ALL INDIA CO-ORDINATED RESEARCH PROJECT ON CROPPING SYSTEMS RESEARCH

ANNUAL REPORT 2006-07

NG SYSTEMS RESEARCH CENTRE
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Kerala

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CROPPING SYSTEMS RESEARCH CENTRE,
KERALA AGRICULTURAL UNIVERSITY, KARAMANA,
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Kuruvilla Varughese
Chief Agronomist

CONTENTS

I. INTRODUCTION

The State of Kerala, occupying an area of 38,863 sq. km., is situated in the south-western tip of the Indian Peninsula, between 8° 18'and 12° 48' north latitudes and 74° 52' and 77° 22' east longitudes as a long strip of land, 32 to 133 km wide, between the Western Ghats in the east and the Arabian sea in the west, with a 580 km long coastal line. In the south, the State is bounded by Tamil Nadu and in the north by Karnataka. The landmass of Kerala has an undulating topography, stretching from the east with a series of hills and valleys intersected by numerous small rivers and streams flowing into the Arabian sea on the west. Kerala is a land, highly diversified in its physical features and agro-ecological conditions. The undulating topography ranges in altitude from below mean sea level (MSL) to 2694 m above MSL. Based on topography, Kerala may be divided into four well defined natural geographical divisions each running almost parallel, in the north-south direction viz. (I) High ranges (above 750 m MSL) which includes parts of the Western Ghats (ii) High-land (75 – 750 m MSL) comprising of land sloping from the Western Ghats (iii) Mid-land (7.5 to 75 m MSL) lying between the lowlands and the mountains and Low-land (up to 7.5 m MSL) comprising mainly the coastal areas.

The rainfall distribution in Kerala is bimodal, the bulk of the rainfall received during the south- west and the north- east monsoons. The average annual rainfall is mostly around 3000 mm and the annual temperature ranges between 21° C and 35° C. Kerala has a rich and fertile soil nourished by as many as 44 rivers, large mineral deposits, vast track of forestry, rich marine life and a temperate climate.

Kerala State has a unique cropping pattern, the major crops being coconut, rubber, rice, tapioca and banana. The cropping system approach has now slowly shifting to the farming system approach along with watershed approach for natural resource management, strengthening of marketing, processing and value addition.

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON CROPPING SYSTEMS RESEARCH

The AICRP on Cropping Systems is one of the largest research projects operating under the ICAR. It was initiated during 1956-'57 as a continuation of "Soil Fertility and Fertilizer Use Project" with centers in all agro-ecological regions of the country. Recognizing the importance of the system approach for enhancing agricultural productivity, the project was upgraded into a Directorate during the VII five-year plan and was re-designated as the Project Directorate of Cropping Systems Research, Modipuram, Meerut (U.P.).

The Cropping Systems Research Centre, Karamana, was established in the year 1955 under the auspices of the Fertilizer Use and Soil Fertility Project sponsored by the ICAR. The set up of the station underwent a change both in its technical programme and staff pattern in 1968, when the All India Coordinated Agronomic Project was initiated. The mandate of the station is based on reprioritization of the thrust areas of research with lead function of maximizing the productivity levels of rice and rice based cropping system. The verification functions are the multi-location trials and integrated production trials, bio-energy conversion and organic recycling and water requirement of crops. The on-farm research component involves verification and testing of developed technologies to conduct simple fertilizer trials in the farmers' field in a phased manner.

In Kerala, during the period under report (2006-'07), the AICRP on Cropping Systems is operating at Karamana as its main centre with the objective to study the production potential under adequate and limiting resources, judicious use of fertilizers, irrigation and weed management. The ECF unit is operating Sadanandapuram in Kollam district.

Cropping Systems Research Centre, Karamana (Main Centre), under the NARP (Southern Region) of Kerala, is located at Nedumcadu, 3 km southeast of Thiruvananthapuram Central Railway Station. It is situated at 11° North latitude and 77° East longitude at an elevation of 33 m above MSL. The Centre forms a part of 19.3 coastal ecosystem-hot humid-per humid region.

The soil of the research farm belongs to the soil type of riverine alluvium with an acidic soil reaction. The texture of the soil is sandy loam to sandy clay loam, generally low in N but medium in P and K status. The area enjoys a tropical climate with a mean annual rainfall of 1600 mm.

II. RESEARCH ACTIVITIES

II a. ON STATION RESEARCH

ONGOING RESEARCH PROGRAMMES

The experiments being conducted under the AICRP on Cropping Systems are as follows.

1. Performance of different crops in rice based cropping system (1a).
2. Permanent plot experiment on integrated nutrient supply system in a cereal based crop sequence (2a).
3. Long range effect of continuous cropping and manuring in a rice based cropping system (2b).
4. Development of organic farming package for the system based high value crops
5. Site specific nutrient management in hybrid rice
6. Integrated weed management in a rice based cropping system.(concluded)

II b. ON FARM RESEARCH

ONGOING RESEARCH PROGRAMMES

1. ECF Experiments
2. Front line demonstration on oilseeds

III. RESULTS

The results of experiments conducted during 2006-2007 are delineated in the following pages.

On Station Research

Experiment 1(a)

Performance of different crops in rice based cropping system

Experiment 1a

Performance of different crops in rice based cropping system

1. Objective : To study the performance of different crops in rice-based cropping system in terms of soil fertility, energetics and economics.

2. Year of start : 2006-'07 Kharif

3. Layout of the experiment :

Design : Randomised Block Design

Replications : 3

Plot size : Gross : 9 m x 6 m

Spacing : Kharif : 20 cm x 15 cm
Rabi : 15 cm x 10 cm

Rice variety : Kharif : *Aiswariya* (MD)
Rabi : *Kanchana*(SD)

Treatments : 8

Table 1.1 Treatment details

Treatment	Kharif	Rabi	Summer
T_1	Rice	Rice	Fallow
T_2	Rice	Rice	Sweet potato var. Kanhangad local
T_3	Rice	Rice	Pumpkin var. Ambili
T_4	*Rice*	Rice	Sesamum var. Thilarani
T_5	Rice	Rice	Amaranthus var. Aruna
T_6	Rice	Rice	Cowpea (Vegetable) var. Vellayani Culture
T7	Rice	Coleus var. Nidhi	Daincha
T8	Rice	Cassava var. Vellayani Hraswa	Daincha

(* common package of practices recommendations were given to the crops)

4. Results obtained during the period under report

The experiment commenced during Kharif 2006. Prior to raising kharif crop, the experimental site was kept fallow for a season. During kharif, plant height, number of tillers, number of productive tillers, growth yield and straw yield of rice were on par in all treatments (Table 1.2). A similar situation prevailed during Rabi season with respect to rice. However, during rabi, coleus and tapioca crop performed well and yielded 13.1 t/ha and 11.4 t/ha of tuber respectively (Table 1.3).

During summer, the different crops raised gave good yield (Table 1.4). The rice-rice-amaranthus system (T5) resulted in maximum system rice equivalent yield, followed by rice-rice-sweet potato (T2).

Table 1.2 Effect of treatments on the biometric characters and grain and straw yield of rice during kharif season

Treat ments	Plant height (cm)	No. of total tillers per hill	No. of productive tillers per hill	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1	106.40	11.47	10.80	4427.99	7331.59
T_2	107.87	12.60	12.00	4936.12	8238.97
T_3	105.40	12.53	11.47	4718.35	7694.54
T_4	108.13	10.73	9.80	5008.71	8028.46
T_5	106.20	12.07	11.47	4210.22	7360.63
T_6	107.33	10.93	10.00	4790.94	7738.10
T_7	107.07	11.93	10.80	5008.71	7781.65
T_8	103.20	12.00	11.07	5008.71	7839.72
CD (0.05)	NS	NS	NS	NS	NS

Table 1.3 Effect of treatments on the biometric characters and grain and straw yield of rice during rabi season

Treat ments	Plant height (cm)	No. of total tillers per hill	No. of productive tillers per hill	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1	73.47	5.87	4.87	3032.88	4818.59
T_2	73.93	6.27	5.47	2653.77	4535.15
T_3	76.87	6.60	6.33	2990.36	4889.46
T_4	77.87	5.47	5.00	2533.30	4889.46
T_5	81.07	6.53	6.07	2869.90	4641.44
T_6	78.33	6.53	5.93	2494.33	4145.41
CD (0.05)	NS	NS	NS	NS	NS
T_7	Tuber yield of Coleus			13147 kg/ha	-
T_8	Tuber yield of Cassava			11429 kg/ha	-

Table 1.4 Economic yield of different crops raised during summer and annual system rice equivalent

Treatment	Economic yield (kg/ha)	System rice equivalent yield (Rs./ha/year)
T_1	-	7461
T_2	17500	22902
T_3	16083	15750
T_4	337	8173
T_5	17750	24830
T_6	7013	14299
T7	19197	19356
T8	20617	12012

Uptake of nutrients

The uptake of N and K was found to be significantly lower for T_7 (coleus) and T8 (cassava) than treatments T1 to T6 with rice in the rabi season (Table 1.6). P uptake was markedly reduced in T7 while in T8 it was significantly higher.

During summer, T7 (sweet potato) gave the highest uptake for all the nutrients compared to the other crops(Table 1.7). The leguminous crops cowpea (T6) and daincha (T7 and T8) also gave significantly higher uptake of N, P and K compared to T3 (pumpkin), T4 (sesamum) and T5 (amaranthus).

Table 1.5 Nutrient uptake by rice during kharif season (kg/ha)

Treatment	Grain			Straw		
	N	P	K	N	P	K
T_1	46.71	6.39	10.39	48.32	7.51	207.98
T_2	49.76	6.75	14.64	70.23	12.06	239.39
T_3	46.28	6.06	15.21	52.18	8.65	199.40
T_4	48.58	6.52	16.65	56.34	8.47	223.29
T_5	49.34	7.10	13.74	62.45	10.73	215.46
T_6	48.58	6.55	14.30	54.32	9.65	204.21
T_7	50.87	8.13	19.27	54.62	9.50	177.83
T_8	50.61	9.00	14.24	55.03	14.29	195.85
CD (0.05)	NS	NS	NS	NS	NS	NS

Table 1.6 Nutrient uptake by crops during rabi season (kg/ha)

Treatment	N	P	K
T_1	64.84	9.21	146.19
T_2	66.77	10.17	135.15
T_3	63.18	8.95	137.06
T_4	60.83	8.72	142.99
T_5	73.67	11.37	140.98
T_6	58.68	9.21	120.22
T_7	14.83	5.77	27.26
T_8	42.98	16.93	39.62
CD(0.05)	13.39	3.45	29.62

Table 1.7 Nutrient uptake by crops during summer season (kg/ha)

Treatment	N	P	K
T_1	0.00	0.00	0.00
T_2	166.53	38.01	130.01
T_3	19.47	6.21	25.39
T_4	32.26	9.33	29.82
T_5	20.21	6.57	33.31
T_6	112.47	13.51	53.91
T_7	113.88	24.76	98.79
T_8	92.49	17.03	73.84
CD(0.05)	78.20*	6.72*	18.46*

* T_1 was excluded during statistical analysis

Table 1.8 Soil fertility status during summer, kharif and rabi season

Treatment	Kharif			Rabi			Summer		
	Avail.N (kg/ha)	Avail.P (kg/ha)	Exch.K (kg/ha)	Avail.N (kg/ha)	Avail.P (kg/ha)	Exch.K (kg/ha)	Avail N(kg/ha)	Avail.P (kg/ha)	Exch.K (kg/ha)
T_1	146.35	7.93	198.99	158.89	10.27	55.25	154.71	10.71	53.01
T_2	167.25	8.68	183.68	154.71	10.03	58.24	142.17	16.85	48.91
T_3	150.53	9.29	160.53	129.62	12.97	56.37	142.17	39.06	47.79
T_4	179.80	8.07	250.51	146.35	10.50	79.52	137.98	18.39	97.81
T_5	158.89	9.43	220.64	133.80	13.63	37.71	154.71	15.07	263.95
T_6	150.53	8.49	185.17	137.98	9.99	57.12	125.44	29.82	150.83
T_7	150.53	8.68	141.49	146.35	15.26	163.52	129.62	15.17	82.13
T_8	158.89	8.45	145.97	150.53	19.55	234.83	137.98	15.21	72.80
CD (0.05)	NS	NS	NS	13.98	4.23	58.70	NS	15.56	84.10

Experiment 2a

Permanent plot experiment on integrated nutrient supply system for a cereal based crop sequence

(KAU Code No.BR/01-00-12-85/KAR/ICAR-Co.ord)

Experiment 2a

Permanent plot experiment on integrated nutrient supply system for a cereal based crop sequence

1. Objectives : To develop a suitable integrated nutrient supply system for a cereal based crop sequence involving more efficient use of fertilizers in conjunction with judicious combination of organic manures by their effective recycling technique, without detrimental effect to long term soil fertility and improving crop productivity.

2. Year of start : 1985-'86

3. Crop sequence and variety : Rice – Rice (var. Aiswarya -Aiswarya)

4. Organic source : FYM, Paddy straw (damaged), Gliricidia leaves

5. Layout of the experiment

Design : Randomised Block Design

Replication : 4

Plot size : Gross plot size : 16 x 6.3 m^2
Kharif : 15.2 x 5.7 m^2 Rabi: 15.2 x 5.9m^2

Spacing : Kharif : 20 x 15 cm Rabi: 20 x 10 cm

Table 2.1 Treatment details

Treatment	Kharif	Rabi
T_1	No fertilizers, no organic manure (control)	No fertilizers, no organic manure (control)
T_2	50% RDF* of NPK through fertilizers	50 % RDF of NPK through fertilizers
T_3	50% RDF of NPK through fertilizers	100 % RDF of NPK through fertilizers
T_4	75 % RDF of NPK through fertilizers	75 % RDF of NPK through fertilizers
T_5	100% RDF of NPK through fertilizers	100 % RDF of NPK through fertilizers
T_6	50 % RDF of NPK through fertilizers + 50 % through FYM	100 % RDF of NPK through fertilizers

T_7	75% RDF of NPK through fertilizers + 25% through FYM	75% RDF of NPK through fertilizers
T_8	50% RDF of NPK through fertilizers + 50% through crop residues	100% RDF of NPK through fertilizers
T_9	75% RDF of NPK through fertilizers + 25 % through crop residues	75 % RDF of NPK through fertilizers
T_{10}	50% RDF of NPK through fertilizers + 50 % through green manuring.	100 % RDF of NPK through fertilizers
T_{11}	75% RDF of NPK through fertilizers + 25 % through green manuring.	75% RDF of NPK through fertilizers
T_{12}	Farmers practice (3t FYM, 90:22.5:22.5kg NPK/ha)	Farmers' practice (90:22.5:22.5 kg NPK/ha)

*RDF: Recommended dose of fertilizers - (90:45:45 kg NPK/ha)

6. Results obtained during the period under report

Growth characters and yield

The influence of treatments on the growth habit of rice crop presented in Table 2.2, indicates that only the height of the crop was appreciably differed due to the treatments during kharif and rabi seasons. The total and productive tillers were not influenced by the treatments. The absolute control treatment gave smaller plants during kharif and rabi seasons. In general the growth characters were better expressed during kharif season and reflected in the final yield also. The grain and straw yield as influenced by the treatments are presented in Table 2.3. During kharif season the integrated approach of nutrient management by substituting either 25 or 50 percent of recommended dose of fertilizers as organics viz., crop residues, farm yard manure or green manure produced higher grain and straw yield and they were on par with each other. The farmers practices in which 50 per cent reduction of P and K fertilizers with full dose of N as RDF and the application of 3t/haFYM resulted in higher yield than full dose of NPK as fertilizers indicating the necessity of organic manure for the better utilization of chemical fertilizers in rice cultivation. Among the fertilizer treatments full dose recorded higher grain yield than 75 or 50 percent RDF as fertilizers.

Table 2.2 Effect of integrated nutrient management on growth characters of rice

Treatment	Plant height (cm)		Total tiller per hill		Productive tillers per hill	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
T_1	96.0	77.4	11.2	6.7	10.6	6.2
T_2	109.9	88.4	10.7	7.6	10.1	7.4
T_3	105.5	91.7	11.3	8.5	10.5	8.4
T_4	101.6	83.9	10.7	8.0	9.9	7.7
T_5	110.7	87.8	11.8	7.8	10.8	7.4
T_6	108.4	93.9	12.1	7.7	11.9	7.4

T_7	111.2	94.6	10.7	8.1	9.7	7.8
T_8	105.5	92.5	10.9	8.1	10.5	7.8
T_9	110.9	96.9	11.8	8.0	11.3	7.8
T_{10}	112.2	90.6	11.9	8.7	11.3	7.8
T_{11}	111.3	91.7	12.3	8.8	11.5	8.3
T_{12}	107.3	92.3	11.9	9.1	11.1	8.6
CD(0.05)	8.5	9.4	NS	NS	NS	NS

In rabi season also like kharif season integrated use of organics and fertilizers resulted in higher yield. Since only 75% of RDF was applied in T7, T9 and T11 there is a possibility of 25% reduction in the application of fertilizers by integrated use of organics and fertilizers. Between T5 and T12 there was not much difference indicating that 3t/ha FYM during kharif season alone with recommended rate of N is not sufficient for higher productivity.

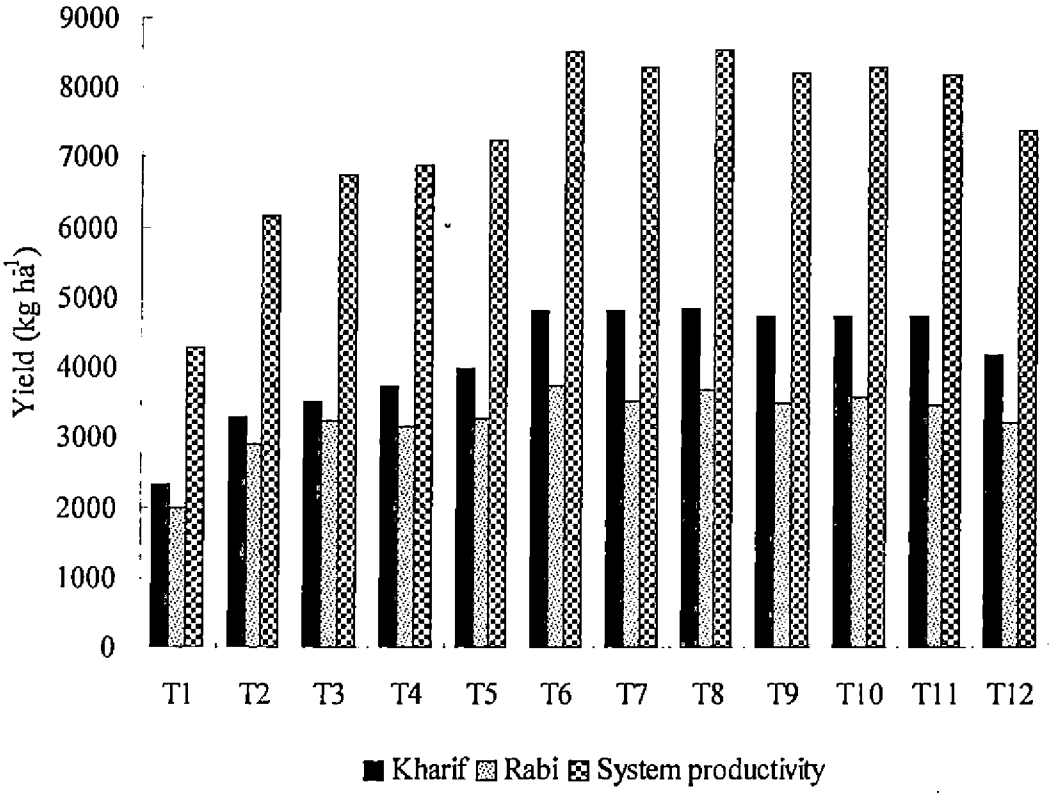

Fig. 2.1 Effect of integrated nutrient management on the productivity of rice–rice cropping system

The system productivity of kharif and rabi season in which integrated use of fertilizers and organics alone recorded more than 8t/ha followed by full application of

RDF (7.7 t/ha). The result is clear indicator of integrated management of nutrients for sustained grain yield and soil health.

Table 2.3 Effect of integrated nutrient management on the productivity of rice–rice cropping system

Treatment	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
	Kharif	Rabi	System Productivity	Kharif	Rabi	System Productivity
T_1	2308	1978	4286	3780	3192	6972
T_2	3275	2885	6160	4992	4195	9187
T_3	3506	3234	6740	5425	4976	10401
T_4	3730	3150	6880	5684	4621	10305
T_5	3982	3262	7244	5684	4948	10632
T_6	4790	3722	8512	6853	5366	12219
T_7	4790	3499	8289	6882	5310	12192
T_8	4840	3680	8520	7098	5561	12659
T_9	4718	3492	8210	6911	5394	12305
T_{10}	4725	3568	8293	7069	5561	12630
T_{11}	4732	3443	8175	6911	5185	12096
T_{12}	4177	3192	7369	6204	5088	11292
CD(0.05)	136.9	197.5		224.3	326.9	

Uptake of nutrients

The influence of treatments on the uptake of N, P and K by the plant during kharif and rabi are presented in tables 2.4 and 2.5 respectively. During kharif the treatments significantly influenced the uptake of nutrients with those receiving organics either as FYM, crop residue or green manure recording higher uptake of these nutrients in both grain and straw. But K uptake by straw showed no significant difference. During rabi the treatments did not influence nutrient uptake by the crop except for N uptake by straw.

Table 2. 4 Effect of treatments on the uptake of nutrients (kg/ha) during kharif season

Treatment	Grain			Straw		
	N	P	K	N	P	K
T_1	21.55	3.36	5.30	29.47	4.68	18.73
T_2	31.93	4.98	7.37	38.73	4.88	19.89
T_3	34.29	5.32	8.22	44.88	4.81	28.28
T_4	35.17	5.82	7.70	42.55	5.45	24.33
T_5	39.89	6.90	8.13	47.28	7.01	21.56
T_6	45.25	10.29	9.93	50.08	7.15	25.84
T_7	42.25	9.34	10.02	51.37	7.78	33.91
T_8	46.85	9.85	10.40	54.52	7.70	35.40
T_9	40.92	9.10	10.50	50.09	7.79	28.58
T_{10}	43.44	8.38	9.61	52.10	8.44	24.74

T_{11}	46.09	8.49	11.11	55.37	6.13	31.78
T_{12}	42.00	7.06	8.83	53.14	4.96	27.10
CD(0.05)	7.73	0.67	1.62	11.98	1.83	NS

Table 2.5 Effect of treatments on the uptake of nutrients (kg/ha) during rabi season

Treatment	Grain			Straw		
	N	P	K	N	P	K
T_1	55.59	12.14	13.97	15.86	4.89	42.77
T_2	23.68	8.20	6.01	24.35	6.39	50.11
T_3	34.04	8.75	6.68	29.12	8.90	60.06
T_4	30.28	9.60	7.84	30.90	9.29	55.15
T_5	30.41	7.72	6.67	31.73	8.07	57.73
T_6	35.86	10.27	7.81	39.23	10.64	66.03
T_7	35.77	10.26	8.53	29.36	10.71	55.04
T_8	38.73	9.39	8.08	38.84	8.10	76.09
T_9	35.59	9.82	7.55	37.70	10.62	70.47
T_{10}	40.73	8.43	8.08	32.51	8.92	69.67
T_{11}	37.0	10.36	7.22	33.20	8.74	65.33
T_{12}	30.71	8.41	6.92	31.07	8.52	65.97
CD(0.05)	NS	NS	NS	9.35	NS	NS

Soil nutrient status

The levels of available N and exchangeable K showed significant variation among the treatments with the treatments T6 to T11 receiving integrated nutrient supply giving significantly higher values during both kharif and rabi (Table 2.6).

Table 2.6 Soil nutrient status at the end of kharif and rabi seasons as influenced by the treatments

Treatment	Kharif			Rabi		
	Avail. N(kg/ha)	Avail P(kg/ha)	Exch.K (kg/ha)	Avail. N(kg/ha)	P (kg/ha)	Exch.K (kg/ha)
T_1	137.98	9.63	66.08	147.39	5.67	45.78
T_2	175.62	12.43	87.92	185.02	7.60	57.12
T_3	172.48	13.41	92.68	225.79	8.23	63.56
T_4	178.75	11.66	101.36	185.02	24.01	65.80
T_5	197.57	16.10	112.00	210.11	10.68	74.76
T_6	200.70	14.18	108.36	216.38	11.59	73.64
T_7	200.70	14.53	127.12	200.70	10.40	65.24
T_8	222.66	14.56	122.92	241.47	11.45	70.56
T_9	222.66	15.82	119.84	222.66	10.78	73.92
T_{10}	232.06	13.34	131.04	244.61	11.80	77.56
T_{11}	228.93	16.03	136.64	232.06	10.01	74.20
T_{12}	185.02	11.10	108.08	203.84	8.33	61.32
CD (0.05)	50.76	NS	31.62	46.45	NS	13.84

Experiment 26

Long range effect of continuous cropping and manuring on soil fertility and crop productivity

(KAU Code No. BR/01 – 00 – 10 –77/KAR(3)/ICAR Co. ord.)

Experiment 2b

Long range effect of continuous cropping and manuring on soil fertility and crop productivity

1. Objectives : The main objectiv of the experiment is to study the long range effect of rice - rice cropping sequence with high yielding varieties at graded fertilizer levels on the yield stability and soil fertility.

2. Year of start : 1977-'78

3. Crop sequence and variety : Rice-Rice
Aiswarya - Aiswarya

4. Layout of the experiment

Design : 3^2 x 2 partially confounded factorial design with one control plot in each block (three blocks per replication).

Replication : 4

Treatments : All the 18 combinations of 3 levels of N, 3 levels of P_2O_5 and 2 levels of K_20, plus one control plot in each block.

N levels :
N_1 - 40 kg N/ha
N_2 - 80 kg N/ha
N_3 - 120 kg N/ha

P levels :
P_0 - No application of P_2O_5
P_1 - 40 kg P_2O_5/ ha
P_2 - 80 kg P_2O_5/ ha

K levels :
K_0 - No application of K_2O
K_1 - 40 kg K_2O/ha

Plot size

Gross : 10 m x 3 m
Net : 9.2 m x 2.4 m (Kharif)
9.2 m x 2.6 m (Rabi)

Spacing : 20 cm x 15 cm (Kharif)
20 cm x 10 cm (Rabi)

5. Results obtained during the period under report

The long term effect of skipping of N, P and K on growth and yield characters of rice crop is presented in tables 3.1 and 3.2 respectively.

Continuous skipping of phosphorus for years resulted in stunted growth of the plants which was reflected in plant height that was reduced by more than 5 cm during both kharif and rabi. Decreased levels of N also resulted in a reduction in plant height. The number of productive tillers also showed a decreasing trend with decreasing N, P and K levels.

Table 3.1 Effect of treatments on plant height and total tillers (Kharif and Rabi 2006-'07)

Treatments	Plant height (cm)		Total tillers		Productive tillers	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
N						
N_1	97.81	86.84	11.67	8.72	10.27	8.39
N_2	99.91	87.38	11.62	8.29	10.4	7.82
N_3	100.28	87.79	11.72	8.74	10.45	8.44
CD (0.05)	NS	NS	NS	NS	NS	NS
P						
P_0	96.24	84.2	11.16	8.27	10.09	8.07
P_1	100.24	87.08	11.94	8.22	10.51	7.94
P_2	101.52	90.73	11.92	9.27	1052	8.74
CD (0.05)	2.27	2.52	NS	0.89	NS	NS
K						
K_0	99.04	87.66	11.48	8.6	10.24	8.28
K_1	99.63	87.02	11.87	8.57	10.51	8.23
CD (0.05)	NS	NS	NS	NS	NS	NS

There was a remarkable decrease in grain yield during both seasons with decreasing levels of P application. Increasing P levels from P0 to P2gave an yield increase of more than 25% during kharif and more than 45% during rabi seasons. Though increasing application of N gave an increasing trend in yield during both seasons, there was no significance .A significant reduction in straw yield was also noticed with decreasing levels of N and P application (Table 3.2). The highest grain yield was obtained for N3P2 with no difference between K0 and K1.

Table 3.2 Effect of treatments on grain and straw yield (Kharif and Rabi 2006-'07)

Treatments	Grain yield (kg/ha)		Straw yield(kg/ha)	
	Kharif	Rabi	Kharif	Rabi
N				
N_1	4255.09	3257.38	10463.88	5260.59
N_2	4408.42	3300.93	10765.81	5487.04

N_3	4109.12	3431.58	11209.27	5983.48
CD (0.05)	NS	NS	NS	NS
P				
P_0	3409.96	2656.42	9161.79	4668.34
P_1	4640.24	3518.67	11162.10	4835.42
P_2	4722.43	3814.80	12115.07	6227.35
CD (0.05)	376.93	475.97	1353.46	691.89
K				
K_0	4406.78	3361.90	10699.76	4701.87
K_1	4108.30	3298.02	10926.21	5452.20
CD (0.05)	NS	NS	NS	NS
N x P				
N_1P_0	3495.82	2691.26	8322.04	4494.14
N_1P_1	4632.88	3579.64	11492.34	5565.42
N_1P_2	4636.56	3501.25	11577.26	5722.20
N_2P_0	3790.21	24230.00	10048.72	4859.95
N_2P_1	4724.88	3788.67	10416.7	5983.48
N_2P_2	4710.16	3684.15	11832.01	5617.68
N_3P_0	2943.85	2848.03	9114.61	4650.92
N_3P_1	4562.97	3187.71	11577.26	4957.35
N_3P_2	4820.55	4258.99	12935.96	7342.18
CD (0.05)	NS	NS	NS	NS
N x K				
N_1K_0	4477.10	3240.00	10454.44	5121.23
N_1K_1	4033.07	3274.80	10473.31	5399.94
N_2K_0	4597.31	3501.25	10737.5	5974.77
N_2K_1	4219.51	3100.61	10794.12	4999.30
N_3K_0	4145.92	3344.48	10907.34	6009.61
N_3K_1	4072.33	3518.67	11511.21	5957.35
CD (0.05)	NS	NS	NS	NS
P x K				
P_0K_0	3630.75	2578.07	8907.032	4912.20
P_0K_1	3189.17	2734.81	9416.54	4424.47
P_1K_0	4854.90	3536.09	11190.40	4800.58
P_1K_1	4425.59	3501.25	11133.79	4870.26
P_2K_0	4734.69	3971.57	12001.85	6392.83
P_2K_1	4710.16	3654.02	12228.30	6061.87
CD (0.05)	NS	NS	NS	NS

Uptake of nutrients

Increasing N levels significantly increased its uptake during Kharif by both grain and straw (Table 3.3). Increasing application of P also resulted in a marked increase in the uptake of N by both grain and straw. Uptake of P also showed a marked increase with increasing levels of its application. K uptake also increased with increasing K application. N and P positively interacted with each other in their uptake but K did not influence the uptake of either N or P.

Table 3.3 Effect of treatments on the uptake of nutrients (kg/ha) during kharif (2006-'07)

Treatments	Grain			Straw		
	N	P	K	N	P	K
N						
N_1	53.99	3.90	6.42	128.26	15.07	73.97
N_2	57.64	4.07	6.00	144.19	13.02	75.79
N_3	53.66	3.40	6.28	156.7	16.90	76.86
CD (0.05)	NS	NS	NS	NS	3.04	NS
P						
P_0	44.98	2.53	4.92	114.87	9.3	61.83
P_1	59.19	4.32	6.72	150.54	13.45	79.36
P_2	61.14	4.52	7.06	163.75	22.25	85.43
CD (0.05)	6.48	0.53	0.91	22.63	3.04	9.50
K						
K_0	57.53	3.87	6.44	142.92	15.46	73.41
K_1	52.67	3.72	6.02	143.19	14.54	77.67
CD(0.05)	NS	NS	NS	NS	NS	
N x P						
N_1P_0	45.56	2.87	4.82	103.00	5.87	61.17
N_1P_1	58.53	4.56	6.63	138.79	11.46	82.45
N_1P_2	57.89	4.26	7.82	143.00	27.89	78.30
N_2P_0	50.16	3.32	5.57	129.62	9.30	68.64
N_2P_1	60.55	4.38	6.42	139.78	11.43	74.06
N_2P_2	62.22	4.51	6.00	163.18	18.32	84.66
N_3P_0	39.21	1.40	4.37	112.00	12.72	55.69
N_3P_1	58.49	4.01	7.12	173.06	17.46	81.56
N_3P_2	63.30	4.79	7.35	185.07	20.54	93.33
CD (0.05)	NS	0.92	NS	NS	5.28	NS
N x K						
N_1K_0	57.41	3.95	6.78	126.84	15.08	71.69
N_1K_1	50.57	3.85	6.07	129.68	15.07	76.26
N_2K_0	60.06	4.27	6.00	141.12	14.08	75.16
N_2K_1	55.22	3.87	6.00	147.27	11.96	76.41
N_3K_0	55.11	3.37	6.55	160.79	17.23	73.38
N_3K_1	52.22	3.43	6.01	152.62	16.59	80.35
CD (0.05)	NS	NS	NS	NS	NS	NS
P x K						
P_0K_0	48.90	2.45	5.35	119.88	10.14	59.52
P_0K_1	41.05	2.61	4.90	109.86	8.46	64.15
P_1K_0	62.42	4.58	7.12	152.59	13.90	76.99
P_1K_1	55.95	4.05	6.33	148.49	13.00	81.73
P_2K_0	61.27	4.56	6.86	156.28	22.35	83.72
P_2K_1	61.01	4.48	7.25	171.22	22.16	87.14
CD (0.05)	NS	NS	NS	NS	NS	NS

During Rabi season also the same trend was noticed with increasing levels of N showing an increasing trend in the uptake of N, P and K by both grain and straw (Table 3.4). Increasing N significantly increased N uptake by straw but had no influence on P or K uptake. Increasing P levels significantly increased its uptake by both grain and straw. N and K uptake by the plant was also remarkably increased by increasing levels of P. The levels of K did not influence the uptake of N, P or K by either grain or straw. N and P showed a positive interaction on N uptake during rabi but increasing levels of N showed a constant increase in the uptake of P during rabi season.

Table 3.4 Effect of treatments on the uptake of nutrients (kg/ha) during rabi season (2006-'07)

Treat ments	Grain			Straw		
	N	P	K	N	P	K
N						
N_1	36.59	5.10	6.13	33.20	3.75	78.95
N_2	37.13	4.82	6.28	35.95	3.47	86.14
N_3	38.89	5.12	6.18	43.98	5.11	87.05
CD (0.05)	NS	NS	5.24	NS	NS	NS
P						
P_0	30.24	3.65	4.58	31.46	2.67	69.64
P_1	40.53	5.43	6.57	38.96	5.25	90.27
P_2	41.83	5.95	7.45	42.72	4.40	92.23
CD (0.05)	5.43	1.16	0.92	5.24	2.04	13.22
K						
K_0	38.83	4.91	6.32	38.51	4.26	84.17
K_1	36.44	5.12	6.07	36.91	3.96	83.92
CD(0.05)	NS	NS	NS	NS	NS	NS
N x P						
N_1P_0	31.22	3.64	4.64	28.45	2.71	67.96
N_1P_1	43.51	5.41	6.69	36.06	4.16	86.48
N_1P_2	35.05	6.23	7.06	35.09	4.37	82.42
N_2P_0	28.58	3.21	4.11	32.81	2.87	78.47
N_2P_1	40.38	5.83	7.55	38.75	4.10	92.78
N_2P_2	42.41	5.43	7.18	36.29	3.43	87.19
N_3P_0	30.92	4.09	4.98	33.11	2.42	62.49
N_3P_1	37.70	5.07	5.46	42.05	7.51	91.55
N_3P_2	48.04	6.20	8.11	56.78	5.40	107.10
CD (0.05)	NS	NS	NS	9.08	NS	NS
N x K						
N_1K_0	36.49	4.77	5.96	34.31	3.30	73.27
N_1K_1	36.70	5.42	6.30	32.09	4.20	84.64
N_2K_0	40.70	5.08	6.95	37.72	3.60	94.33
N_2K_1	33.54	4.57	5.61	34.17	3.34	77.96
N_3K_0	40.00	4.88	6.06	43.50	5.89	84.93
N_3K_1	38.47	5.36	6.30	44.47	4.34	89.16

CD (0.05)	NS	NS	NS	NS	NS	NS
P x K						
P_0K_0	29.83	3.43	4.47	32.73	2.64	74.07
P_0K_1	30.65	3.87	4.68	30.192	2.69	65.21
P_1K_0	41.39	5.34	6.69	39.39	5.82	86.29
P_1K_1	39.67	5.54	6.45	38.52	4.68	94.25
P_2K_0	45.26	5.97	7.81	43.42	4.30	92.17
P_2K_1	38.40	5.94	7.09	42.01	4.50	92.30
CD (0.05)	NS	NS	NS	NS	NS	NS

Soil fertility status

The effect of treatments on the nutrient availability of soil is given in table 3.5. Application of different levels of N increased the N availability significantly especially upto N2 during both kharif and rabi. Increased levels of P significantly increased available P levels during both seasons. Increasing K levels also increased its availability which was significant during rabi.

Table 3.5 Effect of treatments on soil fertility level during kharif and rabi seasons

Treatments	Kharif			Rabi		
	Avail. N(kg/ha)	Avail P(kg/ha)	Exch.K (kg/ha)	Avail. N(kg/ha)	Avail P(kg/ha)	Exch.K (kg/ha)
N						
N_1	162.55	11.533	61.88	153.66	11.15	67.15
N_2	177.71	11.35	63.42	170.91	10.72	72.43
N_3	166.73	11.93	62.21	165.16	11.03	66.97
CD (0.05)	9.93	NS	NS	9.17	NS	NS
P						
P_0	160.46	9.92	65.24	166.73	7.66	71.77
P_1	168.30	11.51	65.05	164.12	10.62	68.55
P_2	178.30	13.38	57.21	158.89	14.62	66.22
CD (0.05)	9.93	1.36	6.87	NS	1.02	NS
K						
K_0	168.30	11.566	61.10	164.47	10.67	61.60
K_1	169.69	11.64	63.90	162.03	11.27	76.10
CD (0.05)	NS	NS	NS	NS	NS	5.72
N x P						
N_1P_0	156.80	9.99	59.22	163.66	7.94	63.98
N_1P_1	166.21	10.78	64.82	158.37	10.85	74.76
N_1P_2	164.64	13.82	61.60	148.96	14.65	62.72
N_2P_0	159.94	10.27	69.58	177.18	7.49	80.36
N_2P_1	174.05	11.04	66.36	174.05	10.39	66.92
N_2P_2	199.14	12.72	54.32	161.40	14.28	70.00
N_3P_0	164.64	9.50	66.92	169.34	7.54	70.98
N_3P_1	164.64	12.72	63.98	159.94	10.60	63.98
N_3P_2	170.91	13.58	55.72	166.21	14.94	65.94

CD (0.05)	17.21	NS	NS	NS	NS	12.14
N x K						
N_1K_0	169.34	11.75	62.35	155.75	10.78	62.44
N_1K_1	155.75	11.32	61.41	151.57	11.51	71.87
N_2K_0	173.52	11.25	58.33	171.43	10.46	61.79
N_2K_1	181.89	11.44	68.51	170.39	10.98	83.07
N_3K_0	162.03	11.70	62.63	166.21	10.76	60.57
N_3K_1	171.43	12.17	61.79	164.12	11.30	73.36
CD (0.05)	14.04	NS	NS	NS	NS	NS
P x K						
P_0K_0	159.94	10.28	65.89	170.39	7.71	62.63
P_0K_1	160.98	9.57	64.59	163.07	7.61	80.92
P_1K_0	162.03	11.34	63.47	167.25	10.09	63.37
P_1K_1	174.57	11.69	66.64	160.98	11.14	73.73
P_2K_0	182.93	13.08	53.95	155.75	15.00	58.80
P_2K_1	173.52	13.67	60.48	162.03	15.05	73.64
CD (0.05)	NS	NS	NS	NS	NS	NS

Organic farming

Development of organic farming package
for system based high value crops

(F. No. SRM/ OF/AICRP/2003/9692 dated 30-03-03)

Organic farming

Development of organic farming package for system based high value crops

1. Objectives : To critically evaluate organic farming vis-à-vis farming with integrated nutrient and pest management systems in terms of yield, its quality, soil health and economic advantages. It also envisages to increase manure production using from wastes, its application for raising crops and pest and disease management through use of plant based preparations.

2. Year of start : Kharif, 2003-2004

3. Layout of the experiment : RBD and year will be treated as a replication

Duration	:	5 years
Crop Sequence	:	Cereal-Vegetable-Vegetable (Rice–Cucumber–Bhindi)
Variety	:	Rice : Aiswarya Cucumber : Vellayani local Bhindi : Varshaupahar
Plot size	:	50 m x 6.3 m
Spacing	:	Rice : 20 cm x 15 cm Cucumber : 200 cm x 150 cm Bhindi : 60 cm x 45 cm
Treatments	:	8

Table 4.1 Treatment details of the experiment

T_1	½ NPK+ ½ N as FYM + Micro nutrients
T_2	1/3 NPK + 1/3 Vermicompost +1/3 Neemcake
T_3	T2+ Trap crop (Cowpea)
T_4	T2+ Agronomic management Practices for pest control
T_5	½ NPK + Biofert. N + Rock phosphate + PSB
T_6	T2 + Biofertilizer N + PSB
T_7	Full NPK fertilizers + secondary and micro nutrients
T_8	T2 (Dummy Plot)

Recommended dose of fertilizers:

90:45:45 kg/ha NPK for Rice
70:25:25 kg/ha NPK for Cucumber
50:8:25 kg/ha NPK for Bhindi

4. Results obtained during the period under report

First crop (Rice)

The fourth cycle of the experiment is presented during the year. The first crop (rice) in the sequence was taken during the kharif season. In general the crop performance was impressive during the season. The weed population of the experiment is given in Table 4.4. The growth attributes indicate that the crop was healthy (Table 4.2). During the season all the treatments gave more than 5t/ha indicating more than 1t/ha increase by adopting organic practices and cropping sequences (Table 4.3). The treatment in which full RDF was received as fertilizers and recorded enhanced yield during the initial years of study was leveled by other treatments during the year. The highest yield was recorded in T1 indicating that integrated use of organic and inorganic source of nutrition at 1:1 ratio was actually better than all other organic manure practiced in the study.

Table 4.2 Effect of treatments on the growth of rice (2006- '07)

Treatment	Plant height (cm)	No. of productive tillers	1000 grain weight (g)	No. of grains per panicle
T_1	107.7	9.2	26	118
T_2	109.5	10.1	25	112
T_3	111.7	9.0	26	110
T_4	105.3	9.4	26	114
T_5	103.0	9.5	25	108
T_6	104.6	9.8	25	111
T_7	105.6	9.7	25	109
T_8	105.0	9.1	25	108

Table 4. 3 Grain and straw yield of rice during the first, second, third and fourth years

Treatment	2003-2004		2004-2005		2005-2006		2006-2007	
	Grain Yield kg/ha	Straw Yield kg/ha	Grain Yield kg/ha	Straw Yield kg/ha	Grain Yield kg/ha	Straw Yield kg/ha	Grain Yield kg/ha	Straw Yield kg/ha
T_1	3488	5407	4106	5033	6159	6899	5625	9275
T_2	3532	5508	4480	5133	6316	7000	5450	9000
T_3	3325	5251	5132	5000	7133	7033	5250	8675
T_4	4578	6722	5576	5166	7806	7233	5490	9000
T_5	3925	5813	5553	5000	7718	7000	5150	8500
T_6	3815	5795	4434	5600	6651	7833	5350	8825
T_7	4505	6504	5366	5700	7512	8066	5100	8475
T_8	3617	5649	4083	5133	6124	7166	5075	8380

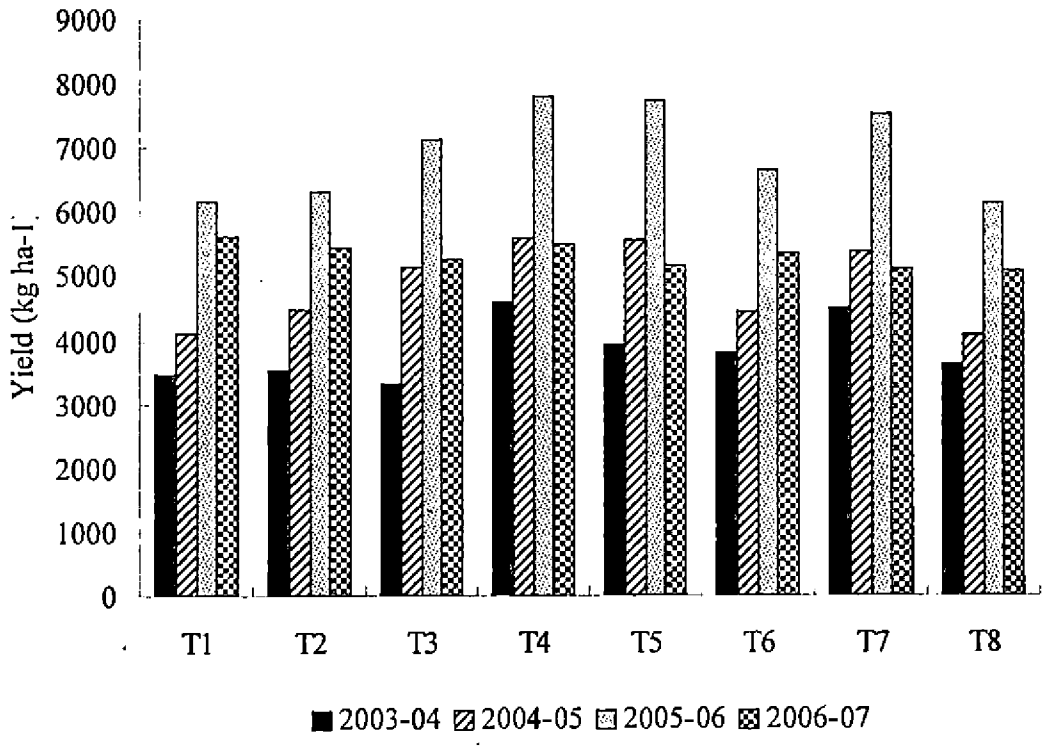

Fig 4.1 Grain and straw yield of rice during the first, second, third and fourth years

Insect/disease during crop period

Mild attack off leaf folder (*Cnaphalocrosis medikalis*) alone was noticed during the later part of crop growth and was controlled by spraying 2 per cent garlic and bird eye pepper decoction spraying. No major diseases were noticed during the crop period.

Table 4.4 Weed population (m2) in rice crop at 30 DAP (2006- '07)

Treatment	*Cyperus* (sp)	*Fimbristylis miliaceae*	Other weeds	Total No. of weeds
T_1	22	15	32	69
T_2	27	19	31	77
T_3	24	17	29	70
T_4	12	16	21	49
T_5	19	19	27	65
T_6	21	22	25	68
T_7	20	20	24	64
T_8	24	24	22	70

Quality test

The organoleptic test of produce indicates no variation due to the treatments.

Second crop (cucumber)

The second crop in the sequence viz., cucumber was sown in slightly raised beds, prepared in two rows for each treatments with 40 cm wide channel in between for facilitating irrigation. Pits of 60 cm diameter and 30-45 cm depth were taken and organic manure and or fertilizers were applied as per the treatment and mixed with top soil in the pit. Four to five seeds were sown in each pit. Unhealthy seedlings were removed and 3 plants per pit were retained at 14 days after sowing. Field drainage channels were also provided for quick drainage in the event of very high rainfall.

The yield data and the quantity obtained in each harvest are abridged in Table 4.5 and 4.6. The data clearly revealed that in cucurbitaceous vegetable, organic and integrated nutrient management gave substantially higher yield. Nutrients applied as fertilizer alone gave lesser yield which is attributed to lower number of fruits per plant.

The individual fruits weighed more than 3 kg and had lower keeping quality ultimately leading to lower market preference. In T7 early harvest was also not possible and peak harvest was delayed by a week. In the organic and integrated nutrient management treatments major harvest was obtained in the second and third harvests while in T7 it was noticed in third and fourth harvests.

The population of red pumpkin beetle never crossed the threshold limit in any of the treatments and no major diseases were noticed during the crop period. The weed population as influenced by the crop is given in Table 4.7. In general the weed count was less in T4 as compared to other treatments.

Table 4.5 Effect of treatments on the fruit characters and yield of cucumber (kg/ha) (2006- '07)

Treatment	Mean no. of fruits per plant	Mean fruit weight (kg/ha)	Mean length of fruit (cm)	Mean width (cm)	Yield (kg/ha)	Keeping quality (days)
T_1	3.0	1.465	31.6	27.5	14833	10
T_2	4.6	1.220	29.1	24.4	16366	12
T_3	2.4	1.802	31.4	29.2	15666	12
T_4	3.0	1.670	34.1	29.1	20633	15
T_5	3.8	1.604	31.7	28.1	18733	14
T_6	4.6	1.706	30.7	28.9	16033	14
T_7	1.4	3.446	44.7	40.4	11366	8
T_8	4.6	1.509	34.1	27.3	16833	12

Table 4.6 Yield of individual harvest (percentage total harvest given in bracket) of cucumber during the second crop season (2006- '07)

Treatments	No. of Harvest (kg/ha)						
	1	2	3	4	5	6	7
T_1	100(0.7)	3233(21.8)	4167(28.1)	2233(15.1)	2833(19.1)	867(5.8)	1399(9.4)
T_2	133(0.8)	1867(11.4)	4500(27.5)	3266(19.9)	3333(20.4)	1933(11.8)	1333(8.1)
T_3	267(0.2)	3267(20.8)	3367(21.5)	2267(14.5)	3333(21.2)	1833(11.7)	1333(8.5)
T_4	333(1.6)	4733(22.9)	6200(30.0)	1233(5.9)	5133(24.9)	1667(8.0)	1333(6.5)
T_5	400(2.1)	5600(29.9)	4100(21.8)	1933(12.1)	4700(25.0)	667(3.5)	1333(7.1)
T_6	567(3.5)	6333(39.5)	3833(23.9)	1033(6.4)	2167(13.5)	767(4.8)	1333(8.3)
T_7	67(0.5)	233(2.0)	3733(32.8)	2833(24.9)	2833(24.9)	667(5.8)	1000(8.8)
T_8	1667(9.9)	5899(35)	3333(19.8)	600(3.5)	2533(15.0)	1447(8.7)	1333(7.9)

Table 4. 7 Weed population during cucumber crop at 30 DAS (2006- '07)

Treatment	Name of weed (sp)		
	Cyperus (sp)	*Fimbristylis miliaceae*	Other weeds
T_1	22	20	31
T_2	19	24	35
T_3	18	22	37
T_4	15	12	18
T_5	14	19	26
T_6	15	14	31
T_7	21	19	41
T_8	26	21	32

Third crop (Summer crop – Bhindi)

The third crop of bhindi was sown in the field after incorporation of the vines of the previous cucumber crop by slight field preparation. The bhindi crop was free from insect and the diseases especially of yellow vein mosaic.

The first harvest was obtained at 40 days after sowing. Due to favourable conditions 18 harvest were obtained during the period and the number of harvests were double as compared to the previous year.

A corresponding increase in the final yield was also noticed during the period. Like the previous year the highest yield was obtained in T4 and T5 which registered more than 10t/ha (Table 4.9). Performance of T7 was slightly better during the later part of the harvest period. The weed spectrum of the crop after a month of sowing is given in Table 4.8.

Table 4.8 Weed population during Bhindi (third crop) season at 30 DAS (2006- '07)

Treatment	Name of weed (sp)		
	Cyperus (sp)	*Fimbristylis miliaceae*	Other weeds
T_1	22	21	30
T_2	26	22	34
T_3	24	22	37
T_4	14	18	25
T_5	25	25	36
T_6	26	29	35
T_7	26	34	32
T_8	28	29	34

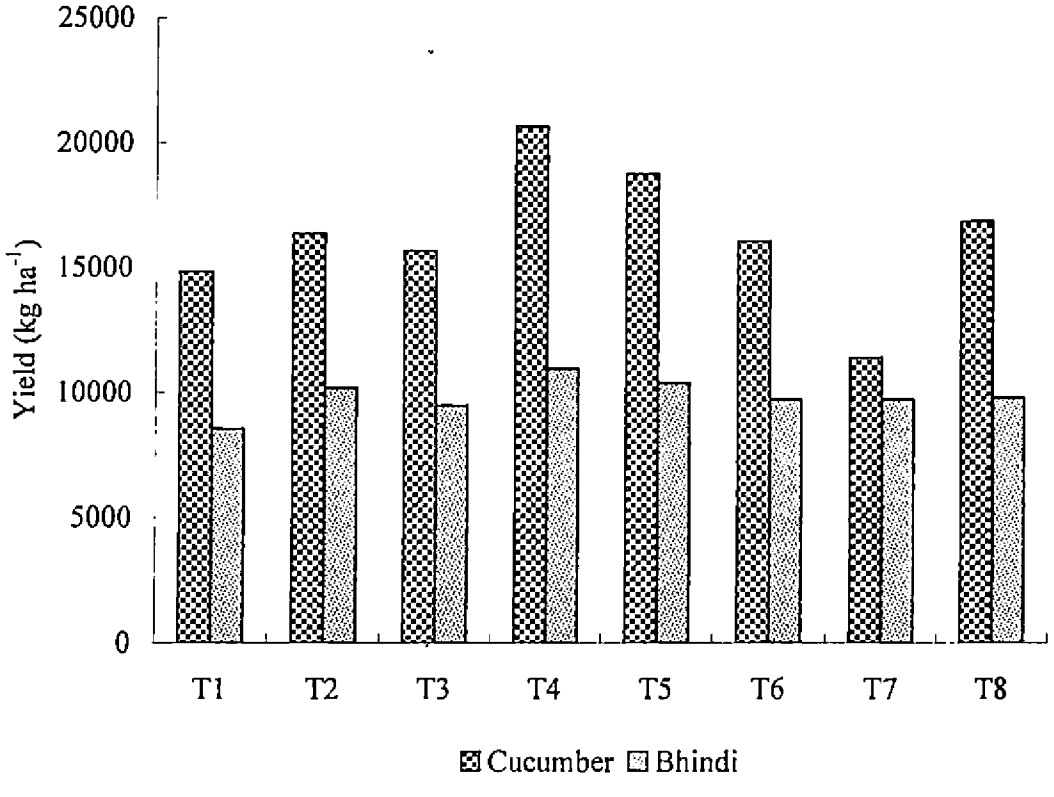

Fig. 4.2 Comparative yields of cucumber and bhindi as influenced by the treatments

Table 4.9 Effect of treatments on Bhindi yield in each harvest (kg/ha) and total yield (kg/ha) and keeping quality (2006- '07)

Treatments	Number of harvest & yield (kg/ha)																		Total yield (kg/ha)	Keeping quality (days)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
T_1	177	150	200	267	333	500	467	533	767	600	500	533	333	800	534	567	767	500	8528	10
T_2	250	350	333	367	433	800	533	533	833	567	467	500	533	833	700	667	933	533	10165	11
T_3	83	283	300	433	400	767	533	500	867	500	467	467	533	833	433	633	867	567	9466	10
T_4	100	833	333	600	567	867	733	600	667	433	267	500	667	1100	700	600	833	533	10933	11
T_5	200	500	433	467	533	900	600	567	667	367	200	333	733	1166	617	600	800	667	10350	10
T_6	93	500	533	500	583	833	700	567	533	333	333	300	399	1000	750	533	800	400	9690	10
T_7	96	400	367	267	400	607	667	667	600	467	367	367	500	1000	833	667	933	483	9688	8
T_8	67	500	399	233	500	667	633	633	533	400	267	400	700	1000	600	700	1000	517	9749	10

Table 4.10 Uptake of nutrients (kg/ha) by rice, cucumber and bhindi (2006- '07)

	Rice Grain Uptake			Rice- Straw Uptake			Cucumber- Total Uptake			Bhindi- Total Uptake		
	N	P	K	N	P	K	N	P	K	N	P	K
T_1	47.81	21.22	9.94	43.41	23.04	120.26	26.02	4.78	7.90	69.02	27.79	70.24
T_2	74.12	23.06	9.26	63.18	25.67	94.20	22.13	5.62	8.11	74.98	29.64	72.07
T_3	62.48	20.77	10.50	60.90	26.34	110.75	22.14	4.38	7.47	93.93	34.04	73.05
T_4	56.00	22.22	7.32	52.65	29.81	69.00	24.60	7.02	10.35	96.08	38.47	74.89
T_5	52.53	19.90	9.10	49.73	27.37	75.08	24.52	4.79	6.80	88.19	37.82	71.50
T_6	72.76	21.16	9.09	41.30	27.60	89.43	12.49	3.46	7.34	66.19	32.46	75.17
T_7	60.69	20.64	8.16	29.75	21.83	74.01	17.39	3.64	5.55	63.35	31.84	66.32
T_8	69.02	19.61	7.95	58.83	21.59	109.22	18.80	4.65	7.56	88.28	38.80	71.98

Table 4.11 Soil N, P and K status as influenced by the treatments (2006- '07)

Treatment	Kharif				Rabi				Summer			
	Organic Carbon (%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Exch. K (kg/ha)	Organic Carbon (%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Exch. K (kg/ha)	Organic Carbon (%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Exch. K (kg/ha)
T_1	0.90	175.62	12.04	94.08	0.92	112.90	8.82	109.76	1.47	112.90	16.10	135.52
T_2	1.10	175.62	12.32	101.92	1.02	125.44	7.98	163.52	1.29	125.44	13.58	207.20
T_3	1.05	137.98	10.50	88.48	1.08	150.53	8.68	118.72	1.19	137.98	9.38	120.96
T_4	0.86	163.07	15.96	54.88	0.90	125.44	9.52	60.48	0.93	112.90	10.50	45.92
T_5	0.75	175.62	14.14	87.36	1.10	150.53	12.04	42.56	0.96	125.44	11.90	78.40
T_6	0.87	125.44	13.16	80.64	0.95	137.98	11.90	42.56	0.87	150.53	13.02	77.28
T_7	0.87	150.53	10.36	71.68	0.77	125.44	10.36	40.32	0.92	150.53	13.72	80.64
T_8	0.95	175.62	13.30	120.96	1.11	137.98	10.78	79.52	1.08	150.53	16.10	97.44

Table 4.12 Microbial population as influenced by the treatments (2006- '07)

Treatments	Population after II cycle of experiment		Population after rice crop		Population after cucumber crop		Population after Bhindi crop (population at)	
	Fungi ($\times 10^3$)	Bacteria ($\times 10^6$)	Fungi ($\times 10^3$)	Bacteria ($\times 10^5$)	Fungi ($\times 10^3$)	Bacteria ($\times 10^5$)	Fungi ($\times 10^3$)	Bacteria ($\times 10^5$)
T1	35	20	16	57	15	40	15	42
T2	40	46	10	69	22	55	17	51
T3	41	28	22	55	28	52	21	58
T4	11	45	26	62	27	59	25	65
T5	26	29	29	55	31	48	23	51
T6	47	37	28	54	26	55	24	59
T7	15	54	21	28	24	32	26	35
T8	8	35	24	49	30	47	29	49

Experiment SSNM

Site Specific Nutrient Management
in Hybrid Rice

Experiment SSNM

Site Specific Nutrient Management in Hybrid Rice

1. Objectives : To maximize the yield in a rice- rice cropping sequence by developing a suitable nutrient management package specific to each site for hybrid rice in Kerala involving more efficient use of nitrogen, phosphorus and potassium with the addition of sulphur and zinc.

2. Year of start : 2006-'07 Kharif

3. Crop sequence and variety : Rice – Rice (var. PHB 71 - PHB 71)

4. Layout of the experiment

Design	:	RBD
Replications	:	4
Plot size	:	6m x 5m
Spacing	:	Kharif - 20cm x 15cm Rabi - 15cm x 10cm
Variety	:	PHB 71
Treatments	:	14

Levels of Nutrients :

N	P_2O_5	K_2O
N_0 – 0kg N/ha	P_0 – 0 kg P_2O_5/ha	K_0 – 0 kg K_2O /ha
N_1 – 150 kg N/ha	P_1 – 30 kg P_2O_5/ha	K_1 – 40 kg K_2O /ha
	P_2 – 60 kg P_2O_5/ha	K_2 – 80 kg K_2O /ha
	P_3 – 90 kg P_2O_5/ha	K_3 – 120 kg K_2O /ha

S - 20 kg/ha
Zn - 40 kg/ha

Table 5.1 Treatment Details

Tr. No.	Kharif (kg/ha)	Rabi (kg/ha)
1	NoP_2K_2SZn	$N_0P_2K_2$
2	$N_1P_2K_2SZn$	$N_1P_2K_2$
3	$N_1P_0K_2SZn$	$N_1P_0K_2$
4	$N_1P_1K_2SZn$	$N_1P_1K_2$
5	$N_1P_3K_2SZn$	$N_1P_3K_2$

6	N_1P_2KoSZn	$N_1P_2K_0$
7	N_1P_2K1SZn	$N_1P_2K_1$
8	$N_1P_2K_2SZn$	$N_1P_2K_3$
9	$N_1P_2K_3SZn$	$N_1P_2K_2$
10	$N_1P_2K_2SZn$	$N_1P_2K_2$
11	$N_1P_2K_2SZn$	$N_1P_2K_2$
12	$N_1P_2K_2SZn$	$N_1P_2K_2$
13	SR*	SR
14	FP**	FP

* SR – State Recommended Doses of Nutrients ** FP – Farmer's Practice

5. Results obtained during the period under report

Growth characters and yield

The first crop of the experiment was raised during late kharif 2006- '07.The effect of treatments on the growth characters of rice during kharif and rabi are presented in table 5.2. The detrimental effect of N skipping was well noticed for T_1 which gave comparatively lower plant height which was significant during kharif season. These plots also gave significantly lower total tillers per plant. But the number of nonproductive tillers was higher for the treatments receiving no sulphur or zinc.

Table 5.2 Effect of site specific nutrient management on growth characters of rice

Treatment	Plant height (cm)		Total tillers per hill		Non productive tillers per hill	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
T_1	101.25	85.90	5.60	6.60	0.75	0.15
T_2	107.10	90.15	6.70	8.10	1.00	0.50
T_3	105.25	92.20	7.35	8.50	0.90	0.45
T_4	107.00	90.075	6.45	7.60	1.00	0.15
T_5	103.00	88.17	6.35	9.40	1.05	0.50
T_6	103.60	87.10	6.95	7.20	0.55	0.70
T_7	105.85	100.55	5.75	9.30	0.85	0.80
T_8	105.65	92.70	6.50	8.00	1.10	0.40
T_9	103.20	92.55	7.10	11.25	1.15	0.85
T_{10}	107.05	92.25	7.25	7.45	1.15	0.30
T_{11}	106.50	94.65	7.35	8.25	1.30	0.30
T_{12}	106.85	88.45	6.70	7.10	1.00	1.05
T_{13}	103.75	85.00	7.15	7.05	1.05	0.50
T_{14}	103.45	90.70	6.55	7.95	1.05	0.30
CD(0.05)	NS	7.77	NS	2.04	NS	NS

The treatment without N application gave lower yield of grain and straw during both seasons (Table 5.3) compared to the other treatments and was significantly less for grain yield during kharif but the effect of treatments were not significant during rabi.

Application of different levels of K did not significantly influence yield. Thus the increased yield can be attributed to the increased N fertility combined with the application of sulphur and zinc.

The treatments did not influence straw yield though N_0 and farmers' practice recorded comparatively lower values. The system productivity of the different treatments showed that the treatments receiving sulphur and zinc along with medium levels of P in the presence of K irrespective of its levels (T_7, T_8 and T_{12}) gave the highest values.

Table 5.3 Effect of site specific nutrient management on the productivity of rice–rice cropping system

Treatment	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
	Kharif	Rabi	System Productivity	Kharif	Rabi	System Productivity
T_1	4300	4598	8899	5075	4687	9762
T_2	7175	5748	12923	7737	6046	13783
T_3	5162	5622	10784	7837	5298	13136
T_4	6975	5351	12326	9175	4755	13930
T_5	7143	5434	12578	7812	5163	12975
T_6	5625	5539	11164	8250	5706	13956
T_7	7512	5643	13156	7050	6317	13368
T_8	7650	6097	13747	9600	4959	14559
T_9	5625	5748	11164	10500	6114	16614
T_{10}	5275	5016	10292	8950	5774	14724
T_{11}	7000	5748	12748	8625	5366	13992
T_{12}	8375	5602	13977	8000	4891	12891
T_{13}	5375	6061	11436	7350	6046	13396
T_{14}	4050	5357	9407	8825	4524	13349
CD(0.05)	1380	NS		NS	NS	

Uptake of nutrients

The uptake of N, P and K differed significantly during kharif but showed no marked difference during rabi (Tables 5.4 and 5.5). The uptake of N and P decreased with decreasing levels of their application. Higher N uptake was found to be associated with high P uptake also but K uptake was not influenced by N application. Uptake of nutrients by straw was not significantly influenced by treatments except for K.

Table 5.4 Effect of site specific nutrient management on the uptake of nutrients (kg/ha) during kharif season

Treatment	Grain			Straw		
	N	P	K	N	P	K
T_1	73.17	15.46	18.33	49.32	12.65	70.44
T_2	128.17	31.36	38.13	72.49	16.85	150.58
T_3	84.38	20.33	25.97	83.58	17.87	80.914
T_4	124.59	29.77	31.26	89.90	20.44	174.75
T_5	119.29	36.43	36.77	69.83	17.12	135.56
T_6	94.18	22.23	36.59	80.23	21.47	127.63
T_7	132.59	30.92	31.99	68.31	17.33	139.62
T_8	132.25	33.17	20.79	89.11	22.02	170.72
T_9	96.82	25.99	30.94	94.86	21.74	194.57
T_{10}	91.93	22.47	20.64	76.69	19.08	175.72
T_{11}	117.66	31.12	30.05	83.62	17.40	165.66
T_{12}	139.15	33.66	46.41	65.78	21.47	157.07
T_{13}	89.40	20.74	27.14	70.18	20.05	132.2
T_{14}	68.52	14.50	18.51	77.13	18.83	188.77
CD	27.51	24.49	11.33	NS	NS	NS

Table 5.5 Effect of site specific nutrient management on the uptake of nutrients (kg/ha) during rabi season

Treatment	Grain			Straw		
	N	P	K	N	P	K
T_1	47.32	12.49	12.02	26.64	20.26	81.51
T_2	64.64	15.48	14.28	34.64	19.55	91.67
T_3	56.15	14.12	15.76	28.54	17.50	97.65
T_4	60.56	17.56	14.48	27.98	17.17	75.92
T_5	51.54	15.56	14.13	34.96	16.96	54.82
T_6	57.56	18.37	13.70	29.57	18.06	92.47
T_7	54.03	17.08	12.33	41.22	19.82	97.04
T_8	64.28	19.40	18.23	34.72	15.35	63.07
T_9	63.05	15.58	17.02	36.15	20.20	94.44
T_{10}	55.61	18.77	13.11	36.39	23.19	102.97
T_{11}	58.54	16.72	15.74	29.96	20.28	93.20
T_{12}	59.37	14.60	14.12	29.81	15.22	90.05
T_{13}	58.18	13.10	18.85	38.69	22.65	88.88
T_{14}	50.58	16.29	14.05	28.30	15.17	69.45
CD	NS	NS	7.90	NS	NS	NS

Soil nutrient status

The effect of different treatments on the availability of major nutrients in soil is given in table 5.6. Skipping of nitrogen in T_1 gave a decreasing trend in the availability of nitrogen in soil though there was no significant difference. But in T_6 with no application of potassium, a marked reduction in exchangeable potassium was noticed especially during the rabi season. Phosphorus availability did not show any effect due to the application of the treatments.

Table 5.6 Soil nutrient status at the end of kharif and rabi seasons as influenced by the treatments

Treatment	Kharif			Rabi		
	Avail. N (kg/ha)	Avail P (kg/ha)	Exch K (kg/ha)	Avail. N (kg/ha)	Avail. P (kg/ha)	Exch. K (kg/ha)
T_1	141.12	13.30	94.64	125.44	14.07	92.96
T_2	156.80	13.34	91.00	150.53	14.18	117.32
T_3	141.12	11.94	91.56	131.71	12.22	104.44
T_4	147.39	12.95	100.52	147.39	13.34	101.08
T_5	150.53	12.22	101.36	144.26	13.83	92.12
T_6	150.53	13.02	73.64	137.98	14.95	68.60
T_7	150.53	12.88	83.72	137.98	14.74	122.08
T_8	156.80	13.86	110.32	131.71	14.46	91.56
T_9	153.66	14.53	118.44	137.98	15.47	131.88
T_{10}	166.21	13.79	99.40	134.85	13.51	96.04
T_{11}	156.80	12.78	118.44	134.85	13.86	96.04
T_{12}	159.94	13.44	99.68	144.26	14.67	101.92
T_{13}	144.26	15.09	108.36	147.39	13.51	125.72
T_{14}	159.94	14.14	113.96	134.85	13.65	100.80
CD(0.05%)	NS	NS	NS	NS	NS	30.43

Weed Control

Integrated weed management in rice-based cropping systems

(No F.No.CSM/2001/675/3.5.01. PDCSR, Modipuram)
(KAU Code – RIC/03-03-10-2003/KAR(1)AICRP)

Weed Control

Integrated weed management in rice-based cropping systems

1. Objectives : To study the most suitable weed management method to control the obnoxious weed flora in rice and rice based cropping systems. The study also envisages to find out whether there is any shift in weed flora due to the impact of cropping sequences.

2. Year of start : Kharif 2001

3. Layout of the experiment :

Design : Split plot design
Replication : 3
Plot size :
Gross : 5.4 m x 3 m
Net : Kharif : 5.0 m x 2.7 m
: Rabi : 5.0 m x 2.8 m

4. Treatment details

Main plot treatment (4): *Cropping Systems*

Treatment	Details
C_1	Rice – Rice – Fallow (Very common in the region where water is a limiting factor)
C_2	Rice – Rice – Bhindi (Best system selected from earlier experiments)
C_3	Rice – Rice – Cassava (Short duration)
C_4	Rice – Rice – Daincha

Sub plot treatments (7): *Weed control methods*

Treatment	Kharif	Rabi	Summer
W_1	Butachlor (1 kg ai/ ha)	Butachlor (1 kg ai/ha)	One hand weeding
W_2	Anilophos 24 % + 2, 4-D Ethyl ester (1 kg ai/ ha)	Anilophos 24% 2, 4-D Ethyl ester (1 kg ai/ha)	One hand weeding
W_3	Pretilachlor 50% E.C (1 kg ai/ ha)	Pretilachlor 50% E.C (1 kg ai/ha)	One hand weeding
W_4	Pretilachlor 50% EC (1 kg ai/ha) + 2, 4-D Sodium salt 1 kg ai/ha as	Pretilachlor 50% E.C (1 kg ai/ha) + 2, 4-D sodium salt	One hand weeding

	post emergent spray at 20 DAP.		
W_5	Stale seed bed preparation	Stale seed bed preparation	Stale seed bed preparation /one hand weeding
W_6	W_5 + One hand weeding at 25 DAP.	W_5 + One hand weeding at 25 DAP.	W_5 + one hand weeding
W_7	Unweeded control	Unweeded control	Unweeded control

6. Results obtained during the period under report

Weed population

The major weed spectrum during kharif and rabi seasons are presented in Table 6.1 and 4.2 respectively. During this year also the obnoxious weed species '*E.crusgalli*' was almost absent in all the treatments.

In general the weed population was lesser in the treatment in which green manure was taken during the summer season. The weed population of all species was invariably higher in the control plot. Stale seed bed followed by one hand weeding was effective in controlling the weed population.

Table 6.1 The number of major weeds under different treatments (Kharif season)

Cropping Systems	*Cyperus* sp.	*Fimbristylis miliaceae*	Other weeds	Total no. of weeds
Cropping Systems				
C_1	23.4	19.4	30.8	73.6
C_2	24.0	19.3	30.0	74.2
C_3	23.9	20.4	29.5	73.8
C_4	20.3	16.3	25.9	62.5
CD (0.05)	NS	3.1	3.0	8.6
Weed control methods				
W_1	22.0	17.1	31.2	70.3
W_2	22.3	18.0	29.5	69.8
W_3	22.8	17.7	26.8	67.3
W_4	23.2	17.5	27.5	68.2
W_5	22.1	16.8	26.4	65.3
W_6	20.0	19.0	26.3	65.3
W_7	29.5	26.0	35.6	91.1
CD (0.05)	8.4	2.3	2.2	4.8

Table 6.2 Number of major weeds as influenced by the treatments (Rabi season)

Cropping Systems	*Cyperus* sp.	*Fimbristylis miliaceae*	Other weeds	Total no. of weeds
Cropping Systems				
C_1	23.8	19.6	22.2	65.6
C_2	18.1	21.8	21.2	61.2
C_3	21.6	20.6	18.8	61.0
C4	14.5	18.3	18.4	51.2
CD (0.05)	5.6	2.3	3.2	5.6
Weed control methods				
W1	17.8	19.0	20.5	57.3
W2	19.4	18.4	19.2	57.0
W3	18.2	18.5	18.6	55.3
W4	19.2	19.7	18.6	57.5
W5	18.5	19.1	20.3	57.9
W6	16.4	18.1	18.3	52.8
W7	27.1	27.6	25.6	80.3
CD (0.05)	2.8	2.7	2.4	4.9

First and Second seasons of rice crop

The influence of cropping systems (summer season crop) and weed management on the succeeding crops of rice are abridged in Table 6.3. During the kharif season the cropping system involving rice-rice-bhindi recorded the highest grain yield and was appreciably higher than other systems. This enhancement might be due to the residual effect of FYM applied to the summer bhindi crop and better physical conditions of the soil.

Among the weed management practices all the chemical, cultural or eco-friendly methods gave remarkably higher grain yield than the control and they were on par with each other. During rabi season also the cropping system involving bhindi during summer season recorded higher grain yield than other system tried. The absolute control plot recorded the lowest yield, while all the weed management treatments were on a par with each other.

Table 6.3 Effect of cropping systems and weed control methods on the growth and yield of rice crop (kg/ha)

Treatment	Kharif				Rabi			
	Plant height (cm)	No. of productive tillers per hill	Grain yield	Straw yield	Plant height (cm)	No. of productive tillers per hill	Grain yield	Straw yield
Cropping Systems								
C_1	95.1	8.4	3378	5637	90.5	7.8	2781	5906

C_2	97.1	8.7	3936	6358	89.7	7.7	2898	5878
C_3	95.3	8.6	3494	5801	88.9	7.7	2830	5879
C_4	96.1	8.5	3628	5939	88.4	7.8	2857	6025
CD (0.05)	NS	0.1	274.6	329.5	1.8	NS	99	90
Weed control methods								
W_1	97.4	8.6	3595	5895	89.6	7.9	2941	5862
W_2	96.2	8.6	3716	5939	90.1	7.8	2866	5881
W_3	96.7	8.5	3713	6105	89.4	7.9	2872	5949
W_4	95.4	8.6	3701	6042	88.9	7.8	2842	6000
W_5	95.9	8.6	3693	6120	89.2	7.8	2908	6021
W_6	95.6	8.5	3611	5944	90.1	7.8	2836	5949
W_7	94.3	8.2	3235	5484	88.6	7.4	2625	5791
CD (0.05)	1.1	0.1	359	205.9	0.97	0.1	100	108

Table 6.4 Details of irrigation given to the summer crop

Treatments	No. of irrigations	Quantity of water applied (mm)	Rainfall received during the crop growth period (mm)	Total quantity of water received (mm)
C_1 – RRF	-	-		
C_2 – RRB	29	290	12.1	302.1
C_3 – RRC	3	150	12.1	171.2
C_4 – RRD	1	50	12.1	62.1

Table 6.5 Economic yield kg/ha as influenced by treatments during summer season

Main plot treatments	Sub plot treatments							
	W_1	W_2	W_3	W_4	W_5	W_6	W_7	CD (0.05)
C_1 - RRF	-	-	-	-	-	-	-	-
C_2 - RRB	8837	8827	8522	9197	9233	9156	8435	115
C_3 - RRC	9464	9382	9104	9361	9207	9361	8898	NS
C_4 - RRD	15246	14814	15637	16358	17823	14917	14557	NS

On Farm Research

ON FARM RESEARCH
EXPERIMENT ON CULTIVATORS FIELD (ECF)

The ECF Unit it the on farm research wing of the AICRP on Cropping Systems. The ECF Unit started in 1971 and had functioned in various districts of the State each with three years duration. Later from 1988 onwards the period of operation was extended to five years and the area of operation had been extended to an agro-ecological zone. Then the ECF functioned from 1988-'93 in the Central Zone with its head quarters at Mannuthy, during 1993-'98 in the Problem Zone with head quarters at Kayamkulam and from 1999 to 2004 again at the Central Zone with head quarters at Vadakkenchery, Alathur. From April 2004 onwards the ECF Unit is operating with its head quarters at Farming Systems Research Centre, Sadanandapuram, Kollam district and covering parts of Southern Zone and Problem Zone which were not covered earlier.

The main mandate of the unit is to conduct on – farm research under the actual farming situations on location specific problems by researcher – extension worker – farmer participatory research. The main goal is to evaluate and refine/develop client oriented need based technologies under different bio-physical and socio-economic conditions existing on farms and transfer appropriate technologies for large scale adoption. During the period under report ECF experiments, FLD on oil seeds and on-farm research on IFS were taken by the centre.

ECF EXPERIMENTS

Experiment No. I
Response of nutrients (NPK) in Rice based cropping systems on farmers field

Objective

To find out the response of N, P and K on farmers field under different sub agro ecological zones.

Treatments	Protocol fixed
T_1 Control	Zero N
T_2 Recommended N for component crops in the sequence	N at 90 Kg ha^{-1}
T_3 Recommended N and P	NP 90:45kgha^{-1}
T_4 Recommend N and K	NK 90:45kgha^{-1}
T_5 Recommend N,P and K	NPK 90:45:45kgha^{-1}

N and K were applied in three equal splits at planting, tillering and panicle initiation, while full dose of P was applied at the time of planting. All the management practices were given according to the package of practices, recommendations of KAU.

Results obtained

NPK response during Kharif season 2006-07

The treatment effects due to mineral nutrition with N, P and K were significant for grain and straw yield. Mineral nutrition with NPK had appreciably increased the grain and straw yield in all locations. Application of N along with K had shown significant effects on grain and straw yield in all locations except Vaikom block where mineral nutrition with N and K had produced higher grain and straw yield as compared to treatments with N and P. The response of N was found maximum in Vaikom block, where as for P it was lowest. Response of rice to K nutrition, as compared to P had recorded higher values in all parts except Vaikom. The average response of N, P and K for the zone was 20.63, 14.06 and 20.03.

NPK Response during Rabi season 2006-07

The data on grain and straw yield presented in Table 7.3 and 7.4 revealed that treatment variation due to mineral nutrition of N, P and K was significant. Application of NPK at recommended dose had produced maximum grain and straw yield in all locations. Mineral nutrition with N and K had shown higher yield in all locations except Vaikom block. The treatment with N and P nutrition had recorded lower grain and straw yield as compared to NK treatment in the blocks viz., Chadayamangalam, Kottarakkara, Karunagapally, Vettikavala and Sasthamkotta. The Zonal response of N, P and K was 18.30, 18.12 and 23.17 during rabi season.

Grain Yield Straw Yield

The data on grain and straw yield are presented in Table 7.1 and 7.2.

Table 7.1 Grain yield of rice to t/ha as influence by treatments and NPK response (Kharif 2006-07)

Treatment	Chadayaman galam	Vaikom	Vettikavala	Karunaga ppally	Kottarakkara	Sasthamkotta
T_1	1.2600	2.308	1.417	1.394	1.510	0.903
T_2	1.949	2.929	1.860	1.003	2.230	1.171
T_3	2.245	3.446	2.700	1.733	3.124	1.690
T_4	2.664	3.197	3.006	2.178	3.416	2.091
T_5	3.502	4.751	3.217	2.366	3.884	2.680
C.D.(05)	0.212	0.144	0.207	0.127	0.263	0.206

NPK Response

Nutrients	Chadayama ngalam	Vaikom	Vettikavala	Karunaga pally	Kottarakara	Sastamkotta	Average
N	21.65	32.54	20.66	11.14	24.78	13.01	20.63
P	6.60	11.48	18.67	16.22	19.86	11.53	14.06
K	15.91	5.96	25.46	26.11	26.35	20.44	20.03

Table 7.2 Straw yield of rice (t/ ha^{-1}) as influenced by treatments (Kharif 2006-07)

Treatment	Chadayamangalam	Vaikom	Vettikavala	Karunagapally	Kottarakara	Sastamkotta
T_1	1.462	3.099	1.851	1.906	1.943	1.540
T_2	2.511	3.752	2.314	1.525	2.817	1.956
T_3	2.812	3.808	2.454	2.529	3.724	2.810
T_4	3.141	3.656	2.738	2.852	3.901	3.565
T_5	3.867	5.000	2.912	3.184	4.503	4.481
C.D.(05)	0.242	0.177	0.143	0.238	0.295	0.380

Table 7.3 Grain yield of rice (t ha-1) as influenced by NPK treatments and NPK response (Rabi 2006-07)

Treatment	Chadayamangalam	Vaikom	Vettikavala	Karunagapally	Kottarakkara	Sasthamkotta
T_1	1.303	2.377	1.397	1.109	1.631	0.958
T_2	2.073	2.809	2.099	0.890	2.379	1.060
T_3	2.454	3.348	3.800	1.494	3.334	1.775
T_4	2.923	3.174	3.991	1.846	3.736	1.947
T_5	3.624	4.586	4.441	2.278	3.947	2.592
C.D.(05)	0.185	0.120	0.482	0.137	0.319	0.179

NPK Response

Nutrients	Chadayamangalam	Vaikom	Vettikavala	Kngply	Kottarakkara	Sastamkotta	Average
N	23.03	31.21	23.32	9.88	10.61	11.77	18.30
P	8.46	11.97	37.8	13.42	21.22	15.88	18.12
K	18.88	8.11	40.93	21.24	30.15	19.71	23.17

Table 7.4 Straw yield of rice (t ha^{-1}) as influenced by NPK treatments (Rabi 2006-'07)

Treatment	Chadayamangalam	Vaikom	Vettikavala	Karunagapally	Kottarakkara	Sasthamkotta
T_1	1.786	2.627	2.850	1.982	2.080	1.674
T_2	2.588	3.470	4.408	1.458	2.872	2.033
T_3	2.917	3.524	5.516	2.174	3.972	3.068
T_4	3.273	3.308	3.493	2.570	3.971	3.491
T_5	3.962	4.858	6.432	3.230	4.265	4.341
C.D.(05)	0.265	0.226	0.999	0.228	0.388	0.297

Experiment No.2
Intensification and diversification of the existing cropping system

Objective

Intensification and diversification of the existing cropping system in order to achieve maximum crop productivity and economic returns.

Treatments

T_1 - Existing cropping system Rice-Rice-fallow
T_2 - Rice-Rice-Amaranthus cv.Arun
T_3 - Rice-Rice-Bhindi cv. Arka Anamika
T_4 - Rice-Rice-Cucumber cv. Mudicode local
T_5 - Rice-Rice-Vegetable Cowpea cv Sharika

The test variety for rice was Uma, a high yielding, medium duration variety tested in RBD. The cost of cultivation and net returns as influenced by the rice based cropping system are presented in Tables 7.5 and 7.6. The data revealed that the cost of cultivation and net returns obtained in R.R.F. (T1) cropping system varied from Rs.39666 to Rs. 48491 per hectare and 7606 to 24082 per hectare respectively. Intensification and diversification of rice fallows with vegetable crops during summer season increased the production cost 3 to 4 times as compared to Rice-Rice-Fallow. Similarly the net returns from the cropping system with vegetable crops in summer was enhanced to the tune of 8 to 9 times as compared to the present cropping system of fallowing of the rice fields during summer season.

Table 7.5 Cost of cultivation (Rs.) of treatment in rice based cropping system under intensification and diversification (2006-07)

Treatment	Chadayaman galam	Vaikom	Vettikavala	Karunaga pally	Kottarakkara	Sastham kotta
T_1	46291	47033	48491	40460	44400	39666
T_2	113991	117566	115333	106626	109933	105380
T_3	130178	132387	135741	125600	113258	127416
T_4	124191	127266	128541	115916	120346	115966
T_5	188291	182500	191575	187466	188566	185566

Table 7.6 Net returns as influenced by treatments under intensification – diversification (2006-07)

Treat ment	Chadayaman galam	Vaikom	Vettikavala	Karunaga pally	Kottarakkara	Sastham kotta
T_1	13519	14514	24082	7606	19695	11015
T_2	83924	113197	82287	41469	89253	61524
T_3	70097	84867	79933	44163	91518	63544
T_4	67367	61393	91865	65062	77550	75984
T_5	226694	198146	192815	173827	204614	193541

Experiment No. 3
Agronomic management practices for increased production of cropping system

Objective

To develop agronomic practices for higher productivity of component crops of the cropping system.

Treatments

T_1 Farmers practice – Random planting with an average NPK of 60 :50:25 kg/ha.

T_2 Farmers practice + recommended technology for addressing constraint No.1 Lack of organic manure application. T_1 + 5 t/ha cowdung application.

T_3 Farmers practice + recommended technology for addressing constraint No.2 Plant population - line planting with a spacing of 20 x 10cm during kharif and 20x10 cm during rabi season. (33 and 50 hills per sq.m)

T_4 Recommended package of practices for component crops (90:45:45 kg NPK/ha^{-1} + 5 t cowdung ha^{-1} and with a spacing of 20x15 cm kharif and 20 x 10 cm during rabi seasons.

Results obtained during Kharif season (2006-07)

The data on grain and straw yield are given in Table 7.7 and 7.8 respectively. The results indicate that the POP had given significantly higher yield over Farmer's practice (F.P) + Organic manure and F.P + optimum plant density is more important and crucial than the application of organic manure.

The farmer's practice remained inferior for both yield parameter studied.

Table 7.7 Grain yield of rice (t ha^{-1}) as influenced by agronomic practices (Kharif 2006-07)

Treatment	Chadayaman galam	Vaikom	Vettikavala	Karunaga pally	Kottarakkara	Sasthamkotta	Average
T_1	2.818	3.813	2.624	2.691	2.738	2.451	2.856
T_2	3.161	4.127	3.078	3.008	3.238	2.726	3.223
T_3	3.516	4.426	3.532	3.264	3.583	3.151	3.579
T_4	4.899	4.680	3.770	3.481	4.024	3.896	4.125
C.D.(05)	0.114	0.149	0.123	0.062	0.193	0.112	

Table 7.8 Straw yield of rice (kg ha^{-1}) as influenced by agronomic practices (Kharif 2006-07)

Treatment	Chadayama ngalam	Vaikom	Vettikavala	Karunaga pally	Kottara kkara	Sastham kotta	Average
T_1	3.108	4.266	2.491	3.163	3.088	2.835	3.159
T_2	3.454	4.362	2.650	3.550	4.039	3.827	3.647
T_3	3.716	4.374	2.968	3.752	4.489	3.882	3.804
T_4	4.282	4.918	3.051	3.839	4.928	4.704	4.287
C.D.(05)	0.124	0.094	0.205	0.154	0.205	0.322	

Results obtained during Rabi season (2006 – 07)

The results obtained during rabi season are given in Table 6.9 and 6.10. the highest grain and straw yield was noticed in treatments with full package of practices. The farmer's practice recorded the lowest grain and straw yield.

Between the two constraints studied, optimum plant density had shown better response than the application of organic manure in all locations.

Table 7.9 Grain yield of rice (t ha-1)as influenced by agronomic practices (Rabi 2006-07)

Treatment	Chadayama ngalam	Vaikom	Vettikavala	Karunaga pally	Kottara kkara	Sasthamkott	Average
T_1	2.998	3.697	3.606	2.480	2.833	2.588	3.034
T_2	3.423	3.932	3.938	2.879	3.402	3.080	3.442
T_3	3.814	4.347	4.432	3.106	3.857	3.445	3.834
T_4	4.168	4.703	4.833	3.376	4.181	3.745	4.168
C.D.(05)	0.098	0.127	0.107	0.913	0.146	0.098	

Table 7.10 straw yield of rice (t ha^{-1})as influenced by agronomic practices (Rabi 2006-07)

Treatment	Chadayama ngalam	Vaikom	Vettikavala	Karunaga pally	Kottara kkara	Sasthamkot	Average
T_1	3.367	4.017	6.044	3.112	3.256	3.456	3.875
T_2	4.257	4.169	6.375	3.427	4.221	3.835	4.381
T_3	4.078	4.197	8.181	3.580	4.489	4.087	4.769
T_4	4.587	4.892	8.647	3.870	4.832	4.865	5.282
C.D.(05)	0.834	0.096	0.271	0.112	0.218	0.302	

Cost of cultivation and Net returns

The cost of cultivation and net returns of the treatments are presented in Table 7.11 to 7.14. the cost of cultivation was higher in F.P + Organic manure, F.P+OP.D and POP + OP.D as compared to Farmer's practice. However there was a substantial increase in net income and the treatment with POP had given the highest net returns.

Table 7.11 Cost of cultivation during Kharif season (2006-07)(Rs/ha)

Treatment	Chadayamangalam	Vaikom	Vettikavala	Karunagapally	Kottarakkara	Sasthamkotta	Average
T_1	19911	18833	17606	19204	18122	19911	18931.12
T_2	21977	21277	20653	21328	21966	21977	21529.67
T_3	24022	22422	22772	22844	23444	24022	23254.33
T_4	25911	23655	23428	24183	24500	25911	24598.06

Table 7.12 Cost of cultivation during rabi season (2006-07)(Rs/ha)

Treatment	Chadayamangalam	Vaikom	Vettikavala	Karunagapally	Kottarakkara	Sastham kotta	Average
T_1	19712	18177	17813	18627	18500	19712	18756.83
T_2	22000	20188	19976	20619	22000	22000	21496.83
T_3	24188	21257	20925	22251	22200	24198	22503.17
T_4	26400	22677	22261	23561	24500	26400	24299.83

Table 7.13 Net Returns obtained during kharif season (2006-07)(Rs/ha)

Treatment	Chadayamangalam	Vaikom	Vettikavala	Karunagapally	Kottarakkara	Sastham kotta	Average
T_1	5291	15311	5682	4915	4892	5291	6897.06
T_2	6331	15529	6567	5635	6252	6331	7774.17
T_3	7400	16494	8389	6454	6870	7400	8834.50
T_4	10032	18116	9809	6966	9487	10032	10740.33

Table 7.14 Net Returns obtained during rabi season (2006-07)(Rs/ha)

Treatment	Chadayamangalam	Vaikom	Vettikavala	Karunagapally	Kottarakkara	Sastham kotta	Average
T_1	6898	14830	15300	3686	6044	6898	8942.67
T_2	8572	14776	16647	4664	8436	8872	10327.83
T_3	9488	17358	19983	5553	11503	9488	12228.83
T_4	10851	19223	20988	6481	13047	10851	13573.50

FRONTLINE DEMONSTRATION (FLD) ON OIL SEEDS

Front line demonstration on oilseeds (sesamum) in rice-rice-sesamum was conducted in 5 locations coming under Alappuzha district.

The mean yield of sesamum is all locations was recorded as 361 kg/ha. While in the control plot it was 262 kg ha^{-1}. There was a yield increase of 37.7% in FLD plots over the man by farmer's area. The yield increase was due to the better Performance of the variety Thilarani than Kayamkulam-1. The B:C ratio was also high in the FLD plots as compared to control plots.

In the first and second crop season, the rice yield was slightly higher than the control plots due to the scientific intervention of the field staff in the FLD plots.

Table 8.1 FLD on Oilseeds (sesamum) Seed yield (kg ha^{-1}) for Rice-Rice-Sesamum sequence

Sl. No.	Selected Farmer			Control plot		
	First crop	Second Crop	Oil seed (kg ha-^{1})	I crop	II crop	Oil seed (kg ha-^{1}
	Rice Yield (kg ha-^{1})	Rice Yield (kg ha-^{1})		Rice Yield (kg ha-^{1})	Rice Yield (kg ha-^{1})	
1	3232	2895	335	3121	2804	262
2	3466	2924	382	3260	2895	248
3	3120	3067	378	3010	2916	255
4	3425	3135	361	3315	3102	263
5	3147	3165	352	3132	2988	282
Average	3278	3037.2	361.6	3167.6	2941	262

Table 8.2 Location, name of the farmer, cropping system followed, yield and economics of FLD plots and control plots

	Location and address of the farmers	FLD crop (Sesame)	Area (ha)	Yield (kg ha-^{1})	Cost of prodn Rs./ha	Gross returns	Net returns	B:C ratio
1	M.Sukumaran, Panichoor Tharayil Muthukulam	Thilarani	0.4	335	8900	16750	7850	1.88
		Kayamkulam -1	0.4	262	7500	13100	5600	1.74
2	N. Janardhanan, Palathail Tharayil Muthukulam	Thilarani	0.4	382	9800	19100	9300	1.94
		Kayamkulam -1	0.4	248	7800	12400	4600	
3	G. Soman, Palappalil Muthukulam	Thilarani	0.4	378	9550	18900	9350	1.97
		Kayamkulam -1	0.4	255	7790	12750	4950	1.63
4	M. Raveendran Nair, Deepam, Muttam	Thilarani	0.4	361	9925	18050	8125	1.81
		Kayamkulam -1	0.4	263	7400	13450	5750	1.77
5	Leela. K. Nair, Deepam, Muttam	Thilarani	0.4	352	9600	17600	8000	1.83
		Kayamkulam -1	0.4	282	8230	14100	5850	1.71

Brief Summary

IV. BRIEF SUMMARY OF EXPERIMENTAL RESULTS

1. **Experiment Ia** *Performance of different crops in rice based cropping system*

   The growth characters, grain and straw yields of rice were on par in all treatments during both kharif and rabi. However, during rabi coleus and tapioca crop performed reasonably well. During summer, the different crops raised gave good yield. The rice-rice-amaranthus system (T5) resulted in maximum system rice equivalent yield, followed by rice-rice-sweet potato (T2).

2. **Experiment 2a**: *Permanent plot experiment on integrated nutrient supply system for cereal based sequence.*

   The results clearly revealed that substitution of either 25 per cent or 50 per cent RDF as organics during kharif season is beneficial for sequential cropping of rice. By giving 75 per cent RDF as fertilizers during kharif and rabi and 25 per cent RDF substituted as organics during kharif alone resulted in comparable system productivity and a savings of 25 per cent fertilizers as compared to 50 and 100 per cent substitution of RDF respectively in kharif and rabi.

3. **Experiment 2b**: *Long range effect of continuous cropping and manuring on soil fertility and crop productivity*

   The results revealed that skipping phosphorus continuously for years significantly reduced crop growth and yield in rice, causes delayed flowering and prolongs days to maturity by about two weeks. Skipping phosphorus also results in poor crop stand, reduced plant height, decrease tillering, ultimately resulting in poor yield. The P uptake by the crop also shows a significant reduction in the treatments receiving no phosphorus.

4. **Organic Farming**: *Development of organic package for system based high value crops*

   The experiment aimed to evaluate organic farming *vis-a-vis* farming with integrated nutrient management on the growth, yield, quality and pest management in high value cropping sequence rice-vegetable-vegetable (rice-cucumber-bhindi). The fourth year sequence was completed during the period under report. In general, an enhancement in yield of all the crops in the sequence was noticed as compared to the first and the second year. The organic treatments were slightly better than absolute inorganic treatments in all the three crops in the system.

5. **SSNM:** *Site Specific Nutrient Management in hybrid rice*

   Increased yields were obtained for the treatments receiving nitrogen along with P and K in the presence of sulphur and zinc. The treatments did not influence straw yield though No and farmers' practice recorded comparatively lower values. The system

productivity of the different treatments showed that the treatments receiving sulphur and zinc along with medium levels of P in the presence of K irrespective of its levels (T_7, T_8 and T_{12}) gave the highest values.

6. **Weed Control**: *Integrated weed management in rice based cropping systems*

The study was initiated from kharif season 2001 and has now concluded. In rice-rice cropping sequence a third crop of bhindi or green manure is possible and depending on the length of growing season a short duration cassava can also be taken. The subsequent rice yield was higher in treatments with a summer crop than fallow. The summer cropping has resulted in a shift in major weed species *Echinochloa crusgalli* from the field. The other weed species was more in the plot that received liberal application of FYM. The weed control treatments viz., chemical, cultural and combination of the two methods recorded lower weed intensity and higher grain yield of rice as compared to control.

7. **ECF Experiments**

i. *Response of nutrients in cropping systems on farmers' field*

In the farmers field N, NP, NK and NPK treatments exerted significant impact on grain yield as compared to the control. The response of NPK was 20.63, 14.06 and 20.13 and 18.30, 18.12 and 23.17 kg/ nutrient applied during kharif and rabi seasons respectively.

ii. *Intensification and or diversification of the existing cropping system.*

Intensifying the existing cropping system of rice- rice- fallow with a third crop of vegetable enhanced the cost of production to the tune of 3 to 4 times with a net return of 8 to 9 times in the zone.

iii. *Agronomic management practices for increased production of cropping system*

The results of study revealed that lack of plant population is the major constraints and its correction increased rice yield in farmer's field. The recommended package of practices recorded positive and significant influence in the farmer's field.

iv. *Front line demonstration on oil seeds*

The front line demonstration of rice-rice-sesamum cropping systems gave better response and yield in FLD field with cv. Thilarani with recommended nutrient application. Though the cost of cultivation was increased to 23.4% it gave higher net income to the time of 59.3% and B: C ratios in all the locations.

V. OTHER ACTIVITIES

a. Details of publications including research papers actually published during the period April 2006 to March 2007.

1. ***Jacob J., Joy, M. and Kiran, K.G.*** (2006). Allelopathic inhibition of polypathogenic fungi by leaf extract of teak (*Tectona grandis* l.f.). In: *Proceedings of 18th Kerala Science Congress* (Ed.) Centre for Earth Science Studies, Kerala: Kerala State Council for Science, Technology and Environment.

2. ***Jacob John, Patil, R.H., Joy, M. and Nair, A.M.*** 2006. Methodology of Allelopathy Research: 1.Agroforestry Systems. *Allelopathy Journal*: 18: 173-214.

3. ***Kamala, N., Sheela, M. S., Varughese, K., Rani, B., Jacob John and Joice Mary Mareena*** 2006. Fluorescent pseudomondas isolate FP- 33 as an effective biopesticide in banana varieties. In: Abstracts, National Symposium on Biotechnological Methods for Crop Disease Management. p 47. Annamalai University

4. ***Kuruvilla Varughese, Jacob John, Rani, B., and Vijayan, M.*** 2007. Scope of crop diversification in paddy fields. In : Invited Papers on special session: *Paddy cultivation in Kerala,* 19th Kerala Science Congress, Kannur, p. 59-70. Kerala State Council for Science, Technology & Environment. Thiruvananthapuram, Kerala.

5. ***Kuruvilla Varughese, Jacob John, Rani, B and Vijayan, M.*** Sustainable management of paddy fields in wetland ecosystem of Kerala. In : Invited paper Kerala Environment Congress 2007, Wetland resources of Kerala 8 to 10th May 2007. Centre for Environment and Development, Thiruvananthapuam

6. ***Kuruvilla Varughese, Rani, B., and Jacob John*** 2006. Performance of short duration cassava in rice based cropping systems. In: Abstracts, 14th Triennial Symposium of the International Society for Tropical Root Crops p. 222

7. ***Kuruvilla Varughese and Rani, B.*** 2006 Integrated nutreient management and planting density on the productivity of rice in coastal ecosystem. *J. Indian Soc. Coastal agric. Res.*, **24** (1), 135- 137, 2006.

8. ***Thomas Mathew and Kuruvilla Varughese*** 2006. Effect of organic and inorganic forms of nutrition on jagaery quality, productivity, sugar yield and energetics of sugarcane *I.J. of Sugarcane tech* Vol.21 (1&2) p.15-19.

9. ***Thomas Mathew and Kuruvilla Varughese*** 2007. Effect of various nutrients on physico – chemical and biological properties of soils in Sugarcane agro ecosystems *Sugar tech.* 9 (2 &3): 147-151

b. Details of Radio programmes, T.V talks, Seminars / Workshops / Summer Institute/Symposia attended.

1. **TV talks:** Nil

2. **Seminars/ Symposiums attended:**

Name and designation	*Name of seminar*	*Venue*	*Date*
Dr.Kuruvilla Varughese, Chief Agronomist	National Seminar on Strategies for improved farming and Ecological Security of Coastal region:	Central Tuber Crops Research Institute, Sreekaryam, Kerala	20to26 -11-2006.
	14th Triennial Symposium of the International Society for Tropical Root Crops Kerala Environment Congress 2007	the Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala Centre for Environment and Development	20 to 26 -11-2006 8 to 10-05-2007
Dr. Jacob John, Assistant Professor (Agronomy)	Seminar cum Harvest Festival on People's Sustainable Rice Farming. Organized by Jilla Panchayat, Thiruvananthapuram	Kalatharackal Panchayat, Thiruvananthapuram	28-02-2007
	One-day Seminar on Status and Problems of Labour in Agricultural Sector of Kerala. Organised by Institute of Labour and Management, Thiruvananthapuram.	Institute of Labour and Management, Thiruvananthapuram	17-03-2007

3. **Workshops attended:**

i. ***Dr.Kuruvilla Varughese*** attended the following

- XXVIth Zonal Research and Extension Advisory Council Meeting, 15,16 December, 2006, NARP(SR), College of Agriculture, Vellayani, Thiruvananthapuram- 695 522

- XXVIIAICRP Workshop at G.B. Pant University of Agriculture and Technology, Pantnagar from 27-06-2006 to 30-06-2006.

- 19th Kerala Science Congress 2007, 29 – 31 January, 2007, Kannur.

- Kerala Environment Congress, 8 to 10, May, 2007. Centre for Environment and Develpoment, Thiruvananthapuram, Kerala.

ii. ***Dr.Jacob John***, Participated in the following:

- 01-9-2006: One-day workshop on "Science & Technology-Input for perspective development of Kerala" at Government Guest House, Thycaud, Thiruvananthapuram

- 24-01-2007: Research-Extension Interface at Palakkad. Organized by Department of Agriculture, Palakkad. Handled a session on Farming System Approach.

- 10-3-2007: One-day workshop on Medicinal Plants at Thiruvananthapuram. Organised by Indian Agricultural Association and Pankajakasturi Pvt. Ltd.

- 14-03-207: One day Workshop on Evaluation of Rice cultivation Projects of Thiruvananthapuram Jilla Panchayat at Thycaud Rest House, Thiruvananthapuram.

iii. ***Dr. Rani, B.***

- XXVIth Zonal Research and Extension Advisory Council Meeting, 15,16 December, 2006, NARP(SR), College of Agriculture, Vellayani, Thiruvananthapuram- 695 522

4. Summer / Winter School

Dr.Jacob John, Participated in ICAR Winter School: "GIS based watershed planning in Agriculture" held at College of Horticulture, Vellanikkara from 02-12-2006 to 22-12-2006.

c.Extension activities undertaken by Dr. Thomas Mathew, ECF Agronomist

i. Imparted one day training on Banana production technology for farmers at FTC Pandalam on 10-7-06
ii. Imparted one day training or organic farming for farmers at RATTC Kozha 18-7-06
iii. Imparted one day training on banana cultivation for the farmers of Nooranadu Krishi Bhavan on 3-8-06
iv. Acted as a resource person in connection with Karshaka dhinam celebrations at Niranam Krishi Bhavan and Panachimoodu Krishi Bhavan on 17-8-06.

v. Imparted one day training on green house technology and methods of irrigation at FTC , Pandalam for farmers on 11-10-06.
vi. Imparted one day training on banana production for the farmers of Nedubram Krishi Bhavan on 6-10-06
vii. Imparted one day training on organic farming for the farmers of Pandalam block on 16-10-07.
viii. Imparted one day training on Mushroom production and cultivation for the farmers at RATTC, Kozha on 18-10-07.
ix. Imparted one day training on Recent advances in rice cultivation for the farmers of Aranmula Krishi Bhavan on 23-10-06.
x. Imparted one day training on INM in vegetable production at RATTC Kozha on 27-1-06.
xi. Imparted one day training on O.F. for the farmers of Ezhumattur, Krishi Bhavan on 3-11-06.
xii. Imparted one day training on organic farming for the farmers at RATTC, Kozha on 6-11-06.
xiii. Imparted one day training on vegetable production for the farmers at FTC, Pandalam on 15-11-06.
xiv. Imparted one day training on organic farming for the farmers of Eravipuram Block on 20-11-06
xv. Imparted one day training on organic farming for the farmers of Chalalloor Block, Calicut on 23-11-06.
xvi. Imparted one day training on organic farming for the farmers of Pala Block.
xvii. Imparted one day training on organic farming for the farmers of Pathanamthitta Block on 15-12-06.
xviii. Imparted one day training on banana production for the farmers of FTC, Pandalam on 16-12-06.
xix. Imparted one day training on vegetable production for the farmers of Mallappally, Krishi Bhavan on 18-12-06.
xx. Imparted one day training to the farmers of Kulanada Block on rice production Technology on 22-12-06.
xxi. Delivered a talk on organic farming in connection with the Golden Jubilee Celebration of Kothamangalam Diocease on 27-12-06.
xxii. Imparted one day training to Agrl. Assistants on organic certification and marketing at RATTC, Koza on 4-1-07.
xxiii. Imparted one day training on Agronomic aspects of rice production for the farmers of Mallapally Block on 6-1-07.
xxiv. Imparted one day training on the Role of biopesticides with reference to human health and environment conservation at Kodukunlanji , VFPCK on 8-1-07.
xxv. Imparted one day training on Rice Production on Technology on 16-1-07 at Kottanadu Krishi Bhavan.
xxvi. Imparted one day training on Rice production in Technology for the farmers of Pathanamthitta and Konni Block on 18-1-07.

xxvii. Imparted one day training on organic production of banana for the farmers held at FTC Pandalam on 19-1-07.

xxviii. Imparted one day training on organic production of pepper and spices for farmers held at FTC, Pandalam on 20-1-07.

xxix. Acted as Jury in the evaluation of Home gardens connected with Kozhencherry Puspa mela on 22-1-07.

xxx. Imparted one day training on organic production of vegetable crops for farmers held at CARD – Krishi Vigyan Kendra, Thelliyoor on 24-1-07.

xxxi. Handled a class on kitchen gardening and vermin composting for the women members of Agri Horti Society Kozhencherry on 3-2-07.

xxxii. Imparted one day training on vegetable production for the Kudumbasree members of Kottarakara Krishi Bhavan on 7-2-07.

xxxiii. Imparted one day training on vegetable production for the Kudumbasree members of Kottarakara Krishi Bhavan on 9-2-07.

xxxiv. Imparted one day training on vegetable production for the Kudumbasree members of Kottarakara Krishi Bhavan on 12-2-07.

xxxv. Imparted one day training on vegetable production for the women farmers of Kottarakara Krishi Bhavan on 13-2-07.

xxxvi. Imparted one day training on mushroom production and cultivation for the member of women in Agriculture on 14-2-07 at Kottarakara Krishi Bhavan.

xxxvii. Imparted one day training on organic farming for the farmers of Adoor Block on 20-2-07.

xxxviii. Imparted one day training on Soil and water conservation for the farmers in connection with Agrl. Seminar sponsored by CADA at Ezhamkulam on 27-2-07.

xxxix. Imparted one day training on Biofertilizers in Agriculture and Homestead production of Azolla and its cultivation for the women group at FSRS, Krishi Vigyan Kendra Kottarakkara on 2-3-07.

xl. Imparted one day training on advances in vegetable production for the farmers of Pramadom Krishi Bhavan 5-3-07.

xli. Imparted one day training on Rice production Technology for the farmers of CADA held at Adoor on 7-3-07.

xlii. Imparted one day training on Recent advances in vegetable production for the farmers of Kottankara Krishi Bhavan on 8-3-07.

xliii. Imparted one day training on Banana production programme for the farmers of Kottankara Krishi Bhavan on 13-3-07.

xliv. Imparted one day training on vegetable production programme for the farmers of AEZ held at Vadaserikkara on 16-3-2007.

xlv. Imparted one day training on Water management in rice for the farmers under CADA on 20-3-07 held at Peringara.

xlvi. Imparted one day training on the use of bio pesticides in organic farming for the farmers of Adoor block on 23-3-07.

xlvii. Imparted one day training on Recent Technologies in water Management in crop production for the farmers of CADA, Adoor.

d. Details of M. Sc. Degree and Ph. D degree awarded based on the project work: Nil

e. Details of Awards/ Honours: Nil

VI. TECHNOLOGIES GENERATED

- Summer rice fallows can be profitably used for taking up a vegetable or green manure crop depending on the availability of irrigation water. If the crop growth period is more than 120 days a short duration cassava can also be taken. This type of crop intensification reduces the weed population and enhanced the yield of subsequent rice crops.

- The fertilizer requirement can be reduced to 25 per cent during rabi season rice by substitution of 25 per cent RDF as organics during kharif season crop.

TECHNOLOGIES GENERATED FROM ECF UNIT

- In certain tracts of 'Kuttanad', rice crop is not responsive to Potassium application and hence can be applied in alternate seasons.

- In the sandy loam soils of 'Onattukara' application of P and K fertilizers are more important since the application of N fertilizers alone makes the crop more vulnerable to pests and diseases.

- Intensification of rice fallows with vegetable crops especially garden long bean (vegetable cowpea) gives more returns to the farmers.

- Optimum plant density in rice is the most important constraint in deciding the yield factor of transplanted rice.

VII. EMERGING PROBLEMS

Rice is the only cereal crop cultivated in Kerala. During last two decades a wide spread conversion of rice field is taking place in the state. Area under rice cultivation which stood at about 32 per cent of the total cropped are in 1974-'75 has declined to about 10 per cent. This conversion of rice field not only reduces the production of rice but also cause irreversible transformation of ecosystem. Hence, the impact of conversion of wet land field on water balance i.e. both surface and subsurface water availability need to probed. Due to very small operational holding rice cultivation has become uneconomical and difficult to sustain in its present form. Hence, for such marginal farmers the situation demands the development of economically viable and ecologically sound management practices through integrated through integrated homestead farming approach.

APPENDIX – I

Meteorological information (week wise) for entire crop season during 2006-'07

Month	Standard week from:	Standard week	Temperature ^{0}C		RH (%)	RH (%)	Rainfall (mm)	No. of rainy days
			Max.	Min.	Max.	Min.		
June' 06	28 – 3 June	22	30	23.5	95.8	86.0	18.8	5
	4-10	23	31.2	25.0	90.5	75.8	0.1	1
	11-17	24	32.0	24.5	90.3	73.2	0.0	0
	18-24	25	30.6	23.5	93.3	79.0	24.3	4
July '06	25-1 July	26	28.0	27.4			0.3	1
	2-8	27	29.7	23.1	95.0	84.3	19.8	6
	9-15	28	29.2	23.8	91.3	80.8	2.1	3
	16-22	29	30.5	24.4	91.2	71.7	0.5	2
	23-29	30	29.9	23.8	88.8	71.2	0.0	0
Aug '06	30-5 Aug	31	30.8	24.0	91.5	72.5	0.5	2
	6-12	32	29.8	23.4	93.5	81.0	4.9	4
	13-19	33	28.8	23.2	96.0	81.0	10.3	7
	20-26	34	30.8	23.8	91.3	84.2	0.0	0
Sept '06	27-2	35	30.4	23.3	91.6	75.1	0.3	1
	3-9	36	31.0	23.9	89.6	82.1	1.7	2
	10-16	37	29.8	22.7	89.7	78.6	13.4	7
	17-23	38	29.7	22.8	95.6	81.3	24.0	6
	24-30	39	30.3	23.0	92.4	79.1	15.1	4.2
Oct '06	1-7	40	30.4	23.1	93.4	83.1	5.7	2
	8-14	41	30.5	23.0	90.6	83.7	12.3	3
	15-21	42	30.4	22.7	96.3	7 9.3	25.3	7
	22-28	43	29.6	22.8	97.0	80.9	27.8	7
Nov '06	29-4 Nov	44	29.4	22.3	96.4	8 1.3	15.8	4
	5-11	45	30.0	23.4	94.4	81.3	6.7	3
	12-18	46	29.9	23.1	94.5	83.9	7.8	3
	19-25	47	31.3	22.3	94.0	74.9	11.8	5
Dec '06	26-2 Dec	48	31.8	23.1	96.7	72.1	3.4	2
	3-9	49	30.8	21.8	96.3	65.9	0.0	0
	10-16	50	31.6	22.4	96.7	74.1	0.9	2
	17-23	51	31.4	22.6	95.4	68.4	0.0	0
	24-31	52	32.2	21.6	93.1	71.0	0.0	0
Jan '07		1	31.3	19.9	96.3	58.1	0.0	0
	8-14	2	31.9	22.1	96.3	59.6	0.0	0
	15-21	3	32.2	21.7	93.7	60.7	0.0	0
	22-28	4	31.2	21.2	94.0	64.6	0.1	1
Feb '07	29-4 Feb	5	31.9	22.0	96.6	61.3	0.0	0
	5-11	6	31.0	21.2	95.1	60.4	0.0	0

	12-18	7	31.8	22.4	93.1	64.4	0.0	0
	19-25	8	32.2	21.0	92.9	50.9	0.3	1
Mar '07	26-4 Mar	9	32.9	23.5	90.7	66.6	0.0	0
	5-11	10	31.9	22.2	92.0	58.1	0	0
	12-18	11	32.0	23.6	91.6	61.3	0.0	0
	19-25	12	33.2	24.4	90.4	63.4	0.0	0
April '07	26-1 Apr	13	32.0	25.9	89.7	64.4	0.0	0
	2-8	14	33.7	24.8	94.6	74.3	7.18	7
	9-15	15	32.6	23.3	95.3	83.4	12.7	7
	16-22	16	32.9	24.4	92.1	71.7	4.7	1
	23-29	17	32.6	25.2	94.4	78	1.8	2
May '07	30-6 May	18	24.7	25.2	92	78	9.3	1
	7-13	19	31.7	24.3	96.6	79.3	8.8	5
	14-20	20	32.1	24.5	92.7	74.7	0.0	0
	21-27	21	32.4	24.9	90.4	76.1	1.4	1
	28-3 June	22	32.6	23.4	92.1	71.4	12.6	4

APPENDIX – II

Statement showing the head wise expenditure and budget provision of AICRP on Cropping Systems (1-4-2006 to 31.3.2007)

I. Main Centre, Karamana

Sl. No.	Head of Account	Budget provision (Rs.lakhs)	Expenditure (Rs.)
1.	Pay and Allowances	20.5	1764006
2.	Traveling allowances	0.50	34816
3.	Recurring contingencies	1.0	120881
4.	Non-Recurring contingencies	0.0	0000
TOTAL		**22.0**	**1919703**

II. ECF Unit, Sadanandapuram

a. ECF unit

Sl. No.	Head of Account	Budget provision (Rs.lakhs)	Expenditure (Rs.)
1.	Pay and Allowances	20.60	1852399
2.	Traveling allowances	0.10	16991
3.	Contingencies	1.60	94500
	TOTAL	**22.30**	**1963890**

b. FLD on Oilseeds

Sl. No.	Head of Account	Budget provision (Rs.)	Expenditure (Rs.)
1.	Traveling allowances	Nil	Nil
2.	Contingencies	10000	10000
	TOTAL	**10000**	**10000**

APPENDIX III

Centre wise Staff position as on 31.3.2007

Category	Sanctioned	In position	Vacant	Name of the incumbent
A.Scientific staff				
Chief Agronomist	1	1	0	Dr.Kuruvilla Varughese
Asst. Prof.(Soil Science)	1	1	0	Dr.B. Rani
Asst.Professor (Agronomy)	1	1	0	Dr.Jacob John
B. Administrative /Supporting/ Paratechnical/Ministerial/ Other posts				
Technical Assistant	1	1	0	Smt.Priya Pillai
Farm Assistant (Sr. Grade)	2	2	0	Smt.Sujatha K.S. Sri.Tomy Abraham
Typist	1	1	1	Smt.Sindhu P.S.
Messenger (Class IV)	1	1	1	Sri. .K. Maniyan