REPORT ON THE ACTIVITIES CARRIED OUT BY CRIN'S TECHNICAL - SCIENTIFIC STAFF IN 1991

C O N T E N T S

REPORT ON THE ACTIVITIES CARRIED OUT BY CRIN'S TECHNICAL - SCIENTIFIC STAFF IN 1991[1]

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INTRODUCTION

This work report includes the different activities carried out by **CRIN**'s technical and scientific staff in support to its Member Countries.

The objective of this report is to make known the support given by **CRIN** to its Member Countries in the fields of Germplasm Management, Collaborative Research, Research Sub-Projects Funded by **CRIN** and Cooperating Countries, In Country, **CIAT** and **IRRI** Courses, Technology Transfer, Surveys of Technological Constraints, Trips Accomplished, and Documentation Exchange.

1/ Work Report presented to CRIN's Technical Advisory Committee in its 5th Annual Meeting held on November 13 to 14, 1991 in Villahermosa, Tabasco, Mexico. This Report was Updated to Include the Activities Carried out in November and December, 1991.

2/ CRIN-Coordinator and Agronomist Respectively.

II. GERMPLASM MANAGEMENT

2.1. Dispatch of Germplasm.

Table 1 shows the different nurseries sent during the first semester of this year. A total of 1,441 lines were sent, thus supplying the demand of all **CRIN** Member Countries, as well as the exchange of germplasm requested by **INIFAP**-Mexico, **HARRS**-Haiti, **IICA**-Haiti, and **ICA**-Colombia. In addition, 2.0 kg of seed of Sesbania rostrata were sent to Guyana to be multiplied and evaluated as a generator of bio-fertilizer.

2.2. Germplasm Evaluation and Selection.

Table 2 shows the total lines planted (1,311) and selected (162) at field and quality laboratory level based on the germplasm introduced from **CIAT**, **IRRI**, **IRAT** and National Programs from Cuba, Mexico, Guyana and Jamaica.

The Evaluated germplasm was split in two sets of 1129 and 182 as shown in Table 2, because of selection practiced to the indicated materials since phenotypic instability was observed in several populations.

2.3. Seed Production.

2.3.1. Variety JUMA 64.

Because of the high demand of variety JUMA 64 by cooperating farmers, in 1991 **CRIN** produced around 1,900 kg of basic seed which were distributed in small quantities to such farmers, located in the Northeast, East, and Southwest regions of the Dominican Republic.

Table 1. Germplasm Sent to Different Countries in the First Semester of 1991.

Country	Set no. and no. lines			Total lines
	1[a]	3[b]	6[c]	
Cuba	82	12	10	104
Dominican Republic	145	12	10	167
Guyana	145	12	-	157
Suriname	145	12	-	157
Trinidad & Tobago				
CES	147	12	10	169
CARONI	147	12	10	169
Haiti				
ODVA	145	12	10	167
ODVA	-	10	-	10
HARRS	10	-	20	30
IICA	26	8	-	34
Jamaica	10	-	20	30
Belize	10	-	20	30
Colombia	64	-	-	64
Mexico	143	-	10	153
TOTAL				1441

a/ Irrigation Set: Tol. to Fungus Disease, Fe Tox, Resist. to HB-Sogata; 110-120 growth duration
b/ Irrigation Set: Salinity Tol., Fungus Diseases, HB-Sogata; 110-120 days gowth duration.
c/ Traditional and Mod. Favored Upland: Medium-sized Varieties, Vigorous; Tol. to Fungus Diseases, HB-Sogata, Moderate drought; 120-140 days growth duration.

2.3.2. Sesbania rostrata.

On August 12, 1991, 750 m^2 were planted with Sesbania rostrata, to increase the amount of seed available to be distributed within **CRIN** Member Countries, and at the same time, to carry out future studies on the improvement of soils affected by a deep land leveling.

Table 2. Rice Germplasm Planted and Selected by CRIN in 1991. Dominican Republic.

Order Number	Nursery	Origin	Lines planted 1st Sem.	Lines planted 2nd Sem.	No. of selected[a] lines
1	Mexican Lines	INIFAP-Mexico	33	85	18
2	Advanced Lines	CIAT-Colombia	68	18	0
3	Workshop-CIAT, 90	CIAT-Colombia	209	-	39
4	Savanna-CIAT	CIAT-Colombia	32	-	28
5	Workshop-Cuba (1), 90	IIA-Cuba	130	79	24
6	Workshop-Cuba (2), 90	IIA-Cuba	250	-	29
7	IRCTN-90	IRRI	79	-	10
8	IIRON-91	IRRI	170	-	4
9	IURON-91	IRRI	95	-	0
10	IRSATON-91	IRRI	43	-	0
11	Guyana	NARI-Guyana	17	-	8
12	Jamaica	NARI-Jamaica	1	-	0
13	IRAT	France	2	-	2
	SUBTOTAL		1129	182	
	TOTAL		1311		162

a/ Selection was practiced at field and quality laboratory.

2.4. Regional Trial.

CRIN collaborated with the Instituto Superior de Agricultura (**ISA**) in Santiago, Dominican Republic, in establishing a trial to compare the yields of 10 promising lines selected by **ISA**'s technicians, which are part of a regional trial conducted by them. This study was discarded since **ISA** did not give the necessary follow-up because of budgetary problems.

2.5. Study on Planting Dates for 4 Rice Varieties.

In support to the Rice Research Center of the Dominican Republic **(CEDIA)**, a study consisting of planting every 15 days during a whole year was started on August 30, 1989, with the objective of comparing varieties JUMA 57, CICA 8 (ISA 40) and TANIOKA with variety JUMA 64 (P3831F3-RH38-8-1M-J182).

Table 3 shows a highly significant difference in characters such as yield and days to flowering among different planting dates and varieties. A significant interaction of planting date and varieties shows that the performance of varieties varies according to planting date.

Table 3. Analysis of Variance of the Study on Planting Dates of 4 Varieties. Juma, Dominican Republic, 1989-1990.

Source of variation		Calculated F value	
	DF	Yield	Flowering
Planting date	22	11.11 **	62.94 **
Replication (Trial)	46	1.49	2.37
Varieties	3	98.19 **	580.40 **
Planting date x variety	65	3.16 **	9.71 **

** Statistically significant at 1%

According to Duncan's test, grain yield of varieties JUMA 64, CICA 8 and JUMA 57 were in the highest significant statistical group in 14, 8 and 1 of all 23 planting dates, respectively (Table 4). Variety TANIOKA showed lower yield potential than the remaining 3 varieties in all 23 planting dates. In comparing average yield of the 4 varieties during the 23 planting dates, the highest yield

Figure 1. Average yield of 4 rice varieties planted during 12 months. Juma, Dominican Republic, 1989-1990.

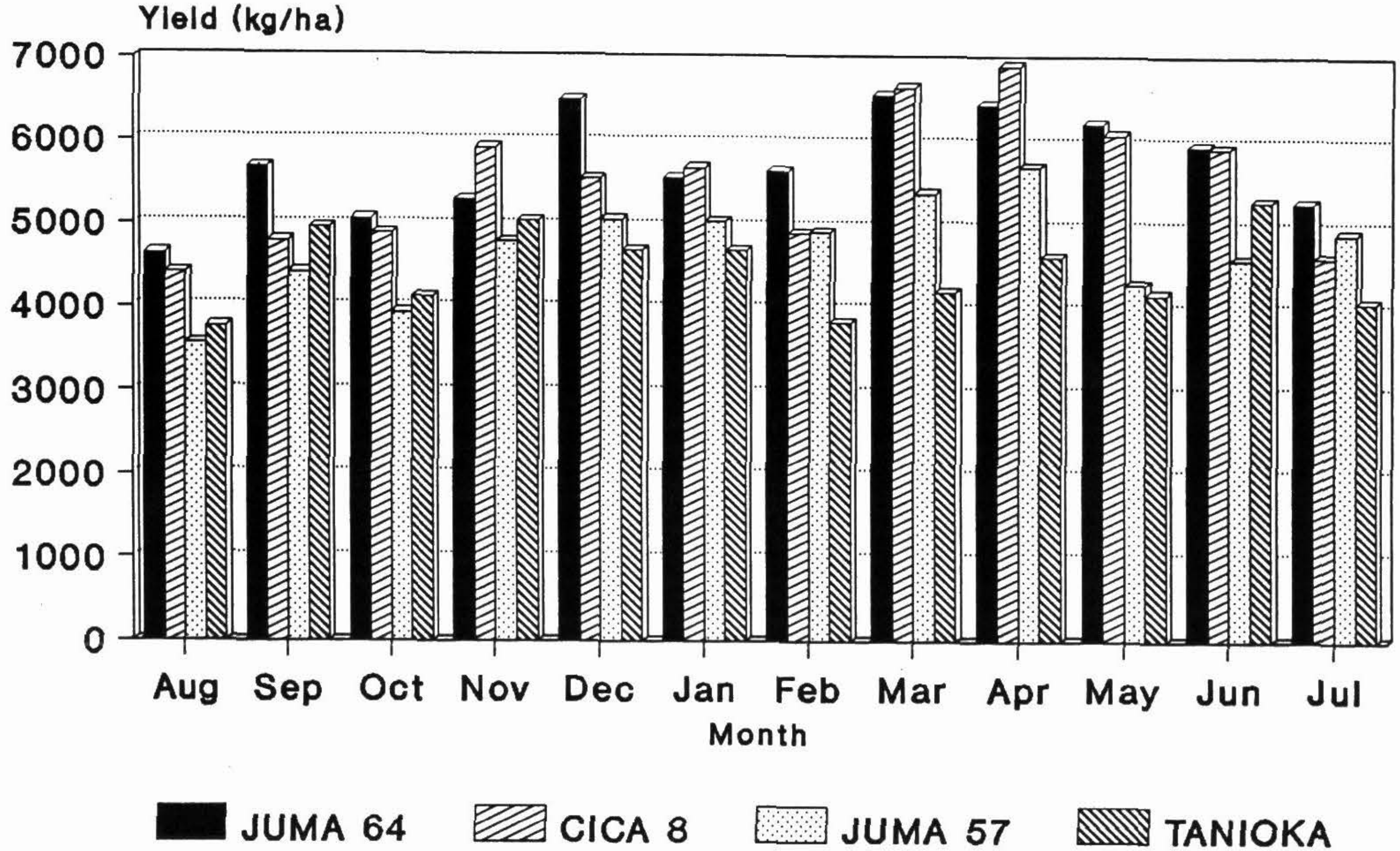
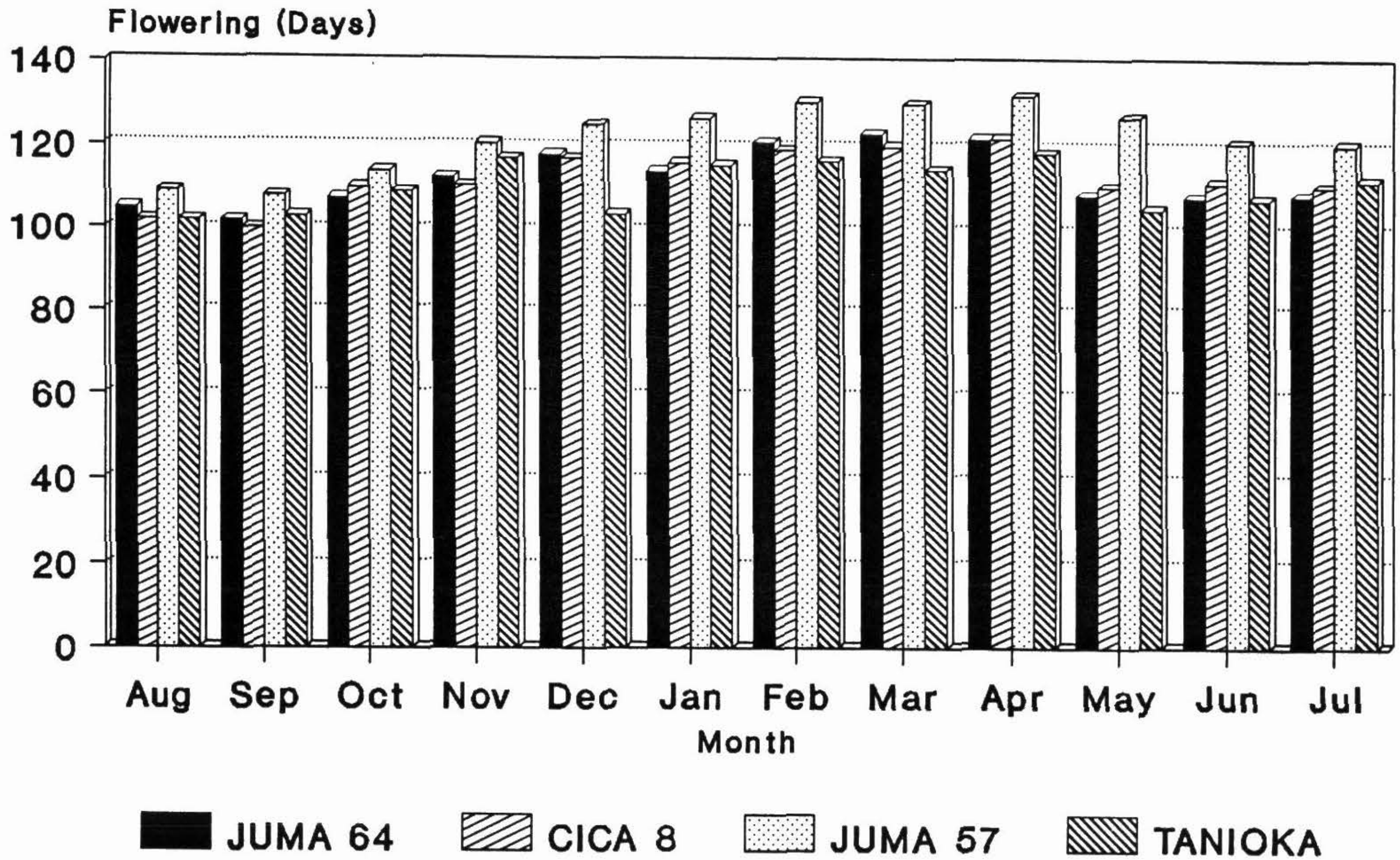


Figure 2. Days to flowering of 4 rice varieties during 12 months. Juma, Dominican Republic, 1989-1990.



corresponded to JUMA 64 (5790 kg/ha), followed by CICA 8 (5580 kg/ha), JUMA 57 (4761 kg/ha), and TANIOKA (4476 kg/ha). The general average yield of JUMA 64 was statistically higher than that of JUMA 57 and TANIOKA, but the same as that of CICA 8.

Table 4 and Figure 1 show that the highest yielding planting season during various consecutive planting dates was from February 22 to June 12, 1990 (from 13th to 20th planting) for varieties JUMA 64 and CICA 8. As to JUMA 57, a consistent yield was observed between February 22 (planting No.13) and April 24 (planting No.17). In regards to TANIOKA, a better yield was observed between November 24 (planting 7) and January 6 (10th planting), as well as between May 28 (19th planting) and June 27 (21st planting).

Figure 2 shows the number of days from planting to flowering of the 4 varieties evaluated. This data show that variety JUMA 57 has longer vegetative cycle than the other varieties. It is observed also that the cycle of all varieties was longer for plantings carried out from December 1989 to early April 1990 (from 8th to 16th planting).

III. COLLABORATIVE RESEARCH

3.1. Observational Study on Planting Methods and on-Farm Weed Control. Dominican Republic.

The farm of cooperating farmer Mr. Rafael Frías located in Juma-Caracol, Dominican Republic, was selected in order to evaluate seeding with the drum seeder vs. broadcast and manual transplant. Direct seeding was accomplished with pregerminated seed.

Table 4. Yield of 4 Rice Varieties in 23 Planting Dates. Juma, Dominican Republic, 1989-90.

Trial	Planting date (D/M/Y)	Yield per variety (kg/ha)[1]			
		JUMA 64[2]	CICA 8	JUMA 57	TANIOKA
1	30-08-89	4636a	4405ab	3552 b	3758ab
2	14-09-89	5749a	4683 b	4288 b	4848 b
3	28-09-89	5600a	4907ab	4533 b	5067ab
4	12-10-89	5823a	5040 b	3787 c	4747 b
5	27-10-89	4304ab	4725a	4069ab	3493 b
6	10-11-89	4883 b	6384a	5257 b	5332 b
7	24-11-89	5707a	5440ab	4320 c	4747 bc
8	08-12-89	5600a	4675 b	3963 b	4382 b
9	22-12-89	7397a	6437ab	6165 b	4987 c
10	06-01-90	5600a	5621a	5125a	5291a
11	21-01-90	5523ab	5749a	4955ab	4091 b
12	07-02-90	4223a	3947a	4213a	3328a
13	22-02-90	7088a	5856ab	5616ab	4320 b
14	09-03-90	6411a	6107a	5723a	4011 b
15	27-03-90	6736a	7221a	5051 b	4368 b
16	09-04-90	6299ab	6567a	5605 b	4069 c
17	24-04-90	6624ab	7301a	5808 b	5157 c
18	11-05-90	6304a	6155a	3856 b	3941 b
19	28-05-90	6160a	6037a	4716 b	4395 b
20	12-06-90	6014a	6278a	4811 b	5278 b
21	27-06-90	5920a	5587a	4363 b	5307a
22	12-07-90	5894a	4922ab	4722ab	4111 b
23	27-07-90	4678a	4306a	5089a	4044a
	Average	5790a	5580ab	4761 bc	4476 c

1/ On the same line, data followed by the same letter are not statistically different, according to Duncan's Test at 5%.

2/ Line P3831F3-RH38-8-1M-J182 was released by CEDIA in Dominican Republic as variety Juma 64.

JUMA 64 was the variety used in all cases and the plot's size per treatment was of 500m2. Chemical weed control was also evaluated in row seeding, complemented with mechanical and manual weeding, as compared to chemical control complemented only with manual weeding for the three planting methods (Table 5).

After land preparation and seed incubation, heavy rainfalls occurred, which caused a one-day delay in planting (one day of hydration plus two days of incubation). At planting time the seminal roots were from 0.5 to 1.0 cm long, which caused sowing rate with the seeder to be of 118 plants/m2, which was reduced to 90 plants/m2, after mechanical weeding (Table 5). This population was lower than broadcast (224 plants/m2) and manual transplant (149 plants/m2).

Among the observed results in this study, there are: The highest yield (6570 kg/ha) corresponded to broadcast with chemical and manual weed control (treatment No.3), which was precisely the one that had the greatest number of plants/m2 (224). The yield of treatment No.4 was of 5461 kg/ha (149 plants/m2), which is the same as that of No.2 (5400 kg/ha) with 90 plants/m2 and higher than No.1 (117 plants/m2), which yielded 5110 kg/ha. The data show that it is not possible to definitely conclude on the superiority of one treatment over the other, based on grain yield only, since the interactions, planting methods, number of plants per m2, and weed control had an effect that could not be quantified.

According to the farmer, row-seeding reduced the time required for hand weeding as compared to broadcast. Mechanical weeding after the application of the triple mixture of herbicides did not influence the time for hand weeding. Based on the above, the cooperating farmer and two neighbors made the decision of planting their farms with the row-seeder and use the mixture of herbicide in early post-emergence of the crop in the following season.

Table 5. Effect of Planting Methods and Weed Control on the Number of Plants and Grain Yield of Commercial Rice, Juma-Caracol , Bonao, Dominican Republic, 1991.

Treatment (No.)	Planting method	Weed control[1]	Rice plants[2] Before (#/m^2)	Rice plants[2] After (#/m^2)	Grain yield (kg/ha)
1	Row Seeding	Chemical and hand weeding	117	-	5110
2	Row Seeding	Chemical, mechanical, and hand weeding.	118	90	5400
3	Broadcast	Chemical and hand weeding	224	-	6570
4	Transplant	Chemical and hand weeding	49	-	5461

1/ - Farmer's chemical control: mixture of Butachlor + Propanil + 2,4-D (5.0 + 5.0 + 0.2) lt/ha of Commercial Product.
- Mechanical control: single weeding with single-row cone weeder 33 days after seeding.
- Major weeds were *Fimbristylis miliacea*, *Ischaemum rugosum*, *Echinochloa colonum* and *Heteranthera reniformis*.

2/ - Number of plants before and after mechanical weeding

In the first and second semester of 1991, two studies on integrated management of undesirable rices and another on validation of methods of control for such weeds were carried out in coordination with the Rice Research Center **(CEDIA)** and the Rice Extension Department **(DFA)**. The detailed description of the above studies are shown in points 3.2.1., 3.2.2. and 3.2.3.

3.2. Integrated Management of Red Rice and other Weeds in the Dominican Republic.

Red rice(*Oryza sativa* L.) affects approximately 34% of the national rice area in the Dominican Republic and is considered a serious problem to rice production. We use the term "red rice" to refer to all spontaneous rices that belong to the same genus and species of the commercial variety. In the Dominican Republic, the most widely distributed spontaneous rices are the well known red rice with red pericarp and another called locally "No Me tope". Many biotypes of red rice with the red pericarp are observed in the country. "No Me Tope" plants are tall and tiller profusely. Their grains do not have a red pericarp and shatter easily at maturity. The technology developed in the Dominican Republic could be useful for rice farmers in other Caribbean countries where red rice and other annual weeds difficult to control, are present.

In the first and second semester of 1991, studies on integrated management of red rice and other weeds were carried out in coordination with the Rice Research Center **(CEDIA)** and the Rice Extension Department **(DFA)**.

3.2.1. Evaluation of Water Management and Mechanical Weeding for the Control of Red Rice in Row-Seeded Rice.

This study was carried out with the objective of identifying the best combination of cultural practices which could achieve an efficient control of red rice. The work was conducted in coordination with Eng. Omar Medina, **CEDIA** Researcher and **CRIN** counterpart.

The experiment was established in March 1991 on a farm highly infested with red rice, owned by Mr. A. Jiménez, located in La Ceiba, Bonao. A split-split plot experimental design with 4 replications was used. Large plots, sub-plots and sub-sub-plots corresponded to pre-plant herbicide application, water management and mechanical weed control, respectively.

The pre-plant herbicide application consisted of applying Oxifluorfen (3.0 lt/ha) into a water layer 6 days after the final plot leveling. The field was drained 6 days after the application and seeded the day after. The water management consisted of flooding subplots 5, 10, and 15 (Check) days after seeding. Each sub-plot and sub-sub-plot was leveled individually.

The planting method used was row-seeding with pregerminated seed using the manual drum seeder. Seeding rate was of 85 kg/ha at a distance of 20 cm between rows and the variety used was JUMA 64. Mechanical weeding was accomplished 23 days after seeding, through the use of the single-row cone weeder. In order to make treatments uniform, a mixture of Propanil + 2,4-D (4.0 + 0.25 lt/ha, respectively) was applied to control weeds, complemented by one hand weeding.

Regardless of the chemical and mechanical control used, flooding plots gradually at 5 and 10 days after seeding reduced the number of red rice plants, and consequently, increased commercial rice yield (Fig. 3 and 4). One mechanical weeding 23 days after seeding controlled red rice by 40% and increased commercial rice yield by 12% (Table 6).

Figure 3. Effect of the beginning of gradual flooding on red rice control. La Ceiba, Dominican Republic, 1991.

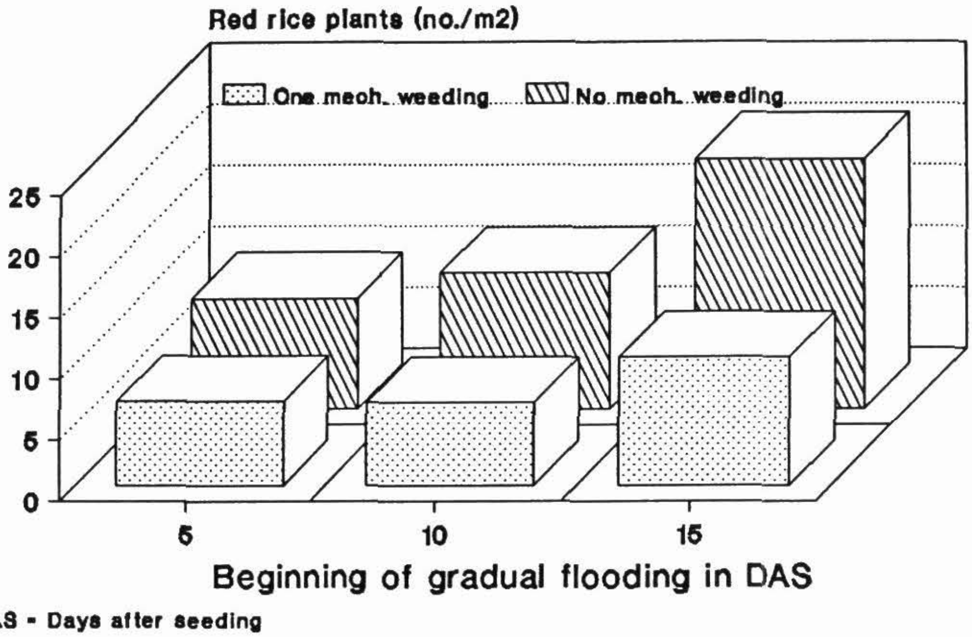
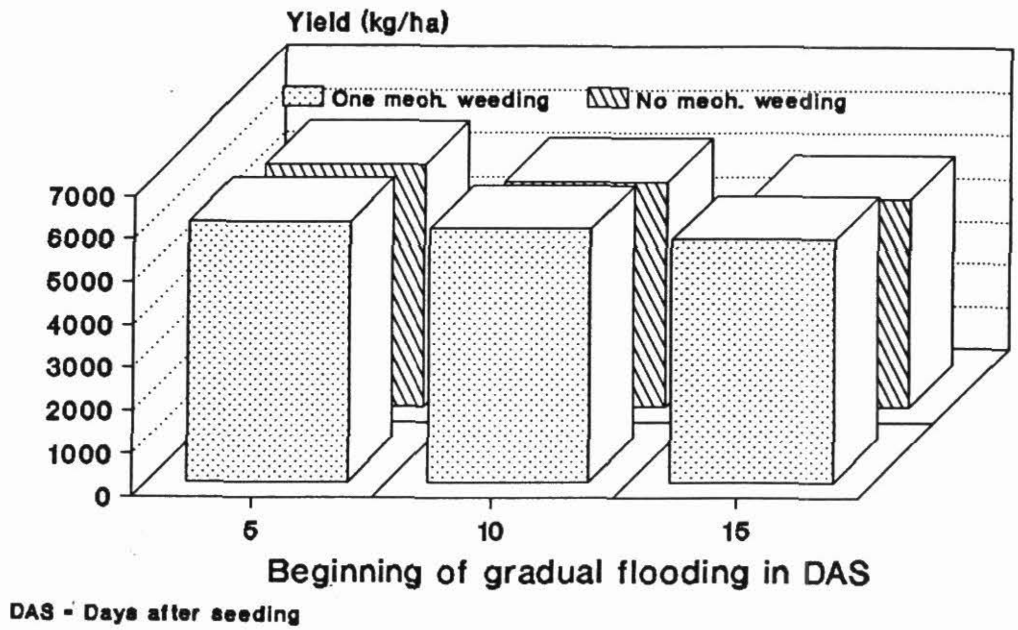


Figure 4. Effect of the beginning of gradual flooding on rice yield. La Ceiba, Dominican Republic, 1991.



The data show that the combination of gradual flooding 5, 10 and 15 days after seeding (DAS) and one mechanical weeding, resulted in a better control of red rice (Fig. 3) and a higher yield (Fig. 4). As to treatments without mechanical weeding, gradual flooding at 5 and 10 DAS achieved a significant control of red rice, which also resulted in a higher yield (Fig. 3 and 4).

The results show the potential that exists in combining water management and mechanical weeding to control red rice in irrigated fields.

Table 6. Effect of Mechanical Weeding on the Number of Plants of Red Rice and Yield. La Ceiba, Bonao, Dominican Republic. 1991.

Mechanical weeding	Red rice plants (no./m^2)	Yield (kg/ha)
1[a]	8.1	5935
none	13.6	5315
Difference	- 40%[b]	12%[b]

a/ At 23 days after seeding.
b/ Statistically significant at 1%.

3.2.2. Interference of Red Rice with Commercial Rice.

In 1990 a study was conducted in Limón del Yuna, Dominican Republic, in order to quantify losses in rice yield caused by different infestation levels of red rice. In 1991 a second study was carried out, as shown in point 3.2.1.

These results and the ones of 1990 were used to calculate regression curves (Fig. 5), in order to estimate potential crop losses, due to the interference of red rice.

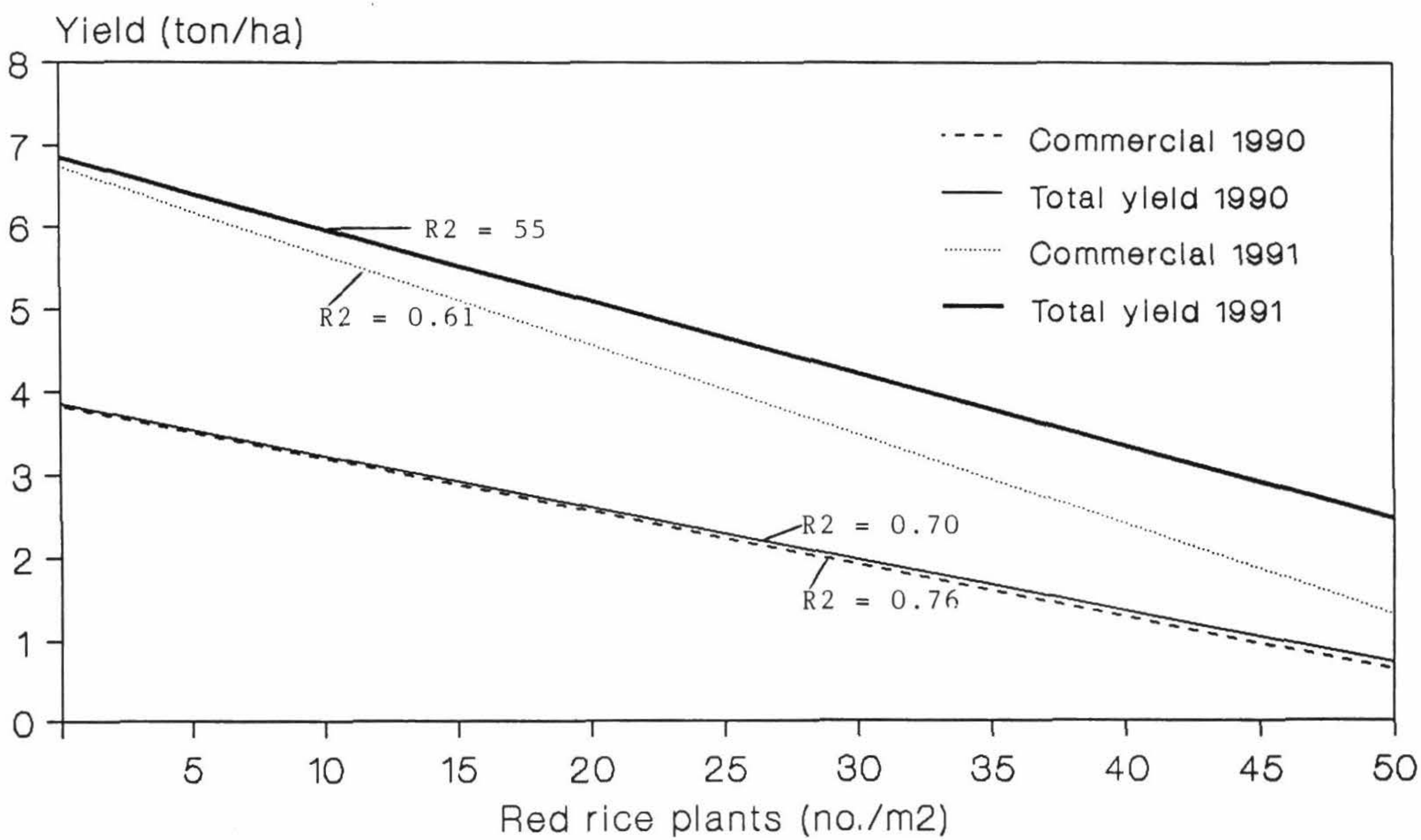
The effect of red rice populations on commercial and total rice yield was different for the two experiments (Fig. 5). This difference was due to the fact that red rice biotypes, commercial rice varieties and field conditions were different in each case.

In the 1990 study, red rice biotypes were mainly tall plants, with high tillering capacity; whereas the infestation of red rice in 1991 consisted of a mixture of short and tall plants. Those short plants have less tillering capacity and are less competitive with the commercial rice. In 1990, variety CICA 8 (ISA 40) lodged, both in the infested and non infested plots. Lodging increased as the infestation level increased.

In the 1991 study, no lodging was observed in variety JUMA 64. The highest yield observed in 1991 as compared to 1990 was due mainly to better field conditions and not to varietal differences, since varieties JUMA 64 and CICA 8 have similar yield potential.

A better knowledge of the interaction among major biotypes of red rice, agricultural practices (planting rate, dosage of fertilizer, etc.) and rice varieties will be very useful in taking decisions for the control of red rice in the Dominican Republic.

Figure 5. Interference of red rice plants with rice yield. Dominican Republic, 1990 & 1991.



3.2.3. Validation of Methods for Control of Red Rice with Farmers' Participation. Los Barros, Bonao.

These studies were carried out in the Community of Los Barros, Bonao where Eng. Jesús Rosario, a **CRIN**-trained and **DFA's** extensionist, pointed out the presence of a heavy infestation with red rice.

Before beginning the studies, a meeting was held with 8 cooperating farmers in order to analyze the rice problem, determine the feasible choices for solution, choose the research plot, and schedule the activities. Based on this, experiment I was conducted during the first semester of 1991.

During the second semester two other experiments were also scheduled, designed and conducted with the participating farmers. The experiments were designed according to the results of experiment I and the study on water management and mechanical weeding (point 3.2.1), as well as other technologies under evaluation, and farmers' criteria.

The objective of these experiments was to validate new technologies on integrated red rice and weed control with the participation of small farmers.

3.2.3.1 Materials and methods

Experiment I was established in february 1991 on a commercial farm highly infested with red rice. This study consisted of five treatments of 500 m2 each without replication. Treatments' description is shown on Table 7.

Table 7. Description of Treatments in Experiment I.

Treatment	Description
T_1	Land preparation (2 puddlings) and leveling in 7 days; flooding with a water layer during 19 days; drainage; row seeding; mechanical weeding at 20 and 32 days after seeding.
T_2	Land preparation (2 puddlings) and leveling in 7 days; soil kept wet for 8 days to stimulate weed germination; weed control with Paraquat; light flooding 2 days after herbicides application and seed broadcast the day after. Weed control in early post-emergence with a mixture of Butachlor, Propanil and 2,4-D (3.0 + 4.0 + 0.3 lt/ha, respectively).
T_3 (Check)	Land preparation (2 puddlings) and initial leveling; soil kept wet for 11 days; final leveling and seed broadcasting the next day. Weed control in early post-emergence with a mixture of Butachlor, Propanil and 2,4-D (3.0 + 4.0 + 0.3 lt/ha, respectively).
T_4	Land preparation (2 puddlings) and leveling in 7 days, soil kept wet during 6 days to stimulate weed germination; application of Oxifluorfen (3.0 lt/ha) on a water layer and draining the field 6 days after the application. Broadcast the day after; weed control in early post-emergence with a mixture of Propanil and 2,4-D (3.5 + 0.3 lt/ha, respectively).
T_5	Land preparation (2 puddlings) and initial leveling; soil kept wet for 11 days, and then final leveling. Row seeding, mechanical weeding at 20 and 32 days after seeding.

All treatments were hand-weeded twice at 61 and 82 days after seeding. Red rice plants were not eliminated in 6 representative plots per treatment which were randomly distributed, in order to evaluate the efficiency of all treatments and quantify the damage caused by red rice.

Experiment II was conducted with the same farmer of experiment I and consisted of six treatments of 400 m^2 with 2 replications. Treatments' description of experiment II is shown on Table 8.

The land preparation consisted of 2 passes with the Hydrotiller. Leveling was completed immediately after the second tillage for treatment 1 (Oxifluorfen) and 7 days later for the other treatments. Oxifluorfen (3.0 lt/ha) was applied on a water layer 4 days after the final leveling. The plots were drained 6 days after the application and seeded the day after. All treatments were planted (direct seeding and transplanted) in rows 20 cm apart, mechanical weeded twice and hand-weeded once. A manual row seeder was used with pregerminated seed for the direct seeding. Mechanical transplanting was done with a manual transplanter designed by IRRI and under evaluation in Dominican Republic. Seedlings of 25 days were used for mechanical and manual transplanting. The early post-emergence weed control consisted of one application of a mixture of Propanil and 2,4-D (4.0 + 0.2 lt/ha, respectively). In treatment 1, it was decided to include mechanical weeding because of the poor control of red rice achieved by Oxifluorfen. JUMA 64 was the variety used.

Experiment III was carried out in a commercial field seeded in rows 20 cm apart, using the variety JUMA 57. The experimental field was infested with red rice and well levelled. A randomized complete block desing (RCBD) with 3 replications was used. Table 9 shows the description of the treatments. The single-row cone weeder was used for the mechanical weeding.

Table 8. Description of Treatments in Experiment II.

Treatment	Description
T_1	Oxifluorfen, row-seeding, post-emergent herbicides and mechanical weeding.
T_2	Row-seeding and mechanical weeding.
T_3	Row-seeding, post-emergent herbicides and mechanical weeding.
T_4	Mechanical transplanting, post-emergent herbicides and mechanical weeding.
T_5	Manual transplanting and mechanical weeding.
T_6	Manual transplanting, post-emergent herbicides and mechanical weeding.

Table 9. Description of Treatments in Experiment III.

Treatment	Description[1]
T_1	One mechanical weeding at 15 DAS[2], followed by 2,4-D + Propanil at 20 DAS, and one mechanical weeding at 33 DAS.
T_2	2,4-D + Propanil at 20 DAS (Farmers' practice).
T_3	2,4-D + Propanil at 20 DAS, followed by two mechanical weedings (24 and 33 DAS).
T_4	2,4-D + Propanil + Butachlor at 20 DAS.
T_5	One mechanical weeding at 15 DAS, followed by 2,4-D + Propanil + Butachlor at 20 DAS.

1/ Herbicide dosage: 2,4-D = 0.350 lt/ha, Propanil = 5.0 lt/ha, Butaclor = 4.0 lt/ha

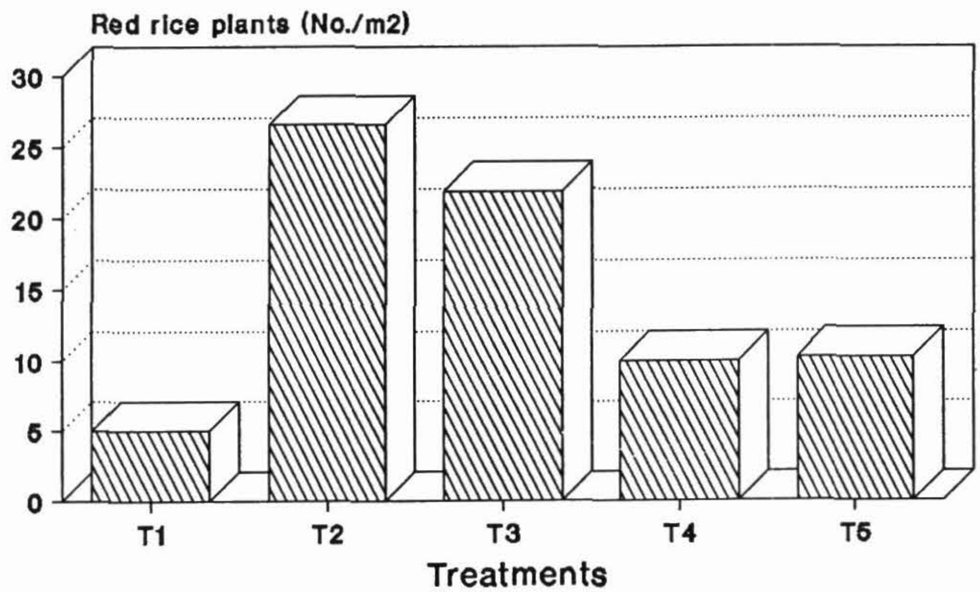
2/ DAS = Days after seeding

3.2.3.2 Agronomic results and discussion

i) Control of red rice and other weeds

In experiment I, the effects of the treatments on red rice control are summarized in Figure 6. Flooding and mechanical weeding (T1), chemical control with Oxifluorfen (T4) and mechanical weeding alone (T5) significantly decreased plant population of red rice, as compared to check without control (T3). On the other hand, it can be observed that the treatment with Paraquat as suggested by farmers (T2) was not effective. It should be pointed that in check treatment (T3) there was an 11 days span between initial and final leveling. This practice influenced the decrease of red rice population, since this was less than the observed in treatment with Paraquat (T2).

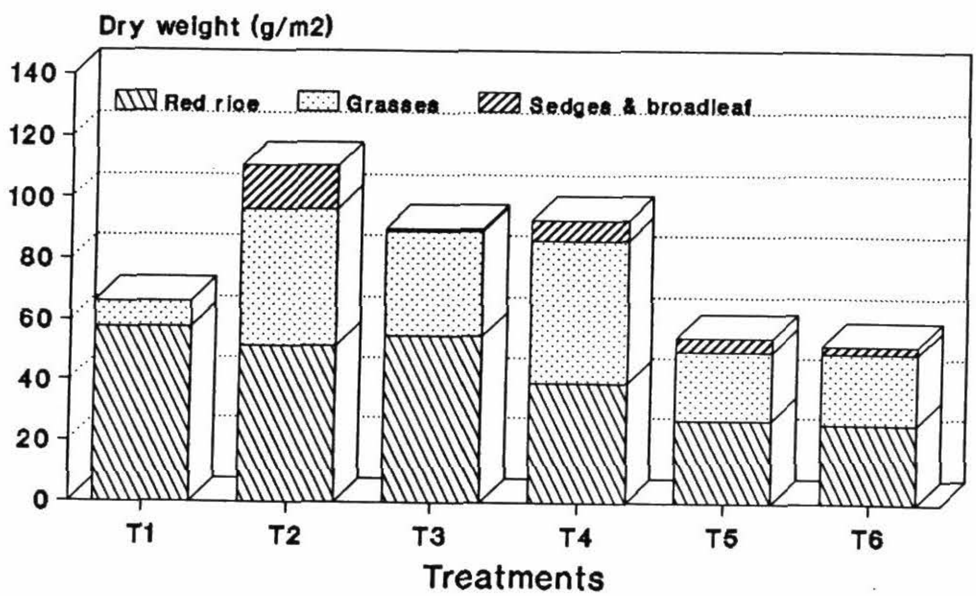
Figure 6. Red rice plants as influenced by methods of control. Experiment I. Los Barros, Dominican Republic, 1991.



Average of 12 samplings of 1 m2 per plot

In experiment II, the effects of treatments on red rice and other weeds are shown in Figure 7. Rice transplanted manually in rows followed by two mechanical weedings (T5 and T6) had greater effects in decreasing red rice infestation than the other treatments. On the other hand, treatment with Oxifluorfen (T1) was not effective in controlling red rice. The poor control of red rice with Oxifluorfen observed could, however, be ascribed to low rate of germination at the moment of its application (only 4 days after the final land preparation). The application in post-emergence of 2,4-D and Propanil before mechanical weedings reduced grasses, sedges and broadleaf weeds, in row-seeded rice (T3 versus T2 of Fig. 7). The effects of these herbicides were not significant in transplanted rice (T6 versus T5 of Fig. 7).

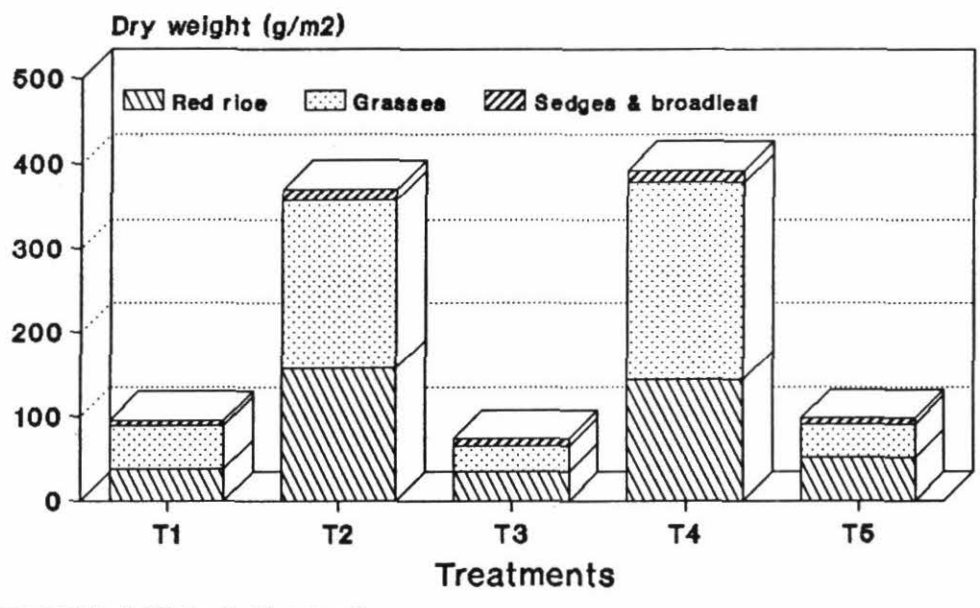
Figure 7. Weight of weeds as influenced by methods of control. Experiment II. Los Barros, Dominican Republic, 1991.



Dry weight at 65 days after planting

In experiment III, the effects of the mechanical weeding in row-seeded rice are shown in Figure 8. In plots treated with 2,4-D and Propanil, two mechanical weedings (T1 and T3) reduced significantly the infestation of red rice and grass weeds as compared to the chemical control alone (T2). Passing the rotary weeder before (T1) or after (T3) the application of the mixture of the post-emergent herbicides did not influence significantly the control of all weeds. One mechanical weeding before the application of the mixture of 2,4-D, Propanil and Butachlor (T5) decreased also red rice and grass weeds infestation as compared to chemical control alone (T4).

Figure 8. Weigth of weeds as influenced by methods of control. Experiment III. Los Barros, Dominican Republic, 1991.



Dry weight at 85 days after seeding.

The effects of early post-emergence application of 2,4-D and Propanil followed by two mechanical weedings on weed control in row-seeded rice were similar in experiment II and III (T3 in both Fig. 7 and 8). In general, mechanical weeding, with or without chemical weed control, provided a significant degree of control of red rice and other weeds. In contrast, Oxifluorfen had a significant effect on red rice control in experiment I, but not in experiment II.

ii) Rice yield

In experiment I, treatments with flooding and mechanical weeding (T1), Oxifluorfen (T4) and mechanical weeding alone (T5) produced the highest yields, in a range from 6694 to 6955 kg/ha (Fig. 9). On the other hand, except for treatment with Paraquat (T2), the elimination of red rice plants through hand weeding did not influence total rice yield significantly (Fig. 9).

In experiment II, manually transplanted rice (T5 and T6) produced the highest yield (Fig. 10). Yield of row-seeded treatments with direct seeding (T1, T2 and T3) was lower than the transplanted one, probably because the plots were harvested too early by the farmer and sampling had to be done at the same time. At that time, a high proportion of the kernels in the lower portion of panicles were still at the milk and soft dough grain stages. On the other hand, mechanically transplanted rice (T4) produced slightly less than the treatments transplanted manually presumably

Figure 9. Rice yield as influenced by methods of weed control. Experiment I. Los Barros, Dominican Republic, 1991.

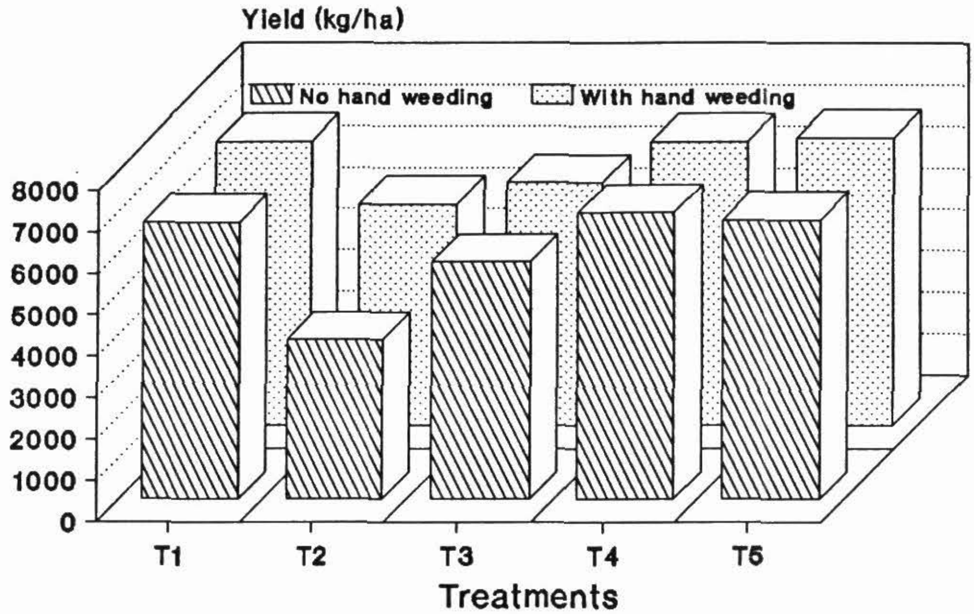
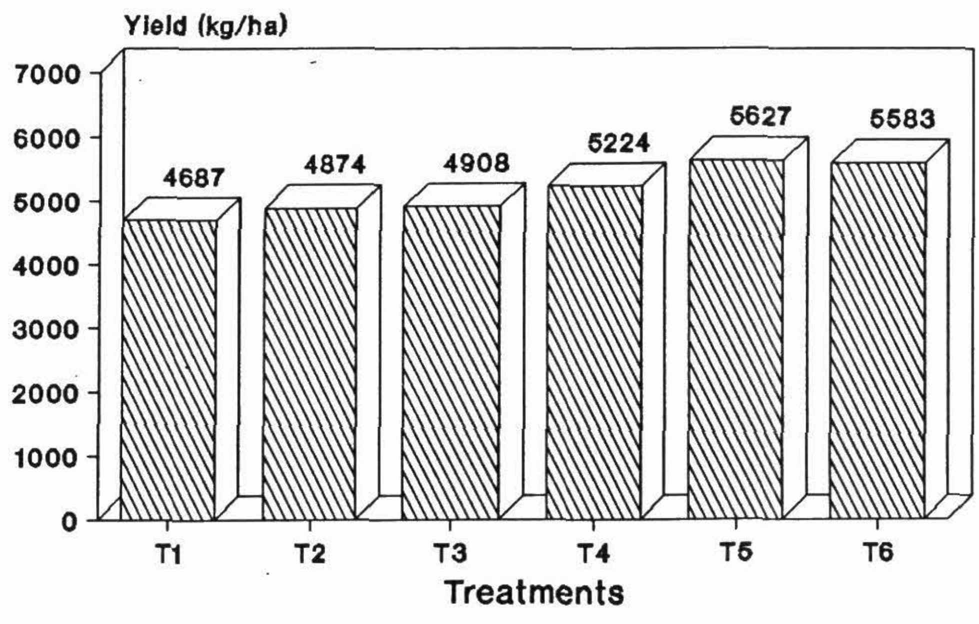


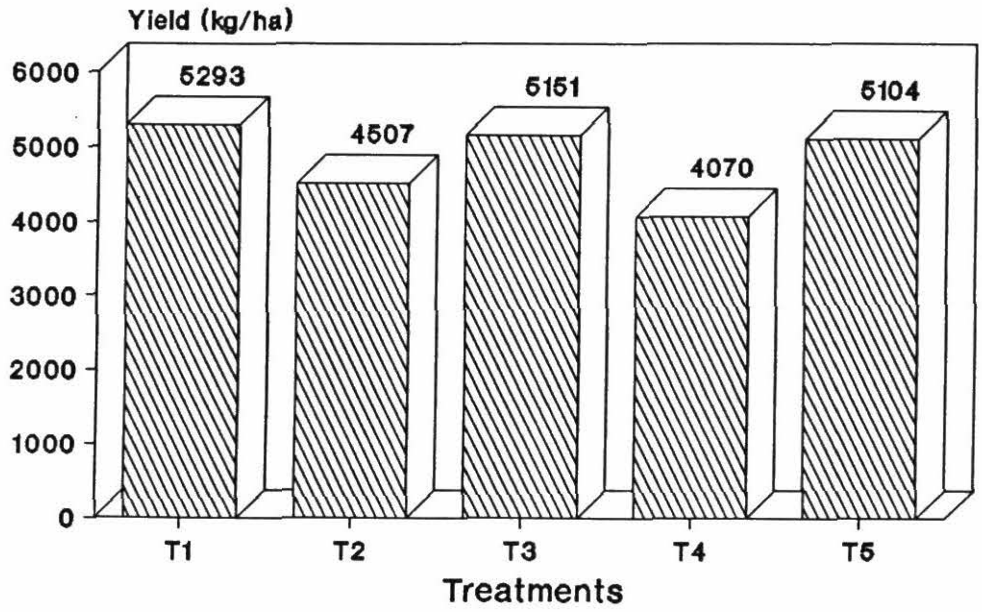
Figure 10. Rice yield as influenced by methods of weed control. Experiment II. Los Barros, Dominican Republic, 1991.



because of mechanical problems with the manual transplanter since about 40% of the hills had to be replanted. At harvest time, many of the plants from these hills were still at milk and soft dough grain stages.

In experiment III, the plots with mechanical weeding (T1, T3 and T5) produced the highest yields, ranging from 5104 to 5293 kg/ha (Fig. 11). Mechanical weeding decreased the weed population to be controlled later by hand (Fig. 8), resulting in enhanced rice grain production.

Figure 11. Rice yield as influenced by methods of weed control. Experiment III. Los Barros, Dominican Republic, 1991.

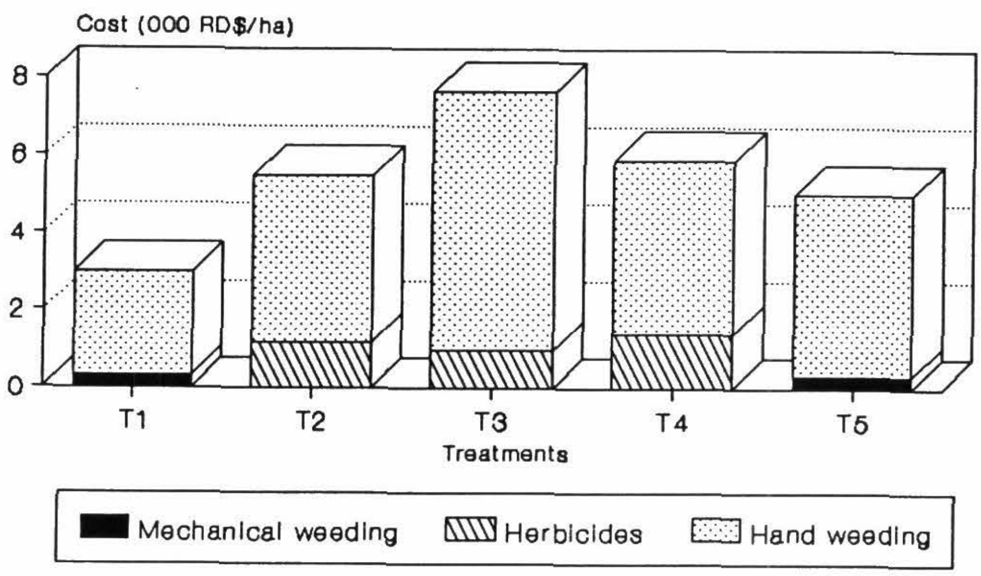


In summary, an effective early control of red rice and other weeds by chemical and/or mechanical methods had a marked effect on rice production.

3.2.3.3. Economic Results.

Figure 12 and Table 10 show the cost and gross income of treatments in experiment I. According to these results, treatment 1 was the most efficient in economic terms since its cost (RD$3,001.00/ha) was much lower than the rest of the treatments, which costs varied from RD$5,056.00/ha to RD$7,660.00/ha. In addition, its yield was the second highest of the trial (6866 kg/ha) as indicated in Figure 9.

Figure 12. Cost of treatments in experiment I by method of weed control



Treatments 4 and 5 also produced high yields (over 6855 kg/ha), but their hand-weeding expenses reduced their economic efficiency as compared to treatment 1. On the other hand, treatments 2 and 3 (check) had the least economic efficiency among all treatments, due to high hand-weeding costs and lower yield (5348 and 5870 kg/ha, respectively).

Even though treatment 3 achieved better control of red rice than treatment 2, its hand-weeding cost was much higher. This was due to a high infestation with Ischaemum rugosum and Cyperaceae, which were better controlled by the herbicide Paraquat used in treatment 2.

Table 10. Economic Efficiency of Treatments in Experiment I. Los Barros, Dominican Republic. First Semester, 1991.

Treatment (No.)	Yield paddy (kg/ha)	Gross[1] income (RD$/ha) (A)	Total cost of weed control (RD$/ha) (B)	A/B Ratio
1	6866	28,013.00	3,001.00	9.33
2	5348	21,820.00	5,519.00	3.95
3	5870	23,950.00	7,660.00	3.13
4	6855	27,968.00	5,897.00	4.74
5	6955	28,376.00	5,056.00	5.61

US$1 = RD$12.50
1/ Sale price = RD$4.08/kg of paddy rice

The economic results of experiment II are presented in Figure 13 and Table 11. These results show that treatments 5 an 6 had the lowest costs of the trial, with RD$2,671.20/ha and RD$3,021.00/ha, respectively, as well as the highest gross income (RD$20,145.30/ha and RD$19,986.30/ha, respectively), making them the most efficient in economic terms. These treatments were followed in order of economic efficiency by treatments 4, 3 and 2.

Treatment 1 had the least economic efficiency, due to the great expenses incurred in herbicides as compared to the other treatments. The use of more herbicide did not prevent this treatment from having the lowest yield of the trial (4,687 kg/ha), and therefore the lowest gross income.

Figure 13. Cost of treatments in experiment II by method of weed control

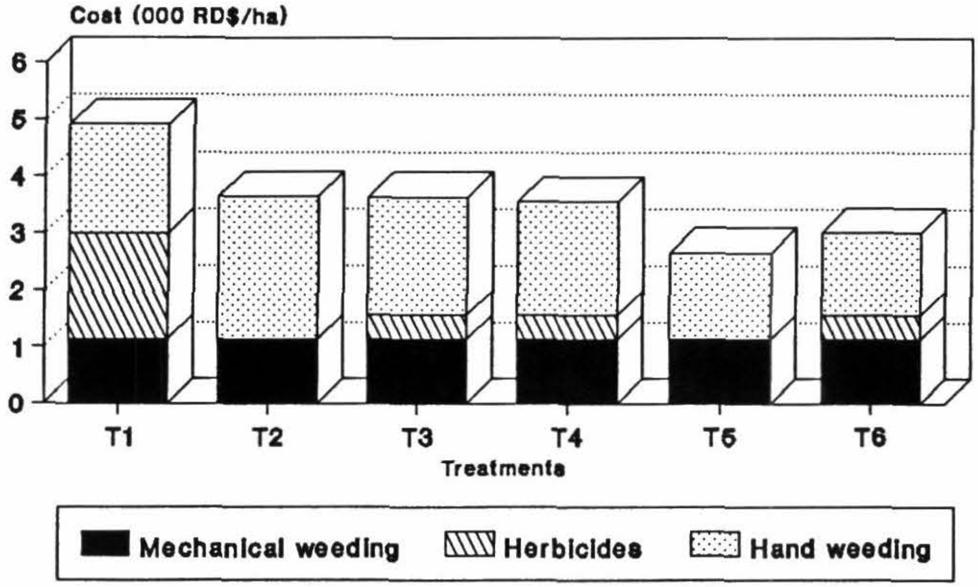


Table 11. Economic Efficiency of Treatments in Experiment II. Los Barros, Dominican Republic. Second Semester, 1991.

Treatment (No.)	Yield paddy (kg/ha)	Gross[1] income (RD$/ha) (A)	Total cost of weed control (RD$/ha) (B)	A/B Ratio
1	4687	16,790.40	4,929.00	3.41
2	4874	17,474.10	3,657.00	4.78
3	4908	17,585.40	3,641.10	4.83
4	5224	18,730.20	3,561.60	5.26
5	5627	20,145.30	2,671.20	7.54
6	5583	19,986.30	3,021.00	6.62

US$1 = RD$12.50
1/ Sale price = RD$3.58/kg of paddy rice

3.2.3.4. Evaluation and Adoption of the New Technology by Farmers.

Prior to the evaluation of the technologies, a "field day" was held in the Community of Los Barros in order to show the land preparation work (design of straight levees and land leveling), the study of alternatives for the integrated management of red rice, and the equipment used (8-row drum seeder and single-row cone weeder). This activity was attended by 11 technicians and 25 farmers.

Before and after harvest of each experiment, the treatments tested in the field were discussed and evaluated with all 8 participating farmers.

At the end of the first season, from the options for the integrated management of red rice in experiment I, the farmers chose the treatment that includes "flooding the field before planting, row-seeding and mechanical weeding" as the most effective and economical one. However, the treatment including only row-seeding and mechanical weeding seems to be a very good prospect.

During the second season, the treatment including row-seeding, post-emergent herbicides and mechanical weeding was chosen by the farmers as the most economical integrated control of red rice and other weeds under their conditions. However, it was pointed out that heavy rain dispersed the seeds sowed in rows in two fields. In this case, the rotary weeder could not be used without destroying many rice plants.

Because of the good control achieved on red rice, some farmers preferred the treatments in which rice was transplanted manually in rows, followed by two mechanical weedings (T5 and T6 of experiment II).

The adoption of new technologies is evident in the Community of Los Barros. From its 23 farmers: a) Thirteen are developing their land totally or partially; b) Four of them have row-seeded and three used the cone weeder; c) One farmer has transplanted rice manually in rows and will use the cone weeder to control red rice, and; d) Eight farmers planted the new variety JUMA 64, because of they saw its good yielding potential and earliness, on the farms with integrated management of red rice. However, the number of farmers planting this variety would have been higher if more seed have been available at planting time.

3.3. Determination of the Efficiency of Urea Placed in Residual Soil Layer with a Pneumatic Injector.

This study was carried out with the objective of obtaining research-level results under Caribbean conditions on the efficiency of Urea injected to the soil with a pneumatic injector provided by the Netherlands Fertilizer Institute, as compared to top-dressed application. This study is part of an agreement between **CRIN** and the above Institute.

Two field experiments, each conducted during the first and second semester of 1991, were located at CEDIA, Dominican Republic. Soil was a silty clay loam with a pH 5.6 and 2.8% organic matter.

Planting methods were, transplanting and row-seeding during the first and second semester, respectively. For transplanting, seedling 25 days old were used and planted at a distance of 20 x 20 cm. Row-seeding was made with pregerminated seed using the manual row seeder. Seeding rate was of 85 kg/ha at a distance of 20 cm between rows.

In both experiments, variety JUMA 64 was used. In each experiment, all plots were fertilized before transplant with an equivalent of 80 kg/ha of P_2O_5 and K_2O. The experiments were laid out in a randomized complete block design. Plot size was 3 x 10 m.

The evaluated treatments correspond to the application of 0, 60, 90 and 120 kg of N/ha using the injection and top-dressing methods. Injection of total N was made at one week after transplanting and three weeks after row-seeding. The distance between injections was 40 x 40 cm in transplanted plots and 40 x 50 cm in row-seeded ones. Plots were kept flooded (5-10 cm) for injecting Urea. In top-dressed method, the total dosage of N was split in 40, 40 and 20% of total N, applied at 1 and 4 weeks after transplanting and at panicle initiation, respectively. In row-seeded rice this was made at 3 and 6 weeks after seeding and at panicle initiation, respectively. Plots were drained one day before top-dressed application and re-flooded the day after.

Results of the experiments are presented in Table 12 and 13. In the transplanted rice experiment, deep placement of Urea with the pneumatic injector significantly increased grain yield as compared to top-dressed application of equal levels of Nitrogen (Table 12). In the row-seeded experiment, however, there was no significant effect of Urea application methods on grain yield.

In the transplanted rice experiment, the highest yields of variety JUMA 64 (7653 and 7419 kg/ha) corresponded to the application of 120 and 90 kg/ha of injected N, respectively (Table 12). No significant difference in rice yield was found between the application of 60 kg/ha of injected N, (6493 kg/ha) and the application of 120 kg/ha of top-dressed N (5830 kg/ha). However, the injected-N treatment surpassed the top-dressed one in 663 kg/ha.

Plant height and the number of panicles per m^2 were increased by the injection of Urea in both experiments. In the transplanted experiment, none of the treatments with Urea had significant influence on the number of grains per panicle and 1000-grain weight (Table 12). In the row-seeded experiment, these yield components were, however, affected by the methods of Urea application (Table 13). For the application of 90 and 120 kg/ha of total N, the injection decreased the number of grains per panicle as compared to top-dressed. But this effect was not reflected in the grain yield because of the higher number of panicles per m^2 in the injected Urea treatments (Table 13).

The results obtained from this study show that, in transplanted rice, deep placement of Urea increased Nitrogen efficiency as compared to top-dressing in the conditions of Juma, Dominican Republic. However, in row-seeded rice, deep placement of urea did not improve the efficiency of N.

Table 12. Treatments and Results of the Comparative Study on Urea Application Methods in Transplanted Rice. Juma, Dominican Republic, 1991[1].

No.	Treatment description	Plant height (cm)	Yield (kg/ha)	Panicles/m2 (no.)	Grains/ panicle (no.)	1000 grains weight (g)
1	Check (0 N)	79 d	3656 e	179 c	80a	30.7a
2	60 kg of N/ha injected	95ab	6493 b	275ab	91a	31.5a
3	90 kg of N/ha injected	95ab	7419a	286a	89a	31.7a
4	120 kg of N/ha injected	96a	7653a	290a	92a	31.2a
5	60 kg of N/ha top-dressed	89 c	5018 d	202 c	80a	31.3a
6	90 kg of N/ha top-dressed	90 bc	5362 cd	244 b	84a	31.7a
7	120 kg of N/ha top-dressed	91 bc	5830 bc	247 b	93a	31.6a
Coefficient of variation (%)		3.7	7.9	8.3	8.8	2.0

_1/ In the same column, data followed by the same letter are not statistically different according to Duncan's Test at 5%.

Table 13. Treatments and Results of the Comparative Study on Urea Application Methods in Row-Seeded Rice. Juma, Dominican Republic, 1991.[1]

No.	Treatment description	Plant height (cm)	Yield (kg/ha)	Panicles/m2 (no.)	Grains/ panicle (no.)	1000 grains weight (g)
1	Check (0 N)	73 d	3553 c	276 c	42 c	29.5a
2	60 kg of N/ha injected	88 bc	5987 b	369 b	52ab	30.7a
3	90 kg of N/ha injected	92ab	6483ab	443a	47 bc	30.5ab
4	120 kg of N/ha injected	93 a	6785ab	486a	47 bc	30.2 b
5	60 kg of N/ha top-dressed	85 c	5778 b	350 b	52ab	30.1 b
6	90 kg of N/ha top-dressed	85 c	6602ab	389 b	55ab	30.8a
7	120 kg of N/ha top-dressed	90ab	7115a	391 b	58a	30.5ab
Coefficient of variation (%)		3.1	10.6	7.9	11.4	0.9

_1/ In the same column, data followed by the same letter are not statistically different according to Duncan's Test at 5%.

3.4. Various Supports Given by CRIN to Haiti Through ODVA.

Collaboration was given to **ODVA** in the evaluation of an Observational Trial of genetic material planted at Maugé Experimental Station; preparation of their research program;

drafting of research proposals following the scientific method for the evaluation of introduced and advanced rice lines; agronomic trials, and **IPM**.

In June, the following experiments were established at Maugé Experimental Station: Evaluation of material introduced from **CRIN** (60 lines), Preliminary yield trial (14 lines selected in 1990-91 from the germplasm sent by **CRIN**, and 2 checks), Advanced yield trial (15 advanced lines selected from the germplasm sent by **CRIN** in 1990-91, and 1 check). Also an on-farm zinc correction experiment was established in Ti-Jardin.

The following experiments were planned to be planted in July: Evaluation of salt tolerance of 22 lines supplied by **CRIN**; Evaluation of methods for correcting Zinc deficiency problems; Establishment of 4 trials on on-farm correction of Zinc deficiencies and a study on thresholds of action for stink bug (Oebalus ornatus). Only the germplasm studies have been continued at Maugé Experimental Station due to many reasons.

As an additional support to researchers at Maugé Experimental Station, Eng. J. Coulombe translated from English into French part of the publication Standard Evaluation System for Rice, 3rd Ed., **IRRI**, 1988. This information corresponds to the data to be recorded in the scheduled trials.

IV. RESEARCH SUB-PROJECTS FUNDED BY CRIN AND COOPERATING COUNTRIES.

4.1. Advance Information on the Integrated Pest Management Sub-Project.

4.1.1. Guyana.

Three (3) **IPM** studies were carried out in Guyana on rice blast (Pyricularia oryzae sacc.). The experiments here reported were carried out at **NARI**'s Experimental Station, Coastal Plains Unit, in Burma, Guyana. These works were implemented by Eng. Cleveland Paul, **NARI**'s counterpart in the **IPM** sub-project.

Rice blast is known as the most serious rice disease in Guyana. For this reason, **NARI**'s rice program has put a major emphasis on the introduction and development of rice lines resistant to leaf and neck blast. The rice variety RUSTIC, highly susceptible to rice blast, covers around 70% of the rice area of the country, but farmers continue to plant it because of its good grain quality for export.

According to the above, it is required to identify different management strategies of the disease using a susceptible variety, until a resistant one is identified and released. This points at the need of determining which are the best fungicides, with their dosages and time of application, the most effective combination of such fungicides, as well as appropriate cultural practices (seeding rate, N dosages and water management) that keep the disease's incidence and severity at rentable levels for the farmers. The following studies try to reach that goal.

4.1.1.1. Evaluation of New Fungicides for Rice Blast Control.

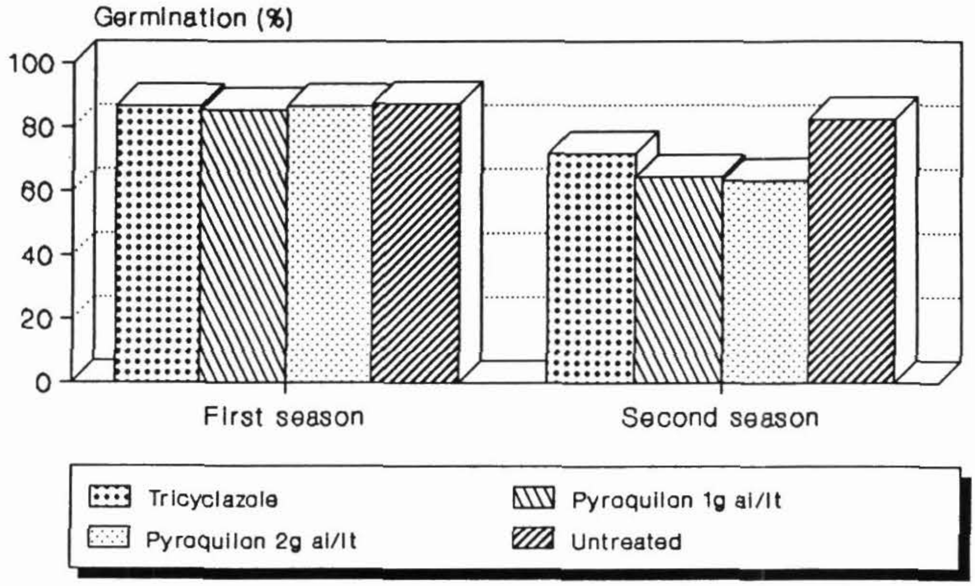
This experiment was carried out with variety Rustic in two seasons (1st and 2nd semester) of the year in order to evaluate the effectiveness of different fungicides which include the use of products separately or in mixtures, applied to the seed or the plant, to control rice blast.

i) Evaluation of fungicides for seed treatment:

The systemic fungicides Tricyclazole and Pyroquilon were evaluated in seed treatment for leaf blast control. Solution for one kg of seed was prepared by suspending the amount of active ingredient (a.i.) of product in one liter of water. For Tricyclazole, the dosage used was 1.5 g of a.i. per liter of water. For Pyroquilon, it was 1 and 2 g of a.i. per liter of water. Seed treatment was made by soaking the seeds into the solution for 24 hours. After soaking, the seeds were kept in a shady place during 3 days for incubation.

Due to the low incidence of leaf blast, it was not possible to evaluate the effectiveness of the seed treatments. However, the results show that treating seed with Tricyclazole and Pyroquilon with an incubation of 3 days reduced seed germination (Fig. 14). In the future, seed treatments for rice blast control should be evaluated in an area of high pressure of the disease.

Figure 14. Effect of seed treatment on germination of rice variety Rustic. Guyana, 1991.



ii) Evaluation of fungicides for foliar application

Six fungicides were evaluated at their recommended dosage for blast control through foliar application (Table 14). The first application was made at appearance of first symptoms of the disease, and the second one at 5 and 80% of panicle emergence for the first and second season, respectively.

A randomized complete block design with 4 replications was used. Plot size was 5 x 5 m. Panicle blast incidence was determined at grain dough stage by counting affected panicles of 8 random samples of 25 panicles per plot. Affected panicles were defined as panicles with lesions partially or completely around the panicle base or the uppermost internode or the lower part of panicle axis near the base.

Table 14. Fungicides and and Dosages Evaluated for Blast Control by two Foliar Applications. Guyana, 1991.

Treatment	Product	g of a.i./ha[1]
1	Busan (Metham-Sodium)	450
2	Carbendazim	225
3	Carbendazim + Metiram	125 +1200
4	Edifenphos	500
5	Iprobenfos	480
6	Tricyclazole	225
7	Untreated (check)	-

1/ Dosage/application

Due to the low incidence of leaf blast, no differences were observed between fungicides for the first foliar application; therefore no data was collected.

In both seasons in which the experiment was conducted, Tricyclazole caused a significant decrease in the percentage of panicles affected by blast (Fig. 15). In the first season, when less pressure of the disease was observed, Edifenphos and the mixture of Carbendazim and Metiram also reduced panicle blast incidence. However, the effectiveness of these fungicides was less than Tricyclazole during the second season, when the disease's pressure was greater and the second application was made late (80% of panicle emergence).

During the first season, fungicide treatments did not have a significant effect on rice yield (Fig. 16). Late infection of

Figure 15. Effect of various fungicides on panicle blast control of rice variety Rustic. Guyana 1991.

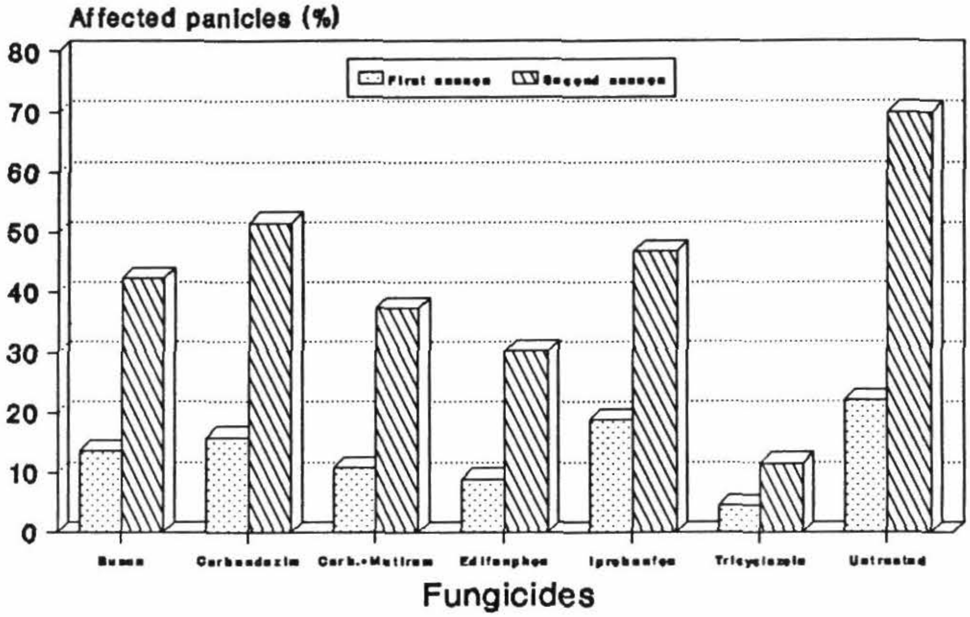
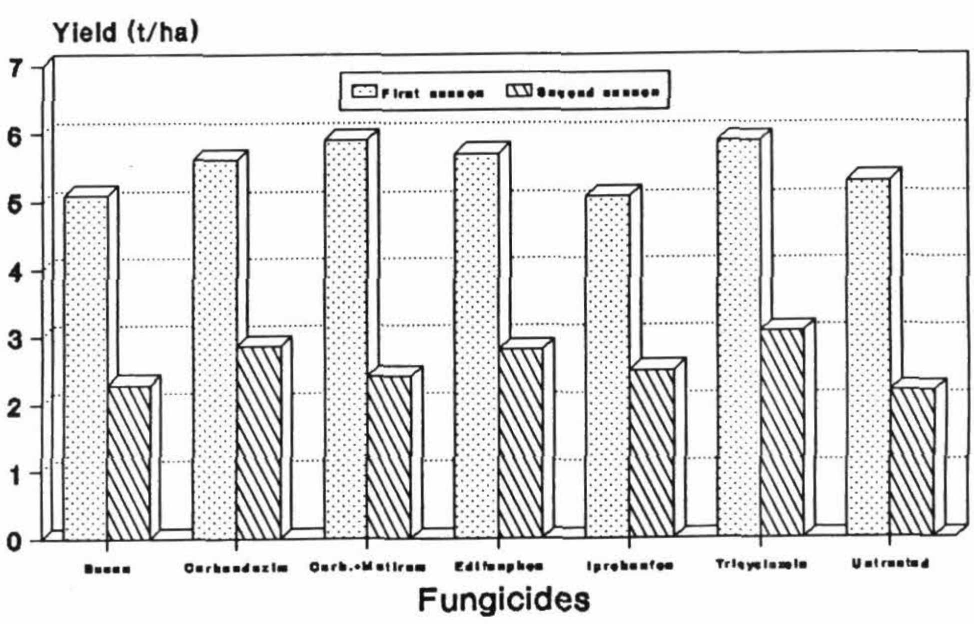


Figure 16. Effect of various fungicides on grain yield of rice variety Rustic. Guyana, 1991.



panicles with blast and its low level of incidence (22% for check without treatment) seems to hide the positive effect of Tricyclazole, Edifenphos, and the mixture of Carbendazim and Metiram.

In the second season, plots treated with Tricyclazole produced the highest yield (Fig. 16). However, this yield was not significantly higher than that of plots treated with Carbendazim and Edifenphos.

In both seasons, Iprobenfos, which is the fungicide used by farmers in Guyana, reduced slightly the panicle blast incidence, but did not increase the grain yield, significantly.

Until a commercial variety resistant to blast be released in Guyana, Tricyclazole appears to be the most effective fungicide in reducing blast incidence and therefore increasing the yield of variety RUSTIC. Nevertheless, the economic feasibility of using Tricyclazole in large fields has to be examined.

4.1.1.2. Evaluation of 2 Doses of Nitrogen with 2 Fungicide Treatments and 3 Seeding Rates.

This experiment was carried out during the second semester of 1991. The experiment was laid out in a split-split plot design with 4 replications. Nitrogen doses, fungicide treatments and seeding rates were assigned to main, sub and sub-subplots, respectively. Fungicides Tricyclazole and Iprobenfos were applied at the same time with and doses indicated in point 4.1.1.1. Panicle blast incidence was determined with the same methodology of the previous experiment.

In all fungicide treatments used, the decrease of seeding rate had no effect on panicle blast incidence and grain yield of variety *RUSTIC (Fig. 17 and 18). On the other hand,* a high dose of N (120 kg/ha) increased panicle blast incidence slightly and had a negative effect on grain yield as compared to a low dose (Fig. 19 and 20).

Figure 17. Effect of seeding rate and chemical treatment on panicle blast incidence of variety Rustic.Guyana 1991.

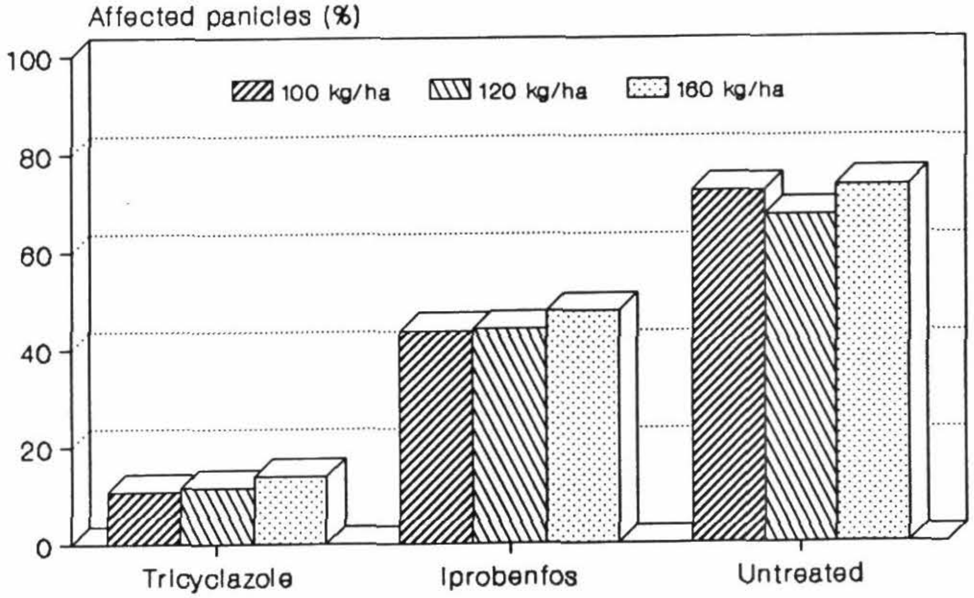


Figure 18. Effect of seeding rate and chemical treatment on grain yield of variety Rustic. Guyana 1991.

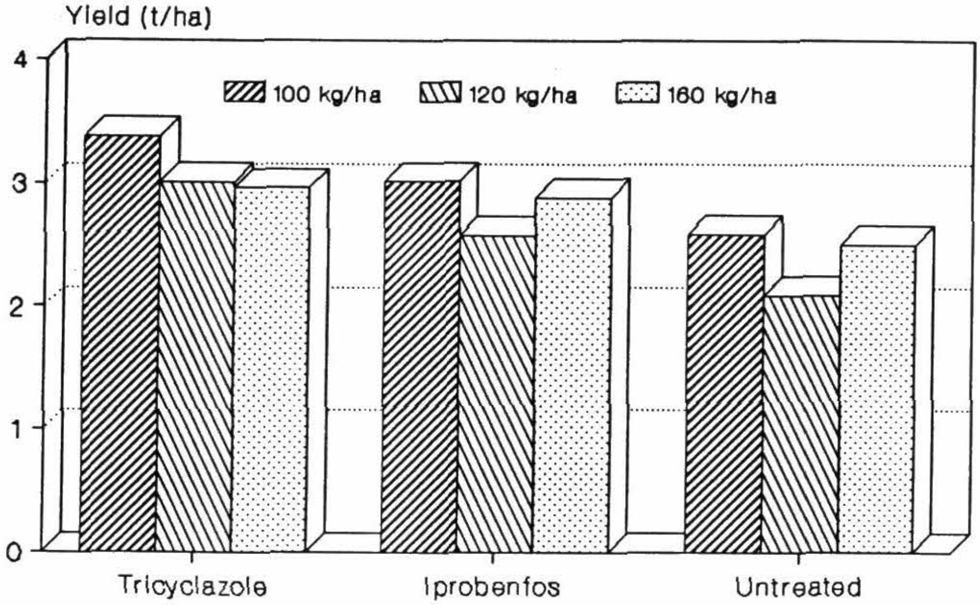


Figure 19. Effect of two nitrogen doses and chemical treament on panicle blast incidence of variety Rustic.Guyana 1991.

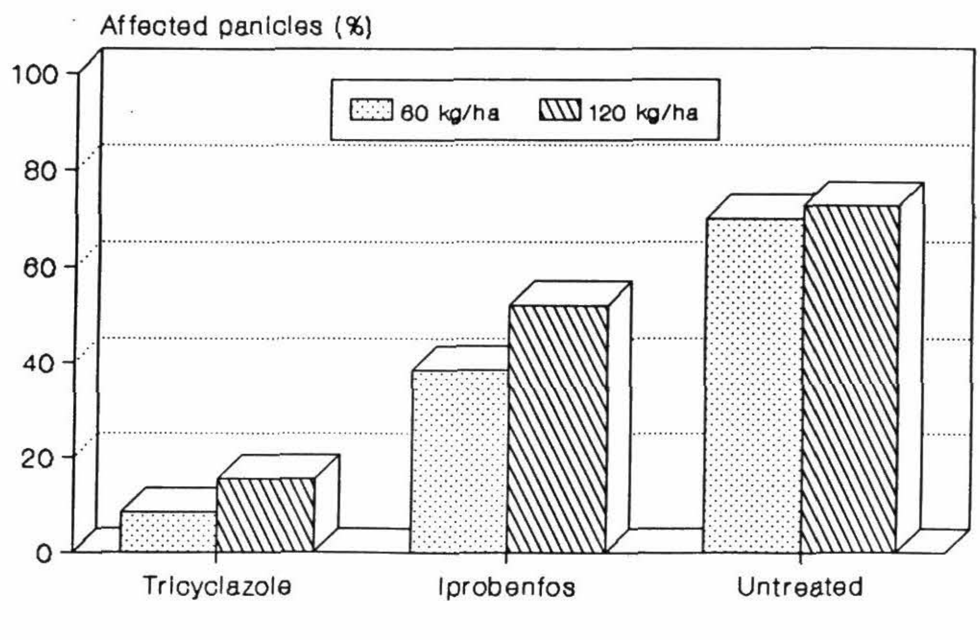
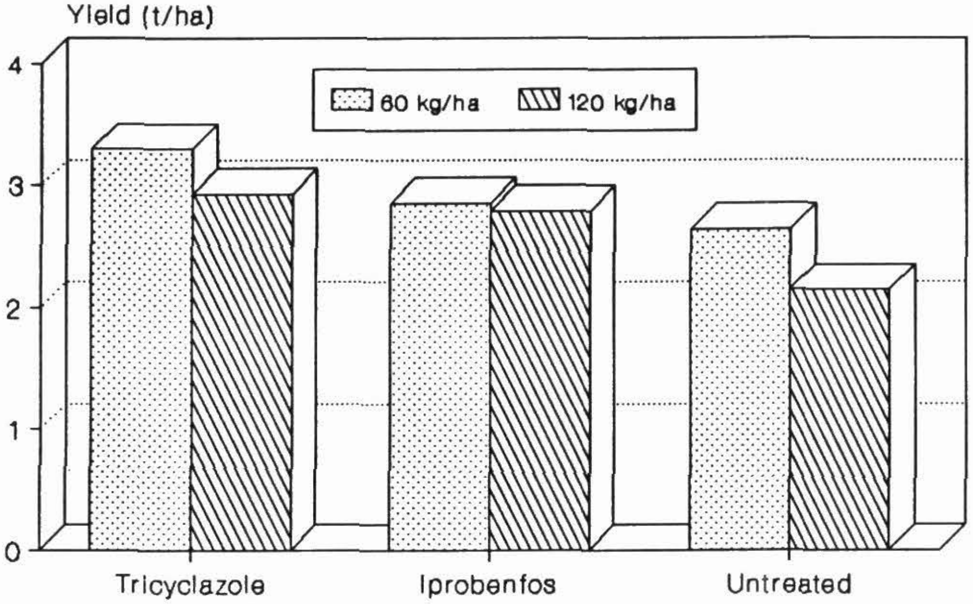


Figure 20. Effect of two nitrogen doses and chemical treament on grain yield of variety Rustic. Guyana 1991.



Regardless of the seeding rates and N doses, Tricyclazole and Iprobenfos significantly decreased panicle blast incidence and increased grain yield. However, Tricyclazole was significantly superior to Iprobenfos.

The above results indicate that the combination of low doses of N (<120 kg/ha) with an effective fungicide can significantly reduce the incidence and severity of panicle blast, and increase grain yield on a susceptible variety, such as RUSTIC, in lowland conditions.

Seeding rate appears to be less important than the dose of Nitrogen; however, additional studies are required to support this observation.

4.1.1.3. Effect of the Dose of Nitrogen on the Incidence of Rice Blast in Two Rice Varieties, with and without Chemical Protection.

This experiment was carried out during the second semester of 1991. The varieties used were IR44624 and RUSTIC, which are resistant and highly susceptible to rice blast, respectively. The doses of Nitrogen used were 0, 40, 80, 120 and 160 kg/ha. Field protection was made with 2 foliar applications of Tricyclazole (225 g of a.i./ha, each). The first application was made upon appearance of the first symptoms of the disease on the leaves, and the second one when rice plants were at 80% panicle emergence.

Leaf blast incidence was determined by visual assessment of the percentage of leaves attacked at 40 days after seeding, following the methodology described in point 4.1.1.1.

i) <u>Effect on blast incidence</u>

For the variety IR44624, the percentage of leaf area and panicles affected by rice blast was less than 1% for all doses of Nitrogen, with and without chemical protection.

For the variety RUSTIC, both leaf and panicle blast incidence increased gradually with increasing doses of N up to 120 and 160 kg/ha without and with chemical protection, respectively (Fig. 21 and 22). Leaf and panicle blast incidences were drastically reduced by Tricyclazole at all doses of N. However, its effect increased with increasing N doses up to 120 and 160 kg/ha for leaf and panicle blast, respectively.

Figure 21. Effect of Nitrogen dose and chemical protection on leaf blast incidence of variety Rustic.Guyana 1991.

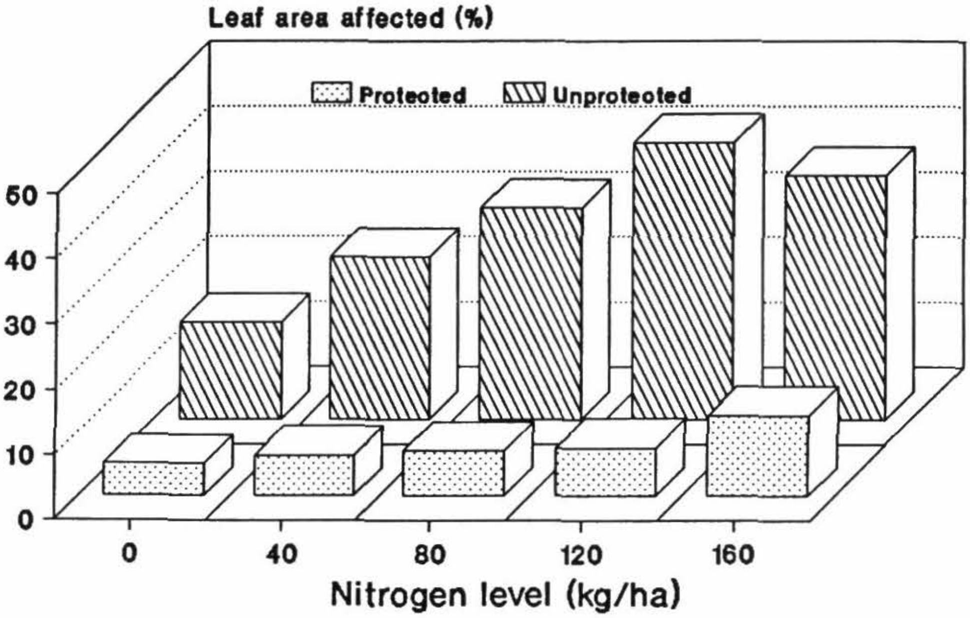
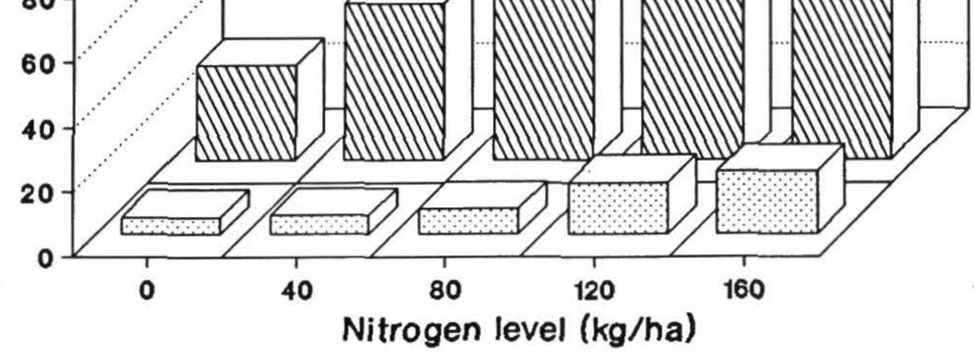


Figure 22. Effect of Nitrogen dose and chemical protection on panicle blast incidence of variety Rustic.Guyana 1991.

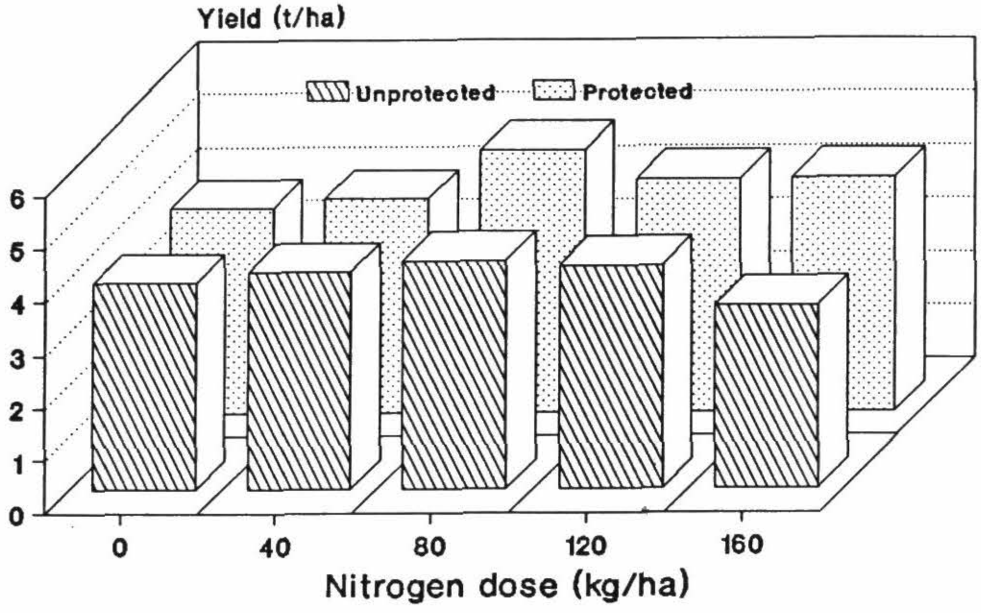


Previous results indicate that by properly managing N fertilization,leaf and panicle blast can be reduced. However, for a susceptible variety like RUSTIC a suitable combination of chemical control and N fertilization should be used in order to attain better results.

ii) Effect on grain yield

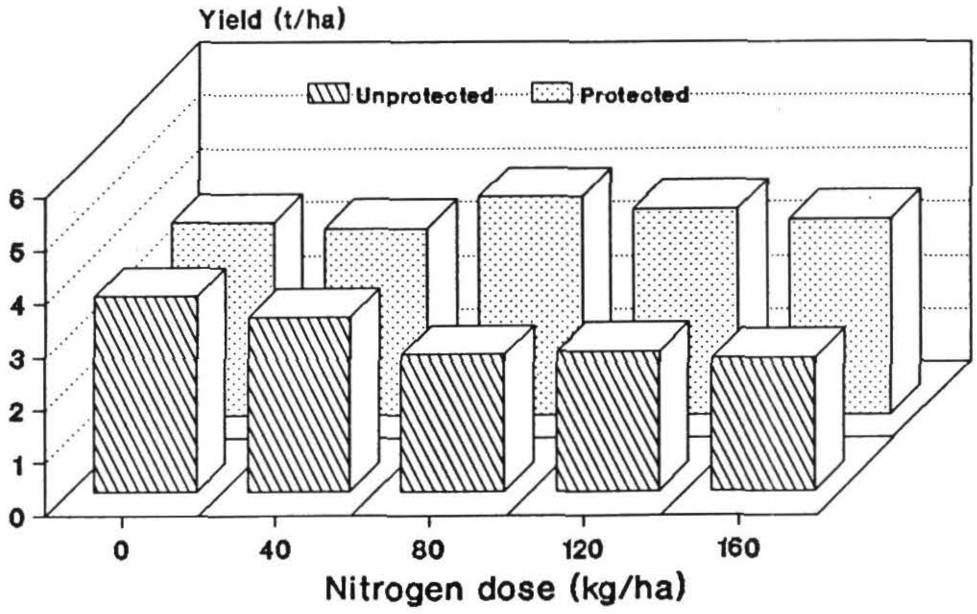
For the variety IR44624 (resistant to blast) grain yield increased with increasing doses of N up to 80 kg/ha (Fig. 23). However, this effect was not significant in unprotected plots.

Figure 23. Effect of Nitrogen dose and chemical protection on grain yield of variety IR 44624. Guyana, 1991.



In unprotected plots of the variety RUSTIC (susceptible to blast) grain yield decreased with increasing doses of N (Fig. 24). N doses did not affect significantly the grain yield of variety RUSTIC in protected plot against blast with 2 applications of Tricyclazole. It should be noted, however, that there was no significant effect on grain yield in protecting the crop with Tricyclazole in plots without N fertilization and with the dose of 40 kg of N/ha.

Figure 24. Effect of Nitrogen dose and chemical protection on grain yield of variety Rustic. Guyana, 1991.



In conclusion, grain yield response to N fertilization is different for resistant and susceptible varieties to blast under a favorable environment for disease development. Although grain yield increased with the protection of Tricyclazole in variety IR44624, because of the low incidence of blast in both protected and unprotected plots, additional studies are required to support this result. For variety IR44624, other studies have to be conducted in order to determine the optimum dose of N under different conditions. As to variety RUSTIC, further studies should be conducted with doses of N up to 80 kg/ha, in order to determine if these cultural and chemical practices are effective and economical under different conditions.

4.1.2. Trinidad & Tobago.

4.1.2.1. Thesis.

Mr. S. Dyal, Entomology Post-graduate student **(UWI)** has sent three reports to **CRIN** on the preliminary research results at **CARONI**, about the study on ecology and biology of Sogatodes oryzicola and S. cubanus.

The first results of this research show that from six evaluated sampling techniques the light trap, net sweeping and the visual method were the most effective ones. However, additional studies in which samplings were made every week and every two weeks (late in 1989, 1990, and 1991), showed that there is no significant difference among such sampling methods.

On the other hand, the results on population dynamic of Sogatodes from January to June, 1990 are shown in Figure 25. In addition two peaks in the activity of Sogatodes spp. were determined to occur at twilight and dawn (Figures 26 and 27).

4.1.2.2. Field Survey.

The survey started in October 1990 on rice pests in small farmers' fields and was completed in the first semester of 1991. Eng. B. Cooper, Trinidad's counterpart in this sub-project compiled the results and prepared a report in collaboration with Dr. W. G. des Vignes.

The results of this study show that weeds appear to be the most serious problem for small farmers. Eleven genera of weeds were recorded, which are: Hymenachne amplexicaulis (Rudge) Nees, Leersia hexandra, Sw., Echinochloa colonum (L.) Link, Ludwigia decurrens Walt., Ludwigia hyssopifolia (G. Don) Exell., Sphenochlea zeylanica Gaertn., Ischaemum rugosum Salisb., Leptochloa scabra Nees., Fimbristylis littoralis Gaudich., Aeschynomene sensitiva Sw., Marsilea minuta L., Ipomea aquatica Forsk.

Seven collected insect pests have certain importance in rice crop. However, populations of such pests were from moderate to low in most cases. Four beneficial insects were observed, in addition to nine rice diseases, which incidence was from moderate to low in the evaluated fields. Of the observed diseases, sheath blight (Rhizoctonia solani) and narrow brown leaf spot (Cercospora oryzae) were the ones with major incidence.

Figure 25. Incidence of Sogata in the period January - June, 1990. **CARONI** - Trinidad.

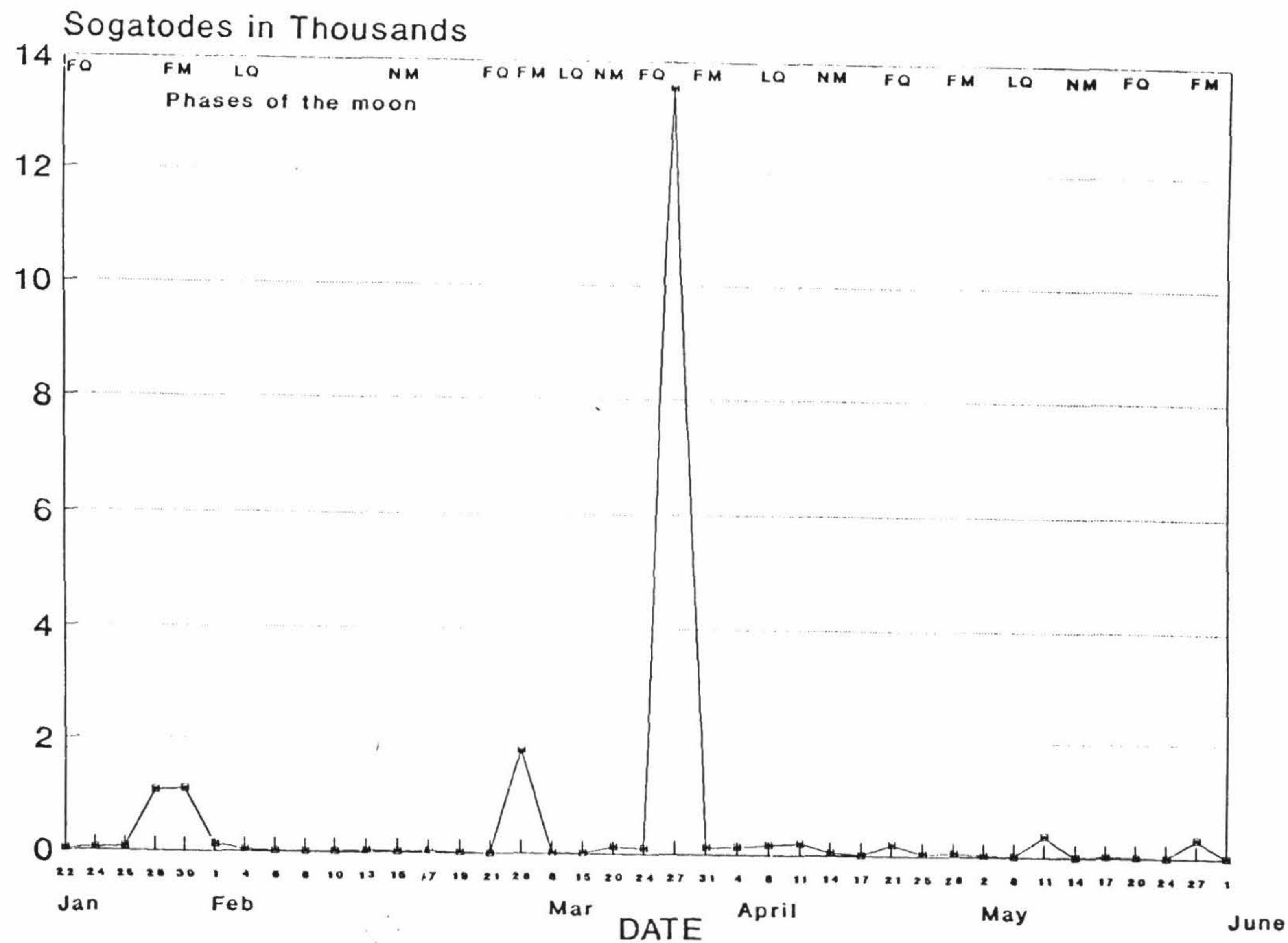
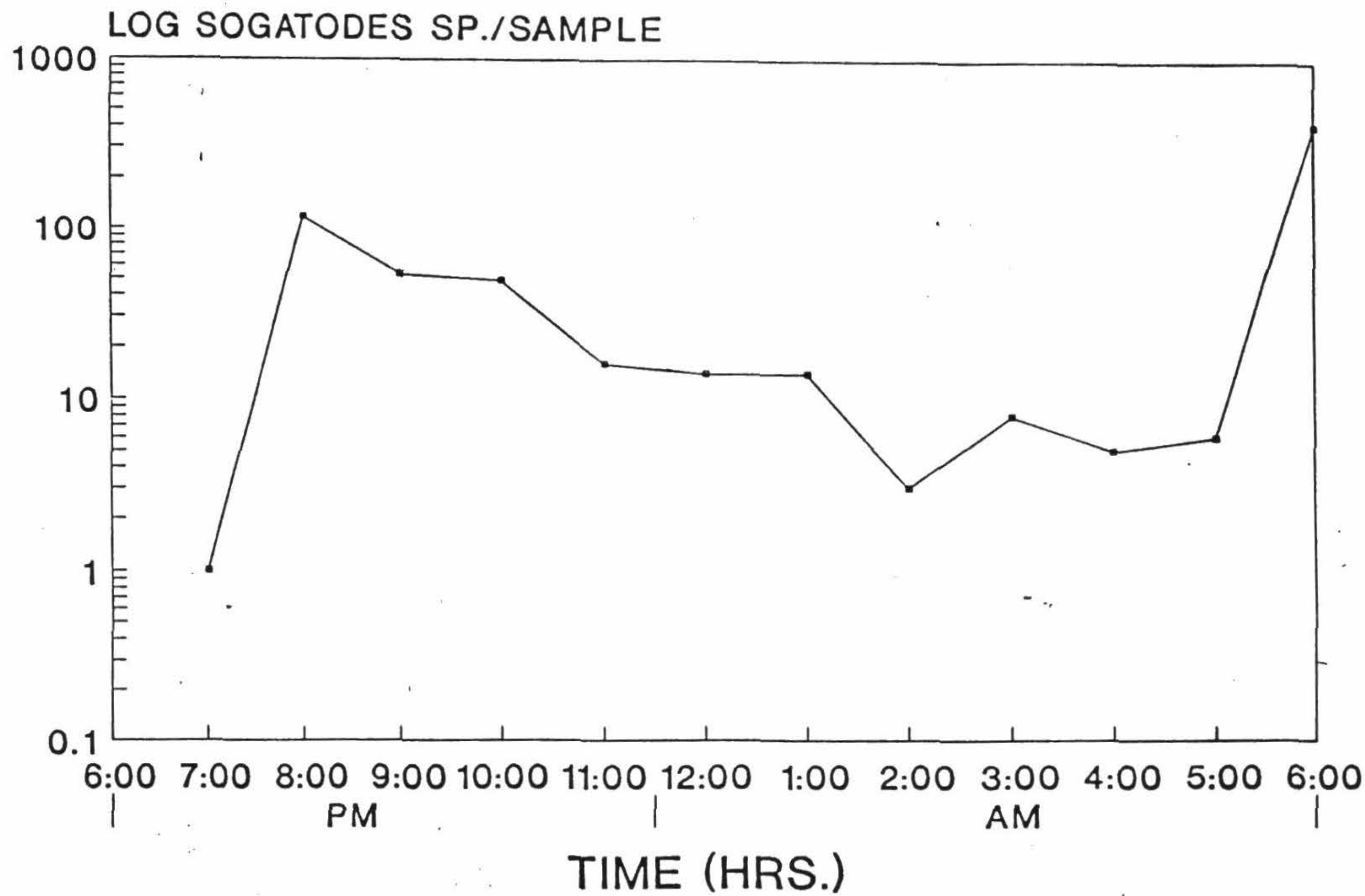
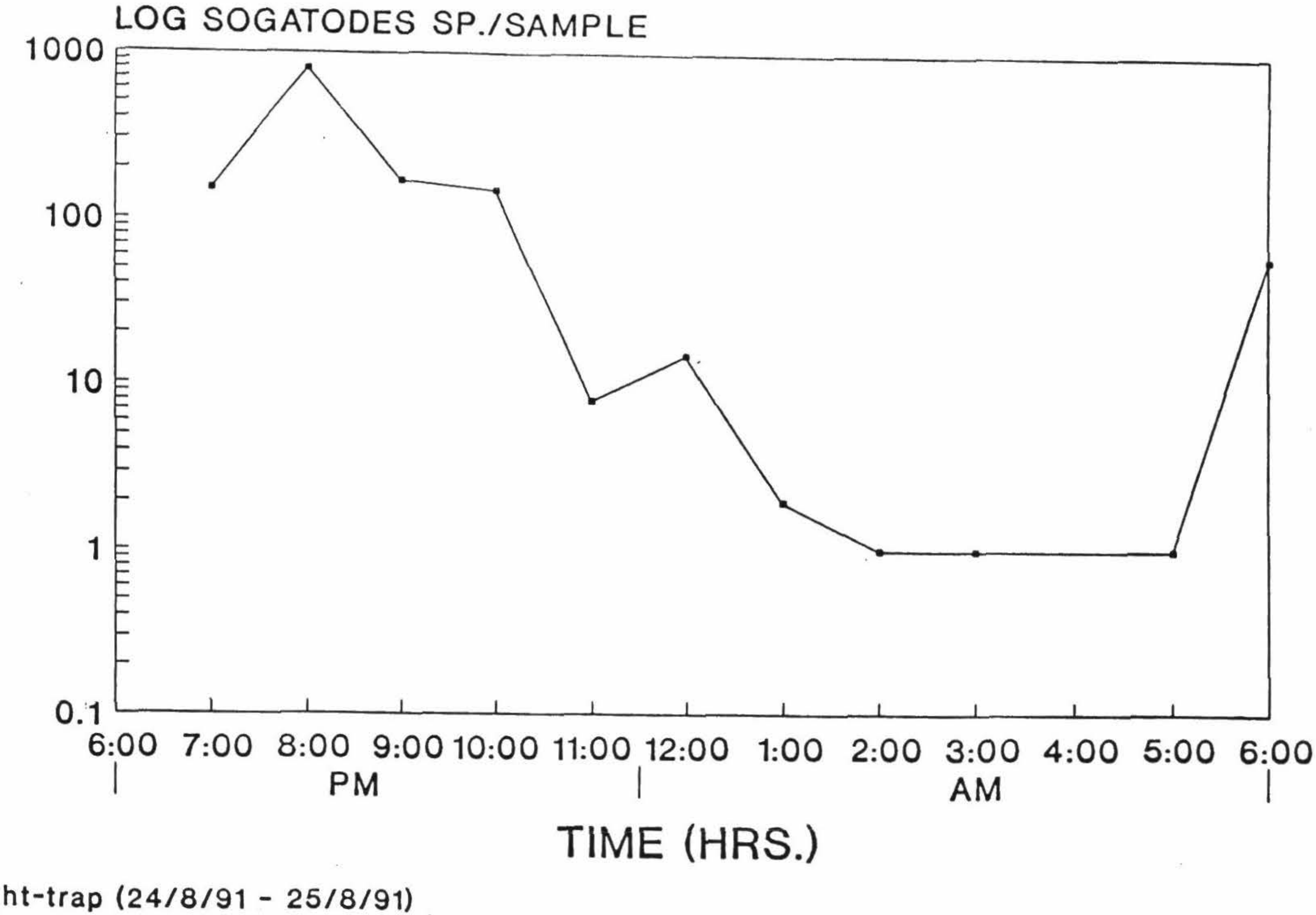


Figure 26. Nocturnal activity of Sogatodes sp. on rice on 7-8 February 1990, using light-trap sampling method. CARONI - Trinidad.



Light trap (7/2/90 - 8/2/90)

Figure 27. Nocturnal activity of Sogatodes sp. on rice on 24 - 25 August, 1991, using light-trap sampling method. CARONI - Trinidad.



These data are very important to aim research at the development of an IPM Program for small farmers.

4.1.3. Suriname.

SNRI has appointed engineers R. Grawde and G. Van Der Kooye to participate in the Regional **IPM** Sub-project.

4.1.4. Monitoring Tour and Workshop on Integrated Pest Management.

As a result of the research developed by **CRIN** Member Countries involved in the **IPM** Project (Trinidad & Tobago, Guyana, and Suriname), it was decided to make a "Monitoring Tour and Workshop on Integrated Pest Management" in coordination with such countries, **CIAT** Rice Program, **CRIN** and **IIA** of Cuba.

This tour was carried out from November 7 to 11, 1991. The Activity started in Guyana and ended in Trinidad, with the participation of scientific personnel from Guyana (1) Suriname (2), Trinidad & Tobago(3), **CIAT** (3), **CRIN** (2), Cuba (2), in addition to other scientists of each country. The activity in each country consisted of visiting rice fields first and then participating in the conferences and in sessions of discussion and recommendations. Eight research papers were presented in Guyana and 17 in Trinidad for a total of 25 (Tables 15 and 16).

Table 15. Research Papers Presented During the First Meeting of the "Monitoring Tour and Workshop on Integrated Pest Management" Carried out in Guyana and Trinidad & Tobago (September 7-11, 1991). Guyana.

Topic	Institution[1]	Country	Speaker
- Virulence Analysis in Rice.	CIAT (Rice Program)	Colombia	Dr. F. Correa
- The Role of Agronomic Practices in the Incidence and Management of <u>Hydrellia wirthi</u> Korythowski in Colombian Rice Fields.	CIAT (Rice Program)	Colombia	Dr. A. Pantoja
- Interference of Red Rice with Rice and Implication for its Management.	CIAT (Rice Program)	Colombia	Dr. A. Fischer
- Integrated Management of Red Rice in Cuba.	IIA	Cuba	Dr. G. Antigua
- Crop Protection Practices in Rice Cultivation in Guyana.	NARI	Guyana	Mr. E. Ralph
- Evaluation of New Fungicides for Rice Blast Control in Guyana.	NARI	Guyana	Mr. C. Paul
- Distribution and Relative Abundance of Species of Rice Paddy Bugs in Guyana.	FAO/NARI	Guyana	Dr. A. Duodo
- Weed Incidence on Selected Farms in Guyana.	NARI	Guyana	Ms. C. Richards-Haynes

1/ **CIAT**-Centro Internacional de Agricultura Tropical; **IIA**-Instituto de Investigación del Arroz; **NARI**-National Agricultural Research Institute.

4.2. Small Farm Machinery Sub-project.

4.2.1. Jamaica.

CRIN Coordinator and Agricultural Engineer traveled to Jamaica this year in order to see the preliminary works on the evaluation of **CRIN** funded small farm machinery. We noticed that the first prototype of the Hydrotiller had been made and is being used to prepare most of the ricelands of Meylersfield project; however, the evaluation of other available machinery had not been started because of lack of personnel or interest, according to our observation.

Table 16. Research Papers Presented During the Second Meeting of the "Monitoring Tour and Workshop on Integrated Pest Management" Carried out in Guyana and Trinidad (September 7-11, 1991). Trinidad & Tobago.

Topic	Institution[1]	Country	Speaker
- Integrated Weed Management in Rice at Cuba.	IIA	Cuba	Dr. G. Antigua
- Chemical Weed Control in Rainfed Transplant Rice (Oryza sativa L.) in Trinidad.	CES	Trinidad	Mr. D. Ramdin
- A Review of Efforts to Control Weeds in Swamp Rice.	CARONI	Trinidad	Dr. G. F. Mason
- Approaches for Competition Studies.	CIAT (Rice Program	Colombia	Dr. A. Fischer
- Screening Rice Germplasm for Tagosodes orizicolus Resistance and Detecting the Percentage of Vector.	CIAT (Rice Program	Colombia	Drs A. Pantoja, R. Zeigler and F. Correa.
- Towards the IPM of insect Pests of Rice in Trinidad CARONI.	CARONI	Trinidad	Dr. W. G. des Vignes
- Basic Ecological Studies on the Rice Planthoppers, Sogatodes orizicola and S. cubanus in Trinidad.	UWI	Trinidad	Mr. S. Dyal
- Damage/Loss Assessment Studies on Rice to Simulate the Effects of Hydrellia sp. (Diptera: Ephydridae) in Trinidad.	CARONI	Trinidad	Mr. L. Granger
- Biological Control of Water Weevil Lissorohptrus brevirostris in Cuba.	IIA	Cuba	Dr. R. Meneses
- Pest and Their Management at the Foundation for Mechanized Agriculture in Suriname.	SML	Surinam	Mr. G. Van Der Kooye
- Review of the Efforts Made Towards the Development Integrated Pest Management in Rice Cultivation in Suriname.	SNRI	Surinam	Mr. F. R. Grawde
- Genetic Studies of Sources of Resistance to Rice Hoja Blanca Virus.	CIAT (Rice Program)	Colombia	Ms. D. Vergel, Drs. F. Cuevas and F. Correa
- Rice Diseases at CARONI and Approaches to their Control.	CARONI	Trinidad	Dr. R. H. Phelps
- Brown Leaf Spot Disease x Fertilizer Interaction in Rice at CARONI (1975) Limited.	CARONI	Trinidad	Drs. C. R. Shand and R. H. Phelps
- Notes on Pest and Disease Problems at CARONI Rice Project.	CARONI	Trinidad	Dr. E. Rampersad
- Diseases of Rice in Trinidad and Tobago: Historical Incidence and Observations.	CES	Trinidad	Mr. G. L. Rajnauth
- Integrated Pest Management (IPM) of Rice (Under Lowland Rainfed Conditions). Extensive Survey of Pests and Diseases of Rice in Trinidad. Phase I.	Agricult. Extension Service	Trinidad	Mr. B. Cooper

1/ IIA-Instituto de Investigación del Arroz; CES-Central Experiment Station; CIAT-Centro Internacional de Agricultura Tropical; UWI-University of the West Indies; SML-Foundation for the Development of Mechanized Agriculture in Suriname.

The assistance of **CRIN's** personnel was offered to Engineer Gilpin to continue with the machinery evaluation. It was agreed that he ould prepare a schedule of activities; however, he did not communicate with us even though we left telephone messages in his office.

4.2.2. Dominican Republic.

4.2.2.1. Field Days.

During 1991, 8 field days were organized with small farm machinery in coordination with the National Center for Appropriate Technology (**CENATA**), Rice Extension Department, and the Rice Research Center (Table 17).

These activities were aimed at technicians, rice farmers and agricultural journalists who make a total of 416 participants.

4.2.2.2. Fabrication

i) CENATA

CRIN contracted with the National Center for Appropriate Technology **(CENATA)** to fabricate 2 Hydrotiller prototypes, the first of which was terminated on April 19, and the Second one in the period from May 13 to 31 with the participation of 2 Haitian technicians (welding technicians). With this, it is hoped that in the future **CRIN** could initiate the fabrication of Hydrotillers in Haiti, together with **ODVA**.

Table 17. Field Days Carried out in the Dominican Republic on Rice Farm Mechanization with Small Machinery. CRIN, 1991.

Machinery	Date	Location	No. participants			Provenance
			Agricultural technicians	Farmers	Others	
Hydrotiller and Row Seeder	February, 21	La Ceibita La Vega	30	55	-	Santa Clara Farm
Hydrotiller, Powertiller, Row Seeder, Manual Transplanter and Stationary Thresher.	May, 18	Juma, Bonao	15	10	-	Los Barros Project
Hydrotiller, Powertiller, Row Seeder, Manual Cone Weeder and Manual Transplanter	May, 25	Juma, Bonao	-	-	20	Agricultural Journalists
Hydrotiller, Row Seeder, Manual Cone Weeder and Stationary Thresher.	September 3	Juma, Bonao	20	13	-	Eastern Region
Hydrotiller	September, 12	Maicillo, Higuey	23	127	-	Laguna, Nisibón
Hydrotiller	September, 13	Arroyo Rico	26	40	-	Sabana de La Mar
Hydrotiller, Row Seeder, Manual Cone Weeder, Stationary Thresher.	October, 2	Juma, Bonao	15	-	-	CVMA Program[1]
Hydrotiller, Row Seeder, Manual Cone weeder and Stationary Thresher.	October, 3	Juma, Bonao	4	18	-	San Juan de La Maguana
TOTAL			133	263	20	

1/ Managers of Farm Input Selling Centers

ii) Indumets and Loposolo Workshops

In order to diversify manufacturers of small farm machinery, CRIN contracted with Mr. Alcedo Quero, owner of Indumets Workshop (Industria Metalica, S. A.), the fabrication of five single-row and two 2-row manual cone weeders, two 8-row drum seeders, and a manual transplanter, with highly satisfactory results.

In the second semester of 1991 rice farmers from the Southwest region had Indumets Workshop made a Hydrotiller and two 8-row drum seeders. Likewise the Rice Extension Department of the Dominican Republic asked had Loposolo Workshop to fabricate a Hydrotiller

iii) Machinery Promotion

In order to promote rice crop mechanization in the Cibao region (North-Central), some cooperating farmers were selected (Juma-Caracol, Los Barros, El Guamal, of Land Reform AC-001 Project) and were provided with the hydrotiller to prepare their lands and the drum seeder to sow pregerminated seed. Of all selected farmers, 19 planted an area of 54.97 ha with the Drum Seeder, 10 prepared their lands with the Hydrotiller (18.39 ha), and 4 weeded their farms (8.06 ha) with the Manual Cone Weeder (Table 18).

The idea of this is that farmers convince themselves of the feasibility and low cost of such machinery and decide to request their fabrication with the financial support of the Agricultural Bank and private funding. As an example, a hydrotiller fabricated

Table 18. List of Farmers who Used Small Farm Machinery in Bonao, Dominican Republic. 1991.

User	Machinery	Location
F. Marte	Drum Seeder	AC-001 Project
D. Frías	Drum Seeder	AC-001 Project
R. Frías	Drum Seeder	Juma-Caracol
C. Paredes	Drum Seeder	AC-001 Project
G. Martínez	Drum Seeder	AC-001 Project
N. Mateo	Drum Seeder	Juma-Caracol
Mr. Ferrer	Drum Seeder	AC-001 Project
A. Hiciano	Drum Seeder	Jayaco
R. Núñez	Drum Seeder	AC-001 Project
S. Piña	Drum Seeder	AC-001 Project
R.Constanzo	Drum Seeder	AC-001 Project
F. Almonte	Drum Seeder	AC-001 Project
N. Rodríguez	Drum Seeder	AC-001 Project
J. Antonio	Drum Seeder	Bejucal
R. Reyes	Drum Seeder	AC-001 Project
F. Méndez	Drum Seeder	AC-001 Project
M. Hernández	Drum Seeder	Los Barros
CEDIA	Drum Seeder	Juma
M. Reyes	Drum Seeder	Juma
F. Méndez	Hydrotiller	AC-001 Project
M. Jorge	Hydrotiller	Los Barros
M. Ramírez	Hydrotiller	Los Barros
M. Pérez	Hydrotiller	Los Barros
P. Grullón	Hydrotiller	Los Barros
N. Roja	Hydrotiller	Los Barros
R. Frías	Hydrotiller	Los Barros
G. Martínez	Hydrotiller	Juma-Caracol
D. Frías	Hydrotiller	Juma-Caracol
A. Hiciano	Hydrotiller	AC-001 Project
M. Ramírez	Manual Cone Weeder	AC-001 Project
M. Hernández	Manual Cone Weeder	Jayaco
M. Jorge	Manual Cone Weeder	Los Barros
F. Méndez	Manual Cone Weeder	Los Barros

in the Dominican Republic could have a total cost between RD$22,000 and RD$25,000 which is less than 50% of the price of Yanmar or Taitiling power tillers, which have an average price between 60 and 65,000 pesos. A drum seeder costs RD$2,000, a cone weeder RD$1,000, and a transplanter costs RD$4,000.00.

4.2.3. Workshop on Agricultural Mechanization in the Caribbean.

From March 4 to 7, the Commonwealth Secretariat and the Caribbean Industrial Research Institute (**CARIRI**) organized a Workshop on Agricultural Mechanization in the Caribbean in Trinidad & Tobago (Port of Spain). Technicians from Belize (1) Dominican Rep. (2), Haiti (1) Guyana (1) and **CRIN** Agricultural Engineer participated with **CRIN**'s support.

The activities developed by **CARIRI** and **CRIN** on agricultural mechanization in the region were highlighted in this workshop. It was agreed to nominate a group of representatives from different Caribbean agencies (**CARDI, CARIRI, U.W.I., CARICOM**, etc.), with the objective of preparing a detailed proposal for organizing an Agricultural Mechanization Network in the future to be submitted for discussion before the Steering Committee of Ministers Responsible for Agriculture (SCMA).

4.2.4. Evaluation of Seed Processing Machinery at CIAT

Engs. G. Malena and A. Leury, **CENATA**'s Technician and **CRIN** Agricultural Eng., respectively, participated in the evaluation of machinery used in seed processing (cleaning, drying and storage) of beans, to which some adaptations were made by the technical personnel of **CIAT** Seed Unit to be used in rice. This activity was held at **CIAT** from march 11 to 23.

According to this evaluation, the necessary adjustments were made to such machines, and were used to organize a course at **CIAT**. Details of the above course are shown in the following chapter.

V. IN COUNTRIES, CIAT AND IRRI COURSES

Table 19 shows the number and kind of courses and workshops offered to Caribbean rice scientists and technicians. In 1991, 19 agricultural scientists and technicians were trained.

5.1. Courses in the Dominican Republic.

At the request of **ODVA**'s Director in Haiti, **CRIN** organized specific In-Service Courses in the period from May 13 to 31, 1991. This activity was attended by 5 Haitian technicians who work at Maugé Experimental Station, Rice Seed Certification Program (processing plant and on-farm seed production), and Farm mechanization Department.

The topics dealt with were:

- Laboratory methods applied to seed processing.
- Production of genetic and basic seed, and seed certification.
- Interpretation of designs and fabrication of Hydrotiller.

It should be pointed out that Mssrs. Marie Carmene Albert, Joseph D. Denis and Richard Laporte were trained at **CEDIA**, whereas Mssrs. Luc E. Dolné and Eugene Risnel were trained at **CENATA** where they helped in the fabrication of a Hydrotiller with the advice of the Center's technicians.

Table 19. Training of Scientific Personnel of CRIN Member Countries in 1991.

Activities/Countries	Number of participants
In Country Courses	
Dominican Republic	3[a]
	2[b]
In Service Courses	
CIAT	
Rice Program	1[c]
	1[d]
Seed Unit	10[e]
IRRI	
Agricultural Engineering	1
Water Management	1
TOTAL	19

a/ Course on Seed Production Technology in the Dominican Republic.
b/ Course On Fabrication of Small Farm Machinery in the Dominican Republic.
c/ Course on Weed Control Methods at CIAT, Colombia.
d/ Thesis at CIAT-Colombia.
e/ Workshop-Course on Development Systems for Seed Production and Processing at Small Enterprises Level at CIAT-Colombia.

5.2. Courses at IRRI.

André Leury, **CRIN** Agricultural Eng. participated in the Rice Farm Mechanization course held annually by **IRRI**'s Agricultural Engineering Department. This activity took place from May 6 to June 14, 1991. The participation of Engineer Leury was encouraged in order to reinforce and aim his training at the field of rice farm mechanization with small farm machines and their implements.

With **CRIN**'s economic support, Eng. August Wilfred Lila, from Suriname, participated in the Irrigation Water Management Training Course (August 26 - October 4, 1991), held at **IRRI**, and attended by 19 rice researchers from 10 countries (Latin America, south and south-west Asia).

5.3. Courses at CIAT.

5.3.1. Seed Unit.

CRIN and **CIAT** Seed Unit held a "Workshop Course on Development Systems for seed production and processing at Small Enterprise Level", attended by 10 rice researchers, 2 per each of the following countries: Suriname, Guyana, Trinidad & Tobago, Belize and Haiti. **CRIN** Staff participated actively in lectures, field practices and discussion of seed projects for each country.

5.3.2. Rice Program.

Eng. César Moquete from the Dominican Republic, who at present is taking courses towards his Master's Degree at the Universidad Nacional de Colombia, at the same time is doing his thesis entitled "Coincidence among Evaluations of Rice Crop in Different Countries".

Eng. Jorge García de La Osa, Researcher at **IIA**, Cuba, participated in an In-service course in which he developed research activities on weed control methods with the direct advise of Dr. A. Fischer.

VI. TECHNOLOGY TRANSFER

6.1. Juma-Caracol

Technology transfer was continued with 3 cooperating farmers located in the area of Juma-Caracol, who have continued to apply modern technology for rice production under **CRIN**'s supervision, but giving them the necessary flexibility in final decision-makings.

In addition to those mentioned above, three other farmers were incorporated into the transfer of technology project during the second semester of 1991. Two of them are located in the comunity of Los Barros, and the other in the AC-001 Project in Juma.

i) Gilberto Martínez

The technology used by this farmer was land preparation with power tiller and leveling with horse. Broadcast was done with pre-germinated seed of variety JUMA 57 at a rate of 89 kg/ha. Weed control was accomplished 18 days after sowing with a mixture of molinate/propanil + 2,4-D (5.0 + 1.27 lt/ha, respectively), complemented with 2 hand weedings. Fertilization was accomplished with 122-52-52 kg/ha of N, P, K, respectively. The fertilizers used were the formula 15-15-15 and Urea.

During the second semester this farmer prerared the deepest part of his farm with the Hydrotiller, and planted variety JUMA 64 with the 8-Row Drum Seeder.

ii) Erasmo de La Cruz

The land was prepared with a power tiller and leveled with a horse. Transplant was made with 28-day-old seedlings of variety JUMA 64 using a seeding rate on seedbed equivalent to 120 kg/ha. Weed control was accomplished with a mixture of molinate/propanil + 2,4-D (5.0 + 1.0 lt/ha, respectively), applied 18 days after transplant and complemented with two hand weedings. Fertilization was completed with 103-50-50 kg/ha of N, P, K, respectively, using the formula 15-15-15 and Urea. This technology was not changed for the second crop.

iii) Rafael Frías

Land preparation during the first semester was completeded with a power tiller and leveling with a CRIN-designed leveling board attached to the power tiller. Planting was mainly transplant (2.2 ha) with variety JUMA 64 with a seeding rate on seedbed equivalent to 70 kg/ha. Also 0.63 ha were broadcast with pregerminated seed at a rate of 55 kg/ha.

Chemical weed control was accomplished with a triple mixture of Butachlor + Propanil + 2,4-D at a dose of (5.0 + 4.0 + 0.2 lt/ha, respectively), applied 15 days after transplant and 21 days after broadcast. Fertilization was accomplished with 99-29-29 kg/ha of N, P, K, respectively, using the formula 15-15-15 and urea.

For the second crop, Mr Frías' farm was prepared fully with the Hydrotiller and leveled with the leveling board. Seeding was completed with the Drum Seeder using pregerminated seed at a rate of 80 kg/ha. The rest of the activities were carried out using the same technology applied during the first semester.

iv) Dionosio Frías

This farmer used the Hydrotiller for land preparation and planted variety JUMA 57 with the 8-Row Drum Seeder at a seeding rate of 85 kg/ha. Weed control and fertilization were managed by the farmer on his own.

v) Fabián Méndez

The technology applied in this farm included the design and construction of straight leeves, land preparation with Hydrotiller, and leveling with horses. Planting was done with the 8-Row Drum Seeder using pregerminated seed at a rate of 90 kg/ha. Weed control practices included one application of the mixture Propanil + 2,4-D, and two mechanical weedings with the Cone Weeder. The fertilizer applications were left to the farmer.

vi) Maximiliano Jorge

In this farm the land was puddled with the Hydrotiller and leveled with horses. The planting method was transplanting using 28-day-old seedlings of variety JUMA 64. Weed control consisted of one application of Propanil + 2,4-D(4.0 + 0.3 lt/ha,respectively), two mechanical weedings, and one hand weeding at 65 days after seeding. Fertilization was managed by the farmer.

It should be pointed out that insect and disease control practices were managed directly by farmers without **CRIN's** assistance.

Table 20 shows the economic analysis of production of technology-transfer farms in Juma-Caracol during the first semester of 1991. Mssrs. Martínez, de La Cruz and Frías, obtained yields of 7139.8 kg/ha, 5614.85 kg/ha, and 6945.23 kg/ha, respectively. Sale price varied from 4.04 to 4.12 pesos per kilogram of paddy.

In Comparing production costs of these 3 farmers, it can be seen that they ranged from RD$12,518.9 to RD$12,785.65/ha. However, the net income varied because of yield differences. The benefit-cost ratios of Mssrs. Martínez' and Frías' were similar (2.25 and 2.29, respectively), and Mr. de La Cruz's was lower (1.78) because his yield was lower than the other two farmers' in at least 1,330 kg/ha. The data of the 3 farmers correspond to the cropping season of the first semester, 1991.

Table 21 shows the economic results of the six rice farms assisted by DFA-CRIN during the second semester of 1991. According to the data presented, Mssrs. Fabián Méndez and Gilberto Martinez had the highest yields (6513 and 6304 kg/ha, respectively), whereas the lowest was produced by Mr. Maximiliano Jorge (4808 kg/ha).

Table 20. Economic Analisis of Production of Three Technology Transfer Farms in the Dominican Republic. First Semester 1991[1].

Rice[2] Farmers	Yield (kg/ha)	Price (RD$/kg)	Gross income (RD$/ha)	Production cost (RD$/ha)	Net income (RD$/ha)	Benefit/Cost Ratio
Gilberto Martínez	7,139.80	4.04 (0.32)	28,827.65 (2,306.21)	12,785.15 (1,022.81)	16,042.50 (1,283.40)	2.25
Erasmo De La Cruz	5,614.85	4.07 (0.33)	22,875.33 (1,830.03)	12,875.65 (1,030.05)	9,999.68 (799.98)	1.78
Rafael Frías	6,945.23	4.12 (0.33)	28,631.73 (2,290.54)	12,518.90 (1,001.51)	16,112.83 (1,289.03)	2.29

_1/ Data in parenthesis are the equivalent in U.S. dollars, US$1 = RD$12.50.

_2/ Data from farms of Mssrs. Martínez, De La Cruz and R. Frías correspond to the 3th, 4th and 5th crop, respectively, after land development.

Table 21. Economic Analysis of Production of the Transfer of Technology Farms Assisted by DFA-CRIN. Second Semester, 1991[1].

Farmer	Paddy yield (kg/ha)	Sale price (RD$/kg)	Gross income (RD$/ha)	Cost of producti6n (RD$/ha)	Net Income (RD$/ha)	B/C Ratio
Gilberto Martínez	6,304	4.61[2] (0.37)	29,061.44 (2,324.92)	15,441.86 (1,139.35)	13,619.58 (1,185.57)	1.88
Erasmo de La Cruz	5,238	3.45 (0.28)	18,071.10 (1,445.69)	11,474.80 (917.98)	6,596.30 (527.70)	1.57
Rafael Frías	5,805	3.66 (0.29)	21,246.30 (1,699.70)	13,831.80 (1,106.54)	7,414.50 (593.16)	1.54
Dionisio Frías	5,542	3.74 (0.30)	20,727.08 (1,658.17)	13,492.06 (1,079.36)	7,235.02 (578.80)	1.54
Fabián Méndez	6,513	3.65 (0.29)	23,772.45 (1,901.80)	12,284.42 (982.75)	11,488.03 (919.04)	1.94
Maximiliano Jorge	4,808	3.61 (0.29)	17,356.88 (1,388.55)	13,495.00 (1,079.60)	(3,861.88) (308.95)	1.29

_1/ Figures in parenthesis are the equivalent in U.S. dollars, US$1.00 = RD$12.50

_2/ Mr. Gilberto Martínez obtained a higher price because a big part the paddy produced was sold as rice seed.

Production costs of the farmers ranged from RD$11,474.80 to RD$15,441.86. The highest cost corresponded to Mr. Martínez, and the lowest to Mr. De La Cruz. According to the benefit-cost analysis, Mssrs. Méndez and Martinez had the highest return per peso invested with RD$1.94 and RD$1.88, respectively, while Mr. Jorge had the lowest return of all six farmers (B/C ratio = 1.29).

VII. SURVEYS OF TECHNOLOGICAL CONSTRAINTS

7.1. Surveys of Technological Constraints to Rice Production in the Dominican Republic.

This survey started in 1990 in cooperation with the Rice Extension Department **(DFA)** of the Ministry of Agriculture **(SEA)**. Questionnaires were distributed and collected during 1990 with final analysis being completed in 1991.

The objective of the survey was to define the technology use by rice farmers and identify the main constaints limiting rice production in the Dominican Republic. This information would be very useful in the design of research and extension policies aimed at overcoming those constraints.

7.1.1. Methodology.

The sample selected consisted of 160 rice farmers from the 5 most important rice producing regions, which comprise 97% of total area planted (Table 22). This sample included small, medium and large private farms, as well as those distributed by the Agrarian Reform. The interviews were carried out with the cooperation of Extension Agents from **DFA.**

Table 22. Number of Rice Farmers Selected in the Dominican Republic, 1990.

Region	% National area planted	No. of farmers
Northeast	18 %	27
Northcentral	40 %	60
Northwest	26 %	40
Southwest	10 %	23
East	3%	10
Total	97%	160

7.1.2. Results

From the 160 questionnaires distributed, 127 were completed and collected (80%). The remaining 33 questionnaires could not be completed due to logistic and budgetary constraints. The main results that came out of the survey include:

7.1.2.1. Land Preparation.

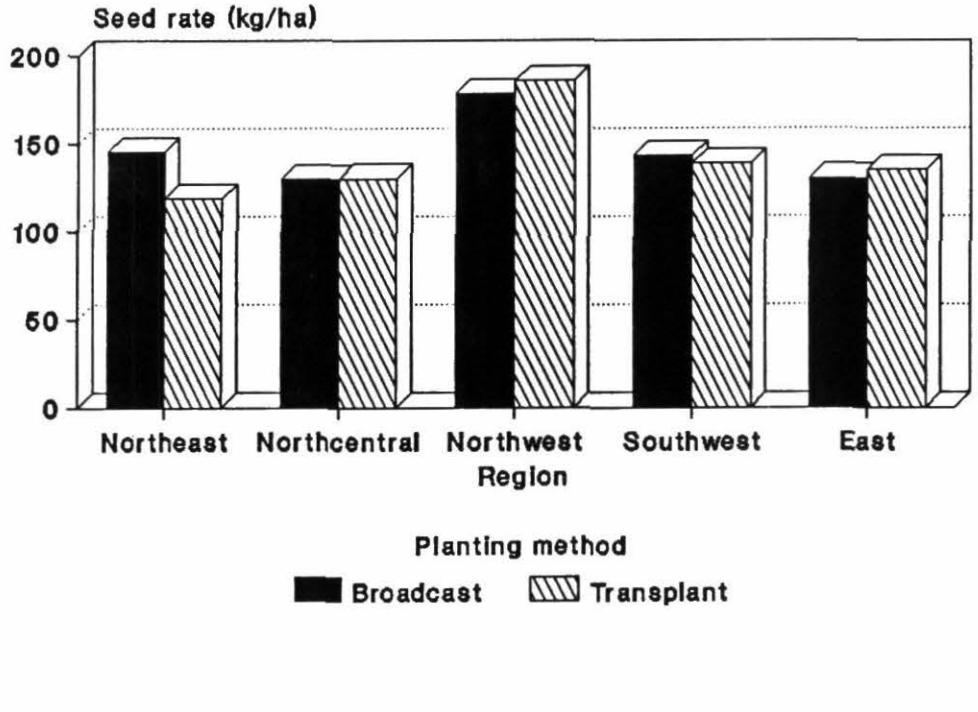
Farmers carry out three to four operations during land preparation before leveling. The most cammon method of land preparation consist of 3 to 4 puddlings with power tiller. In the Northwest and Southwest regions is very common that farmers first prepare the land dry and then puddle the soil using a tractor or a power tiller.

7.1.2.2. Planting.

Direct seeding is the planting method used by the majority of rice farmers in the country. A few years ago, transplanting was the prefered practice, but sharp increases in labor costs lowered the interest of farmers in using this method.

Farmers are using an average of 145.3 kg of seed/ha in direct seeding and an equivalent of 141.6 kg/ha in transplanting (Figure 28). They claim that a high seeding rate is necessary in order to compensate for the low quality of rice seed available in the market, as well as for the seed losses caused by rats on the field and on seedbeds.

Figure 28. Seed rate used by rice farmers in the Dominican Republic, 1990.



The highest seeding rates were found in the Northwest region, with 178.5 and 185.7 kg of seed/ha for direct seeding and transplanting, respectively. A survey carried out by **DFA** in 1983 placed the use of seed in this region in 119.0 and 129.0 kg/ha for direct seeding and transplanting, respectively. This indicates that seeding rate has increased in this region over the past decade. The Southwest region has also observed an increase in seeding rate during the same period, from 83.0 to 143.0 kg/ha (72.3%) for direct seeded rice, and from 94.0 to 138.5 kg/ha (47.3%) for transplanted rice. On the other hand, it was observed that farmers are using approximately the same seeding rate for either broadcast or transplanted rice.

For transplant, most farmers are using seedlings over 30 days old, except for the East region where 67% of farmers use seedlings 20-30 days old (Table 23). In the case of the Southwest region, 67% of farmers polled use 41 day-old seedlings for transplanting.

Older seedlings usually recover more slowly than younger seedlings. However, older seedlings are sometimes prefered because they give better weed competition, especially when weeds are not controlled early. Late transplanting may also be a result of delays in land preparation caused by unavailability of machinery at the time needed.

Table 23. Age of Rice Seedlings Used for Transplant in the Dominican Republic, 1990.

Region	Mean age (Days)	Percentage of farms		
		20-30 days	31-40 days	Over 40 days
Northeast	36	24	59	18
Northcentral	37	18	53	29
Northwest	35	23	64	14
Southwest	41	0	33	67
East	36	67	0	33

7.1.2.3. Fertilization.

The level of Nitrogen applied by the farmers polled varied from o to 282.0 kg/ha, with a mean level of 150.8 kg/ha, usually divided in 3 aplications (Figure 29). Farmers in the Northwest and Southwest apply the most Nitrogen, while those in the East region only apply 96.6 kg/ha, the lowest in the country. The Nitrogen level has increased considerably in the Northwest and Southwest regions since 1983, when the dosage reported was 119.5 and 96.6 kg/ha, respectively.

The average amount of Phosphorus and Potasium applied to the rice crop were of 59.3 and 46.2 kg/ha, respectively.

The majority of farmers make their first fertilizer application in the period between 22 and 35 days after seeding (DAS) (Table 24). However, 67% of farmers in the East region prefer to make this application before 21 DAS, while in the Northwest they do it when crop is over 35 days old. In transplanted rice this application is usually made at 7-15 days after transplanting (DAT). Nevertheless, a considerable proportion of producers make this application after 15 DAT, especially in the Northwest region (45%).

Figure 29. Nitrogen level used by rice farmers in the Dominican Republic, 1990

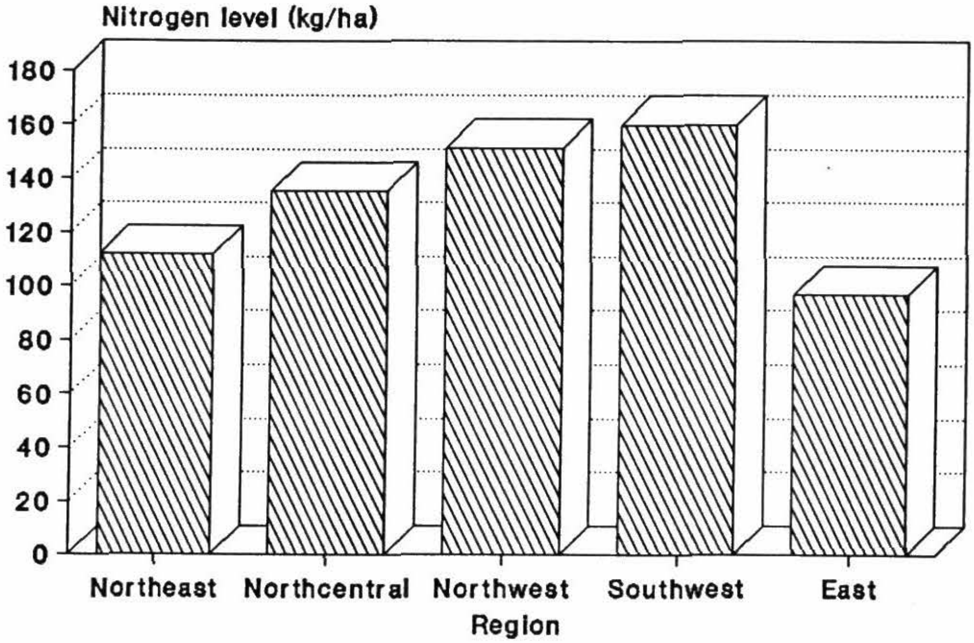


Table 24. Time of First Fertilizer Application in Rice Crop in the Dominican Republic, 1990.

	Direct seeding (% of Farms)			Transplanting (% of Farms)	
Region	= < 21 DAS[a]	22-35 DAS	> 35 DAS	7-15 DAT[b]	> 15 DAT
Northeast	12	79	9	83	17
Northcentral	0	100	0	55	45
Northwest	38	62	0	75	25
Southwest	8	50	42	67	33
East	67	17	17	N. A[c].	N. A.

a/ DAS = Days after seeding
b/ DAS = Dat after transplant
c/ N.A. = Not available

7.1.2.4. Crop Protection.

i) Weed control

The common practice used by farmers for weed control consists of one application of the mixture Propanil + 2,4-D, and then complement with the necessary hand-weedings. The herbicide application is made at 15 to 30 DAS in direct seeded rice, depending on the type of weed present and the infestation level (Table 25). In the Southwest, however, 43% of farmers make the application after 30 DAS, which may be due to the fact that 87% of these farmers rotate rice with beans, corn and sweet potatoes, which helps reduce weed pressure on rice crop.

Table 25. Time of First Herbicides Application in Direct Seeded Rice in the Dominican Republic, 1990.

	Percentage of Farms			
Region	7-14 days	15-22 days	23-30 days	After 30 days
Northeast	0	38	53	9
Northcentral	22	33	44	0
Northwest	11	56	33	0
Southwest	0	0	57	43
East	0	43	57	0

Rice farmers usually hand-weed twice during one season, though many farmers hand-weed up to 4 times when weed infestation, especially with Echinocloa spp, becomes serious; thus increasing cost of production (Table 26). Another reason for the need of 2 or more hand-weedings is the fact that herbicide applications are not being managed properly. For instance, knapsack sprayers are not being calibrated before application and hollow cone nozzles are widely used for herbicide applications instead of the recommended fan nozzles.

Table 26. Number of Hand Weedings Performed by Rice Farmers in the Dominican Republic, 1990.

Region	Range	Mean	% farmers making 2 or more weedings
Northeast	1-4	2.1	30
Northcentral	0-3	1.6	22
Northwest	1-3	2.0	88
Southwest	1-2	1.7	67
East	1-2	1.6	55
Mean (Weighted)		1.90	

ii) Insect control

Farmers sometimes make up to 5 application of insecticide in one season, with the national average being 2 applications per crop (Table 27). In the Northwest, farmers made 3.1 application in average due to the serious attacks of *Oebalus* sp. which occur in this region.

iii) Disease control

None of the farmers interviewed mentioned diseases among the main factors affecting rice production in their farms. Nonetheless, approximately one half of the farmers in the Northeast, Northcentral and Southwest regions apply fungicide at least one time during the cropping season. In the East only 10% of the farmers used fungicide; whereas in the Northwest, 88% of the farmers polled applied fungicide, with 61% applying at least twice per season.

Table 27. Number of Insecticide Applications Made by Rice Farmers in the Dominican Republic, 1990.

Region	No. of Applications		% farmers making 2 or more weedings
	Range	Mean	
Northcentral	0-5	1.9	30
Northeast	0-5	2.2	37
Northwest	2-5	3.1	70
Southwest	0-3	1.0	7
East	0-4	1.5	27
Mean (Weighted)		2.1	

Farmers make many fungicide applications because they like to include a fungicide in each insecticide application they make. The main reasons given for applying fungicide are to obtain heavier and cleaner rice grains, better plant growth, and disease prevention.

7.2. Technology of and Constraints to Rice Production in Guyana.

This study describes the results of a farm survey in the main rice producing regions of Guyana. The objective of the survey was to define the technology of rice production and identify the main constraints limiting rice production in Guyana. This would allow the development of suitable research projects that would appropriately address farmers' needs.

The survey was jointly organised and funded by the Caribbean Rice Improvement Network **(CRIN)** and the National Agricultural Research Institute **(NARI)**.

7.2.1. Methodology.

The survey was conducted in the main rice producing regions of Guyana, designated region Nos. 2, 3, 4, 5, & 6. One hundred and eighty farmers were selected from the farm registers of the Guyana Rice Milling and Marketing Authority **(GRMMA)**, the Mahaica-Mahaicony-Abary/Agricultural Development Authority **(MMA/ADA)** and Regional Administration Region No. 4 (Agric. Dept.).

The number of farms selected from each district were as follows:

Region #		No. of farmers
2		50
3		40
4		30
5		30
6		30
	TOTAL	180

An additional 20% of the sample frame was selected as alternate farms to allow for any inactive farms selected in the sample frame.

One hundred and forty nine questionnaires (83%) were completed. The remaining 17% represented farmers who were inactive for reasons of death, migration, or diversification etc. Interviews were conducted by the regional agricultural staff (mainly crop reporters).

7.2.2. Results.

Results from the survey showed that productivity was highest in Region 3 (4.1 t/ha of paddy) and lowest in Region 5 (2.7 t/ha); the highest yield was 52% better than the lowest. Mean yield of paddy was 3.5 t/ha with Region 5 and 6 being respectively, 23% and 3% below the mean; Regions 3, 4 and 2 were respectively 17%, 9% and 6% above the mean (Table 28). The difference in productivity between those farms above the mean and those below could be attributed to both non-technological and technological factors. This discussion will underscore the differences between the highest and lowest yield which is indicate of occurrences for the other regions.

Table 28. Mean Paddy Yield of Rice Farmers in Guyana, 1991.

Region No.	Mean Yield		% deviation from mean yield
	t/ha	S. E.	
3	4.1	0.14	+ 17
4	3.8	0.16	+ 9
2	3.7	0.08	+ 6
6	3.4	0.11	- 3
5	2.7	0.16	- 23
Mean (weighted)	3.5	0.52	

7.2.3. Non-technological Factors.

Three non-technological reasons could be identified as contributory factors to differences in yield between Regions 3 and 5. Firstly, highest yield were associated with farms of small size in Region 3, practically all farms were less than 8.1 ha (20 ac), with 73% being less than 4.0 ha (10 ac). However, in Region 5 most farms (78%) were between 4.5 - 24.3 ha (11 - 60 ac). This suggests that farmers were more efficient in managing smaller holdings than larger ones.

Secondly, it was found that a higher proportion of farms in Region 5 were engaged on other agriculture and non-agricultural activities, while in Region 3, the well being of farmers was more dependent on rice production, therefore more time and effort go towards ensuring the success of the rice crop.

Associated with this is the third reason, that farmlands in Region 5 are located further away from the homestead that those in Region 3. Hence the frequency of farm visits and the rapidity with which corrective action could be taken in the event of crop disturbances (eg. in water management, crop protection) may be lower and slower in Region 5.

7.2.4. Technological Factors.

Three contributory factors were identified here and these were, time of sowing, frequency and quantify of Urea applied and crop protection. Generally, farms with above average yields planted mid-late June, while those farms below average planted before and after this period. In Region 5, farmers planted early June and early May as opposed to farmers in Region 3 who planted early-mid

June. Planting mid June may have allowed the rice crop to be in a position to capitalize on optimum environmental conditions. Studies could be initiated to examine the correlation between planting date and yields.

Rice responds positively to increasing levels of Nitrogen and more frequent applications. In Region 3, farmers apply Urea 2 and 3 times as opposed to Region 5 where equal proportions of farmers (48%) apply it once and twice (Table 29). Eighty-three kilograms Urea per hectare is applied once in Region 5 and 122 kg/ha twice; while in Region 3, 138 kg/ha is applied twice and 168 kg/ha three times (Table 30). Thus, farmers in Region 3 apply up to 100% more Urea than farmers in Region 5.

Table 29. Percentage of Rice Farmers in Guyana Applying Urea at Various Frequencies, 1991.

	No. of Urea applications		
	1	2	3
Region No.	% of farmers		
2	6	90	4
3	10	66	24
4	15	85	0
5	48	48	4
6	14	48	38
Mean (weighted)	16	70	13

Thirdly, farmers in Regions 3 and 5 reported the highest incidence of insect and disease; however farmers in Region 3 instituted control measure earlier than do farmers in Region 5. They applied chemicals at least one week before their counterparts in Region 5. This factor could be related to farm proximity to homestead referred to earlier on, where by speed of response to crop disturbances is reduced in Region 5. Furthermore, Region 5 reported the highest incidence of weed infestation, while Region 3 showed the lowest level.

In general therefore, farmers in Region 3 seemed able to afford their rice crop better protection against insects, disease and weeds. With this environment, the rice crop will be in a better position to achieve its potential.

Table 30. Quantity of Urea Applied at Various Frequencies by Rice Farmers in Guyana, 1991.

	Frequency of Urea application									
	1 application	2 applications				3 applications				
	1st	1st	2nd	Total	S. E.	1st	2nd	3rd	Total	S. E.
Region No.	kg Urea/ha									
2	64	59	70	129	8.9	77	56	46	185	42.8
3	72	70	68	138	12.4	56	56	56	168	0.0
4	59	63	61	122	3.3	0	0	0	0	-
5	83	50	72	122	13.1	63	63	63	188	0.0
6	105	63	66	129	5.7	55	55	52	161	4.2
Mean (weighted)	81	61	67	129		58	57	53	167	

VIII. TRIPS ACCOMPLISHED

In the period from January 16 to early december, 1991 **CRIN's** scientific staff has made 17 trips to its Member Countries in order to support the different collaborative research activities that are being developed in coordination with national rice programs. Visited countries, period and purpose of such visits are shown in Table 31.

IX. DOCUMENTATION EXCHANGE

9.1. CRIN's Headquarters.

Five publications (shown in Table 32) are being processed in 1991.

9.2. Scientific Papers Sent to CRIN Member Countries.

Table 33 shows the list of 74 different scientific papers that have been sent to **CRIN** Member Countries. These can be arranged as follows:

i) All 8 **CRIN** Member Countries were provided with 54 scientific articles in the fields of fertilization, post-harvest, integrated pest management, land leveling, Phytopathology, rice drying systems, **CRIN**'s By Law approved by the **TAC** in 1990, as well as the annual report on the activities developed by **CRIN** in 1990.

ii) Eleven (11) scientific articles requested by **ODVA's** technicians and suggested by **CRIN**'s staff were sent separately to Haiti. These articles deal with correction of zinc deficiencies, yield components, and the use of rice plant residues as organic fertilizers.

Table 31. Summary of Trips Accomplished by CRIN Personnel in the Caribbean Region, 1991.

Country	Name	Period of visit	Purpose
Guyana and Trinidad & Tobago	J. Coulombe	January 16-22	Follow-up and evaluation of the IPM sub-project.
Guyana and Trinidad & Tobago	M. Rivas	January 22-February 8	To collect information for a survey on the rice situation in Guyana and Trinidad.
Jamaica	J. Armenta A. Leury	January 27-30	Follow-up of the farm machine evaluation sub-project and supervision of financial expenses.
Belize	J. Coulombe	February 17-21	To participate in the reorganization of the rice program at TREC, and to identify other actions that CRIN could support.
CIAT-Colombia, Dom. Rep., Haití, Trinidad & Tobago and Guyana	J. Armenta	February 24-March 12	To accompany CRIN Evaluation Committee, gather information on the quantitive and qualitative impact of CRIN in its Member Countries.
Trinidad & Tobago	A. Leury V. Rodríguez	March 3-8	To Participate in the Caribbean Farm Mechanization Workshop.
Haiti	J. Coulombe	March 4-6	Follow-up to collaborative research in Agronomy, IPM, and to accompany CRIN Evaluation Committee.
CIAT-Colombia	A. Leury	March 9-23	To participate in the evaluation of seed processing machines at CIAT Seed Unit.
Guyana	J. Coulombe	April 3-10	Evaluation and planning of the IPM collaborative sub-project and establish the study on rice bug Oebalus spp.
Haiti	J. Coulombe	June 10-14	To advise ODVA in developing a rice research plan.
CIAT-Colombia	J. Armenta	June 9-15	To participate in the Committee for the identification of the outstanding Latin-American Rice Farmer, and Meeting of CRIN Steering Committee.
Haiti	J. Coulome	July 29 - August 2	To advise ODVA in Developing a Rice Research plan; Follow-up and Evaluation of Collaborative Research.
Haiti	J. Armenta	September 19-20	To Attended the Meeting of the GADET (Analytical Group for the Technological Development of Haiti) Organized by IICA and the Division of Research, Development and Training of MINAG.
CIAT-Colombia	J. Coulombe A. Leury J. Armenta	September 14-28 September 14-28 September 21-28	To participate in the Workshop-Course on Rice Seed Supply Systems Based on Small Enterprises.
Guyana and Trinidad & Tobago	J. Armenta J. Coulombe	October 5-12 September 29 - October 12	Follow-up of IPM Sub-project, Organization of Workshop and Monitoring Tour.

Cont. on next page

Table 31 (Cont.)

Country	Name	Period of visit	Purpose
Mexico	J. Armenta J. Coulombe M. Castillo M. Rivas V. Rodríguez C. Reyes	November 1-6	To participate in the Germplasm Selection Workshop carried out by **INGER** in two Ecosystems of Mexico; in the VIII International Rice Conference for Latinamerica and the Caribbean and the V Meeting of TAC-CRIN.
CIAT-Colombia	J. Armenta J. Coulombe A. Leury	November 28- December 10	To Attend the Annual Program Review and to Make Administrative Arrangements Concerning to CRIN.

Table 32. List of Publications Processed by CRIN in 1991.

Title	Languages		Stage
	Spanish	English	
For-year Report of **CRIN**'s Activities. (1986-1989)	x	x	Printing
Rice in the Caribbean 4 (2): 1990	x	x	Mailed
Rice in the Caribbean 5 (1): 1991.	x	x	1st review both languages
Round Table on Plant Protection.	x	x	Mailed
CRIN News-Releases 001. May, 1991.	x	x	Mailed

iii) Five additional scientific articles related to red rice control methods, competition, and morphological characteristics and growth of varieties of such "weed" were sent to **NARI**-Guyana.

iv) A copy of the handbook on Standard Evaluation system for Rice was sent to Belize, as well as information on rice blast and a manual of procedures recommended for establishing experiments for germplasm evaluation written by the **CRIN** Coordinator, which will help support the new researcher appointed by **TREC**.

v) A manual of selected bibliography for the management of irrigation water was sent to Cuba, as a complement to the national land leveling project.

Table 33. List of Scientific Articles, Magazines and Manuals Sent to CRIN Member Countries in 1991.

No.	Title
	Sent to All CRIN Member Countries
1	Properties and uses of neem, Azadirachta indica.
2	Lowland rice response to potassium fertilization and its effect on N and P uptake.
3	Concurrent observation of several processes of nitrogen metabolism in soil amended with organic materials.
4	Effect of pre-harvest flooding of paddy on the milling and cooking quality of rice.
5	Combined application of organic and inorganic N and their effect on rice.
6	Weed seed contamination in rice seed.
7	Field performance tests of turtle tiller and boat tractor.
8	Comparative performance of hand sprayers using different application techniques.
9	Mesobraconoides psolopterus (Hymenoptera: Braconidae), a larval parasitoid of the White rice borer, Maliarpha separatella (Lepidoptera: Pyralidae), in West Africa.
10	Etude des mécanismes d'adaptation du riz (Oryza sativa L.) aux contraintes du milieu. I. Modification anatomique des racines.
11	Etude des mécanismes d'adaptation du riz (Oryza sativa L.) aux contraintes du milieu. II. Effets de la nutrition azotée sur la consommation d'oxygéne par les racines et l'évolution de l'acidité.
12	Two methods of land leveling.
13	Biological weed control with mycoherbicides.
14	Rice water weevil - the next potential threat to **ASEAN** rice cultivation.
15	Influence of azolla, sesbania, and urea supergranule **USG** on rice yield and nitrogen uptake.
16	Microwave is alternative method of drying rice.

Table 33 (Cont.)

17 Nitrogen uptake by paddy rice (Oryza sativa L.) from N labelled coated urea and ammonium sulfate.

18 Interrelations among physicochemical grain quality characters in rice.

19 Novos equipamentos possibilitam implementacao de médias e grandes lavouras.

20 Response of rice to rate and time of application of organic meterials.

21 Effect of planting season on the incidence of rice diseases.

22 Rice Journal, March 1990. pages 4 and 5.

23 Rice Journal, april 1990. Pages 4 and 5.

24 Eliminacao de arroz vermelho pelo beneficiamento de sementes.

25 Milling performance of rice varieties under different moisture absorption environments.

26 Impact of seed-borne pathogens on quarantine in Japan.

27 A methodology for performance evaluation of puddling implements.

28 Effect of processing on thiamin and riboflavin contents of some high-yielding rice varieties of Punjab.

29 IRRN 15:4 (August 1990). Pages 8, 19 and 20.

30 The role of **FAO** in **IPM** in Africa.

31 Japanese journal of tropical agriculture.

32 The interdependence of ammonia volatilization and denitrification as nitrogen loss processes in flooded rice fields in the Philippines.

33 Research results: Statewide **IPM**'s first 10 years.

34 Revista Mexicana de Fitopatología.

35 Fitopatología Venezolana.

36 Potential effect of land-leveling on soil fertility in a Brazilian rice soil.

Table 33 (Cont.)

37 Bacterial sheath brown rot of rice caused by _Pseudomonas fuscovaginae_ in Malagasy.

38 Upland rice response to potassium fertilization on a Brazilian oxisol.

39 Cereal foods. International focus rice. Pages 247 to 257.

40 Microwave-vacuum drying of parboiled rice.

41 Reglamento Interno de **CRIN**, aprobado por el **CTA** en 1990, Cuba, (Versiones Español - Inglés).

42 Informe de las actividades realizadas por el personal técnico-científico de **CRIN** en 1990. (Versiones Español - Inglés).

43 Economic guidelines for crop pest control. (**FAO** production and Protection Paper No. 58).

44 Cereal by-products and alternative feeds.

45 Differences of papermaking properties between rice and wheat straw fibers.

46 Correlation between physical and chemical changes of rice straw as a major constituent under composting.

47 Feedlot performance of goat, sheep fed oil plam and rice by-products.

48 A review of basic concepts in rice-drying research.

49 Rice abstracts, December 1990, Volume 13 No. 6.

50 Feeding value of lye-treated rice straw with or without Urea-Molasses supplementation for yearling cattle and carabaos.

51 Rice and rice byproducts for fattening swine.

52 Proveitamento da palha de arroz como cobertura do solo em sistema de plantio direto de milho em Varzea em sucessao ao arroz.

53 Arthropod foodwebs of major insect pests of rice.

54 Evaluating insect pathogens againts insect pests of rice.

Table 33 (Cont.)

Sent to ODVA-Haiti

55 Componentes del rendimiento en arroz. **CIAT.**

56 Instructivo técnico para el cultivo del arroz en Cuba. Cinc. Mayo 1989.

57 Efecto del tiempo de incorporación de la paja en el rendimiento del arroz. C. A. Guerrero y M. P. Feng. **CEDIA-SEA**, Rep. Dom. Octubre, 1979.

58 Nutrient losses from burning rice straw. **IRRI** Annual Report for 1988. Page 360.

59 Growth of rice on Iron-Toxic soil as affected by straw incorporation and presubmergence. **IRRI** Annual Report for 1987. Pages 355 and 356.

60 Influence de la longueur de la submersion avant repiquage et de l'enfouissement de paille sur les proprietes physico-chimiques de deux sols de rizieres et sur le developpement et les rendements du riz. Agronomie Tropicale XXXII-1.

61 Effect of Sesbania, Azolla and rice straw incorporation on the kinetics of NH_4, K, Mn, Zn and P in some flooded rice soils.

62 Straw as a source of nutrients for wetland rice. Organic Matter and Rice, **IRRI**, 1984.

63 Compost as a source of plant nutrients. Organic Matter and Rice, **IRRI**, 1984.

64 Action de la paille enfouie sur les caracteristiques physico-chimiques des sols submergences de rizieres de basse casamance et sur le developpement du Riz. Agronomie Tropicale XXXIII-4

65 Corrección deficiencia de Zinc en arroz inundado. Ing. Agrón. G. Peña **CEDIA-SEA**, Rep. Dom. Marzo, 1988.

Table 33 (Cont.)

Sent to NARI-Guyana

66 Interference of red rice (Oryza sativa) with Rice (O. sativa).

67 Seed dormancy in red rice (Oryza sativa) I. effect of temperature on dry-afterripening.

68 Red rice research.

69 Control of red rice (Oryza rufipogon Griff.) in rice (O. sativa L.)

70 Growth and morphological characteristics of red rice (Oryza sativa) biotypes.

Sent to Belize

71 Copy of the standard evaluation system for rice manual

72 Photocopy on rice blast evaluation.

73 Procedure recommended to establish germplasm evaluation experiments in Belize. CRIN-1991.

Sent to Cuba

74 A selected bibliography on irrigation management.

PERSONNEL

Jorge L. Armenta S. - Coordinador

Jean Coulombe - Agronomist

André Leury - Agricultural Engineer based in Haiti

Manuel Castillo - Asociate Scientist

Manuel Rivas - Agricultural Economist

César Moquete - Associate Researcher *

Cirilo Reyes - Associate Researcher

Victoriano Rodríguez - Associate Researcher

Norma Pacheco - Administrative Assistant

Margarita Paulino - Secretary

Mercedes Santos - Secretary

Marjorie Cianciulli - Secretary based in Haiti

Ramon Capois - Assistant Technician

Paulino Santiago - Driver

Blas Lagares - Laboratory Assitant

Especialized Laborers (4)

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* Study Leave Starting February 1991.