SECTION A - GENERAL

i) Name of the centre with actual location of the research farm: The research station is located at 10° 20' north latitude and 76° 20' east longitude at an elevation of 3.25 m above mean sea level. The nearest railway station is Chalakudy which is about 3 km from the research station. The farm is situated in the Chalakudy municipal area, Trichur District.

ii) Name of the project : Co-ordinated Project for Research on Water Management.

iii) Sanction order of the project : No.F7(4)74-SW & DF dated, 10.6.1975.

iv) Date of start : July 1974.

v) Report period : 1987-88

vi) Sanctioned budget for 1987-88 and actual expenditure headwise furnished in Table-1.

Table - 1

Sanctioned budget for 1987-88 and actual expenditure headwise for the year 83-84, 84-85, 85-86, 86-87 and 87-88

d of account	Sanctioned budget for 1987-88	Actual expenditure					Remarks
		1983-84	1984-85	1985-86	1986-87	1987-88	
ay of Officers ay of Establish-ment	235500/-	88344.72 41327.55	86548.79 43374.57	83379.87 42245.85	148131.68 81943.37	149875.82 77819.35	
llowances		93901.43	113519.51	145282.63	104945.47	86880.32	
ravelling llowances	10000/-	6922.98	6999.84	9978.38	9700.40	10000.00	
ontingencies:							
) Recurring	80000/-	96854.31	85982.81	89965.51	77005.78	97899.45	
) Non-recurring	30000/-	23889.25	-	-	-	21021.90	

vii) Instruments/Equipments purchased during the period

S.L. No.	Name of the Instrument/ Equipment	Date of purchase	No.	Cost (Rs.)	Stock Book entry page	Remarks (ICAR approval Lr.No.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Moisture cans (Aluminium)	16.3.88	300nos.	1688.00	P. 49 of S.R of Lab instrument & equipment	No.14-14/85/ A.F.C. dt. 28.2.88 of ICAR.
2.	Conductivity Meter-systronics	31.3.88	1No.	4951.40	p.104 "	"
3.	Water still glass vensil single distillation water still	19.3.88	1No.	3392.00	p.102 "	"
4.	Pocket calculator.	31.3.88	1No.	200.00	p.56 of S.R.F.	"
5.	High speed mechanical stirrer.	31.3.88	1No.	4667.50	-	"
6.	Stevenson screen	31.3.88	1No.	2800.00	p.106	
7.	Wet seive shaker with seive set.	31.3.88	1No.	3224.00	p.105	No.PC/B.2 (cky)87-88 dt.14.3.88

viii) Staff position

Sl. No.	Name of the sanctioned post	No.	Name of the incumbent	Date of joining	Date of leaving	Remarks
1	2	3	4	5	6	7
1.	Chief Scientist	1	Dr.G.Ravindranathan Pillai	20.11.80	31..7.87	
			Mr.P.Chandrasekharan	3..6.88	Till date	
2.	Agronomist	1	Dr.Abdul Salam	20..5.87	31..7.87	Vacant from 1.8.87 onwards
3.	Soil Physicist	1	Mrs.G.Santhakumari	29..3.82	Till date	She was in charge of Chief Scientist from 1.8.87 to 2.6.88.
4.	Agrl. Engg.	1	Mrs.Lissy Devid Chirayath	17..7.86	16..3.88	Jr.Asst. Prof.was working against the post.
5.	Jr.Agronomist	1	Mrs.Reena Mathew	21..8.87	Till date	-do-
6.	Jr.Soil Physicist	1	1)Dr.K.A.Mariam	15.12.86	7..8.87	
			2)Mrs.Manorama Thampatty	1.9..87	Till date	JAP is working against the post.
7.	Jr.Soil Chemist	1	Mr.C.S.Gopi	10..4.84	Till date	
8.	Jr. Agri.Engg.	1	Mrs.E.V.N.Sheela	17..7.86	16..3.88	JAP was working against the post.
9.	JSA/Filed Asst.	3	1)Mrs.T.A.Vasanthy	8..9.86	Till date	
			2) Mr.M.T.Varghese	8..6.87	Till date	
			3) Mr.P.K.Reghu	8..9.86	8..6.88	
10.	Jr.Stenographer	1	Mrs.M.A.Sujatha	1..7.87	20..6.88	
11.	Jeep Driver	1	Mr.M.P.Paul	29..7.86	Till date	
12.	Jr. Attendant	1	Mr.T.R.Balakrishnan	1..6.86	11..7.88	
13.	Messenger	1	Mr.K.Radhakrishnan	20..7.81	Till date	

ix) Brief description of the study area

Topography: Flat plains

Soil characteristics

The soils of the study area are in sandy loam texture, with sand 75-85%, silt 4-12% and clay 7-11%. The bulk density of the undisturbed soil varies from 1.3 to 1.6 g/cc.

The depth of soil vaires from 45 to 90 cms. The pH and EC of the soil ranges from 5 to 6.1 and 0.2 to 0.5 mmhos/cm respectively.

The content of oganic carbon ranges from 0.57 to 0.64%, the available P_2O_5 from 10-12 kg/ha and available K_2O from 35-39 kg/ha, which are very low.

Farm: The total area of the farm is 8.95 ha of which 7.05 ha is wet land and 1.90 ha upland. The area runs into a fine gradient to south west and the wet lands are terraced. The main sources of irrigation water are Chalakudy Irrigation Project, one municipal pond and two wells in the farm, which fulfill the irrigation needs of the farm in most of the months. Water Scarcity will occur in the summer months especially in March-April, during which period the canal irrigation is possible only twice in a week.

Irrigation Project: The Chalakudy Irrigation Project, which is also known as Chalakudy river diversion scheme started functioning in 1966. The water let down after power generation from the two hydroelectric projects of Peringalkuthu and Sholayar maintains a steady flow of water in the river. The dam was built across the Chalakudy river at Thumburmuzhi,

which is about 10 km from the research centre. There are two main canals, viz Right bank canal and left bank canal. The irrigation water from right bank canal is utilized for the irrigation in the farm.

The quality of the irrigation water is good and the conductivity of water ranges from 0.10 to 0.16 mmhos/cm and the PH ranges from 6.0 to 6.6

Command Area: The total area of the Chalakudy command is 19690 ha covering areas under Ernakulam and Trichur districts. The canal water is available throughout the year except the months of March and April. For the irrigation of Kharif and Rabi crops in the command areas, adequate water is supplied by canals and during the summer months only about 7000 ha are irrigated by canal, because of the limited supply of water from the hydroelectric projects.

The command area is having an undulating topography with hills, hillocks and valleys. Plantation crops like rubber, coconut, arecanut, spices and perennial fruit trees like Mango, Jack etc. are grown in the upland hills. Annuals grown are rice, pulses, oil seeds, vegetables, banana and tuber crops. In the rice fields two crops of rice are generally grown and only in limited area summer rice is grown where there is assured water supply. In summer fields, where the water supply is limited, farmers are now practising to grow pulses like cowpea, green-gram, blackgram etc. and oil seeds like sesamum and groundnut.

Problems of Watermanagement in the Command area

High rainfall especially during Kharif season (south west monsoon) causes water logging in low lying fields which necessitates the development of adequate drainage technology for raising rice crop more profitably during this season. soil erosion and consequent nutrient loss from the hilly areas of the region warrants the need for soil and moisture conservation studies. The rabi crop is usually subjected to water stress during the later periods of growth, which is the reproductive phase of the crop. Scarcity of irrigation water in summer season stresses the need for the development of suitable rice based cropping pattern which uses water more efficiently and economically. Hence the watermanagement practices in relation to cropping patterns has to be worked out for the system as a whole rather than individual crops.

The yield of perennial crops such as coconut, arecanut, pepper etc can be boosted up by irrigating them in the dry periods of the year. Hence studies have to be carried out to formulate appropriate irrigation schedules and methods of irrigation for perennial crops. The unavailability of cultivable land necessitates the study of intercropping system in perennial crops and their water requirement. Loss of water during conveyance and distribution is estimated to be very high for which technologies have to be formulated to minimise these losses.

x) Weather during the study period

The daily record of rainfall and the weekly weather data during the year 1987 are furnished in Table II and III respectively and Fig.1.

During the year 1987, the maximum rainfall of 926.6 mm was received during the month of June followed by August and July (542.4 and 456.88 mm) respectively. All the months from May '87 to December '87 received rainfall above 200 mm. But during the months from January to April no rainfall have been received except for the month of March which received only 6 mm. This uneven distribution of rainfall during the year, causes water logging as well as moisture stress condition.

The total rainfall received during the year under report is 2975.8 mm as against 2341 mm during the year 1986.

The maximum temperature of 36.97°c was recorded during the 3rd week of April and the minimum temperature of 18.5 °c was recorded during the last week of December. Relative humidity in the morning was maximum during the second week of June (97.86%) and in the evening during the fourth week of October (92%).

The values on open pan evaporation was ranging from 1.46 to 5.45 mm/day. During summer season, the mean evaporation was 4.37 mm/day.

Table 2

Daily record of rainfall (mm) during the year 1987 at Agronomic Research Station, Chalakudy

Date	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1					13.0	25.2	67.0			24.0	18.4	
2						62.2	18.0					
3						143.2	11.0	6.8		1.4		
4						8.5	30.0	17.0	2.2	9.6		
5						23.0	46.2		31.0		0.4	1.2
6						7.0	29.2					
7							21.4	22.4			28.0	19.6
8						6.0	16.0			0.6	27.2	
9						10.2	50.0			36.0	4.2	62.0
10						2.2	2.6			0.6	29.2	81.2
11						22.3	8.2	8.0				
12						5.2	2.0	34.2		24.0		
13					0.2	32.2		46.2				1.8
14						11.0	4.2	25.8		5.4		
15						49.0	92.2	3.0			9.4	37.4
16					5.7	55.2		7.0	28.0	10.2		
17					6.7	31.1		32.0		5.4		
18						86.8	7.0	35.3	3.2			
19					10.6	0.4	4.0	45.2	4.2		14.0	
20						18.0	1.0	12.0	78.2	10.0	58.2	

(Table-2 Contd.)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
21			6.0		2.0			23.3		18.4		
22							3.4	15.0		38.2	15.4	
23					6.8	117.1		7.6	4.2			5.3
24							4.0	63.4	66.0		3.4	
25						1.0	20.0	42.0	12.8	6.4	38.2	
26					13.6	13.6		28.4		9.2		
27						126.0		22.2		12.2		
28						52.2		9.2		5.0		
29							19.4	36.2				
30					1.2	18.0			28.6	15.0		
31										2.0		
Total rainfall			6.0	-	97.5	926.6	456.8	542.2	258.4	233.6	246.0	208.5
No. of rainy days			1		8	25	21	22	10	19	12	7

Table III

Weekly weather data recorded during the year 1987 at Agronomic Research Station, Chalakudy

Standard week	Temperature (°c)		Relative Humidity %		Pan evaporation (mm/day)	Wind speed (km/day)
	Max.	Min.	I	II		
January						
1. 1 to 7	32.87	19.09	71.43	39.40	3.64	42.86
2. 8 to 14	33.90	21.40	79.00	38.71	3.53	36.86
3. 15 to 21	33.43	18.79	83.57	29.43	3.97	54.0
4. 22 to 28	34.43	19.30	84.00	31.14	4.12	50.43
5. 29 to 4	33.89	19.80	74.57	38.14	4.26	49.86
February						
6. 5 to 11	34.91	20.06	68.57	34.43	4.04	51.43
7. 12 to 18	34.34	18.86	80.57	32.57	4.23	51.14
8. 19 to 25	35.03	22.54	78.42	45.57	4.39	58.14
9. 26 to 4	35.43	22.40	81.29	37.86	4.30	74.0
March						
10. 5 to 11	36.03	22.52	76.43	31.71	4.62	57.43
11. 12 to 18	35.24	22.73	72.70	40.14	4.78	88.14
12. 19 to 25	35.33	21.60	78.14	39.57	4.61	74.43
13. 26 to 1	36.31	23.21	69.00	42.57	4.69	66.29
April						
14. 2 to 8	35.44	24.89	78.93	44.86	4.65	70.00
15. 9 to 15	34.54	25.41	73.36	52.93	4.57	81.71
16. 16 to 22	36.97	26.00	73.07	52.57	5.17	78.14
17. 23 to 29	35.50	25.03	87.07	53.29	4.22	70.14
18. 30 to 6	35.03	24.10	73.36	49.43	4.91	74.0
May						
19. 7 to 13	36.41	25.03	73.71	42.00	5.45	84.29
20. 14 to 20	35.20	23.83	78.50	51.64	4.34	58.57
21. 21 to 27	34.31	23.43	84.07	58.5	3.62	49.43
22. 28 to 3	34.75	23.77	81.00	45.29	4.25	66.00
June						
23. 4 to 10	31.27	22.68	94.93	50.14	2.68	67.57
24. 11 to 17	30.11	23.69	97.86	53.14	1.46	42.43
25. 18 to 24	31.01	23.90	86.29	58.29	3.15	78.57
26. 25 to 1	31.36	24.07	91.57	68.71	3.04	52.57
July						
27. 2 to 8	31.19	23.64	94.64	79.93	3.86	48.57
28. 9 to 15	30.66	23.07	93.21	81.93	3.53	43.00
29. 16 to 22	30.80	24.53	90.86	70.14	3.13	73.71
30. 23 to 29	30.94	23.27	88.86	65.14	3.05	84.71

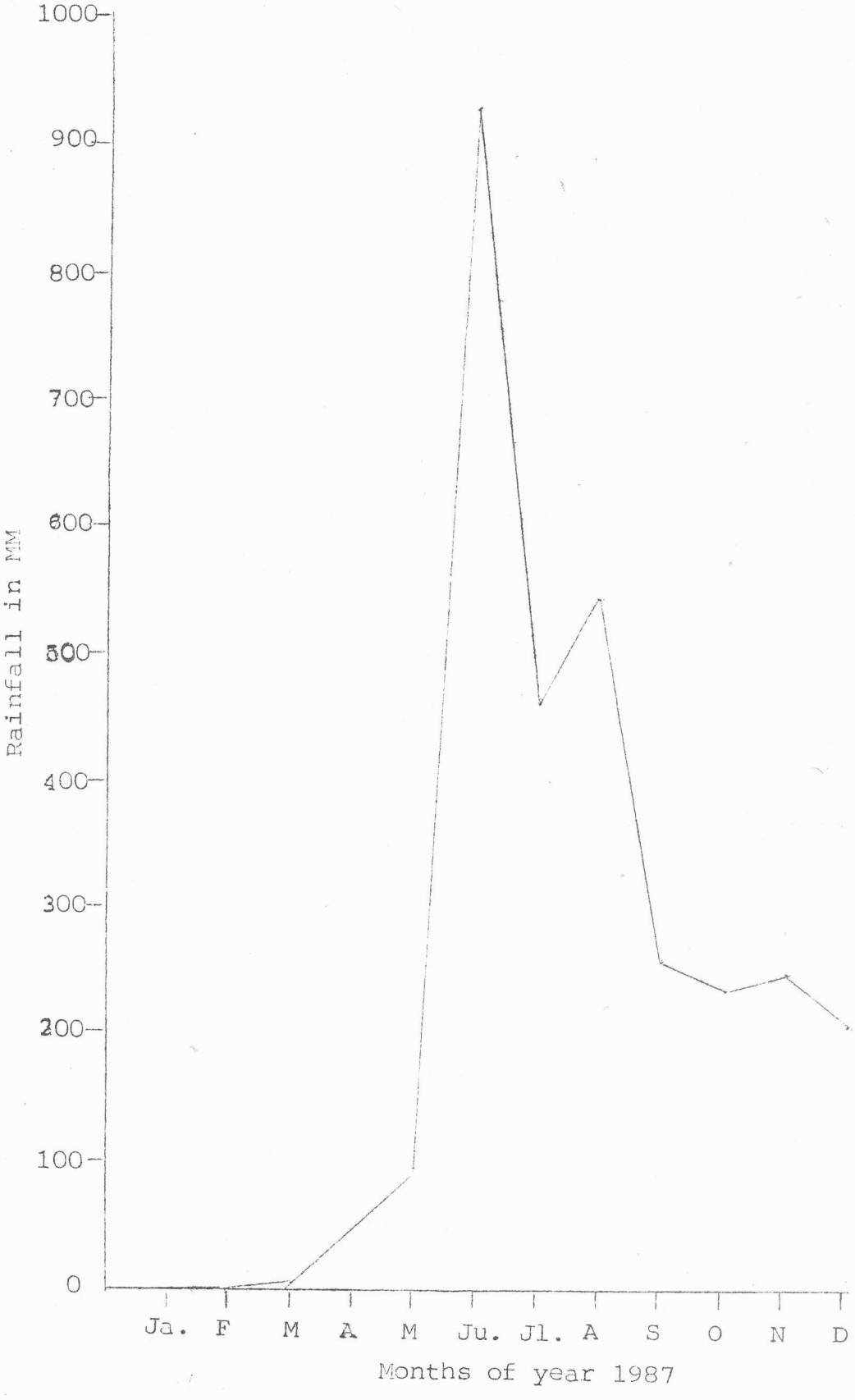
(Contd..)

(Contd.. Table III)

August						
31. 30 to 5	30.44	20.61	82.00	73.93	3.60	50.71
32. 6 to 12	31.00	23.79	88.57	66.14	3.39	42.43
33. 13 to 19	29.86	23.94	94.71	73.00	3.37	41.43
34. 20 to 26	29.57	23.21	92.57	87.71	3.46	59.29
35. 27 to 2	30.57	23.36	94.29	76.14	3.40	56.00
September						
36. 3 to 9	30.96	23.50	70.86	66.43	3.71	54.00
37. 10 to 16	32.06	24.43	85.00	61.43	3.75	86.57
38. 17 to 23	33.21	23.50	94.29	63.00	3.83	47.43
39. 24 to 30	32.54	24.09	89.71	57.00	3.78	55.57
October						
40. 1 to 7	31.61	23.74	88.21	73.57	3.65	41.71
41. 8 to 14	32.36	24.50	87.43	76.64	3.66	41.86
42. 15 to 21	32.21	24.21	84.71	80.86	3.74	48.86
43. 22 to 28	33.14	24.04	91.00	92.00	3.72	36.43
44. 29 to 4	33.31	23.86	85.79	75.36	3.51	38.57
November						
45. 5 to 11	32.81	23.64	90.43	65.43	3.24	36.71
46. 12 to 18	32.24	23.61	85.29	66.21	3.51	32.71
47. 19 to 25	33.00	22.54	91.21	67.00	3.43	33.71
48. 26 to 2	32.36	20.47	83.43	64.5	2.64	22.57
December						
49. 3 to 9	32.19	18.64	90.71	66.14	1.73	45.43
50. 10 to 16	32.04	22.44	86.07	66.00	2.53	45.43
51. 17 to 23	32.36	21.21	83.14	62.36	2.74	37.29
52. 24 to 30	33.07	19.86	81.86	52.36	3.20	48.14
53. 31 to 6	32.07	18.5	84.29	54.79	2.94	41.86

*I - Morning observation
II - Afternoon observation

Monthly rainfall 1987



SECTION - B

Objectives of the Centre

The main objectives are:

1. To develop cropping pattern suitable for varying water management and fertility situations.
2. To test new crops and varieties for their adaptability and performance under different moisture conditions.
3. To estimate the water requirement of annuals like rice, pulses, oilseeds, vegetables, banana, tuber crops and perennials like coconut, arecanut, pepper etc.
4. To evolve suitable measures to increase water use efficiency of crops.
5. To work out economics and optimum schedules of irrigation of crops cultivated in the region.
6. To study the ground water fluctuations, quality of ground water and recycling of drainage water for irrigation.
7. To find out cheap and efficient methods of irrigation for different crops.
8. To evaluate water conveyance losses through seepage and to develop economically viable design to reduce these.
9. To carry out the detailed study of the soil characteristics of the command area soil.
10. Conducting on farm water management studies in the farmers field with improved water management techniques developed at the research centre.

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SECTION - C

BRIEF TECHNICAL PROGRAMME OF THE CENTRE

(contd..)

SECTION - 2

RESEARCH ACCOMPLISHMENTS

EXPERIMENT No.1

1. WM.21 : Studies on "On farm irrigation water management in the command of a irrigation minor"

Introduction: A compact area of 25.3 ha of paddy fields was selected for conducting the on farm irrigation water management in the command of the Chalakudy irrigation project at Thuravoor Village, near Angamaly in Ernakulam District. This project was commenced from the year 1984-85 and is being continued. The fields are terraced slopes where two or three crops of rice are usually cultivated.

The main objectives of the projects are:

1) To study the present water utilization pattern in the command area and to test the field applicability of improved water management technology developed at the research centres on a large scale in farmers fields with a view to increase irrigation water use efficiency.
2) To evaluate the impact of adopting a scientifically planned rice based cropping pattern formulated on the basis of the agricultural situation and irrigation water availability of the locality on increasing the crop production and economic uplift of farmers.
3) To generate more effective and field oriented water management technology for easy adoption by farmers on a large scale.

2. Location : The study area is located in Thuravoor Village near Angamaly in Ernakulam District. The area is situated about 18 km. south of the Agronomic Research Station, near Angamaly.

The water from the branch canal of the Left Bank Canal of the Chalakudy Irrigation Project is getting into the field through a single spout. Usually canal water is available from the middle of June to April.

3. Significant highlights of Bench mark Survey indicating water management constraints in Agricultural production.

The project was started with a Socio-economic Survey of the 100 farmers whose area is selected for the study. Complete information about the individual farmers was collected through the survey. The survey indicated the Social and Agricultural background of the farmers.

Classification of farms	No. of farmers
Area of less than 0.2 ha	55
" " 0.2 to 0.5 ha	34
" " 0.5 to 1 ha	10
Area of above 1 ha	1
Total	100

The following are the major problems identified which limit the agricultural production and wastage of irrigation water in the study area.

1) The farmers were not following the scientifically planned cropping pattern to the area based on season and availability of irrigation water. This may lead to crop failure especially during summer months.

2) The farmers were practising field to field irrigation resulting in the heavy loss of water and nutrients. Properly laid out irrigation and drainage channels were not seen in the area. Iron toxicity is a major problem in the area especially during rabi and summer season, which may be due to inadequate drainage.

3) Staggered planting with different varieites having different duration mostly with low yielding local varieities creates problem for the distribution of water.

4) The scientific water management techniques were not practised in the area.

4. i) Number and date of Coordination Committee meetings held during the report period.

1.	21..7.87	5.	13..1.88
2.	26..8.87	6.	10..2.88
3.	15..9.87	7.	9..3.88
4.	24.11.87	8.	13..5.88

ii) Whether group meetings of farmers of the operational research are organised. If yes, their number and subject matter discussed.

Two group meetings of the farmers of the operational research project were organised during the period under report.

1) A Karshaka Seminar and Kissan Mela was organised at Thuravoor on 19.9.87. About 135 farmers participated in the seminar. Director of Extension inaugurated the function which was chaired by Director of Research.

In the Seminar, Officers of the Department of Agriculture and Command area Development authority actively participated. Scientists of different disciplines from Kerala Agricultural University took classes on the following aspects and actively participated in the discussion.

The main topics discussed in the seminar were

1) Crop management and cropping systems.
2) Improvement of soil fertility.
3) Water management of crops like rice, coconut, Pulses & Oil seeds, Banana, vegetables, tuber crops etc.
4) Manures and fertilizers.
5) Irrigation and drainage problem of the area and their management.
6) Pests and diseases of crop plants.
7) Livestock Management.
8) Fish farming.

After the classes there was a live discussion on various problems faced by farmers and the scientists and officers of different departments suggested remedial measures.

2) The second meeting of the farmers was organised on 21.3.88. This programme was conducted as a one day training programme in which about 75 farmers participated. Facilities were made available to the farmers to study the various aspects of the water management research going on in the station and other stations of University.

iii) Farmers association:

The farmers were organised to form an Association ie. Thuravoor Karshaka Samithi and got officially registered.

A comittee of the farmers consisting of 9 menbers including President and Secretary was constituted for the effective implementation of the Programme.

The following improved technologies were recommended and tested in the study area based on the problem identified in the Socio-economic survey.

i) Suitable cropping patterns were formulated and adopted using varieties of appropriate duration and high yield. Time schedules in different operations and scientific management practices recommended by the Kerala Agricultural University were also transferred.

ii) Shallow continuous submergence of (5 ± 2 cm) water was strictly maintained.

iii) Changing the existing practices of field to field irrigation to channel to field irrigation.

iv) Providing drainage facilities in the ill-drained areas.

Irrigation and Drainage channels

The canal water is directed into a pond at the beginning of the study area and from the pond water is let into the field in a pond through a central irrigation channelhaving 50 cm width and 50 cm depth constructed upto the tail end of the field. From this channel, irrigation could be effectively done.

Drainage channels were dug along the southern and northern side of the field which could effectively control the excess water and also the iron toxicity problem and other ill effects of water stagnation.

Input supply

Inputs like fertilizer, pesticides, fungicides and paddy seeds of high yielding varieties were partially supplied from the Lab to Land Programme of the centre.

5. Year of commencement : 1984-85

6. Area covered : Study area - 25.3 ha
Control area - 23.8 ha

7. i) Dates when water was available at the outlet during the report period.

Canal water was available throughout the months from June to December 1987 and during this period the excess water would flow through the outlet.

From January to May, the spout of the canal remained open for five days continuously and the next five days closed.

ii) Presence of wells/tube wells etc.

One big pond is present in the corner of the study area which can act as a reservoir of the canal water. From the canal spout, the water is collected in this pond and regular flow is maintained through the field channel by regulating the level of water in the pond.

8. Results of the previous year

The results of the onfarm water management conducted during the year 1985-86 and 86-87 are furnished below.

Particulars	1986-87 summer		1986-87 summer	
	Study area	Control area	Study area	Control area
Grain yield (kg/ha)	2893	1700	3300	1250
Straw yield (kg/ha)	3180	2500	3125	1890
Irrigation water used (mm)	1175	1525	1157	1342
Water use efficiency (kg/ha mm)	2.46	1.11	2.85	0.93

9. Description of water management technology demonstrated during the year.

Before starting the cultivation irrigation and drainage channels were laid out in the area under the supervision of the Scientist of Agronomic Research Station, Chalakudy.

During kharif season, there was no need of irrigation in the study area. Hence the water management adopted was the careful maintenance of shallow submergence. Drainage channels were provided throughout the length of the field during this period, so as to enable the flow of the excess water.

During the early periods of rabi season also, no irrigation was necessary. But in the later part of rabi season, irrigation was given and shallow submergence maintained.

In both the seasons, especially in rabi season the crop in certain fields was badly affected by bronzing disease caused by ferrous iron and hence in these fields

flow submergence was practised intermittantly and drainage was provided. In all cases channels to field irrigation was practised.

In the summer season, the crop was irrigated throughout the growth period from the canal. During this season also the bronzing was a serious problem which could be controlled by application of lime and providing drainage.

In summer months ie. from January to April, Canal water was available to the study area continuously for 5 days and then no supply for next 5 days. With the result water scarcity was felt in a few fields where we practised continuous submergence at 7 cm depth when canal water was made available. As soon as canal water supply was stopped the ponded water disappeared in two days and the fields were left dry for 2 or 3 days. The station result that irrigation can be prolonged upto 3 days after disappearance of ponded water without any reduction in yield, has been proved convincingly in the study area and the results bear testimony to that.

10. Results obtained during the year.

1) Kharif season

Sowing was done during the third week of June after the application of fertilizers and organic manure as per Package of Practices recommendations. All the operations like land preparation, application of fertilizers, sowing etc. were done as per the time schedule fixed at the instance of the Karshaka Samithi.

The variety used was Thriveni which is a short duration one and was found to be the most suitable one for the area. During the third week of July weeding was carried out and top dressing with N and K was done. Attack of leaf roller and sheath blight was observed in some areas and could be controlled by the spraying of Ekalux and Hinosan. From the month of June onwards, the maintenance of shallow submergence was practised in all the fields. In September, the crop was harvested and the yield data are furnished in the table attached.

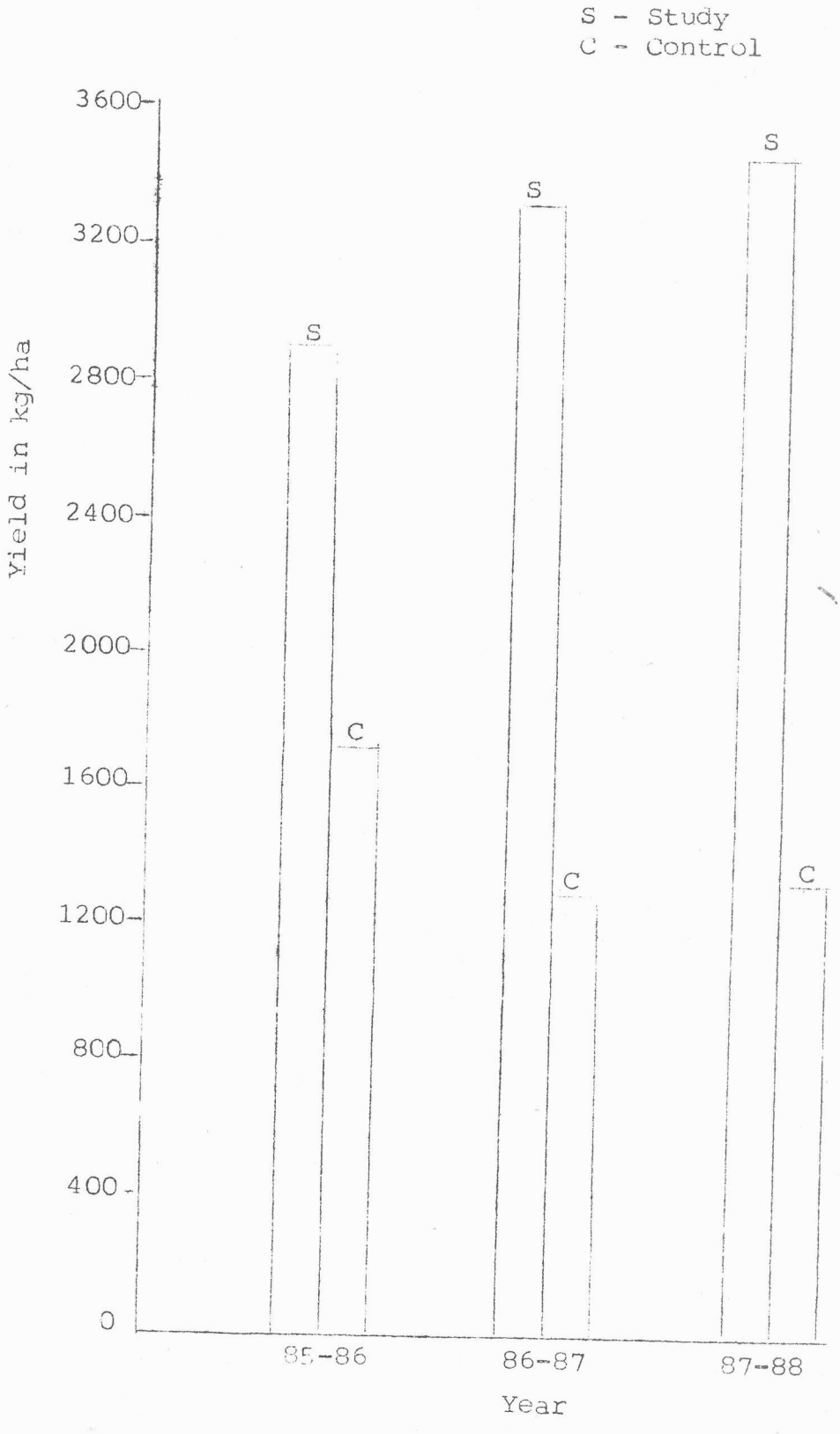
2) Rabi season

The medium duration variety Pavizham was sown during the first week of October and all the cultural operation were undertaken as per package of practices recommendation. The attack of case worm and damping off was noticed in most of the fields which could be effectively controlled by the timely application of Ekalux and Hinosan. Top dressing with N and K was done during the third week of November. The attack of stem borer was observed during the tillering stage and Dimecron was sprayed against its attack. The crop was harvested during the last week of January and the yield recorded are furnished in the table attached.

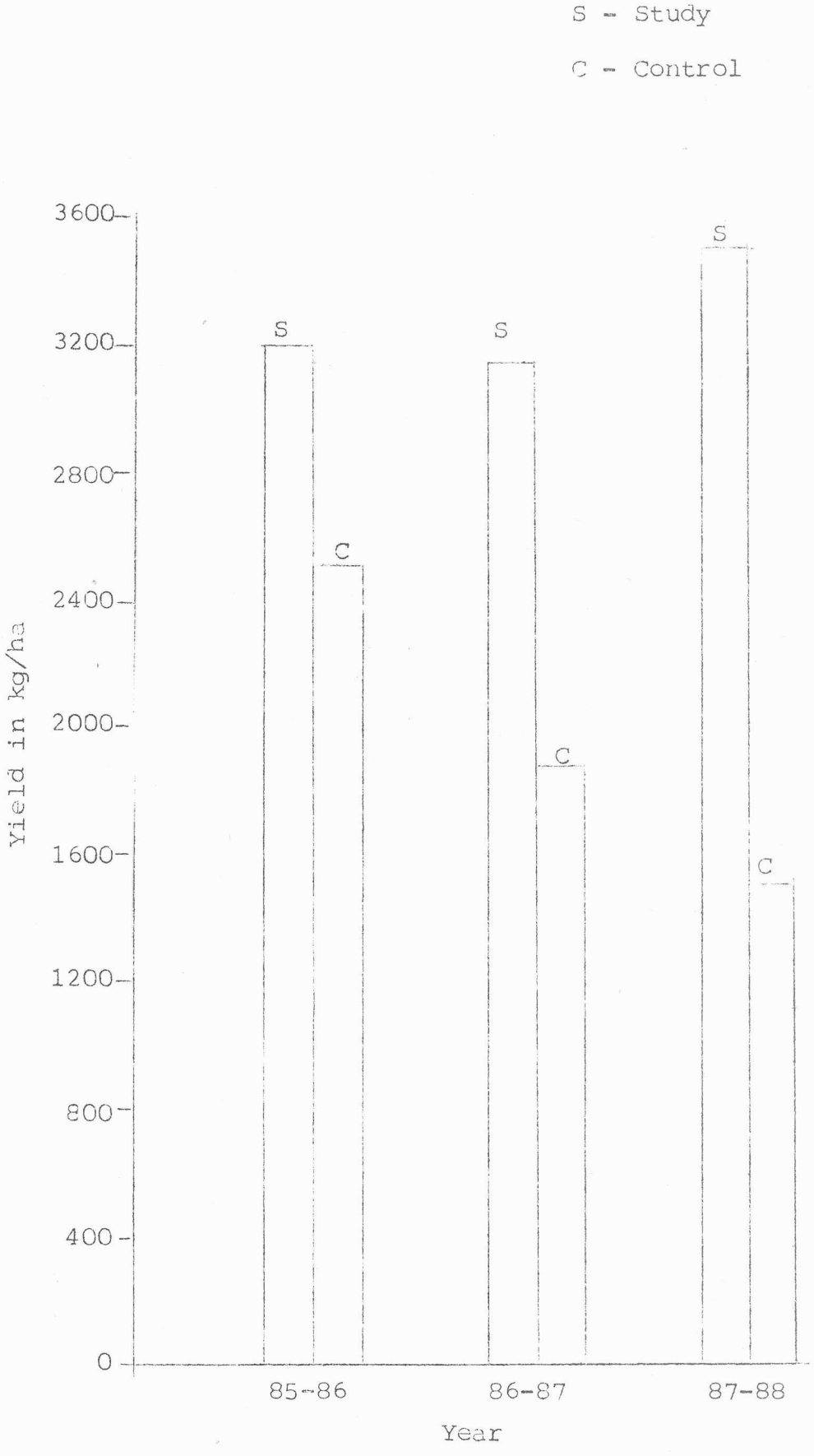
3) Summer season

Thriveni seeds were sown during the 3rd week of February 88. Application of organic manures, fertilizer and lime was done before sowing. Time schedules for all the operations was strictly adhered to. For the summer

Grain yield in kg/ha in the study and control area



Straw yield in kg/ha in the study and control area



crop the artificial irrigation was a must. For effective utilization of the canal water, one common irrigator was engaged and his wages was paid by Samithi.

Completed the harvest of the summer crop by the fourth week of May and the results are furnished in Table attached.

From the yield data, it can be observed that in all the season maximum yield of grain and straw was obtained from the study area as compared to control area. The grain yield of 2800, 2500 and 2450 was obtained for Kharif, rabi and summer season and in each season the increase over control was 77%, 123% and 165% respectively.

The increase in the yield of straw was also noticed in all the three seasons in the study area.

Hence it can be proved that the yield in farmers fields of fragmented holdings could be increased by adopting Scientific Cultivation and water management practices as group management.

Measurement of irrigation water

The measurement of irrigation water was done during the summer season by measuring the inflow-outflow by using the parshall flumes.

The data on water use is presented on the table attached.

The irrigation water use was 1168 mm in the study area and 1504 mm in the control area. Hence there was a saving of 336 mm of water in the study area by adopting scientific water management. Since the scarcity of

irrigation water was severe during summer, this saving of water in the study area was quite appreciable.

The water use efficiency in the study area was 2.93 whereas it was 0.86 in the control area. Thus it showed that more grain yield could be obtained per unit of water by following scientific water management practices.

In short the results of the study revealed the possibility of adopting scientific water management practices in rice in farmers field on a large scale by organising the small farmers under group management. Thus the yield of rice could be increased and thereby the income of the farmer on account of irrigation water savings.

11. Difficulties encountered in the implementation of the programme.

Without giving any financial assistance in kind as fertilizer, pesticides, seeds etc, it was very difficult to organise the farmers.

12. Any other relevant information.

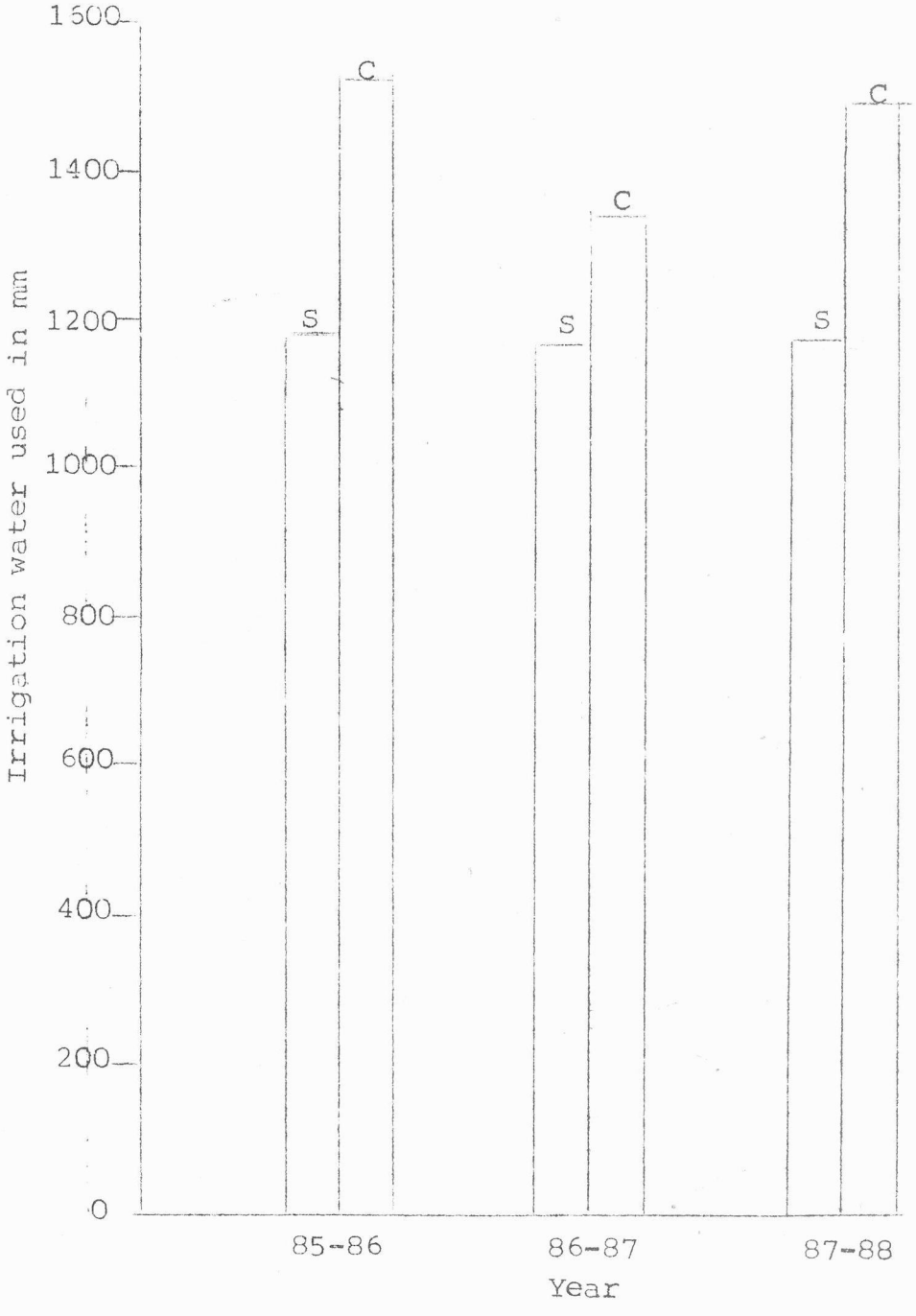
Because of the success of this project in farmers field, the authorities of department of Agriculture, command area development and irrigation render assistance to the farmers in the study area.

During the year under report after the rabi crop, about 750 meters of the irrigation channel was lined with cement concrete with the collaboration of the command area authorities. This channel has been so constructed as to serve as irrigation channel as well as drainage channel by providing holes in different levels. Hence there was no

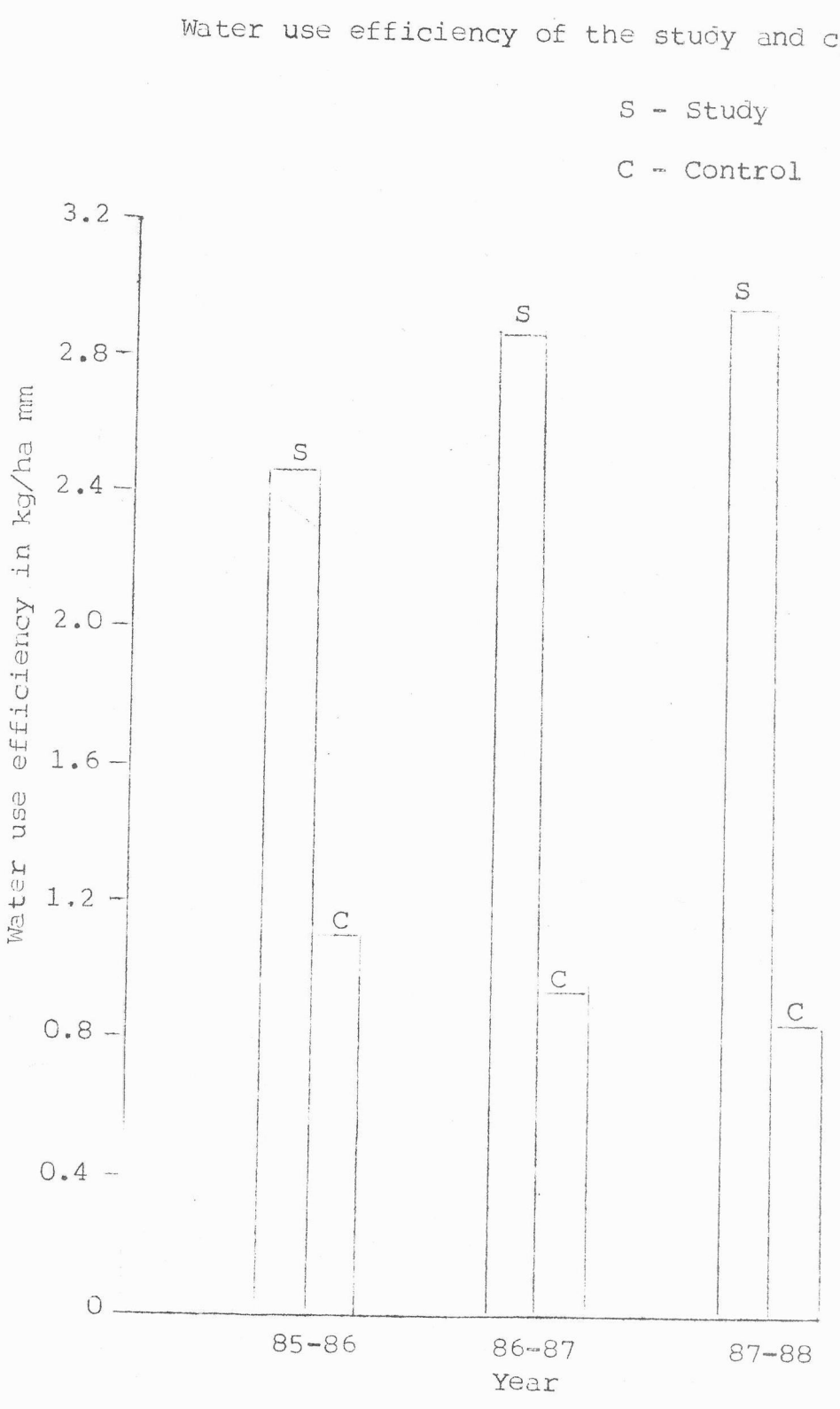
Quantity of irrigation water used in mm in the study and control area

S - Study

C - Control



Water use efficiency of the study and control area



problem of water scarcity during the year. And also drainage will not be a problem during the coming years. The command area people agreed to complete the lining of the channel during the ensuing year.

In short this programme in Thuravoor was a grant success. The results revealed that rice yields in the fragmented farm holdings of Kerala could be remarkably improved by adopting scientific water management and other cultural operations. These can be effectively and economically carried out through the farmers group organisation.

Table-1.1

Yield of rice of the operational research project

Yield in kg/ha	Kharif		Rabi		Summer	
	Study area	Control area	Study area	Control area	Study area	Control area
Grain	2800	1576	2500	1120	2450	1300
Straw	3200	1800	2300	1400	3500	1500

Table-1.2

Water use efficiency of study area and control area

	Study area	Control area
Irrigation water used in mm (from February to May)	1168	1504
Grain yield in kg/ha	3450	1300
Water use efficiency in kg/ha mm	2.93	0.86

EXPERIMENT No.2

1. Title of the experiment : WM.5 Studies on rice based cropping pattern under constraints of irrigation water.

2. Objectives:

   a) To find out the appropriate rice based cropping pattern for varying irrigation water supplies.

   b) To study thelong term effect of cropping pattern on soil physical-chemical properties.

3. Year of commencement : 1983. Repeated in the same site with same randomisation.

4. Initial soil characteristics:

   a) Soil texture : Sandy loam

   b) pH : 5.2

   c) E.C. (millimhos/cm) : 0.35

   d) Organic carbon (percentage) : 0.39

   e) Available P_2O_5 (kg/ha) : 15.2

   f) Available K_2O (kg/ha) : 35.0

   g) Available water storage capacity % : 11.4

5. Crop Rotation followed : Rice - Rice - Rice

6. Sowing/Planting

   i) First crop (rice)

      a) Planting : 15.7.1987

      b) Method : Transplanting

      c) Seed rate : 60 kg/ha

      d) Spacing : 15 cm x 10 cm

ii) Second crop (Rice)

a) Planting : 20.10.'87

b) Method of planting : Transplanting

c) Seed rate : 60 kg/ha

d) Spacing : 15 cm x 10 cm

iii) Third crop

1. Rice

a) Planting : 9.2.88

b) Method, seed rate and spacing as in the first and second crop.

2. Cowpea

a) Sowing : 13.2.88

b) Method : Dibbling

c) Spacing : 20 kg/ha

d) Spacing : 25 x 15 cm

3. Groundnut

a) Sowing : 13.2.88

b) Method : Dibbling

c) Seed rate : 75 kernals/ha

d) Spacing : 25 x 25 cm

4. Sesamum

a) Sowing : 13.2.88

b) Method : Dibbling

c) Seed rate : 4 kg/ha

d) Spacing : 25 x 15 cm

5. Bhindi

a) Sowing : 13.2.88

b) Method : Dibbling

c) Seed rate : 8 kg/ha

d) Spacing : 60 x 50 cm

7. Harvesting date

1. First crop - Rice : 2.10.87

2. Second crop - Rice : 8. 1.88

3. Third crop

i) Rice : 26.4.88

ii) Cowpea : 11.4.88, 30.4.88

iii) Groundnut, iv) Sesamum } The crops were completely damaged.

v) Bhindi : 29.3.88, 2.4.88, 5.4.88, 8.4.88 11.4.88, 13.4.88, 15.4.88, 22.4.88

8a) Fertilizers and Manures

i) Rice

NPK : 70:35:35 kg/ha

FYM : 5t/ha

ii) Cowpea

NPK : 20:30:10 kg/ha

FYM : 5 t/ha

iii) Groundnut

NPK : 10:75:75 kg/ha

FYM : 5 t/ha

Lime : 1.5 t/ha

iv) Sesamum

NPK : 30:15:30 kg/ha

FYM : 5 t/ha

v) Bhindi

NPK : 25:10:25 kg/ha

FYM : 10 t/ha

Kind of fertiliser formulation : N as Urea
P as Single Super Phosphate
K as Muriate of potash

c) Time of application

i) Rice: Full dose of FYM and phosphorus and half the dose of nitrogen and potash were applied as basal. The remaining half dose of nitrogenwas applied in two equal splits at the time of active tillering and panicle initiation stages. Half the dose of potash was top dressed at the time of panicle initiation.

ii) Cowpea: Full dose of FYM, Phosphorus, potash and half dose of nitrogen were applied as basal. The remaining half dose of nitrogen was applied as foliar spray, one month after sowing.

Groundnut: Applied the entire quantity FYM and fertilizers as basal. Lime was applied at the time of flowering and incorporated with the soil.

iv) Sesamum: Full dose of FYM, phosphorus and 3/4 the dose of nitrogen were applied as basal and incorporated into the soil. The remaining dose of N was applied as 3 percent folliar spray after 25th day of sowing.

v) Bhindi: Full dose of FYM, phosphorus and potash and half dose of nitrogen were applied as basal and remaining half dose of nitrogen was top dressed one month after sowing.

9. Irrigation (Treatment-wise) inclusive of presowing irrigation.

a) First crop (Rice)

Continuous submergence of 5± 2 cm was given to all plots uniformly by check basin method.

b) Second crop (Rice)

Particulars	Water management practices	
	I_1	I_2
1. Date of irrigation		
November'87	14,17,24,29	14,19
December'87	2,5,18	1,8
Total number of irrigation	7	4
2. Depth of irrigation water applied each time.	7 cm	7 cm
3. Total water used for the season	490 mm	280 mm
4. Mathod of irrigation	Check basin	Check basin

c) Third crop

1. Rice

Particulars	Water management practices		
	D_1	D_2	D_3
a) Dates of irrigation			
March 1988	3,5,7,10, 11,14,16, 19,22,24, 26,28,30	3,7,15, 22,26,30	3,10,23,28
April 1988	2,4,6,8, 10,12, 15	4,8,12	2,8,13
Number of irrigations	20	9	7
b) Depth of water applied each time	7 cm	7 cm	7 cm
c) Total water applied during crop season	1400 mm	630 mm	490 mm
d) Method of irrigation followed.	Check basin	Check basin	Check basin

2. Other crops in the sequence

Particulars	Water management practices			
	I_1	I_2	I_3	I_4
Date of irrigation				
March 1988	-	27	20	13, 27
April 1988	-	-	2	5
Number of irrigation	-	1	2	3

10. Layout of the experiment.

First crop season

Rice was raised in all the plots giving uniform package of practices.

Second crop season

Crop : Rice

Design : Randomised block design

Treatments : 2

1) I_1 - 7 cm irrigation one day after the disappearance of ponded water.

2) I_2 - 7 cm irrigation three days after the disappearance of ponded water.

No. of blocks : 60

Total No. of plots : 60 x 2 = 120

Third crop season

Design : Split plot design

Main plot treatments : 5 (cropping sequences)

Sub plot treatments : 6 (3 irrigation levels each for the two irrigation levels of the previous season).

Replication : 4

Treatments

Cropping sequences : 5

C_1 : Rice - Rice - Rice

C_2 : Rice - Rice - Cowpea

C_3 : Rice - Rice - Groundnut

C_4 : Rice - Rice - Sesamum

C_5 : Rice - Rice - Bhindi

Irrigation levels : 3

Rice

D_1 - 7 cm irrigation one day after the disappearance of ponded water.

D_2 - 7 cm irrigation three days after the disappearance of ponded water.

D_3 - 7 cm irrigation five days after the disappearance of ponded water.

Cowpea, Groundnut, Sesamum

I_1 - Irrigation at IW/CPE ratio of 0.3

I_2 - Irrigation at IW/CPE ratio of 0.6

I_3 - Irrigation at IW/CPE ratio of 0.9

Bhindi

I_2 - Irrigation at IW/CPE ratio of 0.6

I_3 - Irrigation at IW/CPE ratio of 0.9

I_4 - Irrigation at IW/CPE ratio of 1.2

Depth of irrigation : 50 mm

Plot size

Gross : 4.8 m x 2.5 m = 12 m^2

Net : 2.1 m x 4.2 m = 8.82 m^2

11. i) Plot wise crop yield in kg per net plot in the actual layout followed and

ii) Anova for economic yield.

a) First crop season - Rice

Plot No.	Plot wise grain yield (kg/plot)			
	R_1	R_2	R_3	R_4
1	1.95	2.00	2.20	2.10
2	1.95	2.45	1.95	2.30
3	2.25	2.35	2.10	2.05
4	1.85	2.00	2.20	2.00
5	2.00	1.65	1.85	1.80
6	2.15	1.95	1.90	2.15
7	2.30	2.20	1.60	1.85
8	2.25	1.55	1.65	2.00
9	2.15	1.60	2.10	1.80
10	2.30	1.50	1.75	1.65
11	2.00	1.55	1.75	1.65
12	2.10	2.00	1.70	1.90
13.	2.20	1.50	1.85	2.35
14	2.15	2.05	1.85	2.00
15	2.00	2.15	2.30	2.15
16	2.15	2.10	2.10	1.90
17	2.25	2.30	2.10	1.95
18	2.05	2.15	2.00	2.15
19	1.60	1.80	1.95	2.00
20	2.00	2.2	2.05	2.00
21	1.90	2.15	2.00	2.00
22	2.10	2.00	1.90	2.00
23	2.05	2.10	1.95	2.00
24	2.10	1.95	2.05	1.85
25	2.20	2.30	2.10	2.10
26	1.90	2.55	2.25	1.95
27	1.95	2.25	2.10	2.30
28	1.85	2.45	2.25	2.15
29	2.10	1.80	1.95	1.85
30	2.35	2.25	2.15	2.00

A N O V A

Source	df	ss	MS	F	Table Value
Total	19	10.972	0.2215		
Replication	3	0.6644	1.244	0.485	
Treatment	4	4.977	0.4442	2.80	3.26
Error	12	5.331			

2. Second crop season - Rice

Plot No.	Plot wise grain yield (kg/plot.)			
	R_1	R_2	R_3	R_4
1	3.00	2.15	2.25	2.0
2	2.25	2.25	3.00	2.25
3	2.20	2.10	2.50	1.80
4	2.20	2.28	2.30	2.25
5	2.50	2.30	2.25	2.00
6	2.60	2.00	2.75	2.00
7	1.75	2.10	2.00	1.75
8	2.25	2.10	2.30	1.75
9	2.00	1.75	2.25	1.75
10	2.20	2.10	2.00	1.75
11	2.50	2.00	2.00	1.80
12	2.15	2.00	1.65	1.80
13	2.50	1.60	1.75	1.95
14	2.30	2.00	1.75	2.00
15	2.50	1.75	1.75	2.50
16	2.50	2.00	2.10	1.75
17	2.50	2.00	2.00	1.75
18	2.50	1.80	1.75	2.00
19	2.3	1.50	1.75	2.00
20	2.00	2.00	2.00	1.75

(Contd..)

(Contd...)

21	1.80	2.15	2.00	2.00
22	2.30	1.70	2.20	2.00
23	2.25	1.75	1.75	2.00
24	1.75	1.90	1.75	2.00
25	2.55	1.60	2.00	2.50
26	2.60	2.15	2.20	2.35
27	2.25	2.10	2.00	2.50
28	2.50	2.20	2.25	2.25
29	3.25	2.00	2.10	2.00
30	2.25	2.20	1.75	2.25

Statistical analysis was done using paired 't' test. The effect of water management practices was found to be non significant.

Culculated value of 't' = 0.300

Table value = 2.093

3. Third crop season.

Two crops in the sequence viz. groundnut and sesamum were completely damaged due to rain at the podbearing stage. The plot yields of the other 3 crops in the sequence are given below.

1. Rice

Treatments	Replications			
	R_1	R_2	R_3	R_4
$C_1W_1D_1$	2.100	1.200	2.000	2.250
$C_1W_1D_2$	0.300	2.250	2.350	0.850
$C_1W_1D_3$	0.750	2.250	1.700	0.500
$C_1W_2D_1$	2.300	0.700	2.000	0.750
$C_1W_2D_2$	2.250	1.750	2.000	1.600
$C_1W_2D_3$	1.300	1.500	1.700	0.500

ANOVA

Source	df	ss	MS	F	Table value
Total	23	10.6024			
Replication	3	2.384	0.795	1.815	
Treatment	5	1.652	0.3304	0.755	2.90
Error	15	6.5664	0.43776		

2. Cowpea

Treatments	Plot wise grain yield (kg/plot)			
	R_1	R_2	R_3	R_4
$C_2W_1I_1$	0.678	0.480	0.581	0.499
$C_2W_1I_2$	1.144	0.530	0.499	0.561
$C_2W_1I_3$	1.188	0.683	0.780	0.940
$C_2W_2I_1$	0.890	0.733	0.327	0.325
$C_2W_2I_2$	1.09	0.632	0.280	0.427
$C_2W_2I_3$	1.634	0.572	0.474	0.808

ANOVA

Source	df	ss	MS	F	Table value
Total	23	2.368			
Replication	3	1.366	0.4553	12.543	
Treatment	5	0.458	0.0916	2.52	2.90
Error	15	0.544	0.0363		

3. Bhindi

Treatments	Yield of fruit (kg/plot			
	R_1	R_2	R_3	R_4
$C_5W_1I_2$	5.715	8.415	8.651	6.281
$C_5W_1I_3$	9.019	5.597	7.751	5.917
$C_5W_1I_4$	5.725	3.799	8.410	6.909
$C_5W_2I_2$	7.067	8.53	7.202	5.043
$C_5W_2I_3$	5.192	5.165	8.606	4.593
$C_5W_2I_4$	3.587	5.799	8.091	5.363

ANOVA

Source	df	ss	MS	F	Total value
Total	23	61.1517			
Replication	3	21.3909	7.1303	3.455	
Treatment	5	8.8131	1.7626	0.8543	2.90
Error	15	30.9477	2.0632		

12. Economic Crop yield and by-product yield

1. First crop - Rice

Table-2.1

Grain and straw yields of rice as influenced by crop ... sequences

Cropping sequence	a) Grain yield kg/ha		b) Straw yield kg/ha	
	1986-87	1987-88	1986-87	1987-88
C_1	2740	2322	2857	2603
C_2	2712	2137	3302	2617
C_3	3102	2350	3348	2425

(Contd...)

(Contd..Table 2.1)

C_4	2965	2254	3289	2811
C_5	3022	2414	3225	3351
Mean	2908	2295	3204	2761
C.D.(0.05)	NS	NS	NS	NS

Uniform package of practices including water management were adopted in all the treatments during the first crop season. The grain and straw yields didnot show any significant difference between the plots which clearly indicate that the various crops in the sequence cultivated during the third crop of the previous year didnot influence the yield of rice in the succeeding crop season.

2. Second crop - Rice

Table-2.2

Yield of grain and straw as influenced by crop sequence and water management practices.

Crop	Water management practices					
	W_1	W_2	Mean	W_1	W_2	Mean
	1986-87			1987-88		
a) Grain yield (kg/ha)						
C_1	2863	2930	2897	2602	2591	2596
C_2	2839	2627	2733	2243	2262	2252
C_3	2802	2740	2771	2300	2328	2313
C_4	2839	2527	2683	2196	2205	2200
C_5	2797	3052	2925	2530	2550	2539
Mean	2828	2775		2374	2387	
C.D. (0.05)						
Irrigation levels:	NS			NS		

Crop	1986-87			1987-88		
	W_1	W_2	Mean	W_1	W_2	Mean
b) Straw yield (kg/ha)						
C_1	2262	2324	2293	1973	1927	1950
C_2	2313	2166	2240	1918	1899	1909
C_3	2287	2245	2268	1728	1700	1714
C_4	2220	2207	2245	1879	1912	1896
Mean	2274	2204		1875	1868	
C.D.(0.05 Irrigation levels:	NS			NS		

The data on grain and straw yields as influenced by water management practices are presented in Table 2.2. It was observed that neither cropping sequences nor water management practices significantly influenced the grain and straw yield. The W_1 and W_2 treatments (irrigation at one day and three days after the disappearance of ponded water) received 7 and 4 irrigation respectively. The failure of water management practices to register any appreciable differences in straw and grain yields can be attributed ~~to~~ to intermittant rains and high water table during the critical stages of the crop.

3. Third crop

The data on cropwise yield during the third crop season are furnished in Table 2.3. Contrary to the previous two seasons, none of the crops showed significant response to

the irrigation practices. The lack of response in yield is due to the rain received during the crop period.

Table-2.3

Economic yield (kg/ha) of different crops in the sequence during the third season as influenced by irrigation treatments.

Treatments	1986-87			1987-88		
	W_1	W_2	Mean	W_1	W_2	Mean
1. Rice						
D_1	428.0	439.3	433.6	213.9	163.0	188.5
D_2	123.4	124.7	124.1	171.5	215.4	193.5
D_3	76.50	75.10	75.80	147.4	141.7	144.6
C.D.(0.05) Irrigation levels:	19.5			N.S		
Treatments	W_1	W_2	Mean	W_1	W_2	Mean
2. Cowpea						
I_1	149.50	163.10	156.30	634.3	644.8	639.5
I_2	157.90	168.0	163.0	774.9	688.5	731.7
I_3	233.90	213.70	223.8	1017.9	988.6	1003.3
Mean	180.80	181.60		809.0	774.0	791.0
C.D.(0.05) irrigation levels:	25.8			N.S		

D_1 - 7 cm Irrigation one day after the disappearance of ponded water.

D_2 - 7 cm Irrigation 3 days after the disappearance of ponded water.

D_3 - 7 cm Irrigation 5 days after the disappearance of ponded water.

(Contd..)

(Contd..Table2.3)

Treatments	W_1	W_2	Mean	W_1	W_2	Mean
3. Bhindi						
I_2	1385.3	1298.5	1341.9	823.7	789.2	806.45
I_3	1791.6	1687.4	1739.5	801.7	667.7	734.7
I_4	1933.9	1857.5	1895.7	704.2	647.4	675.8
Mean	1703.6	1614.5		776.5	701.4	

C.D.(0.05)
Irrigation levels: 107.4 NS

I_1 - Irrigation at IW/CPE ratio of 0.3

I_2 - Irrigation at IW/CPE ratio of 0.6

I_3 - Irrigation at IW/CPE ratio of 0.9

I_4 - Irrigation at IW/CPE ratio of 1.2

13. Soil moisture studies in the crop root zone.

Only few irrigations were possible for each treatment due to rain during the crop period. Two crops were completely damaged. Hence soil moisture studies conducted are not complete and so not reported.

14. Periodic ground water fluctuation in the experimental area.

Month	Depth from the ground surface	
	Maximum (cm)	Minimum (cm)
July '87	10	Flooded
August 87	10	Flooded
September 87	32	3
October 87	15	Flooded
November 87	13	4
December 87	20	6
January 88	97	17
February 88	123	45
March 88	140	52
April 88	103	25

15. Important weather conditions during crop growing season

Month	Rainfall		Temperature °C		Mean RH (%)	Mean open pan evopo-ration (mm/day)	Mean wind speed (km/hr)
	Total (mm)	No. of rainy days	Mean maxi-mum Temp.	Mean mini-mum Temp.			
July 87	456.8	21	30.85	23.4	82.75	3.57	2.67
August 87	542.2	22	30.26	22.83	82.54	3.41	1.97
September 87	258.4	10	31.00	23.89	75.12	3.75	2.56
October 87	233.6	19	32.74	24.11	86.07	3.68	1.73
November 87	246.0	12	32.60	22.20	75.5	3.32	1.30
December 87	208.5	7	32.41	20.37	73.96	2.53	1.78
January 88	-	-	33.15	18.87	63.46	3.26	1.858
February 88	1.6	1	35.04	21.81	64.31	3.899	2.38
March 88	317.7	5	35.27	24.10	62.5	4.23	2.72
April 88	246.4	15	34.3	24.27	70.22	4.03	2.35

Total rainfall = 2211.2 mm

16. Data on important biometric observations and quality attributes as influenced by treatments.

1. First crop season - Rice

Table-2.4

Biometric characters as influenced by crop sequences

Treatments	Biometric characters (Mean)			
	Height of plant (cm)	No. of tillers per hill	No. of productive tillers/ hill	Percentage of filled grains per panicle
C_1	67.13	6.83	4.04	74.04
C_2	66.62	6.90	4.03	70.67
C_3	66.56	6.71	3.94	75.25
C_4	67.23	6.68	4.20	69.75
C_5	69.74	6.65	4.04	74.83
Mean	67.45	6.75	4.05	72.91
C.D.(0.05)	NS	NS	NS	NS

2. Second crop season - Rice

1. Mean height of plants at harvest

Table-2.5

Height of plants as influenced by crop sequence water management practices

Treatments	Water management practices		
Cropping sequences	W_1	W_2	Mean
C_1	72.83	72.67	73.30
C_2	72.15	72.67	72.41
C_3	73.73	72.38	73.05
C_4	70.63	71.27	70.95
C_5	73.48	72.93	73.20
Mean	72.56	72.00	
C.D. (0.05)		NS.	

2. Mean number of tillers per hill

Table-2.6

Number of tillers per hill as influenced by crop sequences and water management practices.

Cropping sequences	W_1	W_2	W_3
C_1	5.22	5.46	5.34
C_2	5.02	5.27	5.14
C_3	5.82	5.52	5.67
C_4	5.80	6.05	5.92
C_5	5.22	5.32	5.27
Mean	5.42	5.52	
C.D. (0.05)		N.S	

3. Mean productive tillers

Table 2.7

The number of productive tillers per hill as influenced by crop sequences and water management practices.

Treatments	Water management practices		
	W_1	W_2	Mean
C_1	4.38	4.52	4.45
C_2	4.22	4.37	4.29
C_3	4.72	4.48	4.60
C_4	4.50	4.32	4.41
C_5	4.40	4.55	4.47
Mean	4.44	4.45	
C.D. (0.05)		N.S	

4. Percentage of filled grains per panicle.

Table-2.8

Percentage of filled grains per panicle as influenced by crop sequences and water management practices.

Treatments	Water management practices		
	W_1	W_2	Mean
C_1	60.92	57.83	59.37
C_2	59.75	54.33	57.04
C_3	55.50	54.08	54.79
C_4	57.25	54.75	56.00
C_5	55.92	57.33	56.62
Mean	57.87	55.66	

C.D. (0.05) NS.

The mean height of plants and the yield contributing characters of rice for the 1st and 2nd crop seasons are furnished in the above tables. None of the characters were significantly influenced by the different crop sequences or water management practices

17. Incidence of pests and diseases with control measures taken.

The rice crop was mildly attacked by leaf roller during both the kharif and rabi season which was controlled by spraying Ekalux. Attack of stem borer was moderate in the second crop season. One spraying with Hinosan was enough to check the spread of sheath blight disease which affected the crop after the panicle initiation stage during 2nd crop season.

18. Any other relevant information

During the third crop season, groundnut and sesamum were completely damaged due to heavy rain which coincided with the pod bearing stage. Hence the data for the year 1987-88 is not complete.

EXPERIMENT No.3

1. Title of the experiment : WM.1.1 Effect of varying water regimes on the yield of rice under varying levels of soil fertility.

2. Objectives:

   1) To find out the optimum water regime for wet sown rice in relation to nitrogen levels.

   2) To quantify the adverse effect of prolonged stress on crop yield.

3. Year of commencement : 1987-88

4. Intial soil characteristics:

   a) Soil texture : Sandy loam

   b) pH : 5.64

   c) EC (mmhos/cm) : 0.28

   d) Organic carbon (%) : 0.52

   e) Bulk density (g/cc) : 1.37

   f) Available P_2O_5 (kg/ha) : 9.8

   g) Available K_2O (kg/ha) : 26.1

   h) Available water storage capacity. : 10.9

5. Crop Rotation followed : Rice - Rice - Green manure

6. Sowing

   a) Date of sowing : 15.10.1987

   b) Method : Dry sowing - broad casting

   c) Seed rate : 100 kg/ha

7. Harvesting date : 16.1.1988

8. Fertilisers and manures :

a) Dosage : FYM - 5 t/ha

Nitrogen as per treatments

P_2O_5 35 kg/ha

K_2O 35 kg/ha

b) Kind of formulation : Nitrogen as Urea,

P as Superphosphate

K as Muriate of Potash

c) Time of application : N as per treatments, P applied full basal K applied as two equal split doses, one at active fillering stage and the other at panicle initiation stage.

9. Irrigation details

Particulars	Treatments			
	I_1	I_2	I_3	I_4
1. Dates of irrigation				
November '87	12,14,16,18, 23,27,29.	12,17,24 29	12,18	12
December '87	1,3,5,8,12, 14,17,19, 21,23,26, 28,30	2,6,19, 23,28	1,21,28	5,23,31
January '88	1,5	1	3	5
Total number of irrigation	22	11	6	5
Uniform irrigation upto 12.11.87				
2. Total water applied for irrigation.	104 cm	77 cm	42 cm	35 cm
3. Depth of water applied each time	7 cm	7 cm	7 cm	7 cm
4. Method of irrigation.	: Check basin			

10. Lay out of experiments

a) Treatments

1. Water Regimes.

i) Continuous submergence of 5 ± 2 cm.

ii) 7 cm irrigation one day after the disappearance of ponded water.

iii) 7 cm irrigation 3 days after the disappearance of ponded water.

iv) 7 cm irrigation 5 days after the disappearance of ponded water.

2. Nitrogen levels

i) 0 kg N/ha

ii) 50 kg N/ha

iii) 100 kg N/ha

iv) 150 kg N/ha

N applied in 3 split doses @ 25,50 and 25 percent of the total dose at sowing, tillering and panicle initiation stages respectively.

b) Design : 4^2 Factorial RBD.

c) Replication : 3

d) Plot size : 20 sqm.

11. 1) Plot wise crop yield

Sl. No.	Treatments	Dry weight of grains kg/plot		
		* R_1	R_2	R_3
1.	N_oI_1	3.75	3.60	3.30
2.	N_oI_2	3.50	3.50	4.10
3.	N_oI_3	3.30	3.35	2.75
4.	N_oI_4	3.50	3.0	3.50
5.	N_1I_1	4.00	4.50	5.20
6.	N_1I_2	4.50	4.60	5.00
7.	N_1I_3	4.50	4.65	4.50
8.	N_1I_4	4.25	4.50	5.0
9.	N_2I_1	4.60	4.50	5.25
10.	N_2I_2	3.85	4.00	5.00
11.	N_2I_3	4.20	4.00	4.50
12.	N_2I_4	4.10	4.10	4.20
13.	N_3I_1	4.60	4.25	4.60
14.	N_3I_2	5.00	4.60	4.70
15.	N_3I_3	4.50	3.30	4.50
16.	N_3I_4	4.15	3.90	3.75

*R - Replication

ii) ANOVA

Table-3

Source	df	ss	Mean square	F	Table value
Total	47	16.49			
Replication	2	0.972	0.486	4.301	
Nitrogen	3	9.50	3.167	28.02*	2.92
Irrigation	3	1.508	0.503	4.45*	2.92
N x I	9	1.122	0.125	1.103	2.27
Error	30	3.388	0.113		

* Significant at 5% level.

12. Economic crop yield and by-product yield.

Table-3.1

a) Grain yield kg/ha

Treatment variables	water regimes				Mean
	I_1 (C.S)	I_2 (1DADW)	I_3 (3DADW)	I_4 (5DADW)	
N_o - 0 kg N/ha	1775	1850	1567	1667	1715
N_1 - 50 kg N/ha	2283	2383	2275	2292	2308
N_2 - 100 Kg N/ha	2392	2142	2117	2067	2180
N_3 - 150 kg N/ha	2242	2350	2050	1967	2152
Mean	2173	2181	2002	1998	

*DADW : Days after disappearance of ponded water.

i) SE(cm) : 56.50

ii) CD at 5% Irrigation : 140

Nitrogen : 140

Interaction: NS

The data on grain yield of rice as influenced by water regime and nitrogen levels are furnished in Table 3.1 and Fig. 3.1.

Statistical analysis of the data revealed that the different water regimes and nitrogen levels significantly influenced the grain yield. Among the water management practices the treatment receiving irrigation one day after the disappearance of ponded water (I_2) recorded the highest yield of 2181 kg/ha which was on par with I_1, the treatment receiving continuous submergence (2173 kg/ha). The lowest yield of 1998 kg/ha

was recorded by I_4, the treatment receiving irrigation 5 days after the disappearance of ponded water and I_3 (2002 kg/ha) receiving irrigation 3 days after the disappearance of ponded water. The treatments I_1 and I_2 received 1040 mm and 770 mm of water in 22 and 11 irrigations respectively. The treatment I_2 receiving irrigation one day after the disappearance of ponded water is considered superior to continuous submergence, taking into account the yield, total water use and number of irrigations.

Regarding the nitrogen levels, the highest grain yield of 2308 kg/ha was recorded by N_1 (50 kg N/ha) which was on par with N_2 (100 kg N/ha) recording an yield of 2180 kg/ha. The lowest yield of 1715 kg/ha was recorded by N_o (No Nitrogen) and was significantly inferior to all the other treatments. The yield was found to increase as the level of Nitrogen increased from 0 to 50 kg/ha, but with further increase in nitrogen a decreasing trend was observed.

From the above results, it can be concluded that during the second crop season under wet sown conditions short duration rice need irrigation one day after the disappearance of ponded water and 50 kg Nitrogen per ha. for maximum yield. This may result in saving 270 mm water and 11 nos. of irrigations without any appreciable difference in yield as compared to continuous submergence.

b) Straw yield

The data on straw yield (kg/ha) is presented in Table 3.2 and Fig. 3.2.

From the data it can be observed that the levels of Nitrogen influenced the straw yield significantly whereas the influence of different water regimes and their interaction effect were not significant. The highest straw yield of 2656 kg/ha was recorded for N_1 (50 kg/ha) as in the case of grain yield and it was on par with the yield obtained for N_2 (100 kg N/ha) and N_3 (150 kg N/ha) levels of nitrogen.

Even though the various water management practices were not significant the trend observed for straw yield is the same as that of grain yield. Maximum straw yield was obtained in I_2 ie. 7 cm irrigation one day after the disappearance of ponded water followed by continuous submergence.

Table-3.2

Straw yield of rice (kg/ha) as influenced by water regimes and nitrogen levels.

Treatments / Nitrogen levels	Water regimes				Mean
	I_1 (C.S)	I_2 (1DADW)	I_3 (3DADW)	I_4 (5DADW)	
N_o - 0 kg N/ha	1717	2167	2125	2250	2065
N_1 - 50 "	2950	2833	2367	2633	2696
N_2 - 100 "	2667	3167	2417	2200	2613
N_3 - 150 "	3125	2458	2408	2333	2581
Mean	2615	2656	2329	2354	

C.D. (0.05) Water management : N.S
Nitrogen : 328
Interaction : N.S

c) Yield contributing characters

The data on the yield contributing characters are presented in Table 3.3.

The effect due to irrigation on yield contributing characters namely number of productive tillers, number of grains per panicle, 1000 grain weight and chaffiness was not significant. However the trend of the results indicate that irrigation 1 DADW and continuous submergence (I_2 and I_1 respectively) tended to increase the number of productive tillers and number of grains per panicle.

Though not significant, the nitrogen levels favourably influenced the yield contributing characters, viz. number of productive tillers and number of grains per panicle.

Table-3.3

Yield characters of rice as influenced by different water regimes and nitrogen levels.

Treatments	Number of productive tillers per squre	No. of grains per panicle	Chaffiness (%)	1000 grain weight (g)
Water regimes				
I_1 - Continuous submergence	132	77.32	37.93	22.42
I_2 - 1 DADW*	142	68.33	38.00	22.00
I_3 - 3 DADW	136	72.76	38.43	22.60
I_4 - 5 DADW	135	73.46	40.33	21.95
C.D. (0.05)	NS	NS	NS	NS
Nitrogen levels				
N_0 - No nitrogen	127	66.25	36.06	24.50
N_1 - 50 kg N/ha	144	77.34	39.64	21.86
N_2 - 100 kg N/ha	140	73.97	43.63	20.92
N_3 - 150 kg N/ha	134	74.26	35.36	21.62
C.D. (0.05)	NS	NS	5.99	1.84

*DADW - Days after disappearance of water.

13. Soil moisture studies in the crop root zone. : The experiment was to study the water requirement of the crop.

14. Periodic ground water fluctuation in the experimental area.

Month	Depth from the ground surface	
	Maximum (cm)	Minimum (cm)
October 1987	10	Flooded
November	15	"
December	14	8
January 1988	64	11

15. Important weather conditions during crop growing season.

Month	Rainfall		Temperature		Mean RH (%)	Mean open pan evaporation (mm/day)	Mean wind speed (Km/ha)
	Total (mm)	No. of rainy days	Mean Maximum	Mean Minimum			
October '87	233.6	19	32.74	24.11	86.07	3.68	1.73
November	246.0	12	32.60	22.20	75.5	3.32	1.38
December	208.5	7	32.41	20.37	73.96	2.53	1.78
January '88	-	-	33.15	18.87	63.46	3.26	1.358

Total rainfall : 688.1 mm

16. Important biometric observations and quality attributes.

1. Height of plants (Table-3.4)

The height of plants at harvest was significantly influenced both by water regimes and nitrogen levels. The height of the plants decreased on the irrigation interval was increased while the height increased with

increasing levels of Nitrogen. But the height of plants at panicle initiation stage was found to be influenced by Nitrogen levels only, the maximum being recorded for N_3 (150 kg/ha) which was on par with N_2 (100 kg N/ha).

2. Number of tillers per square meter.

The number of tillers per square was recorded at panicle initiation stage and harvest and are presented in Table 3.4.

The number of tillers both at panicle initiation stage and harvest were not influenced by water regimes. The different Nitrogen levels favourably and significantly influenced the number of tillers at harvest but the effect was not significant at the panicle initiation stage. Maximum number of tillers was noted for N_3 (150 kg N/ha) and was on par with N_2 (100 kg N/ha) and these two treatments were significantly superior to N_1 and N_0 (50 kg N/ha and no nitrogen respectively)

17. Incidence of pests and diseases with control measures taken.

During the maximum tillering stage. The crop was was infested by sheath blight. The attack was heavy in the plots where higher doses of Nitrogen was applied. The disease was effectively controlled by spraying Ediphenphos. Attack of leaf roller started from the flowering stage on wards. Satisfactory control was obtained with application of Quinalphos except in plots with higher doses of Nitrogen.

18. Any other relevant information : Nil

Table-3.4

Growth characters of rice as influenced by different water regimes and nitrogen levels at PI stage and harvest.

Treatments	Height of plants		No. of tillers per sq. meter	
	PI stage	Harvest	PI stage	Harvest
Water Regimes				
I_1 - Continuous submergence	45.92	66.4	115	180
I_2 - 1 DADW*	46.41	63.28	112	193
I_3 - 3 DADW	46.58	63.00	100	185
I_4 - 5 DADW	47.00	61.00	104	180
C.D. (0.05)	NS	3.42	NS	NS
Nitrogen levels				
N_o - No nitrogen	38.58	56.87	109	164
N_1 - 50 kg N/ha	45.33	63.78	113	176
N_2 - 100 kg N/ha	50.67	65.57	105	195
N_3 - 150 kg N/ha	51.33	67.47	103	203
C.D. (0.05)	2.39	3.42	NS	24.3

*DADW - Days after disappearnce of water.

EXPERIMENT No.4

1. Project number and title of the experiment : WM.2.1. Studies on the effect of irrigation schedules on the growth and yield of coconut.

2. Objectives:

a) To study the response of coconut to water management practices during summer season and to evolve a suitable irrigation schedule.

b) To find out the efficiency of water use in various treatments.

c) To workout the economics of irrigation in coconut.

3. Year of commencement : 1982-83 (same plantation)

4. Initial soil characteristics

a) Field capacity (%) : 0-20 cm - 17.69
20-40 cm - 20.83

b) Wilting point (%) : 0-20 cm - 8.65
20-40 cm - 9.20

c) pH : 5.75

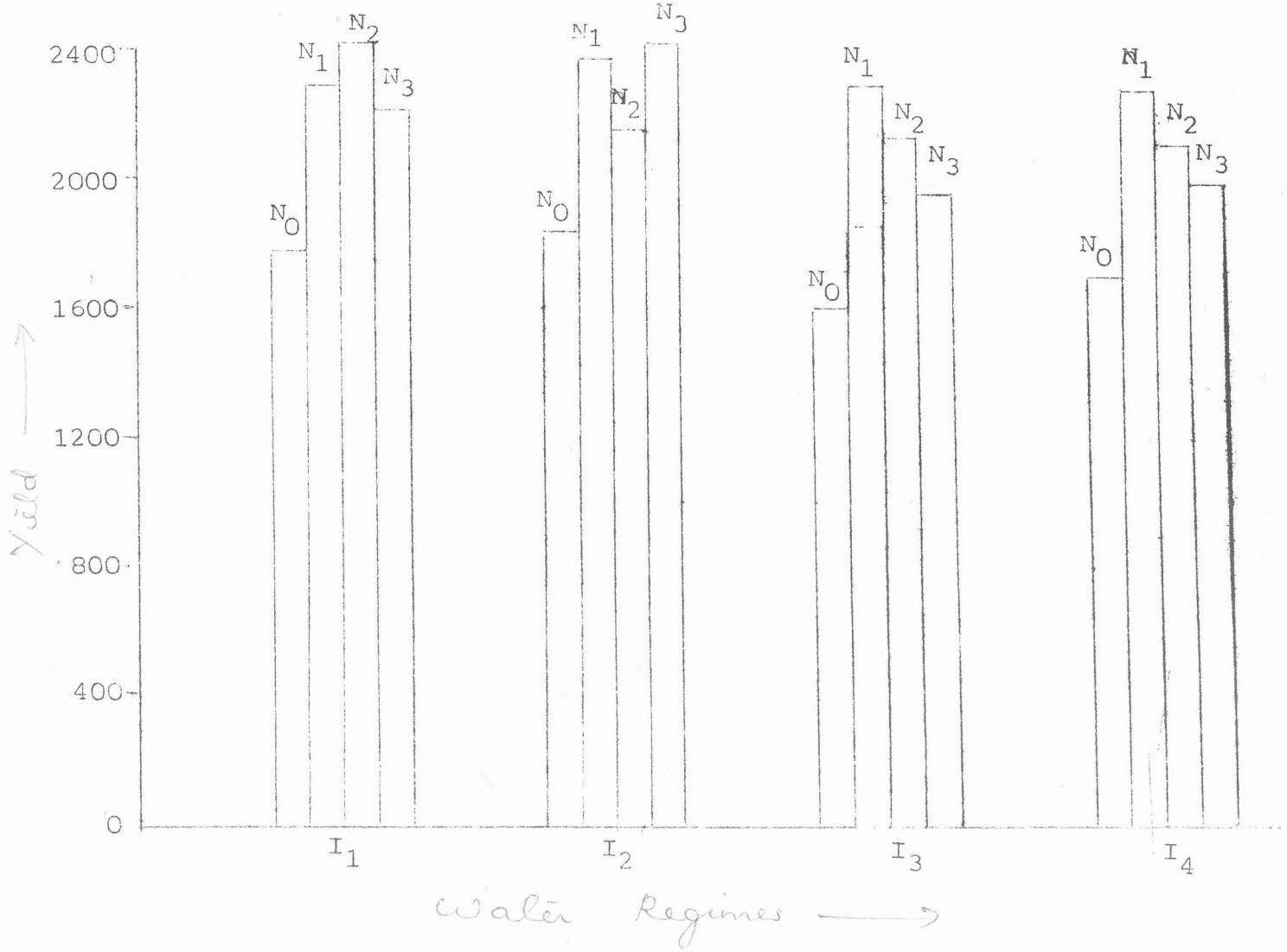
d) E.C. (millimhos/cm) : 0.28

The data on physical constants and mechanical composition of the different layers of the soil profile estimated before the commencement of the experiment is presented in Table-4.1.

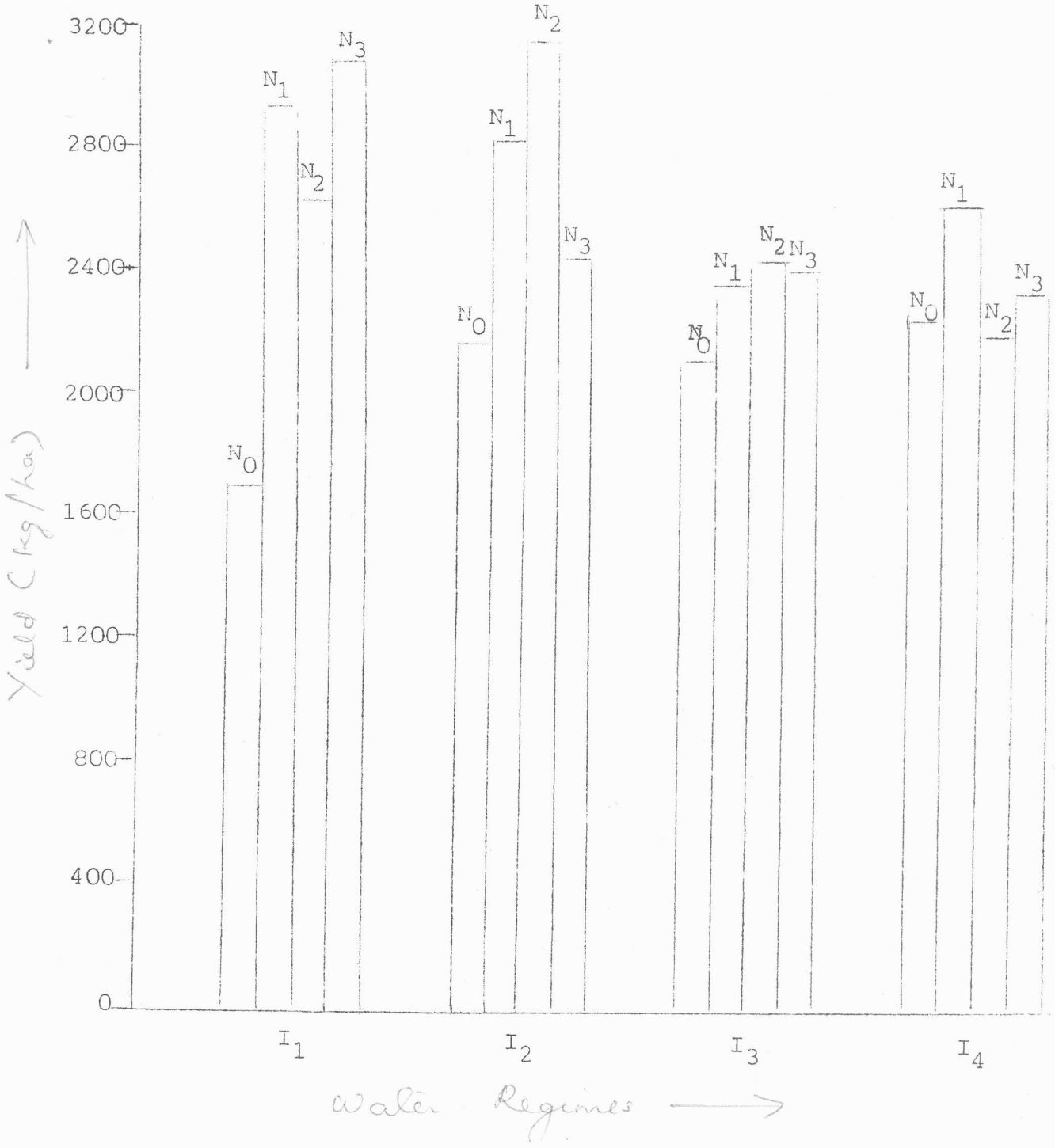
5. Crop rotation followed : The crop is perennial and raised as a sole crop.

6. Sowing : The experiment was taken up in a private coconut garden at Kodassery owned by Sri. K.Sreedhra Menon, Kuravangad House. The garden consists of 292 palms in an area of 4.25 acres. The palms (about

Yield of rice (kg/ha) as influenced by water regimes and nitrogen levels



Straw yield of rice as influenced by water regimes and nitrogen levels



10 years old at the time of starting the experiment) are west coast tall variety planted at a spacing of 7.5 m x 7.5m.

Before imposing the treatments during the first year of study, the pre-experiment yield of eighty selected palms were recorded. The annual nut yield of four adjoining palms were added and the resultant twenty groups of palms were ranked according to their total nut yield. These groups were further classified in to 4 blocks (replications) each having five groups (treatments) in the order of their ranks. The nut yield was further subjected to statistical analysis which confirmed the uniformity of palms in their yield potential within a replication.

7. Harvest dates: During the year under report, the post experiment data on nut yield was recorded and in this also 8 harvests were obtained from April 87 to April 88.

8. Fertilizers and manures

a) Dose	:	N, P_2O_5 and K_2O @ 0.34:0.17: 0.68 kg/palm/year.
		Green manure @ 40 kg/palm/year
		Cowdung @ 25 kg/palm/year
b) Kind of fertilizer formulation	:	N as urea
		P as Superphosphate
		K as Muriate of potash
c) Time of application	:	Three equal splits in April-May, August-September and December-January in each year. Organic manures were applied during South West monsoon period.

d) Method of application : Broadcasted in the basins and incorporated with the soil.

9. Irrigation

The treatmentwise details of the irrigations given during 1982-83, 1983-84, 1984-85, 1985-86 and 1986-87 are presented in Tables. During the year under report all the treatments were given irrigation on farmers practice.

10. Layout of treatment:

a) Treatments - 5

T_1 - Irrigation at 75 mm CPE (50 mm depth)

T_2 - Irrigation at 50 mm CPE (50 mm depth)

T_3 - Irrigation at 25 mm CPE (50 mm depth)

T_4 - Irrigation once in 3 days i.e. farmers' practice (20 mm depth)

T_5 - No irrigation

b) Design : Randomised Block Design

c) Replication : 4

d) Plot size : 4 palms/Plot (with one border row all around the plot)

11. a) Nut yield/tree in the post experiment period 1987 (Total of 8 harvests)

Treatments	Replication				Mean
	R_1	R_2	R_3	R_4	
T_1	98.56	104.50	103.65	92.46	99.79
T_2	114.50	109.85	112.20	104.80	110.34
T_3	108.38	118.58	124.40	115.25	116.65
T_4	116.24	122.45	128.60	123.24	122.63
T_5	102.64	92.75	98.30	97.54	97.81

ii) Anova

Source	df	ss	MS	F
Total	19	2225.32		
Block	3	127.94	542.64	
Treatment	4	1821.03	455.26	19.76*
Error	12	276.35	23.03	

* Significant at 1% level
C.D.(0.05) 7.4

12. Economic crop yield

Completed the experiment during the year 1986-87. During the year under report, the post experiment data on nut yield and number of bunches/tree were recorded and furnished in table Nos. 4.5 and 4.6 along with the nut yield obtained in previous years 1982 to 1986. (Table 4.2 to 4.4)

From the current years data, it can be observed that maximum nut yield of 122/tree/year was recorded by the T_4 which received irrigations at 3 days interval and was on par with T_3 (116 nuts) ie. irrigation at 25 mm CPE.

During the experimental periods, in the first two years (1983 and 1984) the treatments did not influence the nut yield. However in the subsequent years the palms responded well to irrigation. The effects due to treatments on nut yield in the 3rd and 4th year was significant and almost similar. The treatments T_2 (50 mm CPE), T_3 (25 mm CPE) and T_4 (Once in 3 days) were on par with each other and significantly superior to no irrigation (T_5).

Results of the study on scheduling irrigation to a standing crop of coconut in a sandy clay loam soil indicated that the crop responded well to irrigation during dry months (January to May) from the 3rd year onwards. Irrigating the crop with 500 litres of water through basins taken at 1.8 m radius at CPE values of 50 mm (approximate interval of 12 days) was most economical.

The effects of irrigation in nutyield was reflected in the succeeding year also in case of irrigation at 3 days interval and irrigation at 25 mm CPE.

13. Soil moisture studies

During the year under report, only the nut yield was recorded to study the effect of irrigation given during previous years. Hence no moisture studies have been worked out.

14. Periodic ground water fluctvations in the experimental area

The ground waterwas always below 2 m in the experimental field.

15. Important weather conditions during the crop growing season.

Important weather conditions prevailed during the crop period (monthly mean)

Month	Total Rainfall (mm)	No.of rainy days	Max. temp. (°c)	Minimum temp. (°c)	Mean R.H 8AM	Mean R.H 2PM	Mean P.E. (mm/day)	Mean wind speed (km/day)
April '87	-	-	35.64	25.27	75.23	50.35	4.61	74.43
May '87	97.5	8	35.23	24.08	77.58	50.03	4.59	65.52
June '87	210.8	25	32.49	23.56	91.80	57.30	3.15	73.40
July '87	456.8	21	30.85	23.40	91.75	73.75	3.57	64.12
August '87	542.2	22	30.26	22.83	90.22	74.87	3.41	47.29
Sept. '87	258.4	10	31.08	23.89	88.03	62.20	3.75	61.43
October '87	233.6	19	32.74	24.11	87.22	84.43	3.68	41.48
November '87	246.0	12	32.60	22.20	83.90	67.10	3.32	33.23
December '87	208.5	7	32.41	20.37	86.34	61.59	2.53	42.61
January '88	-	-	33.11	18.87	32.61	44.32	3.26	44.61
February '88	1.6	1	35.04	21.81	83.00	45.63	3.90	57.14
March '88	17.7	5	35.00	24.71	78.84	54.20	4.23	65.29
April '88	246.4	15	34.30	24.27	84.91	55.54	4.03	56.37

Table-4.1

Initial soil characteristics of the experiment on coconut

Soil depth (cms)	Physical constants					Mechanical composition (%)				
	Apparant sp. gravity (g/cc)	Abosolute sp. gravity (g/cc)	Max. water holding capacity (%)	Pore space (%)	Volume expansion of 100 ml soil(ml)	Coarse sand	Fine sand	Silt	Clay	Textural class
0- 15	1.242	2.036	33.01	42.49	4.523	39.6	27.0	6.2	26.2	Sandy clay loam
15- 30	1.238	2.192	37.89	45.49	4.613	32.7	27.0	6.6	27.6	Sandy clay loam
30- 45	1.149	2.547	39.74	44.89	9.395	30.2	21.6	7.2	32.4	Sandy clay loam
45- 60	1.090	1.853	45.54	47.20	12.731	26.5	17.0	8.8	41.4	Sandy clay
60- 90	1.000	1.893	53.59	51.85	13.475	18.2	14.7	13.4	48.0	Clay
90-120	0.978	1.779	57.04	51.88	15.617	16.6	13.6	14.2	50.4	Clay

Table 4.2

Harvestwise nut yield per coconut

Pre-experiment period - 1982

Serial number of the harvests	Treatments				
	T_1 75 mm CPE	T_2 50 mm CPE	T_3 25 mm CPE	I_4 once in 3 days	T_5 No irrigation
1st (5--2-82)	3.27	3.24	5.06	6.60	6.46
2nd (5--2-82)	9.51	14.93	11.00	10.10	8.71
3rd (24--3-82)	20.15	17.13	21.68	19.76	19.32
4th (10--5-82)	10.54	10.81	8.63	12.07	11.39
5th (21--6-82)	8.34	5.13	6.38	5.43	5.98
6th (18--8-82)	4.30	3.88	3.63	2.50	2.73
7th (27-10-82)	2.27	3.38	1.31	2.60	2.04
8th (15-12-82)	4.75	8.81	33.44	6.00	2.56
Total	63.13	67.31	61.13	65.06	56.19

Table 4.3

Harvestwise nut yield per coccnut during the experimental pericd

Serial number of the harvests	Treatments				
	T_1 75 mm CPE	T_2 50 mm CPE	T_3 25 mm CPE	T_4 Once in 3 days	T_5 No irrigation
(1)	(2)	(3)	(4)	(5)	(6)
First year (1983)					
1st (31--1-83)	12.38	11.94	9.63	10.75	9.56
2nd (16--3-83)	19.31	26.75	19.19	18.50	27.75
3rd (25--4-83)	13.56	15.13	11.56	12.94	14.06
4th (30--5-83)	10.44	10.25	8.30	8.56	10.75
5th (13--7-83)	6.63	5.75	6.69	7.06	6.94
6th (26--9-83)	3.81	4.69	3.56	2.69	4.38
7th (16-11-83)	2.63	3.25	2.00	2.63	1.88
8th (23-12-83)	5.13	6.75	5.94	6.56	5.44
Total for 1st year	73.89	84.51	69.87	69.69	80.76
Second year (1984)					
1st (31--1-84)	6.25	9.31	8.63	6.81	6.25
2nd (6--3-84)	3.88	4.06	3.94	2.69	4.81
3rd (4--4-84)	9.50	10.06	9.44	8.25	7.50
4th (9--5-84)	6.88	4.00	4.31	4.00	2.63
5th (10--8-84)	5.75	6.13	6.56	7.94	5.69
6th (18--9-84)	1.63	1.13	1.63	1.13	0.56
7th (13-11-84)	0.59	0.69	0.38	0.69	0.44
8th (22-12-84)	5.25	4.44	5.00	9.94	3.81
Total for 2nd year	39.83	39.82	39.89	41.45	31.69

(Contd...)

(Table 4.3 Contd.)

(1)	(2)	(3)	(4)	(5)	(6)
Third year (1985)					
1st (4--2-85)	14.25	19.94	17.63	14.50	11.00
2nd (16--3-85)	19.25	20.25	18.38	20.31	20.94
3rd (22--4-85)	26.25	25.94	22.19	24.50	23.13
4th (17--6-85)	15.00	15.00	19.88	20.88	14.69
5th (26--7-85)	11.25	11.19	16.00	14.75	10.31
6th (17-10-85)	6,00	6.50	11.94	11.19	5.13
7th (10-12-85)	6.25	7.38	12.19	8.06	5.25
8th (21--1-86)	5.69	6.56	11.69	10.50	5.44
Total for 3rd year	104.07	112.76	126.90	124.69	95.89
Fourth year (1986)					
1st (14--3-86)	12.00	13.00	17.94	16.88	10.89
2nd (28--4-86)	13.50	15.81	25.00	22.56	12.75
3rd (7--6-86)	10.56	11.56	15.00	13.06	9.56
4th (22--7-86)	10.50	13.69	14.44	12.75	8.06
5th (3-11-86)	6.13	10.31	11.00	9.25	2.63
6th (24-12-86)	9.63	11.56	12.75	14.88	7.13
7th (3--2-87)	16.19	18.06	18.75	18.69	13.00
8th (13--3-87)	17.56	19.88	19.13	23.75	13.63
Total for 4th year	96.07	113.87	138.01	131.82	77.07

Table 4.4

Mean nut yield per palm per year

Yearwise (1983 to 1986)

Treatments	Nut yield			
	1983	1984	1985	1986
Irrigation at				
75 mm CPE (T_1)	73.87	40.80	104.06	96.07
50 mm CPE (T_2)	84.50	39.81	112.75	113.87
25 mm CPE (T_3)	66.75	39.87	129.88	119.26
Once in 3 days (T_4)	69.68	41.43	124.68	131.82
No irrigation (T_5)	80.75	31.68	95.87	77.07
SEm I	7.57	6.92	10.39	11.08
C.D.	NS	NS	12.57	24.14
C.V. %	10.08	17.87	9.16	9.92

Table 4.5

Post experiment data on nut yield 1987

Harvestwise nut yield per coconut

Serial No. of harvests	Treatments				
	T_1	T_2	T_3	T_4	T_5
1. 24--4-87	13.31	16.69	17.00	17.31	18.56
2. 5--6-87	17.25	18.44	12.50	18.56	18.94
3. 20--7-87	11.94	13.00	15.06	11.94	15.31
4. 21--9-87	9.44	13.25	8.13	8.00	8.94
5. 6-11-87	9.94	6.63	4.63	4.63	7.06
6. 23-12-87	10.06	12.31	11.75	11.13	12.25
7. 6--2-88	14.85	14.35	23.32	24.50	9.40
8. 12--4-88	13.00	15.67	24.26	26.56	7.35
Total	99.79	110.34	116.65	122.63	97.81

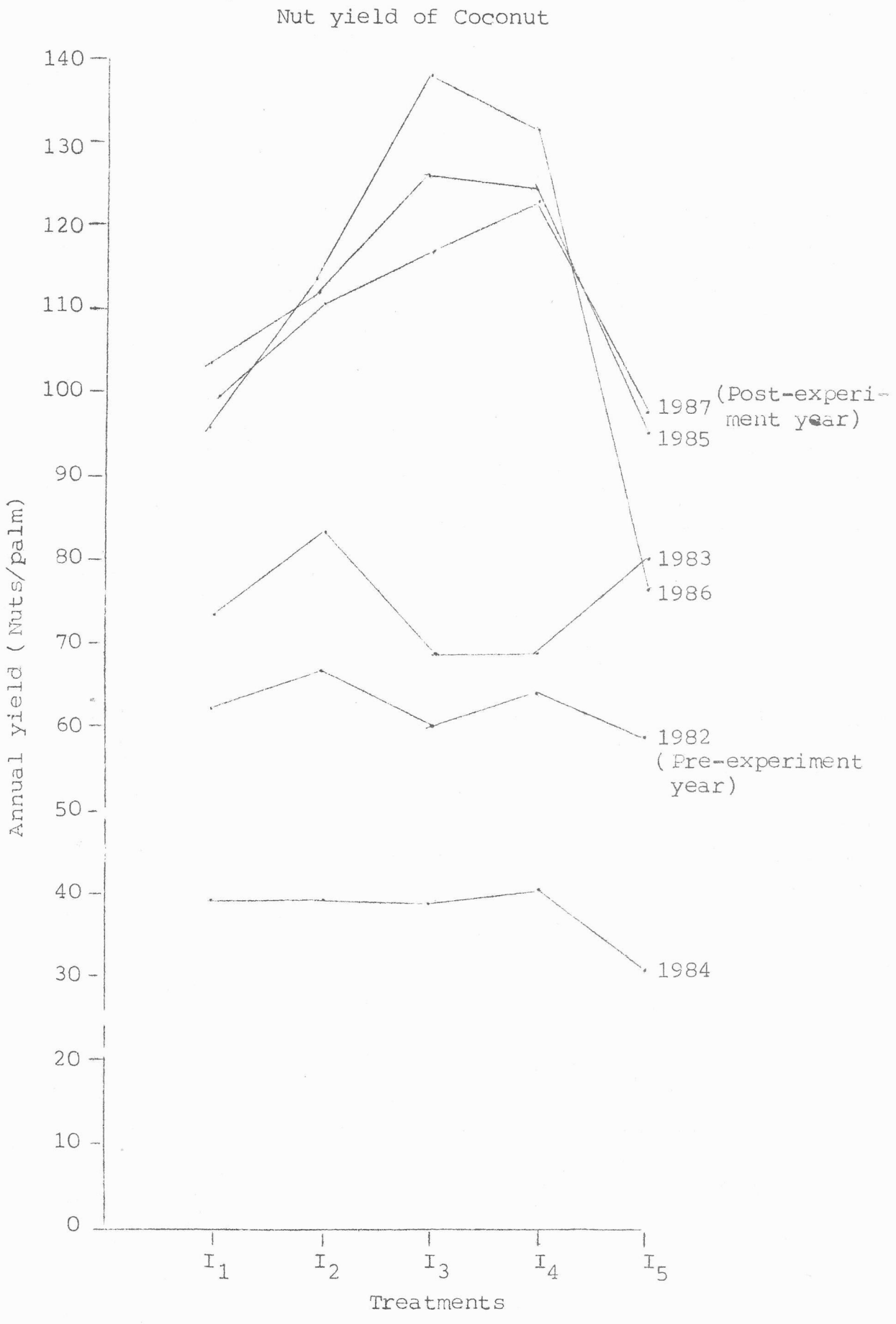

Nut yield of Coconut
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Annual yield (Nuts/palm)
1987 (Post-experiment year)
1985
1983
1986
1982 (Pre-experiment year)
1984
I_1
I_2
I_3
I_4
I_5
Treatments

Table 4.6

Post experiment data on number of bunches of tree

Harvestwise data on number of bunches/coconut

Serial no. of harvests	Treatments				
	T_1	T_2	T_3	T_4	T_5
1. 24--4-87	1.50	1.56	1.44	1.44	1.31
2. 5--6-87	1.56	1.63	1.50	1.60	1.63
3. 20--7-87	1.56	1.50	1.69	1.38	1.63
4. 21--9-87	1.63	1.75	1.63	1.56	1.56
5. 6-11-87	1.69	1.81	1.25	1.25	1.56
6. 23-12-87	1.63	2.13	1.63	1.75	1.81
7. 6--2-88	1.54	1.69	1.49	1.41	1.52
8. 12--4-88	1.58	1.72	1.51	1.48	1.56
Total	12.69	13.79	12.14	11.87	12.58

16. Data on important biometric observation.

Since the experiment was over, no biometric observation were recorded.

17. Incidence of pests and diseases : NIL

18. Any other relevent observation.

During the year under report, all the trees received common irrigation. Only the nut yield was recorded to study the effect of irrigation given in previous years.

EXPERIMENT No.5

1. Title of the experiment : WM 2.4 Response of Colocasia (*Colocasia esculenta*) to varying levels of irrigation at different levels of nitrogen.

2. Objectives:

   1) To study the response of Colocasia to various irrigation levels with respect to its growth and yield.
   2) To find out the most economic dosage of nitrogen.
   3) To work out the optimum combination of levels of irrigation and nitrogen.
   4) To study the influence of irrigation and fertilizer application.
   5) To workout the economics of irrigation and fertilizer application.

3. Year of commencement : 1987-88 summer

4. Initial soil characteristics:

   a) Soil texture : Loamy sand
   b) Available water holding capacity (%) : 11.2
   c) pH : 5.75
   d) E.C.(millimhos/cm) : 0.28
   e) Organic carbon (%) : 0.35
   f) Bulk density (g/cm^3) : 1.45
   g) Available P_2O_5 (kg/ha) : 14.45
   h) Available K_2O (kg/ha) : 30.12

5. Crop rotation followed - Rice-Rice-Colocasia

6. Sowing

a) Date : 18.1.1988

b) Method : Dibbling

c) Seed rate : 1500 kg/ha

d) Spacing : 60 x 45 cm

e) Variety : Thamarakannan

7. Harvest date : 20.6.88

8. Fertilizers and Manures:

a) Dosage : N as per treatment

P -- 50 kg P_2O_5/ha

K -100 kg K_2O/ha

b) Kind of fertilizer : N - as Urea

formation

P - as Superphosphate

K - as Muriate of potash

c) Time of application : Full dose of P, half dose of N and K were applied with in a week after sprouting and the remaining half dose of N and K were applied after one month.

d) Method of application : Placement.

9. Irrigation

Particulars	Treatments			
	I_0	I_1	I_2	I_3
a) Dates of irrigation				
January 88	27	27	27	27
February 88	NIL	23	15	9,24
March 88	NIL	10	5	10,28
April 88	NIL	NIL	2	9
May 88	NIL	NIL	NIL	NIL
June 88	NIL	NIL	NIL	NIL

(Contd...)

(Contd...)

b) Depth of water applied (mm)	50	50	50	50
c) Total water applied (mm)	50	150	200	300
d) Total number of irrigation	1	3	4	6
e) Rainfall received during the crop period (mm)	801.10	801.10	801.10	801.10
f) Method of irrigation followed	Furrow irrigation			

10. Lay out of the experiment

a) Treatments

1) Levels of irrigation : 4

I_0 - No irrigation

I_1 - Irrigation at 0.3 IW/CPE

I_2 - Irrigation at 0.6 IW/CPE

I_3 - Irrigation at o.9 IW/CPE

2) Levels of nitrogen

N_0 - No nitrogen

N_1 - 40 kg N/ha

N_2 - 80 kg N/ha

N_3 - 120 kg N/ha

b) Design : Factorial R.B.D

C) Replication : 3

d) Plot size : Gross area - 5.4 m x 3.6 m

Net area - 4.95m x 3 m

11. Plotwise crop yield

1. Yield of Colocasia tubers (kg/net plot) as influenced by irrigation schedules and nitrogen levels.

Sl. No.	Treatments	Replication I	Replication II	Replication III
1	I_oN_o	6.80	6.80	6.40
2	I_oN_1	14.00	5.60	5.20
3	I_oN_2	12.00	12.0	6.80
4	I_oN_3	12.80	10.0	7.20
5	I_1N_o	10.0	9.6	6.0
6	I_1N_1	14.0	16.0	8.80
7	I_1N_2	20.0	10.4	6.4
8	I_1N_3	10.8	10.8	7.6
9	I_2N_o	9.6	8	6.4
10	I_2N_1	16.8	8	12.0
11	I_2N_2	14.4	10	9.2
12	I_2N_3	16.0	15.84	4.8
13	I_3N_O	12.0	7.60	6.80
14	I_3N_1	20.80	12.0	5.60
15	I_3N_2	7.60	14.40	12.80
16	I_3N_3	12.0	8.4	7.2

2. ANOVA

Source	df	SS	MSS	F	
Total	47	85.136			
Replication	2	32.176	16.088	14.678	
Nitrogen	3	12.464	4.152	3.788*	2.92
Irrigation	3	3.816	1.272	1.161	2.92
N x I	9	3.648	0.408	0.372	2.27
Error	30	33.032	1.096		

*Significant at 5% level

C.D. (0.05) - 0.309

12. Economic crop yield and yield contributing characters.

1. Tuber yield

Statistical analysis of the yield data of tubers revealed that effects due to levels of nitrogen alone was significant while irrigation schedules and interaction were non significant (Table 5.)

Among the different levels of nitrogen N_1 (40 kg N/ha) recorded the highest tuber yield of 10710 kg/ha which was on par with N_2 (80 kg N/ha) and N_3 (120 kg N/ha). Eventhough the above treatments were on par, a decreasing trend in yield was noticed in the treatments from N_1 (40 kg N/ha) to N_3 (120 kg N/ha). Hence the application of N @ 40 kg/ha was sufficient for maximum production of tuber yield in colocasia. The nonsignificant results due to the different water management practices may be due to the availability of frequent rains during experimental period especially from March to June. Number of irrigation given to all the treatments were only few during these months which is the tuber formation period.

Yield contributing characters

1. Number of tubers per plant is presented in table 5.2. As in the case of tuber yield, the nitrogen levels significantly influenced the number of tubers/plant. The effect of irrigation and the N x I inter-actions were nonsignificant. Among the nitrogen levels, the N_2 (80 kg N/ha) recorded the highest number of tuber/plant (15 No.) and was on par with N_1 and N_3 (14 and 13 respectively).

Table 5.1

Yield of colocasia tubers (kg/ha) as influenced by irrigation scheduled and nitrogen levels.

Treatments	Nitrogen levels (kg/ha)				Mean
	N_0 0	N_1 30	N_2 60	N_3 90	
I_0 - No irrigation	6172.83	7654.30	9259.24	9259.24	8086.41
I_1 - Irrigation at 0.3 IW/CPE	7901.22	11975.28	11357.99	9012.33	10061.71
I_2 - Irrigation at 0.6 IW/CPE	7407.39	11357.99	10370.35	8839.49	9493.81
I_3 - Irrigation at 0.9 IW/CPE	8148.13	11851.82	10740.72	8518.50	9814.79
Mean	7407.39	10709.84	10432.08	8907.4	

Irrigation schedules - NS

Nitrogen levels - 2288.89

Interaction - NS

Table 5.2

Number of tubers/plant as influenced by irrigation schedules and nitrogen levels.

Treatments	Nitrogen levels (kg/ha)				Mean
	N_0	N_1	N_2	N_3	
Irrigation levels					
I_0 - No irrigation	11.13	16.53	14.07	11.9	13.45
I_1 - Irrigation at 0.3 IW/CPE	10.40	14.80	16.87	12.67	13.68
I_2 - Irrigation at 0.6 IW/CPE	8.53	11.27	14.60	14.80	12.3
I_3 - Irrigation at 0.9 IW/CPE	9.93	15.8	15.73	12.8	13.57
Mean	10.03	14.60	15.32	13.05	

C.D. (0.05) for irrigation schedules - NS
C.D.(0.05) for Nitrogen levels - 3.45
C.D. (0.05) for interaction - NS

13. Soil moisture studies.

Due to the continuous availability of rains irrigation were carried upto the month May only. The difference in moisture percentage between after the irrigation and before the next irrigation is presented in Table 5.3.

Table 5.3

Depthwise soil moisture (%) during the crop period

Treatments	I_1 - IW/CPE = 0.3			I_2 - IW/CPE = 0.6				I_3 - IW/CPE = 0.9					
umber of irrigation	1	2	3	1	2	3	4	1	2	3	4	5	6
itrogen levels and Depth (cm)													
0 - 15	4.21	2.30	2.3	4.04	2.12	2.32	2.89	2.5	2.96	3.12	2.12	2.74	2.85
15 - 30	4.32	2.20	3.1	2.8	3.20	3.45	3.25	2.05	3.15	2.16	3.24	2.92	2.76
N_0 30 - 60	3.77	2.09	3.5	2.01	2.52	3.68	3.16	2.83	3.06	2.96	2.86	2.16	2.94
60 - 90	2.56	1.86	2.3	2.48	2.31	2.16	2.85	2.06	2.17	3.02	2.91	2.85	2.34
0 - 15	4.5	2.87	2.6	3.95	1.89	3.13	3.04	2.08	3.16	3.16	2.65	2.69	267
15 - 30	4.53	2.53	3.54	3.11	2.24	2.68	2.69	3.12	3.04	3.25	2.98	3.14	2.83
N_1 30 - 60	4.56	2.56	4.25	2.8	2.14	3.54	3.54	2.74	2.89	2.94	2.75	2.85	2.48
60 - 90	2.62	2.63	2.89	2.61	2.32	2.96	2.45	3.25	2.71	2.58	2.10	2.93	2.82
0 - 15	5.62	2.21	3.25	4.06	0.85	4.12	2.96	4.12	2.96	1.67	3.04	2.18	2.12
15 - 30	5.24	2.15	4.26	3.67	1.85	3.26	3.26	3.23	3.18	2.94	2.95	2.56	2.19
N_2 30 - 60	3.18	2.24	4.87	3.07	1.46	2.89	4.10	4.87	2.19	2.85	2.86	2.89	2.67
60 - 90	2.33	1.81	3.25	2.01	1.26	2.56	2.89	3.12	2.96	2.16	2.74	2.45	2.78
0 - 15	3.21	2.1	2.94	4.12	1.46	3.64	2.76	3.96	3.19	1.94	2.66	2.26	2.04
N_3 15 - 30	3.53	2.02	3.86	3.05	2.28	3.25	2.94	3.23	2.56	2.85	2.96	2.94	2.65
30 - 60	2.41	1.70	3.98	2.95	2.50	2.10	3.25	3.56	2.88	2.67	3.12	2.18	2.54
60 - 90	3.28	1.68	2.56	2.67	1.92	2.06	3.16	4.12	3.19	2.77	2.85	2.79	2.69

14. Periodic ground water fluctuation in the experimental area.

Month	Depth from ground level in cm.	
	Maximum	Minimum
January	110	75
February	124	90
March	118	62
April	30	22
May	80	28
June	29	18

15. Important weather conditions/prevailed during the crop period.

Month	Total rain-fall (mm)	No. of rainy days	Mean temper-ature (°c)		Mean R.H (%)		Mean open pan evapo-ration mm/day	Mean wind speed km/hr
			Max.	Min.	8 AM	2.PM		
January	-	-	33.11	18.87	82.61	44.32	3.26	1.85
February	1.6	1	35.04	21.81	83.0	45.63	3.90	2.38
March	17.7	5	35.37	24.1	78.84	54.20	4.23	2.72
April	246.4	15	34.3	24.27	84.9	55.54	4.03	2.35
May	123.70	9	33.34	24.52	86.81	33.34	3.05	2.63
June	689.7	27	30.58	23.28	91.67	30.58	2.05	2.15

16. Growth characters.

The data on important growth characters are furnished in Table 5.4.

a) Height of plants.

The data on plant height recorded two months after germination revealed that both the irrigation and nitrogen levels significantly influenced the plant height at early stages. The treatments I_2 and I_3 (IW/CPE ratio of 0.6 and 0.9 respectively) which received maximum number

of irrigation during the early periods recorded maximum height when compared with I_0 (No irrigation) and I_1 (IW/CPE = 0.3) when received lesser number of irrigations. Among the nitrogen levels the maximum plant height was recorded by N_2 (80 kg N/ha). The interaction effects were not significant.

b) Number of suckers/plant

The levels of nitrogen alone showed a significant influence on the sucker production. The highest number of suckers was produced by N_2 (80 kg N/ha) and was on par with N_1 (40 kg N/ha) and N_3 (120 kg/ha).

c) Number of leaves per/hill

The number of leaves/hill was also significantly influenced by levels of nitrogen alone. The levels of nitrogen showed a positive significant influence on number of leaves, and N_3 (120 kg N/ha) recorded the maximum number and was on par with N_2 (80 kg N/ha).

Table 5.4

Data on important biometric observations and quality attributes

a) Height of plants as influenced by irrigation schedules and nitrogen levels (cm)

Levels of irrigation	Nitrogen levels				
	N_0	N_1	N_2	N_3	Mean
I_0 - No irrigation	38.20	37.73	44.20	44.83	41.24
I_1 - Irrigation at 0.3 IW/CPE	44.53	42.13	48.13	42.00	44.20
I_2 - Irrigation at 0.6 IW/CPE	33.07	34.06	39.6	38.0	36.18
I_3 - Irrigation at 0.9 IW/CPE	29.06	38.00	45.87	34.2	36.78
Mean	36.2	37.98	44.45	39.76	
C.D. (0.05) for irrigation		4.049			
C.D. (0.05) for nitrogen		4.049			
C.D. (0.05) for interaction		NS			

b) Number of suckers/plant as influenced by irrigation schedules and nitrogen levels.

Levels of irrigation	Levels of nitrogen				Mean
	N_0	N_1	N_2	N_3	
I_0 - No irrigation	2.4	2.6	3.06	4.0	3.02
I_1 - Irrigation at 0.3 IW/CPE	3.0	3.73	3.27	3.73	3.43
I_2 - Irrigation at 0.6 IW/CPE	2.87	3.00	4.2	3.13	3.30
I_3 - Irrigation at 0.9 IW/CPE	1.87	3.13	4.13	3.53	3.17
Mean	2.53	3.12	3.66	3.60	

C.D. (0.05) for irrigation — NS
C.D. (0.05) for nitrogen — 0.717
C.D. (0.05) for interaction — NS

c) Number of leaves/plant as influenced by irrigation schedules and nitrogen levels.

Levels of irrigation	Levels of nitrogen				Mean
	N_0	N_1	N_2	N_3	
I_0 - No irrigation	3.67	3.80	3.80	5.0	4.07
I_1 - Irrigation at 0.3 IW/CPE	3.80	4.07	4.40	4.4	4.17
I_2 - Irrigation at 0.6 IW/CPE	3.67	4.13	4.0	4.87	4.17
I_3 - Irrigation at 0.9 IW/CPE	3.80	4.0	4.93	4.47	4.3
Mean	3.73	4.0	4.28	4.68	

C.D. (0.05) : Irrigation schedules - NS
Nitrogen levels - 0.421
Interaction - NS

17. Incidence of pest and diseases:

The attack of thrips was observed in few plots and sprayed with Ekalux to control this. No major diseases were observed during the year under report.

18. Any other relevent information : Since this variety of Colocasia (Thamarakannan) is a short duration one having 5 months duration, this can be included in the cropping systems after two rice crops under limited water supply.

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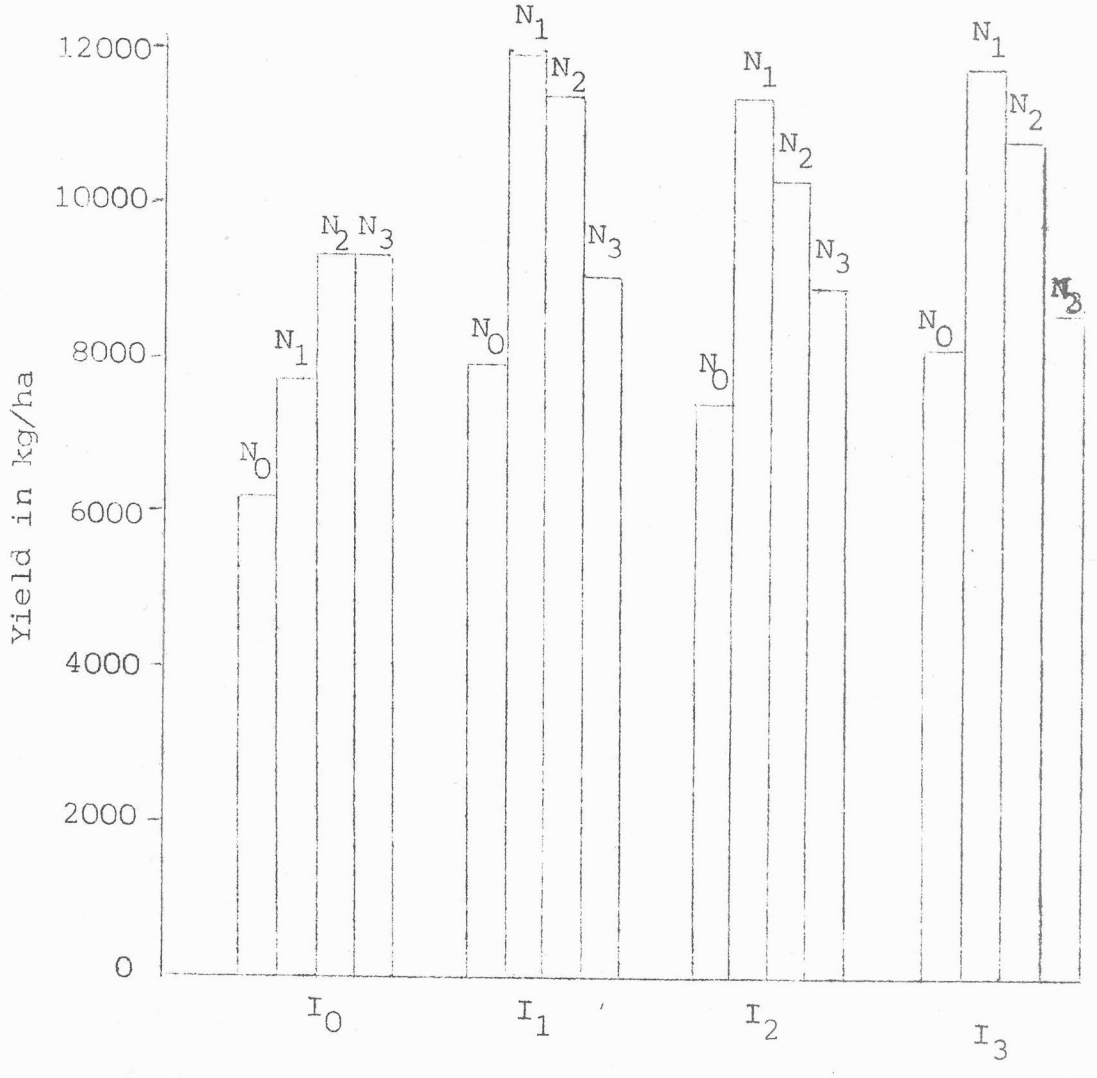
Yield of Colocasia tubers (kg/ha) as influenced by irrigation schedules and nitrogen levels



EXPERIMENT No.6

1. Title of the experiment : W M 2.2 Water management practices for bittergourd (Momordica charantia L.) under graded doses of nitrogen.

2. Objectives

1) To find out the effect of timing and frequency of irrigation on the growth and yield of bittergourd.

2) To study the response of bittergourd to graded doses of nitrogen under different moisture regimes.

3) To work out the economics of irrigation and fertilizer application.

4) To work out optimun combination of levels of irrigation and nitrogen.

3. Year of commencement : 1986 - 87 Repeated in the same field with same randamisation.

4. Initial soil characterstics

a) Soil texture : Loamy sand

b) Available water holding capacity (%) : 10.8

c) P^H : 5.8

d) E.C. (mm hos/cm) : 0.36

e) Organic carbon (%) : 0.36

f) Bulk density (g/cm^3) : 1.40

g) Available P_2O_5 (Kg/ha) : 13.74

h) Available K_2O (Kg/ha) : 28.91

5. Crop rotation followed : Rice - Rice - Vegetables

6. Sowing:

a) Date : 14.1.88

b) Method : Dibbling

c) Seed rate : 5 kg/ha

d) Spacing : 2 m x 0.75 m

e) Variety : Priya (VK - 1)

7. Harvesting dates : 14.3.88, 19.3.88, 28.3.88, 5.4.88, 11.4.88, 16.4.88, 20.4.88.

8. Fertilizers & Manures:

a) Dosage : N - as per treatment

P - 25 kg P_2O_5/ha

K - 25 kg K_2O/ha.

b) Kind of fertilizer formulation : N - as Urea

P - as Super Phosphate

K - as Muriate of potash

c) Time of application

25% of nitrogen and full dose of phosphorus and potash were applied as basal dose and the remaining 75% of nitrogen applied in 6 equal splits of 12.5% each at fortnightly intervals.

d) Method of application : Placement

9. Irrigation

a) Dates of irrigation

Month	Treatments			
	I_1	I_2	I_3	I_4
February	17, 21, 26	17, 26	17, 29	17, 19, 21, 23, 26, 28.
March	1,5, 9, 13, 17, 22, 26, 29	3, 13, 25, 31	11, 26	1, 3, 5, 7, 9, 11, 13, 16, 19, 21, 23, 25, 27, 29, 31.
April	1, 5	-	5	2, 4

b) Depth of water applied (mm)	40	40	40	40
c) Total water applied (mm)	520	240	200	920
d) Total number of irrigation	13	6	5	23
e) Rainfall received during the crop period.	283.7	283.7	283.7	283.7

f) Method of irrigation followed. : Check basin

10. Layout of experiments

a) Treatments

i) Levels of irrigation:

I_1 - Irrigation at 15 mm CPE

I_2 - Irrigation at 30 mm CPE

I_3 - Irrigation at 45 mm CPE

I_4 - Farmers practice (once in two days)

ii) Levels of nitrogen

N_o - No nitrogen

N_1 - 30 kg N/ha

N_2 - 60 kg N/kg

N_3 - 90 kg N/kg

b) Design : Factorial R.B.D.

c) Replication : 3

d) Plot size

1) Gross : 8 x 5.25 M

2) Net : 4 x 3.75 M

11. i) Plot wize crop yield

Yield of bittergourd (Kg/net plot) as influenced by irrigation scheduled and nitrogen levels.

Treatments	Replications		
	R_1	R_2	R_3
I_1N_0	15.675	16.489	15.319
I_1N_1	23.846	22.583	22.488
I_1N_2	26.943	28.415	27.285
I_1N_3	28.232	26.004	29.482
I_2N_0	14.678	15.114	13.071
I_2N_1	18.506	22.162	21.503
I_2N_2	19.404	22.862	23.954
I_2N_3	26.74	25.162	24.308
I_3N_0	10.441	14.09	12.754
I_3N_1	17.912	20.564	19.532
I_3N_2	18.742	21.984	21.05
I_3N_3	25.792	22.975	22.613
I_4N_0	16.705	15.282	17.265
I_4N_1	23.062	24.711	22.645
I_4N_2	29.037	32.239	28.617
I_4N_3	28.994	31.242	30.025

ii) ANOVA

Source	df	SS	MSS	F	Table Value
Total	47				
Replication	2	13.766	6.883	1.359	
Nitrogen	3	945.022	315.007	62.192**	2.92
Irrigation	3	208.32	69.44	13.709**	2.92
N x I	9	71.148	7.905	1.561	2.27
Error	30	151.95	5.065		

C.D. (0.05%) : 1.876

** Significant at 1% level.

12. Economic crop yield and yield contributing characters.

1. Fruit yield:-

Statistical analysis of the yield data showed that the effects due to irrigation and nitrogen were significant (Table-6.1), but their interaction was not significant.

Among the irrigation levels, I_4 (Farmers practice of once in two days) recorded the maximum fruit yield of 16712 kg/ha, and was on par with I_1 - 15 mm CPE (an approximate interval of 4 days) which recorded the yield of 15709 kg/ha. The treatments I_2 & I_3 (30 mm & 45 mm CPE) were significantly inferior to I_4 & I_1. The number of irrigations received by I_1, I_2, I_3 and I_4 were 13, 6, 5 and 23 respectively. Corresponding quantity of water used by the above four treatments were 520mm, 240 mm, 200 mm and 920 mm. Hence it is more economic

Table-6.1

Yield of bittergourd (kg/ha) as influenced by irrigation schedules and nitrogen levels during the year 1986-87 and 1987-88

1986-87

Treatments	Nitrogen levels (kg/ha)				Mean
	N_0 0	N_1 30	N_2 60	N_3 90	
Irrigation levels					
I_1 - Irrigation at 15 mm CPE	12824.79	21810.55	27026.58	31389.48	23263.52
I_2 - Irrigation at 30 mm CPE	15433.47	18003.49	32325.25	29741.90	23876.03
I_3 - Irrigation at 45 mm CPE	10276.09	19037.91	25456.30	24123.3	19723.07
I_4 - Farmers practice once in two days	11331.83	23636.76	28323.58	32174.62	23867.37
Mean	12466.22	20622.17	28282.93	29257.33	

C.D. (0.05) Irrigation schedules : 1022.01
Nitrogen levels : 1022.01
Interaction : NS

1987-88

Treatments	Nitrogen levels (kg/ha)				Mean
	N_0 0	N_1 30	N_2 60	N_3 90	
Irrigation levels					
I_1 - Irrigation at 15 mm CPE	10551.67	15314.74	18364.93	18603.91	15708.79
I_2 - Irrigation at 30 mm CPE	9525.02	13815.64	14716.74	16935.39	13748.20
I_3 - Irrigation at 45 mm CPE	8285.47	12890.54	13727.86	15862.06	12691.48
I_4 - Farmers practice once in two days	11166.99	15648.29	19976.02	20057.80	16712.28
Mean	9882.29	14417.30	16696.39	17864.77	

C.D. (0.05) Irrigation schedules : 1250.67
Nitrogen levels : 1250.67
Interaction : NS

Yield of bittergourd (kg/ha) as influenced by irrigation schedules and nitrogen levels

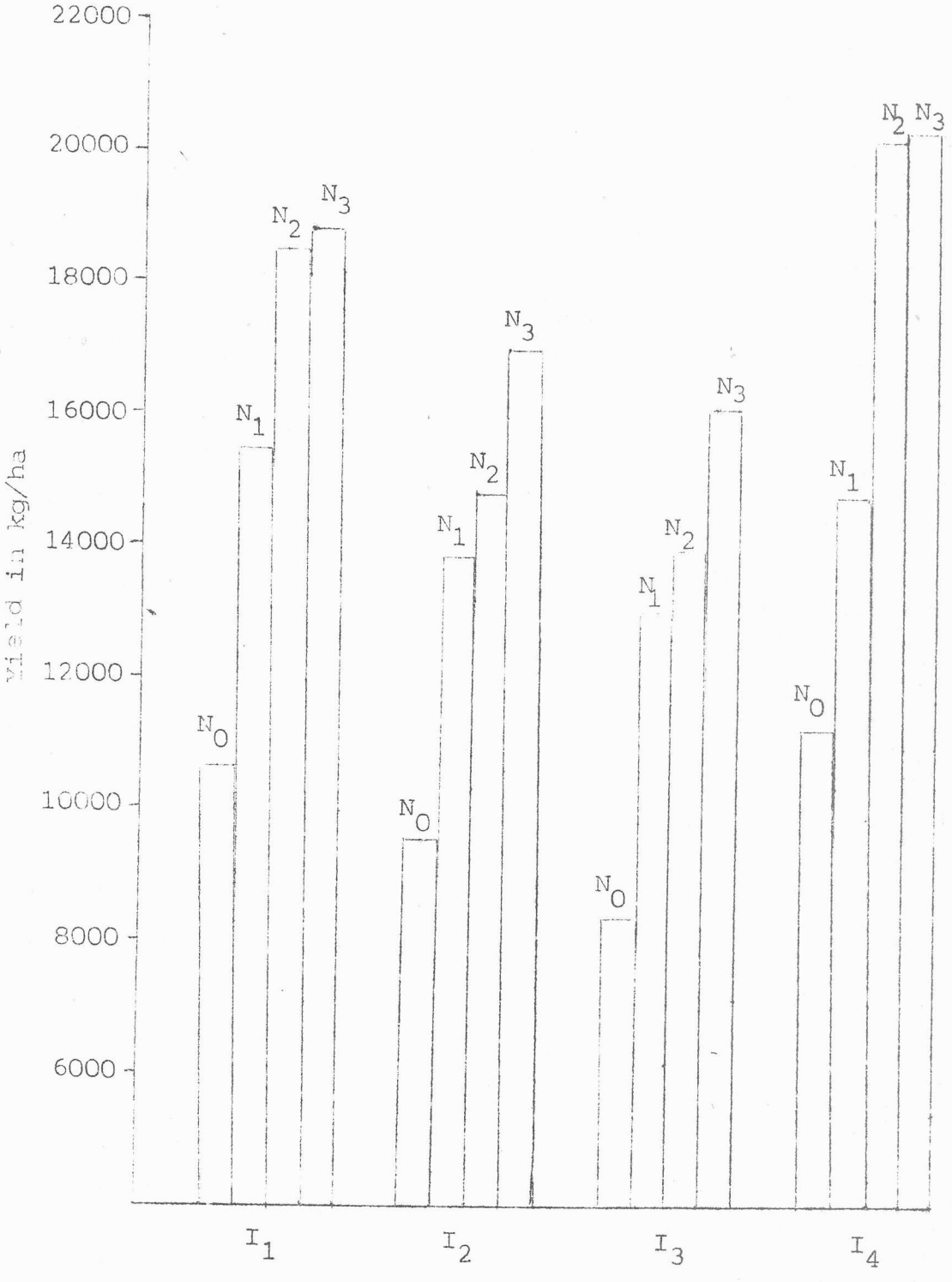


Table-6.2

Yield contributing characters as influenced by irrigation schedules and nitrogen levels.

a) Number of fruits.

Treatments	Nitrogen levels (kg/ha)				Mean
	N_0 0	N_1 30	N_2 60	N_3 90	
Irrigation levels					
I_1 - Irrigation at 15 mm CPE	85778	10667	119556	113778	106444.75
I_2 - Irrigation at 30 mm CPE	80223	116889	107779	118223	105778.50
I_3 - Irrigation at 45 mm CPE	94667	112889	110223	111778	107389.25
I_4 - Farmers practice (once in two days)	98000	114223	111556	112223	109000.50
Mean	89667	112667	112278.50	114000.50	

C.D. (0.05) Irrigation schedules : N.S

Nitrogen levels : 13420.07

Interaction : N.S

b) Girth of fruit (cm)

Treatments	Nitrogen levels (kg/ha				Mean
	0	30	60	90	
Irrigation levels					
I_1 - Irrigation at 15 mm CPE	9.70	10.13	10.60	9.90	10.08
I_2 - Irrigation at 30 mm CPE	10.47	10.17	10.2	10.33	10.29
I_3 - Irrigation at 45 mm CPE	9.6	9.8	9.6	10.16	9.79
I_4 - Farmers practice	8.83	9.8	10.37	10.97	9.9
Mean	9.65	10.01	10.16	10.34	

C.D. (0.05) Irrigation : 0.307
Nitrogen : 0.307
Interaction : 0.186

c) Length of fruits (cm)

Treatments	Nitrogen levels (kg/ha)				Mean
	0	30	60	90	
Irrigation levels					
I_1 - Irrigation at 15 mm CPE	17.30	17.70	18.30	18.33	17.94
I_2 - Irrigation at 30 mm CPE	17.53	18.35	18.5	18.33	18.18
I_3 - Irrigation at 45 mm CPE	16.16	17.3	18.53	19.23	17.81
I_4 - Farmers practice	16.50	18.06	18.50	19.70	18.19
Mean	16.90	17.85	18.46	18.9	

C.D. (0.05) Irrigation : N.S
Nitrogen : 0.654
Interaction: N.S

to irrigate the crop at 15 mm CPE (approximately 3-4 days interval) taking into account the yield, total water used and number of irrigations.

Levles of nitrogen on fruit yield indicated a positive and significant influence with each successive level of nitrogen. However the magnitude of increase was higher upto 60 kg N/ha.

Among the levels of nitrogen N_3 (90 kg N/ha) recorded the highest yield (17865 kg) which was on par with N_2 (60 kg N/ha). The treatments N_0 (no nitrogen) and N_1 (30 kg N/ha) were significantly inferior to N_2 & N_3. The level of nitrogen @ 60 kg N/ha can be taken as the most economic dose of nitrogen for bittergourd.

2. Yield contributing characters.

The data on different yield contributing characters such as number, girth and length of fruits are geven in Table 6.2.

a) Number of fruits.

The effect of irrigation on the number of fruits not significant but the levels of nitrogen significantly influenced the number of fruits. N_0 (No nitrogen) was significantly inferior to N_1, N_2 and N_3 which were on par with each other.

The interaction between irrigation and nitrogen was also not significant.

b) Girth of fruits.

Irrigation schedules, nitrogen levels and their interaction significantly influenced the fruit girth. The girth of fruits increased with nitrogen levels and the maximum was recorded by N_3 (90 kg N/ha)

Among the irrigation levels I_2 (30 mm CPE) recorded the maximum girth.

c) Length of fruits.

The water regimes did not influence the fruit length significantly. However the application of nitrogen had a positive significant effect on this character. N_3 (N - 90 kg/ha) recorded the highest length of fruit of 18.9 cm against 16.90 cm for N_0 (No nitrogen)

13. Soil moisture studies in the crop root zone

1) Periodic rate of water use.

Depthwise consumptive use (%) at different growth phases in Bittergourd

Treatments	Depth (cm)	I_1		I_2		I_3		I_4	
		Vegetative phase	Reproductive phase	Vegetative phase	Reproductive phase	Vegetative phase	Reproductive phase	Vegetative phase	Reproductive phase
N_0	0-15	22.64	20.31	7.98	17.31	22.63	18.61	17.61	19.61
	15-30	15.69	20.24	16.88	13.66	28.21	18.03	23.61	21.24
	30-60	27.40	28.88	32.74	36.35	33.10	33.18	33.33	30.25
	60-90	34.25	30.57	43.94	32.66	16.05	30.16	25.44	29.09
N_1	0-15	20.06	18.04	10.45	23.63	6.70	21.54	21.42	16.46
	15-30	12.74	19.48	14.81	19.85	19.39	14.80	18.59	16.64
	30-60	28.98	33.51	35.64	30.23	40.07	28.60	30.35	31.22
	60-90	38.20	28.96	39.10	26.28	33.65	35.46	29.33	36.29
N_2	0-15	31.39	16.52	10.51	14.59	19.37	19.38	22.45	18.67
	15-30	22.03	21.39	15.77	12.48	18.86	19.26	19.86	16.17
	30-60	27.76	26.89	41.92	33.81	31.35	29.27	31.50	33.03
	60-90	32.99	35.19	31.79	34.45	30.23	32.30	26.63	32.13
N_3	0-15	22.51	16.51	13.30	17.74	21.10	23.54	24.61	18.03
	15-30	24.72	27.86	16.27	20.29	17.00	23.23	20.83	17.82
	30-60	24.98	36.57	21.20	30.93	31.57	32.90	28.26	33.00
	60-90	27.78	38.10	49.22	31.03	30.31	39.11	26.23	31.13

I_1 - Irrigation at 15 mm CPE

I_2 - Irrigation at 30 mm CPE

I_3 - Irrigation at 45 mm CPE

I_4 - Farmers practive (once in two days)

N_0 - No nitrogen

N_1 - 30 kg N/ha

N_2 - 60 kg N/ha

N_3 - 90 kg N/ha

2) Moisture extraction pattern (Depth wise in %) at different growth phases in bittergourd.

Treatments	Depth (cm)	I_1		I_2		I_3		I_4	
		Vegetative phase	Reproductive phase	Vegetative phase	Reproductive phase	Vegetative phase	Reproductive phase	Vegetative phase	Reproductive phase
N_0	0-15	33.18	26.72	13.38	26.78	21.50	27.59	24.49	26.61
	15-30	22.65	29.52	26.63	20.96	26.44	26.38	32.24	30.49
	30-60	19.79	21.80	25.81	27.72	26.39	24.27	22.82	15.97
	60-90	24.37	21.97	34.19	24.54	25.66	21.75	20.45	13.74
N_1	0-15	30.81	25.85	16.96	33.37	10.11	30.67	31.66	26.22
	15-30	19.16	29.45	23.69	27.64	27.98	19.50	24.20	26.64
	30-60	21.76	25.34	28.52	21.07	37.97	25.88	21.81	14.53
	60-90	28.30	19.30	30.83	17.92	23.95	23.97	22.32	16.13
N_2	0-15	37.89	26.85	18.39	24.19	26.11	26.85	35.73	17.87
	15-30	26.23	26.46	19.64	20.40	30.01	26.04	26.72	16.9
	30-60	16.52	25.24	27.4	27.65	22.71	25.27	20.89	14.93
	60-90	19.35	21.45	26.98	27.75	21.76	21.80	17.23	16.52
N_3	0-15	32.98	26.85	19.85	23.30	30.10	27.20	34.52	16.46
	15-30	35.69	26.45	23.96	26.25	28.52	26.86	28.13	16.26
	30-60	11.53	25.22	20.49	26.25	22.26	24.58	19.50	14.83
	60-90	19.78	21.40	35.71	24.19	19.09	21.86	17.85	10.9

I_1 - Irrigation at 15 mm CPE

I_2 - Irrigation at 30 mm CPE

I_3 - Irrigation at 45 mm CPE

I_4 - Farmers practice (Once in two days)

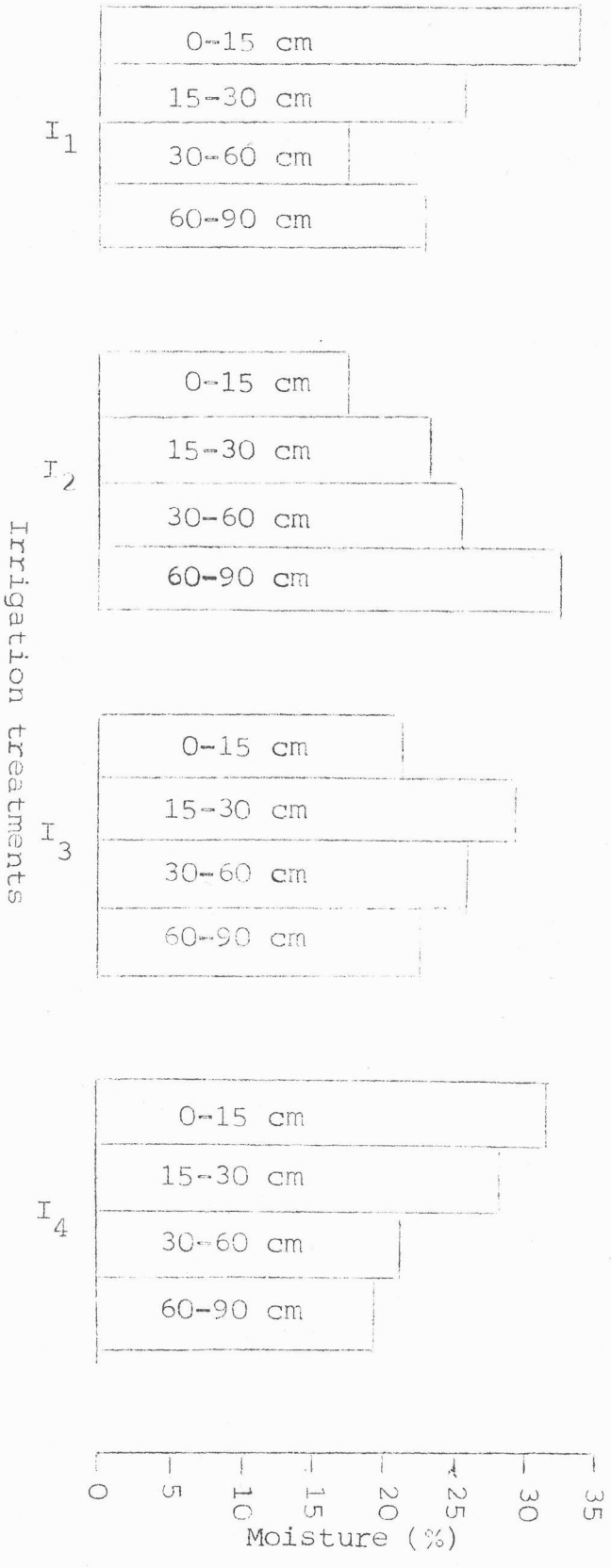
N_0 - No nitrogen

N_1 - 30 kg N/ha

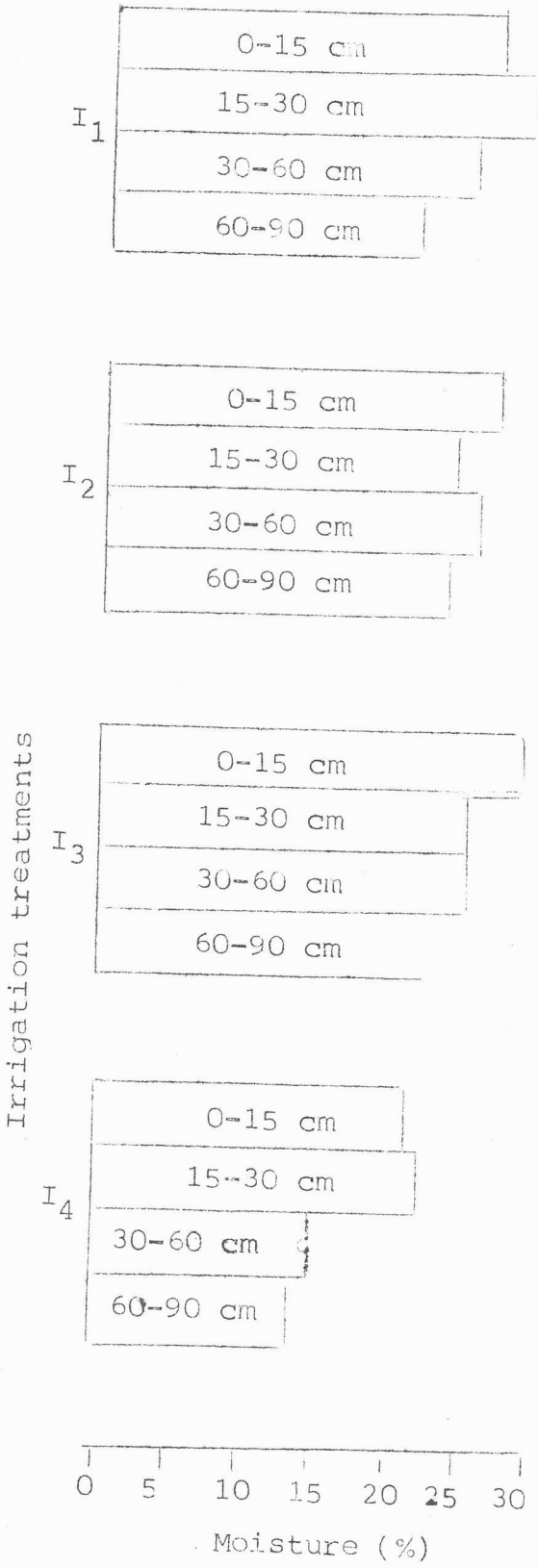
N_2 - 60 kg N/ha

N_3 - 90 kg N/ha

Moisture extraction pattern (Depthwise) during the vegetative phase of bittergourd



Moisture extraction pattern (Depthwise) during the reproductive phase of bittergourd



3) Seasonal consumptive use (mm) of bittergourd as influenced by irrigation schedules & nitrogen levels.

Treatments	Nitrogen levels (kg/ha)				Mean
	N_0	N_1	N_2	N_3	
Levels of Irrigation	0	30	60	90	
I_1 - Irrigation at 15 mm CPE	265.36	267.68	251.27	214.53	249.71
I_2 - Irrigation at 30 mm CPE	118.47	108.42	116.08	106.05	112.26
I_3 - Irrigation at 45 mm CPE	80.81	35.56	65.15	66.62	74.54
I_4 - Farmer's practice once in two days	327.56	295.82	317.70	308.54	312.41
Mean	198.05	189.37	187.55	173.94	

4) a. ET/E pan ratio during the vegitative phase of bittergourd

Treatments	Nitrogen levels (kg/ha)				Mean
	N_o	N_1	N_2	N_3	
Irrigation levels	o	30	60	90	
I_1 - Irrigation at 15 mm CPE	1.80	1.73	1.55	1.16	1.56
I_2 - Irrigation at 30 mm CPE	1.28	1.24	1.20	1.06	1.56
I_3 - Irrigation at 45 mm CPE	0.95	0.70	0.70	0.73	0.77
I_4 - Farmer's practice (once in two days)	2.39	2.23	2.18	2.62	2.36
Mean	1.61	1.48	1.41	1.39	

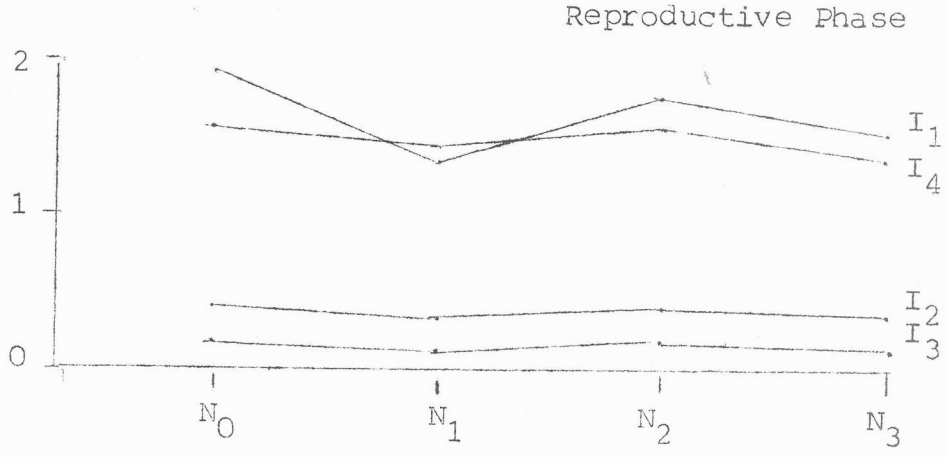
b) ET/E pan ratio during the reproductive pahse of bittergourd.

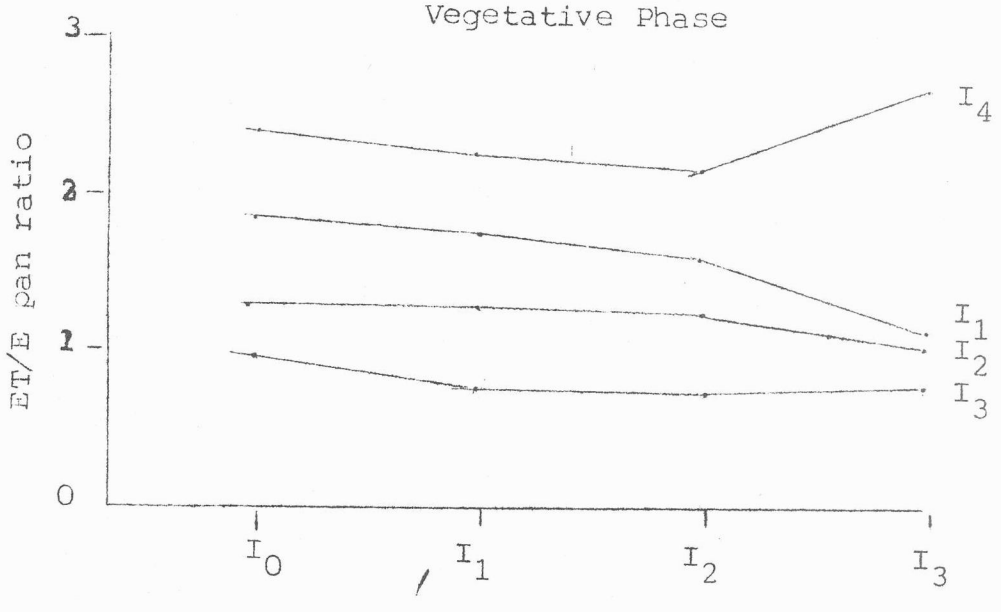
Treatments	Nitrogen levels (kg/ha)				Mean
	N_0 0	N_1 30	N_2 60	N_3 90	
I_1 - Irrigation at 15 mm CPE	1.94	1.38	1.84	1.57	1.68
I_2 - Irrigation at 30 mm CPE	0.48	0.38	0.47	0.42	0.44
I_3 - Irrigation at 45 mm CPE	0.28	0.24	0.25	0.21	0.25
I_4 - Farmers practice (once in two days)	1.60	1.42	1.60	1.37	1.5
Mean	1.08	0.86	1.04	0.89	

14. Periodic ground water fluctuation in theexperimental area

Month	Depth from ground level in cm	
	Maximum	Minimum
January	118	29
February	125	49
March	145	60
April	80	35

ET/E pan ratio during the growth period of bittergourd





15. Important weather conditions prevailed during crop period.

Month	Total rain-fall (mm)	No. of rainy days	Mean max. Temp. (°c)	Mean mini. temp. (°c)	Mean R.H (%)		Mean openpan evopo-ration (mm)	Mean wind-speed (km/hr)
					8 AM	2 PM.		
January	-	-	33.11	18.87	82.61	44.32	3.26	1.86
February	1.6	1	35.04	21.81	83.0	45.63	3.90	2.38
March	17.7	5	35.27	24.1	78.84	54.20	4.23	2.72
April	246.4	15	34.3	24.27	84.9	55.54	4.03	2.35

16. Growth characters

1. Height of plants:-

The data on plant height at 30 days after sowing is furnished in table 6.3. The height of plants was significantly influenced by irrigation and I_4 (Farmers practice) recorded the maximum height. Levels of nitrogen did not show any significant influence on plant height.

2. Dry matter production (Vegitative portion)

The data on dry matter production is presented in Table 6.4. The irrigation schedules, nitrogen levels and their interaction significantly influenced the plant dry weight. The dry matter production was highest for I_1 (15 mm CPE) and the lowest for I_4 (Farmers practice). Among the nitrogen levels N_3 (90 kg N/ha) recorded the maximum dry weight.

Table-6.3

Height of plants as influenced by irrigation schedules and nitrogen levels

Treatments	Levels of nitrogen (kg/ha)				Mean
	N_0 0	N_1 30	N_2 60	N_3 90	
Levels of irrigation					
I_1 - Irrigation at 15 mm CPE	147.30	139.50	189.67	175.00	162.87
I_2 - Irrigation at 30 mm CPE	170.43	176.60	168.67	190.67	176.59
I_3 - Irrigation at 45 mm CPE	140.67	173.00	147.33	141.00	150.50
I_4 - Farmers practice	168.33	181.33	201.50	192.33	185.88
Mean	156.63	167.61	176.79	174.75	

C.D. (0.05) Irrigation schedules : 17.61

Nitrogen : N.S

Interaction : N.S

Table-6.4

Plant dry weight (vegetative parts) as influenced by irrigation schedules and nitrogen levels.

	Levels of nitrogen (kg/ha)				Mean
	N_0 0	N_1 30	N_2 60	N_3 90	
Levels of irrigation					
I_1 - Irrigation at 15 mm CPE	0.833	0.867	1.250	1.300	1.063
I_2 - Irrigation at 30 mm CPE	0.800	1.263	0.833	1.250	1.037
I_3 - Irrigation at 45 mm CPE	0.550	1.180	0.867	1.200	0.950
I_4 - Farmers practice	0.917	1.067	0.783	0.933	0.925
Mean	0.778	1.095	0.933	1.171	

C.D. (0.05) Irrigation schedules : 0.065
Nitrogen : 0.065
Interaction : 0.125

17. Incidence of pests and diseases with control measures taken.

The attack of leaf feeding insects and fruit fly noticed was controlled by spraying insecticides. Fungicidal spray was also given against the leaf spot disease.

18. Any other relevent information : Nil

EXPERIMENT No.7

1. Project number : WM 2.3 Effect of various mulches on the growth and yield of Banana Cv. Palayankodan grown under irrigated and rainfed conditions.

2. Objectives:

   1) To evaluate the influence of different mulches on the growth and yield of banana cv. Palayankodan.
   2) To study the effect of irrigation on the bunch yield of bananacv. Palayankodan.
   3) To study the effect of different mulches on moisture conservation and reduction in irrigation requirement of banana cv. Palayankodan.
   4) To study the economics of mulching and irrigation in banana cv. Palayankodan.

3. Year of commencement : 1987-88

4. Initial soil characteristics

   a) Soil texture : Loam
   b) pH : 5.9
   c) EC (millimhos/cm) : 0.36
   d) Origanic carbon % : 0.53
   e) Available P_2O_5 (kg/ha) : 37
   f) Available K_2O (kg/ha) : 135

5. Crop rotation followed : Monoculture

6. Sowing/planting

a) Date	:	20-6-87
b) Spacing	:	2.25 m x 2.25 m
c) Variety	:	Palayankodan

7. Harvesting dates : Harvesting started from March 1988 and is being continued.

8. Fertilizers and manures:

a) Dosage (as per package of practices recommendations).	:	N : 100 g/plant P_2O_5: 200 g/plant K_2O : 400 g/plant
b) Kind of fertilizer formulation.	:	N as Urea P as Superphosphate K as Muriate of Potash
c) Time of application	:	Two split doses in August and December.
d) Method of application	:	Broadcasted in the basins and incorporated with soil.

9. Irrigation

Particulars	Treatments		
	I_1	I_2	I_3
a) Dates of irrigation			
January 88	4,15,25	4,25	4
February 88	2,11,19, 29	11,26	1,26
March 88	8,16,29	14	23
April 88	6	2	
(No irrigation treatments were given after the 1st week of April due to the availability of rains)			
b) Depth of water applied (mm)	40	40	40
c) Total water applied (mm)	440	240	160
d) Total No. of irrigation	11	6	4
e) Method of irrigation followed.	Check basin	Check basin	Check basin

10. Lay out of the experiment:

a) Treatments : 12 (4 irrigation levels and 3 mulches)

Irrigation levels : 4

I_0 - Rain fed

I_1 - Irrigation at 30 mm CPE

I_2 - Irrigation at 60 mm CPE

I_3 - Irrigation at 90 mm CPE

Depth of irrigation - 40 mm

b) Mulches : 3

M_0 - No mulch

M_1 - Mulching with dried leaves. (5-8 cm thickness)

M_2 - Mulching with polythene sheet.

b) Design : Factorial R.BD

c) Replication : 4

d) plot size : 4.5 m x 4.5 m

(4 plants per treatment with a spacing of 2.25 m x 2.25 m)

e) Variety : Palayankodan

11. Plotwise crop yield in kg/net plot in the actual layout followed.

Harvest was not completed during the year under report.

12. Economic crop yield and by product yield. NA

Soil moisture studies in the crop root zone.

i) Consumptive use of water during irrigation period (mm)

Treatment	I_1	I_2	I_3
M_0	520	206	149
M_1	582	275	170
M_2	451	247	162

(Irrigation period includes reproductive and maturity stages of the crop)

ii) Moisture extraction pattern depth wise (%)

Treatment	Depth (cm)	I_1	I_2	I_3
M_0	0-30	45.76	49.02	41.61
	30-60	36.34	34.36	34.90
	60-90	17.90	16.52	23.49
M_1	0-30	46.90	38.18	50.00
	30-60	35.05	36.72	26.47
	60-90	18.05	25.10	23.53
M_2	0-30	53.65	41.70	50.61
	30-60	27.05	33.19	25.92
	60-90	19.30	25.11	23.47

14. Periodic ground water fluctuation in the experimental area.

Ground water was below 2 m during the experimental period.

15. Important weather conditions prevailed during the crop period (monthly mean)

Month	Total rain-fall (mm)	No.of rainy days	Max. temp. (c°)	Min. temp. (c°)	Mean R.H. (%) 8AM	Mean R.H. (%) 2PM	Mean P.E. (mm/day)	Mean wind speed (km/day)
July 87	456.8	21	30.85	23.40	91.75	73.75	3.57	64.12
August 87	542.2	22	30.26	22.83	90.22	74.87	3.41	47.29
Sept. 87	258.4	10	31.08	23.89	88.03	62.20	3.75	61.43
Nov. 87	246.0	12	32.60	22.20	83.90	67.10	3.32	33.23
Dec. 87	208.5	7	32.41	20.37	86.34	61.59	2.53	42.61
Jan. 88	-	-	33.11	18.87	82.61	44.32	3.26	44.61
Feb. 88	1.6	1	35.04	21.81	83.00	45.63	3.90	57.14
Mar. 88	17.7	5	35.00	24.71	78.84	54.20	4.23	65.29
April 88	246.4	15	34.30	24.27	84.91	55.54	4.03	56.37
May 88	123.70	9	33.34	24.52	86.81	62.77	3.05	63.00
June 88	689.7	27	30.58	23.28	91.67	81.40	2.05	51.67

16. Data on important biometric observations and quality attributes.

Harvest not completed.

17. Incidence of pest and diseases with control measures taken.

Sigatoka disease was noticed in vegetative phase which was controlled by spraying 1% Bordeaux mixture.

18. Any other relevant information.

The experiment will be repeated during next year with ratoon crop.

EXPERIMENT No.8

1. Title of the experiment : WM.15.2. Evaluation of long term effect of canal irrigation on changes in physical and chemical properties of soil.

2. Objectives :

1. To monitor the changes in hydraulic properties of soil over a period of time.

2. To work out the changes in chemical properties of soil.

3. Year of commencement : 1985-86

4. Technique:

Periodic soil sampling to monitor the changes in profile characteristics will be done from various location (garden land and wet land) upto 120 cm depth or upto water table or upto the depth of impermeable layer, if any, at an interval of 30 cm. During the 1st, 5th and 10th year of study the profile upto 120 cm will be opened and in the remaining years, the soils upto 60 cm depth will be collected. In situ determination of water transmission properties will be made. In case where in situ determination is not possible core sample will be collected for laboratory determination. The study will be continued in the same area for at least 10 years.

5. Locations selected

a) Intensively canal irrigated area with stagnant water.

1. Wet land

(In garden land, this type of location is not seen).

b) Intensively canal irrigated area (without stagnant water).

1. Wet land (2) Garden land

c) Unirrigated cultivated area near the canal irrigated area.

(1) Wet land (2) Garden land

d) Unirrigated cultivated area likely to be brought under irrigation shortly.

(1) Wet land (2) Garden land

e)Control (The area lying near the canal, but above the canal level where canal irrigation is not possible).

(1) Garden land (In wet land this type of land is not seen).

6. Work done during the period.

The major garden land soil series namely Thodupuzha(Tpa) and the wet land soil series namely Kothamangalam (Klm) of the Periyar Valley Irrigation Project command area were selected for the studies. The soil samples were collected from the same location in each year.

During the year under report samples at a depth of 60 cm at an interval of 15 and 30 cm were collected.

The particle size distribution of the samples collected during the year 1985-86 (1st year sample) was determined and furnished in Table 8.1 and 8.2.

The hydraulic conductivity and bulk density of the undisturbed core samples of soils collected during the year '86-87 was estimated and furnished in Tables 8.3 and 8.4.

The chemical properties like pH, EC and organic carbon of the above samples were estimated and furnished in tables 8.5 and 8.6.

This project will be continued for 10 years and hence no conclusion can be drawn with the available data.

Table 8.1

Mechanical composition of wet land soil series -

Kothamangalam (Klm) - 85-86

Sl. No.	Location/ treatment	Depth in(cm)	Percentage of			
			Coarse sand	Fine sand	Silt	Clay
1.	Intensively canal irrigated area with stagnant water	0-15	40.73	24.18	14.02	19.99
		15-30	41.59	31.01	9.44	16.38
		30-60	40.66	29.67	10.47	17.88
		60-90	47.33	26.85	6.04	18.88
		90-120	55.30	26.21	7.62	6.01
2.	Intensively canal irrigated area	0-15	45.76	26.72	5.25	21.63
		15-30	48.34	27.18	7.19	16.13
		30-60	46.94	23.90	6.38	22.19
		60-90	52.88	20.27	5.69	20.25
		90-120	57.52	19.90	5.0	16.62
3.	Unirrigated cultivated area near the canal irrigated area	0-15	36.85	26.36	13.19	21.31
		15-30	41.33	23.72	10.69	22.81
		30-60	38.11	24.27	11.87	23.75
		60-90	39.99	24.13	10.94	22.49
		90-120	41.18	24.06	10.69	22.25
4.	Unirrigated area likely to be brought under irrigation shortly	0-15	41.83	24.26	9.25	23.44
		15-30	41.93	22.40	10.69	24.13
		30-60	40.39	25.76	9.15	24.06
		60-90	41.68	22.63	9.19	26.38
		90-120	43.30	22.54	9.0	24.32

Table 8.2

Mechanical composition of garden land soil series - Thodupuzha (Tpa) - 85-86

Sl. No.	Location/ treatments	Depth in(cm)	Percentage of Coarse sand	Fine sand	Silt	Clay
1.	Intensively canal irrigated area with stagnant water	This type of location is not seen in garden land.				
2.	Intensively canal irrigated area	0-15	36.25	23.18	12.56	26.56
		15-30	38.36	17.93	11.38	30.31
		30-60	38.44	17.85	11.75	30.25
		60-90	39.87	18.71	13.76	25.09
3.	Unirrigated cultivated area near the canal irrigated area	0-15	38.36	25.08	12.69	22.94
		15-30	38.46	23.69	14.75	22.44
		30-60	38.09	21.81	16.25	22.75
		60-90	37.53	24.53	14.75	22.50
		90-120	37.76	22.93	14.63	24.00
		120-150	36.44	22.93	15.00	23.50
4.	Unirrigated area likely to be brought under irrigation shortly	0-15	39.85	23.91	10.38	24.85
		15-30	40.64	22.84	10.40	25.12
		30-60	42.11	21.89	11.00	23.66
		60-90	40.81	22.95	11.11	23.93
		90-120	43.29	21.81	10.25	24.25
5.	Control	0-15	35.38	26.16	10.38	27.63
		15-30	39.05	26.16	10.88	23.43
		30-60	37.63	28.26	9.63	23.88
		60-90	37.45	25.80	12.25	23.25
		90-120	37.59	24.43	10.12	27.38

Table 8.3

Hydraulic conductivity (mm/hr) of undisturbed soil of garden land and wet land Series (86-87)

Description	Garden land soil series - Tpa. Depth in cm.			Wet land soil series- Klm - Depth in cm.		
	0-15	15-30	30-60	0-15	15-30	30-60
1. Intensively canal irrigated area with stagnant water	This type of location was not available in this soil series.			Core samples could not be taken due to stagnant water.		
2. Intensively canal irrigated area	33.6	25.36	18.39	10.27	14.27	17.44
3. Unirrigated area near the canal irrigated area	15.2	22.2	24.10	39.32	44.39	46.93
4. Unirrigated area likely to be irrigated shortly	11.74	28.92	25.26	17.75	32.60	27.90
5. Control (Area lying near the canal but above canal level where canal irrigation is impossible)	9.66	20.63	22.83	33.68	36.78	29.60

Table 8.4

Bulk density of undisturbed soil (g/cc) of wet land and garden land soil series - Kothamangalam (Klm) and Thodupuzha(Tpa) - 86-87

Sl. No.	Description	Wet land soil series - Kothamangalam (Klm) Depth in cm			Garden land soil series - Thodupuzha (Tpa) Depth in cm.		
		0-15	15-30	30-60	0-15	15-30	30-60
1.	Intensively canal irrigated area with stagnant water	Core camples could not be taken due to stagnant water.			This type of location is not available in this soil series.		
2.	Intensively canal irrigated area	1.262	1.483	1.521	1.497	1.562	1.601
3.	Unirrigated cultivated area near the canal irrigated area	1.297	1.383	1.498	1.422	1.410	1.395
4.	Unirrigated area likely to be brought under irrigation shortly	1.610	1.522	1.510	1.512	1.549	1.565
5.	Control	This type of location is not available in this soil series			1.392	1.452	1.440

Table 8.5

pH, EC (mmhos/cm) and organic carbon (%) of wet land soil series - Kothamangalam (Klm)--86-87

Sl. No.	Description	Depth in cm.	pH	EC (mmhos/cm)	Organic Carbon (%)
1.	Intensively canal irrigated area with stagnant water	0-15	4.85	0.311	1.51
		15-30	4.80	0.421	1.02
		30-60	5.00	0.360	1.12
2.	Intensively canal irrigated area	0-15	5.15	0.612	0.76
		15-30	5.01	0.512	0.65
		30-60	4.95	0.373	0.54
3.	Unirrigated cultivated area near the canal irrigated area	0-15	5.22	0.301	0.69
		15-30	5.62	0.283	0.48
		30-60	5.82	0.263	0.46
4.	Unirrigated area likely to be irrigated shortly	0-15	5.11	0.201	0.9
		15-30	5.64	0.322	0.78
		30-60	5.58	0.413	0.54

Table 8.6

pH, EC (mmhos/cm) and organic carbon (%) of garden land soil series - Thodupuzha(Tpa) - 86-87

Sl. No.	Description	Depth in cm.	pH	EC (mmhos/cm)	Organic carbon (%)
1.	Intensively canal irrigated area	0-15	5.17	0.211	0.75
		15-30	5.22	0.218	0.81
		30-60	5.34	0.232	0.37
2.	Unirrigated cultivated area near the canal irrigated area	0-15	5.16	0.198	0.75
		15-30	5.42	0.210	0.82
		30-60	5.38	0.211	0.66
3.	Unirrigated area likely to be brought under irrigation shortly	0-15	5.03	0.196	0.83
		15-30	5.12	0.198	0.59
		30-60	5.08	0.205	0.60

EXPERIMENT No.9

1. Title of the experiment : WM.9 Studies on Soil moisture retention and release characteristics of laterite soils of varying percentage of gravel.

2. Objective:

1) The water storage capacity of the laterite soils is very much influenced by the gravel content which vary from 25-60%. The study will be useful for scheduling irrigation in laterite soils of Kerala which occupy nearly 60% of the geographical area of the state.

2) To workout the moisture retention characteristics of laterite soils containing varying percentage of gravel.

3) To workout the relationship between moisture retention and the physical properties of the soil including gravel content.

4) To develop prediction equations to predict the moisture retention at different tension values from the knowledge of the gravel content in laterite soils.

3. Year of commencement : 1986-87

4. Technique.

Soil samples from major series of laterite soils will be collected upto a depth of 150 cm at an interval of 30 cm. The mechanical composition of the 2 mm seived fractions and the gravel percentage of each sample will be determined. Moisture retention studies of the gravel as well as the seived fraction at different tension values will be done

using pressure plate apparatus. Moisture retention of the soil containing gravel will be found out by working out the mean retention of gravel along with its propertion. Moisture retention will be related to texture, organic matter and gravel content by doing multiple regression analysis.

5. Work done during the period

The soil series Tpa (Thodupuzha) was selected for this study, which is the major soil series of laterite soils of Kerala.

During the year under report, the percentage of moisture retained in 2 mm seived soil and unseived soil upto a depth of 60 cm of 6 profiles at tensions of 0.3,1,3,5,10 and 15 bar was determined and furnished in Table 9.1.

In all the cases, the moisture retention was low in unseived soil samples.

Conclusions could be drawn only after completion of the work.

Table 9.1

Moisture retention of laterite soils of varying percentage of gravel.

a) Thodupuzha series. Profile 3.1

Depth (cm)		Percentage of moisture at different tensions in bars.					
		0.3	1	3	5	10	15
0-15	Sieved soil	16,71	14.25	11.71	11.47	9.44	9.19
	Unsieved soil	14.51	11.48	9.52	8.64	7.8	7.34
15-30	Sieved soil	16.52	14.56	11.0	10.69	8.56	8.33
	Unsieved soil	15.91	13.0	10.62	8.91	7.94	7.81
30-60	Sieved soil	15.62	13.28	10.48	10.27	8.75	8.51
	Unsieved soil	13.63	10.59	9.0	8.28	9.91	7.41

b) Thodupuzha series Profile 3.2

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0-15	Sieved soil	17.59	14.14	12.24	11.42	10.24	8.99
	Unsieved soil	14.40	13.11	10.30	9.70	8.75	8.28
15-30	Sieved soil	14.90	12.93	11.54	10.13	8.99	8.58
	Unsieved soil	14.89	11.87	10.02	8.97	8.88	8.03
30-60	Sieved soil	15.12	14.03	11,10	11.37	9.40	9.09
	Unsieved soil	12.92	10.27	10.24	9.44	8.18	7.69

c) Thodupuzha series. Profile No.4

Depth (cm)		Percentages of moisture at different tension					
		0.3	1	3	5	10	15
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0-15	Sieved soil	14.67	13.22	9.72	9.09	7.47	6.80
	Unsieved soil	9.54	8.35	7.29	6.41	5.94	5.00
15-30	Sieved soil	16.26	14.51	11.47	10.42	9.03	8.60
	Unsieved soil	8.12	6.93	5.90	5.52	4.96	4.60
30-60	Sieved soil	17.79	14.68	11.90	11.66	10.14	9.42
	Unsieved soil	11.73	9.66	8.22	7.39	5.87	4.96

d) Thodupuzha series Profile No.5.1

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0-15	Sieved soil	15.25	12.81	11.59	11.01	9.74	9.67
	Unsieved soil	15.20	12.25	11.09	9.60	8.76	7.72
15-30	Sieved soil	15.30	13.08	11.35	10.55	9.72	9.41
	Unsieved soil	13.94	11.96	10.81	10.34	8.41	8.12
30-60	Sieved soil	15.16	12.97	11.02	10.93	9.45	9.25
	Unsieved soil	13.55	10.72	9.70	9.01	8.25	7.66

c) Thodupuzha series Profile No.5.2

(1)	(2)	(4)	(4)	(5)	(6)	(7)	(8)
0-15	Sieved soil	13.54	10.45	9.63	9.19	8.58	8.18
	Unsieved soil	12.83	10.20	9.02	8.35	7.74	7.62
15-30	Sieved soil	15.61	13.16	11.3	9.59	8.64	8.32
	Unsieved soil	13.69	10.94	9.48	8.91	7.72	7.39
30-60	Sieved soil	15.72	12.88	11.47	11.20	10.45	10.21
	Unsieved soil	13.28	11.60	10.00	9.61	8.27	7.64

f) Thodupuzha series Profile No.6

Depth (cm)		Percentages of moisture of different tension					
		0.3	1	3	5	10	15
0-15	Sieved soil	14.53	11.19	9.91	9.08	8.00	7.71
	Unsieved soil	10.72	7.40	6.97	5.92	5.88	5.55
15-30	Sieved soil	15.66	12.58	11.28	10.17	9.78	9.33
	Unsieved soil	7.57	6.20	6.00	5.86	5.81	5.34
30-60	Sieved soil	16.57	14.70	12.77	12.53	12.13	11.72
	Unsieved soil	10.43	8.04	7.30	6.87	6.84	6.52

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EXPERIMENT No.10

1. Title of the experiment : WM.18 Studies on evaluation of different lining materials for seepage control.

2. Objectives:

   1. To assess the durability, effectiveness and economics of different lining materials.
   2. To evaluate the actual benefit of lining for watercourse.

3. Year of commencement : 1987-88 (summer)

4. Treatments:

   1. Brick laid in cement sand.
   2. Cowdung mixed with clay.
   3. Polythene sheet (250 gauge)
   4. Control (unlined)

5. Technique: The channel cross section was designed for 45 lit/sec discharge. The channel was having a bottom width of K of 30 cm, top width of 90 cm and a depth of 30 cm. The side slope is 1:1 and the bed slope is 0.4%. The same discharge rate was adopted for all the treatments.

6. Work done during the period

   During the year under report only the brick laid in cement sand was constructed to a length of 100 meters. This experiment could not complete due to the lack of qualified hands because the services of the engineers were terminated.

SECTION E

Summary

1. WM.21. Studies on onfarm irrigation watermanagement in the command of an irrigation minor.

The centre has implemented an operational research project at Thuravoor in Angamally of Ernakulam District for the last three years. The total area under study was 25.3ha belonging to 100 farm families. The emphasis was on irrigation water management in rice and rice based cropping system under varying irrigation water supplies. For effective implementation of the programme, a Karshaka Samithi was formed, registered and a committee was constituted from this. All the activities were formulated and implemented through this samithi.

Adoption of a suitable cropping pattern using high yielding varieties of medium and short duration rice, strict adherence to the time schedules in various field operation, judicious application of manures and fertilizers based on soil test data, need based plant protection, Scientific watermanagement, channel to field irrigation, shallow submergence and providing drainage wherever necessary and application of lime to eliminate the ill effects of iron toxicity were the area.

This programme was a grant success and the results revealed that rice yields in fragmented farm holdings of Kerala could be remarkably improved by adopting scientific watermanagement and other cultural operations. These can be

effectively and economically carried out through the farmers group organisation.

2. WM.5 Studies on rice based cropping pattern under constraints of irrigation water.

The study was repeated for the fifth year with five cropping pattern (two crops of rice followed by a third crop of rice, cowpea, groundnut, sesamum and bhindi) and two watermanagement practices for rice during the second crop season (7 cm irrigation 1 and 3 days after the disappearence of ponded water) and 3 watermanagement practices for different crops during third crop season (7 cm irrigation 1,3 and 5 days after disappearence of ponded water for rice and IW/CPE ratios of 0.3,0.6,0.9 and 1.12 for other crops) to identify an appropriate rice based cropping pattern under conditions of water scarcity.

The study indicated that there was no residual effect of cropping sequences on the growth and yield of the succeeding crops as in the previous crops. The influence of watermanagement in the grain yield during second crop was not significant, which may be due to the availability of frequent rains during the year. In the summer also, the crop did not respond to irrigation.

3. WM.1.1. Effect of varying water regimes on yield of rice under varying levels of soil fertility.

This experiment was laid out to study the optimum water regimes for wet sown rice in relation to nitrogen levels and to quantify the adverse effect of prolonged stress on crop yield during the Rabi season 1987-88.

The results revealed that during the rabi season, irrigation can be prolonged upto one day after the disappearence of ponded water without any reduction in yield. Maximum yield was obtained when nitrogen was applied at the rate of 50 kg/ha in short duration variety (Thriveni).

4. WM.2.1 Studies on the effect of irrigation schedules on the growth and yield of coconut.

Results of the study on scheduling irrigation to a standing crop of coconut in a sandy clay loam soil indicated that the crop responded well to irrigation during dry months (January to May) from the third year onwards. Irrigating the crop with 500 litres of water through basins taken at 1.8 m radius at CPE values of 50 mm (approximate interval of 12 days) was most economical.

The effects of irrigation in nut yield was reflected in the succeeding year also in the case of irrigation at 3 days interval and irrigation at 25 mm CPE.

5. WM.2.4 Response of Colocasia to varying levels of irrigation under different nitrogen levels.

This experiment was conducted during 87-88 to study the respnse of colocasia to various levels of irrigation and nitrogen with regard to its yield and quality.

The results revealed that the effects due to levels of nitrogen was significant and maximum yield was recorded by nitrogen applied @ 40 kg/ha. The effect of irrigation was not significant during the year under report, which may be due to the availability of frequent rains.

6. WM.2.2 Watermanagement practices for Bittergourd (Momordica charantia L) under graded doses of nitrogen.

The results of the study revealed that the effects due to nitrogen and irrigation were significant in the yield of bittergourd.

Among the irrigation levels the farmers practice of of irrigation of once in two days and irrigating the crop at 15 mm CPE (at an approximate interval of 4 days) were superior to other treatments.

Among the levels of nitrogen 90 kg N/ha recorded the highest yield and was on par with 60 kg N/ha and hence the economic dose of N can be taken as 60 kg N/ha for bittergourd.

7. WM.3 Effect of various mulches on the growth and yield of banana cv. Palayankodan grown under irrigated and rainfed conditions.

Harvest was not completed during the year under report.

8. WM.15.2 Evaluation of long term effect of canal irrigation on changes in physical and chemical properties of soil.

Physical and chemical properties of the 1st year sample have been completed. The hydraulic conductivity, bulk pH, Fe and organic carbon of the second year sample have also been completed. Since this project have to be continued for 10 years no conclusion can be drawn from 2 year data.

9. WM.9 Studies on soil moisture retention and release characteristics of laterite soils of varying percentage of gravel.

Moisture percentage of the 2 mm seived and unseived samples of the Tpa series (laterite series having above 60% gravel) were determined at different tensions. The determination of the aggregate size distribution are being carried out.

10. WM. 18 Studies on evaluation of different lining materials for seepage control.

Not completed the project during the year under report.

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SECTION - F

List of Publications

a) Research articles

1. Kuruvilla Varghese, Jose Mathew, G.R.Pillai and G.Santhakumari - Effect of irrigation on Sweet potato under graded dose of nitrogen and potash. J-Root crops 13(1) : 25-28 1987.
2. G.R.Pillai, Kuruvilla Varghese, Jose Mathew and G.Santhakumari.
   Intercropping food legumes with cassava in a rice based farming system Proc. of international workshop as Food legume improvement for Asian farming systems, Khoon Kaean, Thailand 1-5 September 1986 ACIAR Proceedings No.18 240-241.
3. R.Elangovan, E.K.Kurian and G.Santhakumari.
   Rainfall pattern and cropping system in low rainfall area of Kerala.
   Accepted for publications in Madras Agricultural journal.
4. Kuruvilla Varghese, G.R.Pillai and Jose Mathew.
   Economics of irrigation and mulching in Pineapple var.Kew.
   Published in the proceedings of the international symposium on Arid and Semi arid Zones, HAU, Hissar November 27-29 1986 P 545.
5. G.R.Pillai, Kuruvilla Varghese, Jose Mathew and G.Santhakumari.
   Response of Nendran Banana to irrigation and mulching
   (accepted for publication in Agri. Res. J. Kerala 1987.

6. Jose Mathew, Kuruvilla Varghese, G.R.Pillai and G.Santhakumari.

Response of second crop rice to different water regimes and nitrogen levels (communicated to Agric.Res. J. Kerala).

7. Jose Mathew, Kuruvilla Varghese, G.R.Pillai and G.Santhakumari.

Response of sesamum (sesamum indicum) to water management practices under varying levels of nitrogen. (communicated to Agric.Res.J. Kerala)

8. Kuruvilla Varghese, G.R.Pillai, Jose Mathew, G.Santhakumari and C.S.Gopi.

Effect of irrigation and mulching on the growth and yield of Pineapple (communicated to Agric.Res.J. Kerala)

9. Jose Mathew, Kuruvilla Varghese, G.R.Pillai and G.Santhakumari.

Response of Amorphophallus to irrigation and mulching (communicated to Agric. Res.J. Kerala).

10. Jose Mathew, Kuruvilla Varghese, G.R.Pillai and G.Santhakumari.

Studies on reducing the water requirement of tapioca. (communicated to Agric.Res.J. Kerala)

Research notes

1. Response of chickpea to soil and foliar application of Diammoniam Phosphate. (communicated to Agric.Res. J. Kerala) Kuruvilla Varghese et al

Popular articles

1. Jose Mathew and Kuruvilla Varghese.
   Irrigated amorphophallus for higher income (Malayalam) published in Malayalam Daily.
2. Kuruvilla Varghese and Jose Mathew.
   Suitable cropping sequence for command area (Malayalam) published in Malayalam Daily.
3. Kuruvilla Varghese and Jose Mathew.
   Irrigation requirement for summer crops. Published in 'Kalpadhenu' January-February 1988.

SECTION G

Results of practical utility

a) The findings of the water management studies in the station were included in the package of practice recommendation the Kerala Agricultural University for the year 1987.

1. Pineapple

Pineapple during summer months has to be irrigated at 0.6 IW/CPE ratio (50 mm depth of water). It requires 5 to 6 irrigations during dry months at an interval of 22 days. Mulching the crop with dry leaves @ 6 t/ha will considerably improve the fruit yield.

2. Sweet potato

Sweet potato requires irrigation at IW/CPE ratio of 1.2 (approximate interval of 11 days) for higher tuber yield in non rainy periods. The application of nitrogen and potassium at the rate of 50 kg/ha is ~~significant~~ sufficient for this crop grown under irrigation.

3. Amorphophallus

December-January planted amorphophallus has to be irrigated at 0.9 IW/CPE ratio with 50 mm water through furrows in summer season for higher corm production. It requires about 10 irrigations at an approximate interval of 12 days in non rainy periods. Mulching the crop with dried leaves or paddy waste @ 6 t/ha and coir dust @ 8 t/ha will considerably improve the crom yield.

4. Tapioca

In tapioca all furrow irrigation with 25 mm water at 100 mm CPE and alternate furrow irrigation alternatively with 50 mm water at 75 mm CPE requires only less water and labour for optimum yield. Approximate irrigation interval of the schedules will be 27 and 20 days respectively in summer months.

b) Irrigation scheduling and water use by crops.

1. Cropping system

Studies on the rice based cropping pattern indicated that there was no residual effect of cropping sequences on the growth and yield of succeeding crops. During rabi season rice requires irrigation at 3 days after the disappearance of ponded water and in the summer season one day after disappearence of ponded water. Other crops in the sequences viz. Bhindi, Cowpea and Groundnut requires frequent irrigation.

2. Coconut

Results of the study on scheduling irrigation to a standing crop of coconut in a sandy clay loam soil indicated that the crop responded well to irrigation during dry months (January to May) from the 3rd year onwards. Irrigating the crop with 500 litres of water through basin taken at 1.8 m radius at CPE value of 50 mm (approximate interval of 12 days) was most economical.

c) Operational Research Programme on "Onfarm water management in the command of an irrigation minor".

The operational research project implemented at Thuravoor by the Agronomic Research Station was a grant success and the results obtained revealed that rice yields in fragmented lands of Kerala could be remarkably improved by practicing modern scientific technologies. More and more farmers of the neighbouring area were adopted this practice to optimise the irrigation water use in rice cultivation for better yields.

SECTION H

Details of advisory service rendered by the centre

The following advisory services were rendered by the centre.

1. Operational Research Project

Improved technologies were transferred to the farmers field on a large scale by group organisation of small farmers having fragmented laid through the operational research project of the station. The results obtained from this revealed that rice yields in fragmented lands of Kerala could be remarkably improved by practicing modern scientific technologies. More and more farmers of the neighbouring area were adopted this practices to optimise the irrigation water use in rice cultivation for better yields.

2. Training Camps and Seminars

Training camps, seminars and karshaka mela were organised during the year under report in Kerala Agricultural University research stations and in operational research project area, Thuravoor. About 150 - 200 farmers actively participated. The Scientists of the research station used to visit the ORP area frequently and hold group discussion with farmers. Scientists from research station as well as from Kerala Agricultural University gave lecturers on all relevant subjects and prticipated in the group discussion with farmers in the Seminars and Kissan melas.

3. Co-ordination with other departments

The scientists of the centre keeps a liasion with the department of Agriculture, department of irrigation, Government of Kerala and command area development authority. A permanent cement lined irrigation channel was constructed in the operational research project area in collaboration with the command area officers. The soil collection and profile studies of the command area were done with the help of the soil survey unit of the department of Agriculture.

4. Broadcast through AIR

The following topics were broadcasted by the scientist through AIR an interview with Progressive farmers.

1) Water management for summer rice.

2) Points to be observed in watermanagement.

A talk on the success story was broadcasted by a progressive farmer of the CRP area.

5. Publications

The findings of the centre are included in the package of practice recommendation of Kerala Agricultural University. The success of the operational research project in command area was published as a booklet on Group management in farming system. Articles about its success story appeared in a number of Malayalam Dailies, and magazine.

6. Planning

The water use efficiency of different crops culculated by the centre were utilized by other agencies like P.W.D., Irrigation Department, Soil Survey, Department of Agriculture, Command Area Development Authority for various purposes

like irrigation project planning, to plan the cropping pattern in command areas, scheduling irrigation to crop etc.

7. Advisory service to farmers

A large number of farmers visited the centre to seek advice from the Scientists for Scientific Cultivation, especially Watermanagement and other problem like pest and disease faced by them for different aspects. They curros-ponded through letters also for the above purpose. The scientists also visited a large number of plots of different crops of the farmers for suggesting the scientific cultivation and other aspects on their request.

8. Academic

Students from College of Horticulture and College of Agriculture were visited this station as a part of their study tour. The trainees under command area development authority and department of Agriculture also visited the station and studied the various aspects of watermanagement.

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SECTION-I

Difficulties experienced by the centre

1. Physical facilities of land

The non availability of upland is often a limiting factor in taking up trials in different garden land crops.

2. Finance

Since the prevailing labour wages in the state is comparatively high the allotment of funds under recurring contingencies often become inadequate.

For most of the rice farmers, farming is only a subsidiary occupation and the extent of land available is also very small. Rice farming in this part is very costly often resulting in loss to farmers. The main reason being exorbitant labour wages and poor returns. With the result farmers are tempted to abandon rice farming. The farmers in the ORP area is no exception. During past few years some amount of assistance in kind were made available to them through Lab to Land Programme and they were enthused to adopt our improved technology. Now Lab to Land Programme is not operating in the study area and the farmers are not keen to adopt our technology though they are very much convinced of the benefits. Unless they are given some amount of financial assistance, it will be difficult to get the project going.