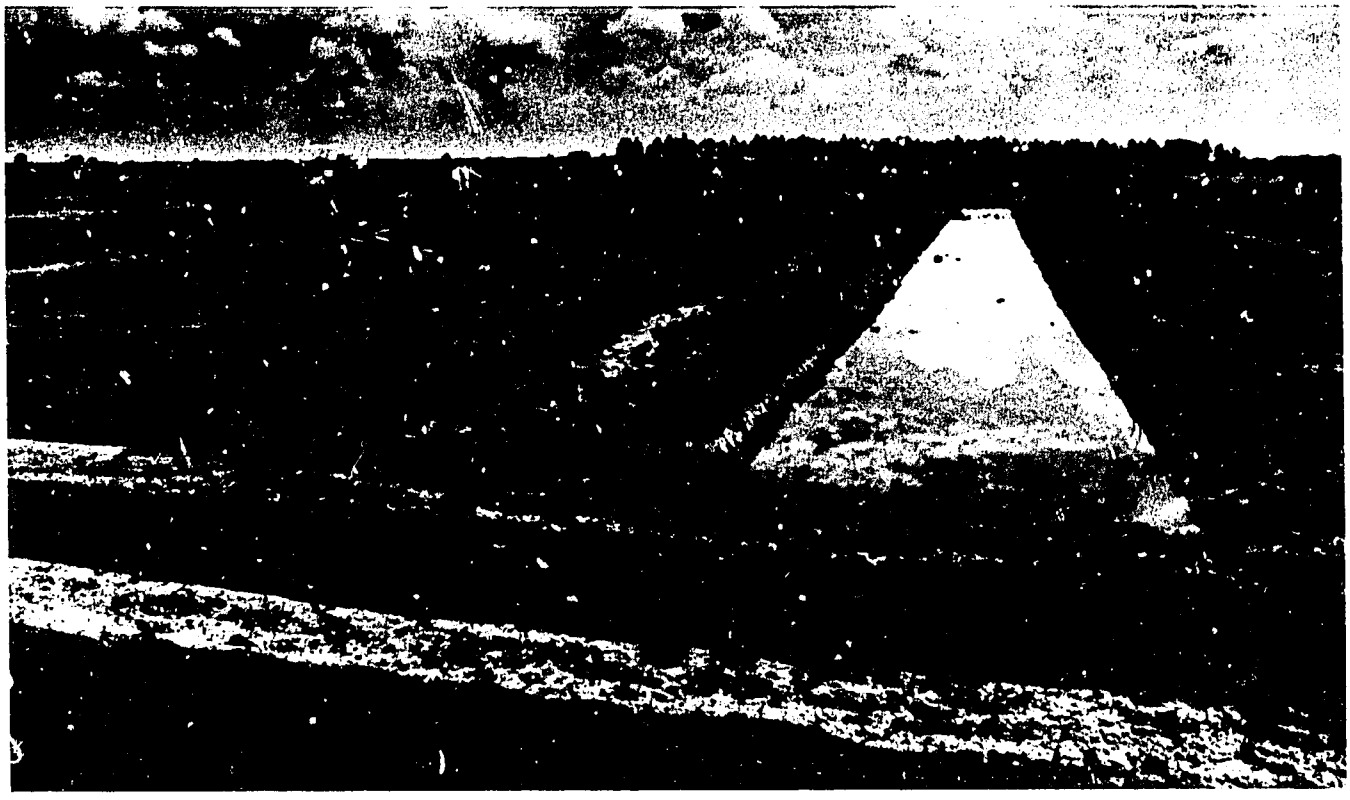

Figure 4. Terrace nursery in CIAT-Palmira. There are strips of lowland, semiupland and upland.

Table 9. Field evaluation of regional trial entries in Jamundi, Colombia, 1979.

Entries	Zonate eyespot[1]	Leaf scald[1]	Narrow brown leaf spot[1]	Blast	
				Leaf[1]	Neck[2]
P 1264-6-11M-1-3M-4	0	7	0.7	0	-
P 1270-1-4M-3-1M-5	0	5.5	0.5	0.2	-
P 1274-6-8M-1-3M-1	0	3	0.5	0	-
P 1342-6-6M-1-2M-3	0	7	0	0	-
P 1369-4-16M-1-2M-4	0.5	2.5	0.7	0	-
P 1377-1-15M-1-2M-3	0	3	1	0	-
P 1377-1-15M-4-1M-1	1	7.5	0.5	0.2	-
P 1386-6-8M-1-3M-1	0.5	7.5	0.7	0.2	-
P 1397-4-9M-3-3M-3	0	3	3	0	-
P 1404-1-1M-1-1M-1	0.2	7.5	2	0	-
P 1429-8-9M-2-1M-5	0	7.5	0.5	0	-
CICA 8 (control)	0.1	2.5	3	0	-
CICA 9 (control)	0	1	0.7	3	20
CICA 4 (control)	0.5	5	1	0	-
CICA 6 (control)	25	7.5	0	0	-

1 Leaf area infected.
2 Percentage of panicle infected.

Table 10. Reaction[1] of selected entries from the International Rice Blast Nursery, VIPAL, 1978, to rice blast in Latin America.

Variety or line	Mexico	Colombia[1] 1	Colombia[1] 2	El Salvador	Guatemala	Costa Rica[1] 1	Costa Rica[1] 2	Dominican Republic	Bolivia	Brazil[1] 1	Brazil[1] 2	Brazil[1] 3
P 1369-4-16M-1-1B	-	-	-	-	-	-	-	-	-	-	-	-
P 1327-3-3M-5-1B	-	+	-	+	+	-	-	-	-	-	+	-
P 1397-4-9M-3-1B	+	-	-	-	-	-	-	-	+	-	-	+
P 1377-1-15M-5-1B	+	-	+	-	-	-	-	+	-	-	+	-
Zenith	+	-	-	-	-	+	-	-	+	+	+	+
Usen	+	-	-	+	+	-	+	+	-	+	+	+
P 1342-6-6M-1-1B	+	-	-	+	-	-	+	-	-	-	-	-
INIA 7	+	+	+	-	-	+	+	-	-	-	-	-
Tikal 2	+	+	+	-	-	+	+	+	+	-	-	-
P 1391-6-11M-1-1B	+	+	-	+	-	-	-	-	-	+	-	-
P 1379-8-9M-3-1B	+	+	-	+	+	-	-	+	-	+	-	-
P 1427-3-9M-1-1B	+	+	+	+	+	-	-	+	+	+	-	-
Kanto 51	+	+	+	NI[3]	+	+	+	-	-	+	+	-
NP 130	+	+	-	+	+	+	+	-	-	-	+	-
IR 4722-251-4	+	+	-	+	+	+	+	+	-	-	-	-

1 - = resistant (0-2 rating); + = susceptible (3-9 rating).
2 1 = Palmira and 2 = Villavicencio in Colombia; 1 = Cañas and 2 = Jicaral in Costa Rica; 1 = Goiania, 2 = Pelotas, and 3 = Campinas in Brazil.
3 No information available.

Table 11. Change in reaction of several cultivars to rice blast in two different seasons and locations, Colombia, 1979.

Variety or line	Villavicencio May	Palmira April	Palmira October
Wagwag	NI[1]	1	3 (4)[2]
Chokoto	1	1 (3)	4
Tsuyuake	1 (3)	1	5
Yashiro-mochi	3	1 (3,4)	4
C 46-15	1	1	4
Cempo Selak	1 (3)	7	7
Jinheung	7	3 (3)	3-4

1 No information available
2 Standard evaluation scale; scale in parenthesis indicates the presence of a few lesions of different type.

Occurrence, Management and Control of Rice Diseases

New disease in Colombia and Panama: the zonate eyespot

In Tocumen and Chiriqui Province of Panama, and in Jamundi and Ibague, Colombia, unusual leaf spots were observed on CICA 6 and CICA 7 (Figure 5). Investigations carried out in the laboratory revealed that the causal organism of this disease is *Drechslera gigantea* (Heald & Wolf). Ito. The zonate eyespot caused by this fungus on grasses has been known since 1923, but this is the first report on the occurrence of the same disease on rice.

The most typical symptom is the minute longitudinally elongated oval spot delimited by dark brown margins. The spot often has a diffused brown halo. Fully developed spots have light brown, straw or whitish centers. The initial symptom is a minute brown dot or water-soaked dot. The size of a fully developed isolated spot is 0.8-4 x 1 mm.

Successive radial growth and coalescing of lesions often form the peripheral belt, which later dries up into a light

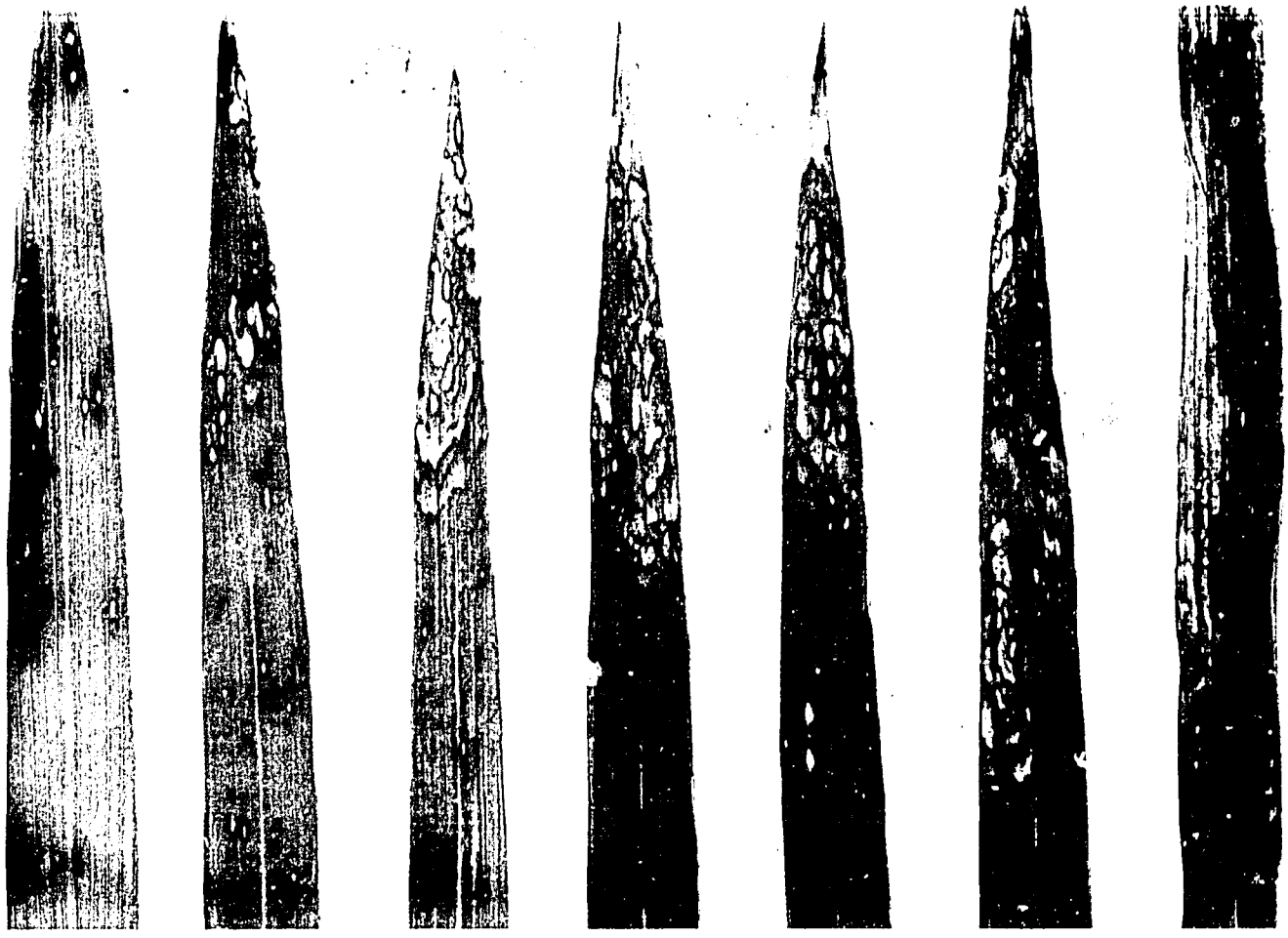

Figure 5. Zonate eyespot on CICA 6 caused by *Drechslera gigantea* (Heald & Wolf) Ito.

brown color with dark brown margins resulting in zonation. The zonation is very similar to that observed for leaf scald but much more irregular. Heavily affected leaves dry and become straw-colored with a faint spot and zonation with alternation of light brown to pale yellow color.

Conidiophores arise singly or in pairs, are straight or flexuous, brown or dark grayish on prune agar medium, usually 200-257 x 10-13 μ with a round 10-15 μ base, which is more commonly observed on the lesion. Conidia are cylindrical, rounded, 200-345 μ x 16-19 μ with 3-6 septa (commonly 5); the hilum is inconspicuous.

The same symptom was produced on CICA 6 and CICA 7 by artificial inoculation with a monoconidial isolate. The reisolated fungus from the inoculated plants was the same as the original isolate.

This fungus causes eyespot on banana and zonate eyespot on several grasses including *Cynodon dactylon* (L.) Pers. and *Eleusine indica* (L.) Gaertn. Heavy dew or prolonged drizzling rain favor the development of the disease.

Susceptibility to stem rot

In the seed multiplication plot planted in 1979A, several varieties including K 2, IR 40, IR 2793-80-1 and Yushin were heavily attacked by stem rot. Large numbers of sclerotial bodies were present inside the stem. It is frequently observed that this disease is highly associated with the infestation of the white stem borer. Although this disease has been known as a minor one, it is widely distributed. Apparently, the low incidence of the disease is due to the high level of resistance of commercial varieties.

AGRONOMY

This year the Agronomy section continued the research on the use of growth regulators, the control of insect pests *(Hydrellia* sp. and *Rupella albinella),* weed control with granulated herbicides, and the continuous rice production system. Studies were carried out on the effect of P and K on the milling and cooking qualities of rice.

Growth Regulators

The physiological effects of different rates and times of application of Folcistein on growth and yield of CICA 8 were evaluated.

Seeds were treated before seeding with a 5% Folcistein solution. When plants reached the maximum tillering stage Folcistein was applied at 0, 300, 500, 700, and 900 cc/ha, with an additional application at flowering initiation (5% flowering). Although the results indicate a slight increase in yields due to Folcistein, the differences were not significant (Figure 6).

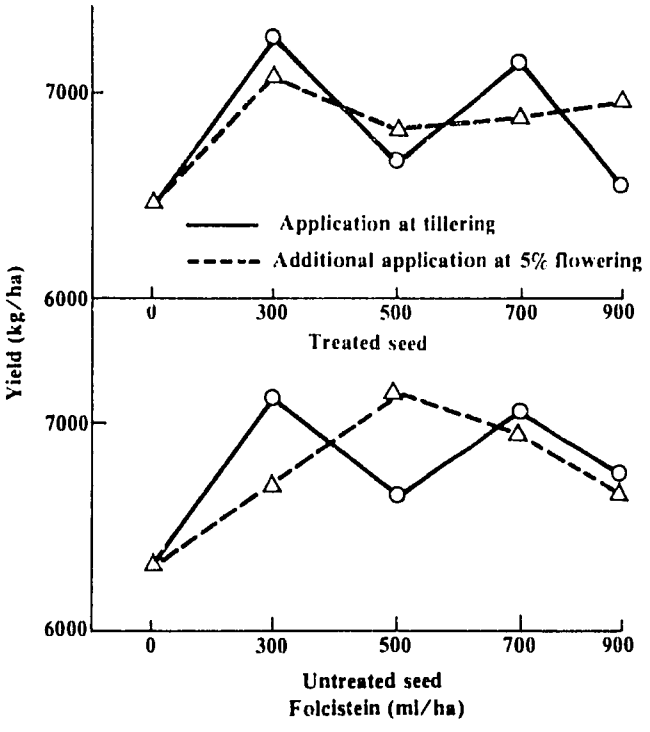

Figure 6. Effect of Folcistein concentration on yield of CICA 8.

Control of Insects

Hydrellia sp.

Hydrellia sp. is becoming an important pest in rice crops throughout Latin America; it has been observed causing severe damage in rice paddies in Ecuador, Colombia, and Venezuela.

Studies carried out indicate that the insect proliferates under flooding conditions and that its population is reduced when the soil surface is dried out. Observations in experimental fields at CIAT and ICA at Palmira, Colombia, indicate that fields planted with pregerminated seeds in wet soils or by transplanting are more strongly attacked than plantings done on dry soils.

The damage is caused by the larva, which bore into the plant causing leaf wilting above the perforated tissue. The damage is more severe when it occurs in the early stages of plant growth.

The effect of various insecticides and cultural practices to control *Hydrellia* sp. was studied in CICA 8 seedlings transplanted to puddled soil.

The insect population decreased as plants developed and these recovered from the damage. No significant differences were observed between yields obtained in the various chemical treatments (Table 12). A useful method to control the insect is to drain the fields immediately after the first symptoms appear, provided that drainage is not maintained for more than five days to avoid weed infestation.

Rupella albinella

Chemical control

The stemborer *Rupella albinella* is frequently observed in rice paddies in Latin America. In some regions rice growers treat the fields with insecticides to control the pest.

During the first semester of 1979, a high population of *R. albinella* was observed in experimental rice fields at CIAT-Palmira. An experiment was carried out to evaluate the efficiency of various insecticides to control the insect (Table 13).

Table 12. Effectivity of several chemical treatments to control Hydrellia sp. in rice fields.

Treatment	Rate of application (kg a.i./ha)	Yield (t/ha)
Drainage		6.01 a[1]
Carbofuran 3G	1.0	5.95 a b
Drainage + carbofuran	1.0	5.88 a b
Metalkanate 3 G	0.5	5.86 a b
Control		5.70 a b
Diazinon 60D CE	1.0	5.48 a b
Tridorforin 3 G	0.5	5.48 a b
Disulfoton 14G	1.0	5.47 a b
Aldicarb 15G	1.0	5.33 a b
Diazinon 14G	1.0	5.17 b

1 Figures followed by the same letter are not significantly different at the 0.05 level.

Table 13. Effectivity of different chemical treatments to control Rupella albinella and damage caused by the insect.

Treatment	Rate of application (kg a.i./ha)	% damaged stems
Carbofuran 3 G	1.0	79.12
Aldicarb 15G	1.0	87.93
Diazinon 14G	1.0	84.03
Metalkamato 3 G	0.5	87.68
Diazinon 600CE	1.0	86.45
Triclorfom 3G	0.5	82.35
Disulfoton 14G	1.0	87.24
Control	-	88.24

No differences were observed between treatments in terms of percent damage and yields, and no significant correlation was detected between these two parameters (r = -0,24). This indicates that under the conditions in which these experiments were carried out, the insecticides compared did not effectively control *R. albinella*. The damage caused by *R. albinella* also did not reduce yields significantly, thus chemical control is not justified.

Biological and cultural control

In another experiment the effect of transplanting density and three N levels (0, 80 and 160 kg N/ha) on damage caused by *R. albinella* and its population, was studied. Additionally, varietal preference and biological control were investigated.

Average damage on CICA 8 was 44% and on IR 22, 28% (Figure 7). The insect population was significantly less at the lowest transplanting distance for both varieties (Figure 8). The infestation of the insect was directly related to the total number of tillers/ha. There was no significant effect of N fertilization on the incidence of the stemborer. Parasitism percentage by *Strabotes abdominalis obscurus* Awart and *Trathala* sp. (Hymenoptera: Ichneumoidae) varied between 64-71% but was not correlated with variety, planting distance or N level applied (Figure 9).

The final yield depended on the planting distance and of the variety used but was not correlated either with the number of larvae or the percentage of damaged tillers.

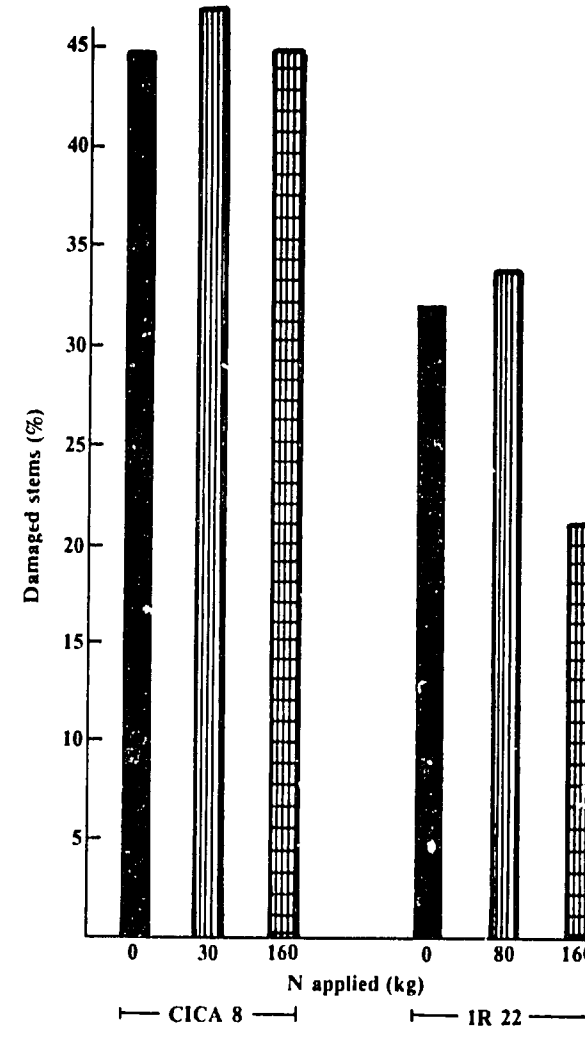

Figure 7. Damage caused by *Rupella albinella* in two rice varieties with three levels of N fertilization.

Weed Control

Weeds are one of the basic factors causing low rice yields. Studies carried out at CIAT (CIAT Annual Report, 1978) indicated that direct seeding with irrigation reduced yields 97.9% in plots where weeds were not controlled.

The best control for weeds is the use of cultural practices complemented with the application of selective herbicides. Chemical control can increase the efficiency and reduce the costs.

Granulated herbicides

In the case of the small rice producer who has available labor but no access to other methods, the hand application of granulated herbicides is easier and more economic than other formulations which require special equipment for their application.

In puddled fields prepared for transplanting and flooding, aquatic dicotyledoneous weeds (e.g., *Limnocharis flava, Jussiaca leptocarpa,* and *Sphenoclea zeilanica)* and members of the Cyperacea family (e.g., *Cyperus ferax* and *C. diffusus)* tend to dominate over grasses.

Several granulated herbicides were evaluated to control weeds in CICA 8 fields. The herbicides were manually applied four days after transplanting and the field was flooded one day after the application; the water level was maintained up to 10 days before harvesting. The results are shown in Figure 10.

Transplanting with irrigation is an effective means to control weeds in rice. Plots treated with herbicides gave higher yields than the unweeded control (Table 14). Significant differences were observed between treatments.

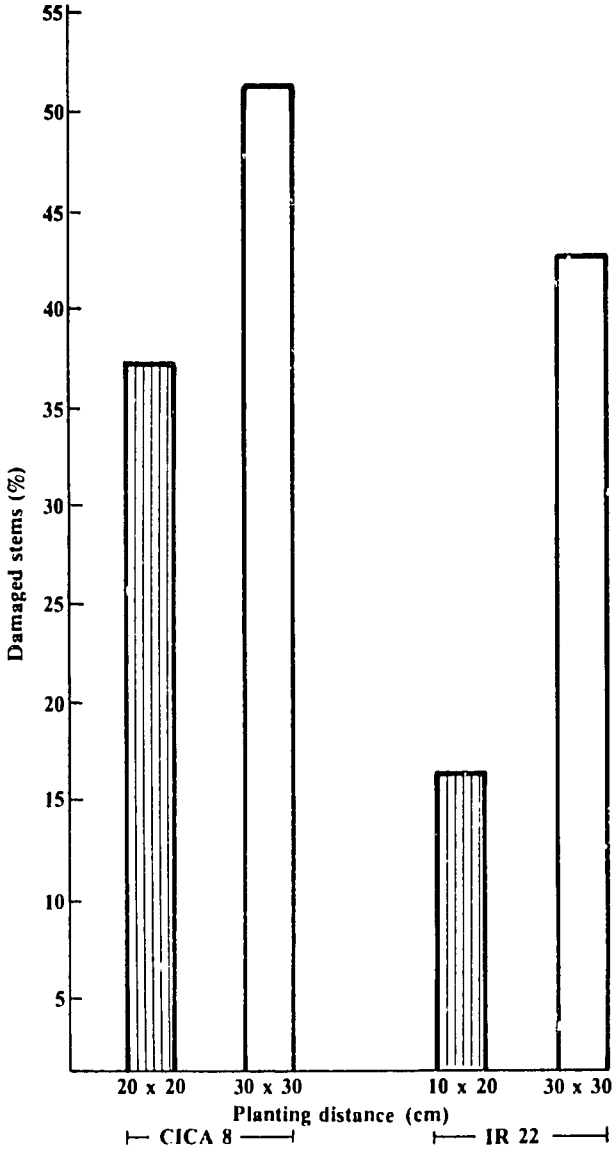

Figure 8. Damage caused by *Rupella albinella* in two rice varieties at two planting distances.

A highly significant and negative correlation exists between weight of weeds and rice yields which indicates that 1 kg of dry weeds/ha decreases dry rice paddy yields by 3 kg/ha.

Planting Density x N Fertilization x Weed Control

The effect of three planting densities (80, 130 and 180 kg seed/ha), three N levels (0, 50 and 100 kg N/ha) and weed control on rice yields was studied.

There was an interaction between N fertilization and planting densities but no significant differences were observed between the individual variables. On the other hand, weed control significantly affected yields (Figure 11).

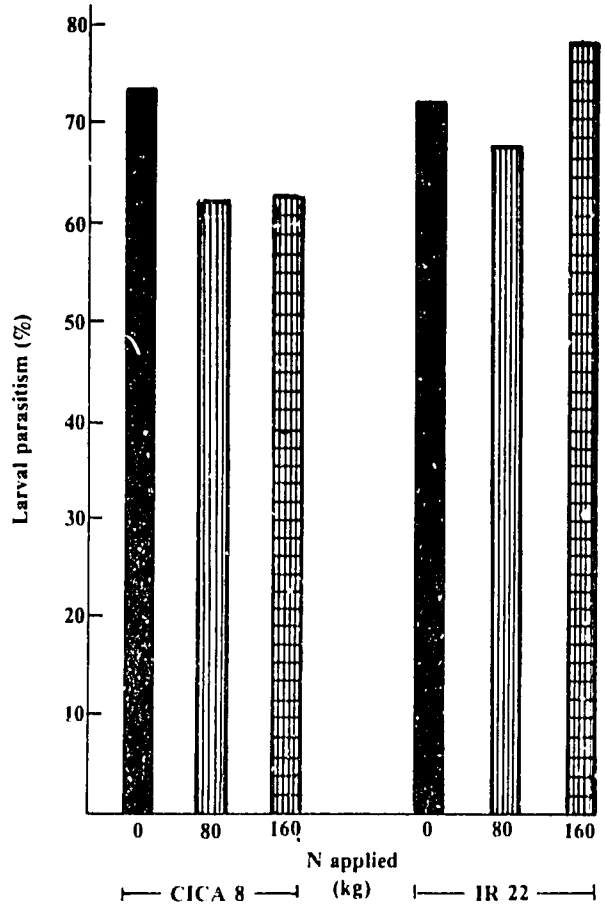

Figure 9. Parasitism of *Rupella albinella* larva in two rice varieties with three levels of N fertilization.

Nitrogen and Dry Matter Distribution in the Rice Plant

The N content and dry matter accumulation in different plant structures of rice varieties CICA 8 and IR 22 were determined in different growth stages, at two planting distances and three N levels. The age at which the first flower primordium is formed was determined due to its importance as an appropriate stage to apply fertilizers.

In IR 22 the flower primordia appeared 55 days after planting; in this stage the plant had only formed 9.20 g/plant of dry matter. The flowering stage commenced 95 days after planting when the plant had accumulated 53.54 g of dry matter. At harvest, 42.1% of dry matter was contained in the grains.

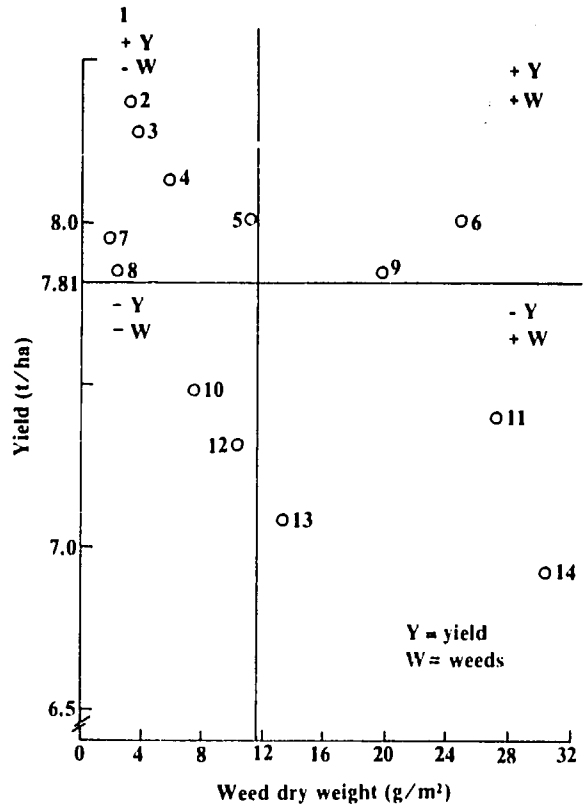

Figure 10. Relationship between mean yield of dry paddy rice and mean dry weight of weeds present.

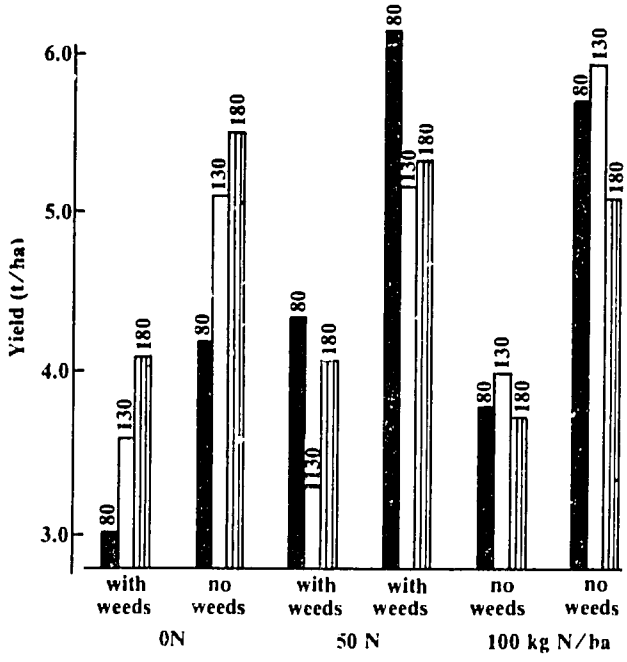

Figure 11. CICA 8 yield at different nitrogen levels, planting densities, with or without weed control.

In CICA 8 the flower primordia appeared 65 days after planting when the plant contained 24.12 g. Flowering occurred 105 days after planting when the plant had accumulated 67.21 g. At harvest, half of the total dry matter was in the rice grains.

Between 35 and 65 days after planting, an increase in N content of leaves, tillers and total plant was observed; after 65 days, the N content decreased in leaves but continued to increase in tillers up to 85 days. The N content increased in the grains of IR 22 and CICA 8, after 95 and 105 days, respectively (Figures 12 and 13).

The age at which the first flower primordium appeared was not affected by the N levels applied or by the planting distances but the higher N levels favored its development.

The mean weight of 1000 grains of rice was 23.80 g for CICA 8 and 20.94 g for IR 22. The ratio of productive grains to empty grains was 6 to 1 for CICA 8 and 2 to 1 for IR 22. CICA 8 showed a higher weight gain of grains (1.08 g/day) than IR 22 (0. 73 g/day).

The ratio of grain to straw was 0.96 for CICA 8 and 0.72 for IR 22, which indicates that CICA 8 is more efficient in converting energy and nutrients.

Azolla as a Potential Biofertilizer

A potential agronomic resource in latin America is the use of the aquatic fern *Azolla* spp. (Pteridofita: Salvinacea)

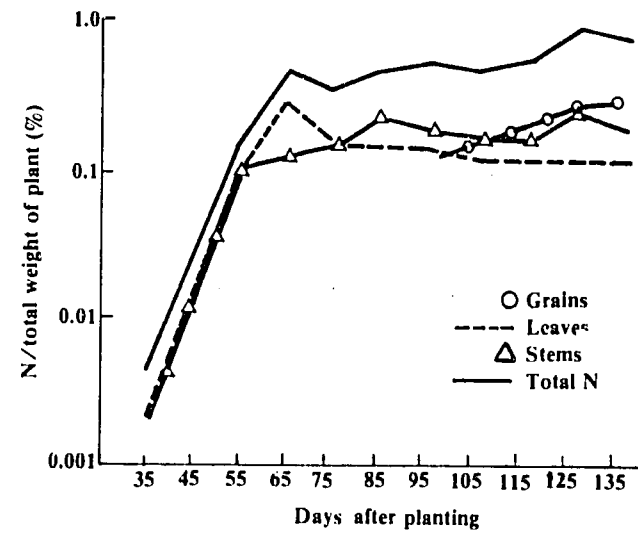

Figure 12. N translocation in rice variety IR 22.

Table 14. Paddy rice yields and dry matter weight of weeds obtained in rice fields treated with different granulated herbicides.

Treatments	Rate of application (kg a.i./ha)	Yield (t/ha)	Dry weight of weeds (g/m^2)
Hand weeding		8.73 a	2.0
Butachlor +2,4-D	0.75 + 0.5	8.37 a b	3.3
Oxyfluorfen +2,4-D	0.2 + 0.5	8.28 a b	4.0
Bifenox	2.5	8.13 a b c	4.0
2,4-D	0.5	8.09 a b c	11.3
Butachlor	1.0	8.09 a b c	25.0
Bifenox +2,4-D	2.0 + 0.5	7.95 a b c d	2.0
Bifenox	3.0	7.85 a b c d	2.3
2,4,5-T	0.8	7.84 a b c d	20.0
Tiobencarbo	1.0	7.48 b c d	7.6
2,4-D	0.8	7.40 b c d	27.3
Tiobencarbo + 2,4-D	0.75 + 0.5	7.31 b c d	10.6
Oxyfluorfen	0.3	7.08 c d	13.3
Control		6.92 d	30.3

1 Figures followed by the same letter are not significantly different at the 0.05 level.

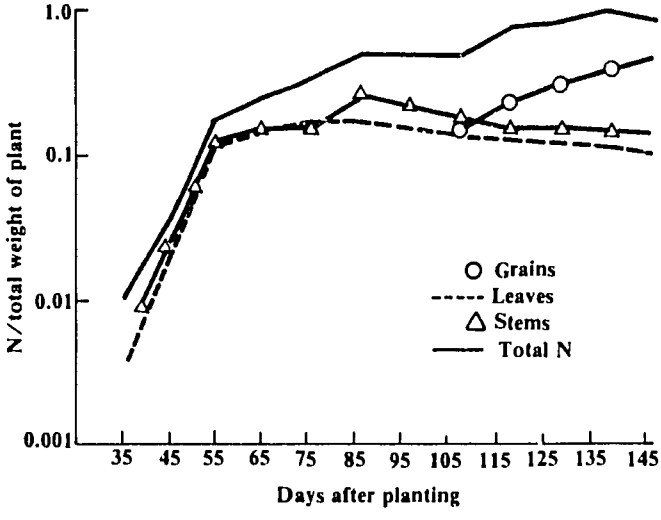

Figure 13. Nitrogen translocation in rice variety CICA 8.

as a biofertilizer in rice paddies with irrigation. *Anabaena azollae* Strans (Nostocaceae) lives in symbiosis with *Azolla* spp. and has the ability to fix atmospheric nitrogen.

Studies carried out in Colombia indicate the presence of *Azolla filiculoides* and *A. caroliniana* but not *A. mexicana* and *A. microphylla*. *Azolla* specimens collected up to the moment in the Valle del Cauca, Córdoba and Bolívar states of Colombia, have been identified tentatively as varieties of *A. filiculoides;* its identification is being established in sporulation studies.

Milling and Cooking Qualities

Mixture of varieties

The area planted to improved dwarf varieties with similar grain and phenotypic characteristics is increasing in

Latin America. Despite the use of certified seed, dropped seeds of one variety can germinate and cause mixtures in succeeding crops of a different variety.

An experiment was carried out to study the effect of the mixture of different proportions of seed of two varieties on yields, milling quality and cooking quality.

Pregerminated, breeders' seed of varieties CICA 4 and IR 22 were used at a seeding density of 60 kg/ha in different proportions (Figure 14). Yield data indicate that yield increases by 6.89 kg/ha as the proportion of CICA 4 in IR 22 increases by 1%.

The different mixtures of varieties CICA 4 and IR 22 did not cause a significant difference in the milling quality represented by the whole kernel yield.

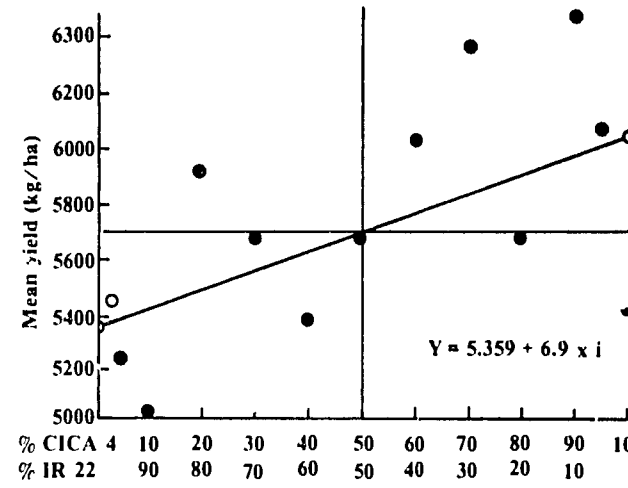

Figure 14. Mean yield of dry paddy rice as a result of the planting of a mixture of seeds of CICA 4 and IR 22 in different proportions.

P x K fertilization

Milling quality is one of the most important characteristics of rice varieties. The effect of time of application of P and K on the milling and cooking qualities of rice was studied.

CICA 4 yielded 65.32% white rice while IR 22 produced 64.21%. The time of P and K application either alone or in mixture did not cause significant differences either in yield, milling results or cooking quality.

Continuous Rice Production

The advantages of puddling the soil under water, combined with the use of pregerminated seed or transplanting over the traditional system of preparing the dry soil and planting dry seed have been widely demonstrated at CIAT-Palmira.

By transplanting or seeding pregerminated seed in a small area every 15 days, higher yields and more efficient use of equipment, labor, water, and soil are obtained.

At CIAT-Palmira continuous rice production plots are maintained to obtain permanent information on costs and yields, to implement new cropping techniques, and to serve as training aids in courses and field days. For this purpose, every 15 days 1/10 ha is planted with pregerminated seed and 1/9 ha is transplanted (i.e., land is cultivated 2.6 times/year in the first case and 2.4 times in the latter). Additionally, six commercial varieties are sown every 15 days to correlate environmental parameters with yield components.

TRAINING

The first course carried out during the first semester of 1979 lasted 25 weeks and had the participation of agronomists from Colombia, the Dominican Republic, Ecuador, Haiti, Honduras and Mexico.

Trainees were responsible for research and production plots in the field, and participating in the design and management of various experiments. These included: The Response of CICA 6 to Different Levels and Times of Application of N; Times of Application of N to Rice Crops; Irrigation and its Effect on the Response to N; and Seeding Density and N Levels in the Transplanting System.

During 1979 two training courses on research and production of irrigated rice were carried out for Latin American researchers and extensionists. The basic objectives of these courses were (1) to contribute to the development of a network of professionals in Latin America to carry out work on rice research and transfer of technology and (2) to collaborate with the national institutions in the training of their professionals. The number of professionals trained and their countries of origin are shown in Table 15.

The second course which lasted four weeks was carried out during the second semester with the participation of 34 agronomists from 13 countries, i.e., Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Haiti, Honduras, Panama, Peru and Uruguay.

During the second semester CIAT cooperated with ICA and FEDEARROZ in a special course on soil puddling for Colombian agronomists.

Table 15. Countries of origin of professionals trained[1] in Rice at CIAT in 1979.

Country	No. of Professionals	Country	No. of Professionals
Argentina	1	Guatemala	1
Bolivia	1	Haiti	2
Brazil	13	Honduras	3
Colombia	7	Mexico	3
Costa Rica	6	Panama	2
Cuba	2	Peru	3
Dominican Republic	1	Uruguay	1
Ecuador	5	United States	1
		Total	52

1 The disciplines in which training participants specialized include Agronomy, Entomology, Plant Breeding, Plant Pathology, and Production.

INTERNATIONAL RICE TESTING PROGRAM FOR LATIN AMERICA

Rice production in Latin America has different limiting factors which vary from one region to another. These constraints are related to soils, climate, diseases and insects. Among the soil factors, acidity is the most important and widely spread characteristic in Central America, northern South America and Brazil. Salinity and/or alkalinity are specific constraints in certain areas of Brazil, Cuba, Ecuador, the Dominican Republic, Guyana, Mexico and Peru.

Drought, low temperature and water floods are the main climatic constraints in some countries. Drought is a serious problem for the upland rice of Brazil and to some extent for the favored upland rice of Mexico and Central America. The temperature affects rice at the seedling or flowering stages in countries like Belize, Brazil (Rio Grande do Sul), Cuba, Peru and Uruguay which are influenced by the winter season of temperate countries. Heavy rains, often occurring in tropical countries, greatly increase the water level of rivers causing floods and destroying rice crops. This problem exists in the main rice producing area of Ecuador and in some regions of Brazil, Colombia and Guyana.

Blast continues to be the main disease constraint of the region. Leaf scald is becoming serious, particularly in Central America, Colombia, Venezuela and Brazil. Sheath blight, narrow leaf spot and brown leaf spot are present but as minor diseases. The hoja blanca virus, a serious constraint of rice during the 60's, is still present but as a minor problem, except in Ecuador where susceptible varieties to both vector and virus are grown commercially.

Among insects, the planthopper *(Sogatodes oryzicola)* is considered a serious threat, especially in countries where varieties susceptible to mechanical damage are still grown. This year a serious damage was caused on commercial crops of Nilo 2 in Panama.

The most economical and practical means of controlling these limiting factors is varietal resistance. Therefore, the activities of the International Rice Testing Program (IRTP) emphasize providing national programs improved germplasm with broad genetic diversity, assembled in specific nurseries for the various constraints.

In 1979 the activities of the IRTP for Latin America continued: (1) evaluating and multiplying elite basic germplasm from IRRI, CIAT and national programs; (2) selecting appropriate entries for testing through specific nurseries requested by national programs; (3) identifying problems and needs of rice production in Latin America; (4) identifying personnel for training at CIAT and IRRI; and (5) assembling and organizing data of nurseries distributed in 1977 and 1978. Another activity this year was the organization of the Third IRTP Conference and Blast Workshop.

Results of Nurseries Distributed in 1977

Data received from various nurseries distributed in 1977 was analyzed and the results were summarized (CIAT Annual Report, 1978). The final reports of the four yield nurseries, VIRAL-P, VIRAL-T, VIRAL-S and VIAVAL were printed and distributed to participants of the Third Conference and to all cooperators in national programs. From the 1977 nurseries, with a total of 105 entries, 63 promising lines were advanced to further yield trials and regional tests by national programs. It is important to mention that among the selected germplasm all entries from yield nurseries of early and medium duration and from the upland yield nursery were included for testing in all countries (Table 16).

Results of Nurseries Distributed in 1978

In 1978, 141 sets from seven specific nurseries for the region were sent to 21 Latin American countries. These nurseries were planted in the main growing season of most of the cooperating countries. Data which have been received from the nurseries is shown in Table 17. This year the percentage of data returned was 68%. This percentage was higher than that for the previous year (59%). Data of yield nurseries (VIRAL-T, VIRAL-S and VIAVAL) are being analyzed and results will be published for their distribution. The best performing entries are indicated in Table 18.

The results of the Observational Nursery (VIOAL) planted at 23 locations under irrigated, favored, and unfavored upland systems, indicated that among the 60

Table 16. Entries for regional tests selected by national programs from nurseries distributed in 1977 in Latin America.

Country	Nursery-1977[1]	Entry number
Argentina	VIRAL-P	7,10
	VIRAL-T	8,9,11,13,14
	VIAVAL	10,11,12,14,20
Bolivia	VIRAL-S	3,7,9,12,13
Brazil	VIRAL-P	2,3,4,5,9,10
	VIRAL-T	1,2,4,7,15
	VIRAL-S	1,13
Colombia	VIRAL-T	2,4
	VIRAL-S	2,3,8
	VIRAL-F	2,4,7,8,9,10
Cuba	VIRAL-S	3
Ecuador	VIRAL-P	1,5
	VIRAL-T	1,3,5,6,7,10,12,14
	VIRAL-S	3,4,6,11
	VIAVAL	2,4,5,11,12,15,21,20
	VIOSAL	15,16,17
Guatemala	VIRAL-P	2,3,4,5,7,8,9
	VIRAL-T	4,5,6,9,11,12,13,14
Honduras	VIRAL-P	9
	VIRAL-T	13,14
	VIRAL-S	3
Nicaragua	VIRAL-P	2,4,5,6,9
	VIRAL-T	3,4,6,10,11,12,13,14
Panama	VIRAL-P	10
		13
Peru	VIRAL-P	1,8
	VIRAL-T	2,5,9
	VIRAL-S	1,2,3,4,5,8,10,11,13,14
Dominican Republic	VIRAL-P	1,4,7,8,9,10
	VIRAL-T	1,2,3,4,5,6,7,9,10,11,12,14
	VIOSAL	4,19,21,24,28,29,36,37

1 VIRAL-P = International Rice Yield Nursery - Early Maturing
VIRAL-T = International Rice Yield Nursery - Medium Maturing
VIRAL-S = International Rice Yield Nursery - Upland
VIRAL-F = International Rice Yield Nursery - Deep Water
VIAVAL = International Rice Sheath Blight Nursery
VIOSAL = International Rice Salinity and Alkalinity Observational Nursery

Table 17. Data sets returned from 1978 IRTP nurseries for Latin America.

1978 nurseries[1]	Number of sets		
	Dispatched	Data returned	Data received (%)
VIRAL-T	25	18	72
VIRAL-S	29	24	83
VIOAL	37	24	65
VIPAL	27	17	63
VIAVAL	11	7	64
VIOSAL	7	3	43
VIRAL-F	5	3	60
Total	141	96	68

1 VIOAL = International Rice Observational Nursery
VIPAL = International Rice Blast Nursery
(For other nurseries see footnote on Table 16.)

Table 18. Average yield and days to flowering of the best five entries in each of the three Internacional Rice Yield Nurseries for Latin America, 1978.

Designation	Origin	Yield (t/ha)			Days to flowering
		Average	Range	Rank	
VIRAL-S, 1978 planted at 22 locations[1]					
IR 1529-430-3	IRRI	4.9	2.6 - 8.6	1	93
CICA 8	ICA-CIAT	4.7	1.8 - 7.5	2	99
CR 261-7039-236	India	4.6	2.1 - 7.9	3	95
IET 6047	India	4.5	2.2 - 8.4	4	97
CR 46-15/IR24[2]	Philippines	4.3	1.8 - 6.7	5	90
VIRAL-T, 1978 planted at 18 locations[2]					
Bg 375-1	Sri-Lanka	6.2	3.5 -10.5	1	97
CICA 8	ICA-CIAT	6.0	1.3 - 9.2	2	103
B541b-Kn-91-3-4	Indonesia	5.9	2.0 - 9.9	3	96
B541b-Kn-22-7-2	Indonesia	5.8	1.5 - 9.6	4	97
IR 4422-98-3-6-1	IRRI	5.6	2.1 -10.2	5	104
VIAVAL, 1978 planted at 8 locations[3]					
B189c-Kn-45-1-3	Indonesia	6.4	4.1 - 9.9	1	100
BW-196	Sri-Lanka	6.3	3.2 - 9.3	2	111
IR 4422-98-3-6	IRRI	6.2	3.0 -10.1	3	106
IR 2796-44-2	IRRI	6.2	3.8 - 8.6	4	107
Chianung Sen Yu 19	Taiwan	5.9	2.8 - 8.3	5	101

1 17 under favored upland and five under unfavored upland conditions.
2 12 were irrigated and six under favored upland conditions.
3 Six were irrigated and two under favored upland. All entries were tolerant to Sheath Blight disease.

entries there were 18 combining tolerance to leaf and neck blast infection and high yield potential. These entries will be included in the appropriate yield nurseries for Latin America in 1980.

The First International Blast Nursery for Latin America (VIPAL-78) was planted in 17 locations of the region and evaluated for leaf blast infection at the seedling stage. Results indicated that among the 150 entries, 26 were resistant with infection types between 1-3; 36 were moderately resistant with infection types not greater than 4; and 88 entries were susceptible with infection types greater than 5. Most of these resistant and moderately resistant entries, based on preliminary results of seven locations available in early 1979, were included for further testing in the Second International Blast Nursery for Latin America (VIPAL-79) distributed this year.

The International Rice Salinity and Alkalinity Observational Nursery for Latin America of 1978 (VIOSAL-78) was planted and evaluated for salinity in the Dominican Republic and Peru and for alkalinity in Mexico. In Peru, none of the 25 entries including the resistant check (Pokkali) survived to high salinity stress (9.0-42.0 mmhos/g-cm^2). However, in the Dominican Republic several selections were tolerant and some of them yielded 3.6-5.0 t/ha.

The alkalinity evaluations on germplasm of VIOSAL-78 made in Culiacán, Mexico indicated that 10 entries were resistant (scores of 1-2) and yielded from 3.4-6.4 t/ha.

The Second International Rice Yield Nursery for Latin America with deep water rices, 1978 (VIRAL-F-78), was planted in Colombia in two locations of the Atlantic coast where floods are expected every year. However, in 1978 the water flood was not high enough to adequately evaluate the germplasm. The maximum water depth in one location was 40 cm and under these conditions all entries reached maturity and best entries yielded 2.5 t/ha.

From nurseries of the IRTP for Latin America distributed in 1978, national programs of various countries have selected several entries for further yield tests and regional trials. Table 19 presents a preliminary list of the number of lines selected from each nursery.

Table 19. Entries for regional tests selected by national programs from nurseries distributed in 1978 in Latin America.

Country	Nursery-1978[1]	Entry number
Argentina	VIRAL-T	9,10,11
	VIOAL	9,12,14,19,30,33,48,55,59
Colombia	VIRAL-T	3,4,7,9,11
	VIRAL-S	1,2,4,6,9
	VIRAL-F	2,3,5,6,7,8
Ecuador	VIRAL-T	5,6,7,8,9,10,11
	VIAVAL	1,3,7,13,15,16,19,20
	VIOSAL	15,16,17
El Salvador	VIRAL-T	5,9
	VIRAL-S	3,4,8,11
Mexico	VIRAL-S	1,2,6,7,10,14,15
	VIPAL	2025,2026,2104
	VIOAL	3,20,29,40,58,60
Dominican Republic	VIRAL-T	8,10,1
	VIOSAL	2,6,10,11,17,18,19,22,25

1 For names of nurseries see footnotes on Tables 16 and 17.

Evaluation of IRTP Nurseries from IRRI

1978 nurseries

In mid-1978, 14 nurseries were received from IRRI and planted at CIAT-Palmira for evaluation, seed multiplication and selection (CIAT Annual Report, 1978). In early 1979, the germplasm was harvested and evaluated under laboratory conditions for planthopper *(S. oryzicola)* resistance and grain quality. Most of the germplasm was discarded because of the poor grain quality and plant type (Table 20). Only those combining good plant type (semidwarf and intermediate in height and resistant to lodging), resistance to *Sogatodes,* early and medium maturing (except for yield nursery of late varieties), long and medium grain size with good milling and cooking qualities, and high yield were included in the various nurseries for Latin America distributed in 1979 (Table 21).

This year four new nurseries were formed as requested by several countries in the Second Conference. These included (1) the Yield Nursery with Late Maturing Varieties requested by Cuba, Ecuador, Guyana, Haiti, Mexico and the Dominican Republic; (2) the Specific Yield Nursery (VERAL) which included 11 promising lines developed by the CIAT/ICA Cooperative Rice Project— these lines resulted from multiple crosses combining blast resistance from Tetep, Colombia 1, Dissi Hatif, C 46-15 and Carreon; the purpose of this nursery is to determine yield potential and blast resistance under different environments of Latin America; (3) the Observational Nursery for Leaf Scald (VIOAL-R) with 57 entries selected as resistant under field conditions from IRON and IURON 1978 IRRI nurseries planted at Tocumen, Panama; and (4) the Yield Nursery for Low Temperature (VITBAL) requested by countries influenced by the winter season of the temperate regions. All entries of this nursery were selected from the 4th IRCTN distributed by IRRI in 1978.

Table 20. 1978 nurseries from IRRI evaluated at CIAT during the second semester of 1978.

Nursery[1]	Number of entries	Number of entries selected
IRYN-E	28	8
IRYN-M	28	8
IRYN-L	26	9
IURYN	28	11
IURON	191	61
IRON	389	139
IRDWON	510	15
IRLRON	261	43
IRARON	137	-
IRCTN	237	22
IRSATON	72	-
IRBN	74	47
IRSHBN	20	6
IRSBN	20	-
Total	1807	369

1 IRYN-E = International Rice Yield Nursery-Early
IRYN-M = International Rice Yield Nursery-Medium
IRYN-L = International Rice Yield Nursery-Late
IURYN = International Upland Rice Yield Nursery
IURON = International Upland Rice Observational Nursery
IRON = International Rice Observational Nursery
IRDWON = International Rice Deep Water Observational Nursery
IRLRON = International Rice Low Rainfed Observational Nursery
IRARON = International Rice Arid Regions Observational Nursery
IRCTN = International Rice Cold Tolerance Nursery
IRSATON = International Rice Salinity and Alkalinity Tolerance Observational Nursery
IRBN = International Rice Blast Nursery
IRSHBN = International Rice Sheath Blight Nursery
IRSBN = International Rice Stem Borer Nursery

Table 21. IRTP nurseries for Latin America distributed in 1979.

Nursery[1]	Number of entries	Number of sets	Yield range[2] (t/ha)
VIRAL-P	23	39	4.3 - 6.7
VIRAL-T	23	28	3.6 - 8.5
VIRAL-Tar	19	9	5.9 - 7.9
VIRAL-S	24	30	4.8 - 8.9
VERAL	14	22	4.7 - 7.0
VIOAL	97	14	4.1 - 9.1
VIOAL-S	52	25	3.9 - 8.7
VIOAL-R	61	18	4.3 - 8.3
VIPAL	120	31	-
VIAVAL	16	12	5.5 - 8.9
VIOSAL	10	8	4.7 - 8.6
VITBAL	23	10	2.9 - 8.1
VIRAL-F	15	8	4.6 - 8.1
Total	497	254	

1 VIRAL-Tar = International Rice Yield Nursery-Late maturing
VERAL = International Specific Rice Yield Nursery
VIOAL-S = International Rice Observational Nursery-Upland
VIOAL-R = International Rice Observational Nursery-Leaf Scald
VITBAL = International Rice Low Temperature Nursery
For other nurseries see footnotes on Tables 16 and 17.
2 Range yield of two seasons at CIAT under irrigated-transplanted conditions.

Among the germplasm included in the yield nurseries of early, medium, and late duration for irrigated conditions and in the upland yield nursery, there were entries from Bangladesh, India, Indonesia, Thailand, and IRRI, Philippines. The best performing entries of 1977 yielding nurseries for Latin America were also included. Tables 22, 23, 24, and 25 show the principal characteristics of the germplasm.

The blast nursery (VIPAL-79) was formed with 120 entries, 73 from VIPAL-78 which showed resistance in six countries of the region and 47 entries from IRBN-78 which showed resistance in 25 locations of Asia and two of Latin America. Most entries are semidwarf, with long grains and resistant or tolerant to the planthopper.

1979 IRRI nurseries

In mid-1979, 12 nurseries with 1800 entries were received from IRRI for evaluation, seed multiplication and selection. These nurseries were planted at CIAT-Palmira in July and August. The germplasm is being harvested and will be evaluated under laboratory conditions for resistance to the planthopper and grain quality in early 1980. The selected material will be included in the various 1980 nurseries for Latin America.

Monitoring Tours and Individual Visits

Monitoring tours and individual visits are activities of the IRTP which have the purpose of observing and evaluating germplasm, learning about cropping systems, and identifying specific problems of the crop and training needs of national programs.

Monitoring tours

In 1979, a monitoring tour to northern South America was made from June 3-15 to observe rice crops and research activities in Ecuador, Colombia, Venezuela, Guyana, and Surinam. One or two rice scientists from each of these countries participated, together with two scientists from CIAT, one pathologist from the Institute de Recherches Agronomiques Tropicales (IRAT), one scientist from the West Africa Rice Development Association (WARDA), and three scientists from IRRI, including the coordinator for Latin America.

Table 22. Principal characteristics of the germplasm in the 1979 International Rice Yield Nursery-Early Maturing Varieties for Latin America (VIRAL-P).[1]

Line No.	Identification	Country of origin	Agronomy: Height (cm)	Agronomy: Maturity (days)	Insects: Sogatodes[2]	Quality: Grain length[3]	Quality: Gelat. temp.[4]	Yield (t/ha)
1	IET 4094	India	80	128	5	3	IL	4.7
2	IR 9129-192-2	Philippines	83	124	5	3	I	4.6
3	RNR 7306	India	78	122	3	5	L	4.3
4	IET 3877	India	113	110	3	5	L	5.1
5	IET 6503	India	81	124	3	3	L	5.1
6	IET 6507	India	86	124	3	3	IL	6.0
7	UPR 70/30-25	India	86	127	3	3	L	5.3
8	IR 7149-35-2-3-2	Philippines	96	122	3	5	L	5.7
9	IR 9129-7-1	Philippines	85	125	3	3	LI	5.1
10	IR 36 (Check)	Philippines	79	133	5	3	IL	4.9
11	IR 9129-102-2	Philippines	85	125	5	3	IL	6.1
12	IR 9168-13-1	Philippines	91	125	3	3	I	5.3
13	KN 361-1-8-6	Indonesia	125	130	3	5	I	5.6
14	IET 5518	India	97	130	3	3	IL	6.2
15	IET 6133	India	91	130	3	3	IH	5.5
16	IET 6508	India	88	126	5	3	L	5.5
17	CNM 20	India	96	128	5	5	IL	6.6
18	IET 4506	India	89	130	3	3	IL	6.1
19	MRC 603/303	Philippines	86	134	3	3	L	5.2
20	CICA 7 (Check)	Colombia	88	138	5	3	L	5.9
21	IET 2881	India	84	127	5	3	I	6.4
22	B541b-Pn-58-5-3-1	Indonesia	98	131	3	3	I	6.7
23	BR 51-46-1-C1	Bangladesh	100	132	5	3	I	6.5

1 Average data of second semester 1978 and first semester 1979 at CIAT under irrigated-transplanted conditions.
2 International resistance scale from 1-9: 1-3 = resistant; 4-5 moderately resistant; 5-6 = moderately susceptible; 6-9 = susceptible.
3 Scale for length of grain: 3 = long grain (6.61-7.50 mm); 5 = medium grain (5.51-6.60 mm).
4 Gelatinization temperature: I = intermediate; L = low; H = high.

A complete report, covering rice area and production, limiting problems and recommendations of the team was published. Participants of this monitoring tour became aware that rice production in the five countries is increasing and that there is much potential for expansion. Most production comes from direct seeding under irrigated or favored conditions. With the exception of Ecuador, most production comes from large mechanized farms of more than 20 ha. Ecuador, Guyana and Surinam have active rice programs to increase production in small farms.

The Guayas river plains of Ecuador offer great opportunities to exploit the use of deep water rice technology on increasing production (Figure 15). Major constraints of the region to increase production are blast, high production costs (land, fertilizers, fungicides, fuel), land leveling, water control and marketing. The hoja blanca virus is still a problem in Ecuador but resistant varieties to the vector have controlled the disease in other countries. Sheath blight and leaf scald are becoming more serious. Stink bugs and *Sogatodes* are the major insect pests. The acidity of soils is another constraint present in Colombia and Venezuela.

Research programs in the region are small and in most countries they are expanding but still need additional financial support from the government and private industry. Several countries have active hybridization

Table 23. Principal characteristics of the germplasm in the 1979 International Rice Yield Nursery-Medium Maturing Varieties for Latin America (VIRAL-T).[1]

Line No.	Identification	Country of origin	Agronomy: Height (cm)	Agronomy: Maturity (days)	Insects: Sogatodes[2]	Quality: Grain length[3]	Quality: Gelat. temp.[4]	Yield (t/ha)
1	G 28B-SI-11-2	Indonesia	136	136	5	3	I	3.6
2	IR 5853-118-5	Philippines	92	132	3	3	L	5.5
3	BR 51-46-5	Bangladesh	108	142	5	3	I	6.1
4	BR 167-2B-9	Bangladesh	107	136	3	5	L	6.6
5	CR 261-7039-236	India	86	138	5	3	L	6.9
6	IR 4422-98-3-6-1	Philippines	107	146	3	3	L	8.2
7	IR 5853-162-1-2-3	Philippines	100	144	5	3	L	7.3
8	SPR 7284-57-5	Thailand	98	142	5	3	L	6.5
9	IR 4568-225-3-2	Philippines	100	139	5	3	L	6.6
10	CICA 8 (Check)	Colombia	92	145	3	3	L	7.3
11	IR 5623-189-3	Philippines	96	137	3	3	I	7.5
12	IR 5624-164-2-1	Philippines	88	137	3	3	L	6.5
13	IR 5201-65-1-2	Philippines	109	147	3	3	IL	6.9
14	IR 7963-30-2-3	Philippines	99	141	3	3	L	6.4
15	IR 7963-30-4-3	Philippines	101	141	3	3	L	7.2
16	IR 2058-78-1-3-2-3	Philippines	104	144	3	3	I	6.7
17	IR 3273-339-2-5	Philippines	90	143	3	5	L	7.0
18	IET 3093	India	91	132	3	3	IL	8.5
19	IR 4744-295-2	Philippines	106	137	5	3	L	6.9
20	CICA 4 (Check)	Colombia	86	134	1	3	I	6.9
21	BG374-1	Sri-Lanka	96	141	5	3	I	6.3
22	B542b-Pn-68-9-2-2	Indonesia	97	141	5	3	I	6.6
23	IET 1785	India	88	140	5	3	I	6.9

1 Average data of second semester 1978 and first semester 1979 at CIAT under irrigated-transplanted conditions.
2 International resistance scale 1-9: 1-3 = resistant; 4-5 moderately resistant; 6-9 = susceptible.
3 Scale for length of grain: 3 = long grain (6.61-7.50 mm); 5 = medium grain (5.51-6.60 mm).
4 Gelatinization temperature: I = intermediate; L = low.

projects such as Colombia, Guyana, and Surinam, and the others are primarily evaluating materials from CIAT and IRRI.

Projects for expanding the rice area are underway in all countries, mostly for irrigated conditions. Some preliminary research is underway to incorporate savanna areas of Guyana and Venezuela to rice production under upland conditions.

Individual visits

Individual visits to Belize, El Salvador, Colombia and Panama were made to oberve and evaluate the 1979 IRTP nurseries planted by national programs.

At Tocumen Experimental Station of the Universidad de Panama the yield nurseries VERAL, VIRAL-P, VIRAL-T, VIRAL-S and VIAVAL and the observational nurseries VIOAL and VIOAL-R were evaluated for reaction to leaf scald, blast, hoja blanca and stackburn, the latter caused by *Alternaria padwickii*. The incidence of these diseases was quite severe, especially the leaf scald which seriously affected several lines. However, most entries of the leaf scald nursery (VIOAL-R) assembled this year showed high tolerance. This indicates a good selection progress since the germplasm of this nursery was selected for this disease from various nurseries planted at Tocumen in 1978.

The hoja blanca virus has not been a problem at Tocumen Experimental Station for the last 2-3 years. But

Table 24. Principal characteristics of the germplasm in the 1979 International Rice Yield Nursery-Late Maturing Varieties for Latin America (VIRAL-Tar).[1]

Line No.	Identification	Country of origin	Agronomy Height (cm)	Agronomy Maturity (days)	Insects Sogatodes[2]	Quality Grain length[3]	Quality Geiat. temp.[4]	Yield (t/ha)
1	CR 1002	India	102	149	3	5	IL	7.5
2	IET 3257	India	102	152	3	5	IH	6.5
3	IET 5656	India	106	152	3	5	I	7.5
4	RP 1064-14-2-2	India	100	152	3	5	I	6.1
5	TNAN 15875	India	98	165	3	5	I	6.2
6	IR 3454-80-2-1	Philippines	91	155	3	5	L	7.4
7	IR 3464-4-3-2	Philippines	91	151	5	3	L	6.2
8	IR 4219-35-3-3	Philippines	114	160	3	3	L	7.2
9	P 2360-2-3-1-9-1	Indonesia	94	151	3	3	I	6.9
10	CICA 8 (Check)	Colombia	87	145	3	3	L	7.3
11	Vijaya (Sel.)	India	83	145	5	5	I	6.3
12	IET 6056	India	100	152	5	5	I	7.9
13	IR 5311-154-1-3	Philippines	100	150	5	3	IL	7.5
14	IR 5853-213-6-1	Philippines	96	161	3	3	I	7.8
15	IR 4219-35-3-3	Philippines	116	157	3	3	L	6.9
16	IR 4744-257-1-3	Philippines	95	150	3	3	L	7.3
17	IR 4422-6-2-3-1	Philippines	100	150	5	3	L	7.1
18	RP 1045-23-2-1	India	83	145	7	5	L	5.9
19	IR 5666-82-2-2	Philippines	96	151	3	3	L	6.5

1 Average data of second semester 1978 and first semester 1979 at CIAT under irrigated-transplanted conditions.
2 International resistance scale 1-9: 1-3 = resistant; 4-5 = moderately resistant; 6-9 = susceptible.
3 Scale for length of grain: 3 = long grain (6.61-7.50 mm); 5 = medium grain (5.51-6.60 mm).
4 Gelatinization temperature: I = intermediate; L = low; H = high.

this year, the virus affected several lines and susceptible varieties such as Nilo 2 and Starbonnet. CICA 4, CICA 7, and CICA 8 plots showed very few plants with hoja blanca symptoms. Although the *Sogatodes* population was higher (4-6 insects/plant) than previous years, it was not high enough to cause direct damage at Tocumen, even to susceptible varieties. Rice scientists of Panama were concerned with a direct damage of *Sogatodes* affecting commercial crops in the Bayano area. Crops of Nilo 2, CICA 7, and Damaris, were inspected. Typical direct damage of the insect (drying of leaves, development of fumagine and no panicle formation) was present only on Nilo 2. In several spots of the field, plants were killed. In the past, Nilo 2 was tested and classified as susceptible to *Sogatodes*. Thus, serious damage is expected if the population increases. Although a breakdown of resistant varieties might occur through new biotypes of the insect, no evidence has been found up to date.

From observations on germplasm of IRTP nurseries planted in El Salvador, Belize and Colombia (La Libertad ICA Experimental Station) a varietal difference to acid soil problems was observed. The symptoms were characterized by a yellowing or oranging of leaves and a coat of iron oxide on roots. There were highly susceptible and highly resistant entries in adjacent plots (Figure 16). Most entries of VIRAL-P and VIRAL-T which were resistant or susceptible in Colombia showed similar reaction in Belize and El Salvador (Table 26). Although there were few entries with different reactions, these field observations might suggest that the yellowing problem in these three countries is the same. In 1980, a new nursery for acid soil problems will be assembled with promising entries showing resistance in these countries. This nursery is considered of great value for countries having acid soil problems.

Other visits were made to participate in International Workshops and Regional and National Rice Meetings in which IRTP activities for Latin America were presented.

Table 25. Principal characteristics of the germplasm in the 1979 International Rice Yield Nursery-Upland Varieties for Latin America (VIRAL-S).[1]

Line No.	Identification	Country of origin	Agronomy: Height (cm)	Agronomy: Maturity (days)	Insects: Sogatodes[2]	Quality: Grain length[3]	Quality: Gelat. temp.[4]	Yield (t/ha)
1	KN 96	Indonesia	111	145	3	3	H	7.7
2	IR 36	Philippines	81	133	3	3	I	5.6
3	IR 1529-430-3	Philippines	84	142	5	3	L	7.6
4	IR 2035-242-1	Philippines	92	147	7	3	I	7.5
5	IR 2061-522-6-9	Philippines	100	126	3	5	L	4.9
6	IR 3304-23	Philippines	125	130	3	3	L	6.3
7	IR 3839-1	Philippines	100	134	3	5	IL	5.7
8	IR 3880-29	Philippines	112	138	5	5	I	5.6
9	KN 361-18-6	Indonesia	134	134	3	5	I	7.7
10	CICA 8 (Check)	Colombia	91	143	3	3	L	7.7
11	IR 5179-2	Philippines	92	128	3	3	L	5.4
12	MRC 172-9	Philippines	118	146	5	5	I	6.8
13	B542b-Pn-68-9-2-2	Indonesia	115	143	5	3	I	8.5
14	BR 51-46-1-Cl	Bangladesh	102	137	3	3	I	7.8
15	IR 9671-01141-5	Philippines	107	143	5	3	L	7.7
16	IR 9679-9-2-3-9	Philippines	97	141	3	3	I	7.1
17	IR 9680-3-9-8	Philippines	99	146	1	3	IL	7.4
18	GAMA 318	Indonesia	105	145	5	5	I	7.6
19	ET 6490	India	108	150	3	5	I	8.9
20	CR 1113	Costa Rica	90	139	5	3	L	4.8
21	IR 4744-257-1-3	Philippines	96	154	3	3	L	8.3
22	B 2360-11-3-2-9	Indonesia	115	147	5	3	IH	8.2
23	IR 4422-143-2-1	Philippines	102	144	3	3	L	6.6
24	IR 4683-19-3-3	Philippines	100	147	5	3	I	6.7

1 Average data of second semester 1978 and first semester 1979 at CIAT under irrigated-transplanted conditions.
2 International resistance scale 1-9: 1-3 = resistant; 4-5 = moderately resistant; 6-9 = susceptible.
3 Scale for length of grain: 3 = long grain (6.61-7.50 mm); 5 = medium grain (5.51-6.60 mm).
4 Gelatinization temperature: I = intermediate; L = low; H = high.

Table 26. Number of entries of some IRTP nurseries with tolerance to acid soil problems in Colombia, Belize, and El Salvador, CIAT-IRRI, 1979.

1979 Nursery type[1]	Number of entries	Reaction to acid soil problems[2]: Colombia	Belize	El Salvador
VIRAL-P	7	R	R	R
	1	S	R	R
	1	R	S	R
VIRAL-T	12	R	-	R
	7	S	-	R
VIOAL-R[3]	21	R	-	-
VIAVAL	11	-	R	-

1 For names of nurseries see Tables 16, 17 and 21.
2 R = resistant; S = susceptible; - = nursery was not planted.
3 Entries were evaluated during two seasons, 1979.

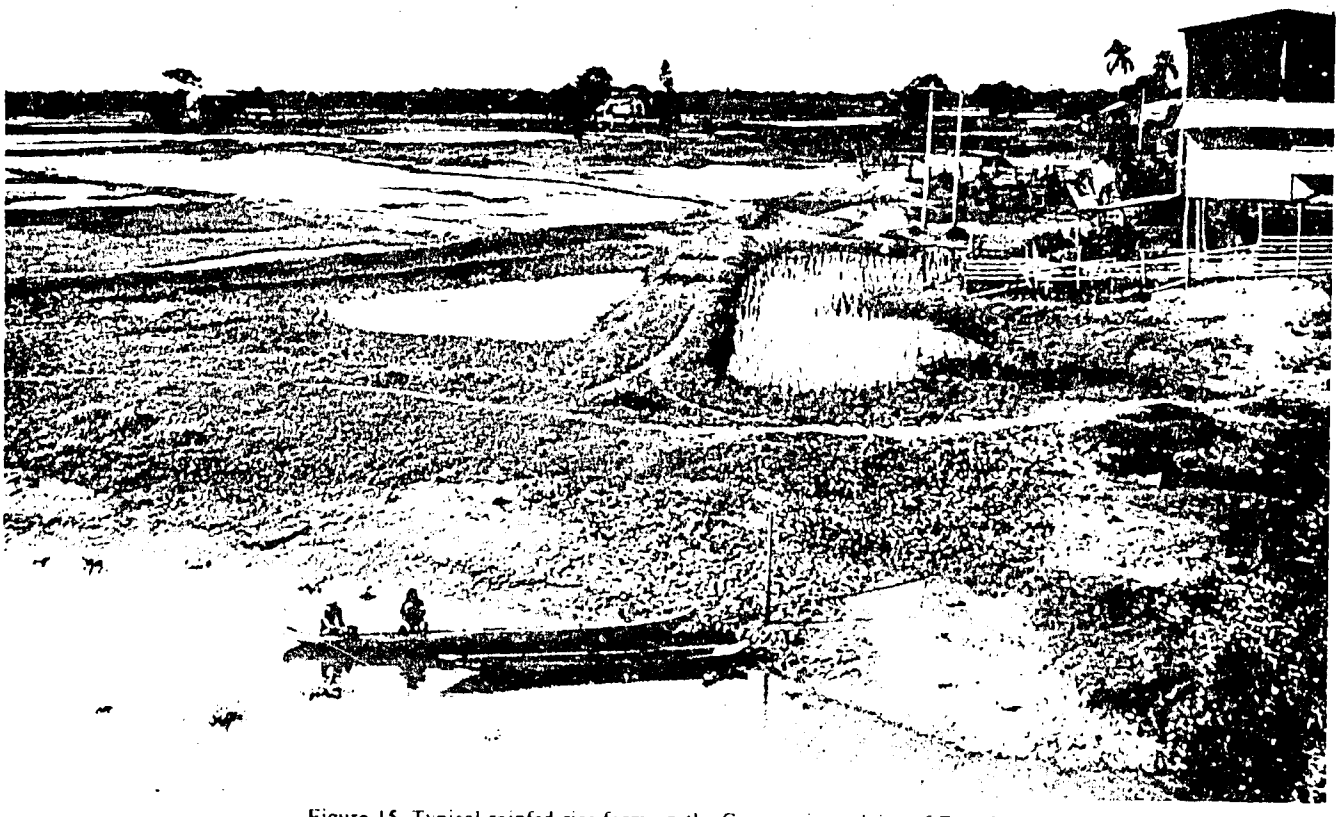

Figure 15. Typical rainfed rice farm on the Guayas river plains of Ecuador.

Figure 16. Rice selections susceptible (left and back plots) and resistant (right plots) to acid soil problems at La Libertad ICA Experimental Station, Villavicencio, Colombia.

Third Conference on IRTP for Latin America

This year, a third conference on the IRTP for Latin America was held at CIAT on May 30-June 2. Leaders and other rice scientists of national programs and international institutions attended the conference. The purposes of the event were to present and discuss final results of IRTP nurseries distributed in 1977 and preliminary results of nurseries distributed in 1978; to strengthen the IRTP network; to correct deficiencies in current operational procedures; to define the needs for new specific nurseries; to emphasize among network cooperators that this program is a means of technology transfer by which improved germplasm in made available to national programs for its evaluation and distribution to farmers; to update information on rice area and production, varieties cultivated and limiting factors; to discuss recent progress and future research on varietal improvement with resistance to blast; and to give cooperators an opportunity to meet and interchange ideas on recent rice problems.

A total of 73 participants attended the conference, including 59 delegates of national programs of 21 Latin American countries (delegates from Argentina, El Salvador, and Mexico did not attend); 6 from international institutions (IRRI, IITA, IRAT, WARDA); 1 from Pennsylvania State University, USA; and 7 from CIAT.

On the basis of the final results of nurseries distributed in 1977, several entries with good adaptation and high yield potential for both irrigated and favored upland rice systems were identified. Lines selected by national programs for further yield and regional trials are indicated in Table 16. From the yield nursery for upland rice, line IR 1529-430-3 was selected by the national program of Cuba and named commercially as IR 1529 in 1978. This line was also selected in Bolivia for seed multiplication and regional tests in Santa Cruz State under the preliminary name Saavedra V-5.

Distribution of nurseries

Regarding the distribution of nurseries for Latin America some minor changes were established. Table 27 indicates the types of nurseries and countries requesting them directly from IRRI in addition to those from CIAT. In 1979, 154 sets of 13 nurseries were dispatched upon request. For 1980, 273 sets were requested by delegates attending the third conference.

Since exchange of germplasm among national programs is of great importance in this network, delegates were asked to nominate lines or varieties for the IRTP nurseries. Table 28 indicates the varieties nominated by several countries to be included in the 1980 nurseries.

Information updating

On the basis of country reports, data on rice area, production, yields and cultivated varieties were updated for Latin America. In the growing season 1977-78, 7.4 million ha were planted (28% irrigated and 72% upland). The total production was 13.5 million tons of paddy rice, 55% of this production from the irrigated area (Table 29).

Table 27. IRTP nurseries from IRRI requested by several countries of Latin America.

	Countries/Number of sets						
Nursery[1]	Costa Rica	Cuba	Ecuador	Mexico	Panama	Peru	Uruguay
IRYN-E		2		1		1	
IRYN-M		2		1		1	
IRYN-L		1		1		1	
IURYN				1		1	
IRON		2		1	1	1	
IURON	1			1	1	1	
IRBN		1		1		1	
IRSHBN		1		1		1	
IRSATON		1		1		1	
IRCTN		1		1		1	1
IRDWON			1	1		1	

1 For names of nurseries see footnote on Table 20.

Table 28. Germplasm nominated for the 1980 Latin American nurseries.

Country	Identification	Type of nursery[1]
Brazil	IRGA 409, P 798-B4-4-1T IAC 47, IAC 25, IAC 164, IAC 165 Seleção Amarelão, IRAT 106	VIRAL-T VIRAL-S
Colombia	Lines 5002, 5005, 5010	VIRAL-T, VIPAL
Cuba	IR 880C-9, Caribe 1	VIRAL-T
Ecuador	INIAP 415	VIRAL-T
Guyana	Rustic 75704, 75708 T, BG 60-283	VIRAL-P, VIRAL-S VIRAL-T VIOSAL
Haiti	Ti Fidele	VIRAL-S
Peru	PNA 221 PNA 115 PNA 237	VIRAL-T VIRAL-S VIOAL
Dominican Republic	J 246, J 222 J 245	VIRAL-T VIPAL
Uruguay	Sel. 976, Line 428	VITBAL
Surinam	Eloni 7231/8, 73114/2, 73151/6	VIRAL-T VIOAL

1 For names of nurseries see footnotes on Tables 16, 17 and 21.

All rice varieties cultivated in Latin America were classified in four types: semidwarfs, improved type USA, improved tall, and traditional. Data indicated that in the growing season 1977-78, 15.2% of the area was planted to semidwarfs or high yielding varieties (HYV), 7.3% with USA types, 50.1% with improved tall types and 27.4% with traditional varieties. The percentage area planted to HYV is still low, mainly because most of the area corresponds to upland rice of Brazil and HYV are not adapted to this system. Excluding Brazil, however, data indicate a 56.0% of the area planted to HYV (Table 30).

Workshop on blast disease

From discussions at the Blast Workshop it was evident that rice breeders do not have at present appropriate methods to identify plants with stable resistance to the disease under field conditions. Since selection techniques are essential for the success of rice breeders, it was suggested that international and national institutions focus blast infections on segregating populations under field conditions, and identify plants with horizontal resistance. The identification of sources with horizontal resistance was also encouraged.

While new approaches for blast resistance selection are found, the present germplasm distribution mechanism (blast nursery) and the seedling evaluation on beds were considered by all participants as the best procedures. Programs with good facilities were encouraged to plant the blast nursery under upland conditions for evaluation of neck blast infection.

Regarding the Fourth IRTP Conference for Latin America which will be held in 1981, delegates from Brazil proposed to include a central discussion topic on drought problems of upland rice.

Seed Distribution

Seed of promising lines and varieties are normally requested by several countries either for testing or seed multiplication. Seed of 22 rice varieties and lines were dispatched to eight countries in the world.

Table 29. Area, production and yields of rice in Latin America, 1977-78 growing season.[1]

Countries	Area ('000 ha)			Production ('000 t)			Yield (t/ha)	
	Irrigated	Upland	Total	Irrigated	Upland	Total	Irrigated	Upland
Argentina	100.0	-	100.0	330.0	-	330.0	3.3	-
Belize[2]	4.4	-	4.4	6.2	-	6.2	1.4	-
Bolivia	-	53.7	53.7	-	86.2	86.2	-	1.6
Brazil	791.8	4776.3	5568.1	2508.0	4968.0	7476.0	3.2	1.0
Colombia[3]	311.2	95.0	406.2	1572.2	142.5	1714.7	5.1	1.5
Costa Rica	4.0	71.7	75.7	16.0	179.9	195.9	4.0	2.5
Cuba	151.0	-	151.0	450.0	-	450.0	3.0	-
Chile	33.0	-	33.0	104.8	-	104.8	3.2	-
Ecuador	38.6	40.5	79.1	123.5	109.4	232.9	3.2	2.7
El Salvador[2]	-	13.9	13.9	-	50.1	50.1	-	3.6
Guatemala	-	11.5	11.5	-	26.0	26.0	-	2.3
Guyana	86.4	35.2	121.6	259.2	52.8	312.0	3.0	1.5
Haiti	30.0	10.0	40.0	90.0	18.0	108.0	3.0	1.8
Honduras	4.0	16.0	20.0	12.0	27.2	39.2	3.0	1.7
Mexico	70.5	52.2	122.7	303.3	120.1	423.4	4.3	2.3
Nicaragua	15.1	4.4	19.5	68.0	6.0	74.0	4.5	1.4
Panama	1.1	108.8	109.9	4.0	184.9	188.9	3.6	1.7
Paraguay	20.7	11.1	31.8	43.4	14.8	58.2	2.1	1.3
Peru[3]	93.5	28.5	122.0	453.9	48.8	502.7	4.9	1.7
Dominican Republic	98.8	-	98.8	299.8	-	299.8	3.0	-
Surinam	40.0	-	40.0	172.0	-	172.0	4.3	-
Uruguay	58.4	-	58.4	243.6	-	243.6	4.2	-
Venezuela	109.3	36.0	145.3	364.9	54.0	418.9	3.3	1.5
Total	2061.8	5364.8	7426.6	7424.8	6088.7	13513.5	3.6	1.1

1 Data provided by leaders of national programs attending the Third Conference of IRTP for Latin America, held at CIAT May 30-June 2, 1979.
2 Data for the growing season of 1976.
3 Irrigated area of Colombia includes 51,262 ha of mechanized upland, and upland area of Peru includes 8500 ha of lowland rainfed.

Table 30. Area planted to different types of rice varieties in Latin America, 1977/78.

Countries	Semidwarfs		Improved USA type		Improved tall		Traditional		Total
	%	Area ('000 ha)	%	Area ('000 ha)	%	Area ('000 ha)	%	Area ('000 ha)	Area ('000 ha)
Argentina	-	-	41.0	41.0	51.0	51.0	8.0	8.0	100.0
Belize	60.0	2.7	40.0	1.8	-	-	-	-	4.5
Bolivia	3.0	1.6	55.0	29.5	40.0	21.5	2.0	1.1	53.7
Brazil	1.8	98.3	5.5	306.2	61.6	3430.0	31.1	1733.6	5568.1
Colombia	76.1	309.1	0.5	2.0	-	-	23.4	95.0	406.1
Costa Rica	100.0	75.1	-	-	-	-	-	-	75.1
Cuba	100.0	151.0	-	-	-	-	-	-	151.0
Chile	-	-	-	-	100.0	33.0	-	-	33.0
Ecuador	69.0	54.6	-	-	9.0	7.1	21.0	16.6	78.3
El Salvador	49.6	6.9	-	-	40.1	5.6	10.2	1.4	13.9
Guatemala	50.0	5.8	50.0	5.7	-	-	-	-	11.5
Guyana	20.0	24.3	62.0	75.4	-	-	18.0	21.9	121.6
Haiti	-	-	40.0	16.0	-	-	60.0	24.0	40.0
Honduras	86.0	17.2	10.0	2.0	-	-	4.0	0.8	20.0
Mexico	55.1	67.6	2.1	2.6	32.5	39.9	10.3	12.6	122.7
Nicaragua	77.8	15.3	11.2	2.2	-	-	10.2	2.0	19.5
Panama	10.8	11.0	-	-	60.0	65.9	30.0	33.0	109.9
Paraguay	28.0	8.9	21.4	6.8	15.6	5.0	35.0	11.1	31.8
Peru	48.8	59.6	-	-	36.8	44.9	13.9	17.0	121.5
Dominican Republic	34.0	33.6	-	-	-	-	50.8	50.2	83.8
Surinam	100.0	40.0	-	-	-	-	-	-	40.0
Uruguay	-	-	85.0	49.6	15.0	8.8	-	-	58.4
Venezuela	97.2	141.2	-	-	-	-	2.7	3.9	145.1
Total area ('000 ha)		1124.4 (15.2%)		540.8 (7.3%)		3712.7 (50.1%)		2032.2 (27.4%)	7410.1
Excluding Brazil: Total area ('000 ha)		1026.1 (55.7%)		234.6 (12.7%)		282.7 (15.3%)		298.6 (16.2%)	1842.0

PERSONNEL

(as of December 31, 1979)

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* Left during 1979.
** Assigned to Training and Conferences.

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