801499

KERALA AGRICULTURAL UNIVERSITY
REGIONAL AGRICULTURAL RESEARCH STATION
PILICODE - 670 353.

C O N T E N T S

PART I

PART II
EXPERIMENTAL DETAILS

***

PART I

1. INTRODUCTION

a) Year of sanction : 1980 as per letter No.3-19/79-Edn. IV of the ICAR

b) Date of start : August 7, 1980

c) Date of completion : August 8, 1985

d) Sanctioned strength of the staff and staff in position (as on 31st March, 1988)

Sl. No.	Category	Staff sanctioned	Staff in position	Vacancy
A.	PILICODE CENTRE:			
1.	Associate Director	1	1	-
2.	Professor	4	4	-
3.	Associate Professor	14	4	10
4.	Assistant Professor	5	4	1
5.	Farm Assistant Gr.I	5	5	-
6.	Laboratory Assistant	6	2	4
7.	Tractor Driver	1	-	1
8.	Driver Gr.II	2	2	-
9.	Photographer-cum-Artist	1	-	1
10.	Administrative Officer	1	1	-
11.	Typist Gr.I	2	2	-
12.	Typist Gr.II	2	-	2
13.	Peon	1	1	-
B.	PANNIYUR CENTRE:			
1.	Professor	1	1	-
C.	TAVANUR CENTRE:			
1.	Assistant Professor	1	1	-

2. OBJECTIVES OF THE STATION:

The National Agricultural Research Project was launched on August 9, 1980 with the objective of conducting location specific, production oriented research in the northern agro-climatic zone of Kerala. The Regional Agricultural Research Station, Pilicode has been assigned the lead function for research on coconut and will also act as the verification and testing centre for rice, pulses, banana and vegetables.

...2

Research on pepper is conducted at Pepper Research Station, Panniyur. The research component of the Kelappaji College of Agricultural Engineering and Technology, Tavanur is functioning as a verification centre for rice, banana and betelvine.

3. RESEARCH REQUIREMENTS OF THE ZONE:

In this zone a good number of crops like coconut, arecanut, pepper, banana etc. are grown together in the majority of the cultivated area. In the undulating topography areas cashew and rubber are grown on a plantation scale. In the low lands, rice is the major crop in the Khariff season and during Rabi, vegetables like cucumber, watermelon, bitter gourd, snake gourd, cowpea; pulses like horse gram, greengram, blackgram, oil seeds like sesamum and ground nut are cultivated.

Three cropping systems have been identified in the northern zone:-

1) Coconut and coconut based farming systems.
2) Rice and rice based farming systems
3) Homestead farming systems.

The problems identified in each system of cropping is critically examined and studies are undertaken to solve these problems.

4. RESEARCH:

a) Salient research results achieved under the project

The results obtained from the ongoing research projects during Rabi (1987-'88) are summarised below:-

(i) Coconut and coconut based farming system

WCT x MDY, WCT x CDG and WCT x CDO were proposed for release for large scale cultivation in Kerala.

A new disease - leaf blight of coconut caused by Pestalosphaeria elaeidis was reported. It was found to cause severe damage.

Paddy:

In the Koottumundakan system of paddy cultivation, a fertilizer schedule of NPK @ 20 : 10 : 10 kg/ha was found to be the most economic one for the Mundakan partner viz., variety Mundon.

Cul. 1727 gave indications of giving fairly good rattoon yield when grown in the single crop lands.

Pepper:

Regarding the control measures for slow wilt disease application of Thimet along with a copper fungicide was found to reduce the symptoms considerably.

For the control of nursery disease of pepper, spraying and drenching with 1% Bordeaux mixture reduced the infection significantly. Under low light intensities the incidence of the disease was more.

Cashew:

A new disease - Nursery blight of cashew caused by Aspergillus niger was recorded. It caused severe damage in the nursery.

5. EDUCATION:

i) Details of participation of NARP staff in teaching.

a) Engaged classes for the students of Vocational Higher Secondary, Trikarpur.

b) Engaged classes for various agricultural seminars organised by different agencies.

ii) Training of scientists for updating knowledge

Dr. Shyam S. Kurup, Junior Assistant Professor and Sri. M. Govindan, Junior Assistant Professor attended the International Symposium on Tropical Ecology, held at Banaras Hindu University, Varanasi and presented research papers. Dr. G.S.L.H.V. Prasada Rao, Associate Professor attended the "National Convention on Agrometeorology" held at Calcutta University, Calcutta during 6-8 March 1988 and presented a research paper.

6. EXTENSION:

a) Seminars:

A seminar was organised on 5.3.1988 in connection with the Golden Jubilee Celebration of the hybrid cocconut in which a large number of farmers participated.

Conducted the Xth Regional Workshop (NARP-KAEP Northern Region) during 13th and 14th August 1987 at RARS Pilicode in which 65 scientific and extension personnels participated.

The following new problems were received from extension and actions taken.

1) Nursery blight of cashew
2) Pestalosphaeria leaf blight of coconut
3) Diseases of banana
4) Attack of slug caterpillar in coconut.

b) Nil

c) Programmes were initiated for large scale production of hybrids released.

Promising hybrids were tried under multilocational trial. Projects were proposed under Phase-II on studies on coconut fodder livestock integrated farming system. Studies on disease of cashew was taken up. Studies on a hitherto unrecord but serious disease of coconut (leaf blight caused by Pestalosphaeria elaeidis) was taken up.

Studies were initiated with special reference to fly breeding and health hazards due to application of fresh fishmanures in tobacco cultivation.

d) Training:

Six numbers of one day vocational training programmes were conducted for farm youth and farm women.

T & V Workshops were conducted for the officers of the Department of Agriculture.

A training programme for Mahila Samajams of the Cannanore District on Social Forestry was conducted on 13th-14th January 1988.

e) Adoption of villages, farmers camp at station and number of farmers visiting station.

Village Adoption Programme was implemented in Pilicode Village.

A seminar was conducted at RARS Pilicode in which more than 150 farmers participated.

200 farmers visited the station under Krishi Darshan Programme. Apart from that about 150 farmers visited the station to contact scientists to solve their agricultural problems.

f) Contact of research scientists with extension officers

. The Xth Regional Workshop (NARP-KAEP Northern region) was conducted during 13th & 14th August 1987 at RARS Pilicode in which 65 scientific and extension personnels participated.

T & V Workshops at Calicut and Cannanore are chaired by scientists of this research station. Problems identified are discussed during the workshop and remedial measures formulated apart from the messages given.

Scientists of this station partake as resource personnels in the diagnostic team and conduct joint field visit along with the officers of the Department of Agriculture. This also helps to find out suitable remedial measures for the Agricultural problems.

g) Specific research practices recommended to extension agencies and extent of adoption.

Demands for the newer hybrid coconut seedlings far exceeds the availability indicating that farmers have fully adopted this technology.

Irrigation and mulching for coconut were also adopted.

Control measures developed by the university for the newer diseases of coconut, cashew and banana were also adopted by the farmers.

h) Major constraints in adoption of research - recommendations if any

Lack of irrigation facilities available in the zone is one of the major constraints in adoption of improved practices.

7. DETAILS OF VISIT OF EXPERTS/SUPERVISION/REVIEW MISSION, THEIR COMMENTS

Dr. M. de Nuce de Lamothe, EEC consultant visited the station on 6.5.1987.

Sri. E.K. Nayanar, Hon'ble Chief Minister of Kerala visited the station on 5.3.1988.

8. SUMMARY AND CONCLUSION:

The National Agricultural Research Project was launched on August 9, 1980 with the objective of conducting location specific, production oriented research in the northern agroclimatic zone of Kerala. The problems identified in different systems of cropping was critically examined and studies were initiated to solve them. The results obtained from the different ongoing experiments clearly indicate the progress achieved to solve the location specific problems. Three hybrid varieties viz., WCT x MDY, WCT x CDG, WCT x CDO were proposed for release for large scale cultivation in Kerala. Solutions were found out for certain newer diseases of coconut and cashew which affected the respective crops very seriously.

The scientists used to participate in various extension activities - participation in agricultural seminars, writing popular articles, radio talks, training farmers, village adoption programmes, krishi darshan programme etc. A number of specific research practices were recommended to extension agencies. The commendable work being undertaken by this research station was well appreciated by distinguished visitors like Sri. E.K. Nayanar, Hon. Chief Minister of Kerala.

---

1. COCONUT AND COCONUT BASED FARMING SYSTEMS

1.1. COCONUT

1.1.1. Utilisation of existing germplasm and description of varieties.

Objectives:- (1) To evaluate the exotic and indegenous cultivars of coconut available in the station (2) to describe the morphological characters of each cultivars and (3) to conduct replicated trials with promising types.

Technical Programme:

Collection of coconut cultivars from various parts of the country as well as from abroad and study of their performance. Detailed description of the cultivars will be recorded and promising cultivars will be tested in replicated trials.

Germplasm collection of coconut consists of 31 exotic and 36 indegenous types. They are as follows:

Indegenous cultivars

1. Andaman Ordinary
2. Andaman Dwarf
3. Andaman Giant
4. Laccadive Ordinary
5. Laccadive small
6. Laccadive Micro
7. Laccadive Dwarf
8. Malrosapuram
9. Kappadam
10. Bombay
11. Gudiathum
12. Chingalpet
13. Thiruthirapundy
14. Tanjore
15. Selam
16. Pollachi
17. Omalur
18. Kulithali

(Contd.....2)

19. Kodiripadu
20. Indupali
21. Godavari
22. Bengal
23. Mysore
24. Basanda
25. Baboor
26. Bansa hybrid
27. Gangabondam
28. Spicata
29. Chowghat Dwarf Orange
30. Chowghat Dwarf Green
31. Chowghat Dwarf Yellow
32. West Coast Tall
33. Kaithathali
34. Ayiramkachi
35. Rangoon Kobbari
36. Verri Kobbari

Exotic cultivars

1. Borneo
2. British Soloman Islands
3. Cochin China
4. Ceylon
5. Fiji
6. Gon Thembili
7. Guam
8. Jamica
9. Java
10. Kalpawangi
11. Karkar Tall
12. Kenya
13. Kudat
14. Lifaon Tall
15. Malayan Dwarf Green
16. Malayan Dwarf Orange
17. Malayan Dwarf Yellow
18. Markhar Tall
19. Navasi
20. New Guinea
21. Philippines
22. Philippines Kalibahim
23. Philippines Laguna
24. Philippines Ordinary
25. San Raman
26. Seychelles
27. Siam
28. S.S. Apricot
29. S.S. Green
30. St. Vincent
31. Thembili

(Contd.....3)

Experimental Design : Planted according to the availability of cultivar.

Total Area .. : 3.5 ha

Results obtained in the year.

During the year 1987-88 also St. Vincent continued its superiority over the other types in cumulative leaf and nut production. It is evident from the Table 1.

Table 1.

Mean growth measurements of new germplasm collection of coconut.

Sl. No.	Cultivar	No.of functional leaves	No. of leaves produced		No. of nuts produced		No. of palms flowered out of six
			in 1987	till date	in 1987	till date	
1.	St. Vincent	23.67	11.33	108.67	15.83	21.50	6
2.	Borneo	25.17	11.33	102.17	0.50	0.50	3
3.	British Solomn Islands	23.00	11.67	101.67	2.17	4.00	4
4.	Kenya	24.17	11.83	95.00	3.17	5.83	5
5.	Guam	18.67	10.33	88.50	2.17	2.67	1
6.	Kudat	23.00	11.67	99.33	7.67	8.50	6
7.	Phillippines Lono	22.60	11.60	97.20	0.83	4.00	3
8.	Kalpawangi	22.17	11.83	99.67	2.67	2.83	3
9.	Andaman Ordy.	23.33	10.83	102.50	2.17	4.17	5
10.	West Coast Tall	20.00	10.33	92.17	1.17	2.33	6
11.	Andaman Giant	23.00	10.67	96.17	0.67n	0.67	2
12.	Seychelles	24.00	11.50	98.17	6.67	6.67	5
13.	Siam	16.00	9.00	84.00	-	-	-
14.	Laccadive Ordinary	13.80	6.60	67.60	-	-	-
15.	Kaithathali	17.20	9.20	87.80	-	-	4

(Contd.....4)

Conclusion:- Among the fifteen new introduction planted during 1976 St. Vincent found performing better than all other in the morphological and preliminary yield recorded under rainfed conditions.

1.1.2. Evaluation of Tall x different Dwarfs and their reciprocals.

Objectives: (1) To study the performance of different hybrids involving 15 parental combinations of Tall and Dwarf and to compare with West Coast Tall. (2) To study the extent of heterosis in different combinations and the influence of different Dwarf male parents on growth, flowering, yield and other characters for selecting promising Dwarf types as pollen parents.

Technical programme:

Lay out	:	RBD
No. of treatments	:	16
No. of Replications	:	5
No. of seedlings/plot	:	1
Gross area	:	0.96 ha
Net area	:	0.47 ha

Results obtained in the current year

The data on growth and yield recorded during the year under report also showed the superiority of WCT x MDY hybrid over the others and was on par with WCT x CDG and WCT x CDO. In respect of morphological characters like number of leaf production and number of functional leaves, WCT x GB was superior to all other crosses and WCT (Table 2).

(Contd.....5)

Table-2

Mean growth and yield characters of different hybrids recorded during 1987-88

Sl. No.	Hybrid/ Cultivar	No. of leaves			No. of nuts produced		Copra content (g)	Oil content (%)
		on the crown	Produced in 1987	till date	in 1987	Till date		
1.	WCT x CDO	32.40	13.60	159.40	131.60	504.0	193.15	65.31
2.	CC X CDO	29.4	13.60	153.8	97.2	304.0	218.91	63.26
3.	AO x CDO	29.4	12.6	156.6	109.2	361.4	184.13	61.44
4.	LO x CDO	28.4	12.2	149.8	114.0	345.8	168.91	63.0
5.	Fiji x CDO	29.0	12.2	159.0	114.8	420.6	221.50	62.82
6.	Fiji x GB	29.0	13.8	158.2	81.4	285.6	186.31	64.15
7.	WCT x MDY	31.40	12.8	156.8	177.2	624.4	206.91	66.33
8.	WCT x TBL	29.2	12.4	157.6	121.0	387.2	211.25	62.21
9.	WCT x SS	30.6	13.8	162.2	113.0	430.0	191.68	64.91
10.	WCT x CDG	30.5	13.0	161.7	171.0	614.5	205.11	64.94
11.	WCT	30.8	14.0	147.6	56.60	195.6	192.3	65.00
12.	CDO x WCT	28.6	12.6	150.6	108.0	301.6	214.83	61.37
13.	CDO x LO	28.2	11.0	144.6	52.2	198.6	167.50	63.53
14.	GB x LO	29.4	12.8	155.4	104.0	357.2	173.50	62.28
15.	WCT x LO	28.2	12.0	150.0	114.0	424.2	191.15	63.67
16.	WCT x GB	35.2	14.6	162.8	78.6	362.0	179.63	67.11
	C.D.	3.86	N.S	N.S	46.88	169.70	N.S.	NS

(Contd.....6)

a) No. of leaves on the crown: WCT x GB was superior to the rest except WCT x CDO and WCT x MDY.

b) No. of leaves produced in 1987: WCT x GB was found to be better than others but there was no significant difference among the treatments.

c) Cumulative leaf production: In this character also WCT x GB ranked first and there was no significant difference between others.

d) No. of female flower production: WCT x MDY was superior and on par with WCT x CDG, WCT x CDO and WCT x LO in number of female flower produced during the year.

e) No. of nuts production : WCT x MDY and WCT x CDG were on par and superior to the rest except WCT x CDO.

f) Cumulative nut production: WCT x MDY and WCT x CDG were on par and superior to the rest except WCT x CDO

Summary and conclusion :

Based on the above results in nut yield the three hybrids namely WCT x MDY, WCT x CDG and WCT x CDO were found to be superior to the rest. The copra study of this hybrid is in progres. The three hybrids mentioned above with WCT as a local check were sent for multilocational trials in 5 different regions during the year under report. The centres were (1) NARP, Kottarakkara (2) RARS Kumarakom (3) R.R.S. Kayamkulam (4) KADP, Vellanikkara and (5) RARS Nileshwar.

(Contd.....7)

1.1.3. Trial of promising seed materials.

Objectives:

(1) To conduct field trials to isolate the superior types and hybrids and to compare the performance of promising exotic types and hybrids with West Coast Tall.

(2) To study the economics of raising promising types and hybrids in comparison to West Coast Tall.

Technical Programme:

Lay out : RBD

Treatments : 13

1. COD x WCT
2. WCT x COD
3. WCT x GB
4. LO x GB
5. S.S. Green
6. Philippines Ordinary
7. Andaman Ordinary
8. Laccadive Ordinary
9. Laccadive Micro
10. Java
11. Kappadam
12. Prepotent Tall
13. West Coast Tall

Replications : 3

Tree/plot : 4

Gross area : 1.75 ha.

Net area : 1.30 ha.

Results during 1987-88 are furnished in Table 3.

(Contd.....8)

Table-3

Mean growth and yield recorded in the Etrial of [illegible] promising seed materials during 1987

Sl. No.	Treatments	No. of functional leaves	No. of leaves produced		No. of nuts produced	
			in 1987	till date	in 1987	till date
1.	CDO x WCT	20.50	11.47	101.69	16.03	19.67
2.	WCT x CDO	21.08	10.42	99.42	18.33	21.25
3.	WCT x GB	25.17	12.17	114.33	23.17	32.75
4.	LO x GB	22.75	10.83	98.50	1.67	5.67
5.	S.S. Green	18.67	9.42	90.75	3.17	3.17
6.	Philippines Ordinary	23.59	11.50	103.59	1.00	1.13
7.	Andaman Ordinary	18.75	10.50	89.58	0.42	0.42
8.	Lacadive Ordinary	21.25	10.75	98.50	1.42	2.0
9.	Lacadive	24.72	10.94	101.22	15.11	22.06
10.	Java	19.25	9.19	89.72	-	-
11.	Kappadam	19.75	10.83	96.42	2.67	2.67
12.	Prepotent Tall	20.47	10.06	88.58	0.83	0.83
13.	WCT	20.36	10.42	92.08	0.17	0.25

a. No. of functional leaves: WCT x GB was best followed by Lacadive Micro in number of functional leaves on the crown.

b. Cumulative leaf production: In this character also WCT x GB was found to be the best treatment followed by Bhilippines ordinary.

c. Cumulative nut production: WCT x GB hybrid was better than others and the next high yielder was Lacadive micro.

(Contd.....9)

Summary and conclusion :

From the preliminary observations recorded for the past 11 years indicate that WCT x GB was better treatment in cumulative leaf production and nut yield. Since it is only a preliminary study we have to wait upto the stage of steady bearing period to get a true picture. Even then there is enough proof that hybrids are better than other promising Tall cultivars.

1.1.4. Large scale multiplication of promising hybrid coconut seedlings

Objectives:

To meet the long term demand of the cultivators for the promising hybrid coconut seedlings and to strengthen the present population of parental trees. to the major research station of the University.

Technical programme :

Collection of parent materials from the source of its origin and planting in different agricultural research station such as Livestock farm, Thumbermuzhi, Thiruvazham kunnu, Tavanur, Mannuthy, Pattambi and Ambalavayal. RARS Pilicode will serve as the lead station and co-ordinate the breeding work at the above different stations. The following number of seed nuts have proposed to be collected.

Cultivar		No. of seed nuts
Laccadive Ordinary	:	1500
Andaman Ordinary	:	1500
Gangabondam	:	750
Total	:	3750

(Contd.....11)

These have to be collected from Lakshadweep Islands, Andaman Islands and Godavari district of Andhra Pradesh, respectively during April/May 1988. The entire seed materials will have to be raised in the nursery at RARS Pilicode and will be distributed to the other sub stations by May 1989.

Work in Progress :

1500 Lacadive Ordinary seed nuts collected from the selected mother plants of C S F Aralam were sown in the nursery. Arrangements were made to collect Andaman Ordinary seed nuts from Port Blair. 84 Nos. of Gangabondam seed nuts collected from Ittikalagunta were taken stock and sown in the nursery. The remaining number of seed nuts will be collected by the end of this year.

1.1.5. Commonsalt as a substitute for potash in the nutrition of adult coconut palms.

Objectives: i) To find out the effect of applying commonsalt on the yield and bearing habit of adult coconut palms.

ii) To find out whether common salt can act as a substitute for potassium in the nutrition of coconut.

Technical Programme:

Lay out	:	R B D
Treatments	:	6
Replications	:	4

(Contd.....12)

Treatment	Na_2O	K_2O in g/palm/year
1	0	0
2	0	1000
3	250	750
4	500	500
5	750	250
6	1000	0

In addition, all the palms received 500g N, 320g P_2O_5, 170g Mgo and 300 g Cao per palm per year. The fertilizers were applied in two splits in May-June and September-October.

Results: Annual leaf production, number of female flowers produced and nuts harvested were recorded.

The yield of nuts obtained, the female flowers produced and the setting percentage worked out for the year 1987 are tabulated (Table 4 and 5).

The maximum number of ripe nuts (87.9 nuts) was recorded by zero Na_2O : 1000 K_2O closely followed by 500g Na_2O and K_2O (81.7 nuts/tree).

Table - 4

Mean yield of nuts/palm/year as influenced by Nacl and Kcl

Treatment	No.of female flowers produced during 1987 per tree	No. of ripe nuts harvested during the year 1987 per tree	The setting percentage worked out
1	304.2	76.9	25.2
2	368.3	87.9	23.8
3	302.3	69.2	22.8
4	326.5	81.7	25.0
5	293.1	65.6	22.4
6	329.5	82.6	25.0

Table-5

Mean nut yield per palm as effected by Nacl and Kcl application

Treatment in g/palm/year		Pre-treatment yield - Mean of 1971-1976	Post-treatment yield - Mean of 1971 - 1976	Percentage increase
Na_2O	K_2O			
0	0	63.6	76.9	20.9
0	1000	68.1	87.9	29.1
250	750	52.8	69.2	31.1
500	500	54.0	81.7	51.3
750	250	41.9	65.6	56.6
1000	0	62.1	82.6	33.0

Conclusion:

The data so far collected showed that the maximum increase in yield was obtained when Nacl and Kcl were applied to get 750g Na_2O and 250g K_2O per palm per year. It is evident that replacement of potash to the extent of 50 per cent or even 75 per cent by soda both applied as chloride is possible without affecting the yield of nuts.

(Contd.....14)

1.1.6. Response of D x T hybrids to commonsalt application.

Objectives: The response of the hybrid D x T to commonsalt is to be studied from young stage onwards.

Technical Programme:

Layout : R B D

Treatment : 6

Replications : 4

Treatment No.	Na_2O	K_2O in g per palm per year
1	0	0
2	0	1000
3	250	750
4	500	500
5	750	250
6	1000	0

In addition to this all the palms received 500g N, 320g P_2O_5, 170 g MgO and 300 g Cao per palm per year. The young palms received 1/10th the adult palm dose three months after planting, 1/3rd in the first year, 2/3rd in the second year and full dose from third year onwards.

Results: The results obtained so far show that applying 250 g Na_2O and 750 g K_2O per palm per year is the best combination to produce the maximum ngrowth characters and precocity in D x T palms grown under rainfed laterite soil. The palms which received neither sodium nor pottassium are stunted in growth. The data are presented in Table-6.

(Contd.....15)

Mean growth and flowering behaviour of D x T hybrids as influenced by Nacl and Kcl (per palm)

Treatment in g/palm/year Na_2O : K_2O	No.of D x T	No. of functioning leaves on the crown	No.of leaves produced in 1987	Cumulative leaf production	No.of palms flowered in 1987	Total palms flowered so far
0 : 0	24	17.6	9.7	97.2	2	16
0 : 1000	22	21.2	10.7	100.1	3	20
250 : 750	23	21.9	11.3	102.6	-	23
500 : 500	24	21.2	10.7	99.8	2	22
750 : 250	23	20.1	10.9	99.5	1	21
1000 : 0	24	21.8	10.7	98.0	2	22

1.1.7. Crop-weather relationships of Coconut.

Objectives: (1) To classify agricultural droughts based on the index of moisture adequacy during the summer and nut yield in the following year.

(2) To estimate the nut yield of the subsequent year using the index of moisture adequacy during the summer.

Technical programme :

1. Data: The per palm mean annual nut yield of WCT of the uniform age, grown in block D from 1946-1971 (stabilised yield period) and the monthly rainfall and potential evapotranspiration from 1944 to 1970 were utilised for this study.

(Contd.....16)

2. Methodology: The mean annual nut yield was listed through simple 't' test after grouping into alternate years to study the effect of alternative bearing during its yield stabilised period. The actual evapotranspiration was worked out during the study period using the Thornthwaite's book-keeping water balance procedure based on monthly rainfall and potential evapotranspiration. The index of moisture adequacy which is the ratio between the actual evapotranspiration, expressed in percentage was worked out. Correlations were worked out between the index of moisture adequacy (Ima) from December to April and nut yield of the following year.

To classify the agricultural droughts, the minimal value of Ima (below which the nut yield decline was seen) was worked out based on the mean index of moisture adequacy (I_{ma}) from December to April and nut yield of the following year using a a graphical technique, given by Azzi (1956).

A multiple linear regression was fitted between the index of moisture adequacy and nut yield.

Results: The annual nut yield in alternative year (Table 7) showed that there was no significant difference in nut yield of alternate year. It indicated that the impact of alternative bearing was not seen in WCT during its yield stabilised period if the mean annual nut yield of entire block was taken into consideration.

(Contd.....17)

The correlation coefficients between the index of moisture adequacy (Ima) and nut yield of the following year (Table 8) showed that the index of moisture adequacy during December to April had a higher positive value (significant 0.001 level) with nut yield of the following year than that of the other periods viz. January-April, February to April and March to April. It indicated that the availability of soil moisture for longer periods is more significant rather than for a period of 2-3 months.

An agricultural drought classification using the index of moisture adequacy during December to April and nut yield of the following year is given in Table 9. It can be seen that 87.5 per cent of the years recorded higher nut yield (45 nuts per palm) when the index was more than 30 per cent. If the index was less than 15 per cent, the nut yield in the following year was less (30 nuts per palm in all the years. Similar was the case when the index was between 15 and 20 per cent. However, the nut yield decline in the following year was seen only in 60-70 per cent of the years when the index was between 20 and 30 percent. This is possible because the palms which are always grown in moderate soil moisture stress conditions during summer under rainfed conditions may not show nut yield decline under similar conditions in the years as the palms do have some adaptibility to the existing environmental conditions.

Table - 7

Nut yield of WCT at RARS Pilicode from 1946 to 1971

Year	Nut yield per palm	Year	Nut yield per palm
1946	34	1947	49
1948	70	1949	30
1950	33	1951	15
1952	40	1953	31
1954	44	1955	47
1956	55	1957	45
1958	38	1959	52
1960	55	1961	53
1962	33	1963	54
1964	61	1965	45
1966	64	1967	64
1968	44	1969	44
1970	23	1971	49
Mean	45.69		44.46

+ = 0.2343 - not significant

Table - 8

Correlation coefficients between the index of moisture adequacy (Ima) and nut yield of the following year

Ima during different months and nut yield of the following year	'r'	Significant at
Ima during December to April and nut yield of the following year	+ 0.6568	0.001 level
Ima during January to April and nut yield of the following year.	+ 0.5897	0.01 level
Ima during February to April and nut yield of the following year	+ 0.5274	0.01 level
Ima during March to April and nut yield of the following year	+ 0,4639	0.01 level

Table-9

Classification of agricultural drought based on the index of Moisture Adequacy during the Summer (December - April) and nut yield of the following year

Index of Moisture Adequacy (%)	Study years	No. of years under the category	Percentage occurrence of years in different yield groups (Nut per palm)					Intensity of drought
			45	40-45	35-40	30-35	30	
30	26	8	87.5	-	-	12.5	-	No drought
25-30	26	9	33.3	22.2	11.4	22.0	12.1	Moderate
20-25	26	5	40.0	40.0	20.0	-	-	Large
15-20	26	2	-	50.0	-	50.0	-	Severe
0-15	26	2	-	-	-	-	100	Disastrous

The following is the multiple linear regression for estimating the per palm nut yield per year using the index of moisture adequacy during December to April.

$$Y = 18.7212 + 0.284\ X_1 - 0.1367\ X_2 + 0.5906\ X_3 - 0.3245\ X_4 + 0.2733\ X_5$$

Where Y is estimated nut yield of the following year (nuts/palm). X_1, X_2, X_3, X_4 and X_5 are the indices of moisture adequacy for December, January, February, March and April respectively. The equations has a multiple correlation coefficient of only +0.7087 though it was significant at one per cent level.

1.1.8. Evaluation Promising Hybrids and cultivars of coconut for planting in the alluvial soils of Malappuram District (on going project)

Objective : This Project was taken up in the instructional farm of K.C.A.E.T., Tavanur since 1983. The Project envisages evaluating hybrids and cultivars of coconut for large scale planting in the Malappuram District.

Technical Programme :

An Experimental garden of coconut was raised in the partially wet land area of the farm with the planting of different hybrids/cultivars on 11-6-83 as per the technical programme. Each treatment comprised 6 plant population (3 rows 2 columns) and replicated thrice. The field was laid out in randomised block design and plants were spaced 7m x 7m apart. The technical programme followed is as follows:

T1 = WCT x CDO
T2 = CDO x WCT
T3 = LO x GB
T4 = WCT x GB
T5 = WCT x MDY
T6 = CDG x WCT
T7 = AO
T8 = Phi
T9 = WCT as check variety

The plants received uniform and good cultural and management practices. The manurial dosage followed was N 1.0 Kg, P_2O 0.5 Kg and K_2O 2.0 Kg per palm per annum.

Some casualities were observed in the plant population and the 27 gaps found as on July 1985 were replanted. Still there are 11 gaps as listed below:

T1	=	WCT x CDO	=	2
T2	=	CDO x WCT	=	1
T3	=	LO x GB	=	1
T6	=	CDG x WCT	=	6
T9	=	WCT	=	1
		Total		11

Results: Since June 1985 biometric observations on number of leaves produced, height, and collar girth of palm were recorded at half yearly interval. Flowering and characteristics of flowering were recorded as and when flowering started in different individuals. The tabulated statement of biometric observations are given in Table-10. The characteristics of flowering are detailed in Table 11.

Table-10

Biometric observations recorded from the Coconut palms as on March 1988

(Total number of population per plot - 6 palms - number of replication - 3)

Treatment	Mean of total number of functional leaves produced during 28-1-86 to 30-3-88	Mean collar girth as on 3-3-88 in cm	Mean Height as on 30-9-87 in cm
T1	23.94	128.33	507.22
T2	22.15	123.33	429.71
T3	22.76	104.1	398.72
T4	23.42	114.43	407.11
T5	26.21	135.67	552.83
T6	23.98	96.11	400.26
T7	21.13	121.01	442.22
T8	23.9	145.4	478.83
T9	19.9	130.6	518.42

Table - 11

Time of first flowering and number of spadices produced as on 20-7-88

Treatment	Month of first flowering and number of palms flowered	Total number of plants on which flowers is noticed as on 20..7..88	Total number of spadices formed as on 20..7..88
T1	3/88 - 2	6/16	18
T2	2/88 - 1	1/17	7
T3	1/88 - 3	6/17	44
T4	3/88 - 1	3/18	10
T5	11/87 - 6	9/18	77
T6	2/88 - 1	6/12	40
T7	-	0/12	--
T8	-	0/12	--
T9	-	0/11	--

Fifty per cent of flowering has been recorded in the hybrids WCT x MDY (T5) and CDG x WCT (T6). Flowering is yet to be started in cultivars like AO (17), Phi (T8) and WCT (T9).

1.1.9. Irrigation-cum-fertilizer trial on Tall x Gangabondam hybrids.

The objective of the trial is to develop an optimum irrigation and fertilizer schedule for Tall x Gangabondam Coconut hybrid grown in sandy loam soils.

The experiment was started during September, 1980.

Technical Programme:

The trial was laid out in split plot design with combination of three levels of irrigation and four levels of fertilizers in the main plot and age at which full dose of the fertilizer was given in the sub plot. Irrigation is given at IW/CPE ratio of 0.5, 0.75 and 1.00. Fertilizer levels were;

F1 : NPK 0.5 : 0.5 : 1.5 kg/palm/year
F2 : NPK 0.5 : 0.5 : 2.0 kg/palm/year
F3 : NPK 0.5 : 1.0 : 2.0 kg/palm/year and
F4 : NPK 1.0 : 0.5 : 2.0 kg/palm/year

The sub plot treatments were:

S_1 : Full dose of the fertilizers given in the 2nd year,

S_2 : Full dose of the fertilizer given in the 3rd year and

S_3 : Full dose of the fertilizer given in the 4th year.

Results during 1987-88

1) Growth characters:- The data with respect to girth at collar, number of leaves produced and number of functional leaves on the crown are presented in Table 12. Irrigations at IW/CPE ratio of 1.00 was significantly superior to others with respect to the number of leaves produced during 1987 and number of functional leaves. Fertilizer level F_1 (NPK - 0.5 : 0.5 : 1.5 kg per palm per year) was superior to other levels for collar girth and it was on par with F_3 for number of functional leaves. The levels of sub plot and interaction effect were not significant.

The data on percentage of flowering are presented in Table 13. It can be seen that higher level of irrigation (IW/CPE ratio of 1.00) and lower level of fertilizer(NPK - 0.5 : 0.5 : 1.5 kg per palm per year) recorded more percentage of flowering.

Table-12

Effect of irrigation and fertilizer level on growth of T x GH hybrids

Treatment	Collar girth (cm)	No. of leaves produced during the year	No. of functional leaves
1. Irrigation			
IW/CPE			
0.50	110.1	10.3	15.3
0.75	112.9.	10.7	15.5
1.00	113.8	11.9	17.7
CD 0.05	NS	0.5	0.8
2. Fertilizer levels (NPK/Kg/palm./year)			
F_1 - 0.5:0.5:1.5	114.5	11.5	16.9
F_2 - 0.5:0.5:2.0	112.7	11.2	16.2
F_3 - 0.5:1.0:2.0	118.7	10.9	17.4
F_4 - 1.0:0.5:2.0	103.3	10.2	14.1
CD 0.05	7.2	NS	0.97
3. Age at which full dose of the fertilizer was given:			
S_1 - in 2nd year	115.9	11.2	16.6
S_2 - in 3rd year	110.9	10.9	16.1
S_3 - in 4th year	109.9	10.8	15.8
CD 0.05	NS	NS	NS

Table-13

Effect of Irrigation and fertilizer levels on percentage of flowering in T x GB hybrids (1984 to 1987)

Treatment	Percentage of flowering
Irrigation :	
0.5	47.6
0.75	52.7
1.00	62.0
CD 0.05	7.1
Fertilizer :	
F1	63.3
F2	53.5
F3	56.9
F4	42.7
CD 0.05	8.3

1.1.10. Standardization of husk burial method for coconut

The objective of the trial started during 1986 is to study the influence of coconut husk on the growth and yield of coconut palm and to standardise the method of husk burial.

T_1 : Burrying coconut husk in linear trenches in between 2 rows of palms.

T_2 : Burrying coconut husk in circular trenches 3m away from the husk.

T_3 : Burrying coconut husk in semicircular trench one $\frac{1}{2}$ trench in one year and the other $\frac{1}{2}$ in the following year.

T_4 : Burrying coconut husk in semicircular trench only.

T_5 : Mulching the basin with coconut husk with its concave side facing down.

T_6 : Mulching the basin with waste coconut leaf.

T_7 : Control.

Another treatment - mulching with coir dust would be added during 1988-89 summer season.

Results:- The pre-treatment yield (mean of 5 years) and post-treatment yield (1987) are presented in Table 14. It can be seen that mulching with waste coconut leaf (T_6) recorded the highest percentage increase in the number of nuts followed by mulching with coconut husk. It is too early to arrive at valid conclusions.

Table-14

Coconut yield as influenced by various methods of husk burrial

Treatment	Pre-treatment yield (mean of 5 years)	Post-treatment yield (1987)	% Increase
T1	76.5	91.6	19.7
T_2	93.9	115.3	22.8
T_3	83.6	91.4	9.3
T_4	80.1	84.5	5.5
T_5	97.9	125.4	28.1
T_6	91.2	137.8	51.0
T_7	81.9	91.8	12.1

1.1.11. Biological control of Oryctes rhinoceros.

Objective : To study the efficacy of the Exotic bio-control agent Platymeris laevicollis and to establish their suppressive potential.

Date of start : 1985 November.

Technical programme :

The predatory insects were reared in the laboratory and released in a four year old plantation of Tall x Gangabondam crosses (500 palms) at an interval of three months. The bugs were released at the rate of 2-3 per palm where beetle attack was noticed.

Results during the period:

Observations on the incidence of beetle were recorded based on the symptom on leaves, spindles and spathes. There was significant difference between the first and the last observation indicating the predatory efficacy of the bugs. However, regarding the survival and establishment of the bugs in the field we could not get only positive results. The observations are being continued.

1.1.12. Susceptibility of Hybrid coconut varieties to Oryctes rhinoceros - Observational trial.

Objective: To study the varietal reaction of different crosses to Oryctes rhinoceros.

The data collected on the beetle attack from a 15 year old plantation of 15 hybrid combinations and WCT recorded that Fiji x COO was the most susceptible hybrid followed by CC x COO. COO x WCT

recorded the minimum incidence based on the percentage damage.

The data are furnished in Table 15 below:

Table-15

Sl. No.	Name of Hybrid	Percentage
1.	WCT x CDO	12.6
2.	CC x CDO	16.8
3.	AO x CDO	13.0
4.	LO x CDY	10.0
5.	Fiji x GB	8.3
6.	WCT x MDY	7.9 **
7.	WCT x TBL	8.8
8.	Fiji x GB	19.4
9.	WCT x SS	9.9
10.	WCT x CDG	9.6
11.	CDG x WCT	6.7 **
12.	CDO x LO	14.4
13.	GB x LO	12.6
14.	WCT x LD	14.0
15.	WCT x GB	9.0
16.	WCT	11.3

1.1.13. Investigations on stem bleeding disease of coconut.

Objectives: (1) To study the etiology of stem bleeding disease of coconut.

(2) To survey the edaptic and agro-meteorological factors relating to stem bleeding disease.

(3) To develop control measures of the disease.

(4) To identify cultivars resistant to the disease.

The first objective of the project ie. study of etiology was discontinued because it has already been proved that the disease is caused by Thelaviopsis paradoxa. In the second objective of relationship of agrometeorology factors with disease incidence we have worked out a nodal aridity index of summer months and disease incidence.

At present the control methods of the disease and the genetic resistance of the disease are presented here.

During last year the fungicidal treatment was applied once in four months. The area of further spread was measured and it was statistically analysed. It was found that the result was not significant. In the pooled analysis of the years 1984 to 1987 the result of the study was significant (Table 15). The effect of Calixin was superior to the other treatments. In the other

aspect ie. Genetic resistance we have screened hybrids of Gangabondam against stem bleeding disease; using the score I to IV. Score I having infection of 0-100 cm^2 Score II 101-200 cm^2 Score III 201-400 cm^2 and Score IV above 400 cm^2. 6 hybrids of Gangabondam i.e. LO x GB, LS x GB, T x GB; AO x GB, CO x GB and J x GB having a total population of 104 palms were screned. It was found that CC x GB was having the lowest infection of 29% and T x GB was having 32% infection while in LS x GB infection was 78% and LO x GB it was 55% (Tabe 17).

Table-16

Percentage increase in the area of infection as a result of different treatments

	1984	1985	1986	1987
Bavistin	1.26	1.32	1.16	0.95
Calixin	0.58	0.43	0.10	0.95
Benlate	0.91	1.45	0.86	1.68
Vitavax	0.91	1.21	1.15	1.36
Coaltar	1.06	1.42	1.65	0.78
Aureofungin sol	1.87	2.28	1.37	1.24
Neem cake	1.34	1.01	0.76	1.00

Table 17

Response of Gangabondam hybrids to stem bleeding disease

	Total	Infected	% infection
LO x GB	11	6	55
LS x GB	9	7	78
AO x GB	13	8	22
CC x GB	24	7	29
T x GB	37	12	32
J x GB	10	4	40

1.1.14. Pestolosphaeria leaf blight of coconut - A new record

Leaf spot or grey blight of coconut caused by Pestolatia palma is known to occur in all the coconut growing areas in the world. Recently Pestolosphaeria placidis (Booth & Robertson) is found to cause leaf blight in coconut. In certain parts of Kerala the disease is found to cause severe damage to the foliage. Hence a study was undertaken to determine the reaction of coconut varieties and hybrids for Pestalosphaeria placidis under natural infection and to find out whether there is any genetic source of resistance or tolerance to this pathogen under field conditions.

Eight coconut varieties and twelve hybrids grown at RARS Pilicode were selected for the study. Five plants of each varieties or hybrids were selected and data on number of leaves infected

and total number of leaves on the crown were recorded and percentage of leaves infected were worked out. Third leaf from below was selected and the percentage of leaflets infected was recorded. Based on the area of infection of the leaf a scoring was given as per the grade chart shown below:

0 : No remarkable symptoms.
1 : Blighted patches covering 1-5% of leaf area
3 : Blighted patches covering 6-25% of leaf area
5 : Blighted patches covering 26-50% of leaf area
7 : Blighted patches covering 51-75% of the leaf area.
9 : Blighted patches covering more than 75% of the leaf area.

None of the varieties and hybrids are immune to this disease. MDY, CDG, CDG x T, CC x G and LS x G produced remarkably no damage to the leaf. MDY has recorded the lowest percentage of leaf and leaflets infection. The hybrid Sp x Sp and Sp x D had the maximum leaf area damaged, followed by WCT. Regarding the percentage of leaves affected LO x GB had the highest value followed by T x G, WCT and Sp x T. Upto a maximum of 20 leaves were infected in one of the palms of WCT and caused heavy damage (Scale 7). However, LO x GB x AO had the maximum percentage of leaflets infected followed by SP x D and GB.

Since CDG showed significantly less disease incidence than WCT, the reaction of the hybrids involving these two as parental combinations were examined. It is seen that both the hybrids T x CDG

and CDG x T showed less incidence of percentage of infected leaves than WCT. Regarding the percentage of leaflets infected was 3.2 for WCT, while it was only 0 for CDG. However, the hybrids T x CDG and CDG x T recorded 1.0

Bordeaux mixture (1%) and Bavistin (0.1%) were found to be effective in controlling the disease. Spraying should be done after cutting and burning the severely infected leaves (Table-18).

Table-18

Reaction of certain coconut hybrids and varieties to leaf blight

Sl. No.	Hybrids/Cultivars of coconut	Percentage of leaflets infected (transformed in angles)	Percentage of infected leaves (transformed in angles)	Scale showing the area of blighted patches on the leaves
1	2	3	4	5
1.	Spicata x West Coast Tall (SP x T)	9.64	27.72	1.40
2.	Laccadive Ordinary x Gangabondam x Andaman Ordinary (LO x G x AO)	47.72	27.77	3.04
3.	West Coast Tall x Chowghat Dwarf Green (T x CDG)	23.61	26.94	1.0
4.	WCT x Yellow Dwarf (T x YD)	40.39	32.59	2.2
5.	Chowghat DWarf Orange x WCT (CDO x T)	30.61	29.74	2.2
6.	WCT x Gangabondam (T x G)	35.56	44.19	2.2

Contd...

(Table 18 Contd.....)

1	2	3	4	5
7.	Chowghat Dwarf Green x WCT (CDG x T)	19.84	33.76	1.0
8.	Andaman Ordinary x Gangabondam (AO x G)	11.93	30.44	1.0
9.	Cochin China x Gangabondam (CC x G)	27.63	30.16	1.0
10.	Spicata x Spicata (Sp x Sp)	41.57	38.46	3.4
11.	Spicata x Chowghat Dwarf Green (Sp x D)	47.06	31.00	3.4
12.	Laccadive Small x Gangabondam (LS x G)	7.28	23.93	1.0
13.	West Coast Tall (WCT)	38.01	40.86	3.2
14.	Laccadive Small (LS)	40.37	20.03	1.4
15.	Laccadive Ordinary (LO)	16.48	13.29	0.8
16.	Chowghat Dwarf Orange (C D O)	40.70	25.44	2.2
17.	Chowghat Dwarf Green (CDG)	13.01	10.21	0.6
18.	Gangabondam (G)	46.62	23.74	2.2
19.	Ayiramkachi	16.16	14.37	1.4
20.	Malayan Dwarf Yellow (MDY)	3.54	6.70	0.4
	C.D.	24.52	9.67	

Data represent mean of 5 replications

1.2. Coconut based farming system.

1.2.1. Evaluation of fodder grasses and legumes in coconut garden.

Objective: To screen fodder grasses and legumes for cultivation in coconut gardens with a view to select the most suitable type for large scale cultivation.

Technical Programme :

The trial started during 1985 was laid out in R B D with 17 fodder grasses and 10 legumes each replicated three times. This is the third year's trial.

Results during the year (1987)

1. Among the fodder grasses, maximum dry matter yield was obtained from Panicum maximum var. Makueni followed by Common guinea and cultivar Hamil (Table 19) Brachia ruzhiensis (Congo signal) also showed some promise.

2. Among legumes, Stylosanthes guianensis cv Schofield and S. Scabra cv Seca gave the highest yield followed by S. Guianensis cv Cook (Table-20)

Table-19

Dry matter yield from fodder grasses grown in coconut garden.

Sl. No.	Name of grass species	Total dry matter yield (t/ha)
1.	Brachiaria ruziziensis	2.27
2.	Brachiaria humidicola	2.74
3.	Panicum maximum cv Makueni	3.45
4.	Panicum maximum cv Hamil	2.90
5.	Panicum maximum cv Gatton	2.74
6.	Setaria anceps cv Narok	0.38
7.	Setaria anceps cv Nandi	1.51
8.	Andropogon gayanus	1.05
9.	Branchiaria decumbens	2.21
10.	Panicum maximum cv Riversdale	2.97
11.	Panicum maximum local	2.95
12.	Panicum maximum cv. Petric	1.70
13.	Melinis minutiflora	1.65
14.	Hybrid Napier	1.90
15.	Panicum maximum (Common Guinea)	3.03
16.	Chloris gayana cv Callidac	1.45
17.	Urochloa mosambicensis	-

Table-20

Dry matter yield from Fodder legumes grown in coconut garden

Sl. No.	Name of species	Total Dry matter yield (t/ha)
1.	Stylosanthus guianens cv. Schofield	1.73
2.	,, ,, cv. Cook	1.22
3.	S. Scabra cv Seca	1.34
4.	S. humilis cv Gordon	-
5.	S. hamata cv Verano	0.93
6.	Centrosema	0.96
7.	Macroptilium sp.	-
8.	Centrosema	0.16
9.	Vigna parkeri cv	-
10.	Stylosanthus scabra cv Fitzroy	1.08

2. RICE AND RICE BASED FARMING SYSTEMS

2.1. RICE

2.1.1. Breeding high yielding varieties of rice for saline area of Kerala

This project was started with a view to evolve high yielding saline resistant varieties from the popular Odacheera variety of rice grown in the saline areas of Cannanore District.

The work was started at R.A.R.S. Pattambi in the year 1976-77 and the mutants produced were selected at Instructional Farm, Mannuthy, in the M2 and M3 generations. These selections were subsequently transferred to R.R.S. Vytilla for further studies.

Seventy nine single plant selections of Odacheera mutants (M6) were transferred to RARS Pilicode during 1981-82 from Vytilla and these are being studied here.

Rigorous selections were made in this station thereafter to identify suitable varieties and during the year 1986-87, viz. mutant lines in the M11 generation viz. OD 15, OD 16, OD 24 OD 42 and OD 72 were carried forward to evaluate their performance in different locations where salinity problems exist.

Three locations viz., Vadakumpad in Tellicherry Sub Division, Kadankod and Kanchara in Kasaragod Sub Divisions were selected for the purpose in 1986-87. The local check used at Tellicherry was

Ptb 20 and in other locations the local variety "Kondrotty."

The crop at two of the locations viz., Kodamkodu and Kanchara perished due to high T.S.S. even before flowering. Where the T.S.S. concentration varied from 5.0 m.mhos to 25.60 m.mhos. The pH ranged between 6.2 to 7.3 in these locations.

At Tellicherry the pH ranged between 6.8 and 7.3 and T.S.S. convent varied between 0.60 to 3.31. Since the trial was not replicated, no statistical analysis could be done. OD 24 with a grain yield of 2712 Kg/ha was the higher yielder. In general, all the mutant lines were superior to the local check.

During the year 1987-88, a replicated trial was conducted in a cultivator's field at Kodankodu Thuruthi. "Kondrotti", a local saline tolerant variety was used as local check. The results obtained from the trial is presented in Table-18.

The grain yield was maximum for the line OD 42 (2527 01 Kg/ha) which was statistically on par with that of OD 72 and the local check "Kondrotti". In the case of straw yield also, OD 42 excelled all the others (Table 21).

Table-21

Yield data of Odacheera mutant. Location: Kadavancode (Thuruthi)

Variety	Grain yield (Kg/ha)	Straw yield (Kg/ha)
OD 15	2016	5633
OD 16	2151	5874
OD 24	2016	6153
OD 42	2527	6346
OD 72	2440	6269
Kondrotty (Local check)	2411	5594
CD	248.46	445.22

The trial is proposed to be repeated during the year 1988-89 Rabi season also.

2.1.2. Fertilizer Management and economics of KOOTTUMUNDAKAN practice of Paddy cultivation

Objective: To assess the most economic fertiliser management schedule and economics of KOOTTUMUNDAKAN practice of paddy cultivation.

The experiment was conducted during 1985-86, 1986-87 and 1987-88.

The varieties THOWAN (Viruppu) and MUNDON (Mundakan) are mixed by weight in the ratio of 3:1 and sown broadcast @ 100 Kg/ha in sub plots of $30M^2$ with 6 treatments replicated 4 times.

The results during all these years were identical and are presented in Table 22.

The grain and straw yields of Viruppu season were not statistically significant as in 1985-86 and 1986-87 indicating that in the case of a broadcast crop of tall indica variety of 115 days duration there is not much difference between the N levels of 40 Kg and 30 Kg/ha. The mean grain yields at 40 Kg and 30 Kg levels were 1922 Kg/ha and 1755 Kg/ha respectively.

During the second crop season the data of grain yield, straw yield and tiller counts were statistically significant. It can be seen from the table that Tr.6 (20.10.10) gave the maximum benefit cost ratio of 1.52 even though the grain yields at 40 Kg/ N/ha (Tr. 1 and Tr. 3) were more than Tr.6. As in the 2 previous years the treatments 1, 2, 3, 5 and 6 were statistically on par with each other and superior to Tr 4 (0.0.0).

Similar result was seen in the case of straw yield and tiller counts.

Pooled analysis of grain yield for 3 years also gave identical conclusion that it was enough to give a fertility dose of 20.10.10 Kg/ha of N P K to the stubbles of second crop partner in the Koottumundakan system of paddy cultivation. (Table 23).

Tr. No.	Particulars N. P. K.	VIRUPPU (THOWAN) Grain Kg./ha	Straw Kg/ha	Prod. tillers/ panicle	Height cm	MUNDAKAN (MUNDON) Grain	Straw	Prod. tillers/ panicle	Height cm	Benefit cost ratio
1	V 40.20.20	1825	3292	1.75	134.6					
	M 40.20.20					1917	3633	6.8	128.4	1.45
2	V 40.20.20	1950	3625	1.70	133.3					
	M 30.15.15					1717	3417	6.4	118.9	1.47
3	V 30.15.15	1738	3375	1.80	128.2					
	M 40.20.20					1908	2892	6.9	119.7	1.42
4	V 40.20.20	1846	3458	1.67	124.0					
	M 0. 0. 0					1358	2200	4.4	112.1	1.28
5	V 30.15.15	1771	3208	1.75	123.1					
	M 30.15.15					1750	3133	4.5	115.1	1.38
6	V 40.20.20	2067	3750	1.75	118.4					
	M 20.10.10					1825	3158	6.6	122.5	1.52
General Mean		1863	3433	1.73	126.9	1746	3072	5.9	119.5	
SE (Means)		-	-	-	-	112	276	0.67	3.8	
C.D. 0.05		NS	NS	-	-	339	832	2.0	-	

V = Viruppu
M = Mundakan

Table-23

Summary of results of Pooled analysis of Grain yield (Kg/ha) of Mundon

Particulars		1 40.20.20	2 30.15.15	3 40.20.20	4 (Control) 0.0.0	5 30.15.15	6 20.10.10	GM	SE (m)	C.D. 0.05
Grain		2733	2622	2711	1922	2516	2689	2532	74.2	234
Percent over Tr. 4		142.2	136.4	141.1	100	130.9	139.9	131.7		
Benefit Cost Ratio	1985-86	1.86	1.73	1.84	1.59	1.78	1.85			
	1986-87	1.61	1.64	1.65	1.35	1.54	1.75			
	1987-88	1.45	1.47	1.42	1.28	1.33	1.52			

2.1.3. Ratooning studies in single crop paddy lands.

Objective: To identify modern rice varieties with ratooning ability, suitable for the single crop paddy lands which remain as slushy fallow during the post first crop period from September to November.

Expt. 1. Screening the available modern varieties and pre release cultures of 90-130 days duration for ratooning ability.

Forty three entries were transplanted in the sub plots of 4.2 m^2 at a fertility level of 90.45.45 over a basal dressing 350 Kg/ha of GN cake. Ten days after the main crop harvest the stubbles were given a weeding followed by the application of Urea @ 40 Kg/ha.

Satisfactory regeneration of ratoon tillers was not seen in these entries. Mala, Rajendra and DGWG produced 3 ratoon tillers but failed to give the minimum ratoon yield of 500 Kg/ha.

Entries:

7944	1537-1	Karuna	Krishna
IR.36	Rajendra	23372	IR. 22
Triveni	Rajeshwari	Cul. 4	IR. 8
Annapurna	DGWG	Cul.1080	Bhadra
IR. 34	Purple	Kumar	Hema
1536-2	Sakthi	Jamuna	Cul.1065
Mala	Rohini	Vijaya	Jayanthi
MN 54-42	Suphala	Rasi	Padma
Anupama	Sabari	Ratna	Padma
2332-1	Kalinga I	Supriya	Parijath
Jyothi	Kalinga II	Vani	

Expt. 2. N. Management of ratcons (observational trial.

Object. To evolve an economic N Management schedule for ratoon crop of rice.

Three cultures identified during 1986-87 (Viz. Cul 1727, BR 51-315-4 and BR 52-96-3) with fair degree of ratooning capacity were tested for ratoon grain yield under 0 and 20 Kg N/ha. The main crop was grown under a fertility level of 90.45.45 NPK over a basal dose of 350 Kg/ha of GN cake. The experiment was laid out in R B D with 6 treatments and 4 replications.

Ten days after the main crop harvest, the plot were given a weeding and top dressed as per schedule. The results indicate that Cul 1727 is capable of giving fair ratoon yields. (Table 24).

Table-24

Mean grain yield of ratoons (Kg/ha)

N Levels	Cul. 1727	BR 51-315-4	BR 52-96-3
0 Kg/ha	687	385	442
20 Kg/ha	1012	502	408
Duration of ratoon crop	68 days	74 days	74 days

Ratoons of BR cultures show highly protracted nature of flowering, though this phenomenon is usually found in ratoon crops. The weeding in ratoon plots becomes a problem when the main crop extends beyond the 15th of October due to aquatic weeds. Since ratooning is worth attempting only if a minimum grain yield of 500 Kg/ha is expected, it was decided to continue the experiment with Cul 1727 only.

2.1.4. Crop-weather studies of paddy.

Objective : 1. To understand the interaction between the physical weather parameters and paddy growth during the first crop season.

2. To prepare Cro-weather calenders for the selected paddy varieties.

3. To find out insect pest and diseases out break in relation to weather.

Technical Programme :

Varieties selected	:	4 (Jaya, IR 8, Thonnooran and Allikannan)
Date of planting	:	Fortnightly planting at four different dates of planting starting from Ist week of June 3rd week of July.

Observations :-

i) Phenological observations such as date of sowing, transplanting, flowering and harvest.

ii) Number of tillers and height of plant per week starting from 15th day after transplantation (50 plants are selected)

iii) Grain yield

iv) Incidence of insect pest and disease.

v) Daily observations on Rainfall, number of rainy days, maximum and minimum temperatures, RH %, pan evaporation and bright sunshine.

Date of start : May 1984

Date of completion : November 1988

The results are furnished in Table 25, below:

Table - 25

Crop weather studies on Paddy

Variety	Grain yield (g/ha) in different dates of planting			
	I	II	III	IV
Allikkannan	34.00 (51.88)	31.5 (54.88)	24.88 (49.13)	8.75 (40.00)
Thonnooran	21.50 (25.50	22.5 (43.75)	23.75 (28.75)	14.38 (25.00)
Jaya	26.25 (26.25)	24.0 (26.38)	15.0 (29.38)	13.75 (25.63)
IR i	24.25 (23.75)	21.75 (36.13)	18.63 (35.25)	7.13 (35.63)

I - 8-6-87 II - 22-6-87

III - 6-7-87 IV - 20-7-87

() - Indicate straw yield in g/ha.

The cultivar 'Allikannan' outyielded the other three varieties viz. Thonnooran, Jaya and IR 8 when planted on 8-6-87. There was a drastic decline in grain yield in the late planted crop. Allikannan gave 34 q/ha when planted on 8-6-87 while it was only 8.75 q/ha when planted on 20-7-88. The results are in confirmation with the previous years results.

It shows that Allikannan was superior when compared to that of Jaya, IR 8 and Thonnooran when planted during the first week of June in Kharif under rainfed conditions in sandy loam soils.

2.1.5. Use of Mussorie Phosphate as a source of Phosphorous to transplanted Rice.

Final Report :

This study was undertaken to find out the possibility of utilization of low cost rock phosphate as a source of phosphorous for rice, either fully or partly replacing super phosphate when applied as a phosphatic fertilizer for the pulse crop in rice fallows.

Materials and Methods

This study was undertaken in the Instructional farm attached to K.C.A.E.T. campus for two years 1986-87. A pulse crop of cowpea was raised during 1986 February to June followed by paddy crop in the same plot during 1986 July to October, as per the technical programme. Similarly another set of experimental investigation was continued for a 2nd year with cropping of cowpea during 1987 March to June, followed by paddy crop during 1987 June to October in the same plot.

Individual plot size selected for experimentation was 6m x 3m. Cowpea variety 'Kanakamani' and Paddy MDV 'Pavizham' were used for investigation. Each plot accommodated 400 plants of cowpea spaced 0.3m x 0.15m apart or 600 plants of paddy spaced 0.2m x 0.15m apart. The crop received all the general management practices except the manurial dosages which were followed as per Technical programme.

The technical programme adopted for the experimentation were as follows:

Treatments - 8	Replication - 3
T1	'0' Kg P_2O_5 for pulse + '0' Kg P_2O_5 for rice.
T2	30 Kg P_2O_5/ha as SSP for pulse and 45 Kg P_2O_5 as SSP for rice.
T3	30 Kg P_2O_5/ha as rock phosphate for pulse alone
T4	45 Kg P_2O_5/ha as rock phosphate for pulse alone.
T5	60 Kg P_2O_5/ha as rock phosphate for pulse alone
T6	T3+15 Kg P_2O_5/ha as SSP for rice.
T7	T3+30 Kg P_2O_5/ha as rock phosphate for rice.
T8	T3+45 Kg P_2O_5/ha as Super phosphate for rice.

Result and Discussion

In each year of investigation, after cropping cowpea, paddy crop was taken in the same plot as per technical programme. Different biometric observations were recorded periodically and also the yield and yield attributes.

In the case of cowpea, No. of pods, weight of pods and seed yield recorded are given in Table 26, below:

Table-16

Yield of Cowpea obtained during First and Second year of Experimentation

Treatment	No. of Pods in Lakhs per Hectare		Weight of Pods in kilogram per hectare		Weight of Seed in Kilogram per Hectare	
	Ist Season	2nd Season	Ist Season	2nd Season	Ist Season	2nd Season
T1	17.25	8.786	280'	1423	1660	806
T2	16.40	9.280	268'	1570	1599	962
T3	16.92	9.348	2872	1551	1694	1001
T4	16.77	9.008	2475	1519	1509	864
T5	17.05	8.793	2852	1388	1705	813
T6	15.65	10.432	2596	1760	1582	1029
T7	15.83	10.199	2583	1809	1502	1029
T8	17.31	10.144	2819	1685	1672	985
	NS	NS	NS	NS	NS	NS

The yield of cowpea, whether in the form of number of pods, weight of pods or seed yield, were not affected by the differential levels of phosphatic fertilization. The treatments were found to be insignificant in both the years of study. There were not any significant improvement in yield even over the control plots with no phosphatic fertilization. Rock phosphate is found to be equally effective as single Super phosphate.

In the case of Paddy, number of panicles produced per hill and yield of grain and straw recorded, are given in Table 27, below:-

Table - 27

Yield of Paddy obtained during First and Second year of Experimentation

Treatment	No. of panicles per hill		Yield of grain Kg/ha		Yield of straw strem Kg/ha	
	First Crop	Second Crop	First Crop	Second crop	First Crop	Second crop
T1	10.28	9.9	3422	3029	2911	2855
T2	9.97	10.97	3309	2901	2965	3021
T3	9.92	9.83	3274	3221	2671	3285
T4	10.16	9.20	3411	3061	2831	2909
T5	10.08	10.27	3300	3109	2778	3181
T6	10.41	10.13	3306	3301	3312	3309
T7	9.87	9.43	3218	3245	2911	3309
T8	9.92	11.60	3450	3109	3045	3261
	NS	CD 1.15	NS	NS	NS	NS

The yield attribute of paddy viz. number of panicles per hill and the biological yield viz., yield of grain and straw were not affected by the variation in the level and form of phosphatic fertilizer. This insignificance was repeated during the 2nd year of investigation also.

Hence it is inferred that phosphate fertilizer application does not have any possible effect on the crops of cowpea and paddy in the particular type of the area, which is predominantly sandy clay loam. Rock phosphatic shall be considered as suitable substitute to single super phosphate in the manuring of cowpea and paddy.

2.1.6. Screening rice varieties for disease resistance.

Objective : To identify rice varieties/cultures having resistance to major diseases - mainly sheath blight - prevalent in northern region of Kerala.

Technical Programme:

Collection of rice varieties/cultures from research stations and from local cultivators. Screening these materials for all major diseases under high disease pressure. Screening of leaf blast will be conducted in dry nursery and for other diseases in transplanted condition. In the case of sheath blight disease - rice stem culture of Rhizoctonia solani will be inoculated at the maximum tillering stage.

Result:

During the previous year 36 entries from the Viruppu crop and 35 entries from the Mundakan crop were identified as moderately tolerant to sheath blight disease. These were put under yield trial. None of the entries showed resistance to Sheath blight. Blast incidence was miled during the season. Brown spot attack was mild in 1st crop and severe in 2nd crop. Tye yield of the Mundakan crop was badly affected due to water scarcity during the flowering phase. The yield data and disease score are given in Table 28 and 29 below:-

Table - 28

Grain yield (Kg/ha) and disease score of rice varieties/cultures.

Ist Crop 1987

Sl. No.	Name of variety/ Cultivar culture	Dry weight of grain (Kg/ha)	Disease Score			
			BL	NBL	SHB	BS
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Short duration:						
1.	Culture 7944	5108	1	-	3	3/1
2.	Mala	5041	1	-	1	1/1
3.	IR 34	4965	-	-	5	3/1
4.	Jyothi	4930	-	-	5	1/1
5.	Annapurna	4701	-	-	1	1/1
6.	Triveni	4270	3	-	5	5/1
7.	IR 36	3812	-	-	3	1/1

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Medium duration:						
8.	M 22-65-2-3-1	5138	5	3	3	1/1
9.	Mn 54-42	5000	3	-	3	1/1
10.	Jaya	4930	-	-	3	1/1
11.	MO5-1536-2	4930	3	1	3	1/1
12.	Bharathy	4861	-	-	3	3/1
13.	Cul 23332-1	4861	-	-	5	1/1
14.	Cul 1537-1	4826	1	1	5	3/1
15.	Anupama	4722	-	1	1	1/1
16.	Sakthi	4583	-	-	1	1/1
17.	Vani	4305	-	-	3	1/1
18	Rajeswari	4305	-	-	5	3/1
19.	Ptb 10	4302	3	-	5	5/1
20.	DGWG	4250	-	-	3	1/1
21.	Rajendra	4166	-	-	1	1/1
22.	Ptb 22	3958	3	1	3	1/1
23.	H 105	3888	-	-	3	1/1
24.	BR 51-4-6-1	3784	-	-	3	1/1
25.	Ptb 32	3680	1	1	3	1/1
26.	IR 8-68	3611	-	-	5	1/1
27.	Vytilla-2	3472	3	1	3	1/1
28.	Cul. 4	3333	-	-	3	1/1
29.	IR 42	3263	-	-	5	3/1
30.	Kayama	3194	1	1	1	1/1
31.	H 4	2881	-	-	3	1/5
32.	Basumathy	2847	-	-	3	1/1
33.	Ptb 5	2638	-	-	3	1/1
34.	Adakkan	2319	-	-	1	3/1
35.	Purple	2083	-	-	5	-
36.	Jaganath	4722	-	-	3	1/1

Table-29

Grain yield and disease score of rice varieties during IInd Crop season

Sl. No.	Varieties/ culture	Grain yield Kg/ha	Disease score			
			BL	NBL	SHB	BS
	C.V.					
	Short duration					
1.	Cul. 1180	3093	1	-	1	5/1
2.	Triveni	2967	1	3	5	5/1
3.	Cul. 12035	2714	-	1	3	3/1
4.	Vijaya	2588	-	1	3	7/1
5.	Suphala	2525	-	5	5	7/5
6.	BR 51	2525	-	-	3	5/5
7.	Sathya	2272	-	-	3	5/5
8.	Supriya	2272	-	-	5	7/1
9.	Krishna	2083	-	1	3	5/1
10.	Mala	2020	3	1	1	7/1
11.	Cul. 12814	1893	-	5	5	7/5
12.	Cul. 7944	1767	-	-	1	3/1
13.	Suma	1578	-	5	5	9/5
14.	Parijatha	1578	-	-	3	3/1
15.	Soorya	1388	-	-	5	7/1
	Medium duration					
16.	IR 8-68	2893	-	-	1	5/5
17.	IR 20	2840	-	-	1	3/1
18.	IR 22	2767	-	-	3	5/1
19.	Ratna	2525	-	-	3	3/1
20.	IR 42	2462	-	-	5	7/1
21.	Cul. 1065	2462	-	-	3	7/1
22.	Suhasini	2146	-	-	3	7/1
23.	Hema	2146	-	1	3	5/1
24.	Vani	2083	-	1	3	5/5
25.	PR 106	2020	-	-	5	7/1
26.	IR 36	2020	-	-	3	5/1
27.	T (N) 1	1957	-	-	3	5/1
28.	Jaya	1830	-	-	3	7/1
29.	Pankaj	1767	-	-	3	5/5
30	Arikirazhi	1641	-	-	3	5/1
31.	Badra	1641	-	-	5	7/1
32.	Chitteni	1641	-	-	3	3/1
33.	Cul. 3	1515	-	-	3	7/1
34.	AU 1	1199	-	-	3	3/1
35.	Jaganath	1136	-	-	3	5/1

2.2. Rice based Farming systems.

2.2.1. Screening varieties of Cucurbitaceous summer vegetables suitable for northern region of Kerala.

The objective of this experiment was (1) to screen varieties of summer vegetables suitable for northern region of Kerala (2) to identify the most economic cucurbitaceous vegetable for the locality.

From the practical point of view the project will facilitate to identify the most suitable variety for the agroclimatic conditions of the northern zone.

Four cucurbitaceous summer vegetable viz., Cucumber, Snake gourd, Bitter gourd and Ridge gourd were included in the trial. The accessions of each variety were put in a replicated trial and the result gained during Rabi are furnished in Table-30, below:-

Table-30

Performance of Cucurbitaceous summer vegetables during 1987-88

Type/Accession No.	Yield of fruits (T/ha)
1. Cucumber :	
19/2	18.2
64/3	14.1
75/1	21.3
41/3	22.1
40/4	22.6
PL	18.1
CD 0.05	4.3

(Table 30 Contd...)

Type/Accession No.	Yield of Fruits (T/ha)
2. Bitter gourd :	
3/3	8.1
66/3	9.8
67/3	10.8
67/2	9.3
17/3	6.4
PL	10.3
CD 0.05	NS
3. Snake gourd:	
13/1	17.8
14/2	17.3
15/2	18.4
13/2	17.9
14/4	15.1
PL	16.1
CD 0.05	NS
4. Ridge gourd:	
26/2	11.8
17/2	9.4
11/2	9.9
13/3	12.1
5/1	11.7
2/3	12.8
4/4	8.7
PL	9.6
CD 0.05	NS

(a) Cucumber : Based on the performance during previous years, the following accessions were studied during 1987-88.

19/2, 64/3, 75/1, 41/3, 40/4 and PL.

The accession No. 40/4 with a yield of 22.578 Tons/Ha was found to be the best, followed by 41/3 (22.093 t/ha) and 75/1 (21.312 t/ha).

(b) Bitter gourd All the following 7 accessions studied were statistically on par in the terms of yield. 3/3, 66/3, 67/3, 67/2, 17/3 and PL. However, the accession No. 67/3 with a yield of 10.825 t/ha gave the highest performance.

(c) Snakegourd : Six accessions were selected during 1986-87 studies. No significant difference was observed among them as far as yield is concerned. Accession No. 15/2 gave the maximum yield of 18.419 t/ha followed by 13/1 with 17.77 t/ha.

(d) Ridge gourd : There was no statistically significant difference between the accessions studied in terms of fruit yield per ha. Accession No. 2/3 gave the maximum yield of 12.769 t/ha, followed by 13/3 with a yield of 12.125 t/ha.

Comparative yield trial will be conducted during the ensuing season in all the above four vegetables based on the performance during the year under report.

2.2.2. Vegetable management for the northern region of Kerala.

Sub title : Irrigation-cum-spacing trial on cucumber grown in rice fallows

The objective of the trial is to find out an ideal irrigation method for cucumber grown in rice fallows under varying levels of population density.

An observational trial was laid out during 1987 with two irrigation levels and three spacings.

Irrigation:

I_1 - Cultivator's practice of daily irrigation.

I_2 - Pitcher irrigation

Spacing (m^2)

S1 - 0.75 x 0.75

S_2 - 1.00 x 1.00

S_3 - 1.50 x 1.50

S_4 - 2.00 x 1.50

Results: The data on number of fruits per plot, weight of fruits/plot and yield per hectare are given in Table 31 below. Cultivator's practice of daily irrigation and spacing 0.75 x 0.75 m^2 gave the highest yield followed by cultivator's practice + 1.00 x 1.00 m^2 spacing and pitcher irrigation + 0.75 x 0.75 m^2 spacing.

Table-31

Effect of irrigation methods and spacing on yield of cucumber grown in rice fallows

Treatment	No. of fruits/ plot	Weight of fruit/ plot (Kg)	Yield (t/ha)
		(Plot size: $36m^2$)	
I_1 - Cultivator's practice			
S_1	179	166.9	46.4
S_2	138	135.7	34.8
S_3	80	71.9	19.9
S_4	57	60.8	16.9
Mean	113.5	108.8	29.5
I_2 - Pitcher Irrigation			
S_1	167	120.1	33.4
S_2	117	90.5	25.1
S_3	72	62.9	17.5
S_4	55	50.8	14.1
Mean	101.7	81.08	22.5

3. PEPPER

3.1. Germplasm collection and screening of pepper varieties

At the beginning of the year under report, there were 70 cultivars and 117 wild accessions in the germplasm. During the year, 3 more cultivars and ten wild types were acquired and thus, at present there are 73 cultivars and 127 wild accessions in the collection. The new cultivars added are Kuching, Billi-Malligasara and Vokkale.

Collection of wild types was done from Agasthya-koodam hills in Trivandrum District, Periya Forests in Wynad and Bhagamandala and Thalacauvery forest ranges in Kodagu district. Some of these wild types are still in the nursery and will be added to the collection during next year.

During the year under report, 49 cultivars in the germplasm have flowered and harvested. The yield data and spike characters are presented in Table 32 and 33 respectively.

Table-32

Germplasm collection - Harvest - Data
1987-88

Sl. No.	Cultivar	Date of harvest	No.of plants harve-sted	Total No.of spi-kes	Total green yield Kg.	Mean green yield per plant Kg.	Per-centage of dry to green pepper
1	2	3	4	5	6	7	8
1.	Arakulam munda	15-1-88	3	2598	8.080	2.693	32.1
2.	Arivally	-do-	6	2142	5.770	0.961	33.0
3.	Chumla	-do-	2	304	1.300	0.650	31.2
4.	Kottaram	-do-	5	1900	5.630	1.126	32.5

(Table 32 Contd....)

1	2	3	4	5	6	7	8
5.	Karivilanchy	16-1-88	3	605	0.710	0.236	30.7
6.	Uthirenkotta II	-do-	1	138	0.280	0.280	32.4
7.	Perumkody	-do-	4	2541	6.620	1.655	32.3
8.	Mundi	-do-	3	2949	8.180	2.726	32.0
9.	Munda	-do-	4	1184	4.290	1.073	33.9
10.	Balankotta I	-do-	1	815	3.750	3.750	27.5
11.	Sullia	-do-	4	2471	9.900	2.475	29.5
12.	Karimunda I	-do-	3	1483	5.149	1.713	34.0
13.	TMB V	-do-	3	2188	4.830	1.610	31.5
14.	TMB VI	-do-	2	399	1.050	0.525	28.1
15.	Vally	-do-	3	401	0.960	0.320	30.6
16.	Kottanadan I	29-1-88	2	1415	3.170	1.585	34.5
17.	Perumunda	-do-	5	318	1.050	0.210	29.8
18.	Karivally	-do-	4	598	2.030	0.508	29.0
19.	Neelamundi I	-do-	6	736	2.550	0.425	28.8
20.	Tulakodi	-do-	2	699	3.090	1.545	33.2
21.	Veluthanamban II	-do-	2	351	0.920	0.460	32.8
22.	Narayakodi I	-do-	2	369	1.000	0.500	33.7
23.	Veluthanamban II	-do-	4	2098	7.570	1.893	32.0
24.	Kalluvally II	-do-	2	339	1.620	0.810	34.0
25.	Balankotta II	-do-	4	1212	4.770	1.193	32.5
26.	Karimundan III	-do-	6	5075	17.650	2.942	36.5
27.	Kottanadan II	22-2-88	1	554	0.060	0.060	-
28.	TMB XII	-do-	1	175	0.500	0.500	-
29.	TMB IX	-do-	1	61	0.150	0.150	-
30.	Kuthiravally II	-do-	4	474	1.520	0.380	31.8
31.	Neelamundi II	-do-	5	1078	5.080	1.016	30.0
32.	Ceylon	-do-	2	500	2.170	1.085	35.5
33.	Cheriyakaniakadan	do-	3	523	0.895	0.179	31.5
34.	Padappan	-do-	3	115	0.340	0.113	-
35.	Panniyur 1	-do-	1	47	0.300	0.300	-
36.	TMB VIII	-do-	1	165	0.190	0.190	-
37.	Culture 406	-do-	5	1209	5.710	1.142	42.5
38.	Neelagiri	-do-	4	967	1.305	0.326	31.2
39.	Cheriyakaniakadan	do-	3	733	1.110	0.370	31.7
40.	Karimunda II	-do-	3	810	2.350	0.783	36.0
41.	Kaniakadan	-do-	3	926	2.510	0.836	33.5
42.	Kalluvally IV	-do-	1	300	0.760	0.760	34.0
43.	TMB IVI	-do-	1	222	0.190	0.190	-
44.	TMB II	-do-	1	137	0.480	0.480	-
45.	Arikottandan	-do-	1	416	1.615	1.615	36.0
46.	TMB IV	-do-	3	709	1.480	0.493	42.5
47.	Poonjarmunda	-do-	4	1049	4.800	1.200	31.9
48.	Kuthiravaly I	-do-	2	1562	5.600	2.800	32.7
49.	Kumbakody	-do-	6	4497	19.050	3.175	32.4

Table - 33

Spike characters of cultivars in germplasm of pepper

Sl. No.	Cultivar	Mean weight of a spike (g)	Mean length of a spike (cm)	Mean No. of flower	Mean No. of Developped berries/ spike
1	2	3	4	5	6
1.	Arakkulam munda	3.11	9.56	31.56	23.12
2.	Arivally	2.69	7.86	25.44	22.68
3.	Chumala	4.27	11.09	39.40	37.44
4.	Kottaram	2.96	8.16	27.12	22.08
5.	Karivilanchy	1.17	6.84	16.12	13.52
6.	Uthirenkotta	2.02	11.62	14.35	13.20
7.	Perumkody	2.61	10.02	30.88	25.44
8.	Mundi	2.77	9.75	34.32	25.04
9.	Munda	3.62	7.97	40.60	30.68
10.	Balankotta	4.60	8.82	39.24	31.44
11.	Sullia	4.01	5.79	36.64	32.24
12.	Karimunda	3.47	6.25	35.52	34.12
13.	TMB V	2.21	7.21	12.92	12.28
14.	TMB VI	2.63	5.90	12.68	11.84
15.	Vally	2.39	7.28	22.92	17.84
16.	Kottanadan	2.24	5.34	26.76	23.64
17.	Perumunda	3.30	5.96	43.92	43.04
18.	Karivally	3.39	6.33	28.00	26.12
19.	Neelamundi	3.46	7.32	34.48	32.48
20.	Tulakodi	4.42	11.61	44.92	38.16
21.	Veluthanamban II	2.62	7.33	24.6	23.4
22.	Narayakodi I	2.71	5.76	30.76	25.32
23.	Veluthanamban I	3.61	8.00	34.76	31.80
24.	Kalluvally II	4.78	7.65	54.52	48.40

(Table 33 Contd.....)

1	2	3	4	5	6
25.	Balankotta	3.94	7.90	34.72	30.08
26.	Karimunda III	3.48	6.78	31.48	28.16
27.	Kottanadan II	0.01	3.95	15.44	14.12
28.	TMB XII	2.86	4.44	30.76	29.12
29.	TMB IX	2.46	8.12	31.76	2 .96
30.	Kuthiravaly II	3.21	8.17	41.00	37.24
31.	Neelamundi	4.71	8.13	28.88	26.48
32.	Ceylong	4.34	10.72	38.40	37.64
33.	Cheriyakania-kadan	117.71	6.85	25.52	22.36
34.	Padappan	2.96	5.01	30.04	28.72
35.	TMB VII	1.15	6.08	13.68	12.80
36.	Culture 406	4.73	11.96	37.2	30.36
37.	Neelagiri	1.35	7.43	7.36	6.96
38.	Cheriyakania-kadan I	1.52	8.24	24.24	18.76
39.	Karimunda II	2.90	7.47	32.88	29.0
40.	Kaniakadan	2.71	6.54	31.72	28.92
41.	Kalluvally IV	2.53	4.82	2 .32	28.76
42.	TMB III	0.85	4.83	10.48	9.76
43.	TMB II	3.50	5.70	29.76	28.76
44.	Arikottanadan	3.88	6.94	39.72	38.40
45.	TMB IV	2.09	7.09	24.16	25.20
46.	Poonjarmunda	4.76	7.27	24.16	23.20
47.	Kuthiravaly I	3.59	7.83	30.20	25.12
48.	Kumbakody	4.27	8.07	37.00	35.00
49.	Panniyur 1	6.38			

First of all, there is considerable variation in the period of maturity of the berries of different cultivars. Some cultivars (Kuthiravaly I and II, Poonjar Munda, Kumbakodi) took 43 days more in 1987 and 48 days more in 1988 to mature than the earliest maturing ones like Arakulam munda, Balankotta, Mundi etc. Some others were intermediary. Some of the most important cultivars can be tentatively classified into (1) Early maturing (2) Late maturing and (3) Intermediary.

(1) Early maturing types:

Arakkulam munda
Kottaram
Perumkodi
Mundi
Balankotta I
Sullia
Karumunda I
TMB V
Veluthanamban I

(2) Late maturing :

Neelamundi II
Arikottanadan
Poonjar munda
Kuthiravaly II
Kumbhakody

(3) Intermediary

Munda
Kottanadan I
Veluthanamban II
Balankotta II
Karimunda III
Ceylon
Culture 406

Though the early and late maturing types can definitely be classified as such, the intermediary types are showing some variation in their period of maturity. This factor will have to be verified in coming years.

As regards yield, the Karimunda types, Kuthiravaly, Arakulam munda, Poonjar munda, Balankotta types and Kumbhakodi are showing better performance. This is in confirmation with our previous findings in the matter. However, yield data for more number of years is required to draw a definite conclusion.

3.2. Breeding - Intervarietal Hybridisation in Pepper.

Intervarietal hybridization involving 14 parental combinations were carried out during July-August, 1987. The details of hybridisations done are furnished hereunder:

Sl. No.	Parental combination	No.of flowers pollinated	No. of seeds obtained	No.of seeds germinated
1	2	3	4	5
1.	Uthirenkotta x Panniyur 1	110	50	35
2.	Uthirenkotta x Karimunda	605	150	105
3.	Uthirenkotta x Panniyur 1	91	20	14
4.	Panniyur 1 x Kuthiravaly	135	35	21
5.	Panniyur 1 x Kuthiravaly	437	100	68
6.	Uthirenkotta x Panniyur-1	121	25	13
7.	Panniyur 1 x Karimunda	44	10	6
8.	Panniyur 1 x Kuthiravaly	676	155	109
9.	Panniyur 1 x Karimunda	171	40	28
10.	Uthirenkotta x Panniyur 1	86	20	12
11.	Uthirenkotta x Karimunda	1305	300	210
12.	Kalluvally x Uthirenkotta	428	100	76
13.	Panniyur 1 x Kuthiravaly	112	50	38
14.	Panniyur 1 x Karimunda	447	100	67

A total number of 171 hybrid and open pollinated seedlings obtained from previous year's hybridisation programme were transplanted to the main field.

In the main field, 315 seedlings progenies flowered during the year and of these 98 vines were harvested. The remaining 217, though flowered, did not produce any fruits. The yield and spike characters of some promising types are furnished in Table 35. Spike yield of these promising types from the commencement of their flowering (1985-86) are furnished in the Table 36. Culture No. 5629 which performed well during the previous year did not flower during this year.

Table-35

Yield of some promising cultures

Sl. No.	Culture No.	Spike yield (green) in Kg.			
		1985-86	1986-87	1987-88	Total
1	2	3	4	5	6
1.	4176	--	--	0.995	0.995
2.	4178	0.355	0.775	1.235	2.365
3.	4180	0.940	0.770	1.845	3.555
4.	4199	--	0.310	1.127	1.437
5.	4220	--	--	2.070	2.070
7.	4632	0.340	0.418	1.325	2.083
8.	4799	--	--	0.810	0.810
9.	4834	--	0.270	1.590	1.860
10.	4848	--	--	1.430	1.430

(Table 35 continued..)

Sl.	2	3	4	5	6
11.	4881	--	--	1.820	1.820
12.	4968	--	--	1.385	1.385
13.	4970	--	--	1.480	1.480
14.	4971	--	--	1.800	1.800
15.	4975	--	--	1.935	1.935
16.	5029	--	0.276	2.032	2.308
17.	5035	--	0.277	1.210	1.487
18.	5036	--	0.575	1.490	2.065
19.	5037	--	1.250	2.150	3.400
20.	5096	--	--	0.732	0.732
21.	5128	--	--	2.445	2.445
22.	5185	--	--	0.785	0.785
23.	5200	--	--	1.110	1.110
24.	5227	--	--	1.870	1.870
25.	5232	--	0.280	1.170	1.450
26.	5294	--	--	0.550	0.550
27.	5308	--	1.375	1.535	2.910
28.	5420	--	--	1.030	1.030
29.	5705	--	--	1.260	1.260
30.	5834	--	--	1.200	1.200
31.	6279	--	--	0.235	0.235
32.	5293	--	1.022	0.387	1.407
33.	5629	--	1.215	0.820	2.035

During the year under report, culture No.5128 an open pollinated seedling of c.v. Cheriyakaniakadan, though flowered for the first time gave the maximum yield. Though the c.v. Cheriyakaniakadan is characterised by small and narrow leaves, short spikes and small berries, its progeny ie. Culture 5128 has a very robust and luxuriant vegetative growth with extraordinarily large and broad leaves, long spikes and very extrabold berries. The 100 berry weight and volume are the maximum and higherto unknown among cultivated types. The culture along with the other promising types are being multiplied for further testing.

Under the hybridisation programme, some of the cultures identified earlier as promising ones were put in a P.Y.T. planted during 1987. Eight promising cultures are tried in this experiment along with Panniyur 1 and Karimunda as check varieties. There are ten plants under each type and they are planted in C.R.D. Some of the plants have started flowering during this year. The data is presented in Table 37 below:-

Though this first yield data do not permit us to draw any defenite conclusion, it is indicated that Cultures 331, 141 and 239 have higher yield potential than the others. Yield data for 2-3 years more are necessary to draw any definite conclusion.

3.3. Multilocational trial of promising cultures of black pepper.

The experiment aims to evaluate seven promising cultures producted at Pepper Research Station, Panniyur at two locations viz. Panniyur and Peruvannamuzhi. At Panniyur, the experiment was laid out in 1984 in R.B.D. with five replications and six vines per plot. The standard used is coral tree (Erythrina indica) and spacing is 3 x 2 M.

The cultures under evaluations are the following:

i)	Culture 54	- Karivally OP
ii)	Culture 211	- Taliparamba VII OP
iii)	Culture 239	- Perumkodi OP
iv)	Culture 331	- Uthirenkotta x Cheriyakaniakadan
v)	Culture 406	- Karivilanchi x Cheriyakaniakadan
vi)	Culture 1171	- Perumkodi OP
vii)	Culture 1199	- Kuthiravaly OP
viii)	Karimunda	- As check variety
ix)	Panniyur 1	- As check variety

In the trial the total number of plants flowered during the year under report are as follows:

Culture 239	-	6
Culture 1199	-	Nil
Culture 406	-	12
Culture 54	-	2
Culture 1171	-	3
Culture 211	-	Nil
Culture 331	-	3
Panniyur 1	-	4
Karimunda	-	Nil

3.4. Multilocation trial of cultivars in black pepper.

The experiment aims to evaluate nine cultivars at three centres viz. Ambalavayal, Chinthappally and Panniyur. At Panniyur the experiment was laid out in 1984 in RBD with five replications and six vines per plot. The standard used is coral tree (Erythrina indica) and spacing 3 x 2 M.

Cultivars under evaluation are the following.

i) Aimperian
ii) Arakkulam munda
iii) Kalluvally
iv) Karimunda
v) Kottanadan
vi) Kuthiravaly
vii) Narayakodi
viii) Neelamundi
ix) Panniyur-1

In the trial, the total number of plants flowered during the year as follows:

Neelamundi	-	1
Panniyur 1	-	5
Kalluvally	-	3
Aimpirian	-	Nil
Kottanadan	-	4
Narayakodi	-	2
Kuthiravely	-	3
Arakkulam munda	-	3
Karimunda	-	3

3.4. Irrigation-cum-fertilizer experiment

An irrigation-cum-fertiliser experiment on two cultivars of black pepper was laid out and planted in 1987 with the following details.

Layout	:	Split plot design
Main plot treatments	:	Three levels of irrigation (I_1, I_2, I_3) with combination of varieties (V_1 and V_2)
Sub plot treatments	:	Three levels of fertilisers (F_0, F_1 and F_2)
Replication	:	Three
Plot size	:	Six vines
Spacing	:	4 x 2 M.
Standard	:	Erythrina indica

1. Irrigation levels

I_1 - No irrigation

I_2 - Irrigation at IW/CPE ratio 0.125

I_3 - Irrigation at IW/CPE ratio of 0.25

2. Fertiliser doses

F_1 - No fertilisers

F_2 - 50:50:150 of NPK per plant per year

F_3 - 75:75:225g NPK per plant per year.

3. Varieties:

V_1 - Karimunda

V_2 - Panniyur 1

Total No. of plots - 54

Boarder rows are provided between different irrigation treatments, between replications and all around the experimental area.

Treatments will be started from the third year, ie. 1989. Fertilisers will be applied in two splits.

The pepper vines were planted in July 1987 and Gap filling was done in July, 1988.

3.5. Testing of cultures/cultivars for shade tolerance

It is estimated that 80% of pepper plants grown in the state are in homestead gardens. These gardens are characterised by moderate to

heavy shade due to the presence of various tree species such as Coconut, arecanut, jack, mango etc. Pepper usually prefers an open area and so types of pepper plants which can give satisfactory yields even under such shaded condition is felt need. So, an experiment to locate shade tolerant types was started in 1982. Under this experiment 34 cultivars/promising cultures are planted in a shade plot. The design of the experiment is C.R.D. and there are 15 plants under each treatment. Some of these plants have started bearing during 1987 and the yield data is presented in Table 38. As the plants have not yet started steady bearing, the present yield figures have only very little relevance, but, still some indication are brought out by the data.

More number of plants have flowered under Neelamundi (8) followed by cultured 239, 557 and Panniyur 1 (6 each showing their precocity even under shaded conditions.

Maximum spike length was observed in culture 1171 (17.0 cm) followed by culture 818 (16.6 cm) 231 (16.5 cm) and maximum single plant yield was recorded in Arakulam munda (3.767 kg) followed by Kalluvally (2.84 kg) and Culture 818 (2.680 Kg). However, a few more years' yield data is necessary to draw a definite conclusion.

3.6. Observational trial with different tree standards for pepper.

An observational trial using seven tree species viz. Glyricidia maculata, Erythrina indica, Garuga pinnata, Ailanthus malabaricum, Pajnelia rheedi and two varieties of Subabool was laid out in 1982. The tree seedlings/cuttings were planted in 1982 and pepper was planted to them in 1986. The growth of Ailanthus Sp. is maximum and satisfactory, whereas the growth rate of other tree species are not upto the desired level. The period from 1982 onwards had experienced three severe drought years and even in this unfavourable situation, Ailanthus came up well, whereas, the growth of the other tree species were retarded due to the drought.

The experiment is being continued.

3.7. Field experiment for the control of slow wilt disease of pepper.

As per the recommendation of the VII Workshop of the All India Coordinated research project on spices held at Trivandrum during 1985, a field experiment for the control of slow wilt disease of pepper at cultivators' field was started during 1986 with the following treatments.

Treatment 1 - Application of Thimet 3 g ai/vine

Treatment 2 - Application of Bavistin 0.1% (5 litres/vine)

Treatment 3 - Application of Copper Oxychloride 0.43% (5 litres/vine)

Treatment 4 - Application of Thimet + Bavistin

Treatment 5 - Application of Thimet + Copper oxychloride

Treatment 6 - Application of Thimet + Bavistin + Copper oxychloride

Treatment 7 - Control

Design - C.R.D.

Replication - 4

The treatments were applied in two times, one during June before the onset of South West monsoon and the other during November after the end of North East monsoon.

Thimet is applied at the base of the vine and raked well. The fungicides are applied as drench around the base.

The intensity of the disease is recorded using the following scale.

0 No. disease
1 Yellowing of leaf
2 Yellowing and droping of leaf
3 Defoliation
4 Shedding of branches
5 Death of vine

The data recorded is presented in Table 39, below:

Table 39

Effect of Chemicals on the control of Slow wilt disease of pepper

Sl. No.	Treatments	Means of incidence (Angles)
1.	Application of Thimet 3g ai/vine	18.227
2.	Application of Bavistin 0.1% (5 lit./vine)	22.759
3.	Application of Copper Oxychloride 0.3% (5 lit/vine)	16.177
4.	Application of Thimet + Bavistin	16.107
5.	Application of Thimet + Copper Oxychloride	
6.	Application of Thimet + Bavistin + Oxychloride	15.313
7.	Control	22.863

Not significant.

On statistical analysis the treatment effects are not significant. However treatments 5 and 6 have recorded minimum disease incidence and that data in general shows a combination of Thimet with a Copper fungicide can reduce disease symptoms considerably.

3.8. Observational trial for the control of Quick wilt disease of pepper

It was decided in the VII workshop of the AICRP for spices held at Trivandrum during 1985 to start an observational trial for the control of Quick wilt disease. Accordingly, an experiment with following treatments was laid out at two places at Eramom and padiotchal in Cannanore District during the year 1986.

Treatment 1 - spraying and drenching with 1% Bordeaux mixture and pasting with Bordeaux paste.

Treatment 2 - T_1 + application of neem cake @ 2 kg/vine

Treatment 3 - T1 + application of lime @ 1 Kg/vine

Treatment 4 - T1 + application of neemcake @ 2 kg/vine. application of lime @ 1 Kg/vine.

Treatment 5 - Control

Design - RBD

Replication - 5

The first spraying, drenching and pasting and application of lime and neem cake were done just before the onset of South West monsoon. Two more sprayings with Bordeaux Mixture were done during the second week of July and on the onset of North East monsoon.

Incidence of disease was recorded as leaf infection and presented in Table 40 below:

Table-4 :

Incidence of Quick wilt disease on pepper

Locations:	ERAMOM				PADIYOTUCHAL			
Treatments	% of disease incidence (Means)		Incidence of fungal 'Pollu' (Means)	Yield Kg. (Means)	% of disease incidence (Means)		Incidence of fungal 'Pollu' (Means)	Yield Kg. (Means)
	Leaf infection	Branch infection			Leaf infection	Branch infection		
T1 Bordeaux mixture pasting, spraying and drenching	12.656	4.904	2.843	10.562	13.471	2.852	3.433	14.211
T2 T1 + Application of Neem cake @ 2 Kg/vine	11.825	4.666	2.55[illegible]	11.396	12.468	1.815	3.659	15.725
T3 T1 + Application of lime @ 1 Kg/vine	11.990	1.815	3.224	10.952	13.333	3.267	3.250	15.236
T4 T1 + Application of Neem cake @ 2 Kg/vine + Application of Lime @ 1 Kg/vine	11.132	1.281	3.009	12.091	11.974	2.563	2.983	16.412
T5 Control	16.519	9.689	12.442	8.950	19.368	8.005	13.882	15.572
CD	3.036*	5.002*	2.174**	1.029**	2.219**	4.074*	2.240**	0.961**

* Significant at 1%
** Significant at 5%

No foot infection was recorded during the year. In both locations all the treatments were found superior to control.

It is observed that maximum yield was obtained from T4 followed by T2 which is on par with T3 and T1. The result indicate that application of neemcake and lime has got a positive effect on yield.

In the case of incidence of fungal pollu, all the treatments recorded less infection when compared to control.

The general vigour of plants received neemcake and lime has also improved.

3.9. Field trial for the control of Quick wilt disease of pepper.

So far Bordeaux mixture alone has been found to be effective for the management of Quick wilt disease of pepper. A series of experiments for the management of the disease was conducted during the past few years. The data generated from these experiments were critically analysed and reviewed in the workshops of the All India Coordinated research project on spices conducted after the inception of the Project. Difficulty in the preparation of good quality Bordeaux mixture and lack of systemic action are some of the disadvantageous noticed to bordeaux mixture.

A new set of fungicides were suggested for the experiment for the control of the disease during the VII workshop held at Trivandrum during 1985. In the VII workshop held at Regional Agricultural Research Station, Guntur on 30th to 31st January and 1st February, 1987 it was decided to include Aliette also in the trial whenever Phytophtora is a problem in spice crop. The details of the treatments of the trial are as follows:

Treatments:

1. Bordeaux mixture spraying, pasting and drenching.
2. Bordeaux mixture spraying (1%) and pasting (10%) and drenching with 0.3% copper oxychloride @ of 5 litres per plant.
3. Ridomil foliar application and soil drenching - 0.2%
4. Captafol spraying with Bordeaux mixture pasting and drenching with captafol 0.2%
5. Aliette foliar application and soil drenching 0.3%
6. Control.

Design - R.B.C.
Replication - 4
Plot size - 9 plants.

All the plants will receive regular package of practices.

The chemicals were applied as detailed below:-

1. First spraying, pasting and drenching just before the onset of South West monsoon.
2. Second spraying during the last week of July.
3. Third spraying before the onset of North East monsoon.

The results of the treatments were given in Table 41, below:-

Table 41

Effect of Fungicides for the control of Quickwilt disease of Pepper

Sl. No.	Treatments	1986-87 Means of Infection		1987-88 Means of Infection	
		Leaf	Branch	Leaf	Branch
1.	Bordeaux Mixture spraying, pasting and drenching	14.586	0	21,680	11.885
2.	Bordeaux Mixture spraying, pasting and drenching with 0.3% copper oxy-chloride	11.885	11.885	27.713	16.741
3.	Ridomil (0,2%) foliar application and drenching with captafal (0.2%)	16.747	4.862	21.589	25.931
4.	Pasting with Bordeaux paste, spraying and drenching with Captafal (0.2%)	13.667	4.862	28.969	25.931
*5.	Spraying and drenching with Aliette (0.3%)	-	-	35.074	33.074
6.	Control	25.931	9.724	44.903	46.641
	CD	Not significant		10.805	Not significant

* Aliette included during the year 1987-88

No foot infection was recorded during the season. Leaf and branch infection was recorded. There was no significant difference between treatments, during the year 1986-87. However, T3 and T1 was found superior in controlling the leaf infection, whereas effect on branch infection was not significant during the year 1987-88.

3.10. Studies on the control of Nursery Diseases of Pepper

It has been found that about 20-25% of Pepper cuttings are lost every year by nursery diseases. Rotting near nodal region and cut end portion are caused by Colletatrichun gloeasporioides, Pythium spp Rhizoctonia Spp with a view to find out suitable control measures for nursery disease an experiment was laid out and the results are presented in Table 42, below:-

Table 42

Percentage incidence of Nursery disease of Pepper

Sl. No.	Treatments	Light intensity (K.Lux			Mean (angles)
1.	Spraying 1% Bordeaux Mixture	11.6	14.8	16.4	22.11
2.	Spraying 0.1% Difolitan	16.4	18.0	19.2	24.965
3.	Spraying and drenching 1% Bordeaux mixture	11.2	14.0	15.2	21.466
4.	Spraying and drenching 0.1% Difalitan	14.2	15.6	17.6	23.320
5.	Drenching with cheshnut compound	17.2	17.6	22.0	25.330
6.	Control	22.0	27.6	30.8	31.08
	C.D. at 5% level			1.441	

Spraying and drenching were given at fortnightly intervals. The results indicate that spraying and drenching with 1% Bordeaux Mixture reduced the infection significantly followed by drenching and spraying of Difolatan 0.1% at fortnightly intervals. Under low light intensities the incidence of the disease was seen more. This may be due to high humidity prevailing in the shaded condition.

4. MISCELLANEOUS CROPS

4.1. BANANA

4.1.1. Scheduling irrigation for banana cv Nendran grown in clayloam soils.

Objective: The project was started during 1985 to schedule an irrigation method for Banana cv Nendran grown in clayloam soils.

Technical programme:

The trial was laid out in R B D with seven treatments and three replications. The treatments were as follows:-

T_1 - Basin irrigation with 10 mm water on alternate days.

T_2 - Basin irrigation with 20 mm water on alternate days.

T_3 - Basin irrigation with 20 mm water at IW/CPE ratio of 1.00

T_4 - Basin irrigation with 20 mm water at IW/CPE ratio of 0.75

T_5 - Basin irrigation with 20 mm water at IW/CPE ratio of 0.50

T_6 - Subsoil injection with 5 mm water on alternate days.

T_7 - Drip irrigation at the rate of 2.5 mm water/plant/irrigation.

Results: The effect of irrigation levels on growth and yield characters are presented in Table 43, below:

Table-43

Effect of irrigation on growth and yield of Banana cv Nendran grown in clay loam soils dufing 1986-87

Treat-ment	Plant height (m)	Pseudo-stem girth (cm)	Bunch weight (Kg)	No. of hands per bunch	No.of fingers per bunch	Yield per ha. (t)
T1	2.4	52.1	7.8	4.9	41.4	19.6
T2	2.6	55.2	10.7	5.2	52.3	26.7
T3	2.5	53.4	8.8	5.0	44.0	21.9
T4	2.4	50.1	7.4	5.2	45.2	18.5
T5	2.4	49.5	7.6	4.5	39.8	19.1
T6	2.3	50.6	6.2	4.3	34.8	15.4
T7	2.1	46.5	6.6	4.2	36.4	16.4
CD 0.05	0.19	4.24	1.50	0.61	7.97	3.5

20 mm basin irrigation on alternate days was superior to the rest followed by 20 mm basin irrigation at IW/CPE ratio of 1.00 and 10 mm basin irrigation on alternate days.

The pooled data for 1985-86 and 1986-87 are presented in Table 44. It may be seen that basin irrigation at the rate of 20 mm water was significantly superior to other treatments.

The consumptive use, water use efficiency and economics of different irrigation methods are presented in Table 45.

Irrigation at the rate of 20 mm basin irrigation on alternate days (T2) recorded the maximum consumptive use followed by irrigation at IW/CPE ratio of 1.00. The minimum consumptive use was shown by sub soil injection (T6) of water. The same treatment showed the maximum water use efficiency of 57.3 followed by drip irrigation (52.2) and irrigation at IW/CPE ratio of 0.5 (39.3).

The economics of different irrigation methods were worked out and the data on Benefit/cost ratio are presented in Table 45. Irrigation at IW/CPE ratio of 0.5 recorded the maximum Benefit-cost ratio followed by irrigation at IW/CPE ratio of 0.75 and 1.00

Table - 44

Pooled data showing the influence of irrigation levels on banana cv Nendran growin in clay loam soils

Treat-ment	Plant height (m)	Pseudo-stem girth (cm)	Bunch weight (kg)	No. of hands per bunch	No. of fingers per bunch	Yield (t/Ha)
T_1	2.45	55.5	9.1	4.8	42.5	21.9
T_2	2.70	56.6	11.3	5.2	49.1	27.4
T_3	2.55	54.6	9.1	4.9	42.9	22.1
T_4	2.40	51.8	8.4	5.1	42.8	21.[illegible]
T_5	2.40	52.4	8.8	4.7	39.7	21.4
T_6	2.20	50.9	7.0	4.5	35.8	17.2
T_7	2.20	49.3	7.3	4.2	35.9	18.3

Table-45

Consumptive use, Water use Efficiency and economics of different irrigation methods in banana cv. Nendran

Treatment	Consumptive use (mm)	WUE (Kg/mm/ha)	B.C. ratio on total cost	B.C. ratio on irrigation alone
T_1	809.5	27.1	1.74	3.82
T_2	1240.7	22.1	1.94	3.81
T_3	1100.2	20.2	1.81	4.22
T_4	791.1	26.9	1.91	5.29
T_5	545.1	39.3	2.01	6.28
T_6	300.4	57.3	0.56	0.59
T_7	350.7	52.2	1.36	2.59

Summary and conclusions:

The following conclusions are arrived at from the two season's trial.

1. Basin irrigation with 20 mm water (40 l./plant) on alternate days produced heavy bunches in banana cv Nendran grown in clay loam soils.

2. Among the various methods of irrigation tried, basin irrigation at IW/CPE ratio of 0.50 (irrigation at 4-5 days intervals) was found to be the best from the economic point of view. In terms of water use efficiency, sub soil injection of water and drip irrigation were the best.

4.1.2. Design and Development of economic and durable propping method for Banana (Nendran)

Objective: 1. To design and develop a simple durable economic supporting technique for Banana.

2. To compare the performance of new technique with conventional single pole propping method.

3. To compute and compare the economics of conventional and newly developed technique

Technical Programme:

The experiment will be conducted in a Banana (Var. Nendran) garden planted 2m x 2m apart. The details of experiment are--

Design - R B D : Replication : 3

Treatment - 6 Plants/plot - 5x4 = 20 Nos.

T1 : Conventional single pole propping.
T2 : Horizontal Bar Propping.
T3 : Horizontal Hook ring method.
T4 : Vertical Hanging method.
T5 : Horizontal coir net method.
T6 : Hexagonal coir and pole propping method.

Progress of work: In order to carry out the experiment a crop of Banana, nearly 550 Nos. was planted in November 1985. The propping work as per technical programme was taken up during May 1986.

There were no casualities in any of the treatment plot. The performance of propping technique was being closely observed at the time of bunching. Cost comparison was made with respect to the materials used and are given in Tables 46 and 47.

From the above mentioned tables, it is evident that Horizontal Hook ring method and Horizontal coir method are the cheapest method of propping for Banana. Though Horizontal coir net method is the cheapest, Horizontal Hook ring method using GI wires of 14G and 8G will be feasible since the durability of material is more (2-3 years). The coir/chaodi used in coir net method may last for one year and hence will have to be replaced for succeeding crop.

Both methods are simple and easily understandable to farmers and hence quite practical. Extensive studies on large farms especially in areas of high wind velocity, are needed to draw any conclusive result. There is also much scope for altering and finalising the design before it is advocated to farmers. The trial is in progress for the 2nd season ir the farm.

Table - 46

The materials and its cost involved in the different propping method (for 20 Nos. of Banana)

Treatment	Items	Quantity	Total cost
T_1- Ordinary single pole propping method	Bamboo poles	60m	180.00
	Choodi	0.240kg	1.90
	Labour	0.5 MLD	14.00
			Rs. 195.90
	MLD - Man Labour Days		
T_2- Horizontal Bar propping method	Bamboo poles	12 m	36.00
	Bamboo Bar	50 m	150.00
	GI Wire-14G	0.326 kg	4.90
	Choodi	0.336 kg	2.70
	Labour	0.25 MLD	7.00
			Rs. 200.00
T_3- Hexagona hook ring method	Bamboo poles	12 m	36.00
	G I wire 14G	2.121 kg	31.85
	G I wire 8G	1.128 kg	12.40
	Labour	0.5 MLD	14.00
			Rs. 94.25
T_4- Vertical hanging method	Bamboo poles	18 m	54.00
	GI wire 8G	2.820 Kg	32.45
	GI wire 14G	0.490 Kg	7.35
	Choodi	1.12 Kg	10.15
	Labour	0.5 MLD	14.00
			Rs. 117.95
T_5- Horizontal coir net method	Bamboo poles	12 m	36.00
	Choodi	1.305 Kg	11.80
	Labour	0.5 MLD	14.00
			Rs. 61.80
T_6- Hexagonal pole propping method	Bamboo poles	30 m	90.00
	Choodi	1.334 Kg	12.05
	Labour	0.5 MLD	14.00
			Rs. 126.05

Table-47

Tabulated statement of cost

Treatment	Cost per 20 plants	Reduction of cost over conventional method Rs.	% Reduction over conventional cost
T_1	195.90	-	-
T_2	200.60	4.70	
T_3	94.25	101.65	
T_4	117.95	77.95	39.8%
T_5	61.80	134.10	68.5%
T_6	126.05	69.85	35.7%

4.1.3. Observational trial on leaf spot disease of banana.

Objective: To find out a suitable control measure for the leaf spot disease of banana cv Nendran.

Technical Programme:

Twelve treatments which include different fungicides (Calyxin, Foltaf, Bordeaux Mixture and Bavistin) and nutrients (Muriate of Potash and Magnesium sulphate 20 g over the recommended dose) were tried. After cutting and burning the infected leaves fungicidal sprayings were given at monthly intervals.

Results: The initial observation indicate that none of the plants are free from the disease - The number of leaves infected after the commencement of spraying shows that application of 250g each of Muriate of potash and Magnesium sulphate + spraying Bavistin (1%) showed less disease incidence. Detailed study is to be carried out for getting conclusive results.

Treatments	No. of leaves infected		
	Initial 4-5-87	20-5-87	26-6-87
T1 : Calyxin	8.75	1.5	4.25
T2 : Foltaf	8.25	1.5	4.25
T3 : Bordeaux Mixture	8.75	1.25	4.25
T4 : Bavistin	6.75	0.25	4.0
T5 : Magnesium Sulphate (250 g extra)	7.5	0.75	4.75
T6 : Muriate of Potash (250 g extra)	8.5	1.0	4.75
T7 : T5 + T6	8.25	0.75	4.0
T8 : T7 + Calyxin	6.25	1.25	4.0
T9 : T7 + Foltaf	6.25	1.0	4.25
T10 : T7 + Bordeau Mixture	6.5	0.75	4.25
T11 : T7 + Bavistin	9.25	0.25	3.5
T12 : Control	7.0	1.75	5.5

Data represent mean of 4 observations.

4.2. BETELVINE

4.2.1. Survey collection and maintenance of germplasm of Beetlvine.

The objective of this project is to make intensive survey and collection of Betelvine germplasm from Northern region of Kerala and maintenance of the same in the Instructional farm of K.C.A.C.T., Tavanur.

Materials and Methods:

This project was started during August 1985 with the collection and planting of 4 types of Nadankodi collected from different parts of Malappuram District.

1. Anakkayam (A)
2. Irumbuzhi (I)
3. Ponmala (P)
4. Kaippatta (K)

Later to this germplasm 'Seelanthi Karpooram Vella' of Neyyattinkara was added. Though this had a very good establishment initially the crop was damaged after 3 months. 'Aryan' type of Cannanore and another type 'Selam' were also planted on later dates. Vines from Pallippuram (L) Kuzhimanna (M) Tavanur (T), Kainikkara (Kn), Adoor (Ad) and Palode (Pd) were also added to the collection on later occasion.

Crop received general cultural and management practices usually done by farmers. After one year of growth, the vines were lowered. To avoid the attack of diseases the vines from each collection were planted in some other site. The growth rate was observed for 1st six months and thereafter yield alone was recorded.

Sporadic attack of disease especially foot rot was noticed in the germplasm and vines of P, Ka, and I were almost completely wilted.

Out of the 12 collections in the germplasm most of the vines were affected by foot rot and wilt. Eventhough plant protection measures were adopted the disease was seen prevailing.

Later to preserve the entire collection another multiplication plot was maintained with planting of all the twelve collections on 8-7-87.

Result:

In the initial year of investigation ie. 1985-86 study was confined to tye types Kaipatta, Irumbuzhi, Anakkayam and Ponmala. Higher growth rate was observed in Ponmala and Irumbuzhi in terms of increase in length. But shorter internodes and larger leaves were observed in Kaipatta. 'Irumbuzhi' type was found to be the highest yields recording an yield of 1050.20 leaves/basin/annum compared to other 3 types.

During 2nd year of investigation, ie. 1986-87 the following types were maintained in the germplasm.

1. Ponmala (P)
2. Irumbuzhi (I)
3. Anakkayam (A)
4. Kuzhimanna (M)
5. Pallippuram (L)
6. Kainikkara (Kn)
7. Kaipatta (K)
8. Tavanur (T)
9. Cannanore Aryan (CAR)

The growth habits and yield observed in these types were given in Table 48 and also yield obtained from one picking.

Table - 48

Increase in height and number of nodes produced per month in different types

Type	Mean increase in height in cm in a span of 30 days	Mean number of nodes produced in a span of 30 days	Mean No. of leaves obtained from one picking
1-P	31.32	2.87	21.5
2-I	29.78	2.87	16.67
3-A	25.90	4.41	26.20
4-M	71.25	7.19	33.4
5-L	66.64	7.24	34.4
6-Kn	57.13	6.29	26.5
7-K	40.52	5.52	17.75
8-T	36.83	5.37	13.0
9-CAR	36627	4.48	7.5

Complete and continuous harvesting was not possible since most of the vines were started wilting before they start second yielding and control measures could not help saving the crop. In the germplasm accessions from Kuzhimanna, Pallippuram and Kainikkara were found promising.

The vines of Selam and Cannanore Aryan types retained in the older germplasm collection were also found performing good.

A detailed descriptive blank of these accessions has been prepared and varietal characteristics indexed.

During third year of study 1987-88 the following types were maintained in the germplasm.

1. Anakkayam (A)
2. Pallippuram (L)
3. Kainikkara (Kn)
4. Kuzhimanna (Kn)
5. Ponmala Selam (S)
6. Neyyattinkara Seelanthi Karpooram (NSK)
7. Cannanore Aryan (CAR)
8. Palode (Pd)

The other types of the previous year could not be planted in this germplasm for want of stock material.

Most of the vines through replicated enough were attacked by wilt and foot rot disease. The observations are recorded from the surviving populations and are being tabulated.

4.2.2. Basic trial on the manurial requirement of Betelvine

Final Report:

This study envisages collecting basic informations on the manurial requirement of betelvine cultivated as "Koottakkodi" system of cultivation, a system prevailing in the Malappuram District.

Material and Methods:

This study was conducted in the Instructional Farm of KCAET, Tavanur during 1985 to 1987. A betelvine crop in "Koottakkodi" system of planting was raised in 21 basins spaced 2.2 m apart. There

were 6 standards per basin and two vines planted per standard ie., the planting shoots were the terminal healthy orthotropes of 0.6 m long. The vines were planted during August 1985.

For the first two months the crop received a general treatment. During this period two manuring were given, each comprising litter @ 3.5 kg, Cowdung @ 2.5 Kg and Factomphos @ 75 g (first dose) or Urea @ 40 g (as 2nd dose) per basin. This worked out for manurial dosage of 25 t of cowdung and 69 kg of N per hectare applied within 2 months after planting.

Thereafter the crop received differential treatments as follows:-

T_1 - Cowdung alone @ 40 t/ha

T_2-T_1 + N @ 1 t/ha

T_3-T_1 + N @ 0.5 t/ha + P_2O_5 @ 0.4 t/ha + K_2O @ 1.4 t/ha

T_4-T_1 + N @ 1 t/ha + P_2O_5 @ 0.4 t/ha + K_2O @ 1.4 t/ha

T_5-T_1 + N @ 1.5 t/ha + P_2O_5 @ 0.4 t/ha + K_2O 1.4 t/ha

T_6 - T_1 + P_2O_5 @ 0.4 t/ha alone.

T_7 - T_1 + K_2O 1.4 t/ha

(The above dosage fixed was the total per annum. The nutrients shall be applied in 15 equal split application per annum. The total duration of crop is 2 years)

Considering 15 equal split application per annum the manurial dose per application was calculated as 1/15th of the total dose as per treatment. First manurial dose as per treatment was started during

November 1985 and the last dose was applied to the crop during June 1987. The crop survived upto November 1987.

The crop received only 18 split doses of manures as per treatment during the entire period of growth. The intervals of the split application were most often enhanced to overcome the damages due to disease attacks especially wilt and leaf spot and to avoid further intensity of damage due to nutrition. Total of 21 pickings were taken from the crop.

Results and discussion:

The total manures applied to the crop per ha. and the total worked out for one hectare per annum may be seen in Table 49 (total per annum is worked out with the assumption that 12 doses will be given per annum).

Table-49

Total quantity of manure applied to the crop (Kuottakkodi) per hectare during total period of month and that worked per hectare per annum.

Treatment	Total in Kg per Ha for the crop (2 years)				Total in Kg per Ha per annum			
	Cowdung	N	P_2O_5	K_2O	Cowdung	N	P_2O_5	K_2O
T_1	48,347	48,437	-	-	32,230	-	-	-
T_2	48,347	1,198	-	-	32,230	798.4	-	-
T_3	48,347	599	476	1,674	32,230	999.2	317.4	1116
T_4	48,347	1,498	476	1,674	32,230	798.4	317.4	1116
T_5	48,347	1,796	476	1,674	32,230	1197.5	317.4	1116
T_6	48,347	-	476	-	32,230	-	317.4	-
T_7	48,347	-	-	1,674	32,230	-	-	1116

The yield recorded in different treatments did not show any significant variations between each other. But the data generated from this trial gave a lot of basic informations which were not available hitherto. (Table 50).

Table - 50

Total yield of betel leaves from the crop of 1 ha. of Koottakkodi obtained during the entire crop period and the yield worked out per annum

Treatment	Total yield of the crop per ha in lacks	Total yield of the crop per ha/annum in lacks
T_1	306.32	204.21
T_2	335.74	223.83
T_3	324.06	216.04
T_4	283.49	118.99
T_5	317.53	211.69
T_6	293.14	195.43
T_7	278.41	185.61
GT Mean	NS 305.53	203.69

1) Organic manuring is just enough to support betel vine cultivation and inorganic manuring is not essential.

2) If inorganic fertilization is thought off 'N' alone is needed and the optimum dose of 'N' centres around 800 Kg N/ha/annum. This shall be done along with cowdung application @ 32.25 t/ha/annum increasing the quantity of 'N' above the level of 0.8 t/ha/annum is having adverse effect.

3) P_2O_5 and K_2O are not essential and are not having any positive effect on yield.

4) An average yield of 305.53 lac leaves can be expected from one hectare of Koottakkodi crop of betel vine.

The yield values are given in Table-51, below:

Table - 51

Yield obtained per hectare of Koottakkodi crop of betelvine per harvest during the entire period of 9 months

Month of harvest	11/85 1	12/85 2	1/86 3	1/86 4	2/86 5	3/86 6	4/86 7
Yield/ha in '000 lvs	14	83	212	232	484	711	1497

Month of harvest	6/86 8	7/86 9	8/86 10	9/86 11	10/86 12	11/86 13	12/86 14
Yield/ha in '000 lvs.	1973	1473	1347	2273	2230	2350	2176

Month of harvest	2/87	3/87	4/87	6/87	9/87	10/87	11/87
Yield/ha in '000 lvs	1742	2222	1104	2672	1886	1574	1402

The analysis of above data shows that, the commercial harvesting from a Koottakkodi crop of betelvine starts 6 months after planting. The crop can survive upto 2 to 2½ years. The economic yielding will be from 6 months after planting to 2 years after planting. Main yielding season will be during North East Monsoon period and early summer period, probably due to effective utilization of nutrients and sunlight. Heavy showers as in South-West Monsoon period is highly conducive for diseases like leaf spot, wilt, bacterial leaf spot etc. and hence the yield is very much suppressed. During peak yielding season, a single picking may yield upto 23.5 lac leaves/ha. The average yield estimated from one hectare is 203.69 lac leaves per annum.

4.3. CASHEW

4.3.1. Studies on Cashew disease

Nursery blight of Cashew: A new record

During May 1987, Cashew seedlings grown in Polythene bags in a nursery at Chandera, Kasaragod District were found affected by severe seedling blight.

The disease first appears as water soaked lesions at the tip of the young leaves and soon changed into black necrotic patches. It spreads to the complete leaf lamina and then to the subsequent leaves. Finally the whole leaves fall off leaving the stem alone. When the terminal bud or tender shoot is infected, it results in progressive die back and death of the seedlings. Sprouts of

axillary buds below will also get infected. Occasionally the seedlings are attached at the collar region also. The affected seedling show water soaked girdles of darkened tissues around the stem. This is followed by drooping, wilting and death of the seedlings. The affected regions are covered with profuse growth of conidiophores and conidia. After the appearance of the initial symptoms, if the environmental conditions are congenial, the disease spread fast over the entire seedlings and cause severe damage to the nursery.

Isolations made from the infected portions of leaves, tendershoot and collar region consistently yielded a species of Aspergillus. The pathogenicity was proved by artificial inoculation on young healthy seedlings and the same fungus was reisolated from the infected parts. Its identity was confirmed as A. niger under favourable conditions the symptoms appeared on the inoculated seedlings within 48 hours. This is for the first time that A. niger is reported to infect the cashew seedlings and cause severe havoc.

Removing the died and severely infected plants and spraying and drenching with Bordeaux mixture (1%) or Bavistin (0.1%) was found to control the disease effectively.

4.4. GROUNDNUT

4.4.1. Screening groundnut accessions against rust and stem rot disease.

An observational trial to screen groundnut varieties against rust and stem rot disease was laid out with 10 lines received from ICRISAT.

The lines are--

I C G V 87175	I C G V 87182
,, 87160	,, 87176
,, 87170	,, 87167
,, 87020	,, 87157
,, 87155	,, 87184

The results of scoring against stem rot disease was as follows:-

87184 - 1.675%	87182 - 1.85 %
87157 - 5.50 %	87170 - 2.55 %
87169 - 3.565%	86020 - 4.14 %
87175 - 1.665%	87160 - 8.1 %
87155 - 7.32 %	87176 - 6.25 %

Least infection was noticed in 87184 - 1.675% and maximum infection was found in 87160 - 8.1%

Only in the following lines rust was noticed.

87157 - 5%
87155 - 7%
87182 - 3%
87160 - 8%
87176 - 6%

Maximum infection was seen in 87160.

Yield was as follows:

87184 - 3330 Kg/ha	87170 - 1660 Kg/ha
87175 - 3390 Kg/ha	87182 - 2690 ,,
87157 - 3910 Kg/ha	87176 - 2655 ,,
87169 - 3380 Kg/ha	87155 - 3550 ,,
87160 - 2415 Kg/ha	86020 - 2750 ,,

It was found that 87157 was having the highest yield of 3910 Kg/ha.

5. MICROBIOLOGY

5.1. Studies on diazotrophic rhizocoenesis in pepper (*Piper nigrum* L.)

Objectives:

1) To isolate, characterise, screen and select an efficient strain of *Azospirillum*.

2) To study the effect of inoculation of the promising cultures under pot culture conditions.

3) To develop a suitable carrier material for the microbial inoculant.

Technical Programme :

The experiment will be conducted under laboratory and field conditions. It includes isolations of *Azospirillum*, characterization, determining Nitrogen fixing ability, studying nitrogen fixing ability, developing drug resistant markers, inoculating different strains under pot culture conditions, studying the population dynamics of *Azospirillum* and study the effect of inoculation on plant growth and yield.

Results obtained

Inoculation of *Azospirillum Lipoferum* on cuttings of Boughainvilla, Rose and Hemilia had no effect.

Azospirillum (under culture) was employed for dipping black pepper cuttings and planted in the nursery. Observations were recorded 2 months after planting. The data indicate that *Azospirillum*

(Contd.....)

inoculation increases root growth and shoot growth (Table 52, below).

Table-52

Effect of *Azospirillum* inoculation on Black pepper cuttings.

Parameters observed	Inoculation with Azospirillum	Control
Rooted cuttings (%)	72	36
No. of roots/cutting	7	1.0
Dry wt. of roots (mg)	42.3	10.2
Sprouted cuttings (%)	76	50.0
No. of fully opened leaves	1.2	0.7
Dry weight of sprouts/ cutting	250.1	83.4
Length of sprouts/cutting	6.2	4.1

The intrinsic resistance of *Azospirillum* towards antibiotics was studied. 20 isolates of *Azospirillum* isolated from root environment of black pepper were employed. Different concentrations of the antibiotics viz. Streptomycin and Chloramphenicol (5 ppm, 10 ppm, 50 ppm, 150 ppm, 200 ppm and 500 ppm) were tested. All the isolates were resistant upto 10 ppm Streptomycin

(Contd.....)

and Chloramphenicol; while 5% showed resistance upto 150 ppm of both the antibiotics when applied separately. None of the isolates were resistant above 150 ppm. Hence the study indicates that root environments of black pepper harbours a fairly high population of antibiotic resistant strains of Azospirillum. Hence in order to study their behaviour in the soil antibiotic resistant mutants were developed using the mutagen ethyl methane sulphonate. The study is in progress.

Chemotactic response of Azospirillum isolated from the roots of black pepper, coconut and Cinnamon was studied employing several compounds and root exudations. The results indicated that Azospirillum moved towards discs containing malic acid, succinic acid and root exudates within 24 hours. There was no growth of Azospirillum towards Glucose, Cellulose and plain agar (control) discs. The discs containing malic acid with yeast extract attracted maximum. The root exudations in the presence of malic acid exhibited good attractions to the organism than root exudates alone. It is therefore logical and true to argue that the root exudations of plantation crops not only serve as energy source to the bacterium but also attract the organism. Isolates

(Contd.....)

of Azospirillum obtained from Cinnamon and black pepper were also attracted towards root exudates of coconut which indicate that there is no host specificity for the chemotactic response of the bacterium among Cinnamon and coconut.

5.2. Development of methods for the rapid multiplication of Azolla spores

Objectives

To study the native strains of Azolla in the northern tract for their growth and sporulation and developing methods for multiplication of Azolla spores.

Technical programme

Survey of Azolla types occurring in different localities, study the sporulation pattern of different types, study the different parameters influencing sporulation, study the germination of sporocarps and study the storage life of sporocarps.

Isolates of Azolla pinnata PIL 1, maintained in its vegetative phase for the past three years did not produce much sporocorps while those germinated from sporocorps were able to sporulate profusely. An area of about 10 ha was kept under

(Contd..... .)

observations to study the phenomenon and Azolla grown from sporocarps produced large number of sporocarps.

Azolla was grown in an area of 3 Sq.m. during the first and second crop season of 1986 and they were allowed to produce sporocorps. The plot was kept undisturbed to study their germination and growth during Kharif and Rabi 1987. It was found that though the sporocarps were germinated, it was not upto the satisfactory level. Hence the experiment will be repeated after analysing the possible reasons.

..