NATIONAL IRRIGATION BOARD

NIB

Operational Research and Training Project

AHERO IRRIGATION RESEARCH STATION
RESULTS OF THE LONG RAINS 1983 RESEARCH STATION
TECHNICAL REPORT NO. 26

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Results of the long rains 1983 research programme

Technical Report No. 26

Ahero, February 1984

CONTENTS

1. GENERAL INTRODUCTION

This report presents the results obtained from the LR83 research programme for Ahero and Mwea Irrigation Research Stations. The report includes a chapter on upland crops trials conducted in Bunyala and West Kano, which underlines the committment by the National Irrigation Board to make a significant contribution towards self-sufficiency in food production for Kenya. In the efforts to promote these food crops, emphasis is placed on developing or adopting low-input technology that will help farmers to maximize on profit, and minimize the Board's in[redacted]zation Consequently, zero tillage and use of animal power are important components of the upland crops programme. It is intended that these crops would be basically rainfed. Indeed, it is believed that cultivation of dry fo[redacted]d crops in the long rains season would create soil conditions favourable for the rice cr[redacted]in the subsequent short rains season. The r[redacted] research programme, therefore, is aimed at sele[redacted]ving rice varieties that [redacted] the favourable growing conditions emanating from these changes. A suitable management package comprising of crop husbandry, crop protection and water [redacted]t remains the single m[redacted] programme.

1.1. RESEARCH PERSONNEL

1.1.1. Senior Staff

J.J. Njoka - Senior Research Officer and Officer-in-Charge

M.M. Okhoba - Entomologist

A.W. Mwangi - Pathologist

Y.W.K. Malinga - Guest Entomologist

G.A. Mawero - Assistant Research Officer (Agronomy)

S. Eguchi - Agronomist/Mechanization Specialist

S.M. Ouma - Assistant Research Officer (Water Management)

V.A. Wamalwa - Assistant Research Officer (Agronomy)

C.M. Mburugu - Assistant Research Officer (MIRS)

1.1.2 FIELD STAFF

B.O. Ogolla - Head Field Assistant, AIRS

S. Daya - Field Assistant - Labour

P. Owiti - Field Assistant - Machinery, Irrigation works, land preparation

J. Odongo - Field Assistant - Sugarcane agronomy and upland crops

J. Adoyo - Field Assistant - Rice Agronomy

L. Juma - Field Assistant - Entomology

W.J. Nyamunga - Field Assistant - Rice Agronomy

V. Abura - Lab. Assistant, Soils Laboratory

H. Otieno - Field Assistant, Irrigation and Drainage

S. Magondu - Head Field Assistant, MIRS

1.1.3 STAFF CHANGES

During the season reported, there were a number of changes with the Senior Staff cadre:

Mr. P.K. Kuria, Acting Officer-in-Charge was transferred to Hola Irrigation Research Station

Mr. E.M. Njoka, Assistant Research Officer (Agronomy) left the Board and joined Egerton College

Mr. M. Shibata, Soil Chemist left for Japan after his contract expired

Mr. V.A. Wamalwa, Assistant Research Officer (Agronomy) joined the station (new Egerton graduate)

Mr. C.M. Mburugu, Assistant Research Officer ~~(MIRS)~~, joined the station (new Egerton graduate).

2 AGRONOMY (JJN, GAM, SE, VAW)

2.1 RICE VARIETY SELECTION

2.1.1 Medium/late maturing varieties (LR 83 001 RA 016).

2.1.1.1 Introduction:

Crop maturation periods vary quite alot depending on climatic and weather conditions.
The same variety will take slightly longer to ripen in Mwea than in the Western Kenya Schemes. This is largely due to the lower mean temperatures associated with Mwea. Maturation periods are especially important where double and multiple cropping are practised. Under these conditions, early medium maturing varieties are prefered to late maturing varieties because they increase the turn-around period between any two crops.
Medium/late maturing varieties in our case are defined as those maturing in 120 - 140 days.

2.1.1.2 Objectives:

The aim of the experiment was to compare the yield performance of nine medium/late maturing varieties with IR 1561-228-3-3, a commercial variety.

2.1.1.3 Materials and Methods:

The varieties were tested using a randomised complete block design replicated four times. The seedlings were transplanted when 21-days old on plots of 5m x 5m, at a spacing of 20 x 20cm. Two seedlings were planted per hill. Nitrogen fertilizer (Sulphate of ammonia) was applied on two split applications: 26 KgN/ha at transplanting and 26 Kg/ha at 42 DAT. Two hand-weedings controlled the weeds while insect pests were controlled by application of Furadan. Yield data was collected at harvesting.

2.1.1.4 Results and Discussion:

There were highly significant differences among the varieties tested. Highest yield was recorded from IR 2793-80-1, and the lowest from BW 196. The poor performance of BW 196 in Ahero is disappointing in view of its rather good yields in Bunyala in the previous season (Njoka et al, 1983). Three varieties IR 2793-80-1, IR 54 and BG 400-1 outyielded the commercial variety IR 1561-228-3-3, but the differences were not significant (Table 1).

Another commercial variety, BG 90-2, performed rather poorly in Ahero, even though it has very high yields in Bunyala and Mwea.

Table 1. Mean grain yield (Kg/ha at 14% MC) of ten varieties grown at AIRS in LR 83:

Variety:	Mean yield	% of commercial variety (IR 1561-228-3-3)
IR 2793-80-1	4533 a	115%
IR 54	4218 ab	107
BG 400-1	400[illegible] ab	102
IR 1561-228-3-3	3948 ab	100
BG 96-2	3858 ab	98
IR 1529-167-2-2	3655 ab	93
IET 2254	3285 abc	83
BG 90-2	3105 abc	79
ITA 6850	2895 bc	73
BW 196	1985 c	50

S.E = 363 Kg/ha
C.V = 21%

In a column, means followed by the same letter are not different (DMRT), P = 0.01).

The poor performances of both BW 196 and BG 90-2 in Ahero is attributed to their susceptibility to RYMV (Table 2), a disease less serious in Bunyala where single cropping is practised. RYMV has not yet been reported in Mwea. IET 2254, BG 96-2 and IR 1529-167-2-2 showed moderately high incidences of spikelet sterility. Glume discoloration was noticeable on BW 196, ITA 6850 and BG 90-2. These three varieties also had marked incidence of sheath blight.

Table 2. Other agronomic characters of the medium/late varieties, LR 83:

Variety:	Days to maturity	RYMV	Brown spot	Glume discol.	Spikelet sterility	Sheath blight.
IR 2793-80-1	124	1.0	1.1	1.6	1.0	1.4
IR 54	140	1.3	1.0	1.0	2.5	1.0
BG 400-1	142	1.4	0.9	1.8	3.0	0.6
IR 1561-228-3-3	122	0.9	1.3	1.3	1.0	1.4
BG 96-2	141	1.2	0.9	1.3	4.5	1.4
IR 1529-167-2-2	141	1.0	0.9	1.6	4.0	0.8
IET 2254	133	0.9	0.9	1.6	5.0	0.8
BG 90-2	123	1.8	1.2	2.6	2.5	3.4
ITA 6850	118	1.2	1.1	2.8	1.5	3.8
BW 196	147	2.3	1.1	2.8	3.0	3.8

Notes:
1) Days to maturity estimated from: days to 50% flowering + 35 days.
2) RYMV: Mean of scores taken at 28, 42, 56, 70 and 84 DAT.
3) Brown spot: Mean of scores taken at 28, 56, and 70DAT.
4) Glume discoloration: Mean of scores taken at 84 and 98 DAT.
5) Spikelet sterility: scores taken at 84 DAT.
6) Sheath blight: Scores taken at 98 DAT.

2.1.1.5 Conclusions:

Despite the low average yields characteristic of long rains IR 2793-80-1 and IR 54 gave yields higher than the commercial variety. Consquently, the two are already being tested in site performance trials (SR 83).

2.1.2 EARLY MATURING VARIETIES (LR '83 001 RA 016):

2.1.2.1 Introduction:

The gradual shift from double cropping to single cropping in the NIB rice growing schemes has played down the importance of early maturing varieties. Nevertheless, it must be accepted that multiple cropping is one method of increasing food production without necessarily expanding the acreage under cultivation. To this end, early maturing varieties would make it possible to grow several crops per year on a given price of land.

2.1.2.2 Objectives:

This trial was conducted with the aim of comparing the maturation periods and yield potential of nine varieties with IR 1561-228-3-a commercial variety in Western Kenya Schemes.

2.1.2.3 Materialsa and Methods:

The varieties were grown at AIRS during the LR 83 season in a randomised complete block design with four replications. Twenty one days-old seedlings were transplanted at the rate of two seedlings per hill and spacing of 20 x 20cm. Plot size was 5 x 5m. Sulphate of ammonia was applied at transplanting and at 42 DAT at the rate of 26 KgN/ha each application. Handweeding was done twice and Furadan was used to control insect pests. Date selected included maturation periods, yield data, incidence of disease and insect pests.

2.1.2.4 Results and Discussions:

The yield data is given in Table 3. The data shows highly significant differences among the ten varieties tested. Four varieties outyielded the commercial check, IR 1561-228-3-3, without reaching significance levels. However, the highest yielder, BG 400-1 gave significantly better yields than five other varieties. The low average yields are attributed to the prevailing weather conditions as in other trials reported. The best two yielders - BG 400-1 and IR 54 were also among the best three in the medium/late maturing trial. Maturation periods (seed - seed) did not exceed 140 days, the earliest being Abdala Mbana, and the latest BG 400-1. Only one variety matured earlier than IR 1561-228-3-3. The most serious disease appeared to be sheath blight, although BG 34-8 and UPR 251-101-2 showed moderate infection by RYMV and glume discoloration respectively (Table 4).

Table 3. Mean grain yield (Kg/ha at 14% MC) of the early maturing varieties, LR 83.

Variety:	Mean yield:	% of commercial variety (IR 1561-228-3-3)
BG 400-1	4300 a	135%
IR 54	3923 ab	123%
IR 36	3348 abc	105
ITA 6838	3280 abc	103
IR 1561-228-3-3	3190 abc	100
IR 1529-680-3	2938 bc	92
BG 34-8	2868 bc	90
ABDALA MBANA	2755 bc	86
UPR 251-101-2	2748 bc	86
IR 42	2430 c	76

S.E = 307 Kg/ha

C.V = 19%

In a column, means followed by the same letter are not different (DMRT, P = 0.01).

Table 4. Other agronomic traits of the early maturing varieties, LR 83.

Variety:	DMT	RYMV	BS	GD	SS	SB	PH
BG 400-1	140	1.4	1.0	1.0	3.0	1.4	98
IR 54	139	1.7	0.6	1.0	3.0	2.0	95
IR 36	126	1.4	0.8	1.0	3.0	1.8	96
ITA 6838	138	1.9	1.0	1.1	2.5	3.2	108
IR 1561-228-3-3	125	1.[illegible]	0.9	1.0	1.2	0.8	97
IR 1529-680-3	132	1.5	1.0	1.5	3.0	2.0	98
BG 34-8	136	2.5	1.0	1.3	3.0	2.2	109
ABDALA MBANA	116	0.5	0.4	1.6	1.5	1.0	134
UPR 251-101-2	128	1.6	1.0	2.3	2.0	3.0	89
IR 42	135	1.4	1.0	1.4	4.5	2.0	92

Notes: 1) DMT = Days to maturity (seed to seed), estimated from: days to 50% flowering + 35 days.

2) RYMV - Mean of scores made at 28, 42, 56, 70 and 84 DAT

3) BS (Brown spot): Mean of scores made at 14, 28, 42, 56 and 70 DAT.

4) GD (Glume discoloration): Mean of scores made at 84 and 98 DAT.
5) SS (Spikelet sterility): scores made at 84 DAT.
6) SB (Sheath blight): scores made at 98 DAT.
7) PH (Plant height): in cm at 98 DAT.

2.1.2.5 Conclusions:

Only Abdala Mbana, a tall traditional variety matured earlier than IR 1561-228-3-3. Four varieties, however, outyielded the commercial check. Among these, BG 400-1 needs further testing at large scale level in view of its good performance in both early and medium/late variety trials. IR 54 has reached the site performance trials and is proposed for the Minibag Programme.

2.1.3 VARIETY DESCRIPTION TRIAL - AIRS AND MIRS (LR '83 0003 R 21).

2.1.3.1 Introduction:

At present some 300 different varieties, collected over the years are in Ahero Irrigation Research Station. A comprehensive description of each of them is missing although the most important commercial varieties are fairly well known in their performance. As for any selection, breeding or seed multiplication programme it is essential to know the material one is working with, it was felt that a modest variety description trial would be justified. More so it was noted in the Research Station that a serious degree of mixture exists in the current varieties tested. A continuation in seed production with this material could eventually lead to quality and important financial losses.

2.1.3.2 Objectives:

The aims of the trial were twofold. Firstly to describe the varieties tested according to the IRRI's standard evaluation system as to enable the breeder to select his material properly. Secondly to purify the varieties as to produce pure seed for a seed multiplication and maintenance programme.

2.1.3.3 Materials and Methods:

Twenty one promising and commercial varieties were selected in first instance. The seed was raised in nurseries and transplanted after 22 days; spacing 25 x 25cm; 1 plant per hill in plots of 1.25 x 2.00m. All other practicies were according to the current recommendations. The trial was set up at AIRS and at MIRS.

Table 5. Morphological and Physiological traits rice variety description trial. AIRS - LR '83 sowing date: 17/3/83 Transplaning date: 8/4/83

Harvesting dates: 25/7, 1/8 and 5/8/83

No.	Variety	5% Flower	50% Flower	Growth* duration	Plant height	Yield** t/ha	Total tillers	Productive tillers	Panicle length	L	1	L/1	1000 grain weight	RY*** MV	SF*
1.	IR 1561-228-3-3	30/5	8/6	128	99	3.35	27	28	24.5	9.3	2.8	3.3	26.0	1	0
2.	BG 34-8	6/6	15/6	132	99	3.46	26	25	21.0	7.2	3.1	2.3	24.2	0	1
3.	UPR 251-101-2	9/6	17/6	129	90	3.80	34	23	18.5	9.0	2.7	3.3	20.0	0	1
4.	IR 36	10/6	13/6	132	100	3.53	33	24	22.3	9.4	2.5	3.8	19.0	1	0
5.	BG 400-1	11/6	16/6	131	96	2.52	28	15	18.4	8.7	3.2	2.7	28.0	1	1
6.	IR 42	11/6	15/6	131	84	2.06	38	21	20.4	8.4	2.7	3.1	16.5	3	0
7.	ITA 6838	13/6	18/6	136	90	2.62	32	18	24.5	10.2	2.7	3.8	24.0	2	2
8.	CHIANUNG SEN YU 13	14/6	20/6	134	83	3.04	30	23	23.2	8.5	2.7	3.1	18.8	1	2
9.	IR 2793-80-1	15/6	21/6	138	104	3.65	36	28	22.3	8.9	2.5	3.6	22.0	0	3
10.	BR 51-74-6	16/6	22/6	141	99	2.63	29	19	23.2	8.2	2.8	2.9	21.0	1	2
11.	KAOSHUNG 139	16/6	22/6	138	104	3.68	35	20	19.8	7.1	3.5	2.0	25.5	0	1
12.	BKN 7033-13	17/6	23/6	137	93	2.51	29	12	19.7	8.5	2.8	3.0	23.9	1	2
13.	Chinese	17/6	23/6	147	93	2.16	42	30	19.6	9.2	2.5	3.7	18.9	2	2
14.	BG 90-2	18/6	23/6	143	94	2.31	38	17	24.8	8.7	2.8	3.1	21.1	3	2
15.	ITA 6850	18/6	24/6	139	100	4.25	40	23	23.2	9.5	3.4	2.8	23.0	1	1
16.	IR 54	20/6	25/6	140	89	2.95	36	23	22.2	8.9	2.7	3.3	20.1	2	2
17.	IR 1529-167-2-2	22/6	30/6	142	97	4.48	35	25	19.6	8.4	3.3	2.5	27.0	0	2
18.	BW 196	28/6	5/7	148	90	4.65	40	19	21.3	9.1	3.2	2.8	26.0	0	2
19.	IR 822-347	30/6	7/7	150	99	1.89	43	24	19.9	7.3	3.2	2.3	24.9	3	1
20.	IET 2254	2/7	8/7	148	88	3.76	42	14	23.9	9.2	2.7	3.4	26.7	1	1
21.	BG 96-2	4/7	11/7	154	87	2.57	39	9	20.7	8.7	3.1	2.8	29.0	1	0

* Estimated

** $2.5 m^2$ plots

*** 0 = Resistant 3 = Susceptible.

Table 6: Morphological and Phisiological traits of the rice variety description trial, MIRS, LR 83. Sown 14/3/83, transplanted 9/4/ 1983.

	Variety:	Total till. per hill.	Productive tillers per hill	First flower DAS.	Date 50% flowering reached	Mean plant height	Days to ripening (DAS)	% fertile spikelets	Damage by Diopsis	1000 grain wt(g)	Grain yi t/ha.
1.	BG 90-2	13	12	100	107	68.3	142	75	12.3	30.1	4.36
2.	BW 196	20	20	112	123	80.4	158	90	13.6	29.6	4.44
3.	IR 8 ("New")	22	22	122		113.4		86	8.9	21.0	4.[illegible]4
4.	IR 2035-255-2-3-1	25	25	113	122	79.9	157	79	6.8	27.2	4.40
5.	BR 51-74-6	13	13	112	123	94.4	158	64	8.4	25.4	5.[illegible]4
6.	PALIMANI	16	13	84	96	90.3	131	88	9.3	26.0	1.76
7.	BIBI YA MUHAKA	14	13	83	96	104.0	131	66	10.3	29.3	1.72
8.	IR 54	18	17	96	123	80.5	158	64	9.4	24.9	4.54
9.	CHINESE	13	13	105	123	71.8	158	65	11.2	32.4	4.00
10.	IR 822-347	15	15	100	107	69.6	142	87	10.2	24.6	5.76
11.	IET 2254	19	18	91	115	67.4	150	64	10.5	25.0	4.[illegible]8
12.	IP 28	19	18	85	91	78.9	126	85	9.4	26.3	5.[illegible]
13.	IR 2793-80-1	17	17	100	115	74.5	150	76	9.2	27.0	6.4[illegible]
14.	IR 8("Old")	13	11	102	110	75.1	145	73	12.0	31.2	4.5[illegible]
15.	ITA 6850	15	14	100	115	77.2	150	81	8.3	29.0	4.8[illegible]
16.	ITA 6838	13	13	102	115	75.1	150	75	8.0	27.8	6.[illegible]
17.	KN-1B-136-1-8-6-9-1	12	12	100	107	107.7	142	84	9.4	30.3	5.38
18.	IR 532-144	16	16	87	96	67.4	131	74	8.2	29.1	3.54
19.	IR 1561-228-3-3	16	16	85	96	66.5	131	79	11.1	27.7	3.[illegible]2
20.	IR 2071-625-1-252	17	17	92	96	67.8	131	79	8.7	27.5	6.36

2.1.3.4 Results and Discussion:

The results of the variety description trial are given in Table 5 and 6. This exercise was conducted so as to provide a plant breeder/agronomist with some broad information about some basic characteristics of the tested varieties.

Growth duration was estimated either by visual observations, or by computing using the 50% flowering date. Grain yields are only approximate as they were based on small plots.
Grain measurements were not taken in MIRS due to lack of suitable instruments in the station.

2.1.3.5 Conclusions:

More attentions will be paid towards systematic recording of all traits. Rogueing should be done with great care while sample plants (10) per variety should be selected for counting and measuring purposes. The plot size will be increased to five rows of 10m, with alleys of one meter between varieties.
At this point, no firm conclusions can be drawn from this trial.

2.1.4 Site Performance Trials, APS (LR 83 002 RA 019):

2.1.4.1 Introduction:

As in the previous season, a selection of promising varieties was tested in both research plots (extra plots in the scheme) and farmers' fields. However, the trial was only conducted in APS since WKPS and BIS remained fallow throughout the season.

2.1.4.2 Objectives:

In this trial, five varieties selected from the previous season were compared for their yield potential and other major agronomic traits under both research and farmer conditions.

2.1.4.3 Materials and Methods:

In the research fields, the trial was laidout in a randomised complete block design with three replications, in block K and M. The plots measured 6 x 8m and the spacing was 20 x 20cm. Nitrogen fertilizer was applied at the rate of 52 KgN/ha, split into two equal doses, one at transplanting and the second at 42 DAT. In the farmers' fields, each plot was one acre, all husbandry practices being as per scheme recommendations. The five varieties were given to selected farmers in blocks D and M of APS.

The five varieties tested were:

1. BG 96-2
2. IR 2793-80-2
3. IR 1529-167-2-2
4. IET 2254
5. IR 54

2.1.4.4 Results and Discussion:

i) Research fields.

The yield data from the two blocks is presented in Table 7. No significant yield differences are indicated from either block. However, three varieties turned out to be the best three yielders irrespective of the block where they were grown. These were: IR 2793-80-1, BG 96-2 and IR 54.
When compared with yields (of the same varieties) during the previous short rains season, the long rains yields were much lower (ANON, 1983). This is in agreement with the general observation that rice yields are higher in the short rains than in the long rains.
Despite the low average yields characterising the season, it is noted that IR 54 retained a good position as it did in a similar trial in the Table 7. Mean yield data of five varieties grown in blocks M and K of APS, LR 83.

Variety:	Yield (Kg/ha)		
	Block K:	Block M:	Mean:
IR 2793-80-1	4545 a	4910 a	4728
IR 54	4101 a	4236 a	4169
BG 96-2	3832 a	5236 a	4534
IET 2254	3686 a	4035 a	3861
IR 1529-167-2-2	3667 a	3875 a	3771
S.E	299.7 Kg	669.8 Kg	
C.V	13.1 %	26.0 %	

In a column, means followed by the same letter are not different (DMRT, P = 0.05).
Previous season. It is also evident from Table 8 that there was no serious incidence of disease or insect pests, though some damage due to brown spot, glume discoloration, stalk eyed fly and leaf miner was recorded.

The prevailing weather conditions may have caused the slightly higher incidence of spikelet sterility.

Table 8. Some agronomic traits of the varieties from the large scale trial.

Variety:	Vigour 23 DAT	Tillering 56 DAT	Leaf miner 28 DAT	Stalk eyed fly 56 DAT	Brown spot 56 DAT	Leaf blast 56 DAT	RYMV 70 DAT	Glume discoloration 84 DAT	Spikelet sterility 84 DAT	Panicle exertion 84 DAT
IR 2793-80-1	3	1	3	4	2	2	0	1	1	1
IR 54	5	1	3	5	2	2	0	2	2	1
BG 96-2	4	1	3	3	2	2	0.3	1	3	3
IET 2254	4	1	3	3	3	2	1.3	2	3	3
IR 1529-167-2-2.	5	1	3	4	2	2	0.3	1	3	3

ii) Farmers' fields:

The yield data from the farmers fields is given in Table 9.

Table 9: Yield (Kg/ha at 14% M.C) of five varieties grown by farmers in blocks D and M (APS), LR 83.

Variety:	Block D:	Block M:	Mean:	% of Commercial variety (IR 1561-228 3-3).
BG 96-2	4173	4446	4310	78%
IR 2793-80-2	7508	4076	5792	105
IR 1529-167-2-2	7449	4817	6133	111
IET 2254	4441	4817	4629	84
IR 54	7507	5072	6890	124
IR 1561-228-3-3	6080	5002	5541	100

Of the five tested varieties, three (IR 54, IR 1529-167-2-2 and IR 2793-80-2) outyielded the commercial variety IR 1561-228-3-3. Indeed, IR 54 gave the highest yield from both blocks. Block D yields were higher than those from Block M. Poor water supply in block M resulting in delayed transplanting, poor weed control and low fertilizer utilization is suspected to have been the cause for the poor yields in that block. A severe cold spell occurred when the crop in block M was in the ripening stage and this may have affected the yields. No serious incidence of disease or insect pest was reported.

2.1.4.5 Conclusion:

Two varieties - IR 54 and IR 2793-80-2 performed well in both research fields and farmers fields. It is proposed to put them in the Minibag Programme for APS during the LR 84 season.

2.2 AGRONOMY TRIALS:

2.2.1 FERTILIZER TRIAL (LR 83 006 RA 029)

2.2.1.1 Introduction:

Efficiency of fertilizer utilization will depend on method of application and time of application. There is currently a school of thought that suggests that avoiding basal application of Nitrogen fertilizer in favour of topdressing may be beneficial. It is argued that it reduces lodging, disease and pest attack during the vegetative stage and leads to an increase in yield (Matsushima, 1977).

2.2.1.2 Objectives:

The trial was set up to determine the most suitable method and time of N-fertilizer application and also to establish the best rates combination based on 52 KgN/ha.

2.2.1.3 Materials and Methods:

A split plot design with three replications was adopted, with varieties in main plots and fertilizer application timings in the subplots. Two commercial varieties - Basmati and IR 1561-228-3-3 were used. Fertilizer was applied at different DAT's viz: based tillering, reduction division (20-25 days before heading) and at full heading. The methods of application were basal, (which is standard) and topdressing at different stages of growth. All other cultural practices were as per recommendations.

2.2.1.4 Results and Discussions:

Yield data appears in Table 10.

Table 10. Yield in t/ha of Basmati and IR 1561-228-3-3 grown under varying N-fertilizer treatments, LR 83.

Treatment:	Yield (t/ha):		
	Basmati	IR 1561-228-3.3.	Mean:
Basal application	4.45	4.29	4.37
Topdressing at tillering	4.47	3.59	4.03
Topdressing at reduction div.	4.38	4.25	4.32
Topdressing at full heading	2.94	3.30	3.12
S.E	0.28 t/ha	0.52 t/ha 26%	

Significant yield occurred among treatments for Basmati but not for IR 1561-228-3-3. Significant yield differences were observed among the topdressing treatments, with topdressing at tillering and at reduction division being better than topdressing at full heading. There was no difference between standard application (basal) and topdressing treatments.

However, it is noted that in Basmati, highest yields among the replications were found from plots topdressed at tillering (4.99 t/ha and at reduction division(4.83 t/ha), suggesting that it is most beneficial to topdress between 42-56 DAT. This is in agreement with our current recommendation whereby we apply 26 KgN/ha basal and 26 KgN/ha topdressing at 42 DAT.
The variety IR 1561-228-3-3 was seriously affected by RYMV (this trial was planted late and this probably explains the serious attack), and this may have led to the lack of differences among the treatments.

2.2.1.5 Conclusion:

Utilization of Nitrogen fertilizer was best when some fertilizer was applied at the time of transplanting, followed by topdressing in the period 42-56 DAT.

2.2.2 LONG TERM AZOLLA TRIAL (LR 83 004 RA 022):

2.2.2.1 Introduction:

Azolla is a fresh water fern that lives in symbiosis with Anaebena azollae (algae). The algae fix atmospheric nitrogen througout the fern's life cycle. It is estimated that 3-4 crops of Azolla can be grown in one year, and these could fix up to 100 KgN/ha. The rice crop benefits by drawing on the nitrogen accumulating gradually in the soil. This Azolla has been observed to be quite widespread in Ahero and other Western Kenya Schemes.

2.2.2.2 Objectives:

The objective of this study were to look at the possibility of using Azolla as an alternative source of Nitrogen. This would minimize Nitrogen fertilizer requirements and thus reduce production costs.

2.2.2.3 Materials and Methods:

Azolla nilotica was compared with sulphate of ammonia current commercial sourse of nitrogen) and urea (a slow-releasing source of Nitrogen). An unfertilized control was also included, and the four treatments were tested in a randomized complete block design with five replications.
Plot size was 3 x 3m, and spacing 20 x 20 cm. Azolla multiplied outside the experimental plot was spread out in the the Azolla to grow. After it had covered the water surface, the plots were drained and the Azolla incorporated into the soil afew days later.

This was repeated throughout the rice crop's life cycle. Sulphate of ammonia and urea were applied at the rate of 52 KgN/ha. Diseases and insect pests were controlled as required.

Data on yield data, diseases and pests and other agronomic traits collected.

2.2.2.4 Results and Discussion:

Both sulphate of ammonia and urea gave yields that were significantly higher than those of Azolla and the unfertilized control. There were no differences between the two commercial nitrogen sources or between Azolla and the unfertilized control (Table 11).

Table 11. Mean grain yield (Kg/ha at 14% M.C) of the Long term Azolla trial, LR 83.

Treatment:	Yield	% of the control (unfertilized).
Sulphate of Ammonia	3393 a	127%
Urea	3280 a	123
Unfertilized control	2662 b	100
Azolla	2636 b	99
S.E =	141 Kg/ha	
C.V =	11%	

Poor recovery after transplanting seems to have affected the initial performance of Azolla (Table 12). Indeed, it has been observed that if the plots are overflooded soon after transplanting, Azolla tends to smother the young rice seedlings. Glume discoloration, spikelet sterility were also slightly higher than in other treatments; But these do not seem to explain properly the poor yield obtained with urea. What seems to be important is the management of the Azolla in relation to the young seedlings and water management. IRRI Scientists have also found that Azolla requires phosphate fertilizer to grow, and it is possible that in this case Azolla may be competing with the rice crop for the available soil phosphorus.

Table 12. Other agronomic and morphological characters of the <u>Azolla</u> trial, LR 83.

Treatment	Recovery (Missing hills/plot 14 DAT	Vigour 14 DAT	Tiller count 98 DAT	Spikelet sterility 84 DAT	Glume Disc. 98 DAT
Sulphate of Ammonia	14	0.4	16	2	1
Urea	17	1.0	18	3	1
Azolla	11	0.4	16	3	2
Unfertilized	18	1.0	13	2	1

2.2.2.5 <u>Conclusions:</u>

There is need to look at the smothering effect of Azolla on young rice seedlings in relation to time of application of <u>Azolla</u>. The nutritional needs of <u>Azolla</u> itself may be important leading to a possible competition with rice for certain elements. This trial has since been reported on larger plots to ascertain these observations.

2.2.3 <u>Herbicides trial, AIRS</u> (LR 83 008 RA 027)

2.2.3.1 <u>Introduction:</u>

A major yield contraint in Bunyala has been noted to be weeds. Due to competition for nutrient, water and light, weeds cause a reduction in rice yields, by harbouring insects and pests, weeds also make crop protection more expensive. In the Western Kenya Schemes, some of the common weed species include <u>Echnochloa colona</u> and <u>Leptochloa chinensis</u> (grasses), Cyperus SPP(Sedges) and <u>Ludwigia octovalvis</u> and <u>Eichorma crassipes</u> (broad leafed). De datta (1975) has argued that in terms of efficiency, timeliness and crop disturbances, chemical weed control may be preferred to handweedings.

2.2.3.2 <u>Objective:</u>

In the trial repeated, several herbicides were compared with handweedings for their efficiency in weed control and their effect on rice yields.

2.2.3.3 Materials and Methods:

The herbicides were tested in a randomised complete block design, replicated three times. The plot size was 5 x 5m, and the spacing 20 x 20cm. Seedlings of IR 1561-228-3-3 were transplanted at 21 DAS. Sulphate of Ammonia was applied at the rate of 52 KgN/ha, in two split doses. Crop protection and cultural practices were implemented as per schemes recommendations. The treatments included were:

1. Oxadiazon
2. Basagran
3. Tamarice
4. Actril
5. Ronstar
6. Avirosan
7. StamF-34
8. Arozin
9. Handweeding
10. Unweeded control

Data on weed counts, weed weight, incidence of disease and insect pests and yield were recorded.

2.2.3.4 Results and Discussion:

Four herbicides - Basagran PL 2, Oxadiazon, Actril, Avirosan and the handweeeding gave yields that were better than those from the unweeded control (DMRT, P = 0.05).
All other herbicides were not better than the unweeded control. There were no differences among the six herbicides. The yield data from the SR 82 season is given for comparison (Table 13).

Table 13. Mean grain yields of IR 1561-228-3-3 grown under different herbicides at Ahero in the LR 83 and SR 82 seasons.

Treatment:	Yield (Kg/ha at 14% M.C)		
	LR '83:	SR '82:	Mean:
Basagran PL 2	2530 a	4326 abc	3428
Oxadiazon	2457 a	3661 abc	3059
Actril	2447 a	-	
Avirosan	2427 a	3164 bc	2796
Handweeding	2410 a	4002 abc	3206
Tamarice	2293 ab	4476 ab	3385
Ronstar	2250 ab	3326 abc	2788
Arozin	2103 ab	3988 abc	3046
StamF-34	2063 ab	4900 a	3482
Unweeded control	1400 a	2876 c	2138
S.E	291.7 Kg	462 Kg	
C.V	22.6%	20%	

Over the two seasons, the herbicide treatment that gave the highest yield was StamF-34 on terms of fresh weed weights, the best control for grasses was achieved with Tamarice. Oxadiazon, Actril, Avirosan, and handweeding gave complete control of the sedges. Complete control for broad leaved weeds was also recorded from Oxadiazon, Actril, and Avirosan (Table 14).

Table 14. Weed weights and weed counts under herbicide treatments at AIRS during the LR 83 season.

Treatment:	Grass		Sedges		Broad leaved	
	Weight g	Count	Weight g	Count	Weight g	Count
Oxadiazon	203	23	0	0	0	0
Basagran PL2	132	18	5	1	51	6
Tamarice	117	3	137	36	82	12
Actril	53	5	0	0	0	0
Ronstar	327	49	73	16	115	16
Avirosan	64	5	0	0	0	0
StamF-34	122	15	181	47	44	9
Arozin	324	53	8	1	20	4
Handweeding	152	13	0	1	13	3
Unweeded control	461	88	44	16	195	26

1. Weed weights and weed counts are means of samples taken at 30 and 70 DAT. Each sample is a mean of three replications. Clearly, while some herbicides were satisfactorily effective against sedges and broad-leaved weeds, none gave complete control over grasses. Oxadiazon and Avirosan were mildly toxic to the rice crop upon application, but the crop had recovered satisfactorily within two weeks after application of the herbicides.
   Since a bigger proportion of our weed population is made up of grasses, it is imperative that a herbicide effective against grasses be found before chemical weed control could be meaningful under our conditions.

2.2.3.5 Conclusions:

In the on-going large scale herbicide trials more attention will be given to herbicide effective against grasses in addition to the other categories of weeds. A combination of herbicides effective against all three classes of weeds could also be considered.

2.3 MWEA RICE AGRONOMY TRIALS

2.3.1 COLD TOLERANT VARIETY TRIAL, MIRS (LR 83 001 RA 016/017(B).

2.3.1.1 Introduction:

Some rice varieties are sensitive to temperature and will require ideal temperatures for good performance. In Mwea, especially Teberc section, the months of June, July, and August have rather low temperatures that affect rice output. The present commercial varieties do not seem to be tolerant to this cold injury, and their yields are usually very low.

2.3.1.2 Objectives:

The aim of the trial was to screen selected cold tolerant varieties and assess their performance in the Tebere section.

2.3.1.3 Materials and Methods:

The trial was conducted in both Tebere section and MIRS. A randomised complete block design with four replications was used. Six test varieties plus Sindano (check) were included. The plot size was 5 x 5m, and the spacing 20 x 20cm. Cultural practices were as per scheme recommendations.

2.3.1.4 Results and Discussions:

In Tebere section, significant yield differences among the varieties were observed. No differences were noted from the Research Station (Table 15).

Variety:	Yield (Kg/ha) Tebere	MIRS	Mean:	% of commercial variety(Sindano).
K 41-146B	4962 a	5189 a	5076	135%
IR 3941-61-1B	4597 ab	3629 a	4113	109
CR 126-42-2	4406 ab	4452 a	4429	118
SINDANO	3410 ab	4125 a	3768	100
IR 3951-81-3	3121 b	3365 a	3243	86
RP 1311-122B	974 c	3621 a	2298	61
RP 1311-122 c	575 c	3359 a	1967	52
S.E	373 Kg	721 Kg		
C.V	24%	40%		

In a column, means followed by the same letter(s) are not di different (DMRT, P = 0.o1)

At Tebere section, three varieties outyielded the standard check(Sindano) while at the Research Station, two varieties outyielded Sindano. At both sites, K41-146B gave the highest yields. K41-146B and CR 126-42-2 were the best two varieties at both sites.

Even though the incidence of disease and insect pests was low, bird damage was considerable.

2.3.1.5 Conclusion:

In view of the promising performance of K41-146B, CR 126-42-2 and and IR 3941-61-1B, these varieties will be tested further. More cold tolerant varieties will be included in future experiments.

2.3.2 VARIETAL DIFFERENCES IN RESPONSE TO NITROGEN FERTILIZER, MIRS (LR 83 006 RA 024):

2.3.2.1 Introduction:

VERGARA (1979) listed four factors that determine how much nitrogen fertilizer should be applied to grow a good crop of rice. These are, the season of cropping better response being expected during a drier season; fertility of the soil; yield potential of the variety - generally the higher the yield potential, the higher the nitrogen requirements, and fourth, the profit from the fertilizer applied.

Results of the LR 82 season showed no nitrogen - variety interaction (Njoka et al, 1983). The main effects - nitrogen and varieties also did not influence the rice yields. Similar results were reported by Bjoka et al (1983).

2.3.2.2 Objectives:

This trial was initiated with the objective of determining the nitrogen requirements of two commercial varieties in Mwea and two promising varieties.

Four varieties - Sindano, BG 90-2, BG 96-2 and IR 2793-80-1 were grown at five levels of nitrogen - 0, 26, 52, 78 and 104 Kg/ha in a split - plot design at Mwea. Varieties were put in the main plots and nitrogen rate in the sub-plots. Source of nitrogen was sulphate of ammonia, and the fertilizer was applied in split doses. Plot size was 5 x 4m^2 and spacing 20 x 20cm.

Weeds weré controlled by handweeding at 14, 35 and 70 DAT. Diseases and insect pests were controlled as required. The following data was controlled:
incidence of disease and insect pests;
Maturity, Plant height and Grain yields.

2.3.2.4 Results and Discussion:

As in the previous two seasons, there was no nitrogen - variety interaction. However, this season, the two main effects - effect of nitrogen and effect of varieties - were highly significant (P = 0.1).
The varieties x Nitrogen Table of means is given in Table 16. It is evident from the Table that irrespective of the variety, grain yields increased with increasing levels of nitrogen upto 78 KgN/ha, after which yields declined except for IR 2793-80-1. Among the varieties, the highest yield was obtained from IR 2793-80-1. A Kenyan traditional variety, Sindano gave the lowest yield. Between the two commercial varieties, BG 90-2 outyielded Sindano.

Table 16. Varieties x Nitrogen Table of means of grain yields (Kg/ha).

Variety:	Nitrogen levels (Kg/ha) 0	26	52	78	104	Mean:
BG 96-2	4516	4706	5194	5387	5148	4990
Sindano	1982	3208	2874	3687	3391	3028
IR 2793-80-1	5568	5608	5834	6699	6769	6096
BG 90-2	5255	5572	5520	5988	5519	5571
Mean	4330	4774	4856	5440	5207	

S.E. (varieties) = 848.8 Kg; S.E. (Nitrogen levels) = 337.4 Kg
C.V (") = 38.6%; C.V. (" ") = 15.3%.

The results discussed here show that the fertilizer weeds of our commercial varieties and some promising varieties are well beyond the rates currently being applied.

2.3.2.5 Conclusions:

The results presented show that the maximum yield potential of the varieties studied could only be realised at nitrogen levels higher than are currently applied (52 KgN/ha) in Mwea. The findings are especially significant in view of the NPK fertilizer studies which indicated deficiencies of phosphorus and nitrogen in parts of Mwea Irrigation Scheme (Njokah et al, 1983). The NPK studies showed phosphorus to be the most limiting (in Wamumu section).

It is therefore recommended that fertilizer trials especially in Mwea be factorial type so that the effect of other elements can also be elucidated.

2.3.3 DOUBLE CROPPING TRIAL, MIRS:

2.3.3.1 Introduction:

This long term experiment was started during the SR 75 season. Initially mean to continue for ten seasons, it was extended by another ten seasons to ascertain the cause of a downward trend in yields that was observed during the first ten seasons. While the decision to continue the experiment was being made, two seasons were missed.

2.3.3.2 Objectives:

The objectives of the trial were threefold:

i) to study the effect of continuous cropping on soil structure and fertility;

ii) to study variety performance in the wet and dry season (April and August plantings;)

iii) to assess pest and diseases build-up under continuous cropping.

2.3.3.3 Materials and Methods:

Three varieties have been grown in this trial: Sindano(a commercial variety), IR 579-48-1 and Basmati (Commercial variety). The two commercial varieties are tall traditional cultivers that tend to lodge with a high application of nitrogen. IR 579-48-1 is a modern semidwarf responsive to high levels of nitrogen. All cultural practices are implemented as per scheme recommendations.

Data on yield, diseases, pests is recommended each season.

2.3.3.4 Results and Discussions:

The average grain yields (t/ha at 14% M.C) of the trial since its inception are presented in Table 17.

Table 17. Average yields of three varieties under double cropping at MIRS.

Season:	Variety yield (t/ha)			
	Sindano:	Sindano/Fallow:	IR 579	Basmati:
SR 75	7.9	8.4	9.2	7.1
LR 76	6.4	-	7.6	5.6
SR 76	6.7	6.9	7.5	5.3
LR 77	6.0	(5.9)	6.9	5.3
SR 77	6.4	6.4	7.0	4.9
LR 78	5.1	-	5.4	3.9
SR 78	5.3	5.9	6.2	4.9
LR 79	3.4	-	4.2	3.3
SR 79	6.2	7.1	6.5	5.2
LR 80	5.0	-	4.3	3.8
SR 81	3.1	3.6	4.5	3.7
SR 82	6.5	-	6.5	5.2
LR 83	5.9	-	6.4	5.1
LR Average	5.3	6.3	5.8	4.5
SR Average	6.0	6.3	6.3	4.9
Average	5.7			

The Lr 83 season yields were as expected lower than in SR 82 season, however, being only marginally so for IR 579-48-1 and Basmati. Differences among the varieties were highly significa-nt (P = 0.01), with S.E = 195 Kg and CV = 22%. The LR 83 yields were better than those of the last LR season tested (LR 80). The yield trend became confusing after LR season because three seasons were skipped: SR 80, LR 81 and LR 82. It is evident that for the same variety the SR yield is more than the LR yield. However, foregoing a LR crop does not increase the SR crop significantly. No significant build-up of diseases and insects was observed.

2.3.3.5 Conclusions:

This trial will be continued as there are indications that yields are picking up again, after the all-record down of SR 81 season.

2.3.4 MEDIUM/LATE MATURING AND LOWER TANA VARIETY TRIALS - MIRS .

The data from these trials was considered to be unreliable for presentation due to the very high CV values obtained (over 90% in both cases). This was attributed to the very severe bird damage that occurred during the ripening phase of the crop. Being the LR season, this was the only crop in the field in that section, hence even bird scaring was not effective in keeping down the bird damage.

2.4 UPLAND CROPS TRIAL IN BUNYALA, LR 83 (LR83 010 CS 004)

2.4.1 Introduction

The upland crops trial in Bunyala, was a follow-up of the LR82 programme. Whereas the LR82 trial was only in research fields, the LR83 trials were extended to the farmers fields. The crops planted include maize, beans, greengrams, cowpeas, and sorghum. Climatic conditions varied considerably, intially the early months were very dry, a fact which greatly influenced the germination of seeds leading to poor crop stands especially in the fields cropped with maize and beans.

2.4.1.2 Objectives

The main objective was to identify the cultural practices (especially land preparation method, weeding fertilization etc) necessary for large scale upland crops production in paddy fields and identify an upland crop that can perform well in rotation with rice.

2.4.1.3 Materials and methods

The crops planted during LR83 season include
Maize (HB STI) - 1 acre
Maize + Beans (Intercr .. - 1 acre
Beans (Roscoco) - 1 acre
Sorghum (SERENA) - 1 acre
Cowpeas (LOCAL) - 1 acre
Greengrams (LOCAL) - 2 acres

16 tenants also planted the crops under different cultivation methods (all farmers planted greengrams):
- Wet rotavation - 8 acres (8 tenants)
- Dry rotavation - 2 acres (2 tenants)
- Oxen ploughing - 1 acre (1 tenant)

research fields - Zero tillage method - 5 acres (5 tenants)

The planting methods varied from row planting to broadcasting. Infield drains were included to drain out water as most crops could not withstand water logging. Weeding done using manual jembes (hoes) and fertilizers used included TSPp and SA.
Sumithion was used in greengrams and cowpeas trials.

2.4.1.4 Results and discussion

The yields per crop are presented inthe Table 18.

Table 18. Yield of upland crops, LR 83, in Bunyala

Field	Crop	Yield kg/ha at 1490 mc
Research	Maize	177.8
	Maize + beans	190.2 + 44.5
	Beans	83.8
	Sorghum	1050.0
	Cowpeas	67.8
	Greengrams 1	257.2
	Greengrams 2	357.3
Farmers'	* Greengrams (Average)	217.4

* Average of 16 farmers

The crops in Bunyala performed poorly and gave very low yields which did not even reach half their target. This was due to unfavourable weather conditions, being too dry at the planting time, then water logging conditons due to heavy downpour, lateness in planting, poor stand resulting from poor and uneven germination and insect attack(aphids) on some crops like greengrams and cowpeas. But despite these adverse conditions crops like greengrams and sorghum had average performance as compared to maize and beans whose yields were too low.

On the various land preparation methods employed, zero tillage gave good yields as compared to wet rotavation and since the same method has less cost in terms of land preparation, the farmers may adopt it in future provided planting is done on time at the onset of rains. However, this method is only suitable for greengrams which have shown that they can be planted using any method of cultivation.

Less cost of land preparation is incurred where oxen ploughing is employed as compared to land preparation by tractor. Yields from farmers have also indicated that greengrams can be grown with less inputs. However, to increase output and farmers' incomes, farmers need to use fertilizers and chemicals for control of aphids which can cause severe damage during dry weather.

Table 19. gives the cost analysis of the trial.

Table 19. Cost analysis of the upland crops in Bunyala

	Maize	Maize + Beans	Beans	Cowpeas	Green grams	Sorghum
Total Inputs* (Kshs)	2022/50	218.00	2093.85	2022.20	2844.90	2612.05
Yield(kg/ha) at 14% mc	177.8	190.2+ 44.5	83.8	67.80	359.3	1050.0
Unit price(Kshs)	1.45	1.15	4.15	6.50	7.25	1.50
Gross returns (Kshs)	257.80	482.65	389.65	440.70	2604.90	1575.00
Net earnings (Kshs)	-1164.70	-1706.35	-1704.20	-158.50	-240.00	-1037.05
Farmers income (Kshs)	- 872.45	- 772.50	- 940.60	-730.75	- 857.75	-278.50

* Total Inputs = agricultural materials, seed, land preparation and labour for sowing, weeding, harvesting, bird scaring etc labour cost @ 8/30 per day.

Greengrams, apart from giving average yields were also the most profitable crop. Maize, beans and cowpeas gave the farmers negative returns.

2.4.1.5 Conclusions

From the results, greengrams and sorghum may be recommended as the most profitable upland crop to be grown by the farmers. However, the market for sorghum has to be looked into since it fetches very low prices in the local market. But it is good as a food crop, while greengrams could be grown as commercial crop.

Due to low use of agricultural material in zero tillage, the method may be recommended for future use to reduce production cost and also farmers be encouraged to plant in rows.

2.4.2 UPLAND CROPS TRIAL IN WEST KANO PILOT SCHEME, LR83 (LR 83 011 CS 007)

2.4.2.1 Introduction

Single cropping system of rice cultivation has also been adopted in West Kano Pilot Scheme. This means that there will be no rice crop in the scheme during long rains season. Therefore it is with view of utilizing the fallow period during the long rains that research work was started on upland crops.

2.4.2.2 Objectives

The main aim of the trial is to establish cultural practices that can be used to produce an upland crop in paddy fields and identify an upland crop that can be grown profitably by farmers in rotation with rice.

2.4.2.3 Materials and methods

The crops tested during long rains 83 season include:

Crop	Plot size
Maize (HB 511)	2449.4 m^2
Maize (HB 512)/Beans(ROSCOCO)	1689.2 m^2
Beans(ROSCOCO)	1874.6 m^2
Cowpeas (LOCAL)	2158.1 m^2
Greengrams (LOCAL)	1958 m^2
Sorghum (SERENA)	1197.0 m^2

Tomatoes, cabbage, pumpkin, sorghum, maize, beans and greengrams were tested on extra plots of approx. 1 acre.

The crops were grown on plot sizes shown above. Land preparation for all crops included ploughing (using mould board plough), harrowing and ridging except for greengrams where no ridging was done. Infield drains were cut in each field to help in draining out water. The activities per each crop included:-

Maize - Land preparation - ploughing, harrowing and ridging.
Sowing - 2 seeds/hole, row planting seedrate 20 kg/ha at spacing of 60 x 30 cm.
Fertilizer - TSP, 125 kg/ ha basal application SA 125 kg/ha Top dressing

Weeding - once.

Cowpeas - Land preparation included ploughing and ridging
- fertilizer - basic TSP 125 kg/ha
Sowing - 2-3 seeds/hole at spacing of 75 x 30 cm
Seedrate 17.5 kg/ha
Sumithion 50' applied twice at flowering and one week after 1st spraying at a rate of 320 ml/ha.

Greengrams - Land preparation - ploughing and harrowing
fertilizer - basal TSP 125 kg/ha.
- sowing in rows, interrow spacing of 60 cm at seed rate of 7.5 kg/ha
Thinning - Three weeks after germination
Weeding - Twice
Chemical - application of sumithion 50 at a rate of 460 ml/ha.

Sorghum - Land preparation - Ploughing, ridging a half of plot
Fertilizer - basal SA 125 kg/ha, TSP 125 kg/ha
Sowing - 7-8 seeds/hole at a spacing of 75 x 45 cm
Thinning - done at 3 weeks after germination to 4-5 plants per hole
Weeding - Twice at 3 weeks and at 1½ months after germination
Observation extra plots
Land preparation as above
Nursery established for tomatoes and cabbage seedlings. Boma manure was used for nursery.
Crops grown in the plot include maize, beans, sorghum, greengrams, tomatoes, cabbages and pumpkins.
Site - block D1.

2.4.2.4 Results and discussion

The crops in observational extra plots failed completely due dry weather at the planting period and the waterlogging conditions which ensured to heavy rains. The failure was also attributed to poor land preparation especially for the horticultural crops on the heavy soils and also lack of labour which led to poor cultural practices.
Results for the other crops are as given in Table 20.

2.4.4.5 Conclusion

The trial has shown that crops like beans, greengrams and sorghum can perform well in the paddy fields. Therefore in view of this, more work on the same crops will be carried out. There is also need to look into possibilities of establishing a more economic method of cultivation as preparation by tractor is rather too expensive. The crops especially sorghum and greengrams should be given to farmers so as to compare their performance with those grown under research.

2.5 AGRICULTURAL MACHINERY TRIALS

Some research proposals on agricultural mechanization were made in the Forward Plan of work, LR 1983. However, financial constraints did not allow their implementation. All machines have running, maintenance and repair costs. The research station lacks proper storage facilities for machinery, and consequently some machinery have started to breakdown due to improper handling and rat and insect damage. This makes it difficult to promote research on agricultural mechanization. This is a summary of some work in this section undertaken during the season reported.

2.5.1 FIELD TESTING OF TRANSPLANTER

2.5.1.1 Introduction

Since transplanting machines were introduced in the station, no consistent testing of their performance has been made. Latest tests of the machines indicated that levelling of the fields, water management and fertilization were very important. Despite these problems, testing of transplanters was repeated during the LR83 season.

2.5.1.2 Objectives

To test the performance of two types of rice transplanters, with a view of reducing labour requirements for transplanting byuse of these machines.

2.5.1.3 Materials and methods

Two machines were tested using seedlings raised by two different methods. The two types of machines were;

i) Engine powered transplanter: 4 rows, inter-row spacing 28 cm, intra-row spacing 16 cm.

ii) IRRI-manual transplanter: 5 rows, interrow spacing 20 cm.

Two methods of raising seedlings were:

i) by special boxes (KUBOTA,MT-3)
- growing medium a mixture of 80% red earth and 20% five sand
- 3.3 of the mixture/box
- covering soil, 1.01/box
- seedrate, 220g/box (13.5 kg/ha)
- seed soaking - 1 day
- seed incubation(to hasten germination) - 1.5 days
- watering - every day
- varieties - IR1561-228-3-3 and BG90-2

ii) Mass production in the ordinary seedbed
- seedbed: vinyl sheet was put at 3cm depth from the surface of the seedbed
- seedrate - 15 kg/20m^2 (15 kg/acre)
- varieties - IR1561-228-3-3 and BG 90-2

Land preparation(mainfield): The field was first ploughed with a mould-board plough, and then levelled with a handtractor (8HP). When still dry The hard soil was difficult to level and resulted in breakdown of the tractor several times. Of the total field, therefore, only 3560 m^2 were cultivated leaving 440 m^2 uncropped.
Transplanting - seedlings from the special boxes were transplanted 15-17 DAS and those produced from the ordinary seedbed 21 DAS.
52 kg N/ha were applied in two equal splits, one basal the other topdressing at 42 DAT. Weeding was done twice using rotary weeders. Furadan 5G was applied at the rate of 10 kg/ha for insect control.

The activities per crop included :

Maize - Land preparation - dry rotavation, 3 infield drains
Sowing 3 seeds/hole at spacing of 80 x 30
Seedrate - 25 kg/ha
Fertilizer - basal TSP 125 kg/ha
Weeding - twice by jembe

Beans - Land preparation - As in maize
Sowing - 2-3 seeds/hole at spacing of 60 x 30,
Seedrate 37.5 kg/ha
Fertilizer - TSP 125 kg/ha
Weeding - twice by jembe

Sorghum - Land preparation as in maize
Sowing - 85 x 30 cm, 5-6 seeds/hole
Seedrate - 5 kg/hole
fertilizer - TSP, 125 kg/ha basal
SA, 125 kg/ha Top dressing
Weeding - Twice using jembe

Cowpeas - Land preparation as in maize
Sowing - broadcasted
Seedrate - 7 kg/ha,
Fertilizer - 125 kg/ha, TSP
Weeding - Once by jembe
Chemical application - Sumithion 50

Greengrams - Research fields 1 and 2
Land preparation - wet and dry rotavation
3 infield drains
Sowing - broadcasting in field 1 and row
planting in field 2 at a spacing of
6 x 30 cm.
Fertilizer - TSP 125 kg/ha as basal
Weeding - Twice by hand
Chemical - Sumthion 50' (220 ml/ha)

Greengrams (farmers fields)
- Various land preparation viz wet rotavation, Dry rotavation, oxen ploughing, zero tillage.
Sowing - at random with no proper spacing and broadcasting
Fertilizer - Nil, Weeding - Once/twice, Chemical - Nil.

Table 20. Crop yields in kg/ha(14%M) from WKPS

Crop	Plot size m^2	Yield/ha
Maize	2449.4 m^2	513.6
Maize/beans	1689.2 m^2	915.1+109.1
Beans	1874.6	857.2
Cowpeas	2158.1	540.6
Greengrams	1958.0	733.3
Sorghum	1197.0	3367.0

The profitability of each crop was also considered and is presented in the table 21.

Table 21. Cost analysis of the upland crops in WKPS, LR83.

	Maize	Maize+Beans	Beans	Cowpeas	Greengrams	Sorghum
*1 Total input (Kshs)	3494.30	3767.80	3722.75	3373.25	3662.05	[illegible]82.80
yield kg/ha at 14%MC	513.6	109.1	857.2	540.6	733.4	3367.0
*2 Unit price/kg	1.45		4.65	6.50	7.25	1.50
Gross return Ksh	744.70	1834.30	3985.95	3513.90	5317.1 5	5050.50
Net earnings	-2749.60	-1933.50	+263.20	+140.65	+1655.10	+1367.70
Income	-1371.80	-182.15	+2006.20	+1966.65	+4153.40	+3534.00

*1 Total input includes cost of seed, land preparation, labour input for sowing,weeding, thinning, top dressing, harvesting bird scaring, chemical and fertilizer cost.

*2 Unit price/kg - based on local market prices.

From the above tables, the pulse crops performed better and although sorghum had the highest yields. Greengrams crop was the most profitable of all the crops while maize gave negative profit. The low yield of maize was due to poor germination, water logging and also human pests who stole a lot of green cobs. The cost of inputs for this particular trial was particularly very high as the research team was trying to establish ideal conditions for the crop. However for the farmer to gain anything from the crop, a more economic way of land preparation has to be considered and also production cost reduced.

2.5.1.4 Results and discussion

In the mass production of ~~seedlings by ordinary seedbed~~, the vinyl/sheet made it impossible to maintain the bed a "met bed". The soil on top of the vinyl sheet tended to dry very fast, sometimes scorching the seedling above. The seedlings at 21 DAS were still very small compared with those of an ordinary netbed nursery. When the seedbed were cut to size to fit the transplanting machine, the clay soil was too sticky, and the seedlings got stuck around the planting claws of the machine. This mass method was therefore found to be unsuccessful under the circumstances.

The IRRI manual transplanter had too many mechanical breakdowns, and the engine powered transplanter was used throughout.

Despite these problems, some interesting results were obtained. Between the two varieties, BG 90-2 was the better yielder, with more than twice the yield realized from IR1561-228-3-3. Use of the transpplanter seemed to promote tillering, probably to excessive levels. The data obtained is summarised in Table 22.

Table 22. Some agronomic and yield data of two varieties transplanted by engine powered transplanter.

Trait		Variety BG 90-2	IR1561-228-3-3
No. of hill/m^2:	42 DAT	24.0	24.0
	84 DAT	23.7	23.0
No. of tillers/ hill:	42 DAT	37.0	39.2
	84 DAT	46.4	48.9
Average plant height (cm)	42 DAT	51.2	56.7
	84 DAT	82.4	78.9
Weight of 1000 grains(g):		26.0	21.0
Mean yield (kg/ha)at 14%MC		7904	3622

2.5.1.5 Conclusions

Further testing is required before any firm conclusions can be drawn.

3. SUGAR-CANE AGRONOMY TRIALS-AIRS

The importance of sugarcane trials at Ahero Irrigation Research Station has declined and no new trials are being set up. The work on sugarcane therefore is mainly concentrated on maintenance of the on-going trials, some of which are being abandoned after harvesting the required number of economic ratoons. The decline in sugarcane as a crop of major importance at AIRS came as a result of overproduction of cane in the area and also the distance from West Kano to the nearest sugar factory proved uneconomical.

However each season the data collected from the existing trials is reported on as there is still need to assess the yields, maturation periods, and number of economical ratoons between different varieties. During the season no trial was harvested.

4. CROP PROTECTION

4.1 ENTOMOLOGY TRIALS

4.1.1 Insecticide screening trial AIRS(LR 83025 CPE 023)

4.1.1.1 Introduction:

The common rice pests encountered in Wester Kenya rice schemes are, the white stem borer, (Maliarpha Separatella Rag) the rice case worm (Nymphula depunctalis guen) and increasingly the pink borer (Sesamia calamistis), of less significane are the stalk eyed fly (Diopsis thoracica) - the rice leaf miners (Hydrellia spp) and the leaf mining beatles (Triclispa spp) (OKHOBA 81/82).
Extensive insecticide evaluation studies have indicated the superiority of carbofuran 5G in the control of the common rice pest complex. (Okhoba 82) . However, with the reduced % incidence of the various common pests due to the effectiveness of carbofuran 5G, further insecticide screening continues with a view of identifying other suitable effective ard economical insecticides for use, as well as to evaluate the effectiveness of carbofuran 5G at a lower application rate.

4.1.1.2 Objectives

To evaluate the effectiveness of several different promising insecticides for control of major rice pests in Western Kenya Schemes.

4.1.1.3 Materials and methods

The commercial variety IR 1561-228-3-3 was sown on 14-3-83 and transplanted in 200m^2 plots 25 days. Later at a spacing of 20x20 cm two plants per hill. The layout was a complete randomised block design with three replicates. The experiment was conducted at AIRS field 11/6,7,8 and 52 kg/N/ha was applied in split application at transplanting and topdressed at 42DAT.
There were seven treatments

1. Diazinon (Basudin) 60%EC at 1.61/ha
2. Ripcord (Cypermethirin) 40% EC at 11/ha
3. Furadan (Carbofuran) 5G at 10 kg/ha
4. Ekalux (Quinalphos) 25% EC at 11/ha
5. Servin (Carbaryl) 85% WP at 2kg/ha
6. Hostathion(Triazophos) 50% EC at 11/ha
7. No insecticide (control).

The insecticides were applied twice viz at 20 and 45 DAT with standard nursery treatments of 750gms carbofuran per nursery at 14 days after sowing. All insecticides were applied with a hand operated knapsack sprayer except the carbofuran treatment for which a granular broad-caster was used.

Tiller infestation due to Maliarpha Separatella was determined by random selection of ten plant hills per plot. The plants were then dissected in the laboratory to record the percentage of infested tillers. Observations were made at 50 and 80 DAT.

Using a $1m^2$ quadrat, replicated four times per plot, the incidence of "dead hearts" due to Diopsis attack, was recorded at 50 DAT. The same quardrat was used to record the incidence of rice leaf miners, leaf mining beatles and rice case worms at 35 and 50 DAT. The collected grain yields were converted to hectare yields at 14% moisture content and the results expressed in metric tonnes per hectare. The results were then analysed statistically.

4.1.14 Results and discussion

The trial was characterised by the incidence of white stemborers(Maliarpha Separatella) stalk eyed fly (Diopsis thoracica) and the rice leaf miners (Hydrellia spp)

Table 23. Comparative effectiveness of various insecticides on rice pests.

Treatment	% SB Infestation at 50 DAT	100 DAT	%leaf miner damaged leaves at 35 DAT	SEF "dead hearts" incidence at 50 DAT/m^2
Furadan	4.27a	11.80a	7.33	5.40a
Ekalux	11.80a	21.30ab	6.67	5.13a
Diazinon	11.90a	23.37ab	7.00	7.00a
Hostathion	14.23a	29.90ab	7.67	4.47a
Servin	15.37a	28.63ab	6.33	10.2a
Ripcord	16.37a	24.97ab	6.33	2.40a
No insecticide	16.20a	37.80b	17.00	11.27a
SE	4.20	5.64		3.63

* Mean followed by the same letter are not significantly different at the P-0.05 level according to Duncans Multiple Range Test.

The rice case worm and rice leaf mining beatle incidence remained very low and is thus not tabulated.

There was a progressive increase in tiller infestation by the white stemborer from 16.20% at 50DAT to 37.80% at 1 00 DAT in the control plot. The lowest percent incidence of infestation was recorded in the carbofuran 5G, Ekalux and Diazinon treatments respectively. (Table 23). The Hostathion and Servin treatments exhibited poorer control.

The incidence of "dead hearts" due to Diopsis attack was lowest in the Ripcord, Hostathion, Ekalux and Furadant*treatments, these however were not significantly different.

Leaf miners, incidence was also noted at 35 DAT. There was however no significant difference between treatments.

Grain yields in tonnes per hectare varied from 4.30 in the control to 5.33 and 5.44 in the Furadan and Hostathion treatments respectively.

Table 24. Grain yields in tonnes per hectare at 14% moisture content.

Treatment	I	III	III	MEAN
Hostathion	5.58	5.44	5.30	5.44a
Furadan	4.52	5.79	5.99	5.43a
Servin	5.83	4.49	4.45	4.92a
Diazinon	4.49	4.63	4.87	4.66a
Ekalux	4.95	3.92	4.78	4.55a
Ripcord	5.48	4.00	4.06	4.51a
No insectidide	4.36	3.90	4.89	4.30a

SE 0.35 tonnes cv.12%

The hostathion, carbofuran and servin treatment recorded the highest yields, these however were not significantly different from the other treatments.

Cost Table 25 two applications of insecicides per hectare (Jan 1983)

Insecticide		Costs shs./ha
1.	Furadan	460.00
2.	Ripcord	320.00
3.	Diazinon	304.00
4.	Hostathion	280.00
5.	Servin	140.00
6.	Ekalux	120.00

Considering the costs of insecicides and yields compared to the control there was a net benefit of 2399.00, 2195.00, 1317.00, 542.00, 467.00, 173.00 kshs in Hostathion, Furadan, Servin, Diazinon, Ekalux and Ripcord treatments respectively.

4.1.1.5 Conclusion

In view of the lower pest pressure noted during the previous two seasons, (Okhoba 82) and the continued effectiveness of carbofuran 5G, lower rates i.e 0.5 kg 9.1 are being tested on a large scale to reduce insecticide costs. Meanwhile promising alternative insecticides like Hostthathion Ekalux, Diazinon and Servin will continue to be evaluated. Hostathion and Furadan treatments realised the highest net benefits.

4.1.2 Granular Insecticide Formulation trial AIRS (LR83 026 CPE 024)

4.1.2.1 Introduction

The use of granular insecticides spares and thus enhances the efficiency of biological control agents like predators and parasites in suppressing common rice pest, due to their selective and systemic mode of action. (Pathak and Dyck 1973). Their higher residual persistence in paddy fields ensures longer pest control; This coupled with their relative safety of application has led to increased research to screen for effective and economic granular insecticide formulations to control rice pest complexes.

4.1.2.2 Objective:

To compare the effectiveness of some promising granular insecticide formulations for the control of insect pests of rice.

4.1.2.3 Materials and methods

The commercial rice variety IR1561-228-3-3 was sown on 7/3/83 and transplanted 21 days later on 30/3/83 into 10 102m^2 plots at a spacing of 20x20cm 2 plants per hill. The trial was set up at AIRS Field II/3, 52 kg of nitrogen per ha was applied in split application at transplanting and at 42 DAT. The layout was a randomised complete block design with four replicates.

There were four treatments:

1. G 24-480 + BPMC (Brantasan) 10G at 10kg/ha
2. Carbofuran (Furadan) 5G at 10kg/ha
3. Ekalux (Quinalphos) 5G at 10kg/ha
4. No insecticide (control).

The insecticides were applied twice at 25 and 45 days after transplanting using a granular broadcaster. Tiller infestation due to Maliarpha Separatella was assessed at 50 DAT and 100 DAT using random samples of ten plant hills per plot. The tillers were dissected in the laboratory to indicate percent infestation and the various larval stages.

Infestation by the rice leaf miners and stalk eyed flies was assessed using a 1m^2 quadrat replicated four times per plot at 35 and 50 DAT respectively. Grain yields were recorded as well as their moisture content. Grain yields were then converted to tonnes per hectare at 14% moisture content. The collected data was then analysed statistically.

4.1.2.4 Results and discussion

Tiller infestation due to Maliarpha Separatella was recorded at 50 and 100 DAT. (Table 26 below).

The lowest percent infestation was recorded in the Brantasan and carbofuran treatments. There was however no significant difference between the various treatments.

Table 26: Comparative effectiveness of different insecticides on rice pests.

Treatment	% SB infestation at 50 DAT	100 DAT	SEF incidence per $1m^2$ at 50 DAT
1. Furadan	8.60a	7.20a	3.30a
2. Brantasan	8.88a	8.95a	4.45a
3. Ekalux	11.13a	10.74a	5.80a
4. No insecticide	12.50a	14.50a	10.85a
SE	4.75	2.67	1.75

The incidence of rice leaf miners and case worms remained low and is thus not tabulated.
The incidence of "dead hearts" due to Diopsis thoracica was recorded at 50 DAT. There was no significant difference between the treatments.

Table 27: Grain yields in tonnes per hectare at 14% moisture content

Treatment	I	II	III	IV	Mean
1. Brantasan	5.76	4.41	4.70	5.17	5.01a
2. Furadan	6.39	6.02	3.38	3.79	4.94a
3. Ekalux	6.22	5.04	3.70	3.71	4.66a
4. No insecticide	4.41	4.47	4.52	4.87	4.56a

CV 18% SE 0.43 tonnes/ha

Grain yields at harvest were higher in the Brantasan and Furadan treatments these however, were not significantly different from the control.

4.1.2.5 <u>Conclusion</u>

The incidence of stemborers remained low during the season. The grain yields were higher in the Brantasan and Furadan treatments. Further evaluation is envisaged at lower insecticide rates to reduce costs.

4.1.3 Insecticide screening trial MIRS. (LR 83025 CPE 027).

4.1.3.1 Introduction

The rice leaf miner (Hydrellia spp) the rice leaf mining beatle (Trichspa spp) and of recant the rice case worm (Nymphula depunctalis) are the main rice pests encountered in Mwea Irrigation Scheme. The white stemborer (Maliarpha Separatella)is usually noted in higher proportions towards the later part of the season, this being due to the prolonged "closed season" ensued by a single cropping system practised in Mwea Sporadic incidences of the stalk eyed fly are also usually noted. Evaluation for suitable and economic insecticides to control these rice pests is continuing.

4.1.3.2. Objectives

To evaluate the effectiveness of several promising insecticides in the control of major pests of rice in Mwea Irrigation Scheme.

4.1.3.3 Materials and methods

The rice variety sindano was sown 12/3/83 and transplanted 30 days later on 11/4/83 into 448 m^2 plots at the recommended spacing of 20 x 20 cm at 2 plants per hill. The trial was observational and nine insecticides were evaluated.

1. Diazinon (Basudin) 60% EC at 1l/ha
2. Furadan(Carbofuran)5G at 10kg/ha
3. Ekalux (Quinalphos)25% EC at 1l/ha
4. Dipterex(Trichlorophon)95%SP at 1kg/ha
5. Servin(Carbaryl) 85wp at 1kg/ha
6. Hostathion(Triazophos)50%EC at 1l/ha
7. Ripcord (Cypermethrin)40% EC at 1l/ha
8. Sumithion(Fenitrothion)50%EC at 1l/ha
9. Antio(Formothion)33%EC at 1l/ha
10. No insecticide (control)

The insecticides were applied twice viz at 20 and 50 DAT with an earlier application of carbofuran 3G at a rate of 350 gm per nursery at 14 days after sowing. The percent leaf miner, leaf mining beatle and rice case worm damage add incidence of "dead heart" due to the stalk eyed fly Diopsis thoracica was assessed at 30 DAT.

Using a 1 metre square quadrat replicated three times per plot. Infestation by Maliarpha Separatella was assessed through random selection of ten plant hills per plot. Tillers were dissected in the laboratory to indicate infestation and larval stage. Grain yields were recorded at harvest.

4.1.3.4 Results and discussion

The observational trial was characterised by incidence of stalk eyed flies, leaf miners, leaf mining beatles, case worms and the white stem borer.
The incidences of the various pests per treatment were recorded. (Table 28). The incidence of "dead hearts" due to stalk eyed flies remained lowest in the Ekalux and Sumithion treatments.

Table 28: Incidence of rice pests and yields

	%SEF incidence 30DAT	%LM incidence 30DAT	%LMB incidence 30DAT	%RCW incidence 30DAT	%SB incidence at 95DAT	Yield kg/ha at 14%MC
1. Diazinon	10.00	12.10	6.00	8.30	9.00	4083
2. Furadan	9.00	8.00	7.00	11.00	7.00	4010
3. Ekalux	8.40	16.00	12.00	8.00	11.00	3430
4. Dipterex	12.00	13.00	11.00	14.00	9.48	3760
5. Servin	13.00	9.40	9.10	15.10	9.00	3820
6. Hostathion	11.00	7.40	4.80	11.60	15.40	3730
7. Ripcord	13.00	7.40	5.00	12.60	17.00	3190
8. Sumithion	9.00	7.50	6.40	6.90	15.40	3670
9. Anthio	10.00	14.00	12.00	6.50	20.30	3270
10. No insecticide	13.00	18.00	15.50	15.00	21.00	3310

The incidence of leaf miners was noted between 30 and 50 DAT. With the percentage leaf damage ranging between 7.40% and 18.00% in the control plot. The lowest incidence was recorded in the Hostathion, Ripcord, Sumithion and Furadan treatments. The leaf mining beatle damage was also recorded at 30 DAT. The lowest incidence was observed in the Hostathion, Ripcord, Diazinon, Sumithion and Furadan treatments.

Damaged leaves due to rice case worms were lower in the Anthio, Sumithion, Ekalux and Diazinon treatments. Tiller infestation due to Maliarpha Separatella was recorded at 95 DAT. The lowest bincidence being in the Furadan, Diazinon, Dipterex and Ekalux treatments respectively. Grain yields at 14% moisture content were recorded at harvest (Table 29).

Table 29 Cost of two application of insecticides per hectare (Jan. 1983).

	Cost shs/ha
1. Diazinon	304.00
2. Furadan	460.00
3. Ekalux	120.00
4. Dipterex	160.00
5. Servin	140.00
6. Hostathion	280.00
7. Ripcord	320.00
8. Sumithion	110.00
9. Anthio	130.00

In view of the current insecticide costs the highest net benefits over the control were 1512.50, 1185.00, 1058.00 877.00, 736.90, 707.00, 162.00 kshs for the Diazinon Fufadan, Servin, Dipterex, Suminthion, Hostathion, Ekalux treatments respectively. A net loss of 602.00 and 224.00 kshs was recorded from the Ripcord and Anthio treatments respectively.

4.1.3.5 <u>Conclusion</u>

Diazinon, Furadan, Sumithion, Servin, Dipterex and Hostathion showed promise after the control of rice pests in Mwea. Further evaluation of these insecticides is envisaged.

4.1.4 Large scale insecticide trial block D Ahero Pilot Scheme.

4.1.4.1 <u>Introduction</u>

Extensive insecticide evaluation studies have been conducted at AIRS during several previous seasons. The promising emulsifiable concentrate, wettable powders and granular insecticide formulations form these trials were evaluated on a large scale to ascertain previous findings.

4.1.4.2 Objective:

To evaluate the effectiveness of several promising insecticides for rice pest control on a large scale.

4.1.4.3

Materials and methods

This was a large scale observational trial conducted in Block D of the Ahero Pilot Scheme. The trial covered 24 acres of the tenants plots. Six different promising insecticides were used. Only a single insecticide application as opposed to the two standard applications was undertaken. The insecticides evaluated were:

1. Furadan 5G at 10.0kg/per ha applied at 20 DAT
2. Diazinon 60%ECat 1l/ha at 20 DAT
3. Dipterex 95% SP at 1 kg/ha at 20 DAT
4. Servin 85% WP at 2 kg/ha at 20 DAT
5. Ripcord 40% EC at 1l/ha at 20 DAT
6. Ekalux 25% EC at 1l/ha at 20 DAT

Pest infestation was monitored during the season. At 35 DAT, "dead hearts" due to the stalk eyed fly (Diopsis thoracica), leaf miner and rice case worm damage was recorded. At 55 and 90 DAT tiller infestation due to Maliarpha separatella was recorded. The grain yields in bags per acre were recorded.

4.1.4.4 Results and discussion

The trial was characterised by the incidence of stalk eyed flies, rice leaf miner and white boreres. The incidence of the former two however remained low in the various treatmets . The white stemborer percent infestation ranged between 7.50% to 12.80%, with no considerable variation between treatments.

Table 30: Comparative effectiveness of different insecticides on rice pests.

Treatment	No of diopsis dead hearts at 30 DAT/m^2	%leaf miner damage at 35DAT	% SB at 50 DAT	Infestation 95DAT
1. Furadan	1.0	1.0	8.80	10.10
2. Diazinon	1.0	1.0	7.50	11.50
3. Dipterex	0.6	1.5	12.20	15.10
4. Servin	1.2	2.0	9.95	10.00
5. Ripcord	1.4	2.0	12.80	15.50
6. Ekalux	1.0	1.3	9.18	11.40

Table 31: Mean grain yields block D-APS

	Mean yield Bags/acre
1. Furadan	26.5
2. Diazinon	25.0
3. Dipterex	23.0
4. Servin	24.5
5. Ripcord	22.0
6. Ekalux	25.5

The grain yields in Bags per acre were recorded at harvest. The lowest mean yield was 22.00 bags per acre recorded in the Ripcord treatments. The other treatments recorded 1,2,5,3, 3.5 and 4.5 bags more than Ripcord per acre for the Dipterex, Servin, Diazinon Ekalux and Furadan treatments respectively. The highest net yields were obtained from the furadan treatment. It will be noted that throughout the trial only half the active ingredient usually used for all the insecticides was applied with adequate pest control being noted. The higher yields noted in the furadan treatment could also be due to the phytotonic effect it has on rice plant growth since acres treated with furadan were observed to have very vigorous growth.

Further large scale insecticide ev aluation will continue especially with a view of reducing insecticide costs while ensuring adequate pest control.

4.1.5 VARIETAL STEM BORER RESISTANCE TRIAL(LR83 022 CPE 026)

4.1.5.1 Introduction

In the past seasons screening of rice varieties for resistance to stemborer; Maliarpha Separatella showed varying results simply because of population flactuation of moths in the field and most importantly the lack of refined techniques for varietal resistance work. Moreover, the nature of damage by M. Separatella is less obvious. The International Rice Research Institute in Manila has began developing various techniques for the screening of rice varieties for resistance to the common insect pests there. Andres (1975) has developed a technique for field screening of rice varieties for resistance to the whorl maggot, Hydrellia which can be modified for other insect species. The technique requires an established susceptible and resistant rice checks.

4.1.5.2 Objectives

To develop a technique to investigate multiple resistance of rice varieties to two important stemborers, Maliarpha Separatella and Diopsis Thoracica under field conditions.

4.1.5.3 Materials and methods

Field plan for multiple resistance studies of selected rice entries to stemborers as outlined in Andres (1975) Technique for Whorl Maggot with modification.

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       +++++
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   xx  11111 xx
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```

xx - Border rows of IR1561-228-3-3
++ - Resistant check(TKM6)
** - Susceptible check (IR579-48-1-2)
1 - Test rice varieties

Wet seedbed was prepared in Field III/16 ready for transplanting according to the above field plan. The nurseries were sown on 3rd May, 1983. Transplanting took place on 27th May, 1983 in a three 5 metre rows per variety. A total of 22 test rice varieties were transplanted at the usual spacing of 20cm. by 20cm. between and within the rows. The observations for insect pests infestation was carried out on the test varieties at 30 and 60 days after transplanting by examining 10 plant hills in the middle row of each entry and recording the incidence of eggs and 'deadhearts' for Diopsis thoracica, the stemborer, Maliarpha Separatella infestation this was done in 10 plant hills per variety at maturity to give percent tiller infestation and also the 'whiteheads' beside the grain yield in grammes per 3-5 metre rows. On the basis of resistant and susceptible checks the resistant varieties were determined.

The scale for rating the resistant varieties to Diopsis thoracica were based on the'deadhearts'

0 - 10 Deadhearts/10 hills			= Resistant
11-20	"	"	= Moderately susceptible
Over 21	"	"	= Susceptible

4.1.5.4 Results and Discussion

The incidence of 'deadhearts' due to Diopsis Thoracica varied from the initial observations at 30 DAT to 60 DAT (Tables 1 and 2);

The best stage to evaluate the varieties was at 30 DAT. On the basis of the scale for rating, four varieties (4) showed some susceptibility to Diopsis thoracica with an incidence ranging between 16-32 deadhearts/10 plant hills observed (Table 1). These consisted of SUYAI 20, IB568, IR20 and MTU15. The rest of the rice entries showed a very low incidence of deadherarts ranging from one deart/10hills to 16 deadhearts per 10 plant hills (Table 1). CHINAN 2 was found to be the most resistant variety. In general the incidence of deadhearts as the crop grew upto maturity was low and this confirms the earlier observation that Diopsis thoracica is an important pest of young rice seedlings. Thus Andre's 1975 screening technique against whorl maggot appears to be adequate for Diopsis thoracica screening for resistance of rice varieties.

The stemborer infestation being evaluated on the basis of tiller infestation and 'whiteheads' showed fairly close relationships.

The percent tiller infestation at maturity indicated that ARC10952 had the highest percentage of (47.3%) while W1263 had 5.6%.

Similar range was also observed in the incidence of 'white heads' in the same varieties(2.7% and 0% in the two varieties respectively (Table 3).

Using Andre's screening technique with IR579-48-1-2 and TKM6 as susceptible and resistant checks respectively a wide range of rice entries were susceptible (Table 4). Eleven rice varieties were rated susceptible, since, the infestations were higher than the susceptible checks. The infestation of tillers ranged between 12.5% to 47.3%. Four rice varieties were more resistant than resistant check, TKM6. The percent tiller infestation ranged between 8.3% to 5.6% on TKM6 and WI263 respectively.

The Andre's 75 Technique appear to be reliable since the incidence of 'whiteheads' tally with the level of tiller infestation. The higher the infestation of tillers the higher the incidence of 'whiteheads'. Thus the study has identified some possible resistant and susceptible checks in the stemborer, M.Separatella screening work which should be continued.

Table 33: The incidence of 'deadhearts' due to Diopsis thoracica on different rice entries at 60 days after transplanting

Rice Variety	Mean Number tillers/hill	Number of deadhearts/ 10 hills	Rating
IB56-8	16.0	16 Moderately	Moderately susceptible
CHIANAN 2	17.6	10	Resistant
SUYAI 20	37.6	1 0	"
W1253	32.8	8	"
IET 2845	20.0	6	"
IR20	21.9	5	"
MTU15	19.9	5	"
CO7	22.6	5	"
TAITUNG16	18.2	4	"
RATNA	22.7	4	"
IR579-48-1-2	23.6	3	"
CO18	27.0	3	"
IR40	18.2	2	"
CR157-392-4	26.3	2	"
IR1514 E665	35.0	1	"
IR36	27.8	1	"
DM27	24.7	1	"
WI263	22.1	1	"
CO15	21.5	0	"
ARC 10952	17.7	0	"
TKM 6	260	0	"
CO21	20.1	0	"

Table 34: The infestation of selected rice varieties by the white rice stemborer, Maliarpha Separatella at the maturity.

Variety	Mean tillers/hill	Percent tiller infestation(%)	% whiteheads	Rating	g/3row
ARC 10952	18.8	47.3	2.7	VS	825
W1253	20.5	37.8	2.5	S	150
CO21	16.7	35.3	0.0	S	500
DM 27	16.5	35.2	1.8	S	1100
IR20	15.6	32.1	0.0	S	750
RATNA	17.2	28.5	1.2	S	600
TAITUNG 16	13.4	28.4	1.5	S	1250
IET 2845	15.7	25.5	0.6	S	1125
SUYA120	23.0	21.7	0.4	S	875
CHIANAN2	18.6	19.9	0.0	S	825
IR 40	14.7	16.3	0.0	S	725
IR579-48-1 -2 (Susceptible check)	17.6	12.5	0.0	S	975
IR36	22.1	12.1	0.5	S	750
CR157-392-4	25.5	11.8	0.0	S	650
CO7	29.9	11.7	0.0	MS	300
IB56-8	21.0	11.0	0.0	MS	600
CO18	26.0	9.6	0.0	MS	1355
TKM6(Resistant check)	27.6	8.3	0.0	Resistant	530
IR1544E665	31.6	7.0	0.0	R	775
MTU 15	21.2	6.6	0.0	R	75
W 1263	23.2	5.6	0.0	VR	500

4.1.6 Monitoring work in Western Kenya Schemes.

4.1 .6.1 Introduction

In order to establish the seasonal distribution, abundance and incidence of the common rice pests encountered in rice schemes in Kenya, a continuous pest monitoring programme has been established.

4.1.6.2 Objective

To establish the incidence of common rice pests.

4.1.6.3 Materials and methods

Recommendations from the International Rice testing programme (IRRI 1980B) were adopted.
Data collected covered incidence of white stemborers (Maliarpha Separatella (SB); pink borer sesamia calamistis (SC) 'Dead hearts (DH) due to stalk eyed fly (SEF) Diopsis thoracica, leaf miner Hydrellia spp (LM) and rice case worms (Nymphula depunctalis (RCW).
Fields were selected from blocks K,L,N,D,N,O,Pand M in Ahero Pilot Scheme. Ten observational plots were selected per block and A meter square quadrat replicated three times per observation plot was used to monitor the incidence of SEF, LM, RCW at 30 DAT. Tiller infestation by the white stemborer and pink borer was determined by random selection of ten plant hills. These were dissected to confirm incidence per observation point.

4.1.6.4 Results and discussion

Table 35: Mean of incidence of various pests APS (LR 83).

Block	%DH incidence due to SEF DAT	% LM damage 30 DAT	% RCW incidence 30DAT	% SB infestation 60 DAT	% SC infestation 60DAT
K	0.7	0.5	0.4	15.8	0.3
L	4.9	0.8	0.0	5.3	0.0
N	3.5	2.5	0.0	19.2	0.1
D	2.6	2.5	0.0	-	0.8
O	0.5	7.4	1.0	8.4	0.0
M	2.2	11.9	0.0	15.0	0.0
P	3.9	0.8	0.0	7.2	0.2

Tiller infestation due to Maliarpha Separatella was recorded in all blocks monitored in APS, with the highest incidences being in blocks N,K,M, damange due to the pink borer sesamia calamistis was noted on a very limited scale in some blocks.
The incidence of 'dead hearts' due to Diopsis thoracica was highest in blocks L, P and N. While the incidence of rice case worms was low throughout all blocks. The incidence of rice leaf miners remained low except for a higher incidence noted in block M and O.

4.1.6.5 Conclusion

The long rains season was characterised by a low incidence of pests in Ahero Pilot Scheme.

PLANT PATHOLOGY (A.W.M)

4.2 During the LR83 season, screening trials for blast and RYMV were carried out. Determination of yield loss due to RYMV was also carried out a trial was also set down to check how various varieties react to direct innoculation with RYMV viruses. Scheme monitoring for diseases basically for Ahero Pilot Scheme which was in crop continued.

4.2.1 RICE YELLOW MOTTLE VIRUS SCREENING NURSERY.
LR 83 020 cpp 009

4.2.1. Introduction

Rice yellow mottle virus(RYMV) causes reduction in yield by stunting, lowering the number of tillers and reducing the photosynthesing capacity of tillers. The methods of controlling viral diseases that are available to us at present is control of the vector, producing resistant lines (breeding) or screening present varieties for their resistance to RYMV. During this season the last varieties were subjected to natural innoculation and artificial innoculation to select varieties that are resistant to RYMV.

4.2.1.1 Natural innoculation

Objective - To test the resistance of varieties in various stages of varietal selection to RYMV. When the test plants are left to be innoculated naturally. i.e either by the vector or mechanical rubbing of the leaves or any other means available/ of innoculum transmission.

4.2.1.2 Material and methods

Sindano was used as a spreader material for RYMV. Three rows of sindano were transplanted around the 1x20m test plot. In the test plot a spacing of 20x60cm was adopted for sindano. At 18DAT sindano was innoculated with sap from infected leaves. At 21DAT of sindano the test varieties were transplanted in two rows in the 60cm space left in the test plot.

Normal agronomic practice was observed. Furadan 5G was not applied at all to avoid killing the vector.

4.2.1.3 Observations

These were done at 42, 56 and 70 DAT of the test varieties The number of infected hills per variety was expressed as a percentage of the total number of hills.

IR1561-228-3-3 the present commercial variety and proved to be moderately resistant to RYMV (Mwangi 82) and sindano susceptible variety (Baker 71) were used as moderately susceptible and susceptible checks respectively.

The varieties were classified as follows.

1. Percentage infection less than IR 1561-228-3-3 at all DAT observed - Resistant
2. Percentage infection equal to IR1561-228-3-3 at all DAT observed - moderately resistant
3. Percentage infection above IR1561-228-3-3 and less than sindano at all DATS observed - susceptible
4. Percentage infection equal or higher than sindano highly susceptible.

Table 36 - Classification of varieties according to their resistance to RYMV.

Table 36a

4.2.1.4 Results and discussion

RESISTANT VARIETY	% Infection at 42DAT	56DAT	70DAT
KISUKE	0	9	8
Basmati	5	21	3
Sena	3	10	10
Kaoshing	0	0	18
IR 1529-129-2-3-6	0	6	25
IR 36	5	13	37
CHINESE	3	22	23
Palimani	5	23	25
BW 196	0	6	32
IR9708-51-1-1-2	4	8	34
Sindano mai	3	2	36
IR9209-48-3-2	0	28	30
IR 822-347	19	37	28
ITA 6856	18	36	38
R-7-2-3-1	0	31	40
BR 161-28-58	0	13	48

Table 36b

MODERATELY RESISTANT VARIETIES

	% INFECTION AT		
	42DAT	56DAT	70DAT
BG 34-8	0	3	49
TNAU 1756	0	15	51
IR2035-225-2-3	0	16	51
ITA 6850	18	14	53
IET 2254	0	1 7	54
IR8	6	33	50
IR1561-228-3-3	9	35	48
BR 51-74-6	8	31	55
BIBI YA MUHAKA	0	42	48
IR 1529-167-2-2	4	26	54
IR 109-74-2-2	0	44	51
IR 841-67-1-1-1	0	43	53

Table 36c <u>Susceptible varieties</u>

Variety	% infection		
	42DAT	56DAT	70DAT
IR 532-144	0	18	57
MTB 3419	0	29	60
ITA 6838	23	41	65
BG 169-1-1	0	26	68
PAU 41-B-31-1-PR407	0	24	67
UPR -251-101-2	13	26	66
BG 96-2	0	47	59
BKN 7033-13-1-1-3-2	0	47	69
CHIANG SEN YU 13	0	14	74

Table 36d <u>Very susceptible varieties</u>

	% infection at		
	42DAT	56DAT	70DAT
ITA 6833	38	55	75
SINDANO	12	30	75
RP 1158-72-1	0	28	74
IR 1529-680-3	6	40	76
MRC 603-303	4	26	80
BG 90-2	13	49	81
PK 174-18-1-5	0	39	84
IR 3941-1	3	64	88
GUMTI	15	52	97

The results of this season generally agreed for most varieties with the results long rains 1982 (Mwangi et al 1983)

4.2.1.5 Conclusions

The following varieties are confirmed resistant to RYMV. and could be used as a genetic source for resistance,
- Kisuke, Sena, Palimani and BG 34-8; Sindano Mai

The following are confirmed moderately resistant IR 1561-228-3-3, IR7-2-3-1 , IR8 and IR822-347. BR51 -74-6 was moderately resistant as opposed to 1982 long rains whereas it was susceptible comparing the results. The variety is not highly susceptible and would withstand quite abit of infection if planted commercially without affecting the yield. The varieties outlined below are highly susceptible to RYMV - BG 90-2, Sindano, IR3941-1-1 (so far in the large scale variety trial)

Of the four ITA varieties tested ITA 6856, and ITA 6850 were resistant to RYMV while ITA 6833 and ITA 6838 showed susceptibility to RYMV.

4.2.2 Artificial innoculation method.

4.2.2.1 Introduction

On laying down the rice yellow mottle virus nursery explained in (a) above. It is expected that the disease will be transmitted to the test variety naturally as it does under field conditions either through the vectors (species of chysomelidae beatles) or through mechanical rubbing of gutating leaves. Resistance shown in this nursery then is none effectiveness of the variety to the beatle due to the fact that the beatle for any reason does not prefer the leaves.

It is however known that resistance to virus could be either due to unpalatability of the rice variety or due to a plants genetic tolerance to the virus even when infected (Tarr 1972).

4.2.2.2

Objective - to test whether the resistance shown by some varieties was tolerance or resistance to the vector.

4.2.2.3 Material and methods

Two rows three meters long were transplanted at a spacing of 20x20cm per test variety. There were 38 varieties transplanted in one test plot.

There were four test plots with different treatments as follows

Test plot (1) Innoculation at 15 DAT

(2) Innoculation at 30 DAT

(3) Innoculation at 45 DAT

(4) No innoculation

Observations

The following observations were taken

(1) Average height of 5 plants at 70 DAT

(2) Disease development at all DATS

(3) Yield of 25 hills per treatment

(4) No of tillers per variety per treatment at 70 DAT

(5) Days to maturity of the treatments

4.2.2.4 Results and discussions

Field observations showed that early innoculated varieties delayed in maturing.

There was no marked difference in tillering at all days of innoculation.

Table 37 Yield of the test varieties and percentage reduction in yield at various treatments.

Table 37.	15 DAT		30DAT		42DAT		No innoculation	
	TR1 yield in kg/ha	%yield loss	TRII yield kg/ha	%yield loss	TRIII yield kg/ha	%yield loss	TRIV yield	%yield loss
BG 90-2	483.1	91.5	724.5	87.2	2071.3	64.5	5667.6	S
IR2793-80-1	47.7	100	702.0	86.9	2156.6	59.7	5354.4	S
BASMATI	777.6	78.9	1200.1	67.4	2741.2	25.5	3680.4	R
IR822-347	1733.8	19.6	2107.7	42.3	2688.4	24.7	2156.6	M
ITA 6833	398.2	89.4	252.2	93.3	82.7	97.8	3760.5	S
GUMTI	61.4	98.5	68.0	98.4	393.1	90.6	4190.4	S.
PALIMANI	418.6	98	1827.8	47.5	1733.4	50.3	3484.5	R
UPR251-101-2	99	98.2	367.0	93.3	4306.5	21.8	5508.8	
SINDANO	26.5	99.5	1079.8	78.4	1611.3	67.8	5006.0	S
MTP 3419	248.7	92.9	1010.5	71.1	1637.1	53.1	3493.0	R
BIBI YA MUHAKA	192.5	89.7	142.3	92.4	1513.8	18.7	1861.7	
IR 36	286.1	92.3	536.2	85.5	1725.5	53.5	3709.1	M
IR9708-51-1-2	523.1	84.6	432.5	87.3	2633.7	22.4	3394.2	R
KISUKE	1371.7	71.1	2596.5	45.2	3672.8	22.5	4741.2	R
CHINESE	384.7	85	967.1	62.3	248	90.3	2562.9	R
IR1529-129-2-2-3-6	142.0	96.8	900.3	79.5	3161.5	28.1	4398.1	S
ITA 6856	398.7	88.1	508.0	84.8	417.4	87.5	3338.9	R
SENA	551.9	89.9	1690.8	69.1	3007.6	44.9	5456.6	R
R7-2-3-1	355.4	92.6	1041.7	78.4	1757.1	63.6	4828.8	M
ITA6850	84.1	97.4	94.0	97.1	1935.3	40.1	3232.2	R
CHIANUNG SEN YU	83.4	98.7	1057.8	83	2606.7	58	6206.2	M
RP1158-7-8	551.9	86.3	627.0	84.4	1887.3	53	4017.4	
IR1561-228-3-3	265.8	95.6	224.4	96.3	2995.4	50.8	6093.3	M
BG 96-2	204.1	96.4	526.0	90.8	2071.3	63.5	5667.6	R
BG 34-8	128.0	83.3	808.7	89.5	3431.4	66.4	7693.3	R
KAOSHING 139	1056.7	71.5	2008.1	45.7	1725.6	53.3	3695.6	
BR51-74-8	215.1	96.7	179.3	97.2	3442.5	46.4	6427.8	M
BW 196	580.5	90.6	752.8	87.6	466.9	92.4	6145.6	R

From table 37 above the following varieties show resistance when innoculated at 15 DAT producing 1 ton and above per acre and also comparing their yield in this treatment with their potential yield shown by the control.

	Yield at 15DAT	Yield at 30DAT
Kisuke	1.37	2.60
IR 822-347	1.73	2.11
Kaoshing	1.06	2.01

at 30 DAT - The above named varieties yield higher while a few more yield one ton and above.

	Yield at 30 DAT
Basmati	1.2 tons
Palimani	1.83
MTB	1.01
Sena	1.7
R7-2-3-1	1.04
Chianung Sen Yu II	1.06
Sindano	1.08 This however is a 21.6% of the potential yield.

The varieties listed above are low yielders apart from sindano. However they have genetic tolerance to RYMV and will yield even when innoculated artificially.

Other known resistant varieties (Mwangi et al 82) mainely BW196, BG 34-8, BG96-2, IR1561-228-3-3, Chinese, IR 36, all are all not ∠ by the vector. In that their resistance is not indicated by the yield when artificially innoculated- but instead their yields are very low.even at innoculation at 42 DAT.

∠ prefered

It should however be noted from Table 37 above that in most varieties resistance increases with increase in age of the plant even with the most susceptible variety - BG90-2 and IR 2793-80-1.

4.2.2.5 Conclusion

Kisuke, Kaoshing and IR822-347 are very resistant varieties to RYMV though low yielding and would all be used as genetic source for RYMV resistance.

4.2.3 BLAST SCREENING NURSERY

LR83 022 cpp008

4.2.3.1 Introduction

Rice blast caused by Pyricularia orzae can be very destructive to a rice crop under favourable conditions. Long rain season in the Kano plains gives such favourable conditions. A blast screening nursery was laid down to screen varieties for their resistance to Pyricularia oryzae during the season.

4.2.3.2 Objective

To screen varieties for their resistance to blast.

4.2.3.3 Material and method

The nursery was laid down according to the IRRI blast nursery specifications (sixth International Rice Blast Nursery 1976).

It was replicated twice. Four test rows were planted per variety in the following sequence. Two test rows, one susceptible check, two test rows, one susceptible check, Resistant check, susceptible check and then the begining of the next test variety. This sequence was followed for all test varieties.

The nursery was innoculated with the shaff from the previous nursery.

The resistant check was AIR 36.

Susceptible check was Basmati 217.

A row of chlotoraria was sown to maintain a humid micro environment for the nursery and also buffer the movement of the spores.

Observations were done at 28, 42, 70 and 98 DAS and rated according to the International Rice Testing Programe(IRRI 1980b)

Eight plants per test plot were observed and average rates tested. The resistance was then classified according to the average rates at 98 DAS as follows.

3.1 - 9 - Susceptible
2.1 - 3 - Moderately susceptible
1.1 - 2 - Moderately resistant
0 - 1.0 - Resistant

Comparison was then done with the results of LR 82 season as in the table 38 below (Mwangi 82)

Table 38: Classification of varieties according to their resistance to rice blast and comparison of the rate of infection with LR 82 rates.

4.2.3.4 Results and discussion

Table 38a

Resistant varieties

Variety	Long rains 83	Long rains 82
		Scale at 96 DAS 0-1
IR 822-347	0.0	2.0
Chianung Yu 13	0.0	
MTB 3419	0.2	
IR 841-67-1-1-2	0.2	0.1
Kaoshing 13g	0.5	
Chinese	0.6	
Palimani	0.7	2.4
IR 28	0.7	
ITA 6838	0.7	2.6
BG 96-2	0.7	1.3
BG 400-1	0.8	1.2
Bibi ya Muhaka	0.8	1.6
BW 196	0.8	
IR 54	0.9	
IR 9708-51-1-2	1.0	

Table 38b Moderately resistant varieties

	LR 83	LR 82
		Scale 1.0 - 2.0
ITA 6833	1.1	
BR 51-74-6	1.2	1.1
GUMTI	1.2	2.5
KN-1B-361-1-8-6-9-1	1.2	
IR2071-636-2-5	1.3	2.3
BG 90-2	1.3	2
SENA	1 .3	4.8
ITA 6856	1.4	1.6
IR 2153-26-3-5-2	1.5	1.1
IR1529-129-2-3-6	1.6	2.1
TNAU 1756	1.7	
IR 50	1.7	
PAU 143-B-4-2PR-505	1.8	
R-7-2-3-1	1.8	1.6
IR 1529-167-2-2	2.0	

Table 38c

Moderately susceptible varieties — Scale 2-1 - 3.0

	LR 83	LR 82
Basmati 217	2.1	
Sindano mai	2.2	2.6
Chiang Sen Yu II	2.3	1.6
IR 8	2.4	
UPR 251-101-2	2.4	1.3
IR 2793-80-1	2.6	0.5
ITA 650	2.7	
IR 42	2.8	3.1
Kisuke	3.0	0.3
IR 532-144	3.0	

Table 38d Susceptible varieties — Scale 3 - 9

Variety	LR 83	LR 82
IET 2254	3.1	
BG 34-8	3.4	1.4
BR 109-74-2-2-1	3.7	
IR36	3.7	3.3
Sindano	3.9	2.4
IR 1561-228-3-3	4.2	4.4
Rashti 507	4.5	2.3

The results of LR82 and LR83 generally agreed, apart from SENA which surprisingly showed resistance during the LR83 season contrary to its susceptibility in the LR 82 season. During the two seasons the following promising varieties showed susceptibility; Sindano, IR 1561-228-3-3, IR 36 and IR 42. BG 34-8 showed susceptibility in the long rains 83 season only.

BR 51-74-6, R-7-2-3-1, ITA 6856, BG96-2, BG90-2 were among the promising varieties which showed resistance to blast during the two seasons. Other promising varieties showing resistance during LR 83 were BW 196 and IR 54.

4.2.3.5 Conclusion

It will be useful to have standing fungicides to protect the crop against blast as long as IR 1561-228-3-3 continues to be the commercial variety considering its infection rates shown in the results. In the promising varieties we have BG90-2, IR54, BG96-2 and BW 196 which could replace IR1561-228-3-3 should blast pause a threat to the commercial variety.

4.2.4 EFFECT OF THE AGE OF THE PLANT AT INFECTION WITH RYMV TO YIELD REDUCTION.

LR 83 024 cpp 005

4.2.4.1 Introduction

Effects on yield by diseases is controlled by factors like age of the plant at infection, varietal resistance and nutritional stress.

An experiment was set up to asses the effect of age of the plant at infection to the yield during the short rains 82 season. The results indicated that yield was drastically reduced if there is an infection before panicle initiation. and that most often the rice plant produces extra tilles to compensate for the dead ones if innoculated early, reduction in height followed the same trend as the reduction in yield. All these parameters depended on variety. (Mwangi et al). This trial was set up with an objective of testing the SR 82 results and getting additional information on rice yellow mottle virus.

4.2.4.2 Objective

To correlate the effect on yield tillering and maturity to the age of the plant at infection with rice yellow mottle virus.

4.2.4.3 Material and methods

Six promising commercial varieties namely IR 1561-228-3-3, IR 36, BR51-74-6, IR 2793-80-1, BG90-2, BG34-8.

A split plot design six varieties and six treatments was adopted. The main plot was the variety while the subplot was the different days of innoculation. There was a one meter band between the subplot. The nursery was sown in field 18^{III} to avoid infecting the main nursery.

The following treatments were given to the subplots:

Innoculation at 15 DAS
" " 15 DAT
" " 30 DAT
" " Panicle initiation
" " 60 DAT
No innoculation

The innoculation sap was from crushed infected hills and was applied using caboradum grit 80 powder to abbraise the leaves.

Observation

The following observations were taken

1. Number of tillers at 70 DAT
2. Yield per plot
3. Days to maturity

4.2.4.4 Results and discussion

Table 39: Effect of the age of innoculation to tillering

Table 39a Two way table Variety x Replicate

Variety	Rep I	Rep II	Rep III	Rep IV
BG 34-8	121.8	68.6	97.6	80.4
IR 36	73.6	99.6	79.2	84.6
IR 1561-228-3-3	133.4	120.6	105.8	108.8
BR51-74-6	70	82.8	80.2	89
IR 2793-80-1	92.8	105.0	96	98.2
BG 90-2	105	76.2	82	80
Total	596.6	552.8	540.8	541
Mean	99.4	92.1	90.1	90.2

Table 39b: Two way table variety x Age of innoculation

Variety		Rep I	Rep II		Rep III	Rep IV
BG 34-8	48.2	61.8	70.8	59.8	66.6	61.2
IR 36	35.0	59.2	57.4	57.8	54.6	73.0
IR1561-228-3-3	54.0	76.8	76.4	88	80	93.4
BR51-74-6	47.2	55.0	55.0	51.6	58.0	55.2
IR2793-80-1	31.8	68.6	64.2	67.8	81.4	78.2
BG 90-2	47.0	52.6	59.6	69.0	62.4	52.6
Total	263.2	374	383.4	394.	403	413.6
Mean	43.9	62.3	63.9	65.7	67.2	68.9

$CV_a = 38.65$ $SE_a \pm 3.0$ tillers

$CV_b = 20.67$ $SE_b \pm 1.6$ tillers

Duncan multiple range test indicated that there was significant difference between seeds infected in the seed bed in tillering, and also between the ones innoculated at 15 DAT and no innoculation. However the tillering difference was not significant. Between innoculation at 30 DAT and the control. This suggests compensatory tillering of most varieties when infected with RYMV, so long as the variety is in the tillering stage (Transplanting date to pI)

Table 40: Effect of the age of innoculation on yield.

Table 40a. Two way table: Variety x Replicate.

Variety	Rep I	Rep II	Rep III	Rep IV
BG 34-8	14,11 2.9	20,263.5	25,971.7	27,071.1
IR 36	6,436.9	22,616.9	14,039.7	17,449.6
IR 1561-228-3-3	12,993.6	18,661.6	20,574.2	19,779.4
BR 51-74-6	8,713.5	15,730.0	17,845.8	20,510.9
IR2973-80-1	6,064.7	20,568.2	22,049.3	20,821.9
BG90-2	1 1,124.3	19,961.4	17,644.7	26,322.3
Total	59,445.9	117,801.6	118,125.4	131,954.3
Mean	9,907.7	19,633.6	19,687.6	21,992.4

Table 40b: Two way table: Variety x Date of innoculation

	Age of innoculation					
	15DAS	1 5DAT	30DAT	PI	60DAT	Control
BG34-8	89.5	775.1	766.2	16282.3	31697.3	37508.8
IR36	193.2	2739.9	2720.1	9526.6	20585.2	24778.1
IR1561-228-3-3	368.8	1277.2	1248.1	4664.7	29377.7	35072.3
BR51-74-6	211.7	2195.2	652	12791.3	19471.5	27477.6
IR2973-80-1	188.1	412.4	2195.5	7797.9	27710.4	31199.8
BG90-2	1 012.3	4978.9	228.3	19059.9	21797.1	27976.2
Total	2063.6	12378.7	7810.2	70122.7	150639.2	184312.8
Mean	343.9	2063.2	1301.7	11687.1	25105.8	30718 .8
	(d)	(c)	(d)	(c)	(b)	(a)

CV_a = 40%   SEa = 984kg

CV_b = 43.4% SE_b = 943.7 kgs

There is reduction in yield at all ages of innoculation. However it is more drastic at 30 DAT and below (see table 40d above). At sixty DAT however the reduction in yield was also partly attributed to mechanical injuries by carboradum on the spikelets in the milky stage.

Table 41: Effect of the age of innoculation to varietal maturity.

Table 41a: Two way table variety x replicate

Variety	REP I	REP II	REP III	REP IV
BG 34-8	703	696	703	691
IR 36	680	675	696	691
IR1561-228-3-3	675	691	698	703
BR51-74-6	708	708	715	696
IR2793-80-1	687	684	696	696
BG90-2	722	722	703	724
Total	4175	4176	4211	4201
Mean	69508	696	701.8	700.16

Table 41b: Two way table variety x age of infection

variety	15DAS	15DAT	30DAT	PI	60DAT	CONTROL
BG34-8	491	496	462	448	448	448
IR36	491	491	440	440	440	440
IR1561-228-3-3	491	468	458	470	440	440
BR51-74-6	496	491	474	456	455	455
IR2793-80-1	484	472	444	460	448	455
BG90-2	496	496	486	469	462	462
Total	2949	2914	2764	2743	2693	2700
Mean	491.5 a	485.66 b	460.7 c	457.2 c	448.8 d	450 d

CVa = 3.2 SEa = 1.8

CVb = 3.5 SEb = 2.04

Analysis of variance indicate a significant effect on the age of infection to the maturity - Early innoculated hills mature late. Rice yellow mottle virus causes reduction by delaying the maturity of infected varieties when varieties yield. The delay in maturity is apparent when the variety is innoculated at panicle initiation and below.

Of all the six varieties tested there is drastic effect on yield on innoculating at panicle initiation and below. This means that when the transmision is by the vector. The resistance indicated by varieties like BG34-8, IR36, IR1561-228-3-3 is none preference of vector rather than the disease.

4.2.4.5 Conclusion

In susceptible varieties like IR2793-80-1 and BG90-2 which are high yielding it is very important that if the cost of insecticide is lower than the benefit we could get by producing them- they could safely replace IR1561-228-3-3 so long as the vectors are controlled upto panicle initiation.

Since diseased plant will never mature with the rest - Roguing them helps in eliminating the source of infection without affecting the yield.

4.2.5 SCHEME MONITORING

4.2.5.1 Introduction

Disease monitoring points to disease development and the economic threshhold level where control measures should be taken. It is a routine programme that is undertaken in the Western Kenya NIB Schemes.

4.2.5.2 Objective

To assess the disease level and alert the management if control measures are deemed necessary.

4.2.5.3 Material and methods

A few plots per block in Ahero Pilot Scheme were surveyed. Among the diseases surveyed were rice yellow mottle virus brown spot, leaf blast and sheath blight. The rating given in the International Rice Testing Programe (IRRI 1980b) was used.

Rice yellow mottle virus was rated with a quadrant of one metre square thrown randomly and the total number of hills with RYMV recorded. The quadrant was thrown ten times per plot observed; Leaf blast and brown spot incidence was quantified by getting the average rates of ten leafs randomly picked, while ten hills were sampled for sheath blight.

4.2.5.4 Results and discussions

Month	RYMV Hills/m^2 infected		Leaf blast		Sheath blight		Brown spot	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
April	1.8	0-11	0.0	0-0	0.5	0-3	0.8	0-3
May	1.2	0-5	0.3	0-1	0.5	0.3	1.0	0-2
June	0	0-0	0.0	0-0			0.5	0-3

Key - 0 - No infection 4-7 - moderate infection
1-3 - low infection 8-9 high infection

Disease level for the observed diseases listed above were quite low during the season. Rice yellow mottle virus and sheath blight were however in noticeable infection levels.

4.2.5.4 Recommendation

The alternative hosts for RYMV and Helminthosporium oryzae which are a threat should be removed from the paddy fields, by encouraging the farmers to clear their drains and bands, and showing the farmers through demonstrations how these alternative hosts can affect their rice.

5.0 IRRIGATION AND DRAINAGE SECTION

5.1 METEOROLOGICAL OBSERVATIONS

5.1.1 Introduction

Assessment of the agricultural potential of a project area is dependent on the availability of adequate climatic data. Such data are an essential input for the determination of water requirements on which planning, design and operation of both rainfed and irrigated agriculture are based. The cropping calender i.e especially when to start land preparation and therefore when to harvest depend on these agro-meteorological figures. Measurement of these can be used to assess water-soil-plant relationship. Climate therefore has a direct influence on crop yield and thus its monitoring is necessary. The most important variables are temperature, humidity wind, sunshire hours, rainfall, evaporation and radiation.

5.1.2 Objective

To monitor climatical chages that take place with time for both future planning and day to day decision making.

5.1.3 Materilas and method

The agro-meteorological data mentioned above are recorded on daily basis using appropriate instruments. Some of these (i.e air temp., rainfall, wind, evaporation etc) are recorded directly while others like radiation, sunshine hours, humidity etc are calculated using appropriate formulae.

5.1.4 Results and discussion

The meteorological observations were carried out on a routine basis at the three observation stations in Western Kenya NIB Schemes. The daily mean data over a month are given in table 42. It can be seen from the table that Ahero had a slightly higher maximum temp than West Kano and Bunyala due to the influence of lake Victoria and the Yala swamp on the latter two respectively. (anonymous 82,83). It can be further seen that sunshire was quite abundant, which was rather unique during LR seasons, especially West Kano where it averages 7.5 hrs/day. Accordingly radiation was high with West Kano recording the highest ranging between 654 and 694 langleys/day. Evaporation from a free water surface (Eo) was

Table 42. Meteorlogical data for the three W/Kenya Schemes-LR83

Month	tmax. (°C)	tmin (°C)	RH (%)	Sunshine (hrs)	Rad (1/d)	Wind (m/s)	Eva (mm/day)	Eo (mm/day)	Average Rainfall (mm)
AHERO									
April 83	30.2	16.9	73	7.7	540	1.4	5.8	5.0	242
May	29.5	16.8	72	8.1	568	1.2	5.2	5.5	97
June	29.1	15.6	72	7.3	508	1.2	4.6	4.9	63
July	29.2	15.1	74	6.6	491	1.1	4.5	5.0	62
Aug.	28.5	15.7	77	6.4	511	1.3	4.3	5.2	121
Sep.	29 .6	14.9	71	7.0	545	1.3	5.1	5.8	35
1970-1982 Ave.	30.0	13.2	66	7.0	574	1.3	5.8	5.6	
WKPS									
April	29.6	18.0	73	7.9	680	1.6	6.0	6.2	190
May	29.1	17.6	71	8.4	697	1.3	5.5	5.7	767
June	28.7	16.7	70	7.6	694	1.4	5.2	5.3	103
July	28.7	16.1	70	7.2	683	1.3	5.1	5.1	37
Aug.	27.5	15.8	75	6.5	654	1.3	4.7	5.3	221
Sep.	28.3	15.1	71	7.2	713	1.3	5.3	5.7	54
1974-1982 Average	28.9	15.6	63	7.5	661	1.7	6.1	6.7	
BIS									
April	30.4	17.9	76	5.7	590	1.8	5.7	5.6	92
May	29.8	17.8	78	8.8	615	1.6	5.9	6.0	100
June	29.7	16.9	78	7.2	496	1.5	5.3	5.2	87
July	28.9	16.2	74	6.9	530	1.5	4.8	5.2	13
Aug.	28.0	16.3	80	5.7	464	1.4	4.6	4.8	17[illegible]
Sep.	28.6	15.9	74	7.5	551	1.5	5.3	5.8	30
1970-1982 Average	29.2	15.3	65	8.0	629	1.5	5.3	6.2	6

calculated using penman method (Penman 1948). West Kano had the highest calculated Eo than the rest of the other two stations due to relatively high radiation and long sunshine hours recorded during the season.

Conclusion

West Kano Pilot Scheme had relatively higher radiation and longer sunshine hours throughout the season. Consequently a higher evaporation from a free water surface (Eo) was calculated.

5.2 WEST KANO IRRIGATION WATER MONITORING - LR 83

5.2.1 Introduction

Due to poor wet land preparation (rotavation) progress coupled with increasing rotavation cost with decreasing returns, West Kano Pilot Scheme (WKPS) was forced to go to single rice cropping at the beginning of 1983 (omitting LR crop). Thus during the period under report there was no much activities. The only rice crop which was in the field was the late transplanted SR 82/83 crop, besides sugar-cane.

5.2.2 Objective

The aim of the study is to monitor irrigation water use and other related aspects to see where possible improvement could be done.

5.2.3 Materials and methods

The daily pumphouse data(i.e pump hours, discharge, costs of spares, lubricant, electricity and volume of water pumped in and out of the scheme) were kept throughout the scheme. The crop water requirement was also computed.

5.2.4 Results and discussion

During the season the inlet pumps worked for a total of 3572 hrs pumping about 3.1 million m^3 water into the scheme. This was, only a third of the water pumped into the scheme during the same time last year because of off season during the period under report. On the other hand the outlet pumps drained about 1.8 million m^3 out of the scheme as opposed to 8.1 million m^3 drained during the same time last year, about seven times less due to the reason mentioned above. The maximum volume of water drained out occurred during the month of January when a total of 0.7 million m^3 was pumped out because of drainage for harvesting of the late SR 82 crop.

The operation cost of the inlet pumps during the period under report included cost of electricity, spares and lubricant.

The total inlet pump expenditure came to Shs 11766.95 equivalent to about Shs 37 per $10^3 m^3$ of water as opposed to about 30 Shs. during the same period last year. For the outlet pump station, a total expenditure of Shs. 58935.85 was incurred equivalent to Shs. 33 per $10^3 m^3$ of water drained out, almost double that one of LR 82 (Sh $17/10^3 m^3$) season due to high spares consumption.
An average cost of Shs. 36 per $10^3 m^3$ of water pumped in and or out of the scheme is thus calculated.
A peak water requirement of 1 l/s per acre was calculated (anonymous 83, Lenselink 82, Ouma 83 a,b,c). Due to off season during the period under report the three pumps giving an average discharge of 900 l/s were more than enough. However, during single rice cropping (SR seasons) even the four pumps would not be enough to meet the peak water demand of 1795 l/s (1115 and 680 acres under rice and sugarcane respectively).
Therefore an additional of one pump of the same capacity is required (Lenselink 82, Ouma 83).

5.2.5 Conclusion

Under single rice cropping, the four pumps giving an average discharge of 1275 l/s cannot meet the water requirement. Therefore an additional pump of the same capacity is required to make the installed capacity come to 2125 l/s. With properly cleaned and deepened link canal, a pumping efficiency of 85% might be reached. Thus in reality only about 1800 l/s would be achieved (assuming 85% efficiency). This discharge would be enough to meet the water requirement of 1115 and 680 acres of paddy and sugarcane respectively.

5.3 DRAINAGE BEFORE HARVEST TRIAL - LR 83
(LR 83 031 1D 003)

5.3.1 Introduction

Wet land preparation has been a bottle-neck in double cropping of rice in NIB schemes, resulting in prolonged rotavation period, thus interferring with the proper crop and water management practices.

The cost of production has been increasing with decreasing returns. One of the causes of the above is the dryness of the fields at the time of harvest and thereafter.

5.3.2 Objective

Due to late drainage, fields often have limited time to dry out (anonymous 82, 83). For the above reasons a trial was set up to determine the best time of drainage for harvest.

5.3.3 Materials and methods

Four treatments were included to determine how early rice fields should be drained before harvest. 14 DBH(control), 21DBH, 28DBH and 35 DBH. The two rice varities used were the standard variety IR1561-228-3-3 and IR 36. The trial was accomodated in a split plot design with treatments in the main plot and varieties in the subplots. The net area was 50m^2 the seeds were sown on 29/4/83 and transplanted 25 days latter. Harvesting was done on 14/9.83. Observations made included a 1000 - grain wt, grain yield. Diseases and pests were monitored throughout the season.

5.3.4 Results and discussion

The trial has been going on for the last four consecutive seasons and there had been no significant differences among the treatments. The trial was repeated during the LR 83 season for the last time. The results are given in table 43.

Table 43: Mean yield (t/ha) of the two rice varieties at different drainage timings.

Treatments	IR 1561-228-3-3	IR 36	Treatment mean
14DBH	3.30	3.40	3.40a
21 "	3.00	3.10	3.10a
28 "	3.40	2.90	3.20a
35 "	3.60	2.70	3.20a
Variety means	3.30	3.00	

	Main plot	Sub plot
SE	0.17 t/ha	0.15 t/ha
CV	15%	18%

Means followed by the same letter are not significantly different (DMRT, P = 0.05).

There were no significant yield differences among the treatments. One would therefore opt for the alternative which allows the longest drying period i.e drainage 35 DBH - (anonymous 82). However, between 35 DBH and 14DBH, there was 130 mm of rainfall recorded in Ahero, reducing the earliest drainage time of 35 DBH to 14 DBH, if an evaporate of 6mm/day is applied. From 28 DBH to 14DBH, there was a total of 80mm of rain and also from 21 DBH to 14 DBH, there was 18mm of rain reducing the drainage timings of 28 and 21 DBH to actually 15 and 18 DBH, respectively. It can be noticed from the foregoing that all the treatments were more or less reduced to the control (14DBH). This could partly explain the lack of differences among the treatments. Decreasing evaporation due to senescences coupled with the residual moisture in the soil might have also reduced the treatment effects (anonymous 83) If the rice roots explore the upper 25-30cm of the soil, if the moisture content in this layer is about 60-70% by volume (Groot, J.M. 1976), and if moisture content and wilting point around 30% (ILACO 74), see also (Lenselink et al 81), almost 45 mm can be extracted before moisture stress occurs. At the above mentioned extraction rate, this is another one week (Ouma et al 81). From these considerations it would appear that, if one want to induce moisture stress at two weeks before harvest also considering the type of soil (heavy clay) (longer drying period), one indeed should drain three weeks before harvest, (S. Linscombe,1983).

5.3.5 Conclusion

The fact that no differences between draining at 2,3,4 and 5 weeks before harvest were found in the trial was explained by rainfall occuring in the drainage period. This would not make it recommended to drain at 5 weeks before harvest. However, drainage at 3 weeks before harvest instead of two weeks is possible.

6. SUMMARY

From the medium/late maturing variety trial, two varieties - IR 2793-80-1, IR 54 - outyielded the commercial IR 1561-228-3-3 by 15% and 7% respectively. Four varieties, BG 400-1, IR 54, IR 36 and ITA 6838, outyielded IR 1561-228-3-3 in the early maturing variety trial by 35%, 23% 5% and 3% respectively. They were, however, all found to be medium rather than early maturing. In farmers fields (site performance trials), IR54, IR1529-167-2-2 and IR2793-80-1 gave better yields than IR1561 -228-3-3, the Western Kenya commercial variety.

In a fertilizer trial to study the effect of nitrogen application at different stages of growth of the rice plant, it was found that best yields were obtained with a combination of basal application (at transplanting) and topdressing between 42-56 DAT. In a related nitrogen fertilization trial, sulphate of ammonia and urea gave better yields than _Azolla_. It was suspected that the poor performance of _Azolla_ could have been due to the smothering effect of _Azolla_ on young rice seedlings upon flooding.

In weed control, grasses remain a problem. A herbicides trial showed that no herbicide gave a satisfactory control of grasses, though good control was obtained with sedges and broadleaved weeds. Four herbicides - Basagran PL, Oxadiazon, Actil and Avirosan - and hand weeding gave higher yields than unweeded control. Best control for grasses was recorded from Tamarice, while Oxadiazon, Actril, Avirosan and hand weeding gave complete control of sedges and broadleaved weeds (whose populations were low).

In Mwea, three cold tolerant varieties, K41 -146B, CR126-42-2 and IR3941-61-1B outyielded Sindano by 35%, 18% and 9% respectively. In a trial to study interaction between varieties and nitrogen fertilizer, it was found that for the varieties tested, maximum yield potential could only be realized at nitrogen levels above the current recommended rate (52 kg N/ha). Grain yields increased with increasing N levels upto 78 kg N/ha, then declined except for IR2793-80-1, the highest yielder.

Results of the double cropping trial showed that the LR 83 yields were lower than those of the SR 82 season. The yields were, however, better than those of the last LR season tested (LR 1980). No significant build up of diseases and pests was indicated.

Adverse weather conditions played havoc on the upland crops trials. In Bunyala, greengrams and sorghum were the most profitable crops on farmers fields. Serious water stress coupled with an outbreak of aphids and thrips resulted in poor performance and very low yields. In West Kano where weather conditions were better, beans, greengrams and sorghum did better than in Bunyala. Zero tillage was practised by some farmers with greengrams in Bunyala..

Rice was successfully transplanted at AIRS using an engine-powered transplanted and seedlings raised in special seedling boxes. An IRRI designed manual transplanter had too many mechanical breakdowns, and mass production of seedlings by a modified wet bed nursery was unsuccessful.

Amongst the insecticides evaluated cabofuran 5G remained the most effective, other promising insecticides were Hostathion, Ekalux Diazinon. The highest net benefits were realised in the Hostathion and carbofuran treatments.

In Mwea, Carbofuran, Sumithion, Servin, Dipterex and Hostathion gave good control of the common pest complex; large scale insecticide trial at Ahero Pilot Scheme showed that the use of Carbofuran, Diazinon, Ekalux and Servin realised higher net benefits as compared to the Dipterex and Ripcord treatments. IR579-48-1-2 was found to be a suitable susceptible check while TKM6 a resistant check in stem borer resistance studies. The long rains season was characterised by a low incidence of pests in Ahero Pilot Scheme.

Among the varieties tested for genetical resistance to RYMV, only Kisuke, IR 822-347 and Kaoshing showed resistance.
Other varieties to be noted for resistance to RYMV are BW196, BG34-2, BG96-2, Chinese, Palimani and Sena.
IR1561-228-3-3 showed susceptibility to blast. It was therefore shown that as long as IR 1561-228-3-3 continues to be a commercial variety there should be a stand by fungicide just incase of an outbreak of blast.
BG 90-2, IR54, BG96-2 and BW196 were all blast resistant varieties.

Inthe yield reduction trial it was seen that all the varieties innoculated were susceptible to RYMV and that resistance shown by varieties like BG34-8, IR36, IR1561-228-3-3 was resistance to the vector rather than the virus.

It was also seen that late plants infected by RYMV mature later. This meant that roguing diseased hills did not reduce the yield.

It is indicated in the scheme monitoring as long as rice yellow motle virus and brown sport(Helminthosporium oryzae) continue to be noted in the Western Kenya Schemes, and the later also in Mwea Settlement Scheme, crop hygine and removal of alternative hosts on the bands remain very important.

Ahero had a relatively higher maximum temperature than the two other schemes while West Kano Pilot Scheme had longer sunshine hours and higher radiation.

In West Kano, a total of 3.1 million m^3 of water was pumped into the scheme while about 1.8 million m^3 was drained out during the same time. During the season a total operational expenditure of Shs. 176603.80 was incurred; equivalent to an average of Shs. 36 per 10^3m^3 of water pumped in and (or out of the scheme). A peak water requirement of 1 $^1/s$ was calculated, equivalent to an additional of one pump of the same capacity to meet the peak water requirement especially during the main season.

In the fifth year of the trial to determine the best time to drain rice fields, no significant yield differences were found due to rainfall interferences. However, due to reliability of rainfall during the drainage times and also considering the type of soil (heavy clay) drainage three weeks before harvesting is possible.

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