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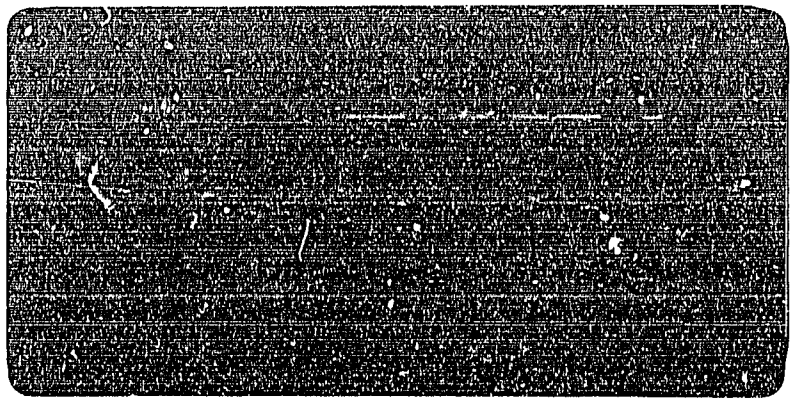

AGRICULTURAL DEVELOPMENT SUPPORT II
HAITI

University of Arkansas, Fayetteville

RICE AND SORGHUM APPLIED RESEARCH

Report #50

ADS-II
Agricultural Development Support II Project # II

RICE AND SORGHUM APPLIED RESEARCH

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Amal K. Chatterjee, Ph.D.
Agronomist, FSR Specialist

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Table of contents

CHAPTER ONE Rice research

1.1 Introduction
1.2 1984
1.3 1985 experiments
1.3.1 Statistical analysis
1.3.2 Data : Charlette April July 1985
1.3.3 Data : Colette
1.3.4 Data : Jogue
1.3.5 Pre extension trials
1.3.6 Researcher managed trials. 1985 2nd season
1.3.7 Data : Jogue
1.3.8 Statistical analysis
1.3.9 Data : Charlette
1.3.10 Statistical analysis
1.3.11 Pre extension trials
1.4 1986 experiments, Ist season
1.4.1 Researcher managed trials
1.4.2 Data : Charlette/Jogue
1.4.3 Statistical analysis
1.4.4 Pre extension trials
1.4.5 Researcher managed trials, 2nd season
1.4.6 Upland rice research
1.4.7 Pre extension trials
1.5 1987 experiments
1.5.1 The treatments and the design
1.5.2 The data
1.5.3 The results
1.5.4 Extension trials of Amina
1.5.5 Extension trials of CIAT 31616 in Jogue
1.5.6 Extension and seed multiplication of Amina
1.5.7 Appropriate technology tools

CHAPTER TWO Sorghum research

2.1 Introduction
2.2 1984 second season
2.2.1 Researcher managed trials
2.2.2 The results
2.3 Farmer managed trials
2.3.1 The results
2.4 1985 second season
2.4.1 Researcher managed trials #1
2.4.2 Results . Bereault
2.4.3 Researcher managed trials #2
2.4.4 Results
2.4.5 Statistical analysis
2.5 1986 second season

2.5.1 Researcher managed trials in Bereault
2.5.2 The data
2.6 1987 First season
2.6.1 Researcher managed trials
2.6.2 The data
2.6.3 Statistical analysis
2.7 Varietal trials in Bereault
2.8 Pre extension trials of M5009 in Bereault
2.9 Researcher managed trials of Pearl millet at Levy
2.10 Researcher managed trial of sorghum at Levy

CHAPTER THREE : Recommendations for rice and sorghum

6.1 Rice : Wetland rice
6.2 Rice : Upland rice
6.3 Sorghum

CHAPTER ONE

Rice research

1.1 Introduction:

Lowland rice is one of the major staples in Haiti and particularly so in the Departement du Sud where the ADS II project has carried on applied research since November 1984 to increase production. This has included innovative and appropriate technology suitable for small farm holders.

The area estimated by the ADS-II national agricultural survey to be under lowland rice cultivation in the Departement du Sud is around 5,500 - 6000 ha. Lowland rice (as contrasted from rainfed upland rice) represents the vast majority of this area. Nationally, some 50,000 hectares are planted in rice annually. In real terms, the effective area is actually 2.5 to 3 times higher since rice is generally cultivated without rotation.

Flooded lowland areas where most irrigated rice is cultivated is generally unsuitable for any other crop except taro. Taro is never grown in mixed association with rice but only on levees around individual rice paddies. It is therefore never in competition with the rice.

Lowland rice cultivation in Haiti is relatively new. It was only in the late 50's that lowland rice was introduced as a crop in the Les Cayes irrigated plain areas where farmers had previously grown sugarcane or other crops. Therefore, it is unreasonable to expect that Haitian rice farmers in Les Cayes would be as skilled or experienced as their counterparts in other rice growing nations of the world who have had a long tradition of growing rice, as in Asia.

Rice cultivation in Les Cayes can be described as primitive. Haitian farmers use only a hand hoe for most of the field operations and plant low yielding varieties that are extremely susceptible to lodging and grain shattering. They use little inputs such as fertilizer and transplant seedlings that are often over a month old. Poor soil preparation and poor water management that results from poor soil preparation in combination with these other factors results in heavy weed infestation.

With this background, ADS II farming systems agronomists started the on-farm research program in November 1984.

The objectives were:

a. To test the high yielding varieties from International Centers of rice research such as the International Rice Research Institute in the Philippines and CIAT in Colombia to find the most suitable variety or varieties for south Haiti agro-climatic zones;

b. To introduce a number of techniqes to plant and harvest rice which would reduce the heavy work associated with these operations;

c. To develop appropriate technology tools for rice cultivation, particularily post harvest operations such as threshing and grain cleaning, as well as the utilization of markers for row planting;

d. To select the most accepted variety or varieties and produce them as seed rice. This meant setting up permanent seed farm in the zone to serve rice farmers not only in the Les Cayes area but elsewhere in the country;

f. To spread the new varieties thus identified, tested and produced as well as the accompanying technology and the innovative tools to all parts of Haiti.

These were lofty goals for a project that had the mandate to carry on field research on all major food crops, not to mention soil conservation work on mountain slopes as well.

However, it is with some satisfaction that the project can now report that most of the goals in rice research were achieved in a very short span of less than four years. This could never have been done had it not been for the excellent cooperation the project received from farmers and from many other people in and out of Haiti. Particular credit goes to International Centers like IRRI and CIAT that sent selected seeds and later blueprints for various tools the project scientists developed. Considerable in-country support was received from the USAID, the Ministry of Agriculture, but most of all, the farmers themselves.

1.2 **1984** : In October 1984, the ADS II project received a small package of seeds that it had requested from IRRI in the Philippines. In all, there were seven High Yielding Varieties (HYVs) in approximately 1 kg packages. The varieties were the elite ones developed at IRRI; some were not even declared as varieties but were rather experimental lines that required further testing.

The seven varieties/lines were as follows :

IR -5931-113-1	later named as	Ti Rose
IR -9669	,, ,,	Colette
IR -13146-452-3	,, ,,	Yole
IR -36	,, ,,	Ti Marie
IR -42	,, ,,	Livia
IR -4819-77-32	,, ,,	Ti Cam
IR -10147-113-51	,, ,,	Amina

In order to ensure that the varieties had a chance of surviving the very first season, the seven varieties were planted in two locations. Thus one half the seeds (about 500 grams) were planted in Charlette and the other half planted in a farm owned and operated by the Mission for Christ, a church organization that had a farm in Collette near les Cayes. The idea was to multiply the seeds first and then plan for proper field trials since 500 gms of seeds could not be enough to plant even one trial.

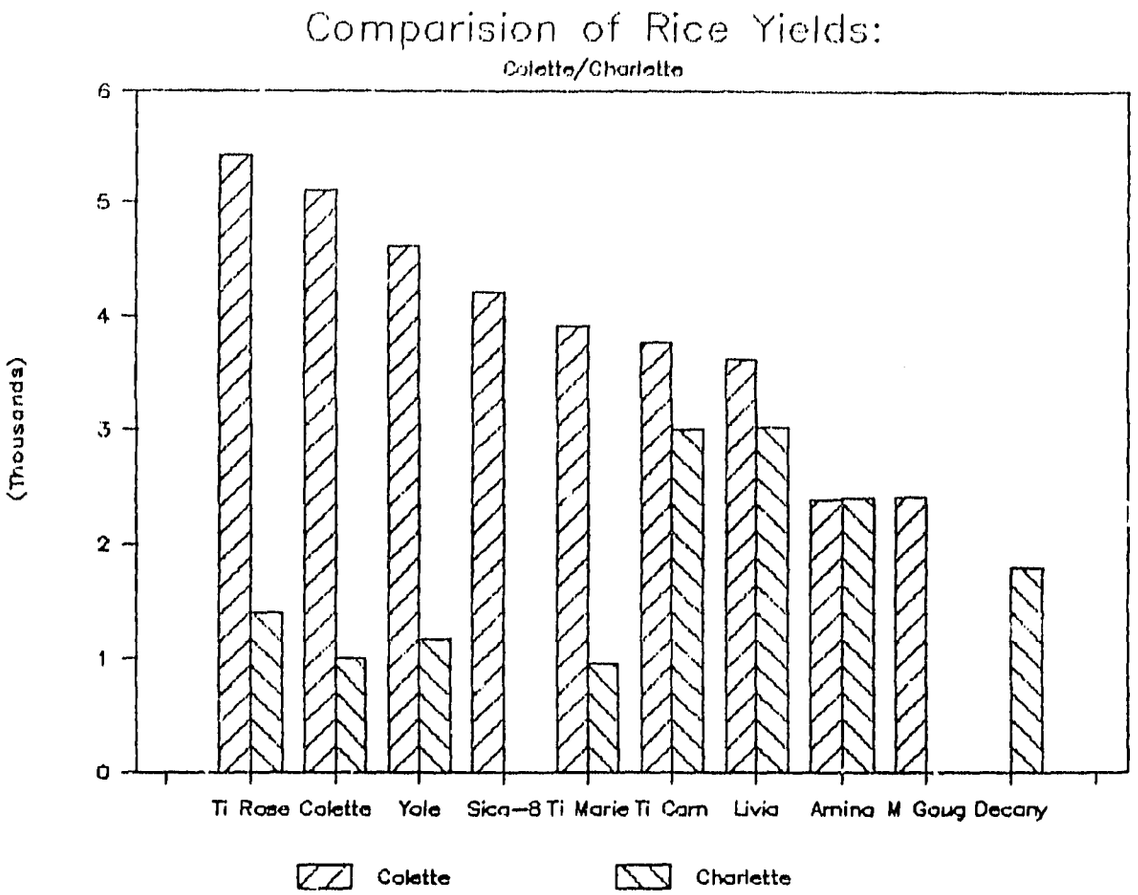
The initial results were mixed. At Charlette the seven varieties were planted by seven different farmers, resulting in seven different management practices. This clearly lead to considerable variability, reflected in the yields of the IRRI varieties. In general, the yields were lower than those obtained in Colette where the varieties were planted under one uniform management system with good irrigation, weed management and better soil preparation.

The following figures depict the yields of the tested varieties as compared with the local varieties used Mme.Gougouse and Decany. A additional variety called Sica 8 was added from the collection of the PDAI project.

rice varieties

1 =	IR-5931-113-1	later named as	Ti Rose
2 =	IR-9669	,,	Colette
3 =	IR-13146-452-3	,,	Yole
4 =	Sica-8	,,	Sica 8
5 =	IR-36	,,	Ti Marie
6 =	IR-4819-77-32	,,	TiCam
7 =	IR-42	,,	Livia
8 =	IR-10147-113-51	,,	Amina
9 =	Mme Gougouse (local)		
10 =	Decany (local)		

This trial showed that in Colette the highest yield was from IR-5931-113-1 (Ti Rose) which gave over 5 tons/ha while the lowest was from IR-10147-113-51 (Amina) that produced 2.5 tons/ha, about the same as the local check Mme.Gougouse. IR-9669 (Colette) followed close behind Ti Rose (Table 1).


Comparision of Rice Yields:
Colette/Charlette
(Thousands)
0
1
2
3
4
5
6
Ti Rose
Colette
Yole
Sica-8
Ti Marie
Ti Carn
Livia
Amina
M Goug
Decany
Colette
Charlette

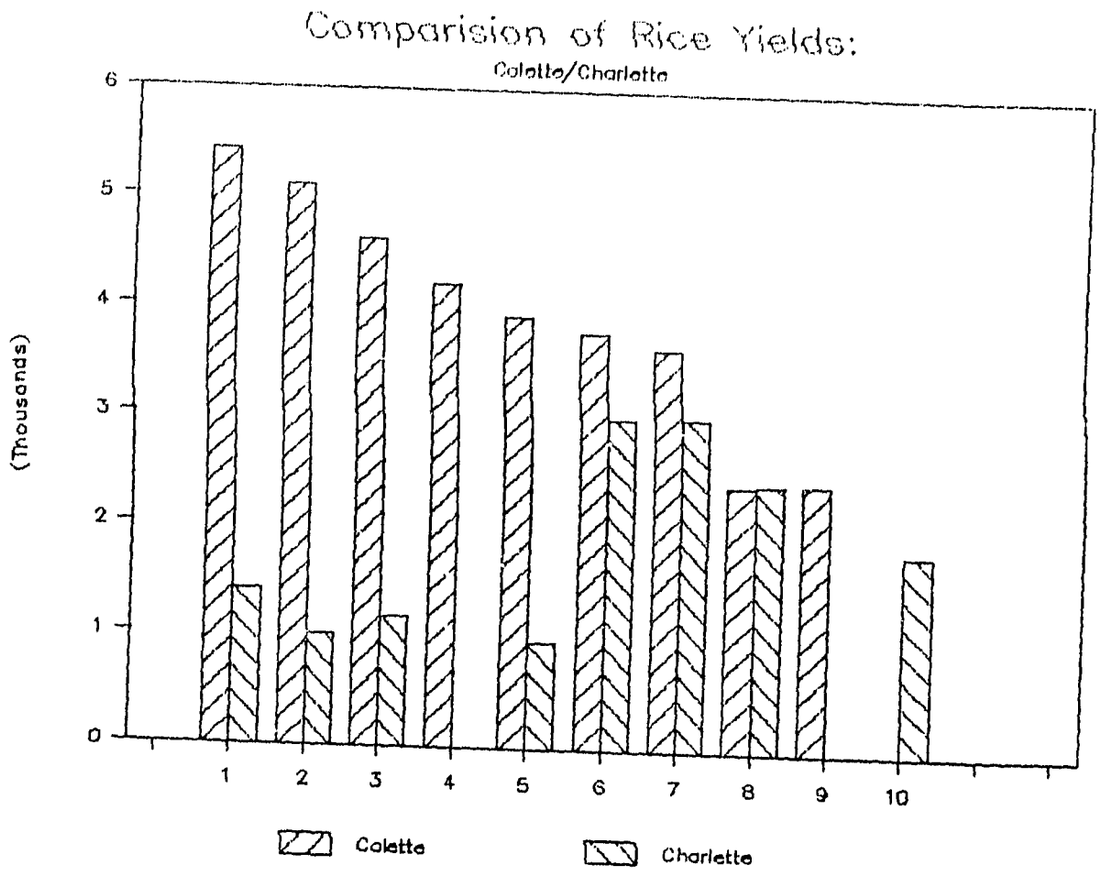

Comparision of Rice Yields:
Colette/Charlotte
(Thousands)
0
1
2
3
4
5
6
1
2
3
4
5
6
7
8
9
10
Colette
Charlotte

Table 1 : Rice variety tests, 1984, Les Cayes.

variety	Locality	Planted surface	grain wt fresh lbs	%humidity	lbs at 14%hum.	Yield kg./ha	Ht. cm.
Ti Marie	Colette	282	108	11.6	111	3936	65.3
	Charlette	290	27	11.0	27.9	962	
Livia	Colette	494	174	10.7	181	3664	73.4
	Charlette	368	108	11.2	111.5	3030	
Ti Cam	Colette	179	66	11.6	68	3799	78.5
	Charlette	110	32	11.3	33	3000	
Colette	Colette	186	93	12.1	95	5107	77.5
	Charlette	103	10	11.4	10.3	1002	
Ti Rose	Colette	72	38	10.7	39	5417	98.5
	Charlette	110	15	11.1	15.5	1409	
Amina	Colette	196	44	8.4	47	2398	100.8
	Charlette	129	30	11.6	31	2403	
Yole	Colette	160	71	10.7	74	4625	83.0
	Charlette	246	28	11.0	28.9	1175	
Sica 8	Colette	341	144	14.0	144	4223	72.1
M.Gougouse	Colette					2420	120.0
Decany	Charlette					1800	

NB. Due to lack of seeds the variety Sica -8 was planted only at Colette.

From these initial results it was apparent that the top performer in Colette was Ti Rose and in Charlette Livia. But nothing was very conclusive because it was felt that the true potential of these high yielding varieties was not achieved in either location. This was particularily true in Charlette where water was scarce, weeds abundant, and soil preparation less than desirable. The only thing really gained was additional seed material that could then be used to plan for a large number of field trials in the coming season. Also, the farmers from Charlette observed that the same varieties performed much better in Colette under better management.

1.3. 1985 :

In 1985 a simple researcher managed trial was designed with four treatments, two replications and in a randomized complete block design as follows:

T1	T2	T3	T4	Rep. 1
T3	T1	T4	T2	Rep. 2

Treatments chosen were as follows :

In Charlette	T1	was Decany (local variety)
	T2	was Ti Rose
	T3	was Colette
	T4	was Yole
In Jogue	T1	was Mme.Gougouse (local Variety)
	T2	was Livia
	T3	was Yole
	T4	was Amina

In all, 16 experiments were planted, 7 in Charlette and 9 in Jogue. The results were analysed in Charlette by pooling all the data of 7 experiments and similarly in Jogue the analysis was based on pooled data of 9 experiments. Each site was treated as a replication.

Thus in Charlette the experiment had 7 x 2 = 14 replications and in Jogue 9 x 2 = 18 replications. This provided greater degrees of freedom for statistical analysis which in effect meant greater accuracy of the analysed data. It was also simpler. The whole idea was to keep the experimental design simple and thereby encourage the farmer to become an active participant in the trial. A complicated design would have failed to attain this vital objective.

1.3.1 Statistical analysis :

In Charlette the results were analysed as follows below. In Jogue the variety Livia being late maturing was not harvested but plowed in for the next crop by the farmer cooperators. This made the data for Jogue incomplete for analysis. However, they showed their preference for Amina which had performed excellently. So it was not a complete loss.

ANOVA for Charlotte :

Source	df	ss	ms	f	Probability
Repititions	6	15307112.9	2551185.4	1.80	0.12
Blocks	1	7342239.4	7342239.4	5.19	0.02
Treatments	3	18213263.2	6071087.7	4.29	0.02
Block xtreat	3	1402663.5	467554.5	0.33	
Error	41	57972087.4	1413053.3		

CV 22.28 %

A Duncan's Multiple Range test showed that

Treatment	Yield Kg/ha		
1	4468	b	Decany
2	5188	ab	TiRose
3	5886	a	Colette
4	5808	a	Yole

although there was no significant difference between the treatment 2, 3, and 4, there was a significant difference between them and the local check which was Decany.

It should be pointed out that although in many statistical analysis a 700 or 800 kg yield difference may not show statistical significance, it may be highly significant from a small farmer's point of view. For this reason, ADS II researchers have always taken into account the farmer's likes and dislikes in planning for the trials in the subsequent seasons.

What we learned from the 1985 trials was that Ti Rose yielded as high as 6304 kg/ha, Colette 7168 kg/ha, and Yole 6372 Kg/ha as compared to the average yield of Decany at 4517 kg/ha.

There was however, an interesting development at this point. The variety Amina which was not included in this season's trial was planted just the same by some farmers and they were very pleased with its height, long transluscent grain and good yield. They also liked its cooking quality better than Ti Rose, Yole and Colette. Colette had coarse grain and short height of 77.5 cms that did not make it popular.

Ti Rose and Yole remained in the competition and Amina re-entered it.

1.3.2 **The data** : Charlotte (April-July 1985)

Yield kg/ha

Replication	Decany	Ti Rose	Colette	Yole
1	2648	3244	3972	4861
2	4072	6259	6244	8224
3	4086	5958	4817	6788
4	9884	5176	6927	6600
5	4389	3842	5422	4450
6	4353	4070	6050	4282
7	3716	4065	5686	4994
8	3600	5958	5651	7049
9	5268	5756	5274	4381
10	5749	5644	5449	4822
11	2118	5199	8097	6013
12	4005	5444	6239	lost
13	4632	6489	6592	7317
14	4718	6119	6500	6147

1.3.3. **The data** : Colette

On April 15,1985 eleven more HYVs were received from CIAT in Colombia and planted on the Mission for Christ farm in Colette to observe their adaptibility in the zone and the yield potential among other plant characteristics.

The results obtained are shown in the table 2 below:

Table 2

Variety	Area planted M2	Wt.kg harvest	Yield Kg/ha
UP 1541	17	10.0	5882
UP 1562	22	9.2	4182
# 31613	18	9.2	5111
# 31610	18	7.9	4389
# 32873	20	3.1	1550
# 31616	13	6.0	4615
# 31617	13	5.0	3846
# 32864	11	1.1	1000
# 32869	15	1.3	876
# 32870	19	1.9	1000
# 5738	16	3.1	1937

Among the eleven varieties, only two varieties were retained, namely CIAT 31613 and 31616. This was because of their good yield, the fact that they matured at about the same time as locally preferred varieties (taking 112 days to mature). Other varieties took longer to mature and had less desirable grain qua (See 3 below.)

Table 3.

Variety	Date planted	Date harvested	Days to mature
UP 1541	April 15,1985	Aug.23,1985	128
UP 1562	,,	Aug. 7,1985	112
# 31613 *	,,	Aug. 7,1985	112
# 31610	,,	Aug. 7,1985	112
# 32873	,,	Sept.9,1985	144
# 31616 *	,,	Aug. 7,1985	112
# 31617	,,	Aug. 7,1985	112
# 32864	,,	Sept.9,1985	144
# 32869	,,	Sept.9,1985	144
# 32870	,,	Sept.9,1985	144
# 5738	,,	Aug. 7,1985	112

* the varieties chosen for further testing.

At about the same time these varieties were being planted, TiRose, Colette and Yole were also planted in the same farm for seed multiplication purposes in April 1985 with the following area in square meters.

Table 4.

Mission for Christ farm, Colette

Variety	Area planted	Date planted
Ti Rose	3488	April 18,1985
Colette	3889	,,
Yole	3488	,,

1.3.4: **The data** ..Jogue.

Although most of the data in Jogue for the varieties Livia and Yole were lost because the farmers plowed in the plots for the next crop, the following yield data were recovered from one site showing the tremendous yield potentiality of the HYVs as compared to the local check.

Table 5.

Site one., Jogue July 1985

Variety	Yield kg/ha Replication one	Replication two
Mme Gougouse	7451	5901
Amina	11818	11846
Livia	8954	8146
Yole	9720	9388

Here Amina was preferred because of the high yield and the good grain quality. Since then, Amina has yielded even higher than 12 tons/ha in the Artibonite valley under much better water and field management, weed control and a higher dose of fertilizer.

Six other varieties received from the ODVA in the Artibonite valley were also tested in Jogue. The results obtained, however, were not very satisfactory:

Table 6.

1985 First season ,Jogue, Plain of Cayes

Varieties	Yield Kg/ha
Cica 8	3579
Quisqueya	3441
Mauge 83-0234	3174
Mauge 174	2777
Mauge T 28	1144
Mauge T 25	4107

None of these varieties showed any promise so were discontinued.

1.3.5: **Pre extension trials** :-

In the first season of 1985 Ti Rose was compared with Amina in a simple pre-extension trial both in Charlette and Jogue. This was done because farmers showed a preference for Amina whereas the ADS II still considered Ti Rose as a variety to be further studied and possibly extended.

The results were as follows :

Table 7.

Locality : Charlette

First season 1985

Yield in Kg/ha

Site	Ti Rose	Amina
1	4046	5405
2	4098	5158
3	4543	5476
4	3921	5075
5	3671	4046
6	3856	4699
7	2902	3654
8	3862	5580
9	4102	6160
10	3282	4093
11	4303	5321
12	3840	4307
Average	3869	4914

Table 8.

Locality : Jogue

First season 1985

Yield kg/ha

Sites	Ti Rose	Amina
1	3848	3070
2	4558	5180
3	Lost	2439
4	3457	2500
5	5665	3895
6	3846	3058
7	4761	3556
8	3809	3140
9	317	4138
10	3503	2900
11	3066	2678
12	3309	3986
13	3610	4760
Average	3884	3485

In these pre-extension trials in Charlette, Amina produced over one ton more than Ti Rose while in Jogue the yields were essentially the same. Jogue did have one site where Amina gave a yield over 11 tons/ha which was better than any other results thus far. However, this was the case of an exceptional farmer who

had mastered all the techniques of growing rice and was highly regarded as a rice farmer.

In general the farmers did not do so well because of the following resaons :

1. Very poor water management. Jogue did not have an irrigation system as in Charlette, rice fields were mostly rainfed. This caused too much or too little water at critical periods.

2. Poor weed management as a result of poor water management.

3. Low fertilizer efficiency that resulted from the above factors.

In Charlette, Amina continued to show its potential and was accepted by most farmers as a variety of their choice. Ti Rose was also planted by many farmers because of its good yield. In one area near Charlette, called Foscave, most farmers still plant Ti Rose and Colette, two varieties that were sent there in a very small quantities in the latter part of 1985.

1985 Second season :

1.3.6 **Researcher managed trials:**

In the second season of 1985 five researcher managed trials each were planted in Charlette and Jogue to include now two CIAT varieties of long grain ie CIAT 31613 and CIAT 31616 that had been screened from the 11 CIAT varieties multiplied at the Colette farm earlier. Ti Rose and Colette remained in the testing phase.

The treatments were as follows :

Charlette :

T1 = Starbonet (local)
T2 = Ti Rose
T3 = Colette
T4 = CIAT 31613

Jogue :

T1 = Mme Gougouse
T2 = Ti Rose
T3 = Colette
T4 = CIAT 31616

Experimental design remained the same as before in RCB with two replications. Since the T1 and T4 were different at each location, the data were analysed separately as follows :

1.3.7 **Jogue: The data**

Sites		Yield kg/ha			
		T1	T2	T3	T4
1	Rep1	2447	2385	3930	3328
	Rep2	2909	4701	3136	4121
2	Rep1	4069	6902	4682	7361
	Rep2	3945	4567	3099	6167
3	Rep1	3277	5960	3461	3837
	Rep2	3473	5029	2462	4958
4	Rep1	1019	2400	2718	3081
	Rep2	1494	1810	2780	3081
5	Rep1	2225	2666	1655	2744
	Rep2	2806	1340	2684	3380

1.3.8: **Statistical Analysis :**

ANOVA

Source	df	ms	ss	f cal	Prob.
sites	4	43479194.3	10869798	10.64	.02
Reps (a)	1	173580.6	173580	0.17	
Error a	4	4088919.7	1022004		
Variety	3	13242264.8	4414088	10.07	.00
Site x var.	12	12585587.2	1071548	2.44	.05
Error b	15	6575406.1	438360		

CV=19.11%

Analysis showed that the sites and varieties were highly significant implying that there was considerable variability among sites as well as among varieties.

DUNCAN's Test :

Variety	Yield Kg/ha	
CIAT 31616	4206	a
Ti Rose	3821	a
Colette	3061	b
Mme Gougouse	2768	b

This experiment put CIAT 31616 at the top although its

Mean yield of 4206 kg/ha was not different from Ti Rose. Consequently the variety CIAT 31613 is still being planted in Jogue by many farmers.

1.3.9: **Charlette Data.**

Sites		Yield kg/Ha T1	T2	T3	T4
1	Rep1	2456	3604	2902	2417
	Rep2	5730	6021	2909	4643
2	Rep1	5297	3132	1665	3119
	Rep2	5678	2709	2279	1871
3	Rep1	5067	3958	5895	5576
	Rep2	5431	4195	4439	4139
4	Rep1	4278	4125	5218	3958
	Rep2	4889	3721	4982	3787

where T1 is Starbonet
T2 is Ti Rose
T3 is Colette
T4 is CIAT 31613

1.3.10: **The statistical analysis.**

In Charlette the results were different from that of Jogue.

ANOVA:

Source	df	ss	ms	f cal	prob.
Sites	3	11668420.3	3889473	1.82	.284
Error a	4	8567502.0	2141875		
Variety	3	6864512.1	2281170	4.72	.021
Site x var	9	15488818.3	1720979	3.55	.022
Error b	12	5817360.0	484780		

CV=17.13%

Here the sites showed more homogeneity but the variety was significant. The Duncan's test showed that the introduced varieties were less productive under moisture stress which is what happened in Charlette during that season. The canals ran dry at critical times causing lower although acceptable yields.

DMRT test:

Variety		Yield kg/ha
Starbonet	=	4853 a
Ti Rose	=	3933 b
Colette	=	3786 b
CIAT 31613	=	3689 b

This showed that under unfavorable conditions, the local variety was better adapted than the HYVs.

1.3.11: **The pre-extension trials .**

Jogue : In Jogue the variety Ti Rose was compared with the local variety Mme Gougouse in 13 sites and the results were as follows :

	Yield kg/ha	
Sites	Ti Rose	Mme Gougouse
1	3848	3070
2	4558	5180
3	lost	2439
4	3457	2500
5	5665	3895
6	3846	3058
7	4761	3556
8	3809	3140
9	3178	4138
10	3503	2900
11	3066	2678
12	3610	4760
13	3309	3986
Average	3884	3485

So, on the average Ti Rose performed better than the local check with yields ranging from 3066 kg/ha to 5665 kg/ha. The local variety ranged from 2439 kg/ha to 5180 kg/ha.

Charlette :

In Charlette where many farmers used Amina as the local variety, Ti Rose was compared with Amina in simple farmer managed trials. All factors remained equal, only the variety was changed.

The data obtained from 14 sites were as follows:

Sites	Yield kg/ha	
	Ti Rose	Amina
1	3059	2810
2	4046	5406
3	4098	5158
4	3840	4307
5	4543	5476
6	3921	5075
7	3671	4046
8	3856	4699
9	4884	4477
10	2902	3654
11	3862	5580
12	4102	6160
13	3282	4093
14	4303	5321
Average	3869	4914

In Charlette the HYV Amina had over one ton more yield than Ti Rose under similar management. This confirmed to us why so many farmers preferred to grow Amina.

1.4: 1986 First season

1.4.1 Researcher managed trials :

In the first season of 1986 the researcher managed trials were exactly the same in design as that of the previous season with a randomized complete block design and two replications. Only the treatments changed. This time the four treatments chosen were as follows :

In Charlette
T1 was the local variety Starbonet
T2 was Amina
T3 was CIAT 31613
T4 was CIAT 31616

In Jogue
T1 was the local variety Mme.Gougouse
T2 was Amina
T3 was CIAT 31613
T4 was CIAT 31616

The design was RCB with two replications.

1.4.2 : **Data Charlette**

Yield kg/ha

Sites		T1	T2	T3	T4
1	Rep1	4000	3400	3800	2400
	Rep2	4600	3000	1400	2200
2	Rep1	3500	4500	4000	4100
	Rep2	3400	4200	4700	4600
3	Rep1	4900	5300	4900	5800
	Rep2	4800	4900	5600	5600
4	Rep1	3500	3600	4600	3600
	Rep2	3700	4300	3900	3700
5	Rep1	3700	3760	4100	Lost
	Rep2	3900	3240	3700	4100
6	Rep1	4200	4700	4800	4800
	Rep2	3700	4800	4300	4700

Jogue: Yield kg/ha

Sites		T1	T2	T3	T4
1	Rep1	2831	2212	2056	2140
	Rep2	1932	2139	1555	1531
2	Rep1	2949	4459	4461	4005
	Rep2	3155	4538	5353	5126
3	Rep1	1017	3863	1181	3972
	Rep2	3186	2264	2337	2526
4	Rep1	1228	2489	2058	2306
	Rep2	2163	2290	2386	1451
5	Rep1	1705	3473	3392	1692
	Rep2	2962	2610	2211	2146
6	Rep1	3000	5800	5400	6200
	Rep2	2000	6300	6000	6000
7	Rep1	6500	5000	4100	4100
	Rep2	5500	5200	5100	5200

1.4.3: Statistical analysis

Charlette:

ANOVA :

Source	df	ss	ms	f cal
Reps	11	26885966.6	2444178.7	
Treatment	3	970833.3	323611.1	0.47
Error	33	22497566.6	681744.4	

CV=20.54%

DUNCAN's range test :

Treatment	Yield kg/ha
CIAT 31613	4150 a
Amina	4142 a
Starbonet	3992 a b
CIAT 31616	3800 b

The local variety Starbonet yield ranged from 3400 to 4900 kg/ha with an average of 3992 kg.

In the final analysis there was no significant difference between the first three treatments but the fourth treatment 31616 yielded less than the others. The yield of 31613 and Amina were esstentially the same.

Jogue :

ANOVA

Source	df	ss	ms	f cal	Probability
Reps	13	94078842.4	7236772.4		
Treatments	3	5796689.5	1932229.8	2.12	.112
Error	39	35499500.0	910245.6		

CV=28.3%

DUNCAN's range test :-

Treatments	Yield kg/ha	
Amina	3760	a
CIAT 31616	3457	a b
CIAT 31613	3399	b
Mme Gougouse(local)	2866	c

In Jogue the treatments were significant but the difference between Amina and CIAT 31616 was not.

It is interesting to note here that in Charlette the yield difference between Amina and CIAT 31613 was not significant either. The local variety did not perform as well as the HYVs in Jogue but this was true elsewhere as well.

1.4.4: **Pre extension trials**

The data : Charlette

During the fist season of 1986 most farmers in Charlette planted Amina as the local variety so no yield comparison could be made. The following data represent 16 farmers in Charlette :

Farm	Yield of Amina Kg./ha
1	4720
2	4000
3	4325
4	3200
5	4800
6	5833
7	3250
8	5600
9	5000
10	1660
11	4250
12	5150
13	7600
14	4100
15	5100
16	4900
Average	4593

There was considerable variation in the yield of Amina obtained on various farms obviously due to variability in management techniques of different farmers. The yield ranged from 1660 to 7600 kg/ha with a good average of 4593 kg/ha of paddy rice.

The data : Jogue

In Jogue 12 farmers planted Amina and Mme Gougouse, 7 farmers planted CIAT 31616 and Mme Gougouse and 6 farmers planted Amina with CIAT 31616. The data obtained were as follows :

Farms	Yield in kg/ha		Difference
	Amina	Mme Gougouse	
1	4200	2100	2100
2	2500	2200	300
3	2800	2500	300
4	2500	1980	520
5	3600	2800	800
6	1800	2100	- 300
7	3600	2100	1500
8	4900	3300	1600
9	1900	2300	- 400
10	2100	4500	- 2400
11	2700	1980	720
12	2500	2500	0
Mean	2925	2530	395
Variance	836875	489166.6	1247208.3
s.d.			1116.78

t Stat. = 1.23
t table = 1.36

The yield of Amina ranged from 1800 to 4900 kg/ha with an average of 2925 kg/ha whereas Mme.Gougouse ranged from 1980 to 4500 kg/ha with an average of 2530 kg/ha. The T-test showed that the average yield of Amina was not significantly different from the average yield of Mme.Gougouse, although 8 out of 12 farms showed Amina with higher yields than Mme Gougouse.

Farms	Yield kg/ha		Difference
	CIAT 31616	Mme Gougouse	
1	5200	3400	1800
2	4500	2200	2300
3	5100	2800	2300
4	2000	2100	- 100
5	3200	2400	800
6	3200	2000	1200
7	2900	4500	- 1600
Mean	3728.6	2771.4	957.1
Variance	1267755.1	699183.6	1722448.9
s.d.			1312.42

t statistic = 1.93
t table value= 1.44

The T-test showed that the average yield of CIAT 31616 was significantly higher than the average yield of Mme Gougouse. In the last group of 6 farms in Jogue, Ciat 31616 was compared with Amina with the following results :

Farms	Yield kg/ha CIAT 31616	Amina	Difference
1	4500	2500	2000
2	5100	3600	1500
3	2000	1800	200
4	2500	2900	- 400
5	3300	2500	800
6	2900	2060	840
Mean	3383.3	2560	823.3
Variance	1188055.5	338666.6	621388.8
s.d.			788.28

t statistic = 2.55
t table value = 1.47

In this analysis the average yield of CIAT 31616 was significantly higher than Amina. All in all, 25 pre-extension trials were established in Jogue.

1986 second season :-

1.4.5 Researcher managed trials

During the second season of 1986 the emphasis of research shifted to cultural practices. The direct seeding vs transplanted method was studied using just two varieties.

Treatments were as follows :

T1 = Local variety transplanted
T2 = Amina transplanted
T3 = Local variety direct seeded
T4 = Amina direct seeded

The design was the same as before (ie. RCB with two replications). The data for Charlette and Jogue were pooled together for analysis.

The reason for this experiment was to see if there would be significant yield differences between the two methods of planting rice. If there were none, then direct seeding would be more attractive to farmers because of the lower labor cost implied: meaning lower cost of production and a greater margin of profit.

The data :

Farms	T1	T2	T3	T4
1	6400	4400	4900	3000
2	5800	3900	6400	4000
3	1400	2700	4500	3000
4	3700	1700	5200	4200
5	4800	3800	4500	4400
6	3900	4500	2900	3200
7	2400	2600	4000	1800
8	3000	3800	3500	2200
mean	3925	3800	4487.5	3225

Analysis :

ANOVA :-

Source	df	ss	ms	f value	Prob.
Sites	7	21989687.5	3141383.9	3.99	0.06
Treatments	3	6438437.5	2146145.8	2.73	0.069
error	21	16529062.5	787098.2		
Total	31	4495718.5			

CV=22.9%

Grand mean = 3859.3

DUNCAN'S range test :

Treatment	Yield Kg/ha	
T3	4487.5	a
T1	3925	b
T2	3800	b
T4	3225	c

s x = 156.8 at alpha 0.1

LSD value = 381.65

1. Hypotheses :Difference in tranplanting and direct seeding for varieties as a whole.

   contrast 1 1 -1 -1

   F value = 0
   Failed to accept hypotheses at 10 % level of significance

2. Hypotheses : Difference in transplanting and direct seeding for the local variety.

Contrast 1 0 -1 -1

F value = 0.61
Failed to accept the hypotheses at 10 % level of significance

3. Hypotheses : Difference in transplanting and direct seeding for the improved variety Amina

Contrast 0 1 0 -1

F value = 1.68
Failed to accept hypotheses at 10 % level of significance

4. Hypotheses : Difference between the two varieties ie local and Amina.

Contrast -1 1 -1 1

F value = 4.84
Failed to reject the hypotheses at 10 % level of significance.

It simply meant that there was significant difference in yield between the local and the improved variety.

1.4.6 UPLAND RICE RESEARCH :-

In 1986, the ADS II project started research on upland rice in the La Force area of Bereault because of several reasons:

a. Upland rice is grown by many farmers as a rainfed crop.

b. It has the potential to grow anywhere in the plains or on the mountain slopes and is not limited to any particular soil type.

c. We believe it has a higher return to the investment as compared to corn or sorghum.

d. It can be easily intercropped with sweet potato, manioc, beans corn, sorghum, or peanuts.

e. It does not require the elaborate land preparation and seed bed preparation, transplanting, and interculture required by lowland rice. It is simple to grow and can be directly planted into holes in the ground like corn or any other crop.

Given the advantages of upland rice cultivation, albeit with lower yields than lowland rice, the ADS II project in late 1986 started a single researcher managed trial in La Force. We were limited to the smmal quantity of seeds received from ODN at that time. The varieties received were as follows :

IRAT 101	T1
IRAT 177	T2
IRAT 190	T3
IRAT 133	T4
IRAT 112	T5
IRAT 13	T6

and were planted in a RCB design with two replications.

IRAT varieties were from the IRAT stations in Senegal, West Africa.

The data :

	Yield kg/ha					
Replications	T1	T2	T3	T4	T5	T6
1	2222	2222	2586	2189	570	2620
2	2028	1412	2359	2050	1339	2803
Mean	2125	1817	2472	2119	954	2706

It was evident that IRAT 13 had the yield advantage over other varieties. The main purpose, however, was to multiply the seed for the next season and observe the performance of these varieties under purely rainfed conditions.

1.4.7 **Pre-extension trials**

During the second season of 1986 the pre-extension trials in Jogue and Charlette were to test CIAT 31616 and compare it with the local variety Mme Gougouse in Jogue and with Amina in Charlette. The following data were obtained and analyzed.

Jogue :

Farms	Yield kg/ha		Difference
	CIAT 31616	Mme gougouse	
1	3100	1900	1200
2	2100	1700	400
3	2600	2200	400
4	2700	1800	900
5	2500	2500	0
6	2800	1700	1100
7	3100	3500	- 400
8	2500	3100	- 600
9	4200	2100	2100
10	2600	2500	100
11	2520	2260	260
12	4600	3200	1400
13	4400	1400	3000
14	1500	1300	200
15	3700	1200	2500
Mean	2994.6	2157.3	837.3
Variance	457752.8	713998.2	1034712.8
s.d.			1041.5

T statistical = 3.11
T table value = 1.345

The analysis showed that the variety CIAT 31616 had a significantly higher yield than the local check Mme Gougouse but this information was not new. Rather, it was a confirmation of past results.

Charlette :-

Farms	Yield kg/ha		Difference
	CIAT 31616	Amina	
1	3200	3000	200
2	4600	4400	200
3	4900	3000	1900
4	3700	3800	- 100
5	5980	4600	1380
6	5100	4200	900
7	3600	4700	- 1100
8	3200	4600	- 1400
9	3200	2200	1000
10	2000	2300	- 300
11	4500	3700	800
12	6400	4200	2200
13	~~5670~~	~~3340~~	~~2330~~
14	4470	2720	1750
15	3370	4260	- 890
16	5910	3690	2220
17	5680	5330	350
Mean	4440	3767	672.94
Variance	752597.2	1474494.1	1340608.9
s.d			1157.84

T statistical = 2.39
T table value = 1.33

In Charlotte the variety CIAT 31616 had a significantly higher yield than Amina and it ranged from 2000 kg to 6400 kg/ha. The yield of Amina ranged from 2000 to 5330 kg/ha with an average yield of 3767 kg/ha.

1.5 : 1987

In 1987 the upland rice research was emphasized because of its potential. At this time the seeds were available from the previous season's experiment in La Force so 4 trials were planned for the first season of 1987.

1.5.1 : The treatments and the design

There were 6 IRAT lines and one local variety making it an experiment with 7 treatments that are noted as follows :

Treatment 1 = IRAT 112
Treatment 2 = IRAT 133
Treatment 3 = IRAT 190
Treatment 4 = IRAT 13
Treatment 5 = IRAT 101
Treatment 6 = IRAT 177
Treatment 7 = Local

Design : The design was an RCB with two replications per site. The experiment was treated as one with 8 replications and 7 treatments. All the experiments were planted at the same time very near each other in La Force so site variability was minimal. What became apparent was the yield difference due to varieties. IRAT 112, 133, and 190 suffered damage due to chickens, so there were some missing values.

1.5.2: The data :

Site	Reps	Yield kg/ha						
		T1	T2	T3	T4	T5	T6	T7
1	1	3120	2310	3860	3010	2360	1840	2520
	2	1830	2460	2560	3400	2340	1910	2230
2	1	0000*	1789	2418	2596	2801	1135	1201
	2	1201	1482	2773	3114	2734	2670	1906
3	1	2020	0000*	0000*	2721	2650	2319	2566
	2	2382	2451	1670	2500	2808	2687	2856
4	1	2254	2268	1251	2643	2755	2383	2695
	2	2102	1720	2046	2856	2829	2867	1986
5	1	0000	2296	1990	2761	2666	3304	3100
	2	0000	2843	2890	2818	3415	3476	3186
6	1	1568	1745	1295	1520	1780	1630	1540
	2	1377	1393	0000	1695	1493	1927	1102
	mean	1984	2069	2275	2636	2594	2346	2249

* Some plots were destroyed by chickens so no data available.

1.5.3: **The results :-**

From the means it is apparent that IRAT 13 again has a yield advantage over all other varieties.

ANOVA

Source	df	ss	ms	F value	5%	1%
Reps	11	12.61	1.15	4.42**	1.94	2.53
Treatmnt	6	4.31	0.72	2.76*	2.24	3.09
Error	66	17.02	0.26			
Total	83	33.94				

CV= 22.16 %

DMRT :

Treatment	Yield kg/ha
Irat 112	1984
Irat 133	2069
Irat 190	2275
Irat 13	2636
Irat 101	2594
Irat 177	2346
Local	2249

The experiments showed that two varieties (ie. IRAT 13 and IRAT 101) need to be further tested against the local check to verify their superiority in terms of yield. With better soil preparation, good seed, better timing and dose of nitrogen and phosphorus and at least two weedings, the IRAT 13 and 101 may have an yield advantage higher than 400 kgs currently obtained.

The highest yield from a single plot came from IRAT 190 that gave 3860 kg/ha but its average performance was not very good. It should be mentioned here that the last two sites suffered prolonged drought and some damage caused by chickens.

Since upland rice can be planted anywhere corn or sorghum is planted, the scope of expanding its cultivation throughout the Les Cayes plains and the mountains is tremendous.

1.5.4 EXTENSION TRIALS WITh AMINA :-

In Charlette, yield data were obtained from 18 farmers who had planted Amina.

Site	Yield Amina kg/ha
1	4165
2	4377
3	6495
4	4582
5	2802
6	2555
7	3303
8	3528
9	5272
10	5224
11	4891
12	3316
13	5168
14	5224
15	3099
16	4979
17	3222
18	4880
Mean	4282

1.5.5 EXTENSION TRIALS OF CIAT 31616 IN JOGUE

In Jogue where the CIAT 31616 is popular, yield data were recorded from 12 locations.

Site	Yield of CIAT 31616 kg/ha
1	3720
2	3130
3	4550
4	2550
5	3660
6	4830
7	2950
8	4430
9	2980
10	3450
11	3530
12	3230
Mean	3584

Comparing the two, Amina had an average yield of 4282 kg/ha as compared with CIAT 31616 that produced an average of 3584 kg/ha. of paddy rice. All raw data were converted to 14% moisture content at which the yield is calculated.

1.5.6 EXTENSION AND SEED MULTIPLICATION OF AMINA:

In January 1987, a project proposal to multiply and produce Amina as seed was submitted to the USAID for financing. The village of Bruny is located in the middle of rice growing area of the Les Cayes plain where currently 105 ha. of rice land is irrigated by a recently compleded, USAID financed canal. The community group of Bruny with the help of Dr.Chatterjee prepared a project proposal to produce Amina rice seed on 10 ha. of irrigated land. The goal was to produce 30 tons of seed rice every five months.

This project was funded at $ 12286.00 and completed in October 1987. Funds provided the cooperative the following :

a. A Yanmar power tiller, trailer, plow and two sets of paddy wheels.

b. 15 rice thresher. and knives to harvest rice

c. 15 knapsack sprayers

d. A large two room depot with a floor space of 72 m2 for storing all the seed after harvest and all the equipment.

e. A drying floor of 12m x 10 m or 120 m2 dimension in front of the depot.

f. All the fertilizer for 10 ha. for one season.

g. 250 marmites of Amina seed for planting.

h. 600 sacs for keeping the seeds in storage.

Since August 1987 when the construction of the depot started, the members of the cooperative have worked solely on a self help basis. Nearing completion, the depot is larger than originally planned. The drying floor is also much bigger.

Starting originally with only 23 members, there are now 47 members in the group that grow Amina in Bruny. Their fields were measured and later digitized in Port-au-Prince to produce computer generated maps of all participating farmers.(cf. Project Document # 35)(See the maps on the following pages.)

The members share the power tiller for their soil preparation needs and the sprayers and rice threshers as well. One farmer member is well trained in operating the power tiller.

Figure 1

TEST PLOT LOCATIONS

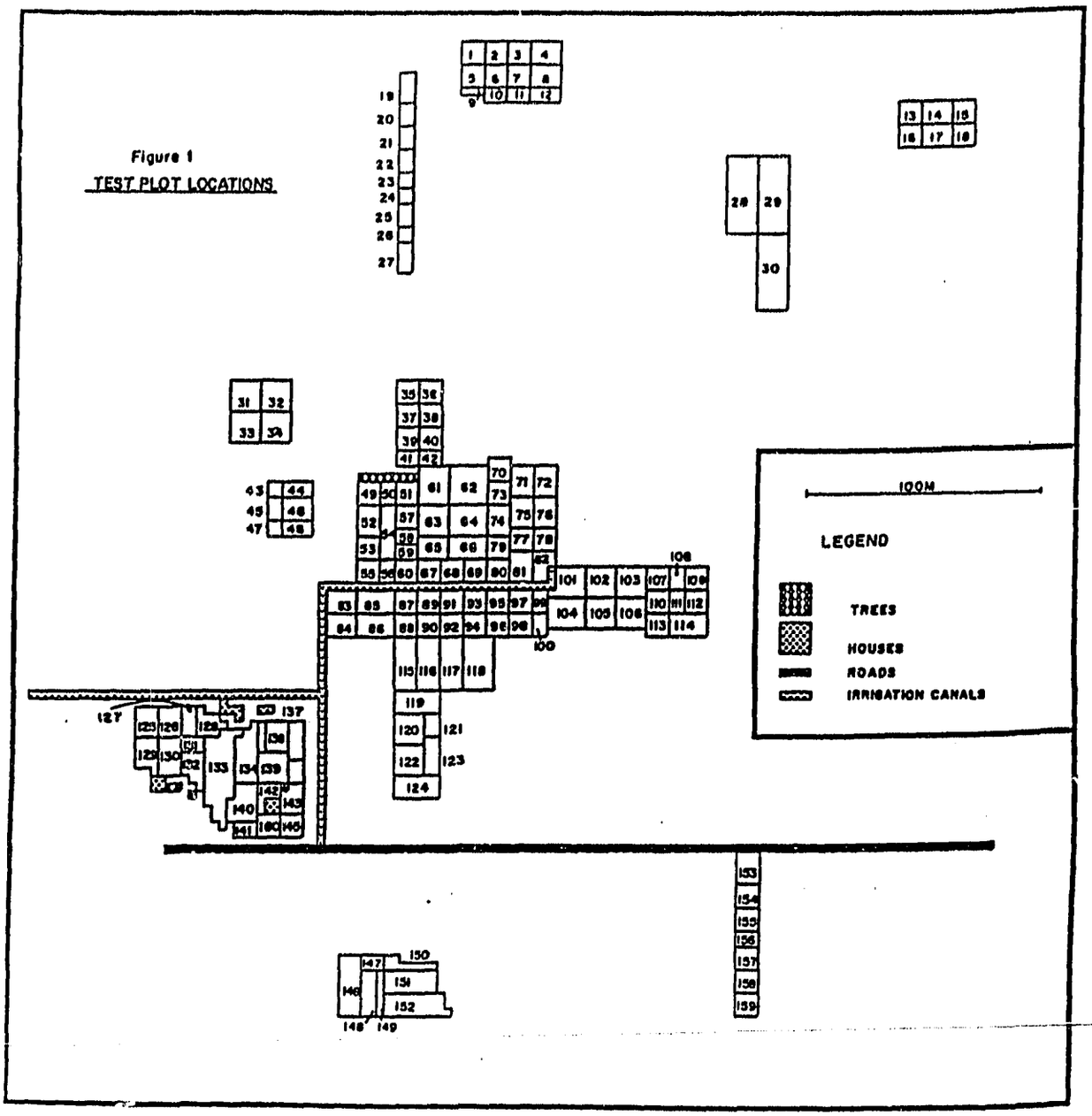
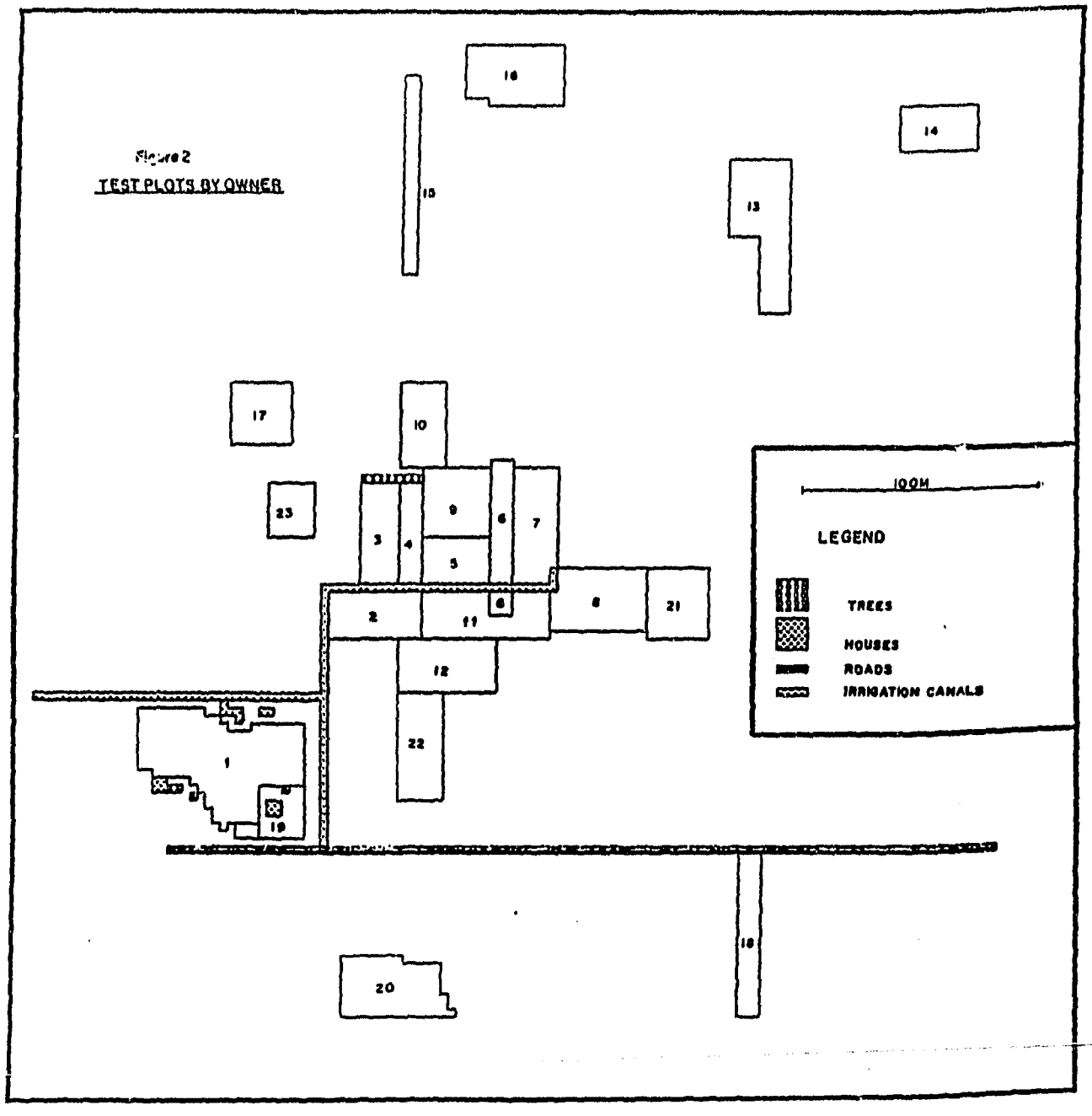


Figure 2

TEST PLOTS BY OWNER



Following is the breakdown of the expenses for the project.

a . Hardware			
267 sacs of cement	=	$ 1523.50	
114 pcs of tin	=	373.10	
30 lbs of roof nails	=	30.00	
16 lbs of 2"nails	=	11.20	
30 bars of iron 3/8	=	102.00	
10 bars of iron 1/4	=	14.60	
37 pcs wood 2x4x16	=	366.80	
10 lbs of nails 4"	=	7.00	
6 bars of iron 1/2	=	33.60	
11 lbs tie wire	=	6.60	
2 dozen boards	=	22.80	
2 padlocks	=	22.00	
Loading charges	=	1.90	
Sub total			2515.10
b. Rice threshers 15	=	600.00	
Sub total			600.00
c. Seed for planting	=	300.00	
Sub total			300.00
d. Fertilizer			
Urea 2000 lbs	=	460.00	
Superphos 1300 lbs	=	416.00	
Sub total			876.00
e. Empty sacs 600 pcs	=	240.00	
Sub total			240.00
f. Power tiller Yanmar	=	4800.00	
Sub total			4800.00
g. 2 doors and 2 windows	=	400.00	
Sub total			400.00
h. Power tiller accessories	=	1490.00	
Sub total			1490.00
i. 15 knapsack sprayers	=	1065.00	
Sub total			1065.00

GRAND TOTAL.....$ 12286.10

During the first season starting April-May 1987, a total of 250 marmites of Amina seed was distributed to the following farmers and planted.

Farmer	Area planted M2	Kg.harvested	Yield kg/ha
1	3900		
2	1798	618	3437
3	1281	364	2841
4	900	509	5655
5	1178	509	4321
6	994	545	5483
7	1820	818	4494
8	2052	859	4186
9	1476	595	4034
10	1300	670	5154
11	2233	1252	5606
12	1595	709	4445
13	1918	1104	5756
14	1350	429	3179
15	4640	1082	2332
16	1188	141	1187
17	1216	554	4556
18	2476	507	2048
19	1988		
20	1188		
21	1339		
22	884		
23	2135		
24	1716		
25	800		
26	4090		
27	1349		
28	1225		
29	2200		
30	3200		
31	1911		
32	1575		
33	760		
34	1260		
35	1196		
36	546		
37	2407		
38	772		
39	1184		
40	535		

Total 67575 m2 or 6.7 ha planted

The goal is to have 10 ha. planted each season so the number of farmers joining the venture will exceed 40.

It is hoped that the Bruny seed multiplication project will serve as a model for seed multiplication for sorghum and black bean. Such cooperatives need to be set up in the Les Cayes plain or in the Maniche valley where most of the improved variety black bean (Tamazulapa) is currently cultivated.

1.5.7 APPROPRIATE TECHNOLOGY TOOLS :

a. The ADS Rice thresher:-

Since early 1985 ADS II has developed a simple rice thresher at a cost of about $10.00 and made it available to farmers in Charlette. This thresher was made of local wood called bois blanc and consisted of a series of cutting edges on which the rice stalks are beaten to separate the grains. This type of thresher commonly made of bamboo is popular in the Philippines and elsewhere in Asia.

The traditional method for threshing rice is to trample the grain by foot which is very tiresome and slow. Soon after the ADS II rice thresher was developed, some farmers started using various other means to thresh their rice. Some used an inverted chair, others used a motor tire or even a door. Farmers or their wives, will usually cut the panicles one by one using a small knife, dry the panicles for a day or two and then trample them to separate the grains.

Using the ADS II introduced method, the farmers will cut the plant at the base using a sickle or even a machete. The rice will then be threshed right away, thus saving considerable time. Just how much time is saved using the sickle and the thresher method is evident from the following Table 9. These data were collected in Colette in 1985.

Table 9

variety	harvest	transport	threshing
IR-4819 (sickle and thresher)	16.3 md (130 h 31 mn)	11.6 md (93 h 6 mn)	18.6 md (148 h 58 mn)
IR-10147(sickle and thresher)	8.5 md (68 h 1 mn)	5.7 md (48 h 31 mn)	6.4 md (51 h 0 mn)
IR-5931(sickle and thresher	20.2 md (162 h 2 mn)	8.7 md (69 h 26 mn)	13 md (104 h 10 mn)
IR-42 (traditional method	113.3 md (907 h 6 mn)		
Mme Gougouse Traditional way	76.5 md (611 h 48 mn)		2.6 md (21 h 6 mn)
Mme Gougouse Traditional way	88.5 md (707 h 46 mn)		2.8 md (22 h 40 mn)

md = One man day (8 hrs of work)

h = hour
mn = minutes

From this study it was found that on the average it took 14 man days to harvest one hectare of rice using the sickle vs 92 man days using the traditional method of cutting the panicles one by one.

Using the ADS II thresher, it took on the average 13 man days to thresh one hectare of rice vs 3 man days by using the traditional method of trampling by feet.

Therefore the thresher method is becoming more popular. Since then, the ADS II project has assisted in the construction of many threshers of welded iron at a cost of $38.00 per thresher and sent them to Corail, the Artibonite valley and the Damien research station. Currently 15 more iron threshers are being built for the Bruny project.

It is hoped that some day a small center for appropriate technology will be built in the Les Cayes Plain where such simple tools can be mass produced at low cost by trained farmers themselves. Right now it is difficult to get private manufacturers to make low cost tools like the ADS II thresher because they see a low profit margin. But the fact remains that as long as the cost is kept high, the majority of rice farmers will not be able to afford the thresher (cf.ADS-II Document #42).

The rice thresher also works for threshing sorghum so it has a much wider applicability and should be of interest to many people involved in rural development work.

b. **The rice grain blower** :

Since June 1987, ADS II agronomist Dr.Chatterjee who had built the rice thresher started working on a prototype model of a simple rice blower based on blue prints received from IRRI in the Philippines. The work was started by Sigi Weis, a Peace Corps volunteer and continued by Dr.Chatterjee after Sigi left the country shortly after his arrival.

The principle is very simple. The blower has a hopper on top that is filled with dirty grains which drop by gravity to a wind tunnel. The fan blows the dirt away and the good grains fall by gravity through a trough into a sac. It is a very simple mechanical device that has been built at a cost of $20.00 for the materials. The model can be seen at Bruny.

CHAPTER TWO

SORGHUM RESEARCH :-

2.1 Introduction :-

During the second agricultural season that starts with the onset of rains sometime in August or as late as October, the sorghum is planted as the main crop in the plains as well as in the mountains.

Farmers plant several varieties of sorghum in Les Cayes that commonly take almost 5 months to mature. It is almost always planted during the second season and very seldom during the first season, due to usually less rainfall associated with this period. Estimated sorghum hectarage is approximately 59,000 ha. (ADS-II Report # 24) in the Departement du Sud.

Traditional sorghum varieties like Beausejour and Panache, among others, grow to a height of 9 to 10 feet, are photoperiodic (eg. they will flower at a certain period irrespective of when they are planted) and in general have low yields of 1 ton or less per ha.

Sorghum is also a neglected crop that traditionally does not receive fertilizer and only one weeding. The low sorghum prices in the market and relatively high cost of fertilizer are incompatible to begin with. The low yield of local sorghum varieties makes sorghum a crop of low returns.

There are high yielding sorghum varieties that have come out from International centers like ICRISAT in India and elsewhere. When the project began in June 1984 such seeds were not yet available to the ADS II agronomists.

2.2 1984 : second season

2.2.1 Researcher managed trials :

In June 1984 during the seminar at Limbe, ADS II researchers sought the help of local development organization in Northern Haiti (ODN) in procuring some local sorghum seeds from St.Raphael that could be tested in the Cayes plains. Thus two varieties Pompon blanc and Blanc populaire were brought to Les Cayes and planted in Bereault and Maniche to see how they will perform in comparison to the local varieties.

The USAID financed PDAI project had worked on sorghum research and had a number of varieties under observation but no particular varieties had yet been recommended or sufficiently multiplied from their station testing program.

So the local varieties from St.Raphael were tested in the absence of anything better. Over the years, this would change as many high yielding varieties would be received from other countries.

The design : The design was an RCB with 3 trteatments and 3 replications . The treatments were as follows :

T1 = Local variety
T2 = Blanc populaire
T3 = Pompon blanc

T1	T2	T3	Rep 1
T3	T1	T2	Rep 2
T2	T1	T3	Rep 3

2.2.2 **Results :-**

The results were far from satisfactory. The two varieties from St.Raphael did not do as well as the local varieties in Maniche and Berault although all the treatments received 60 kg of N (30 kg at seeding time and the rest before panicle initiation stage) and two weeding. It was difficult to get farmers to make two applications in this way.

Treatment	Average yield in kg/ha
1. local variety	2269
2. Blanc populaire	1135
3. Pompon blanc	1409

CV = 26.01%

The treatment was highly significant in the ANOVA test.

2.3 **Farmer managed trials :**

At the same time a simple trial comprising of only two treatments was set up on 13 farmers fields in Maniche and 11 in Berault. The objective was to observe the difference in treatments using just the local variety.

The treatments :-

Treatment 1 was ADS II recommended practice

Treatment 2 was the farmer's practice.

The layout :

T1	T2

Repeated in different sites

A 1000 sq.meter plot was divided up into two plots of equal size and planted the same day with the local variety.

2.3.1. **The results :**

Maniche :

Farmer	Yield in kg/ha Treatment 1	Treatment 2
1	1012	910
2	390	286
3	620	510
4	440	278
5	970	838
6	1190	1078
7	1021	953
8	969	951
9	966	908
10	663	623
11	2152	1884
12	1186	832
13	768	596
Mean	949.8	819

The difference of 131 kg of grain between the two treatments was not significant although the ADS II practice increased yield in almost all the parcells.

Berault :

The results :-

Farmer	Yield in kg/ha Treatment 1	Treatment 2
1	2457	2360
2	320	276
3	457	308
4	1431	1082
5	560	472
6	1000	655
7	2600	1920
8	600	500
9	1320	1000
10	2600	1200
11	1604	560
Mean	1359	939.3

In Berault however, there was a yield difference of 420 kg between the two treatments which only proved that the local variety responded to better management, weed control and a dose of fertilizer and could yield as much as 2600 kg of grain in some cases. However, the average yield remained low both in Maniche and Berault.

There was another problem worth mention here. If a different variety was planted in the adjacent field by another farmer that flowered and matured earlier, thrips would transfer to the experimental plots and cause damage to the flowers causing sterility and significantly lowering yields. In Berault the farmers are wary of planting Beausejour and Panache next to each other because of this problem.

2.4 1985 Second season :

2.4.1. Researcher managed trials # 1, Bereault.

During the second season of 1985, a small sample of selected sorghum varieties were received from Upper Volta. This permitted only two experiments to be conducted in an effort to multipy seed for successive seasons.

The design was an RCB with three replications and 5 treatments as follows :

T1 = Local variety
T2 = ICSV 1002 HV
T3 = E 35-1
T4 = ICSV 1014
T5 = ICSV 1003

Design :

T1	T3	T4	T2	T5	Rep 1
T3	T2	T1	T5	T4	Rep 2
T4	T2	T5	T3	T1	Rep 3

2.4.2. **Results : Berault**

Site		Local T1	ICSV 1002 T2	E 35-1 T3	ICSV 1014 T4	ICSV 1003 T5
1	Rep 1	1211	2937	3100	1750	1866
	Rep 2	723	1500	1583	1333	2333
	Rep 3	962	3066	1900	lost	2000
	Mean	965.3	2501	2194.3	1541.5	2066.3
2	Rep 1	Lost	1354	764	1015	1565
	Rep 2	Lost	1470	678	889	1583
	Rep 3	Lost	509	1127	679	1525
	Mean		1111	856.3	861	1557.6

Here the experiment suffered over 20 % damage due to birds and the local variety was damaged by gall midge. No reliable yield data were therefore available.

In the first experiment, despite bird damage, the Upper Volta varieties did much better than the local variety and in the second site they survived the bird damage albeit with reduced yield. The local variety failed to provide any seed at all.

The varieties from Upper Volta (Burkina Faso) were of 3 to 3.5 months duration and of good grain quality and were of a pearly while color. This was appreciated by farmers who do not like red or reddish colored grains.

ANOVA

Source	df	ss	ms	f cal	Prob
Site	1	4060512.3	4060512.3	26.35	.006
Error A	4	616352.8	154088.2		
Variety	4	3081844.5	770461.1	3.86	.022
Site x Var	4	1748043.8	437010.9	2.19	.116
Error B	16	3193313.2	199582.0		

CV = 32.49%

DUNCAN'S RANGE TEST :

Treatment	Yield kg/ha			
5	1783	a		
2	1623	a	b	
3	1454	a	b	c
4	1079		b	c
1	937			c

In this experiment, treatment 5 (ICSV 1003) was significantly better than treatments 1 and 4 but there was no significant yield difference between treatments 5, 2, and 3. The local variety yielded the poorest results.

This observation was interesting because now it seemed possible to outyield the local sorghum with one or more of the HYVs from Upper Volta but it required more testing so the varieties were multiplied and the seeds retained for the next season.

2.4.3 **Researcher managed trials #2 Berault**

At the same time a second type of simple trial was set up in Berault from the seeds received from the PDAI project in which there were only three treatments with or without fertilizer. The data were recorded from nine trials.

The treatments :

Treatment 1 = Local variety without fertilizer
Treatment 2 = Local variety with fertilizer
Treatment 3 = Madame Charmant without fertilizer
treatment 4 = Madame Charmant with fertilizer
Treatment 5 = M 5009 without fertilizer
Treatment 6 = M 5009 with fertilizer

The design:-

Rep1	T1	T2	T3	With fertilizer (F1)
	T1	T2	T3	Without fertilizer (F0)
Rep2	T2	T3	T1	With fertilizer (F1)
	T2	T3	T1	Without fertilizer (F0)

2.4.4. **Results :**

Site			Yield kg/ha Local T1	M.Charmant T2	M5009 T3
1	Rep 1	F0	2280	2111	3733
		F1	3400	2500	2222
	Rep 2	F0	1300	1111	1666
		F1	1080	1812	3250
2	Rep 1	F0	1440	2286	2556
		F1	2160	1667	2000
	Rep 2	F0	560	1111	2000
		F1	1600	1500	1667
3	Rep 1	F0	2368	1250	2444
		F1	2268	1778	1778
	Rep 2	F0	1520	1556	2444
		F1	2340	1778	1555
4	Rep 1	F0	640	2500	4000
		F1	1600	1333	2111
	Rep 2	F0	400	2000	3667
		F1	408	2556	3556
5	Rep 1	F0	1792	800	2000
		F1	2364	2667	2000
	Rep 2	F0	1760	1680	1840
		F1	1872	1333	lost
6	Rep 1	F0	1360	lost	2222
		F1	2154	2500	3000
	Rep 2	F0	1800	2000	2000
		F1	1200	2666	3375
7	Rep 1	F0	960	1333	2000
		F1	1440	1333	2000
	Rep 2	F0	1280	2143	2600
		F1	1840	1600	3000

8	Rep 1	F0	2320	1250	2444
		F1	2240	1778	1778
	Rep 2	F0	1520	1556	2444
		F1	2320	1778	2667
9	Rep 1	F0	1760	800	2000
		F1	2320	2667	2000
	Rep 2	F0	1760	1333	0000
		F1	1840	1680	1840

2.4.5. Statistical analysis

ANOVA

Source	df	ss	ms	f cal	5%	1%
Site	8	3779508.3	472438.5	0.78		
Blocks	1	604354.0	604354.0	0.99		
Error a	8	4862484.5	607810.5			
Treatment	5	1366886.9	2733773.9	8.74		
BlockxTreat	5	2750577.3	550115.46	1.76		
Error b	80	25014011.3	512675.14			

CV =28.47%

Duncans range test

Treatment	Yield kg/ha	
T1	1490	d
T2	1912	bc
T3	1622	cd
T4	1940	bc
T5	2501	a
T6	2319	ab

In the final analysis it was evident that the local variety of sorghum had the lowest yield without fertilizer but with fertilizer it did as well as Mme Charmant with fertilizer.

The variety M 5009 had on the average over one ton yield advantage over the local variety without fertilizer. With fertilizer, it yielded 2319 kg/ha which is a good yield for sorghum but not the potential of this variety.

It was clear that M5009 was the choice of most farmers not only because it gave a much higher yield than their local varieties but also took only three and a half months to mature compared with almost 5 months for the local varieties that are photoperiodic.

In the final recommendations made in this report, it is strongly suggested that M 5009 be multiplied for area wide extension.

2.5 1986 second season

2.5.1 Researcher Managed trials in Berault

In the second season of 1986 5 researcher managed trials were set up in Berault with 4 varieties and two replications per site with and without fertilizer.

The treatments were as follows :

Treatment
- T1 = M5009 without fertilizer
- T2 = M5009 with fertilizer
- T3 = E 35-1 without fertilizer
- T4 = E 35-1 with fertilizer
- T5 = ICSV 1003 without fertilizer
- T6 = ICSV 1003 with fertilizer
- T7 = ICSV1002HV without fertilizer
- T8 = ICSV1002HV with fertilizer

The design was a split block in RCB

2.5.2 The data

	Yield kg/ha								Average
Reps	T1	T2	T3	T4	T5	T6	T7	T8	
1	1310	1310	1980	1320	1580	1690	590	590	1296
2	1150	1310	590	980	1180	1560	930	590	1036
3	590	2020	1790	2250	1590	3040	1140	2240	1832
4	590.	1070	2070	2490	2740	3710	1330	1650	1956
5	1960	2760	1230	2460	1870	2280	1350	1670	1947
6	1230	3260	1230	2570	1740	2060	1660	2250	2000
7	1130	2040	1960	2580	720	1950	830	1140	1543
8	1150	4390	930	1440	1240	1130	730	830	1480
9	1000	1300	1600	2080	1100	1000	2290	1610	1497
10	1390	2290	1390	2390	800	2590	1290	1590	1716
Mean	1150	2175	1477	2056	1456	2101	1214	1416	

Statistical analysis

ANOVA

source	df	ss	ms	fvalue
Sites	9	7232081.25	803564.58	2.06
Treatments	7	12032758.75	1718965.53	4.41
Error	63	24549628.75	389676.64	
Total	79	43814468.73		

CV = 38.28%

Grand mean =1630
Contrast :

Treatments	1	2	3	4	5	6	7	8
contrast	-1	1	-1	1	-1	1	-1	1

The analysis showed that the treatments with fertilizer were better than the treatments without fertilizer which was expected.

What was less obvious was the fact that with fertilizer the varieties M5009, E35-1 and ICSV 1003 had about the same yield and had an advantage of over 600 to 800 kg over the unfertilized fields. The last variety ICSV 1002HV had the lowest average yield of 1416 kg/ha with fertilizer and had only a very slight yield advantage of 200 kg/ha over the unfertilized plot.

In the next season the same varieties were tested again with similar management using fertilizer applications.

2.6 .1987 First season :

2.6.1 Researcher managed trials

During the first season of 1987 a researcher managed trial was designed to test 3 Upper Volta varieties against the PDAI variety M5009 in a simple RCB design with 7 replications.

The treatments were as follows :
T1 = M5009
T2 = E 35-1
T3 = ICSV 1003
T4 = ICSV 1002 HV

2.6.2 The Data :

All the experiments were set up in La Force area of Berault where the site results were pooled to analyze the experiment as one. In replication 3 and 4 the variety ICSV 1002HV could not be harvested due to severe damage by birds and in other replications the bird damage was between 20 to 30 % as estimated.

Yield in Kg./ha

Variety	Rep1	Rep2	Rep3	Rep4	Rep5	Rep6	Rep7
M5009	1649	1949	621	1348	1500	2800	1900
E35-1	1028	1336	724	517	1800	1200	1200
ICSV1003	921	1030	515	621	1800	1000	1700
ICSV1002	520	621	(670)*	(330)*	1200	1800	1000

NB : * Missing values estimated

2.6.3 **Statistical analysis :**

ANOVA

source	df	ss	ms	F	5%	1%
Reps	6	4.95	.83	6.38**	2.66	4.01
Treatment	3	2.91	.97	7.46**	3.16	5.09
Error	18	2.28	.13			
Total	27	10.14				

CV = 30.81%

LSD .05 = 0.40
LSD .01 = 0.55

DUNCANS RANGE TEST

Treatment	Yield kg/ha
M 5009	1680 a
E 35-1	1111 b
ICSV 1003	1080 b c
ICSV 1002HV	790 c d

In this experiment where the treatments were highly significant, the variety M5009 was on the average superior to the Upper Volta varieties which suffered considerable bird damage. There was no significant yield difference between the varieties E 35-1 and ICSV 1003. The variety ICSV 1002HV was the lowest performer but could do better if bird damage could be better controlled. The Haitian farmers do not have a tradition of constantly guarding their fields during grain ripening so they did a poor job of chasing the birds away even when they were paid to do so. Many experiments with sorghum in Maniche were lost this way. It is also very difficult to carry on research on sorghum out of season. Nevertheless the data showed that M5009 performed well even during the first season and should now be considered for extension and seed multiplication.

E 35-1 and the two ICSV lines should be continued as alternate varieties that surely have the potential of outyielding the local varieties during the main sorghum season. They also have excellent grain qualities.

2.7 **Researcher managed varietal trial in Bereault**

During the same period new 12 varieties from Upper Volta were planted in Macieu for the first time to observe their performance. This trial was not analyzed due to insufficient data. We had only two sites with two replications. The native

varieties of Upper Volta did not bear panicles so none were harvested. The data are presented below for the six varieties harvested :

Varieties	Yield kg/ha				Average yield in kg/ha
	Rep 1	Rep 2	Rep3	Rep4	
ICSV 16-5	275	340	750	650	504
85W89	850	900	750	900	850
ICSV 1078	1100	1400	1325	1300	1281
ICSV 1056	1425	1250	1675	1350	1425
85W81	1350	1350	1250	1200	1288
85W201	800	850	1000	1100	938
Die Dan Kan Fiagi	No panicles				
Fiadi Muanga	,,				
Biadi Pieni	,,				
Conlooli	,,				
Suoodi Pieni	,,				
85W120	,,				

Here the variety ICSV 1056 needs further testing .

2.9 **Pre extension trials of M5009 in Berault :**

In Berault 18 pre-extension plots of the variety M5009 were harvested and the data recorded as follows :

Site	Yield in kg/ha
1	2500
2	2700
3	2000
4	1599
5	1393
6	3063
7	562
8	1711
9	2042
10	814
11	2467
12	2050
13	1824
14	1922
15	1744
16	1501
17	1567
18	3513
Mean	1943 kg/ha

Here the variety M5009 had given an average yield of 1943 kg/ha which was twice the average yield of local varieties. This proved that HYVs of sorghum could be planted anytime during the year depending on the rains and get much higher yield /hectare than local cultivars.

2.9 Researcher managed trial of Pearl Millet.1986 (1st season)

During the first season of 1986 a simple trial was set up at the Levy farm near Camp Perrin to test 5 pearl millet varieties that came from the ICRISAT station in Ouagadougou, Upper Volta.

The idea was to test the feasibility of introducing pearl millet as a drought resistant crop in the mountainous zones where crops often fail due to lack of rain. Although pearl millet is known in some parts of Haiti and known as mil chandelle, it is an unknown crop in the Les Cayes area.

The treatments were as follows :

T1 = ICMS 7704
T2 = ICMS 7703
T3 = WC-C-75
T4 = ICMV 8111
T5 = ICTP 8203

The experiment was planted with two replications but the second replication suffered poor germination and late weeding.

The data

	Yield kg/ha		
Treatments	Rep 1	Rep 2	Mean
T1	573	453	513
T2	467	160	314
T3	1027	213	620
T4	1013	547	780
T5	427	280	354

Statistical analysis

ANOVA

source	df	ss	ms	f value	prob
Reps	1	343731.6	343731.6	8.53	0.043
Variety	4	295867.0	73966.75	1.83	0.235
Error	4	161273.4	40318.50		
Total	9	800872			

CV=38.91%
Grand mean = 518 kg/ha

DUNCANS RANGE TEST

Treatment	Yield kg/ha	
T4	780	a
T3	620	a b
T1	513	b c
T5	353	c d
T2	313	d

The experiment was not very conclusive due to poor yields of most varieties and was discontinued.

2.10 Researcher managed trial on sorghum at Levy farm

1986 1st season

A researcher managed trial similar to one planted in Berault was planted at the Levy farm during the first season of 1986.

The treatments were as follows with three replications :

Treatments

T1 = M5009
T2 = E 35-1
T3 = ICSV 1003
T4 = ICSV 1002Hv

The Data

Yield kg/ha

Reps	T1	T2	T3	T4
1	770	1167	1250	615
2	437	1083	667	375
3	1458	700	850	1007
Mean	883	983	922	665

LSD .05 = 278.5

There was no significant yield difference among varieties although on the average the variety E 35-1 performed slightly better than others.

CHAPTER THREE

RECOMMENDATIONS FOR RICE AND SORGHUM :

3.1 RICE : WETLAND RICE

On-farm applied rice research carried out by the agronomists of the ADS II project since October 1984 ended in the establishment of a permanent seed multiplication farm in Bruny that has been operational since April 1987.

The objective of the Bruni program is to produce 30 tons of Amina seed every season so that it can be distributed to other rice farmers in the plain of Cayes and elsewhere in Haiti. This seed will be available to all concerned at the current market price of paddy rice and can be purchased directly from the cooperative operated by the rice farmers of Bruny.

There are, however, a few recommendations that ADS II field agronomists would like to make.

1. Amina or any other HYV of rice introduced by the ADS II project should be cultivated with care. This includes keeping the seed from contamination with other varieties. In Bruny the quality control is assured by the presence of an agronomist but where farmers depend upon themselves, they must weed out off types before harvesting.

2. The field should be prepared and the grains from the previous crop (even if it is Amina) allowed to germinate. Then the field should be plowed again to destroy the seedlings thus making the field free of off types. This procedure should be repeated every season to assure that Amina remains pure.

3. Wherever possible, the rice straw should be either burned and the ashes mixed with the soil or chopped and plowed in. In the first case it adds potash to the soil and in the second case it also increases the organic matter in the soil. Both are good practices.

4. The seedlings need to be raised with care. Leaving seedlings ~~in the seedbed more than 21 days will drastically reduce~~ yields so fields must be ready for transplanting on the 21st day after seeding rice in the seedbed.

5. A simple marker method to trace rows 20 cms apart is ideal to provide optimum density but it will require very good land preparation. Fields prepared with hand hoe have too many roots or other vegetative matters that impede the easy passage of a marker. One method is to fill up paddies with water for a prolonged period of time so that the

organic matter decomposes thus making the field preparation easier. This of course depends upon the availability of water that can not always be guaranteed.

6. ADS II recommends a very moderate dose of fertilizer. 90 kg of Nitrogen or 200 kgs of Urea/ha is recommended although HYVs like Amina can take up to 160 kg of Nitrogen and still be profitable.

   For P2O5, ADS II recommends 60 kg/ha as a basal dose. This can be provided by superphosphate (46%) or many other complete fertilizers in the market that also contain Potash. One half of the nitrogen should be basally applied and the other half applied at the panicle initiation stage. For HYVs the panicles start at about 45 days after transplanting so a plant can be dissected at that time to see if the panicle has started developing.

7. It is important to maintain 2 to 5 cms of water standing in the paddies for the first thirty days (30) so that the maximum weed control is obtained.

   Rice requires no weeding after thirty days because at that time the canopy closes making it difficult for the weeds to grow. The first weeding should be done 20 days after the field is transplanted. It is easier to do the weeding if the field is planted in rows. Random planting practiced by most Haitian farmers makes weeding very difficult job.

8. Amina, TiRose, CIAT 31613, and CIAT 31616 are all good rice varieties although Amina is the most preferred. However, all these varieties will become obsolete in 5 to 8 years time unless new research is initiated and these varieties replaced. Agricultural research is perhaps the most dynamic and every year improvements are being made over the older varieties so a constant contact should be maintained by Haitian agronomists with all the international centers of rice research to obtain from them the latest results. The international centers will be happy to send seed materials for testing at a nominal cost or often free.

9. Massive extension efforts need to be made to make Amina popular all over Haiti. On its own it will spread but it will take time. The Ministry of Agriculture should take a very active interest in promoting increased food production.

10. Lastly, rice threshers and blowers developed by the project should be mass produced preferably by the farmers themselves at low cost so that all rice farmers can make use of them. It would be ideal to set up an "Appropriate technology Center" in Bruny where a modern workshop can be built with as little as 15000 dollars. There the farmers can be trained to build simple tools like to blowers and the threshers.

6.2 UPLAND RICE :

1. Although the research on upland rice is relatively new and the project has less data, it would appear that a few upland varieties like IRAT 13 and IRAT 101 need special consideration. IRAT 13 and 101 both have given yields of over 2.5 tons/ha which by upland standard is no small feat.

2. At least one more year of research and many field trials should be set up very thoroughly for all the varieties to see which one merits going into pre-extension trials. If enough seeds are available, IRAT 13 and 101 should go into pre-extension trials next season while still being included in researcher managed trials for further verification. This gains time.

3. It is difficult to make recommendations for the fertilizer because upland rice totally depends on rains. However, if the soil moisture conditions are optimum, then within 15 days of seeding 40 kg Nitrogen should be applied as top dressing right after the first weeding.

   The second dose of 40 kg N /ha can be applied one month after the first application only if there is enough soil moisture. For P2O5 a dose of 60 kg/ha is recommended. This should be thoroughly mixed with Urea and applied within 15 days of seeding.

4. Only one weeding before the 30th day is required. Row seeding is the recommended practice.

5. Washing the seeds before seeding is a must. This practice removes the unfilled grains and gives better than 95% or more germination to the selected grains.

6. Rodent control is necessary in both wetland as well as upland rice.

6.3 SORGHUM :-

1. After a few years of intensive research on sorghum the ADS II project recommends that the variety M5009 be extended to all sorghum farmers. It has consistently out-yielded the local varieties and takes only 3 and 1/2 months to mature.
   It is a non-photoperiodic variety that can be planted in both seasons as a rainfed crop. It has good grain quality and color. The problem however, is the shortage of seed. A seed farm modelled after Amina seed farm in Bruny is perhaps the logical solution.

2 The rows are recommended 75 cms apart but many seeds should be planted and weeded leaving only 2 good plants per hill after 10 days of seeding. Reseeding after 10 days is useless because the reseeded hills never catch up with the rest of

the crop. The missing hills can be planted with thinned plants at the time of first weeding that should start 10 days after seeding. Row planting can make weeding easier.

3. At ICRISAT, India, a great deal of research has been done on sorghum and pigeon pea intercropping and some useful data obtained. The ADS II effort on pigeon pea research did not prove sucessful yet most Haitian farmers plant sorghum with pigeon pea. The pigeon pea varieties take 7 to 8 months to mature. In the future some HYVs of pigeon pea from ICRISAT should be looked into that take only 4 months to mature. This way total returns on sorghum/pigeon pea intercropping can be dramatic.

Sorghum varieties like E 35-1, ICSV 1003 and M5009 should all be pushed into a seed multiplication phase and wider extension.