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APPENDICES

PART I

AGRICULTURE

I Rice

CROP IMPROVEMENT

HIGHLIGHTS:

Cultures 15-37-1 and 15-37-2 were found to be very promising high yielding lines with BPH tolerance. These are being yield tested in district trials. Cultures 65-2-3 and M 24-204-2 were found to be tolerant to the BPH and suitable for highly acidic conditions. For Pokkali cultivation, the Culture 174 was found superior to the local Cheruviruppu and Vyttila-1. Performance evaluation studies involving medium tall varieties suitable for broadcast conditions in Onattukara region, the Culture 1004 was found to be quite promising. Breeding for earliness in Mashoori was continued and five cultures were selected for further trials. Culture 1907, a semi-tall culture from Triveni x Bhavani recorded higher grain and straw yield than Triveni. Culture 1999 was selected for non-shattering trait by reselection from Jaya. Twenty short duration semi-tall varieties with broadspectrum resistance to pests and diseases were identified. Culture 31-1 out yielded PTB. 20 in minikit trials.

SUMMARY

Culture 1999 was selected for further trials in the Project for Breeding for non-shattering in the rice variety Jyothy.

In trials on the evaluation of high yielding photo-sensitive varieties, the cultures 2941 (Jaya x PTB 12), Culture 107, Culture-187 and Culture 363 were selected for further investigations.

A total of eleven F_8 cultures and nine F_6 cultures were identified as promising for further studies on the evolution of short duration semi-tall varieties of rice, resistant to pests and diseases.

Culture 1004 recorded the maximum grain yield (4604 kg/ha) in trials for evaluating varieties with medium height suited to the broadcast conditions in Onattukara region. This culture recorded significantly higher straw yield of 21,435 kg/ha.

Fifteen rice varieties were tested under CYT (Ist crop season) at the Kayamkulam station and the entries Jyothi, Culture 3, Culture 1065, IR-22, Annapurna, Kanchi, Culture 16, Triveni and PTB-23 were found to be on par with reference to grain yield. During the second crop season the promising varieties were identified as Blue bonnet, Pankaj and Jagannath.

Five F_6 lines from the cross between WND. 2 and Rohini were identified as promising for cultivation at relatively higher eleveations. The line WR–010 outyielded the parents and the remaining cultures.

In studies on the selection and hybridization work involving Adukkan, a local Wynad variety, it was found that selections were inferior to the check varieties.

Hybridization programme to evolve high yielding rice varieties for the Pokkali areas was continued during the year and 9 promising cultures viz. 4,7,11,16,18,1,74,20 and 23 were selected for further investigations.

The pure line selection from the local Cheruvirippu, a popular pokkali variety was continued and Culture 174 was found to be superior to Cultures 4, 166 and Vyttila–1. A multilocational trial also confirmed the superiority of the Culture 174.

In a project on breeding for earliness in the variety Mashoori by in duced mutation, the culture 1717, 2001, 1925, 2031 and 2091 were found to be promising and these have been identified for further trials.

The International Rice Yield Nursery (IRYN) trials were conducted during the year at the Pattambi Centre.

A total of 76 single plants were selected from crosses involving IR-8 x CH. 1039 and Jaya x CH. 1039 for further investigations on the breeding for cold tolerance.

In trials on breeding rice varieties suited to deep water situations, the progenies from Triveni x Vellathilkolappala and DW–53 x IR. 2071 were evaluated and none was found to be promising.

Seven acid tolerant cultures from Jaya x Mo-1, IR-8 x Karivennel and Kochuvithu x IR-8/ MO-1 x IR-8 were compared during the additional crop season in Kuttanad. The Cultures 65-2–3 and M–24-204-2 showed good performance in acidic situations (pH-4.8)

Nine saline resistant rice varieties were added on to the germplasm collections at the Vyttila station.

In breeding for resistance, 11 cultures showed multiple resistance to Sheath blight and Stackburn in the national screening under AICRIP.

Breeding for resistance to major pests was continued and 42 single plants from F_7 and eleven from F_5 were selected for further studies at the Moncompu Station.

The final evaluation of the BPH resistant cultures revealed the superiority of the Cultures 15–37–1 and 15–37–2. Of these the latter culture was found

to be more tolerant to the BPH. Based on the performance of the cultures for four seasons, these cultures were selected for district trials.

The preliminary variety trials were carried out in the Virippu and the Mundakan seasons involving a large number of cultures identified under the AICRIP programme. The uniform varietal trial was also carried out during the year.

Evaluation of the performance of promising medium duration rice cultures under low NPK levels showed significant varietal variability. The culture N-22-65-2-3-1 was selected for district trials in the project for the selection of cultures from the cross Jaya x MO-1.

In performance evaluation of advanced cultures carried out at the Moncompu Station, the Culture M-15-36-2 recorded the maximum grain yield. This culture was tolerant to thrips and BPH.

Selected cultures from the cross IR. 8 x Karivennel were evaluated during the year and the good performers identified for further trials.

In staggered planting trials involving Culture 31-1 and PTB. 20, it was found that planting carried out in the first week of September recorded the maximum yield. Culture 31-1 was identified to be superior to PTB. 20.

PROJECTS IMPLEMENTED

Breeding for Quality and Yield

	Project titles	*Location*
1	Breeding for lodging resistant fertilizer responsive medium tall rice varieties suited for cultivation in Kerala (Ag. 1. 1 Bot. 1–ii)	Pattambi
2	Breeding for non-shattering in the rice variety Jyothi (Ag. 1. 1. Bot. 4–ii)	Pattambi
3	Evaluation of high yielding photosensitive varieties suited to the different agro-climatic zones (Ag. 1. 1. Bot. 4–iii)	Moncompu
4	Evolving a short duration, semi tall variety of rice resistant to pest and diseases (Ag. 1. 5–Bot–12–xxv)	Moncompu
5	Evaluation of varieties having intermediate height suited to broadcast conditions in Onattukara	Kayamkulam
6	Screening of rice varieties suited to different seasons in Onattukara from the existing high yielding varieties and pre-release cultures of rice under recommended package of practices	Kayamkulam
7	Screening of rice varieties suited to different seasons in Onattukara region from the existing high yielding varieties and pre–release cultures of rice	Kayamkulam
8	Evaluation of high yielding photo–sensitive varieties suited to different agro-climatic conditions	Kayamkulam
9	Selection and hybridization in paddy WND. 2 x Rohini (Ag. 1–12–Bot. 1–vii)	Ambalavayal
10	Selection and hybridization work in Paddy–Adakkan (Ag. 1–12–Bot. 1–v)	Ambalavayal
11	Genetic studies on induced viable mutants in rice *Oryza sativa* (Ag. 1–18–Bot. 3–iii)	Vellayani
12	Hybridization programme–improvement of Pokkali rice	Vyttila
13	Breeding for earliness in the variety Mashoori by induced mutation	Vyttila
14	Pureline selection in Cheruviruppu	Vyttila
15	District Trial of Cheruviruppu culture	Vyttila

Breeding for Tolerance to Stress

16	International Rice yield Nursery (Ag. 1.1.Bot. 14–i–ii and 13–xvi)	Pattambi

17	Breeding for cold tolerant varieties of rice for the high altitude regions of Kerala (Ag. 1.1.Bot. iv)	Ambalavayal
18	Breeding of rice varieties suited to Kerala's deep water regions (Ag. 1-1-Bot. 5-ii)	Pattambi
19	Screening of rice cultures/varieties suited for dry sowing during viruppu season (Ag. 1.1.Bot. 1-ii)	Pattambi
20	Evolving high yielding acid tolerant varieties of Rice (Ag. 1.5.Bot. 5-vi)	Moncompu
21	Collection, maintenance and utilization of saline resistant rice varieties	Pattambi
Breeding for Disease Resistance		
22	Breeding for disease resistance in rice with special reference to sheath blight and stackburn (Ag. 1.1. Bot. 5-ii)	Pattambi
Breeding for Insect Resistance		
23	Breeding of rice varieties resistant to the BPH	Moncompu
24	Inheritance studies of BPH resistance in PTB-19, PTB-33 ARC-62250 (Ag. 1.1. Bot. 8)	Pattambi
25	Final evaluation of the BPH resistant culture (Ag. 1.5. 5-6)	Moncompu
Yield Trials		
26	Preliminary variety trials (Ag. 1.1. Bot. 13. v. xi, xiv)	Pattambi
27	Uniform variety trial (Ag. 1.1, Bot. 13 iv, xii, ix, xv)	Pattambi
28	Performance evaluation of promising medium duration rice cultures under low NPK	Pattambi
29	Evaluation of the selected cultures from the cross Jaya x MO-1 (Ag. 1.5 Bot. 13-xxvii)	Moncompu
30	Project for evaluating varieties and cultures supplied by the cultivators (Ag. 1.5-Bot. 13-xxv)	Pattambi
31	Evaluation of advanced cultures of different crosses (Ag. 1.5-Bot. 13-xxxi)	Moncompu
32	Evaluation of the selected cultures from the cross IR-8 x Karivenal (Ag. 1.5. Bot, 13 xxviii)	Moncompu
33	Periodical planting trial with Culture 31-1 as compared to 2nd crop popular variety PTB-20	Kayamkulam
34	Initial evaluation trial-2-Minikit trials in cultivators' fields and State Seed Farms	Kayamkulam
35	Initial Evaluation Trial-1	Kayamkulam
36	Varietal trial in Paddy (Ag-1-12-Bot.-13-xxxi)	Ambalavayal

BREEDING FOR QUALITY AND YIELD

Breeding lodging resistant fertilizer responsive, medium height rice varieties suited for cultivation in Kerala. Ag. 1-1-Bot.1 (ii) [Pattambi]

Cul. 1907, a semi-tall culture identified earlier from cross between Triven and Bhavani was yield tested in State seed farm during the II crop season. The culture has recorded higher grain yield and higher straw yield than the check variety Triveni in most of the locations.

From among the progenies of different crosses studied in the F4 generation during the year a total of 302 single plant selections have been made.

1907 x Jyothi	= 148
Cul. 24663 x Bharathy	= 38
BR. 51 x Ptb. 26	= 116
	302

It has been decided to combine this project with the project for screening cultures for dry sowing during Virippu season. The 302 lines of the F5 are grown in wet lands in 1980-81 Virippu and uniform lines selected from these will be screened under dry sown up land conditions from 1981-82 onwards.

Breeding for non-shattering in the rice variety Jyothi. AG-1-1-Bot. 4 (ii). [Pattambi]

One culture from reselection (Cul. 1999) and another from irradiation (Cul-1998) were compared during the 1st crop season. Based on non-shattering, the Cul. 1999 was selected for further trial. The results in brief are furnished in Table 1. 1.

Table 1.1. Performance of the non-shattering cultures with the parental variety.

Particulars	I Crop season 1979-80			II crop season 1979-80		III crop season 1979-80	
	Cul. 1998	Cul. 1999	Jyothi	Cul. 1999	Jyothi	Cul. 1999	Jyothi
Mean No. of shed grains per panicle.	2.20	0.70	3.10	0.63	1.20	0.42	1.07
Mean No. of total grain per penicle.	114.9	119.3	99.7	139.40	80.30	105.85	84.2
Mean percentage of shed grains.	1.90	0.60	3.20	0.45	1.49	0.40	1.26
Grain yield kg/ha.	3395	3227	3178	3245	3386	3246	3451

Evaluation of high yielding photosensitive varieties suited to the different agroclimatic zones. Ag. 1-1-Bot. 4 (iii). [Moncompu]

During the previous year, from the F3 generation of the crosses Jaya x Ptb-20, Jaya x Ptb-4 and TR. 17 x Ptb. 4; 65;46 and 52 single plants respectively were selected for further trial. Further 15, and 6 single plant selections were

made from the F2 generation of the cross M1-273 x R-19 and M1-273 x ptb-20. Single plant selections were also made from the F2 generations of the different crosses grown at Mannuthy.

During the current year, from the F4 and F3 generation planted at Kayamkulam during the Mundakan season, the following selections were made.

F4 — Jaya x Ptb-20 — 65 Nos.
Jaya x Ptb-44 — 46 Nos.
Ptb-4 x TR-17 — 52 Nos.

Since the plants (F3 generation) planted at Mannuthy were affected by drought in the last phase it was difficult to make proper selections. Therefore a large number of selections were made which will be grown during the next season for proper selections. The following numbers of selections were made Jaya x Ptb-12 (2941), Jaya x Cochin (107), M1-273 x Cochin (187) and M1-273 x Ptb-12 (363).

Evolving a short duration, semi-tall variety of rice resistant to pest and disease Ag. 1-5-Bot. 13 (xxv) [Moncompu]

Nineteen F6 cultures, 32 F4 cultures and 2 F3 cultures were grown during the additional crop season of 1979 in separate strips in singles. The cross combinations are shown in the table. Observations on the date of flowering, number of productive tillers per hill, count of stem borer, incidence of disease resistance like sheath rot, sheath blight, bacterial leaf blight etc. were recorded. Finally 5 single plants were selected from the F6 progenies and 24 single plants from F4 progenies. None of the plants were selected from the F3 rows. Seeds of the selected single plants were grown during the puncha season of 79-80. All the above characters were noted and recorded. Only two single plants were selected from the F7 progeny row and 9 plants from the F5 progeny rows. Nine single plants were selected from the F7 progeny rows of two cross combinations from the project (Breeding for Rice Varieties resistant to BPH) which were semi-tall and early were added to this project. Now altogether there are 11 F8 cultures and 9 F6 cultures. (Table 1.2.)

Table 1.2. Advanced short duration semi-tall cultures.

Parentage	No. of cultures grown during		No. of cultures to be grown during Addl. crop of 1980.
	Addl. crop of 1979	Puncha crop of 1979-80	
Jaya x Ptb.33	7	1	—
Triveni x Ptb. 33	1	—	—
Cul. 28/LMN/253	1 F6	3 F7	9 F8 from other project.
1561 x Ptb. 33	6	1	1
ARC 6650 x Jaya	3	—	1
Cul. 28/LMN/Ptb. 33	1	—	—
Jyothy x M. 14-2-3	11 F4	8 F5	4 F6
M 14-2-3 x Jyothy	21	16	5
Triveni x M-14-2-3	2 F3	—	

Evaluation of varieties having Intermediate height suited to broadcast conditions in Onattukara. [Kayamkulam]

The experiment was laid out in 7 x 3 RBD with the treatments Cul. 1004, Cul. 1005, Cul. 1017, Cul. 1023, Cul. 1026, Cul. Jyothi and Ptb. 23.

The treatments were significant at 0.01 level. T1, T7, T6 and T5 are on par for grain yield. Maximum yield was recorded by Cul. 1004 (4605 kg/ha). (Table 1.3.)

Regarding the straw yield also treatments were significant at 0.01 level. T1, T5, T2 and T3 on par. Maximum yield recorded by Cul. 1004 Table 1.4 (21435 kg/ha). The straw/grain ratio were as follows:

Straw grain ratio.

T1	:	4.66
T2	:	7.7
T3	:	5.31
T4	:	3.73
T5	:	4.91
T6	:	2.43
T7	:	3.38

Table 1.3: Grain yield in kg/plot (1st crop 1979-80)

Trt. No.	R1	R2	R3	Mean	Kg/hect.
Cul. No. 1004	10.4	8.65	7.8	8.95	4604
Cul. No. 1005	5.65	4.3	4.25	4.7	2418
Cul. No. 1017	7.85	5.9	5.55	6.43	3308
Cul. No. 1023	6.6	4.4	4.0	5.0	2572
Cul. No. 1026	7.0	8.25	7.25	7.5	3858
Jyothi	7.7	9.3	7.4	8.13	4182
PTB. 23	8.6	8.6	8.7	8.63	4439

Table 1.4: Straw yield in kg/plot (1st crop 79-80)

Trt. No./Culture	R1	R2	R3	Mean	Kg/ha
Cul. No. 1004	44.5	45.0	35.5	41.67	21,435
Cul. No. 1005	32.5	32.5	43.5	36.17	18,605
Cul. No. 1017	39.0	34.0	29.5	34.17	17,577
Cul. No. 1023	33.0	17.8	15.2	18,47	9.603
Cul. No. 1026	34.5	36.0	40.0	36.83	18,945
Jyothi	19.0	22.0	18.0	19.67	10,818
PTB. 23	31.1	32.0	24.5	29.2	15.020

Screening of rice varieties suited to different seasons in Onattukara from the existing high yielding varieties and pre-release cultures of rice under recommended package of practices.

(a) **CYT. of first crop varieties.** [Kayamkulam]

15 varieties were tested during this season. During 1979–80 1st crop the treatments were not significant for grain yield. Maximum grain yield was recorded by ARC–11980 (Table 1.5) (4306 kg/ha) followed by Annapurna (4060 kg/ha). The treatments were significant at 0.05 level for straw yield during 1979–80 1st crop. Maximum straw yield was recorded by ARC–11980 (16560 kg/ha) Table 1.6 followed by Sakty (13173 kg/ha). All the treatments Jyothi, Cul. 3; Cul. 1065, IR–22; Mala Cul. 23372, Annapurna, Kanchi, Cul. 16, Triveni, PTB. 23 except IR–32, and Rohini were on par (Table 1:5)

Table 1.5: CYT of first crop varieties
(1st crop 1979-80)
Grain yield in kg/plot

Treatment. No./ varieties	R1	R2	R3	Mean	Kg/ha
1 Jyothi	3.85	4.15	2.80	3.60	3846
2 ARS 11980	3.75	4.30	4.05	4.03	4306
3 Culture 3	3.80	4.00	2.55	3.45	3686
4 Culture 1065	3.55	2.15	1.65	2.45	2596
5 IR-32	4.05	2.90	1.55	2.83	3024
6 IR–22	3.80	3.45	1.65	2.97	3173
7 Mala	4.20	2.75	3.47	3.47	3718
8 Cul. 23372	5.30	3.55	1.70	3.52	3761
9 Sakhti	5.90	2.35	2.70	2.98	3184
10 Annapurna	2.70	4.00	4.70	3.80	4060
11 Kanchi	4.75	3.3	1.6	3.22	3440
12 Cul–16	4.35	3.55	2.8	3.57	3814
13 Triveni	4.2	4.15	2.7	3.68	3932
14 PTB–23	3.95	4.0	3.1	3:68	3932
15 Rohini	2.85	1.8	1.4	2.02	2158

Table 1.6 Straw yield kg/plot

Treatment No/ varieties		R_1	R_2	R_3	Mean	kg/ha.
1	Jyothi	10.0	11.0	4.5	8.53	9113
2	ARS 11980	13.5	18.5	14.5	15.5	16560
3	Culture 3	10.7	12.5	5.4	9.53	10182
4	Culture 1065	12.9	9.9	8.0	9.93	10650
5	IR-32	8.5	4.5	2.1	5.03	5374
6	IR-22	13.8	12.0	6.3	10.7	11432
7	Mala	13.9	7 1	1.5	10.5	11218
8	Cul. 23372	11.1	8.5	3.0	7.53	8045
9	Sakhti	19.0	8.7	9.3	12.3	13173
10	Annapurna	8.0	7.0	9.0	8.0	8547
11	Kanchi	14.5	9.0	3 5	9.0	9615
12	Cul-16	8.2	7.5	4.0	6.57	7019
13	Triveni	8.6	9.7	4.9	7.4	7906
14	PTB-23	11.5	12.5	8.0	10.67	11400
15	Rohini	4.0	2.4	2.4	3.0	3205

(b) CYT of IInd crop varieties

During 79–80 second crop season the treatments were significant at 0.01 level. The highest value was recorded by Blue bonnet (3057 kg/ha) Pankaj (2737 kg/ha) and Jagannath (2581 kg/ha) (Table 1.7)

The treatments were also significant for straw yield at 0.01 level. The highest yield recorded by T5 (10101 kg/ha) which was on par with T_8 (10006 kg/ha) and T_9 (9810 kg/ha) (Table. 1,8)

During 1978–79, maximum grain yield was recorded by Blue bonnet (7332 kg/ha) followed by Jagannath (7000 kg/ha).

CYT of selected varieties suited to IInd crop season

Table. 1.7 (Second crop 1979–80) Grain yield in kg/plot

Tr. No./vars.		R_1	R_2	R_3	Mean	Kg/ha
1	Jagannath	3.5	3.9	4.0	3.8	2581
2	IR-8	3.5	3.5	3.3	3.43	2330
3	Rohini	1.5	1.8	1.0	1.43	971
4	Mashoori	3.8	3.5	3.2	3.5	2377
5	Blue Bonnet	4.8	4.5	4.2	4.5	3057
6	Pankaj	3.8	4.0	4.3	4.03	2737
7	Arabindo	2.8	2·6	2.5	2.63	1786
8	H-4	3.5	5.3	4.0	4.27	2900
9	PTB-9	3.7	4.5	3.0	3.73	2533

Table 1 8 Straw yield in kg/plot (Second crop 1979-80)

Tr. No./vars.		R_1	R_2	R_3	Mean	Kg/ha
1	Jagannath	8.8	8.5	8.5	8.6	5842
2	IR-8	6.0	6.0	6.0	6.0	4076
3	Rohini	3.0	3.0	2.0	2.6	1766
4	Masoori	10.0	9 5	9.9	9.8	6657
5	Blue Bonnet	14.8	15.3	14.5	14 87	10101
6	Pankaj	10.4	9.7	9.3	9.8	6657
7	Arabindo	9.6	7.9	6 5	8.0	5434
8	H-4	14.9	14.5	14.8	14.73	10006
9	PTB-9	14.0	13.0	15.0	14.0	9510

Evolution of high yielding photo sensitive varieties suited to different agro-climatic zones. [Kayamkulam].

Following promising selections were taken from the different cross combinations and carried forward for further breeding work:

Jaya x PTB-20	= 55 Selections
Jaya x PTB-4	= 30 ,,
PTB-4 x TR-17	= 52 ,,
M.1.273 x UR.19	= 27 ,,
M.1.273 x PTB-20	= 8 ,,
Jaya x PTB-33	= 27 ,,

Selection and hybridization in paddy WND-2 x Rohini AG.1 -12, Bot. 1 (vii) [Ambalavayal]

The trial was taken up to evolve a stiff strawed, high yielding tall WND-2 type of rice with a shorter duration than WND-2 and combining the high yield of Rohini. Lines of the progenies of the cross were carried forward and tested with their parents.

During the pevious year five lines (F6) of the cross WND-2 x Rohini was raised during 1978-79. The yield data are furnished in Table 1.9

Table 1.9 Yield (kg) from plots 3m x 2.5m

Replication	WR-010	WR-001	WR-002	WR-002 /1	WR-002	WND-2	Rohini
1	2.60	2.50	3.00	2.30	2.30	3.10	2.90
2	3.10	3.10	2.50	1.90	2.70	2.80	2.50
3	4.00	2.00	2.30	3.00	2.90	2.70	2.40
Mean	3.23	2 53	2.77	2.40	2.63	2.87	2.93

The line WR-010 out yielded all others followed by the parents. This trial was not conducted during 79-80:

Selection and hybridization work in paddy-Adukkan: AG. 1.12. Bot. 1 (v) [Ambalavayal]

Collection of Adukkan variety from different cultivators and selection of promising single plants with desirable characters were done. Detailed study

of single plants and selection for promoting to PYT-CYT of promising cultures were subsequently done. The cultures thus obtained were tested prior to their release.

Table. 1.10 Yield data (kg) from plots 2 x 2m

Treatment	IR-8	Jaya	AD Bulk	AD 74	AD 49	AD 27	AD 7	Total
1	0.89	1.09	0.49	1.46	1.09	0.84	0.71	6.57
2	1.28	0.96	0.58	0.98	1.17	0.95	0.59	6.51
3	1.13	1.69	0.68	0.80	1.01	0.84	0.66	6.81
4	0.94	1.46	0.61	1.28	0.83	0.99	0.65	6.76
Total	4.24	5.20	2.36	4.52	4.10	3.62	2.61	26.65
Mean	1.06	1.30	0.59	1.13	1.03	0.91	0.65	

Jaya ranked top (Table 1.10) among all other varieties followed by AD. 74, IR-8 and AD.49. The lowest yielder was AD Bulk.

Genetic studies on induced viable mutants in rice. AG-1-18-Bot. 3 (iii) [Vellayani]

Seeds of the rice varieties Ptb. 10, ptb.9 and ptb.28 were treated at crtical doses of gamma rays and ethyl methane sulphonate. The M1 study has been completed. Viable mutants comparable to the plant type of high yielding varieties are baing isolated in the generation.

Hybridization programme—Improvement of Pokkali rice. [Vytilla]

Hybridization programme to evolve high yielding rice varieties suitable for Pokkali areas was initiated during 1967-68 by taking crosses between Pokkali x T(N) 1 and pokkali x IR-8. These cultures selected from this breeding programmes were under a preliminary yield trial during the period under report; and the details are given in Table 1.11

Table 1.11 Improved Pokkali cultures (hybridization)

Cul. No.	Height of plant in cm	Flowering in days	Yield in kg/plot	Yield in kg/ha.
5—1	151.5	81	5.750	2875.0
4—4	155.9	80	5.300	2650.0
4—5	152.0	80	5.000	2500.0

Comparative yield trial of the Culture 5-1 and 4-4 will be conductad along with Vytila-1 as standard during the cropping season in 1980.

In another hybridization programme, crossing was done between Pokkali x Jaya during 1974 and 76 culture were in a progeny row trial during 1977. 42 selections were made and three cultures were again under trial during 1978. 23 cultures were selected and a preliminary yield trial (Table 1.12) was conducted during the season in 1979.

Table 1.12 PYT of Pokkali cultures

Cul. no.	Height of plant in cm.	Flowering duration in days	Yield in kg/plot	Yield in kg/ha
4	131.0	79	5.250	2625.0
10	90.0	78	3.150	1575.0
48	79.2	84	2.700	1350.0
27	150.2	89	4.000	2000.0
7	82.0	76	5.200	2600.0
11	82.0	77	5.600	2800.0
45	79.8	81	4.050	2025.0
5	88.4	—	—	—
43	82.2	78	6.520	3260.0
46	78.2	—	3.650	1825.0
47	89.0	81	3.870	1935.0
50	87.6	78	3.200	1600 0
55	92.0	78	4.840	2420.0
66	81.4	79	4.470	2235.0
14	92.2	77	2.150	1075.0
26	98.4	82	2.090	1045·0
12	96.6	80	3.150	1575.0
18	90.6	79	5.470	2725.0
1	116.8	84	5.850	2925.0
62	88.2	82	3.600	1800.0
74	117.2	81	6.900	3450.0
20	153.0	80	6.000	3000.0
53	154.0	81	5.970	2985.0

Considering the yield, height of the plant, duration and other desirable characters the following 9 cultures can be selected for further studies during the next cropping seasons in 1980. viz., Cul. 4, 7, 11. 43, 18, 1, 7 4, 20 and 53.

Breeding for earliness in the variety Mashoori by induced mutation. [Vytilla]

The seeds of Mashoori were got irradiated at the Botany Department of the Kerala University in May 1978. The seeds were subjected to Co_{60} gamma rays irradiation at 10,20 and 30 kr. exposures. The seeds were sown in the field in June 1978 and all the M_1 plants available were harvested separately. The M_2 population raised during this season (June 1979) started flowering in the middle of September 1979. The earliest plant had a flowering duration of 91 days. 125 early plants were selected and harvested separately. These plants have a duration of 120 to 130 days. Plants having a duration of 131 to 135 days were harvested and the seeds of these plants were kept together for further studies during the next cropping season in 1980.

As per the direction of the Research Council the hybrid cultures available at Rice Research Research Station, Pattambi, having Mashoori blood were tried in the pokkali area during the season. Details of the cultures are funished in table 1.13

Table 1.13 Breeding for earliness in Mashoori performance of cultures

Cul. no: with parentage	Height of plant in cm.	Duration in days	Yield in kg/plot 10 sq mts.
Cul. 1925 Jyothi x IR 2153	104.3	108	1 620
Cul. 1945 Jaya/2085/Mashoori	115.3	128	0.835
Cul. 1948 -do-	119.2	128	0.565
Cul. 1953 -do-	82.8	115	0.100
Cul. 1954 -do-	79.4	113	0.800
Cul. 1989 Annapoorna x Mn	114 0	128	0.730
Cul. 1717	104 5	107	2.100
Cul. 2001 Bhavani x Triveni	134.4	115	2.280
Mashoori	145.5	133	3.360
Cul. 2036 Jaya/IR 2071/ Mashoori	104.0	113	0.220
Cul. 2037 -do-	101.4	128	0.800
Cul. 2011 Jaya/2058/Mash0ori	103.5	128	1.000
Cul. 2013 -do-	113.3	108	0.575
Cul. 2014 -do-	143 6	115	0.950
Cul. 2018 -do-	121.2	128	0.990
Cul. 2031 -do-	102.0	115	1.640
Cul. 2019 -do-	127.4	128	1.660
Cul. 2039 Jaya/IR2071/Mashoori	102.0	128	0.225

On the basis of yield and other characters following five cultures are found to be promising and these five cultures can be studied further during the next season in 1980.

Cul. 1717, Cul. 2001, Cul. 1925, Cul. 2031 and Cul. 2019.

Pure line selection in Cheruvirippu [Vytila]

The objective of the project is to evolve a better yielding variety from the popular pokkali variety—Cheruvirippu by pure line selection.

Cheruvirippu is a popular rice variety in the pokkali area of Ernakulam District. It is tolerant to salinity but yield potential is poor. In order to evolve a better yielding variety by pure line selection, a project has been initiated during 1959. Seven cultures were under comparative yield trials during 1975 and 1976. There was no significant difference due to treatment in both the seasons.

A third comparative yield trial was conducted during 1977, but the experiment was completely affected by water pollution and the experiment was discarded. The seeds obtained were used for seed multiplication and conducted an observational trial during 1978 season.

A comparative yield trial (table 1.14) of six cultures was conducted with Cheruvirippu and Vytila-1 as control during the season.

Table 1.14: CYT of pure line selections from Cheruviruppu

Cul. No.	Flowering duration in days	Height of plant in cm.	Mean yield	Yield in kg/ha
Cul.4	95	146.6	8.233	1372.2
Cul. 29	95	149.4	8.683	1447.2
Cul. 74	91	153.1	10.033	1692.2
Cul. 166	95	157.4	7.650	1275.0
Vyttila 1	85	148.1	7.233	1205.5
Cul.168	94	143.7	8.650	1441.6
Cul.174	94	154.8	10.350	1725.0
Bulk	96	147.8	8.183	1363 8

Cul. 174 was superior to Cul. 4, Cul. 166, Bulk and Vyttila 1 and it was on par with Cul. 74, Cul. 29 and Cul 168.

District trial of Cheruviripu cultures

Pure line selection in this variety has yielded 2 promising cultures–No. 74 and No. 174. A multilocation trial was conducted during the year 1977 in 30 locations. The results of the trials from 19 locations were obtained Table 1.15 as the trials in the remaining locations were affected by flood or by severe salinity.

Table 1.15: Results of multilocational trial of, cheruvirpu cultures

Name of the cultivator	Grain yield in kg/plot of 100 m^2 Cul. 73	Cul. 174	Bulk
P. K. Prakasan, Vallually	19.43	22.86	17.20
M. Viswanath Shenoy, Varapuzha	33.00	35.00	36.50
A. K. Jayan, Koonammavu	11.25	18.45	10.20
Paily Varghese, Ezhikkara	24.00	38.00	21.00
P. Bhaskara Menon, Neloor	13.00	16.60	12.00
V. I. Mohammed, Maduvana	8.25	8.30	8.10
K. M. Joosa, Varapuzha	13.50	12.00	6.00
Raghavan, K., Kadamakudi	13.50	17.00	15.50
Muraleedhara Shenoy, Pattanakad	13.00	12.00	8.00
K. Pappan, Pattanakad	10.00	9.00	12.00
T. J. Varghese, Vettakal	7.70	9.00	7.40
K. G. Kumara, Vettakal	9.50	10.00	8.00
Pradurajan, Thaickal	10.00	11.00	11.00
J. T. V. Puthanagadi, Narakal	33.00	35.00	30.00
K. A. Kumaran; Pallipuram	12.00	18.00	13.00
K. K. Kesavan, Edavanacad	14.00	16.00	12.00
R. Krishnan, Kuzhippilli	33.00	35.00	30.00
E. V. Ittyachan, Parur	7.30	1.90	3.60
E. B. Laban, N. Parur	7.60	2.20	4.10
Total	298.030	327.410	265.600
Average yield per plot	15.690	17.230	13.980

Cul. 174 was found to be superior to the other two cultures while Cul. 74 was better than Cheruvirippu bulk.

Multilocation trials were conducted in four locations during the cropping season in 1979 with Cul. 74, Cul. 174 Cheruvirippu bulk and Vyttila 1. Though there was no significant difference among the varieties Cul. 174 gives the highest yield.

Breeding for tolerance to stress

International Rice Yield Nursery

Ag-1-1-Bot. 14 (i), (ii) and 13 (xvi). [Pattambi]

The objective of the project is to test promising materials from the world's rice improvement programmes under a wide range of environmental stresses. Cultures and varieties of different duration groups are yield tested in three series, viz., early, medium and late as IRYN (E), IRYN (M) and IRYN (L).

During the year three trials viz. IRYN (E), IRYN (M) and IRYM (L) were conducted. The data are furnished in Table 1.16, 1.17, and 1.18 respectively.

Table 1 16 Performance of IRYN (E)

IRTP No.	Designation	Flowering duration	Mean height	Tiller per M²	Mean yield kg/ha.
05214	B 4598-PN-32-3-5	93	91	298	2719
04038	B 1014 B-PN-18-1-4	87	83	250	2383
06388	B 2360-6-7-1-4	97	93	385	2719
04407	BKN 7033-13-1-1-3-2	89	80	301	2880
03373	BR 51-54-1	97	88	294	1798
07084	BR 109-74-2-2-2	89	70	301	2295
07085	BR 161-28-25	89	75	371	2719
03407	VR 169-1-1	94	103	308	3158
05377	Mala/J 15	82	96	252	2865
06493	IET 2473 (RP 79-9)	97	83	266	2778
06491	IET 5850 (RP 1158-72-1)	76	71	308	1360
05554	MTU 3419	97	78	362	1944
07414	PAU 128-850-PR. 285	93	83	350	3070
07434	R 7-2-3-1	93	82	292	2281
08022	TNAU 1756	82	71	315	1944
08023	TNAU 8870	73	103	266	2485
06978	UBR 251-101-2	78	68	434	2095
03424	Kaohsuing 139	97	79	287	2737
05604	MRC 603-303	89	74	329	3991
06618	IR 5853-118-5	89	81	350	3991
07826	IR 8608-298-3-1-1-2	74	78	315	2237
06619	IR 9093-216-3	88	72	462	3509
06620	IR 9129-136-2	76	80	350	3304
07971	IR 9129-209-2-2-2-1	78	76	343	3655
06622	IR 9209-181-2	77	76	336	2442
07847	IR 9224-117-2-3-3-2	75	70	364	3114
00266	IR 96	89	72	350	2998
Jyothy		89	85	259	3845
	CD (0.05)				720

Table 1.17 Performance of IRYN (M)

IRTP No.	Designation	Flowering duration	Mean height	Tiller per M²	Grain yield (kg/ha)
06623	BR 61-282-8	97	96	350	4766
07386	BR 161-28-47	98	73	497	3070
03402	BR 168-28-23	97	114	294	2778
03406	BR 168-28-29	100	88	294	3406
03215	IET 3363 (RP-9-10-3-2-1-1	107	85	385	4050
06495	IET 6073 (RP 825-24-7-1)	105	92	318	4328
0649	IET 5905 (RP 1015-24-7-1)	105	72	406	2091
06184	CNM 31	99	80	329	4532
06625	CR 61-7039-238	94	89	336	4430
07105	KMP 40	97	91	350	3801
07926	PAU 48-962-1-5-PR 388	101	87	329	3947
08020	RNR 52147	105	98	441	3406
06494	RP 919-24-7-1	88	79	322	3260
05208	B 4418-126-3-2-1	105	117	266	4240
06383	B 2360-6-5-1-10	111	105	364	4137
06428	B 28508-51-2-2	105	86	490	4342
04612	MRI	116	102	294	3260
06405	SPR 7284	97	93	399	5073
04613	MR 10	91	101	378	3173
06648	CICA 8	100	89	392	4137
06167	BR 4422-98-3-6-1	104	105	315	4137
06710	IR 4568-86-1-3-2	93	80	469	4532
06630	IR 4570-83-3-3-2	105	108	266	3947
06631	IR 5853-162-1-2-3	100	91	406	5368
07519	IR 11248-13-2-3	97	83	413	3991
00582	IR 42	109	92	378	3801
00195	IR.8	109	84	301	3699
Jaya (local check)		97	84	301	3845
	CD (0.05)	—	—	—	934

Table 1.18 Performance data of IRYN (L)

Desigation	Flowering duration (days)	Height (cm)	Tiller per M²	Mean yield kg/ha
BKN 6322-85	148	153	—	—
BKN 6986-66-2	117	112	315	1429
BKN 6986-147-2	158	122	—	—
BKN 6987-161-1-3	146	109	—	—
CR.210-1011	132	109	378	4286
CR.1002	117	105	322	2328
CR.1005	134	111	511	5079
CR.1006	135	102	392	3862
CR.1009	127	98	357	4868
IET.3257 (CR.149-3244-168)	117	110	287	3439
IET.5656 (RP.975-109-21)	116	114	287	3289
IET.5854 (RP.1017-76-1-4-3)	114	115	322	2328
IR.3351-38-3-1	127	101	399	2751
IR.3454-80-2-1	127	104	343	4392
IR.3464-4-3-2	121	91	287	2698
IR.3464-75-1-1	121	99	308	2593
IR.4215-35-3-3	123	110	392	1852
IR.4625-132-1-2	117	92	294	1640
Mashoori	117	139	322	3016
MTU.7029	123	116	287	2169
MTU.7633	121	106	336	3280
RP.1064-14-2-2	121	95	287	3122
SPR.7212-9-2-1	158	161	—	—
TNAU. 17596-4-1	127	427	427	3810
Mashoori	113	130	266	3333
CD (0 05)	—	—	—	1470

lote: Items 1, 3, 4 and 23 flowered very late and hence yield could not be recorded.

reeding cold tolerant varieties of rice for the high altitude regions of Kerala. G.1.1.Bot.5 (iv). [Ambalavayal]

Jaya and IR-8 were crossed with cold tolerant varieties and selections were ıade. The F4 generation of the cross Jaya x CH.1039 and IR.8 x CH.1039 were rown during the year and total number of 76 single plants were selected for further sting and evaluation. The project is ongoing.

Breeding rice varieties suited to Kerala's deep water regions. AG-1-1. Bot.5 (ii). [Pattambi]

It is proposed to impart the floating gene of Vellathilkulappala variety of rice to Jaya, Bharathy, IR 32 and Triveni.

During the year the F3 generations of two crosses DW.53 x IR.2071-625 and Co.25 x (Triveni x Vellathilkulappaala) were raised under non submerged conditions.

None of the materials appeared promising and hence selections for this purpose were not made. It has been decided to close down this project.

Screening of rice cultures/Varieties suited for dry sowing during Virippu season AG.1-1. Bot.1 (ii). [Pattambi]

Seeds of 18 promising entries of IRLRON 1978 International rainfed low land rice observation nursery) were multiplied.

Sixteen promising entries from IRLRON 1979 were selected during the year. It has been decided to include this project with the project for breeding lodging resistant medium height varieties and to conduct the screening work in the uplands from 80-81 onwards.

Evolving high yielding acid tolerant varieties of Rice [Moncompu]
AG. 1—5—Bot. 5 (vi).

The seven acid tolerant cultures from the three crosses M22, M23 and M24 i.e., Jaya x Mo.1, IR-8 x Karivennel and Kochuvithu x IR-8/Mo. 1 x IR-8 were compared with the three standards during the additional crop seasons and puncha crops seasons of '79-80. The yield data were analysed and there was significant difference in yield shown by the varieties. The mean yield of the different cultures and standards during the two seasons are given in the Table 1.19.

Table 1.19 Performance of acid tolerant cultures

Cultures	Mean yield in kg/ha.	
	Addl. crop season 79—80	Puncha crop season 79—80
M23-74-1-1	4079	4478
M23-16-1-1	3556	4801
M33-33-3-1	2731	4989
M22-65-2-3	4015	5930
M22-194-122	3931	5062
Jyothy	3585	4382
Jaya	4425	5176
IR-8	4030	5085
M24-204-2	4030	5665
M24-109-1	3768	5025
C D (0.05)	508 kg/ha	499 kg/ha

A trial was conducted in a private field at Kidangara with a soil pH of 4.8. The survival and growth were observed. Culture 65-2-3 and culture M24-204-2 were found to be good yielding and tolerant to acidic situations. These were tolerant to BPH.

Collection, maintenance and utilisation of saline resistant rice varieties

Eighteen saline resistant rice varieties were collected from different parts of the State during the cropping season in 1977. Three saline resistant varieties—Korgut white, Korgut red, Korgut black—were obtained from Goa.

The following nine new varieties were added to the collection during the year. Orpandi, Mundakan, Karuthakuruka, Infan, Cheruvirippu—Vettakel, Kuttumundakan-Natika, K121, Gettu mutail and SR 268.

All these thirty varieties were sown in the field in June, 1979 and observations such as germination, establishment of plants after transplanting, height of the plants, duration etc., have been recorded. Out of thrity varieties 22 varieties were flowered during September 1979 and harvesting was completed in October. The remaining eight mundakan (2nd crop) varieties, Orpandi, *Munuaka* Cheriaorpandi, Kuttumundakan, Chennali Mundakan, Muthuramundakan, Infan, Kuttumundakan Natika, started flowering in the final week of December 1979. As the water became saline during the lowering period the seed setting was very poor in these eight varieties.

BREEDING DISEASE RESISTANCE

Breeding for disease resistance in rice with special reference to sheath blight and stack-burn, AG 1-1-Bot 5 (ii). [Pattambi]

Among the cultures isolated earlier, eleven cultures were found to show multiple resistance in the National Screening Nurseries under the AICRIP trials.

The cross progenies in F4 generation were all rejected during the year as none of the materials was found as promising. The eleven cultures showing multiple resistance have been supplied to the Professor of Plant Pathology, College of Agriculture, Vellayani for laboratory studies for an further field evaluation in the Adoor Seed Farm in 1980-81.

BREEDING FOR RESISTANCE TO PETS

Breeding of rice varieties resistant to BPH [Moncompu]

During the previous year, selections were made in the two seasons. Four hundred and three single plants from the F4 and 71 single plants were selected from the F2 during the additional crop season and from this, 219 single plants were selected from the F5 and 46 single plants from the F3 were selected during puncha crop season of 1978-79.

During the current year F6 cultures (210 nos) from 12 parental combinations and 46 F4 progenies from 2 crosses were raised during the additional crop of 1979. Sixty one single plants were selected from the F6 and 21 single plants were selected from the F4 progenies, and these were carried over to F7 and F5 respectively during the punja season of 1979-80. Selections were carried out further and 42 single plants from F7 and 11 single plants from F5 were selected for further study. No. of plants selected are given in Table 1.20:

Table 1.20: Plant selections for resistance to pests

Parentage	No. of single plants selected		
	Addl. crop 1979 (F7 seed)	Puncha crop 79 (F9 seed)	
Jaya x PTB-33	31	27	
Triveni x PTB-33	1	1	
234 x IR-26	1	1	
IR-1561 x PTB-33	18	6	
ARC-6650 x Jaya	5	4	
12814 x PTB-33	3	2	
PTB-33 x IET-1444	1	1	
203 x Jaya	1	—	
Total	61	42	
	(F5 seed)	(F6 seed)	
Jaya x PTB-33	21	2	Included
M14-2-3 x Jyothy	—	8	from another
Jyothy x M14-2-3	—	1	project.
Total	21	11	

Inheritance studies on BPH resistance in PTB-19, PTB-33, and ARC-6650
Ag. 1-1-Bot. 8 [Pattambi]

During the previous year, fresh crosses were made and F1 seeds were collected and grown. F2 seeds were collected from the F1 plants and kept.

During the current year, screening could not be undertaken in the F3 against BPH.

Final evaluation of the BPH resistant cultures. Ag. 1-5-5-6 [Moncombu]

Seven cultures from the cross Triveni x Culture 1539 and one culture from the cross Triveni x IR-2061-625-3 were tried in PYT along with two standards in a 10 x 3 RBD during the puncha season of '79-80 and additional crop season of 1979. During the additional crop season, the cultures 15-37-1 and 15-37-2 have recorded maximum grain yield of 5249kg/ha and during puncha season culture 1537-2 has given 5476kg/ha. For the two seasons there were significant difference in yield between different treatments. The mean yield of different cultures and standards during the two seasons are indicated in Table 21.

Table 1.21: Mean grain yield in kg/ha

Culture No.	Addl. crop 1979	Puncha crop 1979-80	Pooled for 4 seasons
1557-1	4573	4382	4320
1537-1	5249	4949	5238
1537-2	5249	5476	5249
1535-2	4721	4365	4932
1544-2	4904	4365	5034
1539-1	5101	4478	5187
1281-3	4276	3685	4138
1539-2	4854	4762	5187
Jyothi	4030	4116	4229
Jaya	4657	4682	4756
CD (0.05)	652 kg/ha	640 kg/ha	683 kg/ha

On the basis of the pooled analysis of the yield data for the 4 seasons Cul-15-37-2, Cul-15-37-1, and Cul. 15-54-2 were selected for District trials during the next seasons.

YIELD TRIALS

Preliminary variety trials Ag. 1-1-Bot. 13 (v, xi, xiv) [Pattambi]

The breeding programme was taken up to evaluate comparative performance of early, medium and late duration rice cultures. Depending upon the duration, group of the materials were of different series viz., PVT-1 (very early) PVT-2 (early) PVT-3 (medium). The results of the trials are furnished in Tables 1.22a, 1.22 b and 1.23a. These trials comes under the All India Co-ordinated Rice Improvement Project.

Table 1.22 a: Preliminary Variety Trial—I crop 1979-80

IET No.	Crosses	Flowering duratian (days)	Grain yield (kg/ha)
1	2	3	4
3273	Manila x IR 22	101	3421
3738	Rexoro x R 11	98	2222
4092	CR 10-114 x CR 115	103	3070
4183	(IR. 8 x Bas. 370) x (Latisail x K bhog)	104	3012
4507	Ratna x Prolifie	100	2982
4593	Sona x RP 9-4	102	3421
4600	Cauvery x W 127 S7	93	1871
4990	HPNS 35	101	2690
5101	IR 20 x IET 2508	102	3246

1	2	3	4
5216	Sona x RP 8-8	102	2953
5233	Cauvery x W 12787	109	3947
5389	CR 44-35 x Laloo 14	95	2281
5544	Laloo 14 x IR 20	95	2281
5642	IR 2042 x CR 94-13	98	2661
5700	-do-	97	2661
5702	(IR 1529-680-3 x (R 94-13) x IR 480-5-9-3	95	2573
5703	Hoyoku x Zinya	95	3012
5705	Hoyoku x Seraup Kechil	99	2719
5706	Jeoku x Kolamba	98	2895
5707	Shirauni x Seraup kechil	99	2982
5708	Shivauni x Goinchiew	98	3801
5711	Sona x RP 9-4	103	2895
5713	IR 22 x (IR. 8^2 x (B. 5589 A4-1812 x T(N) 1)	107	3421
5981	Kumar x Bala	100	3041
5999	IR 22 x Kattisamba	104	3216
6146	Cul. 240 x IR. 22	101	2392
6147	Cul. 240 x IR. 22	104	2485
6200	RP 72 x Mut. 65	109	2922
6233	(Jikoku x Nira-Cul. 3) x Ratna	103	3070
6238	Vijaya x Ptb. 21	113	3392
6255	Dular x CRHP 3	99	2164
6256	(RP 5-12 x BJi) x RP 1017	88	1813
6257	-do-	88	1930
6258	-do-	88	1901
6355	IR 24 x Cauvery	97	3012
6361	IR 24 x TKM 6	103	2047
6679	GEB 24 x (CPSLO 17 x T(N) 1	96	2865
6680	T (N)1 x PTB 10	99	3684
6681	CR 10-268 x Hamsa	99	3041
6635	N 22 x Cauvery	101	2866
6682	EH 402	102	2953
6683	TKM 6 x IET 2222	98	3099
6684	ADT 31 x AD 498	94	2749
6685	42-1 x Ratna	91	2778
6687	(PTB. 18 x PTB. 21) x IR. 8	115	4357
6688	(T 141 x Back) x T 141	114	4298
6689	-do-	106	2749
6014	R 68-1 x Jaya	101	3041
6677	Hamsa x Cross 116	103	3275
6678	IR 22 x NP 130	102	3041

1	2	3	4
4589	Sona x RP 9-4	109	2602
4591	-do-	108	3450
4596	Sona x RP 9-8	98	2778
5688	Vijaya x PTB. 21	114	3363
5179	Sona x RP 9-4	117	2485
5844	Sona x RP 8-8	104	2035
6188	-do-	101	2193
4592	Sona x RP 8-5	114	2655
5071	-do-	109	2632
2714	IR 8 x CB. 45	95	2602
Rasi	—	98	3012
Ratna	—	97	2836
	CD (0.05)	—	869

Table 1.22 b: Preliminary Variety Trial-3-1st crop 1979-80:

IET No.	Crosses	Flowering duration	Grain yield (kg/ha)
1	2	3	4
3202	IR 262 x Lauang Prathan	104	4125
3264	(IR 8 x BJL 43) x IR 22	105	2583
4154	TKM 6 x IR. 8	115	2000
4247	Vijaya x IR 64-37-3-1-2	110	3125
4430	IR 305-3-1-7-1-3 x IR 24	101	4750
4431	-do-	105	3915
4515	Vijaya x CR 129-94	126	2083
4882	PP 72 x MTU 65	109	3958
5107	RP 291-43 x IR 22	106	3083
5116	CR 44-35 x W 12708	100	3458
5269	RP 291-43 x IR 22	112	1833
5709	(GEB 24 x Sigadis) x IR. 8	103	3333
5717	Vijaya x PTB. 21	104	3400
5723	Pusa 114-38-7-32	99	3708
5888	CR 1014 x Krishna	112	3250
5891	CR 70 x Pankaj	142	1417
5900	Jagannath Natural cross	142	833
5901	Pankaj x Kada	142	1042
5902	T. 141 x Jagannath	134	2708
5903	RPW 6-13 x Sona	126	1625
5905	Sona x Mancharsali	113	2458
5906	Sona x Mashuri	115	3125
5907	-do-	110	2292

1	2	3	4
5908	-do-	126	4583
5909	-do-	108	3417
5910	-do-	126	4333
5911	-do-	113	4333
5912	-do-	100	1292
5913	-do-	112	2625
5914	-do-	111	2000
5915	IR 8 x CO.25	142	1583
5928	T (N) x Rashi	104	3750
6846	8838 x (GEB 24 x Sigadis)	105	3333
6170	Bas. 370 x T (N) 1	98	2958
6172	Blue Dawn x M-9	107	3667
6201	PP 72 x Mut. 65	105	3125
6232	Waikoku x CR 1014	117	2708
6234	do	117	2292
6235	Vijaya x (IR8 x Zenith)	117	4333
6236	Vijaya x wase aikoka-3 x IR8	117	958
6237	Vijaya x CR 127-13	117	3083
6239	Dup. IET 3319	113	3083
6252	Vijaya x CR 127-13	108	2833
6253	(C1-9242 x IR.8) x CR 127-53	109	4125
6254	IR 20 x IR.5-114-3-1	105	5250
6259	RPA 5929	104	4083
6260	Jaya x (IR.8 x BJ.1)	107	2542
6263	Pankaj x Vijaya	107	4541
	Jaya	105	3958
	CD (0 05)	—	1685

Table 1.23: Preliminary variety trial 3A-1st crop 1979-80

IET No.	Crosses	Flowering duration	Grain yield kg/ha
1	2	3	4
6264	Pankaj x Vijaya	105	2667
6265	CR 63-5218-1 x Pankaj	109	2556
6268	do	106	4519
6269	Jagannath natural crosss	111	3481
6274	IR.8 x GEB 24	134	2333
6275	CR 44-35 x W 12708	112	3704
6276	IR 1814 x IR 189	109	1556
6277	Raghusail x Chainan-2	105	1259
6278	RP 31-49-2 x Ptnai. 23	147	2889
5711	Sona x RP 9-4	98	3333

1	2	3	4
6282	RPW 6-13 x Sona	113	4741
6283	do	109	3370
4699	Imp. Sabarmati x Sona	113	4741
4701	do	109	3370
6010	IR.8 x W 1263	100	4704
6012	do	102	3593
6084	Vijaya x Palman 579	113	2852
6121	RP 4-14 x Tetep	113	3741
6107	RPW 6-13 x Sona	117	4074
6055	(IR.8 x W 1263) x (TKM. 6 x IR. 8)	107	4556
6096	Sona x RP 9-4	107	3926
6101	do	112	3111
6063	RP 107-13 x Sona	100	3556
6708	Sona x IET 2508	103	4111
6709	IR.20 x Shakti	104	4481
6710	CR 129-118 x RPW 6-13	112	3889
6711	CR 1026 x Hamsa	100	4444
6712	Kumer x Bala	94	3741
6713	TNAU 185-21	91	3667
6614	Hamsa x Cross 116	110	5111
6715	(IR.8 x Siam 29) x (IR.8 x Pta. 21)	109	3481
6716	Jaya x HR. 47	104	3074
5735	Imp Sabarmati x Sona	114	3185
5738	do	117	1730
5802	do	109	3630
Jaya	—	109	4963
CD (0.05)		—	1527

Uniform Variety Trial Ag. 1. 1. Bot 13 iv, xii, ix, xv [Pattambi]

The objective of this project was to study the performance of early, mid and late duration selections in comparison with local checks.

During the year five trials viz., UVT 1, UVT 2, UVT 3, UVT 4 and UVT 5 were conducted. The brief results of the trials are furnished in Tables 1.24 to 1.28

Table 1.24 Uniform Variety Trial-1-III crop 1979

IET No.	Crosses	Flowering duration (days)	Mean ht. (cm)	Tiller per m²	Grain yield kg/ha
1	2	3	4	5	6
2683	TKM 6 x T (N) 1	58	68	763	4267
2585	,,	58	65	602	4156
3280	Dunghanshali x IR 8	58	73	518	4311
4097	,,	56	62	483	3200

1	2	3	4	5	6
4106	Cauvery x (Boak x N22 x REDI)	59	74	679	4178
4107	,,	59	69	574	4244
5849	RPA 5824 x RP 89-9	58	69	413	2889
5850	,,	54	70	413	3267
5851	,,	56	59	539	4000
5858	,,	56	59	567	3667
5860	,,	56	75	504	3356
6148	Bala x Co-13	66	80	427	4289
6149	CO.33/2 x Dawn	58	64	588	3756
Bala Check		58	68	518	4689
Cauvery Check		59	73	504	4244
Annapoorna-Local check		61	67	616	4311
	CD (0.05)	—	—	—	625

Table 1.25: Uniform Variety Trial-2—II Crop 1979-80

IET No.	Crosses	Flowering duration (days)	Mean ht. (cm)	Tillers per m^2	Grain yield kg/ha
3273	Manila x IR.22	99	64	343	1964
3305	IR.8-246 x H 10	92	68	413	2460
3306	IR.8-246 x (P.PMas) x H. 501	92	68	420	2321
3626	TKM 6 Mutant	90	67	462	2123
3629	Manila x IR.22	90	65	329	2421
3630	Manila x IR.22	98	69	413	1786
4555	IR.36	92	61	427	2440
4786	CR.10-114xCR.10-115	86	65	329	1429
5857	RPA.5981xSona	92	72	322	2183
6233	(Jokoku x Nira Cul.3) x Ratna	92	57	441	2222
6238	Vijaya x PTB 21	92	66	490	2480
6711	OR.10-26 x Hamsa	107	67	546	1905
Rasi	Check	100	62	357	2024
Ratna	Check	92	62	399	2202
PTB-20	Local check	92	97	518	2659
	CD (0.05)	—	—	—	399

Table 1.26: Uniform Variety Trial 3–Ist crop 1979–80

IET No.	Cross	Flowering duration (days)	Mean ht (cm)	Tillers per m²	Grain yield kg/ha
2530	IR.8 x Latisail	101	75	455	4841
2671	IR.8 x CH.45	106	75	511	4392
2762	IR.1 x TKM.6	98	84	511	2370
2015	-do-	104	83	385	4052
2993	(Rikku 132 x N22) x SB–26–B	102	87	476	4615
3074	IR.8 x T–3	105	88	490	4170
3195	Palmn 597 x IR.747–B2–6–3	92	80	609	4792
3201	CR.115 x Mannoharsali	99	80	609	4792
3296	IR.8/Tadukan/TKM.6/T (N)1	98	81	606	4592
3319	-do-	96	89	770	3704
4082	Jaya x TKM.6	107	86	406	2740
4094	BU 1 x CR.115	99	81	476	4792
4095	(IR.8 LZN) x Early Prolific	100	73	602	4074
4096	Ratna x Early prolific	98	84	512	3926
4141	(IR 8 BJ–43) x IR.22	106	84	378	4341
4151	TKM.6 x IR.6	122	101	567	—
5721	Pusa 37–6–2–3	100	81	539	4889
5857	RPA 5981 x Sona	104	89	567	4043
Ratna	Local check	98	77	497	3970
Jaya	"	106	79	490	5407
ARC 11775	Suvarnamodan	91	—	—	2963
	CD (0.05)	—	—	—	819

Table 1 27: Uniform Variety Trial–4 — I crop 1979–80

IET No.	Crosses	Flowering duration (days)	Mean ht. (cm)	Tiller per m²	Grain yield kg/ha
2490	IR.8 x NP.130	111	82	378	4558
2729	6473	107	89	532	4550
2730	6475	113	75	266	4793
2830	IR.8 x TKM.6	108	82	392	3582
3004	IR.8/2 x LZN	113	82	294	4832
3057	"	113	84	406	4023
3060	"	113	81	315	4415
3148	IR.20 x TKM.6	115	87	504	4083
4140	(IR.8 x BJ.1 x IR.22	108	82	322	4312
4156	TKM.6 x IR.8	117	93	476	2357
5889	CR 70 x Pankan	123	99	553	2216
6142	29 na x RP 9–4	108	89	420	3857
6143	(IR.8 x B.583 A4) x Latisail)	112	75	280	4132
6144	IR.20 x IR 5–47	112	96	357	4831
Jaya	—	106	86	435	5323
1907	—	91	113	844	4881
	CD (0.05)	—	—	—	854

Table 1.28: Uniform Variety Trial-5 — II crop 1979-80

IET No.	Crosses	Flowering duration) (days)	Mean ht. (cm)	Tiller per m^2	Grain yield kg/ha
4087	CR.63-521-1 x Pankaj	111	81	371	1425
4155	TKM.6 x IR.8	92	66	504	1836
5631	IR.2042 x CR.94-13	98	72	448	1546
5852	Pankaj x Jagannath	107	68	385	1522
5882	CR.63-521-1 v Pankaj	111	91	311	1401
5889	CR.70-0-2 x Pankaj	-	62	406	1546
5890	"	111	89	322	1667
5897	Penkaj x Jagannath	136	72	357	1329
6145	Mashuri Mutant	115	101	357	1329
6205	IR.8 Mutant	115	112	252	1014
6207	IR.8 x BR.34	105	115	371	918
6208	Galleiganthi Sel	92	96	469	1932
6209	T.141 x Jagannath	101	94	399	1860
6212	RP.31-49-2 x Patnai.23	115	81	413	1377
6271	CR.70 x Pankaj	123	85	413	1353
6658	Nera x T (N) 1	112	75	378	2029
5656	Sona x RPW 4-13	101	81	357	1739
Jagannath	Check	101	66	325	2246
Pankaj	Check	108	77	399	1787
PTB.4	Local check	107	114	420	1691
	CD [0.05]	—	—	—	557

Performance evaluation of promising medium duration rice cultures under low NPK level [Pattambi]

The project is undertaken to compare the relative performance of new promising medium duration rice cultures under the NPK levels recommended for high yielding varieties and local varieties.

The experiment was laid out in split plot design with three major treatments and ten minor treatments.

Main plot treatment

M1 : NPK @ 0:0:0 kg/ha (green leaves and cattle manure @ 5000 kg/ha given additionally)
M2 : NPK @ 40:20:20 kg/ha
M3 : NPK @ 90:45:45 kg/ha

Sub-treatment

V 1 : BR.51
V 2 : IR.42
V 3 : Cul.1-5-4
V 4 : Cul.1065
V 5 : Cul.2317
V 6 : Jaya
V 7 : IR.8
V 8 : Sabari
V 9 : Bharathy
V 10 : Aswathy

The mean yield data of the trial during the Ist crop season are furnished in the Table 1.29. The difference between the manurial levels were not significant, but the varietal differences were statistically significant.

Table 1.29: Mean grain yields of ten rice varieties/cultures under three manurial levels

Variety/Culture	Grain yield (kg/ha)			
	M1	M2	M3	Mean
BR.51	1958	2722	2013	2231
Jaya	2208	2750	2500	2486
Cul. 1–5–4	2097	1820	1847	1921
IR.8	1847	2528	2445	2273
IR 42	2487	2430	1750	2222
Aswathy	2362	2500	2250	2371
Cul.1065	1737	2125	1917	1926
Cul.23178	2263	1763	2513	2180
Sabari	2083	2473	2053	2203
Bharathy	2112	2638	2500	2417
Mean	2115	2375	2179	—
CD (0.05)	—	—	—	305

Evaluation of the selected cultures from the cross Jaya x MO 1. AG.1–5–Bot–13 (xxvii) [Moncompu]

During the current year, 9 cultures from tha cross Jaya x MO 1 were tested along with two standards Bharathi and Jaya. The crop was harvesred on 27–2–80. The yield data was statistically analysed and there was significant difference between treatments. The Culture M 22–65–2–3 has recorded maximum yield (6179 kg/ha). The same trial was laid out during the additional crop season of 1979 also. In that trial also the difference between treatments were significant in case of yield and the Culture M 22–194–1–2 has given maximum yield i.e., 5363 kg/ha. The mean yield of the different cultures and standards during the two seasons are shown in Table 1.30.

Table 1.30: Performance of selected cultures

Cultures	Mean yield in kg/ha		
	Addl. crop 1979	Puncha crop 1979-80	Pooled analysis for 3 seasons
1	2	3	4
M22-33-3-1	4422	5102	4507
M-22-65-2-4	4949	5952	5159
Jaya	4779	5442	4728
147-1-1	4705	5726	5023

1	2	3	4
184-1-1	5045	5839	4972
34-2-1	4683	5329	4660
67-3-2	4342	4592	4252
65-2-3-1	5232	5839	5516
65-2-3	4683	6179	4989
194-1-2	5363	5385	5045
Bharathy	4738	4592	4433
CD (0.05)	527 kg/ha	759 kg/ha	489 kg/ha

On the basis of pooled analysis of the yield data the Culture M22-65-2-3-1 has been selected for NSN trial and also for District trials during the next season.

Project for evaluating varieties and cultures supplied by the cultivators.
AG. 1-5-Bot. 13 (xxv) [Moncompu]

Three cultures received from cultivators, viz., NP-3, NP-73, NP-93 were tried in an yield trial along with the standards Jyothi, Jaya and Bhadra during the puncha seasons of 1979-80. The yield data recorded and their rank are given in Table 1:31.

Table 1:31: Performance of cultivator's meterials

Bulture No.	Mean yield kg/ha.	Remark
NP-3	3090	6
NP-73	4252	5
NP-93	6094	1
Jaya	6023	3
Jyothy	5286	4
Bhadra	6066	2
CD (0.05)	751 kg/ha	

Culture NP-93 recorded the maximum yield but it was not significantly different from the yield of the standards Jaya or Bhadra.

Since the yield of the Culture NP-93 was not significantly higher than the standards it was decided to conclude the project.

Evaluation of advanced cultures of different crosses Ag. 1-5-Bot. 13 (xxvi) [Moncompu]

During previous year, four yield trials were done in different locations during 1978-79 and the data analysed. Except one trial Cul. M15-36-2 recorded the maximum yield in all the other trials.

During the current year, three advanced cultures M15-36-2, M8-58-1 and M13-116-1 were compared in the yield trials. Two trials were conducted in the station during the two seasons of 1979-80. Two trials were conducted in cultivator's fields one at Changanachery and another at Alleppey. The yield data of the four cultures are given in the Table 1:32.

Table 1.32: Performance of advanced cultures of different crosses

Culture No.	Trials in Addl. crop 1979		Trials in Puncha 79	
	Moncompu	Changanachery	Alleppy	Moncompu
	kg/ha	kg/ha	kh/ha	kg/ha
M8–88–2	2576	3218	2930	4593
M15–36–2	5204	4187	5695	4756
M13–116–1	4650	3575	4929	4346
Bharathy	5047	3812	5109	4043
Jyothy	4082	3937	5179	4703

In all the trials and also in the pooled analysis Culture, M15–36–2 ranked first in grain yield. The volume weight was also good and it is resistant to thrips and BPH.

This culture is to be proposed for consideration in the variety evaluation committee.

Evaluation of the selected cultures from the Cross IR 8 x Karivennel—Ag. 1–5–Bot. 13 (xxviii) [Mancompu]

To assess the yield potential of advanced cultures selected from the cross IR8 x Karivennel two preliminary yield trials were conducted during the 2 seasons using the 16 selected cultures of the cross IR8 x Karivennel and 2 standards Jyothy and Jaya. In the additional crop, the treatments showed significant difference. But in the puncha season the difference shown by the treatments were not significant. The grain yield (mean) recorderd for the different treatments in the 2 seasons are given in Table 1:33

Table 1.33: Grain yield of selected cultures from IR 8 x Karivennel

Cultures	Mean grain yield in kg/ha	
	Addl. crop	Puncha crop
M23–16–1–1	4099	5102
33–2 1	2716	3453
33–3–1	3975	5102
47–1–1	4889	4960
69–1–1–1	4518	4960
100–2–2	3753	4676
69–1–1	4074	3826
17–1–1	4568	5158
7–1–1	4864	5187
Jyothy	2346	3543
74–1–2–1	3185	3684
30–3–2	3358	4194
69–1–2	3630	3713
17–1–3	4247	5073
106–1–1	3901	3401
83–1–1	3605	4903
106–1–2	3062	4109
Jaya	4938	5102
CD (0.05)	30 kg/ha	—

The top ranking cultures of the crosses along with the top ranking cultures of the cross Jaya x MO. 1 are to be tried in District trials during 1980–81.

Periodical planting trial with Cul. 31-1 as compared to IInd crop popular variety PTB-20 [Kayamkulam]

The objective of this project is to study the optimum time of planting to get maximum yield with minimum total duration.

The experiment was laid out in Split plot RBD design with 4 replications.

Main plot treatments
T1—1st August planting (45 days old seedlings)
T2—15th August planting (-do-)
T3—1st September ,, (-do-)
T4—15th September ,, (-do-)
T5—1st October ,, (-do-)
T6—15th October ,, (-do-)
Sub plots treatments
V1—Culture-31-1
V2—PTB-20

The treatments were significant at 0.01 level for grain yield (Main plot and Main plot x sub plot interaction). 1st September planting recorded the highest yield which was on par with 1st August planting and 15th August planting. Straw yield also was significant at 0.05 level for main plots and sub plots. The highest value was recorded by T1 which is on par with T2 and T4. Variety-1 was superior to Variety-2. (Table 1.34–1.36).

Table 1.34: Grain yield in kg/plot [plot size 4.6×3.2m] IInd crop 1979-80.

Treatments	R1	R2	R3	R4	Mean	kg/ha.
T1V1	2 81	3.18	3.33	4.74	3:52	2390
T1V2	2.59	4.07	3.33	3.92	3.48	2364
T2V1	1.78	2.00	3'55	4.81	3.04	2065
T2V2	2.74	2.50	3.85	4.37	3.39	2309
T3V1	3.40	3.75	3.55	4.40	3.78	2567
T3V2	2.29	3.70	4.22	4.51	3.68	2500
T4V1	3.90	3.20	3,50	3.30	3.48	2364
T4V2	2.44	2.22	2.55	2,11	2.33	1582
T5V1	1.58	1.73	2,47	2.21	2.00	1358
T5V2	2.37	3.33	3,03	2 96	2.92	1983
T6V1	0.66	1.25	0.59	0.59	0.77	523
T6V2	0.96	0.44	0.66	0.59	0.66	449

Table 1.35: Straw yield in kg/plot [plot size 4.6x3.2m]

T1V1	12.9	13.9	17.3	14.7	14.71	9993
T1V2	6.6	14.7	12.5	15.45	12.31	8362
T2V1	8.95	8.55	15.75	19.50	13.19	8960
T2V2	9.05	8.25	13.15	13.95	11.1	7540
T3V1	12.8	12.4	13.7	13.8	13.18	8953
T3V2	4.40	8.65	10.30	11.75	8.78	5964
T4V1	12.5	11.6	13.1	13.5	12.68	8614
T4V2	11.35	11.35	11.9	10.0	11.15	7574
T5V1	5.95	9.5	9.7	11.4	9.14	6209
T5V2	5.5	6.45	6.20	5.8	5.99	4069
T6V1	1 20	5.15	4.55	3.15	3.51	2384
T6V2	2.95	2.95	2.40	2.70	2,75	1864

Table 1.36: Phased planting X Varieties

Time of Planting		Varieties							
		Culture-31-1				PTB.20			
		Grain yield (kg/ ha)	Straw yield (kg/ha)	Date of harvest	Total duration in days	Grain yield in kg kg/ha	Straw yield in kg kg/ha	Date of harv- est	Total dura- tion in days
T1	Ist Aug.	2391	9993	14–1–80	212	2364	362	2–180	200
T2	15th Aug.	2065	960	15–1–80	199	2303	7540	7–1–80	191
T3	Ist Sept.	2567	953	18–1–80	15	2503	5964	7–1–80	174
T4	15th Sept,	2364	614	18–1–80	170	1582	7574	7–1–80	159
T5	Ist Oct.	1358	6209	30–1–80	167	1983	4069	15–1–80	152
T6	15th Oct.	523	234	8–2–80	164	448	1868	30–1–10	150

Initial evaluation Trial–2. Minikit Trials in cultivator's fields and state seed farm [Kayamkulam]

The objective of this trial is to study the yield performance of the Culture 31–1 as compared to the local popular variety PTB–20. From the results (Table 1.37) It is evident that the Culture 31–1 is high yielding as compared to PTB–20 (Table 1:37)

Table 1.37: Results of the Minikit trials conducted during 1979–80 in cultivator's fields and State seed farms

	Date of sowing	Date of Planting	Date of harvest	Total duration in days	Area under trial	Total grain yield in kg/plot		Hectare yield in kg	
						[1] Cul-31-1-	[2] PTB-20	[1] Cul-31-1-	[2] PTB-20
State Seed Farm Adoor	6–10–79	26–10–79	15–2–80	132	25 cents	318	250	3180	2500
State Seed Farm, Aranootimangalam	1–10–79	29–10–79	7–2–80	130	12.5 cents	155	100	3100	2500
Mavelikara	19–7–79	8–9–79	1–1–80	166	1 cent	15	7.9	3750	1975
Kayamkulam	1–9–79	29–9–79	21–1–80	143	5 cent	92.5	29.5	4625	1475
Karunagappally	5–9–79	2–10–79	23–1–80	140	5 cents	83	30.0	4100	1500
Thazhava	27-9–79	25–10–79	14–2–80	140	5 cents	78	28.7	3900	1435
Krishnapuram									
Trial No. 1	5–9–79	27–9–79	6–1–80	123	4 cents	33.6	24.9	2100	1556
Trial No.2	10–9–79	30–9–79	5–1–80	117	4 cents	29,4	24.1	1837	1506
Ochira									
Trial No.1	5–9–79	27–9–79	6–1–80	123	4 cents	33.6	24.3	2100	1518
Trial No.2	10–9–79	30–9–79	5–1–80	117	4 cents	29.4	25.2	1837	1575

Initial evaluation trial—I [Kayamkulam]

This project was undertaken to evolve short duration varieties of rice having resistance to drought, tolerance to pest and diseases. The following varieties were tried:

Cul. -26-1-1 (Tadukkan x Jaya), Cul. 43-1-4 (Cul. 16 x Triveni), Cul. 43-1-6 (Cul. 16 x Triveni), [Cul. 52-3-6 (Cul. 16 x Triveni), Cul. 54-1-3, Jyothi, PTB. 23.

During 1979-80 Ist crop the treatments were significant at 0.05 level. All treatments except T6 were on par for grain yield. Maximum grain yield was recorded by Cul. 43-1-6 (2861 kg/ha) followed by Cul. 26-1-1 (2760 kg/ha) (Table 1.38)

The treatments were not significant for straw yield.

Table 1.38: Grain yield in kg per plot (1st crop 1979-80)

Tr. No·	Treatments	R. I	R. II	R. III	Mean	Kg/ha.
1	Cul. 26-1-1	4.10	4.15	5.45	4.57	2760
2	Cul. 43-1-4	5.35	4.10	4.00	4.4	2708
3	Cul. 43-1-6	4.60	4.75	4.60	4 73	2861
4	Cul. 52-3-6	4.75	4.30	3.95	4.33	2617
6	Cul. 54-1-3	4.00	4.25	4.76	4.33	2619
6	Jyothy	2.5	2.75	1.50	2.36	1429
7	Ptb-23	3 50	4.65	4.00	4.05	2446

Varietal trial in Paddy; AG. 1-12-Bot. 13 (xxxi) [Ambalavayal]

The trial was undertaken to compare the yield potential and suitablity of high yielding varieties and pre-release cultures with a flowering duration of 90 to 100 days in Wynad. Local varieties of Wynad along with high yielding varieties viz, Jaya, IR-8, Annapurna, Cauvery and Rohini were studied for their comparative yield performance. The higher yield was obtained with the variety Kottathondi (700 g/plot of 4m²) and the lowest in the variety Palveliyan (Table 1.39)

Table 1.39: Yield data of selected varieties (g/plot of size 4 m^2)

Variety	grain yield(g/4m^2
Rajamani	30.00
Chennellu	566.67
Palvelian	10.00
Chinthodi	200.00
Kothanadan	100.00
Kunnikarama	120.00
Mullapuncha	315.00
Chettuveliyan	666.67
Mannuveliyan	176.67
Peruvaya	578.33
Kuttiveliyan	40.00
Kottathondi	700.00
Thonnaramthondi	188.33
Velumpala	456.67
Thondi	683.33
Kalladiaryan	133.33
Veliyan	76.67
Gandhakasala	123.33
Punnadan Palthondi	483.33
Kudakuveliyan	43.33
Kuruva	373.33
Amb T1	100.00
Amb T2	210.00
CD (0.05)	122.35

SOILS AND AGRONOMY

HIGHLIGHTS

High volume application of propanil at 1 kg ai/ha and MCPA at 0.5 kg ai/ha extended in 3% urea solution gave consistently good weed control in direct sown punja rice crop in the Kuttanad area. Studies on the development of suitable cropping patterns to the Kuttanad area consequent on the completion of the Thannermukkom barrier, revealed that Bhadra during the punja crop season followed by Triveni as the summer crop and Jaya as the additional crop yielded the maximum grain yield of 10,600 kg/ha. Irrigation of rice with 5 cm deep water at saturation point was found to be more effective than continuous submergence.

SUMMARY

Placement of nitrogen at 90 kg/ha in paperballs gave the maximum grain yield. Continuous application of P for three consecutive seasons showed no response.

In an experiment for monitoring soil fertility variations and crop response, it was found that application of nitrogen had a positive influence in increasing the grain yield, while P and K had no such influence.

The possibilities of using *Azolla* and Blue green algae for partially substituting nitrogen requirements of wet land rice were studied and it was found that these bio-fertilizers were not quite promising.

With a view to formulate fertilizer recommendations for different agro-climatic regions of the State under irrigated and rainfed conditions, 172 A-type and 168 B-type experiments were conducted in cultivator's fields in Calicut and Kottayam Districts. Positive response to nitrogen was obtained up to 80 kg/ha in Badagara and Kottayam zones while response to P and K was not consistent

Studies on the development of suitable cropping patterns for the Kuttanad area consequent on the completion of the Thanneermukkam barrier revealed that Bhadra during the puncha crop followed by the variety Triveni as the summer crop and Jaya as the additional crop gave the maximum grain yield of 10,600 kg/ha year.

In Lysimeter studies to assess ground water contribution in rice production, highest yield was recorded by the treatment in which water level was maintained at ground level. Irrigation with 5 cm depth of water at saturation point was found to be more effective than continuous submergence.

Studies to evaluate the efficiency of combined application of 2, 4-D and urea in controlling weeds occurring in rice fields and to ascertain whether the doses of 2, 4-D could be reduced, were carried out at the Moncompu Station for the second year. Application of 1 kg of 2, 4-D in conjunction with urea was found to be as effective as their separate applications.

Joint application of Propanil at 1 kg ai/ha and MCPA at 0.5 kg ai/ha extended in 3% solution of urea gave consistently good weed control in direct sown rice crop in the Kuttanad area.

Five long term experiments were in progress, two at Pattambi and one each at Kayamkulam, Vyttila and Chalakudy. Treatments receiving cattle manure alone or in combination had a distinct superiority over those receiving green manure.

PROJECTS IMPLEMENTED

	Project titles	*Locations*
Nitrogen Management		
1	Nitrogen use efficiency in low land rice	Pattambi
2	Nitrogen use efficiency in low land rice (medium duration)	Pattambi
3	Technique for increasing nitrogen use efficiency of urea	Moncompu
Phosphate Manuring		
4	Suitability of 'Phosmak' for rice	Pattambi, Moncompu
5	Split application of phosphorus for rice	Chalakkudy
Balanced Fertilization		
6	Monitoring for soil fertility under continuous rice culture	Pattambi
7	Optimum fertilizer rates for rice in sandy tracts	Kayamkulam
Bio-Fertilizers		
8	Multilocational trials on blue green algae	Kayamkulam, Vyttila, Moncompu, Chalakkudy
9	Utility of *Azolla* and blue green algae for wet land rice culture.	Pattambi
Weed Control		
10	Weed control for direct sown crop in puddled soil	Pattambi
11	Combined application of 2, 4-D and urea	Moncompu
12	Flame throwers as a weed control method	Moncompu
13	Weed control in direct sown rice in Kuttanad	Moncompu
Long term experiments		
14	Permanent manurial trial (Tall *indica*)	Pattambi
15	Permanent manurial trial (Dwarf *indica*)	Pattambi
16	Permanent manurial trial	Kayamkulam
17	Permanent manurial trial	Kayamkulam
18	Permanent fertilizer trial	Vyttila
19	Skipping of P & K	Chalakudy
20	All India Co-ordinated Agronomic Research Project	Cultivator's fields in Kozhikode & Kottayam Districts

Production potential		
21	Production potential of rice in Kuttanad	Moncompu
22	Production potential of culture 31-1	Kayamkulam
Irrigation and water management		
23	Effect of water logging on growth and yield of rice	Chalakudy
24	Lysimeter studies to assess the ground water contribution to rice	
25	Effect of impervious layers to prevent percolation loss for increasing irrigation efficiency	Chalakudy
	Agronomic methods for pest control	
26	Effect of timing and frequency of fertilizer application and percolation loss of nutrients and yield of rice	Chalakudy
27	Effect of N/K ratio on BPH incidence and yield of rice	Moncompu
28	Varietal reaction to BPH incidence as influenced by plant density and nitrogen	Moncompu
Harvest and post harvest technology		
29	Harvesting rice at physiological maturity	Pattambi
30	Investigation on premature drying of paddy leaves	Moncompu
Crop weather studies		
31	Effect of crop weather on some high yielding varieties	Pattambi
Multiple cropping		
32	Comprehensive study of rice based multiple cropping	Pattambi
33	Experiments on multiple cropping in Kuttanad	Moncompu
34	Exploratory trial for doublecropping in Pokkali region	Vyttila
35	Input requirements of rice based cropping pattern	Chalakudy
Miscellaneous items		
36	Methods of sowing rice	Moncompu
37	Screening of rice cultures for salinity tolerance	Vyttila

NITROGEN MANAGEMENT

Nitrogen use efficiency in low land rice (Pattambi)

The study on efficient use of nitrogen was conducted at the Rice Research Station, Pattambi. The trials consisted of 10 treatments (Table 1.40) in randomised block design, replicated 4 times, using IR 5 as test variety. The nitrogen dose was 60 kg ha.

The treatment differences were not statistically significant. Nitrogen efficiency was highest in treatment five, which was on par with treatment 4 and 6. In general, nitrogen efficiency was higher when urea applied in two split doses.

Table 1.40: Nitrogen use efficiency in low land rice

Tr. No.	Kg N/ha			Total N kg/ha	Grain yield kg/plot *	
	Basal	Tillering	PI		1st crop 1978-79 (average)	2nd crop 1979-80 (average)
1	0	0	0	0	—	—
2	60	—	—	60	6.1	6.3
3	30	—	30	60	5.7	5.3
4	30	30	—	60	3.6	10.1
5	0	30	30	60	5.7	15.1
6	60 NC	—	—	60	5.5	10.1
7	60 FYM	—	—	60	1.0	3 8
8	60 SG1	—	—	60	6.0	8.3
9	60 SG2	—	—	60	5.5	5.6
10	60 GC	—	—	60	5.8	5.6

* Plot size — 16m²

PI — Panicle initiation
NC — Neem cake coated
FYM — Farm Yard Manure
SG1 — Super Granules 1 g size
SG2 — Super Granules 2 g size
GC — Granulated Compost

Nitrogen use efficiency in low land rice (*Medium duration*). (Pattambi)

Another trial started during the year with a modified treatment schedule was vitiated by severe attack of Brown plant hopper.

Jaya was used in this study with 10 treatments (Table 1 41) and 4 replications.

Table 1.41: New treatment schedule for study on nitrogen use efficiency

Tr. no.	N kg/ha	N source	Method of application
1	0	Check	—
2	54	Urea (Prilled)	½ at planting and ½ at PI
3	54	SCU 1 (Ordinary)	Basal broadcast and incorporated
4	54	SCU 2 (Forestry grade)	-do-
5	54	Super granules	Placement at 10-12 cm soil depth
6	87	Urea (Prilled)	½ at planting and ½ at PI
7	87	SCU 1 (Ordinary)	Basal, broadcast and incorporated.
8	87	SCU 2 (Forestry grade)	-do-
9	87	Super granules	Placement at 10-12 cm soil depth
10	120	Urea (Prilled)	½ at planting and ½ at PI

* SCU—Sulphur Coated Urea.

Technique for increasing nitrogen use efficiency of urea (Moncompu)

The field experiment with eleven treatments (Table 1. 42) and 3 replications was repeated during 1979–80 at the Rice Research Station, Moncompu. Maximum grain yield (5123 kg/ha) was obtained from placement of 90 kg N/ha in paper balls (Tr.5) confirming the earlier findings.

Table 1.42: Grain yield (kg/ha) under different treatments at the Rice Research Station, Moncompu during 1979–80

Tr. no.	N Dose	Grain yield kg/ha	Treatment details
		1979-80	
1	90 Kg/ha as urea	5096	Three doses, ½ at planting, ¼ on 30 th day and ¼ at PI
2	90 Kg/ha ,,	4622	In mud balls as basal
3	60 Kg/ha ,,	4284	-do-
4	45 Kg/ha ,,	4039	-do-
5	90 Kg/ha ,,	5123	In paper balls
6	60 Kg/ha ,,	4441	-do-
7	45 Kg/ha ,,	3797	-do-
8	90 Kg/ha ,,	4809	With goat dung as basal
9	60 Kg/ha ,,	3923	-do-
10	45 Kg/ha ,,	3923	-do-
11	90 Kg/ha ,,	4642	Mixed with 6 fold of its weight of surface soil
	CD (0.05)	548	

PHOSPHATE MANURING

Suitability of Phosmak for rice [Pattambi, Moncompu]

The trial was continued at Rice Research Station, Pattambi and Moncompu during 1979-80 also, to study the efficiency of Phosmak as a phosphatic fertilizer in a randomised block design with 10 treatments replicated 4 times. The test variety was Jaya. The treatment and mean yield details are given Table 1.43

Table 1.43: Effect of different sources of phosphorus on grain yield

Treatment No.	Treatment details	Rate of P as P_2O_5 in kg/ha	Mean grain yield in kg/ha		
			Pattambi II crop season	Moncompu I season	Moncompu II season
1	Check (No P)		3503	3781	3313
2	Super phosphate	20	3785	4548	3595
3	-do-	40	3672	4313	3531
4	-do-	60	3601	4173	3433
5	Phosmak	20	3249	4282	3173
6	-do-	40	3743	4013	3387
7	-do-	60	3856	4563	3461
8	Rock phosphate	40	4054	4438	3589
9	-do-	80	3503	4328	3672
10	-do-	120	3432	4078	3298
				NS	NS	NS

There was no significant difference in grain yield indicating no response to continuous application of P for the three seasons.

Split application of phosphorus for rice (Chalakudy)

A new experiment was started at Agronomic Research Station, Chalakudy to find out the effect of split application of phosphorus on sandy loam soil. The trial was conducted in a randomised block design with 8 treatments and four replications using Jaya as test variety. Nitrogen and potash, were given according to Package of practics. Response to phosphorus was not significant (Table 1.44)

Table 1 44: Effect of split application of P

Treatment No.	Treatment details	Grain yield Kg/ha	Straw yield Kg/ha
T_1	No P_2O_5	3344	3073
T_2	15 Kg P_2O_5/ha as basal	3188	3658
T_3	30 Kg -do-	3188	3699
T_4	45 Kg -do-	3062	3307
T_5	7.5 Kg P_2O_5/ha as basal + 7.5 Kg/ha at tillering stage	2926	3407
T_6	15 Kg P_2O^5/ha as basal + 15 Kg/ha at tillering stage	2561	3516
T_7	15 Kg P_2O_5/ha as basal + 7.5 Kg at T. S. + 7.5 Kg P205 at PI	2874	3319
T_8	22 5 Kg P_2O_5/ha as basal + 15 Kg at T S + 7.5 Kg at PI	2947	3106

BALANCED FERTILIZATION

Monitoring for soil fertility under continuous rice culture: [Pattambi]

A study on the effect of continuous application of nitrogen, phosphorus and potash, alone and in combinations, on soil fertility and yield of rice was taken up. The experiment was laid out in randomised block design with eight treatments replicated five times. Jaya was used as test variety with two levels of fertilizer nutrients. The treatment details and grain yield are furnished inTable 1.45.

Table 1.45 Grain yield

Treatment No.	Treatment	Treatment combinations N P K	Grain yield kg/ha
1	O	0 0 0	2012
2	N	60 0 0	2500
3	P	0 30 0	2022
4	K	0 0 30	2043
5	NP	60 30 0	2429
6	PK	0 30 30	2124
7	NP	60 0 30	2673
8	NPK	60 30 30	2591
		CD (0.05)	330

The treatment differences were significant during the first crop season. Application of nitrogen had a positive influence in increasing the grain yield. Phosphorus and potash had no significant influence on grain yield. Though the highest grain yield was recorded in treatment Nos. 2(N), 5 (NP), and 8 (NPK), all of them had contribution of nitrogen.

Optimum fertilizer rates for rice in sandy tracts: [Kayamkulam]

To assess the optimum level of NPK for rice crop in sandy tract, an experiment was started at Rice Research Station, Kayamkulam during 1979-80. It was continued for first and second crop seasons 1978-79. The experiment consisted of 12 treatments replicated thrice. The results are presented in Table 1.46. Varieties were Jyothi for 1st crop and Jaya for II crop.

Table 1.46: Influence of various fertilizer ratios on grain and straw yield

Tr. No.	Treatment details	I crop		II crop	
		Grain kg/ha	Straw kg/ha	Grain kg/ha	Straw kg/ha
1	NPK at 90:45:45	2132	5217	2034	3917
2	NPK at 90:67.5:67.5	1799	5397	2200	4314
3	NPK at 90:90:90	2018	5350	2178	3968
4	NPK at 90:112.5:112.5	2045	5237	2092	3953
5	NPK at 60:45:45	1919	4817	1998	3679
6	NPK at 60:30:30	2045	4531	1962	4292
7	NPK at 60:60:60	2112	4571	1969	3845
8	NPK at 60:75:75	2552	5683	2077	4343
2	NPK at 45:22.5:22.5	1712	4637	2070	3441
10	NPK at 45:33.75:33.75	1865	4084	1825	3268
11	NPK at 45:45:45	2285	5037	1890	3845
12	NPK at 45:56 . 25:56.25	2065	4686	1969	3982
		NS	NS	NS	NS

The treatment differences were not significant in both seasons. The highest grain yield was recorded in the treatment 8 during I crop season, while treatment 2 recorded highest yield in second crop seasons of 1978–79 and 1979–80.

BIO-FERTILIZERS

Multilocational trial on Blue Green Algae [Kayamkulam, Vyttila, Moncompu, Chalakudy]

Multilocational large scale trials were started to verify the efficacy of blue green algae in various agroclimatic regions of the State. In the year 1979–80, the trial was conducted at the Rice Research Stations at Kayamkulam, Vyttila, Moncompu and Chalakudy with five treatments replicated 5 times. In Chalakudy, the trial was conducted during two seasons. In other stations, the trial was done only once in the year 1979–80. The treatment details and yield data from various stations are presented in Table 1.47.

Table 1.47: Performance of Blue green algae in various agroclimatic regions of the State

Tr. No.	Treatment details	Yield in kg/ha				
		Kayam-kulam	Monco-mpu	Vyttila	Chalakudy	
					Ist crop	II crop
T_1	Full dose of NPK as recommended for the variety	3061	5665	2650	2404	2147
T_2	2/3 dose of N+P&K and blue green algae @ 10 Kg/ha	2777	5354	2610	2388	1939
T_3	2/3 dose of N+P&K alone	2904	5145	2690	2244	1907
T_4	1/3dose of N+P&K and blue green algae at 10 Kg/ha	2398	4546	2700	1731	2083
T_5	1/3 dose of N+P&K alone	2386	4345	2430	1763	1715
	CD (P–0.05)		113 kg/ha	—	—	—

At lower levels of nitrogen, indication was in favour of blue green algae in all locations of the trial.

Utility of Azolla and blue green algae for wet land rice culture (Pattambi)

An AICARP trial to assess the possibilities of using *Azolla* and blue green algae for partially substituting the nitrogen requirements of rice was conducted at Rice Research Station, Pattambi during 1979–80. The field trial was laid out in randomised block design with 9 treatments replicated thrice. *Azolla* and

blue green algae were applied at different rates both alone and in combination with fertilizer nitrogen and were compared witn fertilizer nitrogen alone to study their effect on grain yield of "Jaya" rice during first crop season in the report year. The results are presented in Table 1.48. The trial repeated during II crop season was vitiated by severe attack of stem borer.

Table. 1.48: Grain yield as i nfluenced by different treatments during the first crop season of 1979-80

Treatment No.	Treatment	Grain yield kg/ha
1	Control (no. nitrogen)	3034
2	25 kg N/ha as urea	3423
3	50 kg N/ha as urea	3680
4	75 kg N/ha as urea	4326
5	Azolla @ 5t/ha before transplanting	2826
6	Azolla inoculated and allowed to grow with rice	3243
7	Blue green algae at 10 kg/ha	2986
8	Treatment 5+25 kg N/ha as urea	3284
9	Treatment 7+25 kg/ha as urea	3381
	CD (0.05)	500

Addition of algae or Azolla has not shown any special influence on yield.

WEED CONTROL

Weed control for direct sown crop in puddled soil (Pattambi)

To study the effectiveness of different methods of weed control on direct sown rice crop in puddled soil, a trial under AICRP was started at Rice Research Station, Pattambi during 1979-80. There were 14 treatments as in Table 9 with 4 replications using Triveni as test variety in both seasons. Observations recorded on toxicity rating, no. of weeds per square meter, dry weight of weeds and grain yield are presented in the Table 1.49.

Table 1.49: Visual toxicity rating, dry weight of weeds and grain yield during I and II crop seasons

I Crop 1979-80

Herbicide treatment	Toxicity rating	No. of weeds/ sq. m. at harvest	Dry wt. of weeds	Yield Kg/ha	Toxicity rating	No. of weeds/ sq. m. at harvest	Dry wt. of weeds	Yield Kg/ha
Bifenox/2, 4-D IPE	1.25*	12	5.6	3689	1.25	40	10.3	2065
Butachlor + 2, 4-D IPE	2.50	27	13.0	3502	0.75	30	8.7	1082
CCA 26423	2.00	57	10.9	3502	0.75	112	12.2	1955
Exp. 3391	1.75	38	3.9	3502	0.50	83	6.4	1037
Molinate/Simetryne/MCPB	2·25	44	10.15	3513	4.0	111	8.8	2010
Naproanilide (MT 101)/ Thiobencarb	1.50	25	7.75	3524	0.76	42	8.5	2230
Piperophos/2, 4-D IPE	1.25	133	11.5	3392	0.25	105	17.0	2037
Thiobencarb/2, 4-D IPE	2.50	55	18.0	3557	1.0	81	619	1735
X-52/2, 4-D IPE	2.75	16	3.1	3502	1.75	74	1415	2148
Basalin	1.75	128	18.85	3337	0.25	178	32.7	1927
Renstar	2.30	44	4.65	3226	0.75	50	2.2	1872
Butachlor	1.50	45	5.1	3447	0.75	94	14.00	1652
Weed free check	–	67	3.75	3392	–	–	9.7	1652
Weedy check	–	108	18.5	3392	–	151	23.4	1431
F Test	–	NS	NS	NS	–	NS	NS	NS

Combined application of 2, 4-D and urea [Moncompu]

A field experiment was conducted both in transplanted and direct sown crops during puncha season 1979-80, at Rice Research Station, Moncompu, with 9 treatments and three replications. The experiment was conducted with the objective of studying the efficiency of combined application of 2, 4-D and urea in controling weeds in rice and to find out the possibility of reducing the dose of 2, 4-D. The treatments were:

1 Spraying 2, 4-D sodium salt (Fernoxone) at 1000 g/ha and application of urea on 20th day.
2 Combined application of 2, 4-D (Fernoxone) at 500 g/ha with urea.
3 Combined application of 2, 4-D (Fernoxone) at 750 g/ha with urea.
4 Combined appication of 2, 4-D (Fernoxone) at 1000 g ai/ha with urea.
5 Application of 2, 4-D (Weedone) in granular form at 500 g ai/ha.
6 2, 4-D in granular form (Weedone) @ 750 g ai/ha.
7 -do- @ 1000 g ai/ha.
8 Normal weeding and fertilizer application.
9 Unweeded control.

The results are presented in Table 1.50 (a) & (b)

Table 1.50 (a); Effect of combined application of 2, 4-D and urea on weed growth and grain yield - Transplant crop

	1	2	3	4	5	6	7	8	9	
Dry wt. (kg/ha) of weeds 20th DAA	227	378	357	290	410	390	478	220	657	CD—59
Dry wt. (kg/ha) of weed on 40th DAA	347	537	495	363	783	701	660	240	1154	CD—490
Grain yield kg/ha	5325	4233	4841	5461	4905	4278	6041	3861	,,	CD—697

Table 1.50 (b); Effect of combined application of 2, 4-D and urea on weed growth and grain yield - Broadcast crop

	1	2	3	4	5	6	7	8	9	
Dry wt. (kg/ha) of weeds 20th DAA	143	300	427	147	473	470	462	87	1618	CD—264
Dry wt. (kg/ha) of weeds 40th DAA	197	331	292	196	420	385	368	106	656	CD—53
Grain yield kg/ha	3533	2583	2923	3441	2798	3021	3206	4100	1983	CD—252

Results showed that application of 1 kg 2, 4-D combined with urea is as effective as its spraying in controlling weeds, same trend was noticed in previous year also.

Flame throwers as a weed control method (Moncompu)

The experiment to evolve suitable technique for weed control by burning stubbles, was continued at Rice Research Station, Moncompu during 1979-80. The trial was laid out in RBD with 8 treatments and 3 replications as detailed below:

T_1 Burning stubbles and weeds immediately after puncha harvest using flame throwers.

T_2 Treatment 1 followed by raising cowpea.

T_3 Treatment 1 followed by fallow.

T_4 Treatment 3 followed by burning again before additional crop.

T_5 Fallow after puncha harvest and burning stubbles before additional crop.

T_6 Spraying paraquat at 3.75 l/ha immediately after puncha harvest followed by fallow.

T_7 Fallow after puncha harvest followed by paraquat spray at 3.74 l/ha two weeks before land preparation of additional crop.

T_8 Local practice.

The data showed that the plots which were subjected to a spray of paraquat before the additional crop produced the highest yield of 4775 kg/ha. However, it was found to be as good as other treatments, viz., spraying of paraquat after puncha crop, burning twice after puncha crop and before additional crop, and the the local practice. Regarding efficiency of weed control, the trend was similar to that of grain yield.

Weed control in direct sown rice in Kuttanad (Moncompu)

A field trial with 6 treatments (Table 1.51) and 4 replications were laid out in RBD during puncha season 1979-80 at the Rice Research Station, Moncompu to study the effect of different methods of weed control in a direct sown crop of rice in Kuttand soils. Jaya was the variety used in the trial The results are presented in Table 1.51.

Table 1.51: Effect of different weed control methods on dry weight of weeds and grain yield during 1979-80

Tr. no.	Treatment	Dry wt. of weeds 20 DAA	Dry wt. of weeds 40 DAA	Grain yield Kg/ha
T_1	Stam F34 at 2 Kg/ai/ha	524	408	3375
T_2	MCPA at 1 Kg ai/ha	582	427	3100
T_3	Stam F34 at 1 Kg ai/ha + MCPA at ½ Kg + 3% urea	307	244	3562
T_4	2,4-Dat/1 Kg ai/ha	378	332	3487
T_5	Hand weeding	121	124	4325
T_6	Unweeded control	1389	1086	2360
	CD (0.05)	164	113	—

The applicaiion of Stam F34 @ 1Kg ai/ha + MCPA at 0.5 Kg/ha with 3% urea recorded significant difference over control and was only second to hand weeding.

The experiment was conducted for 3 puncha seasons and recorded consistent results in favour of treatment 3, a combined application of Stam F34, MCPA and urea.

LONG TERM EXPERIMENTS

Five long term experiments are being conducted in the Kerala Agrl. University, two at Pattambi, one each at Kayamkulam. Vyttila and Chalakudy. At Pattambi the experiment was started in 1961 with tall *indica* varieties PTB2 and PTB20 as test varieties during first and second crop seasons respectively was being continued Another experiment on dwarf *indica* rice was started in 1972, with Jaya as test variety. The treatments in both trials are identical except in the doses of NP&K. The experiments are designed to study the long term effects of organic and inorganic fertilizer application on soil characteristics.

The experiments at Kayamkulam and Vyttila are so designed to study the long term effects of various feriilizer nutrients, while the experiment in Chaiakudy is to explore the possibility of skipping P & K in certain seasons. The results of trials are discussed individually.

Permanent manurial Experiment (Tall indica) [Pattambi]

To find out the effect of continuous application of green leaf, cattle manure and ammonium sulphate alone and in combination with and without P & K on the yield of rice was continued with 8 treatments and 4 replications. The varieties were PTB 2 for Virippu season and PTB 20 for Mundakan season.

The treatment effect was significant for grain yield during both the seasons but there was no significant difference between 'organic and organic + inorganic as the treatments 1, 3, 5 and 7 were on par. The Increase in grain yield was more for 'organic' during Virippu while it was more for 'organic + inorganic' during mundakan season. It may be probably be due to less inorganic nutrient loss in rains during Mundakan season. Cattle manure was superior to green leaves as a source of organic manure as in the previous cases. The ancillary data and grain and straw yield for the two seasons are presented in Tables 1.52,53&54.

Permanent manurial trial—Dwarf indica rice

The results (Tables, 55 to 57) during the year was in conformity with previous results. It was similar to the one obtained with tall *indica* rice also. The overall effect of the treatments was significant during both seasons, but there was no significant difference between organics alone and organics with inorganics since treatments 1, 3, 5&7 were on par. This means that whenever there is limitation for organic manure it can be supplemented with inorganics. The superiority

Table 1.52: Permanent manurial trial (Tall *indica*)—Ancillary and yield data (Virippu 1979)

Treatments	Total tiller (mean hill)	Productive tiller (mean hill)	Plant height (cm)	Grain yield kg/ha	Straw yield kg/ha
CM 8000 lb/acre (40 lb N)	6.5	6.2	150.5	2299.8	3192.6
GL ,,	6.5	6.1	125.2	1948.0	2665.0
CM + GL each 4000 lb/acre	6.5	6.2	144.4	2235.0	3314.5
$AmSO_4$ to supply 40 lb N/acre	6.3	6.0	125.1	1953.5	3273.8
CM 4000 lb + NPK 20–20–20 lb	6.6	6.2	145.0	2083.3	2868.0
GL ,, + ,,	5.7	5.6	134.0	1802.0	3558.0
CM & GL each 2000 lb/acre + NPK 20–20–20 lb.	6.2	6.1	141.9	2018.4	3044.0
NPK alone @ 40–20–20 lb	5.8	5.7	135.9	1910.2	3030 3

C. D. for grain yield 306.6 kg/ha

Conclusion — 1, 3, 5, 7, 4, 2, 8, 6

Table 1.53 Permanent manurial trial (Tall *indica*) Ancillary and yield data (Mundakan, 1979)

Treatments	Total tiller (Mean/hill)	Productive tiller	Plant ht. (cm)	1000 grain wt. (g)	Grain yield (kg/ha)	Straw yield
CM 8000 lb/acre	9.13	7.76	94.96	25.5	2396	3652.6
GL ,,	10.73	8.95	82.64	24.51	1825	2638
CM and GL each 4000 lb/acre	9.25	7.34	91.63	25.45	2205	3869
Am. SO_4 to supply 40 lb N/acre (inoragnic)	12.86	10.88	72.85	23.375	1650.4	3355
CM 4000 lb + NPK 20-20-20 lb/acre.	11.43	9.65	92.03	24.65	2530	3666
GL 4000 lb + ,,	10.71	9.03	86.61	24.45	1921	3666
CM and GL each 2000 lb + NPK 20–20-20 lb	10.13	8.43	82.03	25.485	2448.6	4018
NPK alone @ 40-20-20 lb (inorganic)	12.34	11.36	86.03	24.063	1948.0	3639

CD for grain yield: 331.9 kg/ha

Conclusion - 5713,8,6,2.4,

CM — Cattle manure
GL — Green leaf
N — as ammonium sulphate
P — as super phosphate
K — as MOP

Table 1.54: Permanent manurial trial (tall *indica*) Viruppu, 1979-Soil analysis data

Treat	O C%		Av. P_2O_5 kg/ha		Av. K_2O kg/ha		Av. N%		pH		M.W.H.C.		Pore space		Apparent density	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	1.92	1.56	31.5	59.68	193.5	252.7	0.029	0.022	5.6	5.6	45.5	61.0	56.0	62.5	1.248	1.016
2	1.68	1.95	17.85	29.0	196.2	177.4	0.03	0.017	5.55	5.6	43.1	60.4	54.8	59.2	1.298	1.072
3	1.89	1.83	23.1	35.28	196.2	188.2	0.03	0.03	5.65	5.6	47.2	56.1	54.0	63.1	1.214	1.073
4	1.81	1.67	11.5	24.12	145.2	107.5	0.029	0.023	5.55	5.55	45.6	60.8	53.3	62.8	1.212	1.026
5	1.92	1.72	18.9	44.24	188.2	180.1	0.031	0.021	5.35	5.3	44.8	62.3	55.9	61.7	1.306	1.020
6	1.78	2.21	12.9	39.20	177.4	123.7	0.028	0.021	5.75	5.3	42.9	59.5	54.2	61.5	1.271	1.047
7	1.98	1.84	44.1	38.08	177.4	139.8	0.029	0.023	5.6	5.2	42.9	58.7	55.8	61.4	1.308	1.053
8	1.47	1.67	17.85	35.28	146.3	110.2	0.029	0.021	5.35	5.3	42.1	57.5	51.2	61.5	1.316	1.052

Table 1.55: Permanent manurial trial (Dwarf *indica*)—Ancillary and yield data (virupu, 1979)

Treatments	Total tiller (Mean/ hill)	Productive tillers (Mean/ hill)	Plant height (cm)	Grain yield (kg/ha)	Straw yield (kg/ha)
Cattlemanure 8000 kg/ha (90 Kg N)	6.9	5.59	89.54	3721.5	3761.4
Greenleaf ,,	8.03	6.94	78.49	2739·3	3056.9
Cattlemanure and greenleaf each 9000 kg/ha	7.1	5 61	85.40	3276.2	3415.8
Am. SO4 @ 90 kg N/ha	7.1	6.05	78.13	3030.4	2970.5
Cattlemanure 9000 kg + NPK 45 kg/ha	6 91	5.59	87.39	3482.2	3555.3
Greenleaf 9000 kg + NPK 45 kg/ha	6.89	5.63	81 39	2638.2	3203.1
C M and G L each 4500 kg + NPK 45 kg/ha	6.89	5.73	85.69	3269.6	2897.4
NPK alone @ 90–45–45 kg/ha as fertilizer	6.85	5.65	83.60	3169.9	2678.4
CD—513 Kg/ha for grain yield				Significant	Not sig
Conclusion 1, 5, 3 7, 8, 4, 2, 6				at 5%	nificant

Table 1.56: Permanent manurial trial (Dwarf *indica*)—Ancillary and Yield data (Mundakan, 1979)

Treatments	Total till-ers (Mean/hill)	Pro-ductive tiller	% of pro-ductive to total tiller	Plant ht. cm	1000 grain wt. g	Grain yield kg/ha	Straw yield kg/ha
Cattle manure 18000 kg/ha	8.09	5.2	64.4	64.6	27.9	2970.5	2910.7
Greenleaves 18000 kg/ha	9.31	5.1	54.8	62.4	26.3	1628.0	2684·7
Cattlemanure and greenleaf each 9000 kg/ha	8.46	5.1	60.1	67.4	27.6	2917.0	3126.7
Am SO_4 @ 90 kg/ha	9.63	5.1	53.3	63.0	26.2	1688.0	2605.0
Cattlemanure 9000 kg + NPK 45 kg/ha	8.61	5.8	66.8	67.8	26.9	2625.0	2950.5
Greenleaves 9000 kg + NPK 45 kg/ha	8.75	5.4	57.6	69.7	25.8	2140.0	2970.5
Cattlemanure and green leaf each 4500 kg + NPK 45 kg/ha	8.53	4.8	56.1	69.5	26.5	2465.0	3116.7
NPK alone @ 90—45—45 kg/ha as fertilizer	9.53	5.8	61.0	68.1	26.4	2220.0	2818.0

N — as Ammonium sulphate — Significant at 5%

P — as Super phosphate — CD–for grain yield 374.14 kg/ha

K — as MOP — Conclusion 1, 3, 5, 7, 8, 6, 4, 2

Table 1.51 Permanent manurial trial darf *india*) Soil analysis data (1979-80—Virippu and Mundakan)

Tret.	OC%		Av.P_2O_5 kg/ha		Av.K_2O kg/ha		Av.N%		pH		M.W.H.C,		Pore space		Apparant density	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
	2.15	1.52	83.86	126.80	317.18	435.5	0.029	0.026	5.2	6.4	45.6	52.1	53.5	44.2	1.289	1.150
	1.92	1.77	45.16	46.23	215.04	268.8	0.032	0.022	5.4	5.3	46.9	49.2	54.0	56.0	1.242	1.193
	2.18	1.815	30.11	69.88	220.42	349.5	0.028	0.021	5.2	5.4	46.1	48.2	53.4	53.6	1.230	1.156
	1.78	1.795	19.35	35.16	129.02	193.5	0.032	0.022	5.5	5.2	43.1	45.7	52.2	54.0	1.281	1.219
	2.05	1.785	46.23	52.69	271.49	306.5	0.03	0.019	5.5	5.3	47.0	53.1	53.5	60.0	1.252	1.183
	1.86	1.780	43.01	62.36	193.54	225.8	0.025	0.018	5.4	5.4	44.6	50.1	53.4	57.7	1.247	1.208
	1.95	1.890	33.33	26.28	231.17	247.3	0.026	0.019	5.4	5.4	49.6	42.8	52.9	51.5	1.158	1.346
	1.76	1.820	47.31	45.48	220.42	129.03	0.027	0.018	5.3	5.4	45.9	47.7	54.3	54.7	1.264	1.250

of cattle manure over green leaf is evident in all treatments since treatments receving cattle manure alone or in combination had a distinct superiority over those receiving green leaf. The analysis of data for 6 seasons from 1973 to 1978 also gave the same trend of results for both seasons. The anciliary data and the grain and straw yield for virippu and mundakan crops are presented in Tables 1.54, to 1.56.

Permanent manurial trial at Kayamkulam

To find out the effect of continuous application of N both organic and inorganic as well as phosphorus and potash on soil fertility and yield of rice, an experiment is being conducted from 1964-65, with 7 treatments in Randomised block design with 4 replications. The treatment effects were significant at 1% level for grain yield, but treatment 1, 7 and 6 were on par. The details are presented in Table 1.58.

Table 1.58 Permanent manurial trial —Kayamkulam
Grain yield for first and second crop season in 1979-80

Treatment No.	Treatment details	Grain yield Kg/ha first crop	2nd crop
T_1	80 Kg N/ha as cattle manure	2038	2204
T_2	80 Kg/ N/ha as Ammonium sulphate	860	966
T_3	T2 + 20 Kg P205/ha as super phosphate	975	869
T_4	T2 + 40 Kg K_2O/ha as muriate of potash	1156	492
T_5	40 Kg P_2O5/ha as superphosphate + 40 Kg K_2O/ha as muriate of potash	1449	1056
T_6	Combination T_2 + T_5	1634	1117
T_7	60 Kg N/ha as Ammonium sulphate + 20 Kg N/ ha as cattale mannure + Tr.5	1760	2288

Permanent manurial trial [Vyttila]

To find the effect of various fertilizer nutrients under ill-drained and water logged condition and also to evolve a suitable technology for fertilizer application under ill-drained condi,ion, a long term fertilizer experiment was started at Rice Research Station, Vyttila in 1976-77. The experiment was laid out in randomised block design with 10 treatments replicated 4 times in a permanent site using Vyttila 1 as the test variety. The treatment details, plant height and grain yield are given in Table 1.59.

Table 1.59: Permanent manurial trial—Vyttila
Grain yield and plant height

Tr. No.	Treatment effect	Treatment details	Plant height (cm)	Grain yield in Kg/ha
T_1	O	No fertilizer	90·80	1040
T_2	N	N at 20 Kg N/ha as urea	90.25	1195
T^3	P	P at 40 Kg P_2O_5/ha as Tricalcium phosphate	91.90	1055
T_4	NP	T2 +T3	89.20	1000
T_5	NPK	T4 + K_2O at 20 Kg K_2O/ha as muriate of potash	100.00	980
T_6	NPK Ca	T5 + Calcium as calcium carbonate at 1000 Kg/ha	94.00	1140
T_7	NP Ca	T4 + $CaCO_3$ at 1000 Kg/ha	86.20	1125
T_8	P Ca	T3 + -do-	84.60	1110
T_9	NPK	mud balls T5 in mud balls	87.60	1150
T_{10}	NPK	(N Neem cake coated)	90.00	1090

Skipping phosphorous and potash [Chalakudy]

To study the effect of skipping P & K on yield of rice, a long term experiment was laid out at Agronomic Research Station, Chalakudy with 10 treatments replicated thrice, in a randomised block design. The test variety was Triveni for both seasons. The treatment details and grain yield are presented in Table 1.60.

Table 1.60; Effect of skipping P and K on grain yield

Tr. No.	Treatment details	Grain yield kg/ha	
		Ist Crop	2nd Crop
T_1	Applying P during all seasons	2315	1754
T_2	Applying P in alternate seasons starting from Ist season	2273	2104
T_3	Applying P in alternate seasons starting from IInd season	2315	1684
T_4	Appling P once in three seasons starting from Ist season	2160	1613
T_5	Applying P once in three seasons starting from IInd season	2273	1950
T_6	Applying K in alternate seasons starting from Ist season	2146	842
T_7	Appling K in alternate seasons staring from IInd season	1852	1473
T_8	Applying K once in three seasons starting from Ist season	2104	771
T_9	Applying K once in three seasons starting from IInd season	2006	547
T_{10}	Nitrogen alone for all seasons	1613	982

Experiments in cultivator's fields

With a view to formulate fertilizer recommendations for different agro-climatic regions of the State under irrigated and rainfed conditions, experiments are being conducted in cultivator's fields in Calicut and Kottayam districts from 1978–79, under All India Co-ordinated Agronomic Research Project. Two types of experiments (A&B) are included in the programme.

Under type A, 87 experiments in Kozhikode and 85 experiments in Kottayam were laid out.

The treatments under A type experiments were:

T_1	N_0 P_0 K_0	T_7	N_{120} P_{60} K_0
T_2	N_{40} P_0 K_0	T_8	N_{40} P_{20} K_{20}
T_3	N_{80} P_0 K_0	T_9	N_{80} P_{40} K_{40}
T_4	N_{120} P_0 K_0	T_{10}	N_{120} P_{60} K_{60}
T_5	N_{40} P_{20} K_0	T_{11}	N_{80} P_{40} K_{40} + 600 kg lime
T_6	N_{80} P_{40} K_0	T_{12}	N_{120} P_{60} K_{60} + 1200 kg lime

Out of 87 A type experiments conducted in Kozhikode district, 37 were laid out in Khariff season and 50 in Rabi season. The district was divided into 4 zones viz., Badagara, Quilandy, South Wynad and Kozhikode. Salient results noted in each zone are detailed below:

Badagara: Positive response to nitrogen was only up to 80 kg/ha. Response to phosphorus was noted only at higher levels, while response to potash was noticed both at higher and lower levels. There was response to lime and most economical dose was noticed at 80-40-40+600kg lime/ha.

Quilandy: There was response to nitrogen up to 120 kg N/ha but economical dose was found to be 80-40-40 + 600 kg lime per hectare. In Kozhikode and Wynad zones same trend was noticed.

From 85 A type experiments conducted in Kottayam District, positive response to nitrogen was obtained up to 80 Kg/ha while the response to P & K was only upto 20 kg level.

Type B. Comparative performance of dwarf and semi-tall varieties of rice to low and medium levels of fertilizer application.

Treatments:

Khariff

V_1 N_0 P_{45} K_{45}
V_1 N_{40} P_{45} K_{45}
V_1 N_{80} P_{45} K_{45}
V_1 N_{120} P_{45} K_{45}
V_2 N_0 P_{45} K_{45}
V_2 N_{40} P_{45} K_{45}
V_2 N_{80} P_{45} K_{45}
V_2 N_{120} P_{45} K_{45}

V_1-Triveni
V_2-Culture 1907
V_3-BR 51

Rabi

V_1 N_0 P_{45} K_{45}
V_1 N_{40} P_{45} K_{45}
V_1 N_{80} P_{45} K_{45}
V_1 N_{120} P_{45} K_{45}
V_2 N_0 P_{45} K_{45}
V_2 N_{40} P_{45} K_{45}
V_2 N_{80} P_{45} K_{45}
V_2 N_{120} P_{45} K_{45}
V_3 N_0 P_{45} K_{45}
V_3 N_{40} P_{45} K_{45}
V_3 N_{80} P_{45} K_{45}
V_3 N_{120} P_{45} K_{45}

Under B types, 81 experiments in Kozhikode and 87 experiments in Kottayam were conducted in 1979-80.

The culture 1907 out-yielded Triveni in both districts. In Kozhikode, culture 1907 outyielded Triveni even at low levels of N. Most economic level was 80-45-45.

PRODUCTION POTENTIAL

Production potential of rice in Kuttanad

Object of the study is to find out a new cropping pattern for Kuttanad consequent on the construction of Thaneermukom barrier for the prevention of salt water ingression. Various combinations are being tested from 1977. The treatment combinations during different seasons of 1979-80 were:

Ist crop (Puncha)	2nd crop	3rd crop (Additional)	Cumulative Yield Kg/ha
Triveni	Triveni	Triveni	8780
Triveni	Triveni	Jaya	9240
Bhadra	Triveni	Jaya	10600
Bhadra	Fallow	Jaya	8400
Bhadra	Cul. 26-4-2	Triveni	9455

Immediately after harvest of Puncha crop of 1978-79, summer crop was started with Triveni & Cul. 26-4-2 In spite of all necessary precautions and control measures the crop was poor due to different sorts of pest infestations. The crop was harvested on 20-7-79. Culture 26-4-2 yielded 1950 Kg/ha while Triveni yielded only 1900 Kg/ha. Additional crop was planted on 2-8-79 with varieties Jaya and Triveni. Jaya recorded 3125 Kg/ha and Triveni 2435 Kg/ha. Puncha crop was planted on 26-11-79 and harvested on 6-3-80. Bhadra out yielded Triveni. Highest yield of 10600 Kg rice per hectare per year was recorded by the combination of Bhadra, Triveni and Jaya. Lowest yield was from the combination Bhadra-fallow-Jaya yielding only 8400 Kg/ha.

Production potential of Culture 31-1 [Kayamkulam]

A new experiment was started in 1979-80 during IInd crop season at Rice Research Station, Kayamkulam to study the production potential of culture 31-1 to graded doses of fertilizers The experiment was laid out with 5 treatments replicated 4 times. The treatment combinations and yield details are given in Table. 1.61

Table 1.61: Production potential of Culture-31-1

Tr. No.	Treatment			Grain yield Kg/ha	Straw yield Kg/ha
	N	P	K		
T_1	40	20	20	2612	7857
T_2	50	35	35	2996	10482
T_3	70	35	35	2777	10218
T_4	90	45	45	2301	7043
T_5	120	60	60	2698	10383

Effect of water logging on growth and yield of rice

The study on reaction of rice seedlings of different age groups to flooding at successive growth stages was continued during 1979-80 at Agronomic Research Station, Chalakudy The field experiment was laid out in split plot design with 9 main plot treatments and 4 sub plot treatments and 3 replications. The treatment details are:

1. Main plot	45 cm water logging in the following eight growth periods of 12 days duration.	
F1	13-24 days after transplanting	
F2	25-36	-do-
F3	37-48	-do-
F4	49-60	-do-
F5	61-72	-do-
F6	73-84	-do-
F7	85-96	-do-
F8	97-108	-do-
F9	No water logging - 5 cm continuous submergence throughout the crop growth	

Sub plot combinations were two varieties and two ages of seedlings

	Variety	Age of seedlings
1 V_1 a_1	IR8	35 days
2 V_1 a_2	IR8	25 days
3 V_2 a_1	H4	35 days
4 V_2 a_2	H4	25 days

The mean grain yield in kilograms per hectare obtained from different treatments are given below:

Main plot	yield
F1	699
F2	1304
F3	1173
F4	1170
F5	1073
F6	1143
F7	874
F8	788
F9	1429

Sub plot	yield			
V_1a_1	1326			
V_1a_2	1466			
V_2a_1	794			
V_2a_2	600			
		Varietal Total	V_2	2792
			V_1	1394
		Age of seedlings	a_1	2120
			a_2	2060

The results so far obtained indicate that 30 cm submergence of the seedlings for 12 days at different growth stages do not affect grain yield.

Lysimeter studies to assess ground water contribution in rice production [Chalakkudy]

A new experiment was started in third crop season of 1978–79 to assess the ground water contribution in rice when ground water table is at different depths. The treatments and grain yield are given below:

Tr. No.	*Treatment details*	*Grain yield Kg/ha (Triveni)*
T_1	Ground water table at 5 cm above ground level (continuous)	6603
T_2	Ground water table at ground level (continuous)	7063
T_3	Ground water table at 15 cm below ground level	6730
T_4	Ground water table at 35 cm below ground level	5603
T_5	Ground water table at 55 cm below ground level	5238

Highest yield was recorded by the treatment in which water level was maintained at ground level. The same trend was obtained in the previous year also.

Effect of impervious layers to prevent percolation loss for increasing irrigation efficiency [Chalakkudy]

To study comparative efficiency of different puddlers in reducing percolation losses in paddy fields and to compare the impervious layer formation of puddling and sub soil compaction, an experiment in RBD with 4 treatments and 6 replications was continued during first and second crops in 1979-80 at Agronomic Research Station, Chalakudy. The treatment details and grain yield are given in Table 1.62.

Table 1.62: Grain yield

Tr. No.	*Treatment details*	*Grain yield kg/ha* Kharif (Jaya)	Rabi (Triveni)
P_1	Puddling with power tiller	2728	2088
P_2	Soil dressing with laterite loam	2549	2211
P_3	Puddling with country plough	2559	2150
P_4	Sub soil compaction at 30 cm depth by ramming	1687	2330

The study was undertaken for the last 5 years including that of 1979–80. Since the treatments are not showing any significant difference in grain yield or percolation losses, the study is proposed to be discontinued.

Effect of timing and frequency of fertilizer application and percolation loss of nutrients and yield of rice [Chalakkudy]

An experiment with two water management practices and 7 frequencies of fertilizer application replicated 3 times was conducted at Agronomic Research Station, Chalakudy in an RBD layout during 1979–80. The water management practices were:

W1—5 cm continuous submergence

W2—5cm irrigation at saturation point

The four frequencies of fertilizer applications were

Treatment	*No. of splits*	*Stages:*
T1	3	1+2+5
T2	4	1+2+3+5
T3	5	1+2+3+5+6
T4	6	1+2+3+5+6+7

The stages and of frequencies of fertilizer applications were:

1. Basal at transplanting
2. Rooting to 15 days after transplanting
3. Neck node differentiation, 31 days after transplanting
4. Spikelet initiation, 37 days after transplanting
5. Reduction division (early), 43 days after transplanting
6. Reduction division (late), 50 days after transplanting
7. Fifty percent flowering

Mean grain yield in Kg/ha obtained from different treatments are as follows

Water management		W1	W2	Total
Fertilizer levels	T1	2115	2473	4588
	T2	2104	2178	4282
	T3	1957	2031	3988
	T4	2052	1947	3999
	Total	8228	8529	

Irrigation with 5 cm depth of water at saturation point was found be more effective than continuous submergence. This finding is in conformity with lysimeter studies conducted at the same station.

Regarding fertilizer frequencies T1, ie, 3 splits doses–basal, 15 days after transplanting and 43 days after transplanting—gave highest yield.

AGRONOMIC METHODS FOR PEST CONTROL

Effect of N:K ratio on BPH incidence and yield of rice (Moncompu)

The experiment was laid out with an objective of studying the incidence of BPH by applying nitrogen and potash at varying proportions. The study was continued with 5 treatments (Table 1. 63) at Rice Research Station, Moncompu during 1979–80.

BPH population was lowest in plots receiving 180 kg. K_2O/ha. The differences in BPH population in other treatments were significant. The treatment receiving 135 kg. K_2O/ha recorded lowest BPH count, followed by treatment receiving 180 kg. K_2O/ha and difference between these were not significant at 40 DAT. Regarding the grain yield, treatment receiving 135 kg K_2O/ha recorded the highest yield and the difference from treatment with 180 kg K_2O/ha was not significant

Table 1.63: Treatment details and their influence on BPH and yield

Treatment	BPH count/m² (square root value) 20 DAT	BPH count/m² (square root value) 40 DAT	Grain yield Kg/ha
T1 0 Kg K_2O/ha	31.1	35.0	4841
T2 45 Kg ,,	22.8	31.8	5013
T3 90 Kg ,,	22.3	28.7	5044
T4 135 Kg ,,	19.5	22.0	5336
T5 180 Kg ,,	15.7	22.7	5242
CD at 5% level	3.3	5.0	231 Kg/ha

Varietal reaction to BPH incidence, as influenced by plant density and nitrogen (Moncompu)

The experiment was laid out in a 5 x 6 rectangular lattice with 3 replications. The treatments were 4 levels of plant density, 3 levels of nitrogen and two varieties as detailed below:

Spacing	*Nitrogen*	*Variety*
S1 30 x 15 cm	N1 60 Kg N/ha	V1 Jaya
S2 30 x 10 cm	N2 90 Kg N/ha	V2 Jyotoi
S3 20 x 15 cm	N3 120 Kg N/ha	
S4 20 x 10 cm		
S5 15 x 10 cm		

Results of analysis gave the following information:

i) Spacing

Spacing had a significant effect on BPH population. The least BPH count was recorded from plots with a spacing of 30 x 15 cm and this was on par with that of 30 cm x 10 cm.The highest BPH count was noted in treatment of S_3 (20 x 15 cm) and had no significant difference with 15 x 10 cm and 20 x 10 cm.

BPH population/Hill

S_3	S_5	S_4	S_2	S_1	CD 5%
22.75	22.23	21.23	16.25	14.42	2.73

ii Effect of nitrogen

120 Kg N/ha recorded significantly higher BPH population over 90 Kg/ha and 60 kg/ha N. However, the BPH population was at par in the treatments 60 Kg and 90 Kg. Nitrogen per hectare.

BPH Population/hill

N_3	N_2	N_1	CD 5%
12.59	8.65	7.84	2.11

iii) Effect of variety:

There was significant difference between the two varieties Jaya and Jyothi, with reference to BPH population

V_1	V_2	CD 5%
11.21	8.17	1.73

iv) Grain yield:

Nitrogen had significant effect on grain yield. Highest grain yield was recorded from 120 Kg N/ha followed by 90 Kg N/ha.

There was no effect of treatment interaction on grain yield and BPH population.

N_1	N_2	N_3	CD 5%
5056	5420	5639	206 Kg/ha

Harvesting rice at physiological maturity [Pattambi]

To assess physiological maturity and correct time of harvesting of long mid and short duration varieties in different agroclimatic regions, an experimen in split plot design with 4 replications was conducted.

The treatments were:

Whole plot : 3 varieties Jyothi, Jaya and IR5

Sub plot : Time of harvesting

20, 25, 30, 35 and 40 days after 50% flowering. The varietal differences were significant. The highest yield was recorded by the medium duration variety Jaya.

The date of harvesting had a significant influence on grain yield Harvesting the crop at 30 days after flowering recorded the highest grain yield in all the three varieties. However, there was not much difference between the harvests at 30 and 35th days after 50% flowering. The data are given in Table 1.64.

Table 1.64: Grain yield of rice varieties of different duration as influenced by different dates of harvesting

Date af harvest		*First crop 1979–80*
Jyothi		
D1	[20 DAF]	3789
D2	[25 DAF]	3756
D3	[30 DAF]	4033
D4	[35 DAF]	4031
D5	[40 DAF]	3613
	Mean	3844
Jaya		
D1	[20 DAF]	3438
D2	[25 DAF]	4055
D3	[30 DAF]	4163
D4	[35 DAF]	3919
D5	[40 DAF]	3873
	Mean	3889
IR-5		
D1	[20 DAF]	2892
D2	[25 DAF]	2535
D3	[30 DAF]	3188
D4	[35 DAF]	3173
D5	[40 DAF]	3090
	Mean	2975
D1		3373
D2		3449
D3		3794
D4		3708
D5		3525
	Mean	3570
CD (0.05) Variety 440		
,, Date of harvesting: 278		

Investigation on premature drying of paddy leaves [Moncompu]

An experiment was conducted in split plot design with 3 replications using Jaya as test variety, at Rice Research Station, Moncompu to investigate the causes of premature drying of paddy leaves during puncha season in Kuttanad. There were five major treatments and 4 minor treatments.

Table 1.65: The effect of treatments on percentage of dryness and grain yield

Major treatments	Minor treatments	Mean percentage dryness	Mean grain yield kg/plot
T_1	t_1 Spraying trace elements	5.17	14.80
	t_2 Spraying Benlate	5.20	14.76
	t_3 Spraying Agrimycin	5.27	15.70
	t_4 Control	6.00	15.06
		21.64	60.32
T_2	t_1 Spraying trace elements	5.20	14.53
	t_2 Spraying Benlate	6.83	15.10
	t_3 Spraying Agrimycin	5.47	15.00
	t_4 Control	5.07	15.43
		22.57	60.06
T_3	t_1 Spraying trace elements	5.40	14.73
	t_2 Spraying Benlate	5.67	14.86
	t_3 Spraying Agrimycin	6.53	14.83
	t_4 Control	5.47	14.73
		23.07	59.15
T_4	t_1 Spraying trace elements	4.73	14.80
	t_2 Spraying Benlate	6.07	14.93
	t_3 Spraying Agrimycin	5.53	1460
	t_4 Control	5.37	14.13
		21.70	58.46
T_5	t_1 Spraying trace element	5.47	15.16
	t_2 Spraying Benlate	6.27	14.36
	t_3 Spraying Agrimycin	6.30	15.70
	t_4 Control	5.93	15.26
		23.97	60.48

Major treatments (5)

1 Submerged and not disturbed the water after dough stage.
2 Drying after dough stage of the crop.
3 Application of lime at 500 Kg/ha at dough stage.
4 Application of bleaching powder @ 5 Kg/ha at dough stage.
5 Washing at weekly intervals after dough stage.

Sub plot treatments (4)

1 Spraying trace elements (combination of Zn, Mn, Cu, & B as 1% soln.)
2 Spraying Benlate at 0.1% solution.
3 Spraying Agrimycin 500 pp.
4 Control

Cumulative effects due to sub-plot treatments on percentage driage of leaves and yield are as follows:

Spraying	Driage leaves	grain yield
Trace elements	25.97	74.02
Spraying Benlate	30.04	74.01
Spraying Agrimycin	29.10	75.83
Control	27.84	74.61

The effects due to major or minord treatments were not significant (Table 1.65)

CROP WEATHER STUDIES

Effect of weather on some high yielding varieties of rice (Pattambi)

To study the effect of different dates of sowing/planting on the duration, yield and uptake of nutrients on important medium and short duration varieties, the experiment was continued at Rice Research Station, Pattambi during 1979-80. During the year under report, the varieties were grouped according to their duration and separate trial conducted for each duration group under a uniform fertilizer schedule as per Package of practices for each group. The sowings were done at fortnightly intervals. The date of sowing was fixed for all varieties (both medium and short) and planting dates varied according to the duration. The varieties within each duration group and for each date of sowing were randomised and replicated at the time of planting and planting done, from one end of the field and continued, instead of randomising for all the dates of sowing taken together. This system was adopted to suit to agronomic and manurial managements.

The treatments were A group comprising short duration varieties Jyothi, Rohini, Triveni and Annapurna and the B group consisting of Bharati, IR-8, Jaya. There were twelve sowings starting from Ist week of May to the middle of October which covered both viruppu and mundakan sowings for the transplanted crop.

The experiment was laid out in a randomised block design with 5 replications. Transplanting was done at 5 leaf stage, ie., 20-22 days for short duration varieties and 25-28 days for medium duration varieties.

Results for 1979–80:

Rohini recorded maximum yield of 5480 Kg/ha, among the four varieties when sown in middle of June. Next best yield was obtained for Triveni (5039 Kg/ha) followed by Jyothi (4976 Kg/ha) and Annapurna (4834 Kg/ha) for the same date of sowing. The total duration for this date of sowing ranged from 99 to 111 days from seed to maturity, the shortest being Annapurna and the longest Jyothi. Percentage of chaff was minimum and volume weight of grains was comparatively high for this sowing. Mid June sowing was found most suitable for short duration varieties during the year.

Among different dates of sowing for Mundakan season, the yield of Rohini was very poor for nurseries raised from Ist week of August to II nd week of October. Similarly, Annapurna and Jyothi also performed badly when nurseries were raised from Ist woek of August to Ist week of September.

Among the medium duration varieties, (Bharati, IR–8, IR–20 and Jaya), Jaya recorded highest yield ef 5347 Kg/ha among the 4 varieties for sowing of May Ist week; while Bharati and IR–8 recorded 5298 and 4705 Kg/ha respectively for the same date of sowing. All varieties gave high 1000 grain weight (29-33 g) for the sowing done on Ist week of May.

Among different dates of sowing for Mundakan season, the yield was poor when nurseries were raised from the end of July to end of August, i.e., very early sowings reduced the yield for Mundakan crop. In Mundakan season, IR–20 and Jaya gave highest yield for early sowings (Ist week of October) while IR–8 and Bharati gave high yields for late sowings (Middle of October.)

MULTIPLE CROPPING

Comprehensive study on rice based multiple cropping (Pattambi)

With an objective to increase profit from up land paddy field, an experiment was continued in RBD with 3 replications at Rice Research Station, Pattambi, during 1979–80. The experiment consisted of growing an early duration rice in 45 cm spaced flow lines during the first crop season and 7 different crops either in relay with rice or after harvest of rice as detailed below:

Ist crop	*IInd crop*	*Crop system*	*Yield from IInd crop Kg/ha*
Rice	Fallow		
Rice	Horsegram	after harvest	300
Rice	Gingelly	,,	580
Rice	Redgram	Relay	360
Rice	Castor	,,	840
Rice	Bajra	,,	1714
Rice	Corn	,,	6407
Rice	Cotton	,,	632

Maize, bajra, Castor and Gingelly as relay crops in modan lands recorded reasonably good yield.

Experiments on multiple cropping in Kuttanad (Moncompu)

An experiment to find out suitable cropping pattern for the Kuttanad area under the changing conditions subsequent to construction of Thannirmukkom barrier was started in 1977 at Rice Research Station, Moncombu.

Since puncha crop of 1978–79 was late, rotation of crops could not be done during summer 1979.

The additional crop 1979 was grown during the months from June 1979 to September 1979. The grain yield showed no significant difference between treatments. The puncha crop was raised from 3–10-79 to 2–2-1980. There was significant difference in grain yield between treatments. Treatments receiving cowpea and blackgram recorded significantly higher yield to all other treatments.

After harvest of puncha crop of 1979–80, pulses, gingelly, jute and ragi were sown on 19-2–1980. Sweet potato was dropped from the treatments. The modified treatments were:

Puncha	*Summer*	*Additional crop*
Rice	Fallow	Rice
Rice	Cowpea	Rice
Rice	Greengram	Rice
Rice	Blackgram	Rice
Rice	Sesamum	Rice
Rice	Ragi	Rice
Rice	Jute	Rice

Exploratory trial for Double cropping in Pokkali region (Vyttila)

To explore the possibility of taking an additional crop of rice in the pokkali region a trial was started at Rice Research Station, Vyttila during 1976–77. Various treatment combinations were tried at the station as well as in the cultivator's fields at Vettakkal and Edacochin. The trial was designed under Koottumundakan system where first and second crop (Virippu and mundakan) varieties were mixed and sown. The crop mixture during 1976-80 were:

Virippu + Intan
Virippu + 25100
Virippu + Karutha Karuka
Virippu + Koottumundakan
Virippu + Orpandy
Vyttila I + Intan
Vyttila I + 25100
Vyttila I + Karutha Karuka
Vyttila I + Koottumundakan
Vyttila I + Orpandy

The seeds were mixed in 7:3 ratio. As the first crop season was very favourable the first crop varieties suppressed the growth and development of IInd crop varieties. The second crop season was quite unfavourable. All varieties succumbed to the severe salinity developed after harvest of Ist crop.

Input Requirements of rice based cropping pattetn (Chalakudy)

An experiment in split plot design was conducted during both Virippu and mundakan seasons at Agronomic research Station, Chalakudy. It consisted of 4 main plot treatments, 7 sub plot treatments and 4 replications. The treatments were as follows:

Main plot treatments

M1	Rice	Rice	Fallow
M2	Rice	Rice	Green manure
M3	Rice	Rice	Sesamum
M4	Rice	Rice	Cowpea

Sub plot treatments

S1 Normal dose for each crop
S2 75% of the normal dose for each crop
S3 50% of ,,
S4 50% of normal dose for Ist crop and normal dose for IInd and IIIrd crops
S5 50% of normal dose for 1st crop + 75% of normal dose of II & IIIrd crop
S6 25% of normal dose for 1st crop + 50% of II & IIIrd crop
S7 Nitrogen one top dressing at PI stage (1/3 dose of N) normal P & K for Ist crop + 50% N, normal P &K for IInd crop + normal dose for IIIrd crop

The mean grain yield obtained during Ist and IInd crod seasons are as follows:

Cropping sequence

	Ist crop	IInd crop
M1	1323	1027
M2	1398	1012
M3	1373	1070
M4	1338	1189

Fertilizer schedule

S1	1437	1023
S2	1503	1141
S3	1265	1002
S4	1411	1073
S5	1388	1069
S6	1202	959
S7	1302	960

MISCELLANEOUS PROJECTS

Methods of sowing rice(Moncompu)

To evaluate the different methods of sowing of rice with a view to select a suitable method under the cropping conditions in Kuttanad, an experiment was laid out in RBD with five treatments and five replications, using variety Jaya in the

puncha season from October 1979 to February 1980, at Rice Research Station, Moncompu. The treatments and grain yield data are presented in the Table 1.66.

Table 1.66: Effect of different methods of sowing

Tr. No.	Treatment details	Grain yield	Intluence
1	Transplanting (normal method of nursery with seed rate of 30 Kg/ha)	4897	Sig.
2	Transplanting (Dapog seedlings – seed rate at 66 Kg/ha)	5428	
3	Broadcasting (seed rate at 100 Kg/ha)	4297	
4	Dibbling (seed rate at 90 Kg/ha)	4039	
5	Dungball sowing (seed rate 90 Kg/ha)	4522	

Dapog method of raising seedlings and planting recorded a significantly higher yield of 5428 Kg/ha.

Screening of rice cultures for salinity tolerance (Vyttila)

To evolve suitable high yielding photo insensitive saline tolerant rice varieties for pokkali soils of Kerala, a screening trial with 48 entries consisting of cultures and cultivars received from various Research Stations were conducted at Rice Research Station, Vyttila. The trial was also repeated in two locations in farmer's fields at Thuravoor in Shertallai taluk and Varapuzha in Parur talak. The following eight entries found suitable to the regions were selected for comparative yield study.

Sl. No.	Entry No.	Designation	Sl. No.	Entry No.	Desigation
1.	708	RPS 2 Sna x SLR 26B	5	740	IR 5055
2.	721	Cul. 1306 Cuttack	6	743	IR 5062
3.	724	Cul. 1309 ,,	7	735	IR 5059
4.	736	IRAT–8	8	791	PTB 25331

PLANT PATHOLOGY

HIGHLIGHTS

Soil application of zinc and manganese at 10 kg/ha was found to be effective in reducing the incidence of the sheath blight disease of rice. Against sheath rot disease in rice, foliar application of Hinosen was relatively more effective. High volume application of Agrimycin at 45 g/ha was quite effective aganist bacterial leaf blight disease.

SUMMARY

Studies on the Sheath blight disease of rice was continued and *Corticium sasaki* was found to grow very well in Potato Dextrose Agar (PDA) medium.

Seedling root dip with nematicide had no influence on the manifestation of the sheath blight disease.

Soil application of zinc and manganese at 10 kg/ha was found to be effective in reducing sheath blight incidence.

In a multi-locational trial for evaluating fungicides against the Sheath blight, Vitavax appeared to be promising.

Hinosan was more effective in the control of Sheath rot disease.

Studies on the influence of potash on Blast was inconclusive. The general trend was that basal application of nitrogen increased the severity of plant infection, while the split application of potash, half as basal and half at panicle initiation reduced neck infection during the first crop season.

Plots receiving silica, potash, Mn and Mg recorded the lowest disease intensity.

Studies on the Udbatta disease were continued at the Ambalavayal Station and artificial inoculation with the pathogen was ineffective in inciting the disease.

In experiments on the control of the rice earhead complex, Quinalphos 0.05% gave the maximum grain yield.

Basic studies on the morphology and physiology of *Xanthomonas oryzae* were carried out.

Terramycin 250 ppm showed maximum *in vitro* sensitivity against the bacterial leaf blight. Agrimycin at 45 g/ha applied as high volume spray was effective in suppressing field incidence of the BLB.

PROJECTS IMPLEMENTED

	Project titles	*Locations*
Sheath Blight		
1	Studies on the toxin production by *Corticium sasakii* and its role in disease development	Vellayani
2	Strain variation in *Rhizoctonia solani* Kuhn (*Thanatephorus cucumeris* (Frank Donk) causing sheath blight of rice	Moncompu
3	Role of the rice root nematode (*Hirschmaniella oryzae*) in the incidence of sheath blight disease of rice in Kerala	
4	Studies on sheath blight disease of rice	Moncompu
5	Studies on the sheath blight of paddy	Vellayani
6	Chemical control of sheath blight disease of rice	Pattambi
7	Experiment No.10 of All India Co-ordinated Rice Improvement Project—Multilocational trials-control of sheath blight of rice	
Sheath Rot		
8	Symptomatology, etiology and control of sheath rot disease of rice	Vellayani
9	Experiment No.11 of All India Co-ordinated Rice Improvement Project-Multilocational trials-chemical control of sheath rot of rice	Moncompu
Blast		
10	Influence of potash on the incidence of blast disease of rice-Effects of split application and time of application	Pattambi
11	Chemical control of blast disease of rice	Pattambi
Helminthosporium leaf shot		
12	Effect of micronutrients on the incidence of Helminthosporiose of rice	Pattambi
Udbatta disease		
13	Studies on the Udbetta disease of rice	Ambalavayal
Earhead complex		
14	Earhead disease complex control/trial	Kayamkulam
15	Studies on earhead complex of rice	Moncompu
Bacterial leaf blight		
16	Etiology and control of bacterial leaf blight of rice caused by *Xanthomonas oryzae*	Vellayani
17	Studies on pathogenic variability and screening for disease resistance and chemical control	Vellayani
18	Control of Bacterial leaf blight of paddy	Moncompu
Yellowing in rice		
19	Soil amendment trial (Ag. 1.6-Path. 10)	Kayamkulam
20	The role of soil amendments on the incidenc of important rice diseases	Moncompu
National Screening Programme		
21	Screening varieties/cultures for resistance to sheath blight and brown spot	Pattambi
22	Screening for disease resistance-Uniform Blast Nursery (UBN)	Pattambi
23	International Rice Observation Nursery (IRON)	Pattambi
24	Screening of rice varieties against important diseases	Moncompu
25	Epidemiological studies on important rice diseases in Kuttanadu	Moncompu

SHEATH BLIGHT

Studies on the toxin production by Corticium sasakii and its role in disease davelopment. [Vellayani]

Preliminary studies of collection, isolation and purification of the organism was carried out. The pathogen was found to grow very well in Potato Dextrose Agar.

Strain variation in Rhizoctonia solani Kuhn. [Thanatephorus cucumeris (Frank Dank)] causing sheath blight of rice [Vellayani]

Different strains of *R. solani* were collected and isolated in pure culture from rice and collateral hosts like guinea grass, soybean, Amorphophallus, greengram betel vine, *Vinca rosea* and cowpea.

Role of rice root nematode Hirschmaniella oryzae in the incidence of sheath blight disease of rice in Kerala [Vellayani]

The detailed studies on the role of rice root nematode in the incidence of sheath blight of rice revealed that there was no significant correlation between nematicidal seedling dip treatment and disease intensity. The disease intensity was very much reduced by fungicidal application, soil fertilization and nematicidal application. Vitavax and Hinosan were the most effective fungicides to control the disease.

Studies on sheath blight disease of rice Ag. 1-5-Path-2 (vii) [Moncompu]

A detailed experiment to study the effect of 3 levels each of the major plant nutrients NPK on the incidence of sheath blight of rice was carried out at the R R S, Moncompu. A field experiment with 27 treatment combinations and 3 repications were laid out. As the disease pressure was quite low, no difference was noticed. Among levels of major plant nutrients with regard to intensity of sheath blight, medium level of nitrogen had given better grain and straw yield than low or high levels of nitrogen. (Table 1.67).

Table 1.67: Effect of major nutrients on sheath blight

Sheath blight	N1	N2	N3	P1	P2	P3	K1	K2	K3
Score (0-9)	1.6	1.6	1.5	1.9	1.7	1.8	1.7	1.8	1.8
Grain yield (kg/plot)	7.46	8.76	8.43	8.36	8.30	7.79	8.00	8.11	8.53
Straw yield (kg/plot)	14.62	17.39	16.40	16.16	15.79	15.81	16.00	16.09	15.72

A field experiment to assess the effect of 8 common soil fungicides on the control of sheath blight of rice was laid out with 4 replications. The results (Table 1.68) showed that plots treated with Bavistin gave higher grain yield than the other treatments.

Table 1.68: Fungicidal control of the sheath blight

Treatments	Sheath blight score	Grain yield kg/plot	Straw yield kg/plot
Difolatan	1.10	8.9	19.5
Captan	1.10	9.8	21.3
Thiride	1.48	8.9	22.2
Benlate	1.37	9.5	20.5
Bavistin	1.13	10.2	20.3
Vitavax	1.13	9.1	20 0
Kitazin	1.20	9.2	18.5
Control	1.77	7.9	18.5

Studies on sheath blight disease of paddy [Vellayani]

An experiment with 28 treatment combinations (7 levels of micronutrients 2 levels of nematicide (N) and 2 levels of fungicide) was laid out confounding NF totally in 2 replications. Soil application of Zn and Mn at 10 kg each/ha was found to be superior to all other treatments. Combination of foliar application of Mn at 5 kg/ha along with nematicidal application gave effective control of the disease. Similary, combination of soil application of Zn and Mn at 10 kg each/ha along with fungicidal application was also found to be a superior treatment in controlliing the disease.

A field experiment was laid out with 16 treatment combinations (4x2x2) for the factors, NK ratios, nematicide (N) and fungicide (F), confounding NF totally tn 2 replications. The interaction effect of NK ratios, nematicides and fungicides showed significantly different variations in controlling the disease.

A 6x2x2 factorial experiment for the factors A, B, C (Fungicide, Zinc and Mn respectively) confounding BC totally in 2 replications was laid out. Vitavax spray was found as a superior treatment along with Thiride and Benthioarb. Soil application of Zn along with fungicidal spray was found to be effective in controlling the diseaae.

Chemical control of sheath blight disease of rice Ag. 1-1-Path 2.04 [Pattambi]

A field experiment to study the effect of Bavistin, MBC, Difolatan and Vitavax on the control of sheath blight of rice was carried out at the R R S., Pattambi. All the fungicides were found to be significantly superior to control except Vitavax, MBC and Bavisten. The data are furnished in Table 1.69.

Table 1.69: Chemical control of sheath blight

Treatment	Dieease severety (score)	Yield in kg/ha
T1 Bavistin	7.50	1763
T2 MBC	7.00	2073
T3 Difolatan	5.50	1912
T4 Vitavax	7.50	1816
T5 Control	9.00	1442
CD	1.80	NS

Multiocational trial on control of sheath blight or rice [Moncompu]

A field experiment with 5 treatments (Bavistin, MBC, Difolatan, Vitavax and Control) and 4 replications was laid out in RBD in the R R S, Moncompu. Among the different fungicides, Bavistin and MBC were better than the others in disease control as well as in grain yield. Plots treated with Vitavax had significantly lower disease incidence and higher grain yield than the rest of the treatments [Table 1.40].

Table 1.70: Control of sheath blight

Treatments	Sheath blight score (0–9)	Grain yield kg/ha)
Bavisti	2.00	7400
MBC	2.30	7183
Difolatan	4.30	6717
Vitavax	2.90	7967
Control	6.25	6700
CD (0.05)	0.43	29.7

SHEATH ROT

Symptomatology, etiology and control of sheath rot disease of rice (Ag. 1-18 Path. 13.01 [Vellayani]

A field experiment with 7 treatments (Vitavax, Dithane Z–78, Hinosan, Fycop, Difolatan, Cuman L and Control) with 4 replications was laid out in RBD in the Model Agronomic Research Station, Karamana. It was found that plots treated with Hinosan showed less disease intensity than others. Vitavax and Dithane Z–78 were also better in controlling the disease (Table 1.71).

Table 1.71: Sheath rot incidence

Treatments	*Disease intensity*
Vitavax 75% wP	2.305
Dithane Z. 78	2.365
Hinosan	2.158
Fycop	0.315
Difolaton	3.129
Cuman L	3.066
Control	3.480

To study the epidemiology of the disease, a pot culture experiment was laid out using different rice varieties. It was noticed that the total hours taken for the initial symptom expression for certain rice varieties such as Rohini, Co 25, Sabari etc., were comparatively less under humid conditions than in ordinary conditions. After infection, the spreading of symptoms on the upper sheath was also faster under the humid conditions (RH kept at 96% and maximum temperature 31°C). Almost all the infected plants were completely covered by the disease symptoms and the plants attained a dried state in about 20 days before the full maturity.

Experiment No. 11 of All India Co-ordinated Rice Improvement Project-Multilocational trials: Chemical control of sheath rot of rice [Moncompu]

A field experiment with 6 treatments (Bavistin, Hinosan, Panolil, Dithane M-45, Syllit and Control) with 4 replications was laid out in the Rice Research Station, Moncompu. The difference in sheath rot score as well as in grain yield between different treatments was slight and non-significant. However, minimum disease score and maximum grain yield were obtained in plots treated with Bavistin (Table 1.72).

Table 1.72: Control of sheath rot

Fungicide	Sheath rot incidence (0-9)	Grain yield (kg/plot)
Bavistin	3.47	2940
Hinosan	4.00	2770
Dithane M-45	3.70	2820
Panolil	3.82	2830
Syllit	4.22	2580
Control	4.47	2070

BLAST

Influence of potash on the incidence of blast disease of rice—Effects of split application and time of application. [Pattambi]

A field experiment was laid out in split plot design with 3 major treatments (Protected with Hinosan, Bavistin and Unprotected) and 4 minor treatments (NPK applied at various stages of growth) with 6 replications in the Rice Research Station Pattambi. The data gathered on disease index, neck infection and yield during both the seasons did not show any statistical significance (Table 1.73).

Table 1.73; Effect of protected and unprotected rice crop on the incidence of neck blast and yield under NK Management—1979-80—Ist and IInd crop season

Major treatments	Ist crop			IInd crop	
	Disease index (%)	Neck infection (%)	Mean Yield (kg/plot)	Neck infection (%)	Mean yield (kg/plot)
Protected with Hinosan	11.20	26.96	6.18	20.77	2.95
Protected with Bavistin	9.04	27.54	6.22	22.41	3.01
Unprotected control	11.67	25.82	6.17	23.62	2.58
	NS	NS	NS	NS	NS

It was found that basal application of nitrogen increased the disease intensity whereas split application of potash, half at basal and half at panicle initiation stage, reduced the neck infection in the first crop season. When the full

potash was applied at panicle initiation, the disease intensity was reduced but split application was best. In the second crop the result was interchanged. (Table 1.74)

Table 1.74: Effect of splitting and time of application of Nitrogen and potash on the incidence of rice blast and grain yield under protected and unprotected condition—1978-80—I & II crop season

Tr.	Treatments (minor)	Ist crop			IInd crop	
		Disease index (%)	Neck infection (%)	Mean yield (kg/plot)	Neck infection (%)	Mean yield (kg/plot)
1	N ($\frac{1}{3}$ AT + $\frac{1}{2}$ PI) P (full basal) K –do–)	9.91	27.10	6.12	23.85	2.75
2	N ($\frac{1}{2}$ basal + $\frac{1}{2}$ PI) P full basal) K ($\frac{1}{2}$ basal + $\frac{1}{2}$ PI)	12.34	25.30	6.18	21.93	2.77
3	N ($\frac{1}{2}$ AT + $\frac{1}{2}$ PI) P (full basal) K ($\frac{1}{2}$ AT + $\frac{1}{2}$ PI)	10.41	28.95	6.25	22.36	2.91
4	N ($\frac{1}{2}$ AT + $\frac{1}{2}$ PI) P (full basal) K (full at PI)	9.88	25.75	6.20	20.94	2.95
		NS	NS	NS	NS	NS

(AT = Active Tillering—PI = Panicle Initiation)

Chemical control of blast disease of rice. AG. 1-1- Path. 3.01 [Pattambi]

A field experiment to study the effect of fungicides, Bavistin, MBC' Hinosan and Dithane M-45@ 500ml/ ha was carried out in the Rice Research Station, Pattambi. The results showed that there was no incidence of foliar infection in nursery stage or in the main field Only neck blast was recorded. The yield data (Table 1.75) indicated that all the treatments except Dithane M-45 were statistically significant. Even though the disease severity data (Table 1.76) were not statistically significant, the observational difference indicate the trend in the effectivenese of the fungicides, The lowest neck infection resulted in the plots treated with Hinosan.

Table 1.75: Grain yield in fungicide treated plots

Treatment	Kg/ha
Bavistin	2297
MBC	2436
Hinosan	2329
Dithane M-45	2169
Control	1934
CD (0.05)	258

Table 1.76: Blast disease intensity in fungicide treated plots

Treatment	Neck infection percentage
Bavistin	35.82
MBC	28.68
Hinosan	29.01
Dithane M-45	32.60
Control	45.69
	(NS)

HELMINTHOSPORIOSE

Effects of micronutrients on the incidence of Helminthosporiose of rice Ag-1-1-Path-5 (ii). (Pattambi)

A field experiment was laid out to study the effect of silica, potash, manganese and magnesium on the incidence of Helminthosporiose of rice, at the Rice Research Station, Pattambi. All the treatments were equally effective in controlling the disease as compared to control. Plots receiving all the elements together as soil application recorded the lowest disease intensity followed by plots which received manganese chloride as soil application. The data on disease index gathered during both the seasons showed statistical significance. (Table 1.77)

The yield data of the Virippu season showed statistical significance. Maximum yield was recorded in plots where all the chemicals were applied together. The plot which received Mn through soil application was the next best treatment in recording higher yield. Higher yield was recorded in plots which had lower disease intensity.

UDBATTA DISEASE

Studies on the Udbatta disease of rice: Ag-1-12-Path. 11 (Ambalavayal)

It has been found that artificial inoculation was ineffective to induce infection and that the pathogen is internally seed borne.

EARHEAD DISEASE COMPLEX

Control of Earhead disease complex (Kayamkulam)

Two field experiments were conducted during the first and second crop season with 12 treatments (Bavistin, Hinosan, Ekalux, Ekalux-Bavistin, Ekalux-Hinosan, Furadan 50 kg/ha, Furadan-Bavistin, Furadan-Hinosan, Furadan-Ekalux, Furadan-Ekalux-Bavistin, Furadan-Ekalux-Hinosan and Control) and 3 replications at the Rice Research Station, Kayamkulam. During the first crop, the treatments were not significant for any of the characters studied. Maximum grain yield (1925 kg/ha) was recorded by Furadan-Ekalux-Bavistin treatment. During the second crop also the treatments were not significant. Maximum grain yield (2597 kg/ha) was recorded by Ekalux (0.05%) treatment (Table 1.78).

Table 1.77

Effect of micronutrients on the incidence of Helminthosporiose of rice — Mean intensity of disease incidence and grain yield corresponding to different treatments

Treatments	Mode of application	Ist crop (Virippu)					IInd crop (Mundakan)			
		Rate kg/ha	Grain yield kg/ha	Increase over control (%)	Disease index	Efficiency over control (%)	Grain yield kg/ha	Increase over control (%)	Disease index	Efficiency over control (%)
1. Silica as Magnesium trisilicate	Soil	100	3535	29.2	53.60	22.3	1636	17.4	41.45	19.4
2. Manganese as Manganous chloride	Soil	100	3939	44.0	53.46	22.5	1838	31.9	37.40	27.2
3. -do-	Foliar	0.2%	3485	27.4	56.94	17.5	1569	12.6	43.10	16.1
4. Magnesium as Magnesium sulphate	Soil	100	3207	17.2	56.38	18.3	1670	19.8	37.60	26.8
5. -do-	Foliar	0.2%	3333	21.8	58.74	14.9	1549	11.1	44.40	13.6
6. Treatment (1)+(4)	Soil	—	4166	52.3	53.05	28.1	1939	39.1	32.40	36.9
7. Rice hull ash	Soil	1 ton	3476	27.0	59.16	14.3	1596	14.5	42.20	17.9
8. Control	—	—	2735	—	69.02	—	1394	—	51.40	—
CD (0.05)			448		6.44		NS		8.26	

Table 1.78: Effect of insecticides and fungicides on the Earhead disease complex of rice

Treatment	Sheath rot (0–9)	Percentage grain discolouration	Grain yield kg/plot	Straw yield kg/plot	Sheath rot (0–9)	% grain discoloration	Grain yield kg/plot	Straw yield
1. Bavistin	2.33	33.83	7.40	25.66	4.2	23.7	7.8	21.1
2. Hinosan	3.26	30.87	7.27	26.17	3.4	15.0	8.4	20.5
3. Ekalux	6.47	32.78	7.00	27.67	3.2	17.3	8.4	20.3
4. 1+3	3.40	32.58	6.80	24.26	3.4	19.7	8.5	21.0
5. 2+3	4.60	28.87	7.27	24.66	2.9	17.0	8.5	20.8
6. Furadan	5.53	31.30	8.63	31.33	2.9	22.0	10.0	25.5
7. 1+6	1.93	28.40	8.86	32.33	3.3	13.0	10.4	26.5
8. 2+6	1.80	27.27	8.53	30.17	3.3	12.0	10.3	23.8
9. 3+6	6.33	31.09	8.70	32.66	3.1	12.3	10.0	25.5
10. 4+6	2.06	28.65	9.60	34.16	3.0	15.3	9.9	26.1
11. 5+6	2.60	27.51	9.90	33.00	2.5	14.7	10.8	25.6
12. Control	6.33	45.38	8.10	28.83	3.5	31.3	7.7	19.7

BACTERIAL LEAF BLIGHT

Etiology and control of Bacterial leaf blight of rice caused by Xanthomonas oryzae [Vellayani]

The pathogen was isolated from infected paddy leaves. The results of bioc hemical tests carried out to characterise the pathogen are as follows:

Morphological characters: Gram negative—Cultural characters; Starch not hydrolised; Gelatine not liquified; Production of H_2S—positive; Production of indole:positive. Ammonia production; negative—Tyrosinase activity; negative—Arginine not hydrolised—

50 paddy varieties were screened for resistance against the disease by artificially inoculating the pathogen and using the score chart developed by IRRI.

Studies on pathogenic variability and screening for disease resistance and chemical control [Vellayani]

The occurrence of the disease was found to be erratic and, therefore collection of isolates from different areas of the State was not possible. Pure culture of the organism was established and maintained. *In vitro* screening of anti biotics consisting of Agrimycin, Streptomycin, Streptocyclin, Ampicillin, Terramycin and Chloramphenicol at 250 ppm was repeated using the standard filter paper disk method. Terramycin 250 ppm gave maximum *in vitro* sensitivity against the bacterium.

The pathogen was found to survive in plant debris under refrigerated condition for a period of five months and for two months under field condition.

Control of bacterial leaf blight of paddy [Moncompu]

The results of field trials conducted during 1979 additional crop season and 1979-80 puncha season are presented in Table 1.79.

Table 1.79: Control of bacterial leaf blight of paddy with antibiotics

Treatments	1979 Additional crop			1979–80 Punja crop		
	BLB score 0–9	Grain yield kg/plot	Straw yield kg/plot	BLB score	Grain yield	Straw yield
1 Streptocycline 15 g/ha high volume	4.26	6.67	16.5	4.4	8.7	18.7
2 Streptocycline 15 g/ha low volume	4.33	7.03	16.8	4.5	8.3	19.5
3 Streptocycline 7.5 g/ha low volume	4.53	7.10	16.5	5.1	7.8	17.3
4 Agrimycin 45 g/ha high volume	3.40	6.60	16.8	2.9	8.3	18.8
5 A –do– low volume	4.67	7.20	20.0	3.7	8.6	20.8
6 Agrimycin 225 g/ha low volume	4.50	6.73	15.5	4.8	8.6	20.0
7 Untreated control	6.83	6.57	14.8	6.5	7.4	17.5
CD (0.05)	0.77					

The results indicate that the plots sprayed with Agrimycin at 45 g/ha using a high volume spray showed lower BLB incidence and gave maximum yield of grain and straw.

Only the spacing effects were found to influence bacterial leaf blight incidence, yield of grain and straw. The minimum disease incidence was introduced under wider spacings. Highest yields of grain and straw was noticed in medium level of spacing (15x15 and 20x20 cm).

YELLOWING IN RICE

Soil Amendment Trial [Kayamkulam]

A field experiment was laid out in RBD with 10 treatments and 3 replications in the Rice Research Station, Kayamkulam. During the Ist crop season, the treatments were not significiant for grain and straw yield. Maximum grain yield (2539 kg/ha) was recorded by FYM to provide the recommended dose of Nitrogen (Table 1.80). During the second crop also, the treatments were not significant. Maximum grain yield (2926 kg./ha) was recorded by N higher level (120 kg)–P&K recommended dose + 5 kg each of $MnSO_4$ & $ZnSO_4$ (foliar application).

Table 1.80: Yield of grain & straw in kg/ha

	Treatment	I crop Grain	I crop Straw	II crop Grain	II crop Straw
1	NPK recommended dose [90:45:45 kg/ha]	1909	6448	2564	3040
2	120:45:45 NPK kg/ha	2504	7276	2430	3189
3	NPK 90:45:45 kg/ha+10kg each $MnSO_4$+Zn SO_4	1374	6879	2415	2514
4	NPK 120:45:45 kg/ha +10kg. $MnSO_4$+10kg$ZnSO_4$	2182	6820	2891	4032
5	NPK 90:45:45 kg/ha+foliar application of 5 kg/ha of $MnSO_4$+5kg$ZnSO_4$.	2395	6696	2762	4414
6	NPK 120:45:45 kg/ha + Foliar application of 5 kg each of $MnSO_4$+$ZnSO_4$	2445	7405	2926	4082
7	NPK 90:45:45 kg/ha+500 kg lime/ha	1949	6547	2033	2564
8	NPK 120:45:45 kg/ha+500 kg lime/ha	1701	6512	2495	3422
9	FYM to provide recommended dose of Nitrogen	2539	5962	2445	3521
10	Tr.9+10 kg each of $MnSO_4$+ $ZnSO_4$ Basal	2182	5788	2465	3819

The role of soil amendments on the incidence of important rice diseases [Moncompu]

Field experiment with 8 treatments (non-edible oilcakes such as neem, marotti, punna, rubber cakes and industrial and agricultural waste products such as saw dust, coconut pith and rice husk, a control with 3 replications was laid out in the RRS, Moncompu. All the treatments had lower score of sheath blight and sheath rot than untreated control. Minimum incidence of sheath blight and sheath rot was noticed in plots treated with Marotti cake. However, maximum grain and straw yield were noticed in plots treated with rice husk (Table 1.81).

Table 1.81: Effect of soil amendments on rice diseases

Treatment	Sheath blight score (0–9)	Sheath rot score (0–9)	Grain yield kg/plot	Straw yield kg/plot
Neem cake	1.93	4.20	8 5	21.0
Marotti cake	1.40	3.93	9.0	20.8
Rubber seed cake	1.57	5.37	8.8	18.7
Punna cake	1.63	4.73	8.7	19.7
Coconut pith	2.20	4.67	8.9	16.9
Saw dust	2.40	4 47	8.6	21.3
Rice husk	2.10	4.67	9·3	22.7
Control	4.20	5.87	8.5	19.3

A field experiment with 8 treatments of inorganic materials (Ca, Mg, Mn, Cu, Zn, Mo and Bo with a control) replicated three times was carried out. None of the inorganic amendments reduced the incidence of sheath blight and sheath rot. Maximum grain and straw yields were recorded in plots treated with Ca & Mo respectively (Table 1.82).

Table 1.82: Effect of inorganic amendments on rice diseases

Treatments	Sheath blight (score 0–9)	Sheath rot score (0–9)	Grain yield kg/plot	Straw yield kg/plot
Calcium	2.03	3.31	9.3	17.2
Magnesium	1.67	3.23	8.5	16.5
Zinc	1.70	3.27	8.3	17.0
Manganese	1.17	3.53	8.3	16.1
Copper	1.10	3.97	7.7	16.5
Molybdenum	1.20	3.00	7.7	17.7
Boron	1.20	3.77	7.7	16.8
Control	1.47	3.13	7.8	15.7

National Screening Programme [Pattambi]

Screening varieties/cultures for resistance to sheath blight and brown spot.

High level of resistance to these diseases was not seen in any of the cultures. High degree of field tolerance (1–3) was shown by 22 entries (Table 1 83).

Table 1 83: National screening programme

Sl. No.	IET	Designation
1	6786	CRM 10-4817-65-196
2	6864	RP 1045-378-6-4-2 Cauvery
3	7062	RNR 87933
4	7071	RNR 87877
5	7100	KAU 1945
6	7114	KAU 4009-15
7	7120	BK 603
8	7171	R 114-2-1-1-1
9	7189	TNAU 18580
10	5722	Pusa 44-33
11	6234	CR 221-W 1014-82
12	5631	TR 2071-176-1-2-1
13	6205	CN 540
14	6208	OR 1102
15	5713	RP 625-3-2
16	6680	OR 20-31
17	6689	CR 263-506
18	6984	AD 9246
19	5735	RP 967-11-1-3-9
20	5738	RP 967-11-4-10
21	6012	R 35-2752 Cauvery
22	6262	CR 262-16

SCREENING FOR DISEASE RESISTANCE

Uniform Blast Nursey (UBN) [Pattambi]

Out of the 532 cultures screened, 244 rows showed high resistance to neck blast.

International Rice Observation Nursery

There was no incidence of leaf blast during the season. The following entries were found to be promising to local condition (Table 1 84).

Table 1.84: Promising entries in IROB

Entry No.	Designation/cross
30	TR 7963-30-2-3
31	TR 7963-87-3-3
35	TR 9093-270-2-1-3-1
53	TR 9411-5-3-3
69	TR 9788-36-3
79	TR 9859-45-2
104	TR 13415-40-2
130	PAU 128-1191-PR 303
140	BR 51-46-5
173	BR 30-39-1-3
201	TET 6518 (VON 342-68-2-15)
219	TR 8192-31-2-1-2
232	TR 9805-97-1
235	TR 9814-14-3
246	TR 13146-23-3
264	TR 17492-17-12-2
288	CR 1007
295	TR 3483-109-3-2-3

Screening of rice varieties against important diseases [Pattambi]

A total of 195 entries were planted during the year and these were screened by scoring with reference to disease incidence.

Epidemiology

Epidemiological studies on important rice diseases in Kuttanadu Ag. 1-5-Path-12(i). [Moncompu.]

Fortnightly planting with 4 rice varieties, viz., Jaya, Jyothi, TNI and M11-57-5-1 has revealed that the appearance of bacterial leaf blight in rice field is closely dependent on meterological factors like high humidity and scanty rains. The intensity of disease was more in TNI and Jyothi than Jaya and M-11-57-5-1. Maximum sheath blight and sheath rot were noticed in Jyothi and Jaya respectively.

The appearance of bacterial leaf blight starts with intermittent drizzles. Dry climate or heavy rain tended to reduce the spread of the disease.

ENTOMOLOGY

HIGHLIGHTS

Mecap a new granular insecticide was effective against gallmidge and leaf roller at 1/kg ai/ha. Root zone application of Furadan and Cytrolane gave better control of galimidge and stem borer and reduced cost of application. Neem oil application reduced leaf roller attack. Protection from 30 DAT to 60 DAT gave higher yields for Medium duration rice varieties. *Echlnochloa crusgalli* is reported as an alternate host for rice thrips. In Kuttanad, mirid bugs and coccinellid beetles are in abundance from the second fortnight of March. Peak population of field rats in paddy fields of Kuttanad was in June. Limeshell Flesh was found to be an effective carrier for baits against field rats.

SUMMARY

Granular Mecap at 1.5 kg ai/ha was highly effective against the rice gall midge and leaf roller.

Spray formulations of Ripcord (Cypermethrin) and FMC 35001 (analogue of carbofuran) and chlorpyriphos were effective in the first crop season for overall pest control when used at 0.75 kg ai/ha.

Dust formulations were ineffective against internal feeders of the rice plant.

Root zone application of Cytrolane (Mephosfolan) at 4 DAT gave effective control of the gall midge during the first crop.

During the second crop season, seedling dip was found to be on par with application of granular insecticide [carbofuran].

In the Pest management trial, Jaya gave the maximum yield under maximum protection. Under need based application, IR 5 gave highest yield followed by IET 6238, Jaya and RPW 6–17 in that order. In the untreated plots, yields were only half of that recorded under maximum protection.

In medium duration varieties like Jaya, fields which were protected from 30 DAT onwards up to harvest gave highest grain yields.

The international gall midge nursery, Gall midge bio-type screening, Rice BPH nursery, BPH screening were all continued during the year.

Rice thrips was found to be of major importance from the second fortnight of December to the last week of January under Kuttanad conditions.

Echinochloa crusgalli was reported to be an alternate host of rice thrips.

Lime shell flesh was found to be an effective carrier for toxicant against rice field rats.

PROJECTS IMPLEMENTED

	Project Titles	*Locations*
1	New Insecticide trial granules (Ag.1.1.Ent.1. 17)	Pattambi
2	New Insecticide trial (sprays) (Ag.1.1.Ent.1.18)	Pattambi
3	Insect pest control trial (Ag.1.8.Ent.1.19)	Pattambi
4	New Insecticide trial (Dusts) (Ag.1.1.Ent.1.19)	Pattambi
5	Economic Insect pest control trial (Ag.1.1.Ent. 2.05)	Pattambi
6	Pest management trial (Ag.1.1.Ent.14.01)	Pattambi
7	Estimation of loss due to insect pests (Ag.1.1.Ent.2.05)	Pattambi
8	International Rice Gall midge nursery (Ag.1.1.Ent. 2.05)	Pattambi
9	Gall midge biotype screening (Ag.1.1.Ent. 2.05)	Pattambi
10	International Rice brown plant hopper nursery (Ag.1.1 Ent.2.05)	Pattambi
11	Brown plant hopper screening (Ag.1.1.Ent. 2.05)	Pattambi
12	Development of rice variety resistant to BPH (Ag.1.1. Ent.11.01)	Moncompu
13	Stem borer screening (Ag.1.1.Ent.11.01)	Pattambi
14	Biotype screening in stem borer (Ag.1.1.Ent.11.01)	Pattambi
15	National screening Nursery I (Ag.1.1.Ent. 11.01)	Pattambi
16	National screening Nursery I (Ag. 1.1. Ent.11.01)	Pattambi
17	Collection and identification of paddy pests & natural enemies (Ag.1.5. Ent.11 04)	Moncompu
18	Survey of natural enemy complex of BPH [Ag. 1.5.Ent. 9.5]	Moncompu
19	Insect infestation pattern in the Onattukara area [Ag.1.6.Ent.7.01]	Kayamkulam
20	Study on the biology & bionomics of whorl maggot & earhead thrips [Ag.1.1.Ent. 4.01]	Moncompu
21	Population dynamics of sp. of rats attacking paddy in Kuttanad [Ag.23-5 Ent.1]	Moncompu
22	Bait preference of species of rats attacking paddy [Ag.23.5 Ent 2]	Moncompu

INSECTICIDE EVALUATION

New Insecticide trial (Granules) Ag.1.1.Ent.1.17 [Pattambi]

A field experiment with granular insecticides was conducted to evaluate their efficiency in stem borer, gall midge and leaf roller control. During first crop season, eight insecticides and in second crop season six insecticides were evaluated. Mecap was found as highly effective against gall midge and leaf roller. Against stem borer, BPMC, Solvirex, Ficam, and Hilbeech were effective giving higher yields (Table 1.85)

New Insecticide trial (Sprays) Ag.1.1.Ent.1.18 [Pattambi]

The trial consisted of insecticides applied as sprays for insect control. Eighteen chemicals were evaluated during first crop season and fourteen during second crop and compared with a maximum protection treatment and untreated control. In general the incidence of major pests was low. Comparison of grain yields revealed that during first crop season, Ripcord 5 EC, FMC. 35001, and Dursban 20 EC and during second crop season San 155, San 197, and Orthene treated plots gave higher yields. (Table 1.86)

Insect pest control trial Ag.1.1.Ent.1.19 [Pattambi]

In the trial to screen out effective chemicals for controlling leaf roller menace, Zolone, Nuvacron, Azodrin, Sevin and Sumithion at 0.5 and 0.3 kg ai/ha along with combinations of Sevin and Nuvan, Ekalux and Nuvan, and also neem oil were tried during Ist crop season. During second crop season Sumicidin, Oftanol, Nuvacron, Sevin, and Sumithion at 0.5 and 0.35 kg ai/ha with Zolone and combinations of Sevin and Nuvan. Ekalux end Nuvan were evaluated. Application of neem oil, combination of Sevin and Nuvan, Azodrin, Nuvacron, Zolone. Sumicidin and Oftanol effectively controlled leaf roller attack.

New insecticide trial (Dusts) [Pattambi]

Nine insecticides in the dust form were tried to find out their efficiency for rice insect control, with special emphasis on external feeders. Zolone 4D, Sevin 5D, Ekalux 5D, Sumithion 5D, Hilbeech 10 D, Elsan 2D, Paratas 2D and Folidol 2D were applied at 25 kg/ha. The incidence of external feeders was negligible. The dusts were not effective against internal feeders.

Economic insect pest control trial Ag. 1. 1. Ent. 2.05 [Pattambi]

The object of the experiment was to find out the most economical method of insecticide application to get bettercontrol of insect pests and higher yields. Insecticides were used as [1] seedling dip [2] seedling dip and application of granular insecticides and [3] seedling dip and spraying insecticides. These treatments were compared with maximum protection, farmers practice and untreated control. Root zone application of Cytrolane G at 4 DAT gave effective control of gall midge during 1st crop. During second crop Root zone application, seedling dip + granular insecticides (both Furadan and Cytrolane were on par in stem borer control (Table 1.87)

Pest management trial Ag 1. 1. Ent. 14.01. [Pattambi]

The trial was aimed at finding out the efficiency of different methods of pest management, viz., maximum protection need based application of insecticides and no protection with regard to susceptible and resistant varieties. During 1st crop season the varieties used were Jaya and RPW 6-13, and in 2nd crop season, Jaya; IR 5; RPW6-17, and IET. 6238 were used. During 1st crop season, Jaya under maximum protection gave higher yields. During the 2nd crop season under maximum protection, all the 4 varieties gave high yields. Under need based application, IR.5 gave highest yield followed by IET. 6238, Jaya and RPW 6-17. In the untreated plots, the yields were only half of that recorded in maximum protected plots, the highest being by IET. 6238 followed by RPW. 6-17 IR.5 and Jaya (Table 1 88).

Estimation of loss due to insect pests. [Pattambi]

The rice crop is subjected to damage from different insect pests from the seedling stage upto the harvesting stage. To estimate the avoidable loss due to the pest complex at different stages of the crop growth by adopting appropriate protection techniques, a trial was initiated. The treatments included were [1] No protection [2] protection up to 30 DAT by applying Furadan 1.25 kg ai/ha [3] protection from 30 DAT onwards only by applying Furadan at 30 DAT and spraying Ekalux 0.5 kg ai/ha at 50 DAT, [4] protection from 60 DAT only by applying Furadan at 60 DAT, spraying Nuvacron at 80 DAT and further need based sprayings [5] Combinations of Tr. 2 and 3 [6] combination of 2 & 4 [7] Combination of 3 & 4 [8] Combination of 2, 3 & 4. The results reveal that crop protected from 30 DAT onwards upto harvest stage has given the highest yield followed by treatment getting protection from transplanting upto 60 DAT, followed by treatment getting protection from 30 DAT to 60 DAT. (Table 1.89).

Table 1.89: Pest control trial

Treatment	SS% 50DAT	DH% 50 DAT	WEH% at harvest	Yield kg/ha
P_1–No treatment	2.69 [8.81]	25.97 [30.51]	4.10 [11.67]	1219
P_2–Protection upto 30 DAT	3.83 [11.17]	11.35 [19.05]	10.61 [18.94]	1649
P_3-Protection from 30 DAT	1.28 [5.31]	8.51 [16.92]	5.09 [12,93]	3459
P_4–Protection from 60 DAT	8:50 [3.22]	31.23 [33.95]	1.68 [7.45]	1488
P_5–P_2+P_3	2.18 [8.35]	4.25 [11.76]	3.50 [10:58]	3889
P_6-P_2+P_4	3.29 [10.03]	16.89 [23.60]	1.93 [6.27]	2688
P_7-P_3+P_4	1.22 [6.30]	5.27 [12.90]	0.62 [4.44]	4265
P_8–P_2+P_3+P_4	0.77 [3.87]	6.88 [15.12]	0.60 [4.42]	3871
CD		7.65	5.87	784

VARIETAL RESISTANCE

International Rice Gall Midge Nursery [Pattambi]

104 hybrid materials were screened under field conditions to find out their tolerance/resistance to gall midge attack. The incidence of gall midge was low.

Gall midge bio-type screening [Pattambi]

14 hybrid materials were screened under this trial.

Gall midge screening [Patambi]

66 cultures were field evaluated for resistance against gall midge.

International Rice brown plant hopper nursery [Pattambi]

162 cultures were planted in the field for testing their tolerance/resistance against brown plant hopper. There was no incidence of the pest.

Brown plant hopper screening [Pattambi]

100 cultures of the Assam Rice Collections were planted for evaluation of the resistance against brown plant hopper. There was no incidence of the pest.

Development of rice varieties resistant to BPH Ag. 1.1. Ent. 11.01. [Pattambi]

148 cultures developed at Rice Research Station, Moncompu were evaluated for tolerance/resistance against brown plant hopper. The following cultures alone have shownre-sistance under laboratory screening.

M. 1557-3, M. 1535-1; M.1539-1 M.1544-1: M. 1537-3; M. 1537-1;
M. 1533-3; M. 1544-2, M. 1557-1; M. 22-378-1; M. 23-33-3-1;
M. 23-9-1-1, M73. 1-1-2; M. 100-2-2; M. 24-179-1; M. 24-266-2;
M. 24-225-3; M.24-145-1; M. 24-104-1, M. 24-11-1; M. 24-204-2;
M. 24-109-1; M. 22-378-2-3; M. 22-378-2-1; M. 22-98-1-2.

Stem borer screening [Pattambi]

75 cultures were field evaluated for screening, tolerent cultures.

Biotype screening of stem borer [Pattambi]

Biotype variations in insects can be found-out by the differential reaction exhibited by known varieties. 23 test cultures were planted to study the differential reaction. The incidence of stem borer was too low.

National Screening Nursery I [Pattambi]

215 entries were planted for evaluating resistance against major pests. Severe drought, damaged the crop.

National Screening Nursery II [Pattambi]

282 cultures were planted for evaluation, but was damaged by drought.

Another 371 cultures were planted for field evaluation. But the incidence of insects was too low for evaluation.

BIOLOGICAL CONTROL

Collection and identification of paddy pests and their natural enemies in Kuttanad Ag. 1.5 Ent. 11 04 [Moncompu]

Rice thrips are found to be major threat from 2nd fortnight of December to January. *Echinochloa crusgalii* has been found to be an alternate host for the pest.

Cyrtorhinus bugs are in abundance from 2nd fortnight of March.

Survey of natural enemy complex of BPH Ag 1.5. Ent. 9.5 [Moncompu]

The incidence of brown plant hopper was low.. Mirid bugs and Coccinellid beetles made their appearance from 2nd fortnight of March.

BIONOMICS

Insect infestation pattern in the Onattukara area with special reference to stem borer Ag. 1.6. Ent. 7.01 [Kayamkulam]

During the first crop season 17% WE were recored in Jyothy, During second crop season 10% WE on ptb. 20 and 7% on Jaya were recorded. Jyothy had 14% silvershoots during 1st crop while there was only 2% in 2nd crop. Leafroller damage varied from 6 to 40% during 1st crop and 4 to 60% in second crop. Whorl maggot incidence ranged from 4–15%. During second crop case worm incidence was high.

Study on the biology and bionomics of whorl maggot and ear head thrips Ag. 1.1. Ent.4.01 (Moncompu)

Attempts made to rear, whorl maggot on five graminaceous weeds did not succeed.

RODENTOLOGY

Population dynamics of different species of rats affecting rice in Kuttanad. Ag.23.5. Ent.1. (Moncompu)

Studies revealed that peak population of rats attacking paddy was in the month of June. The population is very low from March to May. (Table 1.90).

Bait preference of different species of rats attacking rice crop. Ag.23-5-Ent.2. (Moncompu)

Results of the studies on bait preference indicate that rats prefer lime shell flesh.

Average consumption of bait bases by rats was as follows:

Limeshell flesh 20 gms, Ripe plantain fruit 17.4gms; Dried fish 13.3 gms. Cocount kernel 13.0 gms; Raw tapioca 11.3 gms, Broken rice 3.7 gms, Broken wheat Nil.

Table 1.90

Total No. of field rats caught in each month during 1979

Month	Total Catch	Month	Total Catch	Month	Total Catch
January	14	May	2	September	10
February	4	June	21	October	16
March	2	July	4	November	8
April	1	August	7	December.	9

VARIETAL RESISTANCE

International Rice Gall Midge Nursery [Pattambi]

104-hybrid materials were screened under field conditions to find out their tolerance/resistance to gall midge attack. The incidence of gall midge was low.

Gall midge bio-type screening [Pattambi]

14 hybrid materials were screened under this trial.

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2 Coconut

HIGHLIGHTS

In germplasm evaluation studies, copra yield in the Laccadive ordinary variety was found to be consistently good.

Pre-potency studies in WCT led to the identification of promising mother palms in the Kuttiadi area.

Application of P beyond 225g/palm/year is not essential for red sandyloam soils.

Leaf axil application of fertilizers is injurious to the coconut palms.

Simple fertilizer trials in cultivator's fields clearly showed that in Root (wilt) free areas, yield increase ranging from 20-130% could be obtained by proper NPK fertilization. Root (wilt) affected palms did not respond to fertilization.

In series of screening trials involving varieties and hybrids, none was found to be resistant/tolerant to the Root (wilt) disease.

Elephant foot yam was found to be the most suitable intercrop for the coconut gardens.

Guava was recorded as the alternate host of the coreid bug *Paradasynus rostratus* infesting nuts. The bugs are effectively controlled on alternate hosts by spraying Quinalphos 0.025% suspension.

Protection from the seedling stage onwards with fungicides, nematicides and antibiotics jointly as well as independently and NPK fertilization in conjunction with Ca, Mg, Zn was of no value in affording protection to the palms from the Root (wilt) disease.

SUMMARY

The performance of the indigenous (34) and exotic (29) accessions in the coconut germplasm collection at the Regional Research Station, Pilicode were studied and it was found that the Laccadive ordinary variety gave the highest yield of copra (15.34 kg/tree/year).

The germplasm bank established in the KAU Main campus at Vellanikkara was maintained.

The performance of inter-varietal and inter-racial hybrids involving indigenous and exotic materials was found to be unsatisfactory. Evaluation of WCT and different dwarfs showed that none of the hybrids revealed hybrid vigor in respect of precocity in flowering.

Pre-potency studies in WCT materials led to the identification of a few superior mother palms (Tree numbers 36 78, 14, 54, in the Kuttiady area).

At Balaramapuram, T x D consistently out-yielded T x G hybrids and there was progressive increase in yield in both the hybrids after first bearing.

Survey of the coconut gardens to select superior high yielding genotypes in the midst of Root (wilt) affected palms and studies on the performance of hybrid combinations for pest and disease tolerance/ resistance were in progress.

Nutritional experiments revealed that the effect of N on yield was highly significant. The highest yield of 6,640 nuts/ha was registered at 680 g N/palm. In the case of P, 225 g/palm/year gave the highest yield of 5836 nuts/ha. The highest dose of 450 g P/palm/year had a consistently depressing effect on yield in red sandy-loam soils. Therefore, in red loamy soils, the dose of P need not exceed 225 g/P_2O_5/tree/year.

The economic yield was given by 340 g N + 225 g P + 900 g K.

Leaf axil application of fertilizers was injurious to coconut palms.

Simple fertilizer trials in cultivator's fields clearly revealed that yield increase from 20 to 130% could be obtained by regular NPK fertilization. However, in plantations severely infested with Root (wilt) disease, the nut yield declined by 64.66% even after application of fertilizers.

In spacing-cum-manurial trial on coconut, the maximum yield was obtained from palms which were spaced at 7.5 x 7.5 m and receiving fertilizers at NPK 680g, 450g and 900g.

Hybrid napier grass was found to be better suited as an intercrop in coconut gardens.

Among the annual crops tried in coconut plantations, the elephant foot yam gave maximum profit.

In series of screening trials involving varieties and hybrids, none was found to be resistant/tolerant to Root (wilt) disease.

Protection of the palms from the seedling stage with nematicides, antibiotics, systemic fungicides independently and in combination as well as NPK fertilisation in conjunction with Ca, Mg, Zn nutrition were of no value in protecting the palms from the Root (wilt) disease.

Guava was recorded as an important alternative host of the coreid bug *Paradasynus rostratus* infesting coconut and effective control of the bug on guava was obtained by spraying Qunalphos 0.025% suspension.

PROJECTS IMPLEMENTED

	Project Titles	*Location*
	CROP IMPROVEMENT	
1	Germplasm collection of Coconut (AICC & AIP) (Ag-2.8. Breed 3.01)	Pillcode
2	Germplasm collection of Coconut varieties (Ag.2.19. Breed. 3.02)	Vellaikkanra
3	Study of cross progenies of exotic tall varieties and indigenous varieties (Ag.2.8. Breed. 4.01)	Nileshwar
4	Evaluation of WCT x different dwarfs (Ag.2.8 Breed. 7.01)	Nileshwar
5	Exploitation of hybrid vigour in Coconut (AICC & AIP) (Ag.2.8 Breed 2. 10.02)	Pilicode
6	Trial of promising seed material (AICC & AIP)	Pilicode
7	Production of new cross combinations (AICC & AIP)	Pilicode
8	Studies on the performance of off–type (Natural cross dwarf varieties (Ag.2.8. Breed. 6.01)	Pilicode
9	Prepotency studies in WCT (Ag.2.8. Breed 5.1)	Nileshwar
10	Studies on the second generation selves and simulated progenies in Coconut (Ag.2.8. Breed. 10.01)	Pilicode
11	Progeny row trial with T x D and T x G hybrids (Ag.2.10 Breed. 10.01)	Balaramapuram
12	Survey of gardens to select superior genotypes which are high yielding and resistant or tolerant to major pests and diseeses [(KADP)	Vellanikkara
13	Evolving high yielding varieties which are tolerant/resistant to different pests and diseases (KADP)	Vellanikkara
14	Fixing up selection criteria for hybrid coconut seedlings at nursery stage (KADP)	Vellanikkara
15	Determination of prepotency of hybrid coconuts to produce high yielding progenies (KADP)	Vellankkara
16	Assessment of combining ability of dwarf coconuts (KADP)	Vellanikkara
	CROP MANAGEMENT	
17	NPK fertilizer trial (from seedling stage) (Ag. 2.10. Agron. 1.05)	Balaramapuram
18	NPK fertilizer trial in laterite soils on WCT variety of Coconut (AICC & AIP)	Pilicode

19	Effect of NPK levels and frequency of application on the yield and bearing babits of TxD hybrids (Ag.2.8.1.1)	Nileshwar
20	Nutrition through leaf axil in diseased and healthy palms (Ag.2 8.3–2)	Pilicode
21	Simple fertilizer trial in cultivator's field (Ag. 2.15. Agron. 3.01)	Multi-locational
22	Setting percentage in coconut as influenced by nutrients	Vellayani
23	Spacing–cum–manurial trial on coconut (Ag. 2.10 Agron.9.01)	Balaramapuram
24	Response of DxT hybrids to common salt application	Piiicode
25	Common salt as a substitute for potash in the nutrition of adult coconut palm	Piiicode
26	Nutrional studies in Coconut–I Effect of micronutrients on yield, growth and disease resistance in Coconut (KADP)	Vellanikkara
27	Nutritional studies in Coconut–II Simple fertilizer trials in cultivator's field under different soil types in irrigated and rainfed conditions (KADP)	Vellanikkara
28	Intercropping coconut garden with different varieties of banana	Pilicode
29	Effect of leaf cutting on the productivity of coconut palm (Ag. 2.8. Agron. 6.01)	Piiicode
30	Influence of tapping on the yield of uneconomic palms under irrigated and rainfed condltions (Ag. 2.8 Agron. 7.01)	Nileshwar
31	Studies on the possibility of multiple cropping including rice in unirrigated coconut gardens using modulation technique. (Ag. 1.8. Agron. 12.01)	Pilicode
32	Trial of mixed cropping with tree spices (Ag. 2.9. Agron. 11.01)	Kumarakom
33	Trial cultivation of banana as an intercrop in coconut garden (Ag. 2.9. Agron10.03)	Kumarakom
34	Trial to find out the variety of fodder suitable for cultivation as intercrop in coconut gardens (Ag. 2.9. Agron. 10.04)	Kumarakom
35	Intercropping trial with various annual crops	Pilicode
36	Trials on intercropping of pepper varieties in coconut gardens and to fix up the most suitable shade tolerant variety (Ag. 2.8. Agron. 10.01)	Piiicode
37	Effect of raising cocoa as an intercrop in adult coconut plantations (AICC & AIP)	Piiicode

CROP PROTECTION

38	Effect of application of sodium chloride on the leaf axil of coconut palms on the control of *Oryctes rhinoceros* (Ag. 2.8. Ent.2 (1)	Pilicode
39	Rodent control in coconut garden (Ag.2,8 Ent.5)	Pilicode
40	Chemical control of cockchafer grubs (Ag. 2.8. Ent. 2.1	Nileshwar
41	Coreid bugs attacking coconut palms in the southern parts of Kerala (Ag. 1.10. Ent. 4.01)	Balaramapuram
42	Studies on varietal resistance/toleranceto Root (wilt) disease in coconut Ag. 2.9. Path. 4.01, Ag. 2.9 Path. 4.02, Ag. 2 9. Path. 4.03, Ag. 2.9 Path. 8.02, Ag. 2.9 Path. 8.03, Ag. 2 9 Path. 8.05 and Ag. 2.9. Path. 4.05 at Kumarakom; Project no. 34 at Vyttila and Ag. 2.5. Path. 8.01 at Moncompu)	Kumarakom Vyttila, Moncompu
43	Integrated control of Root (wilt) disease from seedling stage (Ag. 2.9. Path. 5,06)	Kumarakom
44	Integrated control of Root (wilt) disease on young palms Ag. 2.9. Path. 4 04)	Kumarakom
45	Studies on stem bleeding disease of Coconut (Ag. 2.8. Path. 3.01)	Pilicode
46	Relationship between night temperature and the incidence of budrot of coconut (Ag. 2.9. Path. 2 (ii).	Kumarakom
47	Studies on Root (wilt) disease of Coconuf (Ag. 2.18. Path. 4. viii)	Vellayani
48	Study of intensity of various diseases affecting coconut and assessing the yields (Ag. 2.9. Path. 8. (vi)	Kumarakom
49	Disease resistant trial with apparently resistant West coast tall palms (Ag. 2.9. Path. 8. iv)	Kumarakom
50	Studies on the control of grey leaf blight of coconut (Ag. 2.10. Path. 5.01).	Balaramapuram
51	Microbial deterioration of copra (Ag. 2.18. Proc. Tech. 1.03)	Vellayani

CROP IMPROVEMENT

Germplasm collection of Coconut Ag.2.8 Breed 3.01 [Pilicode]

Work on :he introduction and evaluation of coconut varieties was started in 1924 at the Coconut Research Station, Pilicode. The Station has at present 34 indigenous and 29 exotic varieties in its collection Table 2 1.

Table. 2.1 Coconut varieties/cultivars in the germplasm collection at the Coconut Research Station, Pilicode

Exotic	Indigenous
New Guinea	Andaman ordinary
Cochin China	Andaman Dwarf
Siam	Andaman Giant
Strait settlement (Apricot)	Laccadive Ordinary
Strait settlement (Green)	Laccadive small
Java	Laccadive Dwarf
Fiji	Laccadive Micro
Philippines ordinary	Kappadam
Philippines Laguna	Malosapuram
Philippines Kalibahim.	Bombay
Seychelles	Gudiatham
Gonthembili	Chingalpet
Thembili	Thiruthirapundy
Jamaica	Tanjore
Navasi	Salem
Niyorgading	Pollachi
San Ramon	Omalur
Ceylon	Kulithalai
Malayan Dwarf Yellow	Kodiripadu
Malayan Dwarf Green	Indupali
Malayan Dwarf Orange	Godavari
St. Vincent	Bengal
Borneo	Mysore
British Solomon Island	Basanda (Mysore)
Kenya	Baboor (Mysore)
Kaipawangi	Bansa hybrid
Guam	Gangabondam
Kudat	Spikeless
Lono	Kaithathali
	Chowgat Dwarf Orange
	Chowghat Dwarf Yellow
	Chowghat Dwarf Green
	Ayiramkachi
	West Coast Tall

Yield and morphological characters of all varieties except 8 which are in the pre-bearing stage have been recorded.

In respect of the mean annual yield of copra, Laccadive Ordinary stands first with 15.34 kg per tree followed by Philippines (13.66 kg) and Java (13.28 kg). The local West Coast Tall gave an yield of only 10.60 kg copra. No new introductions were made during the year under report.

Germplasm collection of coconut varieties Ag. 2.19 Breed 3.02 [Vellanikkara]

A germplasm collection of coconut was started in 1975 at the Kerala Agricultural University main campus (Instructional Farm), Vellanikkara. Twenty two types listed in Table 2.2: were procured and planted so far.

Table 2 2 Varieties/types/cultivars in the germplasm collection of coconut at the Instructional Farm, Vellanikkara

Laccadive Ordinary	Guam
Andeman Ordinary	Philippines Ordinary
Java	Kenya
Jamaica	British Solomon Islands
Zanzibar	Spicata
San Ramon	Ceylon
Andaman Dwarf	Fiji
Seychelles	Laccadive small
Gonthembili	Laccadive Micro
Borneo	Andaman Giant
Malayan	Cochin China

The palms are coming up well. None of the palms have flowered so far.

Study of cross progenies of exotic and indigenous tall varieties Ag.2.8 Breed 4.01 [Nileshwar]

With a view to exploit genetic diversity which often manifest itself with greater intensity in the inter racial and inter-varietal crosses, 15 hybrid combinations were prepared and six palms in each were planted in the red sandy loam soil of Coconut Research Station, Nieshwar along with their parents in 1967. The data collected during 1979 are presented in Table 2.3.

The performance of the hybrids as well as the varieties in the red sandy-loam soils of Nileshwar was found to be poor and the production of female flowers and nuts were very low. The maximum number of nuts produced per palm per year was 14.66 nuts in LS x CDG hybrid. However, even after 13 years, only 3 out of 6 palms have flowered in this hybrid. Since the palms are only in their early stages of bearing, it is too early to assess their performanee.

Table 2.3: Performance of exotic tails, Indigenous types and their crosses.

Variety/hybrid	No.of plants flowered	Mean no.of female flowers produced	Mean no.of nuts/ palm	Mean no.of leaves produced
Java x WCT	5	29.60	4 2	12.00
Siam x WCT	3	31.00	7.0	9.33
AO. x WCT	3	11.00	1.3	9.33
Philippines x WCT	4	—	—	9.16
LS x WCT	3	18.00	6.3	8.66
CC x WCT	6	2.50	0.33	10.16
WCT x Java	6	29.60	6.10	10.16
WCT x Siam	3	8.66	3.30	8.6
WCT x AO	3	6.33	1.30	8.5
WCT x Philippines	2	—	—	8.16
WCT x LS	4	3.00	0.25	8.66
WCT x CC	6	24 50	8.00	10.50
Philippines x CDG	5	6.00	2.00	11.80
LS x CDG	3	58 66	14.66	11.33
CC x CDG	5	20.20	4.2	10.66
Java	2	—	—	9.33
Siam	4	13.75	3.75	8.66
Andaman ordinary	4	8 25	2 25	9.80
Philippines	2	13.50	2.50	10 16
Laccadive small	4	1.50	0.25	8.33
Cochin China	5	2.60	0.60	10.00

Evaluation of West Coast Tall x Dwarfs Ag.2 8 Breed 7.01 [Nileshwar]

The study was initiated in 1972 at the Coconut Research Station, Nileshwar to identify the best dwarf variety as pollen parent and to compare their performance with the West Coast Tall variety. Planting was done in RBD layout with 9 treatments, 3 replications and 6 palms per plot. None of the palms has flowered so far. Data on growth characters recorded in 1979 are furnished in Table 2.4.

Table 2.4: Growth characters of WCT x Dwarfs and WCT

Treatment	Mean girth at collar (cm)	Mean No. of leaves produced during 1979	Total no.of leaves per plant (mean)
WCT x Gangabondam	90.06	5.96	36 90
WCT x CDG	86.94	7.10	42.30
WCT x Laccadive Dwarf	69.91	6.30	31.10
WCT x CDO	78.60	6.60	35.96
WCT x Niyorgading	85.18	7.50	44.96
WCT x Andaman Dwarf	90.80	6.80	42.50
Natural Cross Dwarf	87.90	6.70	38.10
CDO x WCT	77.60	6.30	37.20
West Coast Tall (WCT)	75.40	5.60	33.70

The data show that in respect of girth at collar WCT x Andaman Dwarf is superior followed by WCT x Gangabondam and Natural cross dwarf while, in the number of leaves produced during the year, WCT x Niyorgading tops the list followed by WCT x Chowghat Dwarf, Green and WCT x Andaman Dwarf. In total number of leaves produced WCT x Niyorgading had the maximum number of leaves followed by WCT x Andaman Dwarf and WCT x Chowghat Dwarf Green.

None of the hybrids had shown hybrid vigour in respect of the years taken for first flowering.

Exploitation of hybrid vigour in Coconut AICC & AIP-A... Breed 10 (...
[Pilicode]

The project aims to study the performance of hybrids of promising Tall varieties and dwarf/semi dwarf forms of coconut. The extent of heterosis and precocity exhibited by the crosses are being studied. The design of the experiment is RBD with five replications. Planting was done in 1973 at the Coconut Research Station, Pilicode. Number of plants in each treatment is five. Details of flowering and nut yield during 1979 are furnised in Table 2.5.

Table 2.5: Details of flowering and nut yield

Treatments	Number of palms flowered so far	Nut yield in 1979 (Total)	Mean no. of leaves produced during 1979	Total number of functional leaves (mean)
WCT x CDO	5	15	11.4	19.8
CC x CDO	4	12	11.2	19.0
AO x CDO	5	—	11.6	18.8
LO x CDY	5	9	10.6	18.2
Fiji x CDO	5	—	11.2	19.2
WCT x Gangabondam	5	—	12.0	24.4
WCT x Niyorgading	5	30	12.2	22.6
Fiji x Gangabondam	5	2	10.8	19.2
WCT x Thembili	4	—	10.8	19.2
WCT x Strait settlement	4	4	10 6	19.2
WCT x CDG	5	22	12.0	21.3
WCT x Laccadive Dwarf	5	—	11.4	19.0
CDO x WCT	5	6	10.0	17.0
CDO x LO	3	—	9.8	17.6
Gangabondam x LO	5	—	11.0	20.8
WCT	2	—	10.0	17.2

In all, 72 plants flowered so far (6 years after planting). The least number of flowered palms was in West Coast Tall. The hybrids in general were precocious. In respect of total nut production, West Coast Tall x Niyorgading gave the maximum number in 1979, followed by West Cost Tall x Chowghat Dwarf Green. In respect of the mean number of leaves also, West Coast Tall x Niyorgading tops the list.

Since the palms have only just started bearing, it is too early to arrive at any conclusion regarding their performance.

Trial of promising seed material A I C C & A I Project [Pilicode]

The relative performance in terms of yield and other economic characters of promising hybrids and varieties were studied in this trial. The design is RBD with 13 treatments, 3 replications and 4 plants/treatment/replication. Planting was done in 1976 at the Coconut Research Station, Pilicode. Growth measurements of seedlings were recorded in 1979 and the mean values are presented in Table 2.6.

Table 2.6: Growth measurements of seedlings in the trial of promising seed material

Treatments	Mean girth at collar (cm)	Mean height (cm)	Mean number of leaves
Dwarf x Tall	99.0	447.4	6.8
Tall x Dwarf	99.8	468.9	6.8
Tall x Gangabondam	103.3	459.6	7.8
LO x Gangabondam	85.3	403.4	6.3
Straitsettlement Green	77.8	392.6	6.7
Philippines Ordinary	86.3	392.8	6.4
Andaman Ordinary	94.2	425.8	6.0
Laccadive Ordinary	89.8	435.6	6.3
Laccadive Micro	93.9	423.1	6.3
Java	87.6	430.8	5.9
Kappadam	82.6	419.0	5.9
Prepotent Tall	80.7	345.8	5.4
West Coast Tall	85.7	407.6	6.1

In respect of the girth at collar and mean number of leaves Tall x Gangabondam was superior to all other hybrids and varieties. None of the seedlings have flowered so far. It is too early to draw any conclusions. The experiment is continued.

Production of new cross combinations A I C C & A I Project [Pilicode]

In this multilocational trial, hybrids of different parental combinations are evaluated under different agro-climatic conditions to identify the most productive and adaptable type to each locality. Hybrids involving various parents will be produced in different co-ordinating centres and exchanged for trial. Accordingly the following hybrids are produced at Pilicode centre.

WCT x Laccadive dwarf

WCT x Chowghat dwarf orange

WCT x Gangabondam

WCT x Malayan Dwarf Yellow

Seedlings of the above combinations have been produced and were ready for supply.

Eighty two hybrid plants obtained from the Project Co-ordinator and planted at Nileshwar Station in 1978 were coming up well. Since these are only about two years old no conclusions can now be drawn.

Studies on the performance of off-type (Natural Cross Dwarf) of dwarf varieties Ag. 2.8. Breed 6.01 [Pilicode]

In the nurseries of dwarf varieties of coconut, a few seedlings will always possess characters different from the mother palms. Mostly, these seedlings will be vigorous and colour variation may be noticed in some cases. These are presumed to be hybrids produced by natural cross pollination. Such seedlings from six dwarf varieties are being compared in this experiment in respect of growth, precocity, yield and other characters. The experiment was planted in 1973 at the Coconut Research Station, Pilicode in RBD with three replications and a single plant per plot. The varieties used were Laccadive dwarf, Strait settlement, Niyurgading, Chowghat Dwarf Green, Chowghat Dwarf Orange and Chowghat Dwarf Yellow. Flowering duration of the varieties are furnished below:

Variety	*Flowering duration*
Laccadive Dwarf	— 2 flowered after 6 years
Strait settlement	— 2 flowered after 6 years and one in 7 years
Niyorgading	— one in 5 years
Chowghat Dwarf Green	— one efter 4 years 2 after 5 years
Chowghat Dwarf Orange	— 2 in 7 years
Chowghat Dwarf Yellow	— 2 in 4 years

The earliest to flower was Chowghat Dwarf Yellow followed by Chowghat Dwarf Green. Yield data of palms are being recorded.

Prepotency studies in West Coast Tall Ag. 2.8. Breed 5.01 [Pilicode, Kuttiadi]

The object of the experiment was to study the possibility of selecting prepotent parents in West Coast Tall variety of coconut which are able to transmit its economic characters to its progenies and to work out standard methods for detection of prepotency in palms.

Seed nuts collected from a large number of mother palms in the Kuttiady area were sown separately in the nursery. Germination percetage, number of quality seedlings, uniformity of seedling etc. were studied. Based on these studies, 15 palms whose seedlings performed satisfactorily at the nursery stages were selected and these seedlings were planted in a randomised and replicated trial at the Coconut Research Station, Nileshwar in 1961. The design adopted was RBD with 4 replications. Each plot consisted of a single row of 5 plants. The data on growth and yield of plants were recorded regularly. Observations recorded during 1979 are presented in Table 2.7.

Table 2 7: Growth characters and yield of progenies in prepotency studies

Parent tree number	Mean No. of leaves produced in 1979	Mean No. of female flowers produced	Setting percentage	Mean annual yield of nuts
5	7.70	59.35	31.76	18.85
14	9.05	92.36	42.22	39.00
19	8.95	85·10	36.60	31.15
30	9.05	76.52	29.84	22.84
34	8.25	66 89	40.83	27.31
63	9.55	113.95	35.58	40.55
50	8.65	73.35	37.21	27.31
54	9.35	93.70	35.96	35.47
55	8.40	65.24	33.75	22.26
65	8.55	68.15	38.22	26.05
75	8.75	54.57	36.54	19.94
78	9.05	98.45	39.80	39.20
81	8.05	58.21	37.88	22.05
85	8.35	49 89	34.91	17.42
100	9.25	75.50	37.01	27.95

The performance of all the progenies were poor when compared to that of their parents at Kuttiady, perhaps due to the difference in agro-climatic conditions of Nileshwar and Kuttiady. However, significant difference was observed between the progenies of different mother palms showing variations in the extent of prepotency in the mother palms. The progenies of the parent tree No.63 recorded the maximum nut yield during the year followed by the progenies of parent numbers 78, 14 and 54. The trial is being continued.

Studies on the second generation selves and sibmated progenies in coconut (Ag. 2.8 Breedr 10.01) [Pilicode]

Crosses between selfed lines of Tall varieties are reported to give hybrids with greater vigour comparable to T x D crosses. The present study was taken up to evolve inbred lines in coconut and to find out whether hybrid vigour was manifested within the crosses between the first generation selves.

Selfing was done in some of the West Coast Tall palms at the CPCRI Kasargode in 1924-26 and the selfed progenies were planted at the Coconut Research Station, Pilicode. During 1959–60, sibmating between these lines and selfing were done. The second generation selves and sibmates thus obtained belonging to six grand parents were planted at Pilicode in 1961. A split plot design in Compact family blocks was adopted for the experiment. The six grand parent family groups were the main plot treatments. Biometeric observations are being recorded regularly. The yield data for 1979 have been recorded.

Progeny row trial with T x D and T x G hybrids Ag. 2.10 Breed 10.03 [Balaramapuram]

The relative performance of T x D and T x G hybrids is being compared in this experiment at the Coconut Research Station, Balaramapuram to find out their adaptability in that locality. A compact family block design was adopted for the experiment with five seedlings of each hybrid in a block and with five replications. The experiment was planted in 1970.

The data recorded in 1979 are presented in Table 2. 8.

Table 2.8: Growth characters and yield of T x D and T x G hybrids

Name of hybrids	Mean No of leaves produced during the year	Mean No. of leaves on the crown	Progressive total of leaves produced	Setting Percentage	Mean nut yield in 1979
T x D	14.54	26.16	96.52	49.35	86.24
T x G	16.86	26.38	93.62	43.87	73.90

As in the case of previous year the mean nut yield of T x D during this year is also higher than T x G. There is also a steady increase in yield every year in both the hybrids. The mean yield increased from 69.8 nuts in 1978 to 86.24 nuts in 1979 in T x D and from 49.4 nuts to 73.90 nuts in T x G. The experiment is being continued.

Survey of gardens to select superior genotypes which are high yielding and resistant or tolerant to major pests and disease (KADP) [Vellanikkara, Kumarakom, Balaramapuram]

The existence of some healthy and high yielding palms in the midst of diseased palms in certain areas indicate the possible tolerance or resistance in such genotypes. A detailed survey in the main coconut growing areas in all districts of Kerala will enable to identify such palms. With this object in view, the present project has been taken under the Kerala Agricultural Development Project (KADP) at the College of Horticulture, Vellanikkara.

Preliminary action ro locate high yielding genotypes was initiated during the year. A detailed survey will be conducted next year and palms with desirable characters will be selected for further studies.

Evolving high yielding varieties which are tolerant/resistant to different pests and diseases (KADP) [Vellanikkara)

Evolution of varieties which are tolerant or resistant to pests and diseases is one of the methods of crop improvement. Coconut hybrids involving different parental combinations will be produced and tested under different agro-climatic conditions to study their resistance/tolerance to various pests and diseases. With this objective in view, the following 11 hybrid combinations produced at the

Coconut Research Station Pilicode were planted at the Instructional Farm Vellanikkara, Coconut Research Stations Kumarakom and Balaramapuram in July 1979.

Gangabondam x Philippines
Chowghat Dwarf Orange x Laccadive Ordinary
Chowghat Dwarf Green x San Ramon
Malayan Dwarf Yellow x Philippines
Gangabondam x Andaman Ordinary
Gangabondam x West Coast Tall
Chowghat Dwarf Green x Philippines
Gangabondam x Laccadive Ordinary
Chowghat Dwarf Orange x Philippines
Chowghat Dwarf Orange x Laccadive ordinary
Gangabondam x SanRamon

Planting was done in RBD with 5 replications and one seedling per replication. Initial growth measurements were recorded at the time of planting.

Fixing up selection criteria for hybrid coconut seedlings at nursery stage (KADP) [Vellanikkara]

Selection criteria have already been fixed for coconut varieties such as West Coast Tall. But no such criteria are available for hybrid seedlings This has resulted in wide variations in respect of age at first flowering, annual yield of nuts, size, copra content and bearing habits, The present investigation taken up under KADP at the Instructional Farm, Vellanikkara is intended to fix up strict norms for selection of hybrid seedlings in the nursery.

A total number of 389 T x D seedlings involving 73 parental combinations and 357 T x G seedlings involving 72 parental combinations were planted at the Vellanikkara campus in 1978 after recording complete details of seedling characters. Growth measurements of seedlings such as collar girth, height, number of leaves and number of split leaves were recorded in 1979 also. The gaps occurred during the year as a result of drying up of 23 WCT x CDO and 21 WCTxG were filled up during the year. The seedlings were coming up well.

Determination of prepotency of hybrid coconuts to produce high yielding progenies (KADP) [Vellanikkara]

T x D coconut hybrids are popular among the cultivators due to their precocious and prolific bearing habits. Naturally there will have a tendency on the part of the cultivators to collect open pollinated seednuts from these hybrids for further multiplication. It is presumed that the F_2 progenies will show segregation for parental characters of F_1 but no detailed confirmatory studies on this aspect have been made. The object of the present study is to find out the desirability or otherwise of using the open pollinated seednuts for further propagation.

The study was initiated at the College of Horticulture, Vellanikkara in 1979. Open pollinated seednuts from 30 TxD palms in six parental combinations grown at the Coconut Research Station, Nileshwar were collected and sown in the nursery. Detailed studies on the nut characters were made before sowing, After sowing, the number of days taken for germination of nuts were recorded. Growth measurements such as girth at collar, height and number of leaves produced were also recorded every month. The study is in progress.

Assesment of combining ability of dwarf coconuts (KADP) [Pilicode]

The influence of pollen parents on the performance of T x D palms have not been fully studied. One of the probable reasons for the poor performance of T x D hybrids reported by a large number of cultivators might be the poor combining ability of the dwarf male parents. The object of the present study is to select dwarf coconut palms having general and specific combining ability.

Sixteen West Coast Tall palms were selected at the Coconut Research Station, Pilicode and each bunch in each palm was pollinated with pollen collected from different dwarf palms namely, Chowghat Dwarf yellow, Gangabondam, Chowghat Dwarf green, Malayan Dwarf Orange, Andaman Dwarf, Laccadive Dwarf, Malayan Dwarf Yellow and Malayan Dwarf Green. Pollinalion was done from the month of December, 1978 to May 1979. Seednuts were collected from the month of December, 79 to March 1980 and the nuts collected were sown in the nursery at Vellanikkara. Nuts received from each combination were sown separately. Germinations have not been started till the end of the year under report.

NPK fertilizer trial starting from seedling stage Ag. 2.10 Agron1.05 [Balaramapuram]

The trial was started in red soil of Coconut Research Station, Balaramapuram in 1964. The three nutrients are tried at three levels each and there are 27 treatments combinations. The levels of nutrients are:

N—O, 340 g and 680g/plant/year

P—O, 225 g and 450 g/plant/year

K—O, 450 g and 900 g/plant/year

The plot size is four trees and spacing adopted is 7.5 x 7.5 m.

The lay out is 3^3 confounded design in 9 plot blocks replicated twice, confounding NPK^3 and NP^2K^2 in replication 1 and 11 respectively.

The nut yield obtained during 1979 are presented in Table 2.9.

Table 2. 9: NPK Fertilizer trial—Yield of nut/ha

		N_0	N_1	N_2	Mean
	K_0	408	133	530	355
P_0	K_1	844	4440	6377	3887
	K_2	1912	3307	6440	3886
Mean		1052	2627	4449	2709
	K_0	0	140	173	1047
P_1	K_1	3355	8840	10489	7561
	K_2	614	11973	12889	8491
Mean		1323	6984	7850	5386
	K_0	0	2960	0	986
P_2	K_1	22	2849	10084	4318
	K_2	2862	6488	12778	7377
Mean		961	4049	7621	4227
G. Mean		1112	4570	6640	4108

The effect of nitrogen was highly significant. Each higher level was significantly superior to the next lower level. The highest yield of 6640 nuts/ha was given by N_2 (680 g N) followed by N_1 (340 gN) with 4570 and N_0 with 1112 nuts/ha.

In the case of phosphorus significantly highest yield of 5386 nuts/ha was given by P_1 (225 g) followed by P_2 with 4227 nuts/ha and P_0 with 2709 nuts/ha. The highest dose of P_2 (450 g) had a depressive effect in the production of nuts. The same trend was noticed during the previous years also. Hence from the results so far obtained it can be concluded that it is not advisable to apply more than 225 g P_2O5/tree/year in the typical red loam soils.

In the case of potash, though K_2 (900 g) has given significantly highest yield of 6685 nuts/ha it was on par with K_1 (450 g) with 5256 nuts/ha. K_0 gave very poor yield of 452 nuts/ha

The interaction of N x K was highly significant at 5 and 1% level. The highest yield of 10702 nuts/ha was given by N_2K_1 but was on par with N_2K_2 with 8984 nuts/ha.

The interaction of P x K was significant at 5% level only. The highest yield of 8491 nuts/ha was given by P_1K_2 followed by P_1K_1 and P_2K_2 with 7561 and 7377 nuts/ ha and were on par with each other. However it may be noted that both K_1, K_2 levels have given a depressive yield when the dose of P_1 was increased to P_2 level. This is also true with the case of P x N, though not significant.

In respect of N x P x K interaction, the highest yield of 12889 nuts/ha was given by $N_2P_1K_2$ followed by $N_2P_2K_2$, $N_1P_1K_2$ and $N_1P_1K_1$ with 12778, 11973 and 10489 nuts/ha The economic yield was however given by $N_1P_1K_2$ (340 g N+225 g P+900 g K) as in the previous year.

NPK fertilizer trial in laterite soils on WCT variety of coconut (AICC & AIProject) [Pilicode]

The experiment aims at finding out the nutrient requirement of WCT variety of coconut in laterite soils from the seedlings stage itself. Planting of coconut seedlings was done at the Coconut Research Station, Pilicode in 1976. The lay out adopted is 3^3 factorial confounded design with 27 treatment combinations. N, P and K are tried at three levels each.

N–500 g, 1000 g and 1500 g/palm/year

P–250 g, 500 g and 750 g/palm/year

K–750 g, 1250 g and 1750 g/palm/year

Besides the above regular 27 treatment combinations, one plot each with $N_0P_0K_0$ (absolute control–no fertilizer) $N_1P_1K_1$ + Ca + Mg. and $N_3P_3K_3$ + Ca. + Mg are also included for observation purpose. There are 6 palms per plot.

Fertilizer application was first started 3 months after planting at the rate of 1/10 of the full dose. One year after planting, the plants received 1/3 dose, in the second year 2/3 dose and from third year onwards full dose in two split applications. Measurements on collar girth, height of plants and number of leaves are recorded twice a year.

Observations recorded during three years after planting in 1979 showed that the seedlings receiving 500 g N, 500 g P and 1250 g K had the maximum collar girth (9.46 cm) height (428 cm), number of functioning leaves (11.2) and the total leaves produced during the year (6.4). This is in conformity with the previous year's result. The trial is being continued.

Effect of NPK levels and frequency of application on the yield and bearing habits of T x D hybrids Ag. 2.8.1.1 [Nileshwar)

The experiment is intended to study whether the yield potential of T x D hybrids can be improved and whether the alternate bearing habit can be reduced by applying heavy doses of fertilizers in split doses.

The trial was started at the Coconut Research Station, Nileswar in 1976. The layout of experiment is RBD with two treatments, 10 replications and 6 plants/plot. The treatments are:

1. N–1000 g + P–640 g + K–2400 g per tree per year in two equal split doses
2. N–500 g + P–320 g + K–1200 g per tree per year in two equal split doses.

The results showed that as in the previous years, higher dose of fertilizers gave higher yields in palms belonging to high yield groups. Higher level of fertilizers was also found to be effective in increasing the yield of palms belonging to low yield groups over that of lower dose. It appears that in high yielding palms, high level of fertilizers tended to produce more number of female flowers. Increased yield of nuts with higher dose in high yielding groups of palms appears to be due to increased female flower production.

Nutrition through leaf axil in diseased and healthy palms Ag. 2.8–3.2
[Pilicode, Kumarakom]

This is a multilocational trial conducted at the Coconut Research Station, Pilicode (healthy area) and Coconut Research Station, Kumarakam (diseased area). The object is to assess the relative efficacy of soil versus leaf axil application of major nutrients on the performance and yield of adult palms in diseased and healthy areas.

The experiment was laid out in completely randomised design with these treatments.

T_1 — Applying 500 g N + 320 g P + 1200 g K per tree per year full in August – September.

T_2 — Applying the above dose of fertilizers through leaf axil

T_3 — Applying the above dose of nutrients half through soil and half through leaf axil.

Leaf axil application was done by splitting the dose into six equal parts. Leaf and soil samples were collected and analysed. The experiment was started in October, 1976.

Observations showed that application of fertilizers through leaf axils caused premature dropping and shedding of leaves as a result of scortching and decay of leaf bases. This is in conformity with the previous year's result. The same result was obtained at Kumarakam also. The project has been concluded.

Simple fertilizer trial in cultivators' field
Ag. 2.15, Agron. 3.01 [Multilocational]

Object of this multilocational trial was to fix an economic level of fertilizers for coconut under rainfed and irrigated conditions in different agro-climatic regions of Kerala so as to ensure a reasonable margin of profit by fertilization. Trials were laid out in the cultivator's fields in 6 centres i. e. Pilicode, Nileshwar, Kayamkulam Kumarakom, Balaramapuram and Vellanikkara.

The Treatments were:–

T_1 — Cultivator's practice

T_2 — Cultivator's practice + 340 g N + 170 g P + 680 g K per palm/year

T_3 — Cultivator's practice + 500 g N + 320 g P + 1200 g K per palm/year.

Eight plots were selected at 5 centres and 4 plots at one centre in Vellanikkara. Twenty trees were allotted to each treatment The experiment was started in 1976 in the first five centres and in 1978 in Vellanikkara. Before commencement of schedule of operations the pre-treatment data on the number of functioning leaves, number of bunches, number of female flowers and number of nuts were recorded. Post treatment data were also collected during the subsequent years.

At Pilicode centre where the soil is lateritic, the mean yield of nuts from eight plots during the years 1977, 78 and 79 are furnished in Table 2.10.

Table 2.10 Mean yield of nuts in the simple fertilizer trial at Pilicode

Treatments	Mean nut yield			Percentage increase over 1977 yield
	1977	1978	1979	
Treatment 1	6087	7467	7306	20.00
Treatment 2	8080	11925	9625	19.80
Treatment 3	5831	10710	10011	72.80

The yield increase was substantial in treatment 3 i. e., cultivators practice+ 500 g N+320 g P + 1200 g K per palm per year. While in Treatment 1 (cultivators' practice) and Treatment 2 (cultivators practice + 340 g N + 170 g P+680 g K) the increase over 1977 yield was only 20.00 and 19.80 per cent, the increase was 72.80 percent, in treatment 3. The experiment will be continued for two more years.

At Nileshwar centre where the soil is red sandy loam, the yield data showed that no additional benefits occurred by increasing the NPK level beyond 340 g, 170 g and 680 g in respect of growth and yield attributes. The higher level has actually inhibited growth and yield. The trial will be continued.

The mean yield obtained from the trial at Balaramapuram which represents red soil region are furnished in Table 2.11.

Table 2.11; Mean yield of nuts in the simple fertilizer trial at Balaramapuram

Treatments	Mean nut yield per plot		Percentage increase over 1977 yield
	1977	1979	
T_1	47.59	69.22	50.63
T_2	40.22	75.26	122.44
T_3	44.61	84.58	130.43

From the Table it is seen that there is significant yield increase in T_2 (cultivators practice + 340 g N+170 g P + 680 g K) and T_3 (cultivators practice + 500 g N + 340 g P + 1200 g K) over T_1 (cultivator's practice). However, the difference between T_2 and T_3 was not significant. The indications are that the production of coconut in the cultivator's fields can be increased considerably by proper and adequate manuring.

The results obtained from the Coconut Research Station, Kumarakom have shown a steady decline in yield even in palms receiving heavy dose of fertilizers. The yield data for 1976 and 1979 are furnished in Table 2.12.

Table 2.12: Yield obtained from simple fertilizer trial at Kumarakom

Treatments	Mean nut yield 1976	1979	Percentage decrease over 1976 yield
T_1	783.0	260.0	66.41
T_2	789.2	283.1	64.12
T_3	833.3	296.1	64.46

It may be of interest to note that there was a steady increase in the Root (wilt) disease intensity during the period of experiment and this might be one of the contributing factors in the decline in yield of palms. The trial will be continued.

Setting percentage in coconut as influenced by the nutrients [Vellayani]

The present study was carried out to ascertain the influence of nutrients on the setting percentage in coconut. The treatments were as follows:-

T_1 — Control + 500 g N + 320 g P + 1200 g K per palm with lime as per the recommended dose
T_2 — T_1 + additional dose of 800 g K/palm
T_3 — T_1 + Zinc sulphate 100 g/palm
T_4 — T_1 + common salt 100 g/palm
T_5 — T_1 + Magnesium sulphate 100 g/palm

Since the effects of the treatments take about three years to manifest, the results will be reported after obtaining data for one more year.

Spacing cum manurial trial on coconut Ag. 2.10 Agron. 9.01 [Baiaramapuram]

To study the interaction between spacing and manuring on the growth and productivity, a trial was laid out at the Coconut Research Station, Baiaramapuram in 1964.

The treatments consisted of combinations of 3 levels of fertilizers ($M_0M_1M_2$) and 3 spacings (S_0, S_1 and S_2), the combinations being as follows:-

S_0 M_0	S_1 M_0	S_2 M_0
S_0 M_1	S_1 M_1	S_2 M_1
S_0 M_2	S_1 M_2	S_2 M_2

S_0 — 5.00 x 5.00 m
S_1 — 7.50 x 6.50 m
S_2 — 10.00 x 10.00 m
M_0 — No fertilizer
M_1 — 34 g N + 225 g P + 450 g K/tree/year
M_2 — 680 g N + 450 g P + 900 g K/tree/year.

The mean yield per palm per hectare obtained during 1979 are furnished n Table 2.13 and Table 2.14.

Table 2.13: Yield of nuts per palm/year

Fertilizer	Spacing			Mean
	S_0	S_1	S_2	
M_0	0.80	4.79	0.80	2.13
M_1	19.19	57.46	75.83	50.82
M_2	31.07	80.14	95.66	68.89
Mean	17.02	47.46	57.93	40.62

Table 2.14: Yield of nuts per ha/year

Fertilizer	Spacing			Mean
	S_0	S_1	S_2	
M_0	321	852	80	418
M_1	7679	10,228	7583	8497
M_2	12,431	14,226	9567	12088
Mean	6810	8449	5743	7000

There was perceptible influence of spacings and manuring on the yield of palms. Irrespective of spacing the palms receiving no manures continued to be very poor in yield,. Also the per palm yield from palms receiving low and high levels of fertilizers (M_1 and M_2) and closer spacing (S_0) were quite low.

The per palm yield was maximum in palms spaced at 10 x 10m and which received high dose of fertilizers (M_2) followed by M_2S_1 and M_1S_2. However, the yield per ha was maximum in M_2S_1 followed by M_2S_0. The treatment M_1S_1 (7.5 x 7.5m spacing and 340 g N + 225 g P + 450g K/tree/year) gave the economic yield with the maximum net return. This is in conformity with previous year's result, The experiment is being continued.

Response of D x T hybrids to common salt application [Piiicode]

The trial was started at the Coconut Research Station, Pilicode in 1976 on young D x T seedlings with the following 6 treatments in an RBD layout.

Treatment No.	NaCl	K_2O in g/palm/year
T_1	0	0
T_2	0	1000
T_3	250	750
T_4	500	500
T_5	750	250
T_6	1000	0

All the palms received a common dose of 500 g N, 320 g P_2O_5, 170 g MgO and 300 g CaO per palm per year in addition to the above treatment. The young palms were given 1/10th of the full dose 3 months after planting and 1/3

and 2/3 doses in the first and the second years respectively. The seedling characters such as girth at collar, height, number of leaves etc. were recorded.

The mean values of measurable vegetative characters recorded during 1979 are furnished in Table 2.15.

Table 2.15: Response of D x T hybrids to common salt application

Treatment	Girth (mm)	Height (cm)	No. of functioning leaves on the crown	No. of leaves produced in 1979	Total no. of leaves produced so far
T_1	66.6	359.6	7.5	5.9	26.9
T_2	67.5	410.2	10.3	6.2	27.3
T_3	90.8	423.8	10.9	6.5	28.5
T_4	90.4	420.3	10.8	6.4	28.8
T_5	84.2	387.3	10.7	6.5	28.8
T_6	85.2	402.6	9.8	6.3	28.3

T_3 (250g NaCl + 750g K_2O) showed the maximum girth, height, number of functioning leaves on the crown, aud this treatment produced the maximum number of leaves during the year. This is in conformity with the previous year's result. The treatment T_1 in which no sodium or potassium was applied had continued to show very poor growth. The trial is being continued

Common salt as a substitute for potash in the nutrition of adult coconut palm [Pilicode]

The trial on adult palms was laid out in 1979 in RBD with 6 treatments 4 replications and 6 palms per plot. The treatments are as follows:-

Treatment No.	NaCl	K_2O in g/palm/year
T_1	0	0
T_2	0	1000
T_3	250	750
T_4	500	500
T_5	750	250
T_6	1000	0

In addition to the above, the palms received 500 g N, 320 g P_2O_5, 170 g MgO and 300 g CaO per tree per annum as common dose. The pre-treatment yield for 6 years (1971-76) and the post treatment yield (1979) are furnished in Table 2.16.

Table 2.16: Mean values of pre-treatment and post-treatment yields in coconut

Treatments		Female flower production	Nut yield	Setting percentage
T_1	Pre	265.9	63.7	21.1
	Post	261.1	77.8	28.8
T_2	Pre	208.9	65.1	21.5
	Post	229.7	71.0	30.9
T_3	Pre	223.6	52.8	22.9
	Post	246.0	74.0	29.4
T_4	Pre	221.5	54.0	25.0
	Post	240.2	76.3	31.7
T_5	Pre	173.7	41.9	25.5
	Post	188.5	54.5	28.0
T_6	Pre	243.2	62.2	25.0
	Post	286.5	103.0	35.9

The post-treatment production was higher during the year as compared to the pre-treatment yields in all the treatments including the treatment in which neither sodium nor potash was applied. It was also of interest to observe that maximum increase in yield was registered in the treatment where 1000 g NaCl + O g K_2O was applied The experiment is being continued.

Nutritional studies in coconut-I. Effect of micro-nutrients on yield growth and disease resistance in coconut (KADP) [Vellanikkara]

The object of the trial was to find out the effect of various micronutrients, namely, zinc, magnesium, boron and molybdenum on the growth, yield and pest and disease resistance in coconut. Four year old Laccadive Ordinary palms planted at the Instructional Farm, Vellanikkara were selected for the study. Pre-treatment growth measurements were recorded. Micronutrients as per schedule are to be applied during June, 1980.

Nutritional studies in Coconut-II

Simple fertilizer trials in cultivators' fields under different soil types, in irrigated and rainfed conditions (KADP) [Multilocational]

With the objective of fixing up an economical level of fertilizers required for coconut under rainfed and irrigated conditions in different soil types in Kerala, trials were laid out in two plots, in cultivators fields in the Calicut distict, the treatments being as follows:

1 Cultivators' practice (60kg organic manure + 25kg dolomite)
2 0.34kg N+0.17kg P+0.68kg K
3 0.50kg N+0.32kg P+1.20kg K
4 1.00kg N+0.50kg P+2.00kg K

The trial will be laid out in Cannanore, Kozhikode, Malappuram and Trivandrum districts also.

A uniform dose of 2kg dolomite and 50kg green leaves or compost were given to the treatments 2, 3 and 4. Flowering, nut yield and disease and pest infestation levels are being recorded. The leaf and soil analysis were to be conducted once in a year. In the case of irrigated plots, fertilizers will be applied in four split doses.

Intercropping coconut garden with different varieties of banana [Pilicode, Nileswar]

In order to identify the most suitable banana variety for growing as intercrop in coconut gardens under unirrigated conditions, studies were taken up at Pilicode (laterite soil) using the banana varieties Robusta, Nendran, Njalipoovan, Dwarf Cavendish and Palayankodan. The experiment was planted in October, 1979 in RBD with 4 replications. The crop was not harvested till the end of the year under report. During the previous year, Robusta recorded maximum bunch weight followed by Palayankodan. The experiment was conducted at Nileswar also using the same varieties.

Effect of leaf cutting on the productivity of coconut palm– Ag. 2. 8. Agron. 6.01 [Pilicode]

The experiment was started in 1977 with the object of studying the effect of cutting leaves on the productivity of the palm and to find out the economic feasibility of leaf removal. There were 6 treatments as follows:

T_1 Control (No leaf cutting)
T_2 Cutting one leaf in alternate months (January to May)
T_3 Cutting one leaf in alternate months (January, March and May).
T_4 Cutting two leaves every month (January to May)
T_5 Cutting two leaves in alternate months (January, March and May).
T_6 Cutting three leaves in alternate months (January, March and May).

The mean pre-treatment nut yield for 4 years (1973-76) and the post-treatment pield during 1977-79 are furnished in the Table 2.17.

Table 2.17: Effect of leaf cutting—Mean pre-treatment yields of palms

Treatment	Pre-treatment yield	Post—treatment yield		
		1977	1978	1979
T_1	54.00	57.00	58.15	36.80
T_2	53.60	60.90	62.90	42.80
T_3	52.43	55.60	62.80	38.80
T_4	58.50	66.00	50.40	40.24
T_5	54.10	62.50	62.05	42.15
T_6	57.30	60.30	65.00	38.47

During 1979, there was a general decrease in yield of nuts in all treatments including the control where no leaf was cut. The trial is being continued.

Influence of tapping on the yield of uneconomic palms under irrigated and rainfed conditions Ag. 2. 8. Agron. 7.01 [Nileshwar]

Preliminary trials had indicated that tapping the uneconomic palms for 2 or 3 seasons increases the nut yield. The present study was taken up to confirm

this finding and also to find out whether by providing irrigation, the toddy yield could be increased. Tapping was done on trees of the following yield groups belonging to both irrigated and unirrigated groups:

Poor yielders (irrigated)–	Less than 30 nuts/annum
Poor yielders (unirrigated)–	,,
Medium yielders (irrigated)–	31 to 60 nuts/annum
Medium yielders (unirrigated)–	,,
High yielders (irrigated)–	Above 60 nuts/annum
High yielders (unirrigated)–	,,

The experiment was started at the Coconut Research Station, Nileshwar in 1977. Tapping was done in 1977 and 1978 and the trees were then left to study their yield performance. During 1979, nuts were not obtained from the tapped trees. Yield during the subsequent years will be observed.

Studies on the possibility of multiple cropping in unirrigated coconut gardens using moisture modulation technique Ag. 1.1. Agron. 12.01 [Pilicode]

The object of the experiment was to explore the possibility of increasing the intensity of intercropping in coconut gardens by regulating moisture in the root zone and to find out the most economic cropping pattern. Successful raising of annual intercrops in unirrigated coconut gardens is practically impossible either due to excessive moisture during monsoons or due to acute drought during summer.

The land between coconut rows were laid out into trenches of 4x4x0.35m. and beds. In the trenches rice was planted during the first and second crop sesons. In the beds, crops with less water requirement such as ginger, turmeric, sesamum, tapioca, groundnut and sweet potato were raised. The experiment was started in 1977 and continued in 1979.

The results during the year showed that the system can be successfully adopted. During the first crop season, rice grown in trenches yielded on an average 1850 kg rice and 3570 kg straw. In the second crop season, rice crop in trench yielded 650 kg grain/ha and 1150 kg straw. Groundnut also grew well in trenches, but these failed to form pods. During the first crop season, the annual crops, green gram, sesamum and sweet potato grown on beds performed well, the mean yields being 845 kg green gram, 275 kg sesamum and 3280 kg of sweet potato respectively. Among the annual crops, tapioca was found to be the ideal crop, yielding tubers at 7500 kg/ha

Residue management studies showed that adopting this technique over a period of 2 years and 4 crop seasons, organic carbon content had increased in the soil.

The experiment was discontinued.

Trial of mixed cropping with tree spices Ag. 2.9 Agron.11.01 [Kumarakom]

The performance of tree spices as intercrops in coconut garden in reclaimed soils of Kuttanad is being studied under this trial. Cocoa, cinnamon, nutmeg, and clove were planted in RBD with five replications in 1978. Growth characters of the plants were recorded. The trial will be continued.

Trial cultivation of banana as an intercrop in coconut garden Ag. 2.9. Agron. 10.03 [Kumarakom]

The trial was intended to find out the most suitable banana variety for growing as intercrop in coconut gardens of the Kuttanad area. Nine varieties were tested and these were Palayankodan, Padatty, Kannan, Poovan, Monthan, Nendran, Zanzibar, Robusta and Gros michael. Planting was done in 1978 in RBD with 4 replications Four suckers were planted per plot in between two adult coconut palms in single row bunds alternated by channels.

Growth measurements were being recorded. Harvest was not completed till the end of the year under report.

Trial to find out the variety of fodder suitable for cultivation as intercrop in coconut garden Ag.2.9. Agron.10.04 [Kumarakom].

Seven fodder varieties, namely, hybrid napier, guinea grass, para grass, Setaria, cowpea. *Stylosanthus* and *Desmodium* were tried to identify the most promising variety for raising as intercrop in coconut gardens in the reclaimed soils of Kuttanad.

The experiment was planted in RBD with 4 replications in plot size of 4 x 3 m. Planting was done in single row bunds. The results showed that the growth and performance of crops like *Stylosanthus* and *Desmodium* were very poor under the conditions prevailing in the area. The general performance of hybrid napier was observed to be the best followed by Setaria, para and guinea grass. The trial is being continued.

Studies on the suitability of annual crops as intercrop in coconut gardens Ag.2.9. Agron.10 05 [Kumarakom]

The object of the trial was to study the suitability of different annual crops as intercrops in coconut gardens in Kuttanad area.

The crops tried were pineapple, banana, elephant foot yam, colocasia, ginger, turmeric and tapioca. Planting was done in 1978 in RBD with 4 replications, the plot size being 4 x 3 m in between two coconut palms grown in single row bunds.

Among the annual crops, elephant foot yam was found to give maximum yield followed by turmeric. Performance of ginger and colocasia were very poor.

The trial was laid out once again in 1979. Banana and pineapple were replaced by redgram and cowpea. The crop was not harvested.

Intercropping trial with various annual crops (Pilicode)

Intercropping trial with tapioca, elephant foot yam, colocasia, ginger, turmeric and sweet potato was conducted for the third year in succession. The trial was planted in RBD with 4 replications, the plot size being 60 m. The yield data and economics of cultivation are furnished in Table 2.18.

Table 2.18: Yield data of crops in the intercropping trial (annual crops)

Intercrops	Mean yield per ha (kg)	Expenditure per ha (Rs)	Gross income per ha (Rs)	Profit/loss per ha (Rs)
Eelphant foot yam	18,410	2860.00	11046.00	+8186.00
Turmeric	12,803	6200.00	10962.00	+4762.00
Ginger	5,339	6750.00	10678.00	+3928.00
Tapioca	19,464	2475.00	4866.00	+2391.00
Sweet potato	1,830	3000.00	457.50	—2542.47
Colocasia	No yield	The crop failed		

Elephant foot yam gave the maximum profit of Rs.8186.00 per ha followed by turmeric, ginger and tapioca. Sweet potato incurred loss and colocasia was a failure. During the previous year, turmeric gave maximum profit followed by tapioca, elephant foot yam and ginger.

Trials on intercropping of pepper varieties in coconut gardens and to fix up the most suitable shade tolerant variety. Ag. 2.8. Agron 10.01 [Pilicode)

The object of the study was to identify the most suitable pepper variety for inclusion in the multistoreyed cropping programme in coconut gardens and to evolve suitable mixed cropping patterns involving coconut, pepper, cocoa and pineapple so as to ensure the highest net return per unit area of land.

The trial was started in 1976 with 6 varieties of pepper, namely, Panniyur–1, Karimunda, Balankotta, Kalluvaily, Kottanadan and Narayakodi. The layout was RBD with 4 replications of 6 trees per plot. The details of flowering and yield obtained in 1979 from the pepper vines are furnished in Table 2.19.

Table 2.19: Performance of peper varieties planted in coconut gardens

Pepper varieties	No. of palms on which vines were trailed	No of vines flowered	Total yield (kg)	
			Wet wt.	Dry wt.
Panniyur–1	24	11	11.555	4.690
Karimunda	24	16	9.560	3.534
Balankotta	24	8	3.030	1.020
Kalluvally	24	2	0.095	0.035
Kottanadan	24	1	0.055	0.200
Narayakodi	24	4	0.480	0.170

The maximum yield was obtained from Panniyur–1, followed by Karimunda Panniyur-1 and Karimunda performed better than the other varieties.

Effect of raising cocoa as an intercrop in adult coconut plantations (AICC&AIP) [Pilicode]

The objects of the experiment were to find out the effect of raising cocoa as an intercrop on the yield and bearing habit of coconut and to study the performance of cocoa under different planting systems.

Planting was done in RBD with 8 replications and three treatments which were, T_1-single row of cocoa in between two coconut rows; T_2-double row of cocoa in between two coconut rows and T_3-control with no cocoa.

Planting was done in 1970 in a 50 year old coconut plantation, spaced at 9m between palms.

The pre-treatment yield of coconuts and the yield of cocoa and coconut during 1979 are furnished in Table 2.20.

Table 2.20: Pre-treafment and post-treatment yields in coconut gardens intercropped with cocoa.

	T_1	T_2	T_3
Pre-treatment yield of coconut trees (Mean yield of nuts for 6 years	57.6	59.8	59.5
Mean annual yield of cocoa kg/ha for the last 4 years	452.0	1000.0	—
Mean post-treatment yield of coconut trees for 3 years	73.5	66.9	70.3

Reduction in the yield of coconut palms grown in plots planted with cocoa in double rows was noticed. The trial is being continued.

Effect of application of sodium chloride on the leaf axils of coconut palms on the control of the Rhinoceros beetle Ag. 2.8. Ent. 2 (i)- [Pilicode]

The object of the present study was to find out the effect of application of sodium chloride in the leaf axils of coconut palms in controlling the pest.

Sodium chloride at the rate of 500 g and 1000g was applied in the axils of the innermost 3-4 whorls of the coconut palm (West Coast Tall) of uniform age in December-January.

As in the previous years, there was no significant reduction in pest infestation as a result of sodium chloride application. The trial has been discontinued.

Rodent control in coconut garden Ag. 2.8. Ent. 5 [Pilicode]

Object of study was to find out the effectiveness of various baits in controlling the rat menace in coconut gardens.

From preliminary studies, it was found that warfarin cake, warfarin mixed with wheat flour (1:19) in 1% groundnut oil, warfarin mixed with rice grain flour

(1:19) in 1% groundnut oil and warfarin mixed with *maida* flour (1:19) were acceptable to rats.

This trial was concluded.

Chemical control of cockchafer grubs. Ag. 2.8. Ent. 3. [Pilicode]

The larvae of cockchafer beetle *Leucopholis coneophora* cause damage to coconut palms by feeding on the root system. They live inside the soil and usually occur in the sandy or sandy-loam soil tracts of Kerala State. The present study was taken up to evaluate the relative efficiency of the following insecticides:

Chlordane	10%	G 60 kg/ha (one application)
Chlordane	10%	G 30 kg/ha (two applications)
Phorate	10%	G 1.0 ai/ kg/ha (one application)
Phorate	5%	G 0.5 ai/ kg/ha (two applications)
Phorate	3%	G 0.5 ai/ k/g/ha (one application)
Chlordane	20%	EC 0 5 ml ai/palm (in 20 l of water)
Chlordane	20%	EC 0.5 ml ai/palm (in 10 l of water)

The experiment was started in 1978. Duting the year application of Chlordane 10% G 60 kg/ha was found to be more effective in controlling the cockchafer beetles. This project was concluded during the year.

Coreid bugs attacking coconut palms in the southern parts of Kerala-Identification, biology and control measures-Ag.1.10 Ent.4.01- [Balaramapuram]

The trial was started in 1976 in order to identify the bugs attacking coconut palm and to work out their bio-ecology and to study the nature of damage, host range and control measures.

All stages of the pest were collected from guava and these were successfully reared in the laboratory. The insect was identified as *Paradasynus rostratus* (Coreidae). The biology of the pest was worked out in detail. Under confinement in cages, the insects did not cause any marked damage to coconuts. The egg parasites of the bug were collected.

The pest was effectively controlled by spraying 0.025% Quinalphos on guava, the main alternate host of the pest in the locality.

Studies on varietal resistance/tolerance to Root (wilt) disease in Coconut (Ag.2.9 Path.4.01: Ag.2.0 Path 4-02: Ag 2.9 Path 4.03: Ag.2.9 Path 8 02; Ag.2.9. Path 8.03; Ag.2,9. Path 8 05; and Ag.2.2. Path 4.05, Project No. 34 at Vyttila and Ag.2.5 Path 8.01)

Nine series of experiments were started to test the varietal resistance/ tolerance to Root (wilt) disease in different varieties and hybrids of coconut. The varieties and hybrids tested and the status of the projects were as follows:

Ag. 2.9 Path 4.01 [Kumarakom]

Strait settlement (Green)	Andaman Giant
Malayam Dwarf	Andaman Ordinary
Java	D x T
Cochin China	West Coast Tall

This was started in 1972. All varieties were found affected by the Root (Wilt) and leaf rot at varying intensity levels. Maximum infection was found in the Jaya variety.

Ag. 2 9 Path 4.0.2 [Kumarakom]

Fiji x Gangabondam	Laccadive Micro x San Ramon
Fiji x Yellow Dwarf	San Ramon x Laccadive Micro
West Coast Tall x Gangabondam	Andaman Dwarf x West Coast Tall
Gangabondam x West Coast Tall	Andaman Dwarf x Yellow Dwarf
West Coast Tall x Green Dwarf	Yellow Dwarf x West Coast Tall
Green Dwarf x West Coast Tall	Laccadive Ordinary x Gangabondam x Niyurgading
West Coast Tall x Niyurgading	Laccadive Ordinary x Gangabondam x Yellow Dwarf
Niyurgading x West Coast Tall	Laccadive Ordinary x Gangabondam x Spicata

Planting was done in 1974 and all hybrids were found infected by the Root (Wilt), the lowest intensity being observed in Fiji x Gangabondam. The highest intensity was in Niyurgading x West Coast Tall.

Ag. 2.9 Path 4.3 [Kumarakom]

West Coast Tall x Dwarf
West Coast Tall x Gangabondam
West Coast Tall x Yellow Dwarf
West Coast Tall x Niyurgading
West Coast Tall x Strait Settlement
West Coast Tall x Laccadive Dwarf
West Coast Tall x Andaman Dwarf
Weat Coast Tall x West Coast Tall
Laccadive Ordinary x Laccadive Ordinary
New Guinea x New Guinea
Andaman Ordinary x Andaman Ordinary
Laccadive Small x Laccadive Small
Java x Java
Philippines x Philippines
Strait Settlement x Strait Settlement
Andaman Giant x Andaman Giant
Fiji x Fiji
Bengal x Bengal
Bengal x Gangabondam
Bengal x Laccadive Dwarf
Green Dwarf x Strait Settlement
Green Dwarf x Thembili
Laccadive Dwarf (NCD)
West Coast Tall

The Project was commenced in 1971. All palms were found infected by the Root (wilt) disease, the highest intensity being in Laccadive small x Laccadive small and the lowest in West Coast Tall x Strait Settlement.

Ag. 2.9 Path 8.02 [Kumarakom]

West Coast Tall x West Coast Tall
West Coast Tall x Gangabondam
West Coast Tall x Green Dwarf
West Coast Tall x Yellow Dwarf
Laccadive Ordinary x Laccadive Ordinary
West Coast Tall x Dwarf

All these hybrids which were planted in 1975 were infested by the disease.

Ag. 2.9 Path 8.03 [Kumarakom]

West Coast Tall x Laccadive Dwarf
Andaman Ordinary x Laccadive Dwarf
Laccadive Ordinary x Laccadive Dwarf
Philippines x Laccadive Dwarf
Java x Laccadive Dwarf
New Guinea x Laccadive Dwarf
Laccadive Dwarf x West Coast Tall
Laccadive Ordinary x Gangabondam x Laccadive Dwarf

Planted in 1974, these hybrids showed Root (wilt) infection during the year.

Ag. 2.9 Path 8.05 [Kumarakom]

Laccadive Ordinary	New Guinea
Cochin China	Philippines
Andaman Ordinary	West Coast Tall

Each of these was crossed with Niyurgading, Gangabondam, Laccadive Ordinary, Green Dwarf, Andaman ordinary and Yellow Dwarf and there were 36 hybrid combinations. The project was started in 1974. All the family groups ware found to be affected by the disease.

Ag 2.9. Path 8.05 [Kumarakom]

San Ramon	Jaya
St. Vincent	Fiji
Jamaica	Chowghat Dwarf Green x KDG
British Solomon Island	,, ,, Orange x KDG
Kenya	,, ,, ,, x Gangabondam
Guam	KDG x Gangabondam
SS Green	West Coast Tall
FMS	

At Kumarakom, these palms were infected by Root (Wilt) and leaf rot disease by the third year of planting.

Project No. 34 (Vyttila)

Tali x Dwarf
Dwarf x Tall
Laccadive Ordinary x Gangabondam
Tall x NCD
West Cost Tall
Laccadive Ordinary
Andaman Ordinary
Andaman Ordinary
Cochin China x Andaman Giant

At Vyttila all these hybrid palms were infected by the disease,

Ag 2.5 Path *8.01* [Moncompu]

Tall x Dwarf
Tall x Gangabondam
Tall x Laccadive Dwarf
Tall x Strait Settlement
Yellow Dwarf x Laccadive Ordinary
Tall x Niyurgading
Cochin China x Gangabondam
Tall x Thembili
West Coast Tall

All hybrids were found to be infected by the disease in varying intensities. West Coast Tall x Laccadive Dwarf and West Coast Tall x Yellow Dwarf showed the minimum incidence.

A general review of the data collected on the disease tolerance/resistance of various varieties and hybrids of coconut show that none of them was resistant/tolerant to Root (wilt) disease. Variations in the number of years taken for the appearance of the disease and in the intensity of disease were noticed.

Integrated control of root (wilt) disease from seedling stage

Ag. 2.9 Path 4.06 [Kumarakom]

The experiment was started in 1976 the Coconut Research Station, Kumarakom. The object was to test whether the Root (wilt) disease could be controlled by giving protection from the seedling stage and later by adopting integrated management practices. There were 11 treatments replicated 3 times.

The design of the experiment was RBD. The treatments were T_1—Control T_2—NPK + Ca+Mg + Zn (Zinc as foliar spray); T_3—NPK + Ca + Mg; T_4—T_3 + Dasanit (Fensulfothion); T_5—T_2 + Dasanit; T_6—T_2 + Agrimycin; T_7—T_3 + Agrimycin; T_8—T_2 + Benlate (Benomyl); T_9—T_3 + Benlate; T_{10}—T_2 + Dasanit + Agrimycin + Benlate and T_{11}—T_3 + Dasanit + Agrimycin + Benlate.

Before planting, the pits were burnt with trash and the seedlings were dipped in Nemagon solution (0.1%).

Observations recorded on the intensity of Root (wilt) disease, showed that the palms in all treatments were affected by Root (wilt) disease, 4 years after planting. The intensity varied from 10.2 in T_{11} to 26.1 in T_1.

Integrated control of Root (wilt) disease on young palms Ag. 2.9 Path 4.04 (Kumarakom)

The trial was started in 1975 to study the efficiency of an integrated approach against Root (wilt) disease. The lay out was RBD with 11 treatments which were replicated thrice. The treatments were T_1–control; T_2–NPK+Ca+Mg+Zn (Zn as foliar spray); T_3–NPK+Ca+Mg; T_4–T_2+Dasanit: T_5–T_3+Dasanit; T_6–T_2+Agrimycin; T_7–T_3+Agrimycin; T_8–T_2+Benlate; T_9–T_3+Benlate; T_{10}–T_2+Dasanit+Agrimycin+Benlate and T_{11}–T_3+Dasanit+Agrimycin+Benlate.

Calcium was given in the form of 12 kg lime/palm/year while Mg was given at 3 kg/palm/year. Zinc was applied as 0.2% solution as foliar spray. Dasanit was applied at 200g per plant in the soil while Agrimycin and Benlate were sprayed at 0.1% and 0.2% respectively.

The data recorded during 1979 did not show any appreciable reduction in the intensity of Root (wilt) disease due to various treatments. This is in conformity with the previous year's result.

Studies on stem bleeding disease of coconut Ag.2.8 Path 3.01 (Piiicode)

The object of the present study was to understand the etiology of the disease and to work out effective measures of control. The technical programme envisaged studies on the age of palm and its relation to disease incidence, bearing capacity in relation to disease occurrence, root system of healthy and diseased palms, and the pattern of discolouration and necrosis of the petioles. Pathogenecity and seasonal influence on the incidence of the disease were also being studied. The study was started in 1977.

Investigation and identification of the causal organisms responsible for immature button shedding in coconut–Ag.2 8 Path 2 (i) (Piiicode)

The project was discontinued.

Role of bacteria in causing bud rot disease of coconut Ag.2 8 Path 2 (i) and Ag.2.9 Path 2 (iii) (Kumarakom, Piiicode)

This project was discontinued.

Relationship between night temperature and the incidence of budrot of coconut Ag. 2.9 Path 2 (ii) (Kumarakom)

The object of the project was to study whether there was any relationship between the fluctuations in the night temperatures and the incidence of bud rot in coconut and to enable forecasting of the disease. The project was commenced in 1977. One hundred coconut palms of age group 5–20 years were selected and the incidence of bud rot disease was recorded at fortnightly intervals. The minimum diurnal and noctural temperatures were recorded along with the relative humidity variations.

The disease incidence was noticed in the months of July, August and February.

OO

3. Spices, Cocoa and other Beverage crops

HIGHLIGHTS

PEPPER

Evaluation of the germplasm indicated the superiority of Cheriyakaniyakadan, Kumbhakodi, Kuthiravally and Kalluvally PTB and the accession No.84. In the varietal trials, Panniyur-1 continued to exhibit superiority over the others. Under the partially shaded conditions of coconut gardens, Karimunda performed the best. Digging the whole garden twice an year (in July and in September-October) was found to be superior to the other cultural treatments. Pepper in plots intercropped with turmeric yielded better. Banana was found to be unsuitable as an intercrop for pepper. Dead standards continued to show superiority over the live ones. Plants receiving 150 g potash per year recorded a low percentage of spike shedding. NAA at 100 ppm and 2, 4-D at 200 ppm gave maximum weight of spikes and berries. Dipping the cuttings in IBA 1000 ppm solution for 45 seconds improved rooting. Middle one-third portion of the runner shoots was found to be the best planting material. Spraying Bordeaux mixture once in July and again in August-September was quite effective in controlling the fungal pollu. One pre-monsoon painting of stem with 10% Bordeaux paste and two or three foliar sprays of 1% Bordeaux mixture were effective against the Quick wilt disease.

CARDAMOM

Cardamom types 7, 107 and 17 were found to be the best performers. Seeds harvested in September gave better germination. Among the seed treatments, gibberellic acid, scarification + hot water treatment and cowdung slurry gave higher germination. The capsule

form was found to be ideal for storage, the best container being polythene lined gunny bag. Fruit set was found to be maximum in plots colonised by honey bees (4 hives/ha). Fumigation of soil with methyl bromide reduced the population of parasitic nematodes in the primary nursery. Ekalux 0.1 % (Quinalphos 0.025%) gave effective control against shoot fly. Soil application of Disyston @ 0.6 g ai/plant was effective in reducing cardamom thrips population. Endosulfan reduced the infestation of capsules by the shoot and and capsule borer. Continuous eradication of the 'Katte' affected plants reduced the percentage of infection. Spraying and/or drenching the soil with 1% Bordeaux mixture reduced the capsule and panicle infection in 'Azhukal' disease.

CLOVE

Clove seeds collected and sown during the month of May gave better vigour and rate of growth of seedlings. Coconut husk pots filled with one part sand, one part cowdung and two tea spoons each of bone-meal and powdered groundnut cake was found to be ideal for raising clove seedlings, Transferring the seedlings from the primary nursery to coconut husk pots at fhe second month and transplanting them to the main field with the container intact at the ninth month gave higher rate of survival. Foliar application of GA 230 ppm + 0.5% urea enhanced the rate of growth of the seedlings.

GINGER

Nadia, Bajpai and Maran were found suitable for obtaining high yield of dry ginger, oleoresin and oil. Rio-de-janeiro was suitable for the second crop of ginger (irrigated) A pre-planting soil drench followed by a minimum of two post-emergence applications (one and three months after planting) of either cheshunt compound or Agallol controlled the Soft rot disease. Cuman and Bordeaux mixture were effeective in controlling the *Phyllosticta* leaf spot.

TURMERIC

Whole rhizomes were the best planting material for realising maximum yield of green turmeric. In the germplasm evaluation condu-

cted at Ambalavayal, T. Sunder, Kuchipudi, Sugandam and Ettamukkala proved superior. Under the partially shaded conditions of coconut gardens, Kasthuri Tanaka, Mannuthy local and Kuchipudi performed well. In another varietal trial, Mannuthy local, with a per hectare yield of 560.6 kg curcumin and 1470.3 kg oleoresin, was found to be superior to the others. A multilocational trial with four promising types conducted in seven locations indicated the superiority of Mannuthy local and Kuchipudi.

BETEL VINE

Xanthomonas betlicola was identified as the causal agent of the bacterial leaf spot of betel vine. "Karilanchikarpuram" and "Thulasivettila" cultivars exhibited some tolerance to the leaf spot.

COCOA

Cocoa pods weighing more than 350 g collected during February and March gave better seedlings. Forkert budding on 8 to 9 month old seedlings and green budding on 3 to 4 month old seedlings were successful. Among the 26 species of insects infesting cocoa, the mealy bug was the most common and destructive. Fenthion, Monocrotophos, Quinalphos and Dimethoate (all at 0.05% concentration) effectively controlled the mealy bugs. Mini box and mini basket methods were found suitable for fermenting small quantities of cocoa beans.

SUMMARY

PEPPER:

Research on pepper was mainly carried out at the Pepper Research Station, Panniyur and in the Pepper Research Scheme functioning in the Main Campus, Vellanikkara. Forty three research projects were implemented during the year.

The performance evaluation of the 105 cultivars and wild types maintained by the Pepper Research Station, Panniyur indicated the superiority of Cheriyakaniyakadan, Kumbhakodi, Kuthiravaly and Kalluvally PTB. The collection number 84 in the germplasm maintained by the Pepper Research Scheme at Vellanikkara exhibited good morphological characters and yield potential. Fifteen cultures isolated from among the hybrid and open pollinated seedlings were put under preliminary yield trial during the year. Further work on hybridization and crop improvement continued.

The hybrid/open pollinated materials developed at the Pepper Research Station, Panniyur were evaluated for yield, disease and pest resistance, and quality characters. Two varietal trials were in progress one at Panniyur and the other at Vellanikkara wherein Panniyur-1 variety was compared with locally popular varieties. At the Panniyur Station, Panniyur–1 gave better yield compared to the others. Kuthiravally gave indications as a better performer than Arakkulam Munda. In the varietal trial at Vellanikkara Narayakody produced the maximum yield/vine, followed by Panniyur-1 and Kottanadan. In a comparative trial of six pepper varieties under partially shaded conditions of coconut gardens, Karimunda ranked first in the number of plants flowered, total spike production as well as in the yield of pepper.

Description of vegetative, sexual and yield characters of 11 varieties was completed at Panniyur. Functional differentiation of the shoot system of pepper vine was studied and the details published.

Work aimed at finding out suitable management practices to rejuvenate the slow wilt affected pepper plants was in progress. The results of a mulching trial indicated that mulched plants gave better yields than the others. Mulching with polythene sheet seemed to be better. The data from a cultural trial indicated that digging the garden twice an year (in July and in September–October) was superior to the other treatments with respect to the yield of green berries. Studies on intercropping in pepper gardens indicated that the yield of pepper was more in the plots intercropped with turmeric than in the other plots. Banana was found unsuitable as an intercrop in pepper gardens. Experiments aimed at standardisation of the pruning techniques in pepper were initiated. In the fertilizer-cum-standard trial, the dead standards were found to be superior to the live ones with reference to the height of plants, number of spikes, length of spikes and weight of spikes. However, the live standards seemed superior with respect ro the yield of green pepper. Split application of fertilizers was found to be better than single application.

The fertilizer trials conducted at Panniyur indicated that application of nitrogen significantly increased the number of spikes and green yield of pepper; but the yield increase was not proportional to the increased nutrient levels. Application of lime at the rate of 500 g per plant did not influence the yield. Another trial indicated that 50 g nitrogen, 100 g phosphorus and 150 g potash may turn out to be the best treatment combination. During the year under report, there was abnormal spike shedding and the plants which received 150 g potash per year recorded a low percentage of shedding. Work on standardisation of tissue analysis technique in pepper was in progress.

NAA at 100 ppm and 2, 4–D at 200 ppm were found to be the best growth regulator treatments which produced maximum weight of spikes and berries. Dipping the cuttings in IBA 1000 ppm solution for 45 seconds

was found to be the best treatment for increasing the percentage of rooting and the root bio-mass. The trial on the influence of planting materials on the growth habit and yield of pepper indicated that the middle one-third portion of the runner shoots was the best planting material.

In the area of crop protection, attempts were made to evolve control measures against pollu beetle, nematodes, fungal pollu, quick and slow wilts, spike shedding and bacterial leaf spot. Biology, nature of damage and control measures of the pollu beetle were studied. The infection of fungal pollu was found to commence with the formation of the spikes, the maximum being during August-September. With regard to the control of fungal pollu, spraying Bordeaux mixture once in July and again in August-September was found to be effective. An experiment was started to examine whether the prophylactic measures now adopted against the quick wilt disease of pepper are sufficient to control the fungal pollu also.

One pre-monsoon painting of the stem with 10% Bordeaux paste followed by at least one foliar spray of 1% Bordeaux mixture was found to be the minimum plant protection schedule for controlling the quick wilt disease of pepper Considering the climatic variations, one or two additional sprayings of Bordeaux mixture may prove benefical.

The extent of spike shedding as well as the physiological causes of shedding were investigated.

CARDAMOM

Research on cardamom was mainly conducted at the Cardamom Research Station, Pampadumpara. Twenty three projects were in progress during the year.

The germplasm collection was enriched during the year by inclusion of more types and wild relatives. The collection included one *Ammonum subulatum* from Sikkim. From the 26 types/wild relatives maintained at the Station, a high yielding type of 'Vazhukka' was selected. In the comparative yield trial of promising types, Types 7, 107 and 17 were found to be the best performers, as compared to the types 7, 103 and 6 during the previous year.

Seeds harvested in September gave nearly 40 per cent germination and these were found to be better to provide more time in the nursery. Ripe seeds gave higher germination than fully ripe or just ripe seeds. Among the seed treatments, gibberellic acid, scarification + hot water treatment and cowdung slurry gave higher germination. The capsule form and polythene lined gunny bags were identified as the best methods of storage. Row spacing at 6 cm, 8 cm and 10 cm using a constant seed rate of 10 g/m^2 gave vigorous seedlings.

Studies on blossom biology indicated that pollen viability was maximum before 10.00 a. m. Fruit set was found to be maximum in plots where four bee colonies were maintained.

A fertilizer trial with three levels each of N, P and K started in 1976 was in progress during the year. Among the different cultural practices, "forming trenches" seemed to have advantage over terracing, pit method and forming basins around the plant.

The field trial conducted to control the nematodes attacking cardamom indicated that fumigation of soil with methyl bromide reduced the population of nematodes in the primary nursery. Studies on the control of the shoot fly in the nursery indicated that spraying 0.1% Ekalux (Quinalphos 0.025%) was the most effective treatment.

Bimonthly application of Temik, Thimet, Solvirex, Disyston or Furadan 3 g @ 0.6 g ai/plant was effective in reducing the thrips population, Disyston being the most effective. In another study, four to eight sprayings of insecticides commencing from June gave equally effective control against thrips. Dusting Ekalux, Phendal or Folidol was also effective.

Endosulfan was found to be effective in reducing the infestation of capsules by the shoot and capsule borer.

Studies on 'Katte' disease control indicated that the percentage of infected plants could be reduced as a result of continuous eradication of the affected plants. Studies on 'Azhukal' disease showed that spraying and/or drenching with 1% Bordeaux mixture was effective in reducing the capsule and panicle infection.

NUTMEG AND CLOVE

The germplasm collected and planted at Vellanikkara was maintained and the growth parameters like height, girth, branching, spread etc. were recorded.

In cloves, studies were undertaken to find out methods for increasing the germination of seeds, to improve the rate of growth of seedlings and to improve the percentage survival in the main field. The seeds collected and sown during the month of May were found to be superior with regard to the rate of growth and vigour of the resultant seedlings. Heavy seeds recorded the highest percentage of germination. The removal of pericarp increased the percentage germination; but did not influence the rate of growth of the resultant seedlings. Clove seedlings from the primary nursery transplanted to improvised coconut husk pots filled with one part sand, one part cowdung and two teaspoons each of bone meal and powdered groundnut cake exhibited higher rate of growth. Foliar applications of GA 200 ppm + 0.5% urea enhanced the rate of growth of clove seedlings. Transferring the seedlings from the primary nursery to coconut husk pots in the second month and transplanting them to the main field with the container intact at the 9th month gave higher rate of survival.

Detailed studies on the etiology and morphology of leaf spot, twig blight and flower shedding of clove, leaf spot and shoot rot of

nutmeg, leaf spot and die-back of cinnamon, sooty mould of clove and cinnamon as well as little leaf disease of clove were undertaken. Studies on the physiology of resistances, host-pathogen relationship, physiological alterations on host-metabolism were also initiated. 250 ppm Bavistin and 1000 ppm Thiride were found to inhibit the growth of *Cylindrocladium quinqueseptatum* causing leaf blight disease in cloves.

GINGER

The germplasm collection maintained at the Horticultural Research Station, Ambalavayal was evaluated for yield and Wynad Kunnamangalam ranked first in this respect followed by China and Arippa.

Detailed studies on 25 ginger types were conducted at Vellanikkara. Maximum incidence of soft rot (27.5%) was recorded in Rio-de-Janeiro and minimum (3.2%) in Maran. Taiwan exhibited highest susceptibility to leaf spot and Tafengiva the least. Maximum attack of shoot borer (43.4%) was found in Valluvanad and minimum (21.3%) in Rio-de-Janeiro. Wynad Kunnamangalam recorded the highest green yield (16927 kg per ha), Nadia the maximum yield of dry ginger (6453.16 kg per ha) and Thodupuzha the maximum dry ginger recovery (25.2%). Maximum oleoresin content was recorded by Rio-de-Janeiro. Karakkal with 2.4% oil and China with 3.4% fibre content were the best types for these characters. The percentage of oleoresin, oil and fibre were maximum at 165 days after planting, whereas maximum yield per hectare of oleoresin and oil were at 270, 245 and 225 days after planting in varieties Rio-de-Janeiro, Maran, Kuruppampady and Wynad local. Nadia, Bajpai and Maran were found suitable for obtaining high total yield of dry ginger, oleoresin and oil.

An experiment to identify varieties suitable for second crop ginger (irrigated) indicated the suitability of the type Rio-de-Janeiro.

In studies on the control of nematodes associated with ginger, soil application of Temik 10% based on Aldicarb at 1.5-4.5 g ai/m^2 was found to be more effective.

Studies on the control of soft rot disease of ginger indicated that soil drenching with Cheshunt compound, Agallol or Thiride reduced the post-emergence rotting. A minimum of two post-emergence applications one and three months after planting of either Cheshunt compound or Agallol in addition to the preplanting soil drench was found necessary to control the disease

Studies on the symptomatology, etiology and control of the bacterial disease of ginger in Wynad were in progress. The indications were that the primary source of inoculum was through soil as well as through seed material. Cuman and Bordeaux mixture were found to be effective in controlling the *Phyllosticta* leaf spot. Of the 22 types of ginger screened, Maran, Karakkal, Burdwan and Nadia were found to be less susceptible to the disease.

TURMERIC

A collection of 34 types of turmeric was evaluated at the Horticultural Research Station, Ambalavayal. T. Sunder, Kuchipudi, Ettamukkala and Sugandam performed the best. Kasthuri Tanaka, Kuchipudi and Mannuthy local performed well under the partially shaded conditions at Mannuthy. In another varietal trial Chayapasupa stood first with respect to the green yield. Mannuthy local had the maximum curcumin content (6.55 percent). Maximum oleoresin content of 21.10% was recorded in the type Duggirala C 11-325. The maximum per hectare yields of curcumin (560.6 kg) and oleoresin (1470.3 kg) were recorded by Mannuthy local. The yield of green turmeric, dry produce, drying percentage, oleoresin and curcumin were found to be maximum at 270 days after planting. In a multilocational trial conducted over seven locations with Mannuthy local, Chayapasupa, Kuchipudi and Armoor, the first two types recorded maximum green yield at three locations each.

Studies were in progress to explore the genetic variability in turmeric with a view to selecting superior types.

BETEL VINE

Studies on the bacterial leaf spot were carried out and the incitant pathogen was confirmed to be *Xanthomonas betlicola* which was found to infect *Piper nigrum*, *Piper longum* and *Peperomia pellucida* also. "Karilanchikarpuram" and "Thulasivettila" cultivars exhibited minimum defoliation after 30 days of inoculation. Of the six antibiotics tested, Chloramphenicol and Terramycin showed better inhibitory effects.

COCOA

Twenty experiments were in progress during the year.

The propagational studies indicated maximum percentage of germination in seeds collected during March. Pods weighing more than 350 g collected during February and March were found to give better seedlings. Delay in sowing affected the germination. Seedlings were ready for transplanting when they were three months old or when they had 30 cm height and 19 leaves. Forkert budding on 8 to 9 month old root stocks or green budding on 3 to 4 month old seedlings were found to be successful. The best time for budding was found to be February to May.

During the year under report, two fertilizer trials were laid out in cultivators' fields in Trivandrum. A spacing-cum-manurial trial was in progress at Vellanikkara. An experiment was conducted at the College of Horticulture to study the effect of shade and moisture regime on the growth of cocoa seedlings. A trial aimed at standardising the training and pruning practices for cocoa was laid out.

Data on aspects of floral biology, fruit set and fruit development were collected.

Twenty six species of insects were found to infest cocoa, the mealy bug (*Planococcus lilacinus*) being the most common and destructive. Application of Fenthion, Monocrotophos, Quinalphos and Dimethoate (all at 0.05% concentration) as high volume sprays during the peak period of infestation in summer months could control the insect. Two applications at an interval of 30 days were required. Investigations on the etiology and control of fruit drop and die-back diseases of cocoa were in progress.

Mini box and mini basket methods in which the beans were kept for six days with turning once in two days were found suitable for fermenting small quantities of cocoa beans.

PROJECTS IMPLEMENTED

CROP IMPROVEMENT

1	Germplasm collection and screening of pepper varieties [Ag 4 (a) 11 Breed. 1.01]	Panniyur
2	Hybridisation and selection in pepper [Ag 4 (a) 15 Breed 1.02]	Panniyur
3	Collection and maintenance of germplasm bank of *Piper* spp [Ag 4 (a) 19 Breed 1.03]	Vellanikkara
4	Varietal trial of pepper in coconut gardens [Ag 4 (a) 11 Breed 4.01]	Pilicode
5	Comparative yield trial of pepper varieties [Ag 4 (a) 11 Breed 4.02]	Panniyur
6	Varietal trial on pepper [Ag 4 (a) 15 Breed 4.03]	Vellanikkara
7	Screening of hybrid and open pollinated seedlings of pepper to evolve a disease resistant and high yielding variety [Ag 4 (a) 15 Breed 6.01]	Vellanikkara
8	Studies on the adaptability of Panniyur–1 variety of pepper in the high ranges	Pampadumpara
9	Morphological studies on pepper varieties [Ag 4 (a) 11 Bot 1.01]	Panniyur
10	Growth, flowering, biology and spike shedding in pepper [Ag H. 4 (a) 10 Bot. 1.04]	Vellanikkara

CROP MANAGEMENT

11	Training and pruning of pepper [Ag 4 (a) Agron. 6.01]	Vellanikkara
12	Spacing–cum–standard–cum–varietal trial on pepper [Ag 4 (a) 19 Agron. 8.01)	Vellanikkara
13	Fertilizer–cum–standard trial on pepper [Ag 4 (a) Agron. 8.01]	Vellanikkara
14	Studies on intercropping in pepper gardens [Ag 4 (a) 11 Agron. 9.01)	Panniyur
15	Fertilizer experiment on pepper [Ag 4 (a) Agron. 1.01)	Panniyur
16	Nutritional trial on local pepper varieties [Ag 4 (a) 11 Agron. 1.02]	Panniyur
17	NPK trial on Panniyur–1 variety of pepper [Ag 4 (a) Agron. 1.03]	Panniyur
18	Adoption of suitable cultural practices in addition to plant protection measures to rejuvenate slow wilt affected plants [Ag 4 (a) 11 Agron. 3.01]	Vellanikkara

19	Effect of mulching with different materials on the growth and yield of pepper [Ag 4 (a) 11 Agron. 401]	Panniyur
20	Cultural trial on pepper [Ag 4 (a) 19 Agron. 5.01]	Vellanikkara
21	Standardisation of chemical foliar diagnostic techniques for N,P and K in the pepper variety, Panniyur–1 [Ag 4 (a) 11 Chem 1.01]	Vellanikkara
22	Standardisation of tissue analysis technique in pepper [Ag 4 (a) 19 Chem 1.02]	Vellanikkara
23	Nutrient uptake and oleoresin content in pepper [Ag 4 (a) 11 Chem. 2.01]	Panniyur
24	Investigations on the nutrition of black pepper [Ag H.4 (a) 19 Chem. 3.01)	Vellanikkara
25	Trials with growth regulators on pepper [Ag H.4 (a) 11 Hort. 1.01]	Panniyur
26	Studies on the influence of planting materials on the growth and yield of pepper	Panniyur

CROP PROTECTION

27	Ecology and control of pepper pollu beetle, *Longitarsus nigripennis* [Ag 4 (a) 18 Ent. 1.02]	Vellayani
28	Trial on pepper pollu beetle with Ekalux EC 25	Panniyur
29	Role of nematodes on the incidence of slow wilt disease of pepper and to find out suitable control measures [Ag 5 (a) 18 Ent. 2.03]	Vellanikkara
30	Investigation of nematodes infecting black pepper (*Piper nigrum L*)and the fungus *Fusarium* sp. [Ag 4 (a) 18 Ent. 20.4]	Vellayani
31	Field trial for the control of fungal pollu of pepper [Ag 5 (a) 11 Path. 1.03]	Panniyur
32	Studies on the etiology and ecology of fungal pollu of pepper [Ag 4 (a) 11 Path 1.04]	Panniyur
33	Studies on 'fungal pollu' of pepper, etiology and nature and extent of damage	Vellanikkara
34	Studies on the ecology of 'fungal pollu' of pepper	Vellanikkara
35	The effect of prophylactic and control measures of quick wilt (stem rot) disease on the control of fungal pollu (anthracnose) of pepper	Vellanikkara
36	Fungicidal trial for the control of quick wilt (foot rot) disease of pepper [Ag 4 (a) 11 Path 2.02]	Panniyur
37	Studies on the ecological factors affecting quick wilt disease of pepper [Ag 4 (a) 11 Path. 2.03]	Panniyur
38	Quick wilt disease of pepper–Ecological studies	Vellanikkara

39	Quick wilt disease of pepper–Survey of collateral hosts of *Phytophthora palmivora,* especially the weeds and other economic plants usually seen in pepper gardens of Kerala.	Vellanikkara
40	Quick wilt disease of pepper–Symptomatological studies (Ag 4(a) 19 Path 2.05)	Vellanikkara
41	Studies on spike shedding in pepper (Ag 4 (a) 11 Path. 3.01)	Panniyur
42	Investigations on spike shedding in pepper (Ag 4(a) 19 Path 3.2)	Vellanikkara
43	Bacterial leaf spot of pepper (*Piper nigrum* L) incited by *Xanthomonas betlicola*. (Ag,4(a) 18 Path. 501)	Vellayani

Germplasm collection and screening of pepper varieties— Ag 4(a) 11 Breed. 1.01 (Panniyur)

The pepper Research Sation, Panniyur maintained a germplasm collection of 105 cultivars and wild types. The yield data of 57 collections for the past 19 years revealed that the performance of Cheriyakaniyakadan, Kumbhakodi, Kuthiravally PTB was better than that of the other varieties. After a period of ten years of regular bearing, most of the varieties showed a declining trend (Table 3.1, However, the Malabar variety Kalluvally PTB exhibited an increasing trend in yields.

Table 3.1: Average yield of promising varieties

Varieties	Average yield (Kg)		
	10th year from bearing	10-19th year	Average of 19 years
Cheriyakaniyakadan	3.128	2.498	2.830
Kumbhakodi	2.938	1.644	2.316
Kuthiravaly	2.504	1.845	2.192
Narayakodi	1.855	1.930	1.891
TMB-II	2.051	1.241	1.760
Kalluvally-I	1.806	2.281	1.930
Kalluvally-II	1.232	1.410	1.312
Kalluvally PTB	1.141	3.098	2.456
Karimunda-I	1.212	1.302	1.255
Karimunda-II	1.591	1.394	1 498
Kottanadan	1.596	1.649	1.341
Vally	1.667	1.222	1·457
Balankotta	1.128	0.964	1.046

Planted during 1957–'58
Regular bearing from 1961-'62.

Hybridization and selection in pepper Ag. 4(a) 15 Breed 1.2 (Panniyur)

Among the hybrid and open pollinated seedlings planted, 188 flowered and these were harvested during 1979-80. Based on the morphological, sexual and yield characters, 56 promising cultures were selected for multiptication and further evaluation. Of these, fifteen cultures were put under PYT during August, 1979. Cuttings of the remaining ones were raised in the nursery for planting during 1980-'81 season.

From the hybridization programme during 1979–'80, 312 hybrid seeds were obtained from the following eight parental combinations:

Karimunda	x	Kuthirvaly
Karimunda	x	Panniyur–I
Kuthiravaly	x	Karimunda
Arakulam Munda	x	Panniyur-I
Uthirankotta	x	*Piper attenuatum*
Uthirankotta	x	Panniyur–I
Panniyur–I	x	Karimunda

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Kuthiravaly	x	Karimunda
Arakulam Munda	x	Panniyur-I
Uthirankotta	x	*Piper attenuatum*
Uthirankotta	x	Panniyur-I
Panniyur-I	x	Karimunda

The hybrid and the open pollinated seeds collected from different varieties in the germplasm were sown in the nursery. A total of 15,922 seeds were sown during February–March, 1980.

Collection and maintenance of germplasm bank of Piper spp. Ag. 4 (a) 19 Breed 1. 03 [Vellanikkara]

The Pepper Research Centre at the main campus, Vellanikkara also maintained a collection of pepper varieties and wild species of *Piper*. After a survey conducted in 1976, 166 types were collected. The collection was enriched in 1978 with the addition of 33 wild types. A number of vines came to bearing during the year. One collection No 84, exhibited good morphological characters and gave good yield for the past two years (Table 3.2). The other features were shorter spikes and short internodal length, as compared to Panniyur—1. There was close setting of berries also.

Table 3.2: Mean performance of the collection No. 84

Std.No.	No. of spikes	Wt. of spikes (g)	Green berry wt. (g)
84/1	9.0	24 0	18.0
84/2	226.0	1256.0	1105.0
84/3	253.5	1285.0	1164.0
84/4	69.5	262.5	218.0
84/5	40.5	197.5	176.0
84/6	50.5	184.0	165.5
84/7	158.0	640.0	578.5
84/8	41.0	230.0	212
84/9	184.0	985.0	901.0
84/10	98.0	435.0	396.5
Total	1170.0	5500.0	4940.5
Mean	117.0	550.0	494.05

Varietal trial of pepper in coconut gardens Ag. 4 (a) 11 Breed 4.01 [Pilicode]

The trial was aimed at identifying the pepper variety most suited as a companion crop in the partially shaded conditions of coconut gardens. The six varieties compared in the experiment were Panniyur—1, Karimunda, Balankotta, Kalluvally, Kottanadan and Narayakodi. From the results obtained so far, Karimunda ranked first in the number of plants flowered, total number of spikes produced and yield of pepper. Panniyur—1 stood second. As the trial was laid out only in 1976, definite conclusions could not be drawn.

Comparative yield trial of pepper varieties Ag 4 (a) 11 Breed 4.02 [Panniyur]

The trial was laid out to compare the performance of Panniyur—1 with local varieties. Panniyur—1 gave better yield as compared to the others. Though Arakkulam Munda was second to Panniyur—1 during the last three years and the average number of spikes produced per plant was higher than in Panniyur—1 during 1978—79, Kuthiravaly gave higher yield during 1979—80 (Table 3.3) than Arakulam Munda. It appeared that after attaining regular bearing stage, Kuthiravaly may perform better than Arakkulam Munda.

Table 3.3: Comparative yield trial of pepper varieties—abstract of yield data

Varieties	1976—77			1977—78			1978—79			1979—80		
	Plants flowered	No. of spikes	Yield of green pepper (kg)	Plants flowered	No. of spikes	Yield of green pepper (kg)	Plants flowered	No. of spikes	Yield of green pepper (kg)	Plants flowered	No. of spikes	Yield of green pepper (kg)
Panniyur–1	3	5	—	45	2858	23.315	52	11017	72.942	56	22047	153.760
Arakulam Munda	15	107	—	36	1949	7.085	39	12531	56.350	38	20159	61.382
Kalluvally	—	—	—	1	9	0.020	4	109	0.278	16	499	1.561
Balankotta	—	—	—	—	—	—	1	10	0.020	17	1541	7.855
Kuthiravaly	3	11	—	14	859	3.985	35	7161	33.939	44	17427	74.165

The figures are the totals of five replications
Total number of plants in each variety is 60

Varietal trial on pepper Ag. 4 (a) 15 Breed. 4.03 [Vellanikkara]

The experiment was aimed at comparing the yield of Panniyur–1 with other cultivated varieties of pepper, namely, Kalluvally, Kottanadan, Karimunda, Narayakody and Cheriyakaniyakadan. Except Kalluvally, all the varieties had established. The plants have commenced bearing during 1979. Narayakody produced the maximum green pepper per vine, followed by Panniyur–1 and Kottanadan (Table 3.4) During 1980, Kottanadan ranked first, followed by Panniyur–1 and Narayakody. (Table 3.5)

Table 3.4: Performance of the varieties during 1979

Varieties	No.of vines estd.	Height of vines (m)	No.of vines flowerad	No.of spikes	Weight of spikes (g)	Green berry weight (g)
Panniyur–1	29	2.74	27	19.30	152.07	133.63
Karimunda	28	3.92	9	12.56	43.22	37.11
Kalluvaily	15	1.25	—	—	—	—
Kottanadan	30	2.54	12	14.25	69.92	60.42
Narayakodi	26	2.06	22	55.45	204.39	174.18
Cheriyakaniyakadan	27	1.64	2	9.50	27.00	17.50

Table 3.5: Performance of the varieties during 1980

Varieties	No.of vines tested	Height of vines (m)	Perim–eter (cm)	No.of vines flow-ered	No.of spikes	Average length of a spike (cm)	Weight of spikes (g)	Green berry weight. (g)
Panniyur-1	28	3.02	97.57	21	30.24	8.35	182.10	165.62
Karimunda	26	2.82	97.57	18	32.33	4.71	91.13	78.33
Kalluvaily	24	1.04	65.00	1	17.00	7.60	43.00	38.00
Kottanadan	29	2.91	142.60	23	113.83	6 59	471.83	436.09
Narayakodi	29	1.88	134.94	20	51.35	6.00	126.05	104.40
Cheriyakani-yakadam	24	2.04	91.77	9	46.78	7.55	99.78	83.11

Screening of hybrid and open pollinated seedlings of pepper to evolve a disease resistant and high yielding variety Ag. 4 (a) 15 Breed 5.01 [Vellanikkara]

The hybrid and open pollinated seedlings evolved at the Pepper Research Station, Panniyur and planted during 1977 and 1978 were maintained. Multiplication of the vines was done for screening. Work on evolving a rapid and efficient technique for large scale screening was completed.

Studies on the adaptability of Panniyur–1 variety of pepper in the high ranges [Pampadumpara]

Panniyur-1 was being compared with four local varieties, namely Karimunda, Aimpiriyan, Narayakodi and Vellanamban. The plants have not yet commenced bearing.

Morphological studies on pepper varieties Ag. 4 (a) 11 Bot. 1.01 [Panniyur]

Detailed studies on the vegetative, sexual and yield characters of the established varieties in the germplasm collection were continued during the year and the studies on 11 varieties were completed.

Based on the observations made. the occurrence of abortive spikes and its intensity in different varieties of pepper was reported during 1979-'80.

The shoot system of pepper was described and a paper on the 'Functional differentiation of .he shoot-system of pepper vine was published during the year. Morphological description of the remaining varieties was in progress.

Growth, flowering, floral and spike shedding in pepper. piper nigrum L. Ag. H 4 (a) 19 Bot. 1.04 [Vellanikkara]

The studies aimed at analysing the growth pattern, floral biology and spike shedding in pepper were in progress as a PG Project.

Training and pruning of pepper Ag. 4 (a) 19 Agron 6.01 [Vellanikkara]

Two experiments were laid out one for standardisation of pruning techniques in bearing pepper vines and the other for standardisation of training and pruning of young pepper vines. In the first experiment. the pruning treatments have not been started as the vines have not yet attained the bearing stage. The training treatments in the second experiment will be given after the establishment of the vines.

Spacing–cum–standard-cum-varietial trial on pepper Ag. 4 (a) 19 Agron 7.01 [Vellanikkara]

A trial with three standards (teak poles, *Erythrina indica* and *Garuga pinnata*), three spacings 2.0m², 2.5m² and 3.0m²) and two varieties (Panniyur–1 and Karimunda) was laid out. Gaps in the standards and the experimental plants were filled up during the year.

Fertilirer–cum-standard trial on papper Ag. 4 (a) 19 Agron 8.01 [Vellanikkara]

The trial was laid out during 1976 with the objective of working out a manuriai schedule for Panniyur-1 grown on live and dead standards. With reference to plant height, number of spikes, average length of spikes and weight of spikes, the dead standards were found to be superior to the live ones. However, the living standards were superior to the dead ones in respect of the yield of green pepper. Split application of fertlizers was found to be better than single application.

Studies on intercropping in pepper gardens Ag. 4 (a) 11 Agron. 9.01 [Panniyur]

The trial was started in 1977–78 with a view to finding out the most profitable intercrop that can be grown in pepper gardens.

Table 3.6: Mean yield of green pepper and intercrops

Treatments	Mean yield of intercrops per plot. Green yield (kg)			Mean yield of green pepper per plot (kg)		
	1977—78	78—79	79—80	1977—78	78—79	79—80
Banana	—	42.43	15.95	11.29	28.65	17.86
Elephant foot yam	113.50	135.00	121.38	10 10	29.22	26.57
Colocasia *	63.58	—	—	10.18	28.10	31.20
Ginger	38.88	32.88	14.75	13.41	25.18	26.19
Turmeric	77.00	71.25	44 50	16.60	41.66	35.09
Control	—	—	—	15.11	30.28	22.04

* Colocasia was completely damaged by wild boars during 1978—79

There was steady decrease in the yield of intercrops except in the case of elephant foot yam. In the plots intercropped with turmeric, pepper yield (green berries) was more than that in the control plots for a ll the three years. During the year under report, pepper yields better than in the control plots were obtained in ail the intercropped plots except in the case of banana plots (Table 3.6.) It seemed that banana was not a suitable intercrop for pepper. The studies are being continued for obtaining confirmatory results·

Fertilizer experiment on pepper Ag. 4 (a) 11 Agron 1.01 [Panniyur]

The experiment started during 1974, was continued. The summary of data on the number of spikes formed and green yield of pepper are presented in Table 3.7.

As can be seen from the data, application of nitrogen at all the three levels 60, 120 and 180g per plant per year) significantly increased the number of spike and green yield of pepper; but the increase in yield did not commensurate with the increased levels of the nutrient. Application of lime@ 500g per plant per year did not seem to have any effect on the yield of the plants. From the data, it can also be seen that the effect of fertilizer on yield was mainfested only from the third year after application.

Nutritional trial on local pepper varieties Ag.4 (a) 11–Agron. 1.02 [Panniyur]

The experiment was aimed at finding out the manurial requirements of two local popular varieties of pepper, namely, Karimunda and Arakulam Munda. The levels of nutrients tried were 50,100 and 150g of nitrogen, 25, 50 and 75 g of Phosphorus and 100, 150 and 200 g of potash per plant per year, all being applied in two equal splits.

The experiment was started in 1978–79 and the results are expected only after continuing it further.

Table 3.7: Effect of nitrogen and lime application on the number of spikes and green yield of pepper

Year	Treatment	No. of spikes per plant per year				Green yield of pepper per plant per year (kg)			
		N_1 (60 g)	N_2 (120g)	N_3 (180g)	Mean	N_1	N_2	N_3	Mean
1974—75	L0 (No lime)	528	510	463	500	3.32	3.65	2.84	3.27
	L1 (500 g lime/p/y)	555	713	552	607	3.53	3.60	3.15	3.42
	Mean	541	511	507	—	3.42	3.62	2.99	—
1975—76	L0	865	611	671	716	5.11	3.46	3.48	4.02
	L1	841	783	586	737	5.02	3.59	3.07	3.89
	Mean	853	697	629	—	5.06	3.53	3-27	—
1976—77	L0	881	832	989	891	6.05	6.10	6.26	6.14
	L1	815	816	656	762	6.14	5.65	4.03	5.27
	Mean	848	810	823	—	6.10	5.87	5.14	—
1977—78	L0	1070	979	856	966	7.65	6.99	5.74	6.77
	L1	968	858	688	837	7.05	6.21	4.28	5.83
	Mean	1016	916	770	—	7.33	6.59	4.99	—
1978—79	L0	1080	558	970	865	7.22	3.34	5.62	5.31
	L1	1181	1101	765	1027	7.33	6.61	4.52	6.16
	Mean	1131	821	878	—	7.28	4.93	5.13	—
1979—80	L0	1082	643	978	903	5.76	2.85	4.22	4.30
	L1	1012	1089	595	900	5.31	5.15	2.84	4.43
	Mean	1047	873	780	—	5.55	4.03	3.51	—

An incidental observation was that the variety Arakulam Munda was more susceptible to the quick wilt disease than the variety Karimunda. There was extensive branch infection in the former, causing severe damage to the plants. The few cases of infection observed in Karimunda were at the foot, resulting in complete destruction of the plants.

NPK trial on Panniyur-1 variety of pepper Ag. 4 (a) 11 Agron 1.03 [Panniyur]

The experiment was started in 1975–76 with three levels (50,100 and 150g per plant per year) each of N,P and K.

The results were not yet conclusive; but the data so far collected indicated that 50 g of nitrogen, 100g phosphorus and 150 g potash per plant per year may turn out to be the best treatment combination. The effect of individual nutrient levels on the yield of green pepper is summarised in Table 3.8.

Table 3.8: Yield of pepper under different nutrient levels

	Yield of green pepper under different nutrient levels					
	1975–76	1976-77	1977–78	1978–79	1979–80	Mean
N-50 g	2.92	2.06	2.22	6.39	4.12	3.13
100 g	2.46	1.62	2.09	5.40	3.46	3.01
150 g	2.51	2.02	1.69	5.75	3.07	3.01
P–50 g	2.75	1.79	1.66	5.22	2.75	2.83
100 g	2.66	1.79	2.18	6.55	4.30	3.50
150 g	2.49	2.12	2.16	5.76	3.58	3.22
K–50 g	2.85	2.17	1.73	4.96	2.56	2.85
100 g	2.71	1.76	2.38	6.05	3.89	3.36
150 g	2.34	1.77	1.88	6.54	4.19	3.34

The effect of fertiliser application was manifested on the yield only after the application of fertilisers continuously for three years.

Another phenomenon observed was the effect of the nutrients on spike shedding. During normal years, when the mean percentage of spike sheddings was less than fifteen, none of the nutrients had any effect on the intensity of spike shedding. But during 1979-80, when there was an abnormal shedding of spike shedding the plants which received 150 g potash per year recorded a significantly low percentage of spike shedding. This observation requires confirmation by further studies.

Adoption of suitable cultural practices in addition to plant protection measures to rejuvenate slow wilt affected plants –Ag 4(a) 11 Agron 3.01 (Vellanikkara)

Work was started to find out suitable management practices to rejuvenate slow wilt affected pepper plants.

Effect of mulching with different materials on the growth and yield of pepper - Ag 4(a) 11 Agron 4.01 (Panniyur)

The trial was started in 1977-78 on three-year old plants with the object of finding out the best material for mulching the basins of pepper plants during the summer months. The abstract of yield data is given in Table 3.9.

Table 3.9: Yield of green pepper under different mulching treatments

Treatments	Mean yield of green pepper per plant (kg)			
	1977–'78	1978–'79	1979–'80	Mean
Saw dust	0.95	2.24	2.61	1.93
Polythene sheet	1.12	2.88	1.56	1.85
Coconut husk	0.65	1.29	2.00	1.31
Arecanut husk	0.93	2.33	1.86	1.71
Dry leaves	1.22	1.72	2.03	1.66
Control	0.62	1.55	1.51	1 23

Though the results were not conclusive, the data indicated that the mulched plants gave better yields than the controls It was also observed that the basins mulched with polythene sheet in the summer months recorded very little weed growth during the ensuing rainy season. Soil moisture percentage was msximum in the basins mulched with dry leaves. The studies are being continued.

Cultural trial on pepper Ag 4 (a) 19 Agron. 5.01 [Vellanikkara]

The trial was started in 1976 with the objective of standardising the cultural practices of pepper to ensure economic returns. The data indicated that "digging the whole garden twice an year" (Treatment B) ranked first in 1979, while "digging one metre around the plants and sickle weeding the remaining area once an year (Treatment C) was superior in 1980. The mean data for the two years (Table 3.10) indicated the superiority of the Treatment B with respect to yield of green berries.

Table 3.10: Performance of vines under different treatments

Treatments	Yield of green berries (g)		
	1978	1979	Mean
A. Digging the whole garden once an year (Sept–Oct)	307.25	141.71	224.48
B. Digging the whole garden twice an year (July; Sep-Oct.)	401.00	297.23	349.12
C. Digging one metre around the plants and sickle weeding the remaining area once an year	165.18	359.64	262.41
D. As in treatment C but twice an year	318.95	295.96	307.45
E. Control (Sickle weeding twice an year)	171.30	291.50	231.40

*Standardisation of chemical foliar diagnostic techniques for N, P and K in pepper variety, Panniyur*1-A4 g.(a) 11 Chem 1.01 [Vellanikkara]

Analysis of leaf and stem samples, collected from the experimental plants of a fertilizer trial of the Pepper Research Station, Pannivur, was done soi

as to standardise the plant tissue for foliar diagnosis. The work was initiated as a P G project.

Standardisation of tissue analysis technique in pepper Ag 4 (a) 19 Chem 1.02 [Vellanikkara)

The experiment was intended to standardise the tissue analysis technique for large scale adoption in pepper for evolving manurial recommendations. The work was started during the year.

Nutrient uptake and oleoresin content In pepper Ag 4 (a) 11 Chem 2.01 [Vellanikkara]

The trial envisaged the estimation of the quantities of major nutrients absorded by the plant under graded doses of fertilisers. The effect of the nutrients on the oleoresin content of the berries was also to be estimated.

As the required laboratory facilities to take up the chemical analysis were not available at the Station, the analytical part of the project was assigned as a Thesis problem to an M. Sc. student at the College of Horticulture. The work was in progress.

Investigations on the nutrition of black pepper Ag. H (a) 19 Chem. 3.10 [Vellanikkara]

The studies aimed at developing nutrient deficiency symptoms in black pepper (under pot culture) were in progress as a Ph. D. project. Critical levels of the major nutrients with respect to yield of pepper under field conditions will also be determined.

Trials with growth regulators on pepper Ag H. 4 (a) 11 Hort. 1.01 [Panniyur]

Previous trials conducted at the Pepper Research Station, Panniyur showed that application of plant hormones like NAA increased the size and weight of berries resulting in increased weight of mature spikes. During the year under report, the trial was continued with different doses of selected plant hormones to identify the best chemical and its optimum concentrations.

Table 3.11: Weight of spikes and berries on application of growth regulators

Treatments	Mean weight of a spike (g)	Mean weight of 1000 green berries (g)	Mean volume of 1000 green berries (ml)
Control	5.898	149.00	127.00
2, 4-D-200 ppm	8.021	170.00	165.05
,, 100 ppm	7.981	153.30	146.05
NAA -200 ppm	8.113	156.40	144.00
,, 100 ppm	9.335	167.80	154 00
MH -200 ppm	6.421	130.40	120.00
,, -500 ppm	6.991	140.70	123.00

As can be seen from Table 3.11 NAA 100 ppm and 2, 4-D 200 ppm were the best treatments. The experiment is to be continued to fix up the correct time and number of applications necessary to obtain best results.

To solve the problem of shy rooting resulting in severe casuality of field planted rooted cuttings, a root hormone (IBA) was tried for the past three years. The initial trials to fix up the concentration and the method of application of the chemical had shown that dipping the basal portion of the cuttings in a 1000 ppm solution was the most convenient and effective method. During the period under report, the trial was continued to fix up the optimum period and duration of dipping the cuttings in the chemical solution.

It can be seen from the Table 3.12 that the percentage of rooted cuttings and the quantity of roots produced by the cuttings dipped in IBA Solution for 45 seconds were good. When the period of dipping was increased to 60 seconds, there was a slight depression in these characters. The shoot development showed a reverse trend. From the previous years' results, it can be stated that shoot development of treated plants will be satisfactory by the time the cuttings are ready for transplantation in June—July.

Studies on the influence of planting materials on the growth habit and yield of pepper [Panniyur]

The objective of the experiment was to find out the best portion of the shoot that can be used as planting material for vegetative propagation of pepper. The results so far obtained are, given in Table 3.13.

The results were not yet conclusive. But taking all aspects into consideration, it seemed that the middle 1/3rd portion of the runner shoots was the best planting material, followed by the apical 1/3rd of runners.

Ecology and control of pepper pollu beetle, Longitarsus nigripennis–
Ag 4(a) 18 Ent. 1.02 [Vellayani]

Survey relating to the incidence of the pest with reference to different elevations and under different intensity of light over different seasons was done. Detailed studies on the biology, nature of damage caused by pest with emphasis on net yield, chemical control of the pest using newer insecticides and terminal residues on the harvest were completed.

Trial on pepper pollu beetle with Ekalux EC 25– [Panniyur]

A trial was conducted with different doses of Exalux EC25 as per the request of M/s Sandoz (India) Ltd.

Two applications of the insecticide were given on 29-8-'79 at the berry setting stage and on 3-10-'79. The spray solutions were applied at the rate of one litre/plant. At the time of harvest 25 spikes were taken at random from each plant. Percentage of 'pollu' infection was recorded and the data statistically analysed after angular transformation. Results are presented in Table 3.14.

Table 3.12: Effect of IBA on rooting of pepper cuttings

Treatments	Observations									
	% cuttings rooted		% cutting without roots		Mean No. of primary roots/ cutting		Mean weight of roots/cuttings (g)		% cuttings which developed shoot	Mean No. of leaves/ cutting
	25 days	45 days	25 days	45 days	25 days	45 days	25 days	45 days	25 days	45 days
Dipping the cuttings with IBA 1000 ppm solution for 15 sec.	32.00	39.00	68.00	61.00	5.11	5.99	0.27	0.41	73.00	1.49
30 sec.	47.00	54.00	53.00	46.00	9.82	10.11	0.34	0.53	69.00	1.37
45 sec.	68.00	72.00	32.00	28.00	12.47	15.97	0.49	0.74	64.00	1.36
60 sec.	56.00	64.00	44.00	36.00	7.29	11.47	0.30	0.67	32.00	1.60
Control	20.00	36.00	80.00	64.00	3.20	3.94	0.11	0.19	72.00	1.52

Table 3.13: Vegetative characters, flowering and yield of pepper raised from different planting materials

Treatments	Mean ht. of plants (cm)	% of plants which produced plagiotropes	Height from which first pl. tr. was produced (cm)	Mean No. of pl. tr. produced per plant	% of plants flowered	No. of spikes	Average yield (kg)
Runners: Top 1/3rd portion	98.16	24.00	102.20	3.56	16.00	135	0.897
Middle 1/3rd portion	177.64	52.00	107.90	6.56	32.00	89	1.177
Basal 1/3rd portion	109.45	29.17	105.83	2.29	8.33	7	0.050
Hanging shoots: Top 1/3rd portion	151.40	40.91	122.18	2.60	18.18	35	0.265
Middle 1/3rd portion	124.80	28.00	100.63	2.65	8.00	7	0.045
Basal 1/3rd portion	110.76	21.74	87.22	6.95	17.39	114	0.745
Top shoots	74.43	90.91	12.28	6.35	27.27	66	0.511

Table 3.14: Effect of different concentrations of Ekalux EC 25 on the incidence of pepper 'pollu' beetle

Ekalux concentrations	Mean % of berries infected	
	Original value	Transformed value
0.05% (0.125% Quinalphos)	1.24	6.24
0.074% (0.01875% Quinalphos)	1.21	5.93
0.1% (0.025% Quinalphos)	0 35	3.25
0.4% (0.1% Quinalphos)	0.29	3.04
Untreated control	1.07	5 81
S.E./plot	—	1.66
F ratio for treatment difference	—	5.95**
CD at 5% level	—	1.98

** — Significant at 1% level.

Role of nematodes on the incidence of slow wilt disease of pepper and to find out suitable control measures Ag 4 (a) 11 Ent. 2.03 [Vellayani]

A nursery was raised for developing a nucleus culture of the root-knot nematode *(Meloidogyne incognita)* infesting pepper seedlings. Studies on establishing the pathogenecity of the burrowing nematode *(Radopholus similis)* was completed. The pathogenic effect of *R. similis* to black pepper was studied with four inoculum levels (10,100,1000 and 10,000 nematodes) on 55 day-old rooted cuttings of Kalluvaily. There was a decline in the growth of plants with increase in the inoculum level. The nematodes penetrated the roots within 24 hours and produced dark brown leisons within 72 hours of inoculation. They were observed to feed on the cortical parenchyma cells. The nematodes laid eggs inside the roots within six days of entry.

Another experiment to find out the relative role of plant parasitic nematodes *R. similis* and *M. incognita* on the incidence of slow wilt of pepper was laid out.

Investigations on the interaction of nematodes infesting black pepper (Piper nigrum L. and the Fusarium sp.- Ag. 4 (a) 18 Ent.204 [Vellayani]

Studies were undertaken to find out the effect of root knot nematode, *Meloidogyne* and the fungus *Fusarium* individually and in combinations on the growth and pathogenic symptoms on pepper vine. The studies revealed that the nematode-fungus interaction significantly affected the various growth parameters. The effect of nematode was more pronounced than that of the fungus.

The nematode *R. similis,* alone and in combination with the fungus *Fusarium,* caused significant reduction in the various growth characteristics of pepper vine. The studies indicated that the nematodes positively aided the spread of the fungus in the roots. No such effects were observed in the stem.

Studies involving the two nematodes indicated that growth was suppressed significantly compared to that in the control when the nematodes were inoculated either alone or in combination.

The two nematodes used together and also in combination with *Fusarium* sp. showed that the growth of pepper vine was considerably affected in all the treatments.

Field trial for the control of fungal pollu of pepper Ag 4 (a) 11 Path 1.03 [Panniyur]

The experiment was started during 1978–79. The main objective of the experiment was to find out the correct time of application of fungicides to control the fungal pollu caused by *Colletotrichum gloesporioides*. Ecological studies on the disease was also conducted.

The fungicides, Bordeaux mixture and Bavistin were sprayed at different intervals as indicated in Table 3.15.

Table 3.15: Percentage of early and late infection of fungal pollu

Treatments	Early infection (mean)	Late infection (mean)
Bordeaux mixture—June	1.12	2.48
Bordeaux mixture—July	1.14	2.02
Bordeaux mixture—August–September	0.81	2.13
Bordeaux mixture—June & July	0.64	1.86
Bordeaux mixture—June & August-September	2.87	3.23
Bordeaux mixture—July & Augest–September	0.76	1.58
Bordeaux mixture—June, July & August–September	1.39	1.61
Bavistin —June	2.40	3.18
Bavistin —July	1.77	2.13
Bavistin —August–September	2.33	2.86
Bavistin —June & July	1.23	2.75
Bavistin —June & August-September	1.67	3.99
Bavistin —July & August–September	1.66	2.64
Bavistin —June, July & August–September	1.66	2.76
Contol	1.62	2.92

Twenty five spikes from each plant were collected at random and observed for the early and late infection by rhe fungus.

The data showed that treatments 6, 4 and 3 gave the best control, followed by treatments 7 and 2. In the case of treatment 4, early infection was less than in treatment no.6, but late infection was higher under treatment 4. Even though Bavistin was on par with Bordeaux mixture, the latter may be pefrerred due to its low cost.

In general, it seemed that spraying of Bordeaux mixture in July and August–September could control tha fungal pollu. The experiment will be continued using Bordeaux mixture alone to get conclusive results.

Studies on the etiology and ecology of fungal pollu of pepper Ag 4 (a) 11 Path 1.04 [Panniyur]

The aim of the experiment was to ascertain the time and stage of maturity of pepper spikes at which the infection by the pathogen causing 'pollu' disease occurred. Pepper spikes were collected at weekly intervals throughout the fruiting season, plated and the percentage of infected spikes worked out.

Table 3.16: Percentage of infection of spikes by fungal 'pollu' at weekly intervals

Date	No. of spikes plated	No. of spikes in which fungus was detected	% of infected spikes
3 -7-79	50	—	—
10- 7-79	50	—	—
17- 7-79	50	—	—
24- 7-79	50	6	12
31- 7-79	50	8	16
7 -8-79	50	8	16
14- 8-79	50	11	22
21- 8-79	50	17	34
28- 8-79	50	42	84
3- 9-79	50	33	66
10- 9-79	50	17	34
17- 9-79	50	31	62
24- 9-79	50	32	64
2-10-79	50	34	68
9-10-79	50	16	32
16-10-79	50	12	24
23-10-79	50	23	46
30-10-79	50	27	54
7-11-79	50	17	34
14-11-79	50	14	28
21-11-79	50	23	46
28-11-79	50	21	42
11-12-79	50	11	22
18-12-79	50	26	52
25-12-79	50	15	30
1- 1-80	50	5	10

The data (Table 3.16) showed that infection started with the formation of spikes, but maximum infection was observed from August-September. Maximum control of the disease was obtained with Bordeaux mixture when applied at the peak period of infection (August-September). The experiment will be continued for getting confirmatory results.

Studies on fungal pollu (anthracnose) disease of pepper, etiology, nature and extent of damage [Vellanikkara]

Work commenced on the project aimed at finding out the mode of infection nature and extent of damage caused by the fungus *Glomerella cingulata* on different parts of pepper vines,

Studies on the ecology of 'fungal pollu' (anthracnose disease) of pepper [Vellanikkara]

Weekly observations on the appearance of symptoms on leaves, vines, spikes and berries were recorded along with meteorological parameters. The critical period of infection on leaves was found to be May, on spikes June and on berries August/ September. *Colletotrichum gleosporioides* was found to be a perennial pathogen on pepper vines. Evaluation of the efficiency of six fungicides (Anthracol 0.1%, Beyleton 0.1%, Bayer 5072 0.01% Bordeaux mixture 1.0%. Fycop 0.02% and Difolian 0.01%) for the control of the disease was done.

The effect of prophylactic and control measures of quick wilt (stem rot) disease on the control of 'fungal pollu' (anthracnose) of pepper [Vellanikkara]

The experiment was designed to examine whether the prophylactic / control measures now practiced against the quick wilt disease of pepper were sufficient to control the 'fungal pollu' or whether separate control measures were necessary for the latter disease. Plots were selected for laying out the experiment.

Fungicidal trial for the control of quick wilt (foot rot) disease of pepper [Panniyur]

The trial was conducted in a farmer's field at Alakode and 1979-80 was the fourth year of the experiment.

Inoculum potential in the soil around each plant was ascertained by the 'castor seed baiting technique'. The fungicides were applied as per the approved technical programme. After the application of fungicides, observations were taken at different intervals on the incidence of foot infection, branch infection and leaf infection. The observed values were transformed and statistically analysed. Results are presented in Table 3.17.

In the case of leaf infection (Lf) no significant difference between the treatments was observed. In the case of branch infection (Br.) treatment effects were significantly better than the control. It can be seen that the treatment effects for foot infection were significant. Except treatments 10, 11 and 12, all the treatments were equally effective in controlling foot infection by the pathogen. This showed that painting the lower stem portion of plant with 10% Bordeaux paste was effective and essential for controlling foot infection. The effect of the treatments on all the infections taken together is presented in the last column (Table 3.17). The treatments were significantly superior than the control, but the efficiency of the treatments in reducing the infection varied. A holistic consideration of the data shows that one pre-monsoon painting with 10% Bordeaux paste coupled with at least one foliar spray (1% B.M.) is the minimum plant protection schedule for controlling quick wilt disease of pepper. However, as the climate (especially the intensity and distribution of rainfall) may vary from place to place and year after

Table 3.17: Effect of fungicidal treatments on incidence of branch, foot and leaf infections of quick wilt

Tr. No.	Treatments	Mean infection		
		Branch infection	Foot infection	Total (Lf+Br+Ft.)
1	Bordeaux Paste in May-June	5.42	0.83	9.75
2	Bordeaux Paste in May-June and July-August	6.67	0	10.80
3	Bordeaux Paste in July-August and September-October	4.58	0.83	7.92
4	Bordeaux Paste in May-June and Bordeaux Spray in July-August	2.50	0	3.67
5	Bordeaux Paste in July-August and Spray in September-October	7.08	0.83	9.58
6	Bordeaux Paste in May-June and July-August and Spray in July-August	0.83	2.50	5.17
7	Bordeaux Paste in July-August and Spray in May-June and July-August	2.08	0.83	4.25
8	Bordeaux Paste and Spray in July-August	5.42	1.67	8.08
9	Bordeaux Paste in July-August and Spray in May-June, July-August September-October	4.17	0.83	6.67
10	Bordeaux Spray in May-June, July-August and Septemcer-October	2.92	4.17	8.42
11	Bordeaux Spray July-August and September-October	4.58	7.50	14.08
12	Control	16.65	7.50	28.08
	C D (0.05)	7.98	4.52	8.10

** Significant at 0.01 level

year, it would be safe to recommend two foliar applications of the fungicides in May-June and July-August or even a third spraying in September-October, along with the pre-monsoon painting with Bordeaux paste.

Studies on the ecological factors affecting 'quick wilt' disease of pepper Ag 4 (a) 11 Path. 2.03 [Panniyur]

The object of this experiment was to study the correlation between macro as well as micro-climatic conditions and the incidence of quick wilt disease of pepper.

An isolated plot of pepper, where quick wilt disease had been appearing continuously for the past few years, was selected and the plants were observed at weekly intervals for the disease incidence. One B-class meteorological observatory was established for recording the agroclimatic factors such as soil temperature, atmospheric temperature, relative humidity, light intensity, rainfall, etc.

The weather parameters thus collected would be correlated with the intensity of disease incidence, after the observations are continued for a few more year.

Quick wilt disease of pepper- Ecological studies [Vellanikkara]

Macro as well as micro-climatic factors and the incidence of the disease were being investigated. The studies are designed to identify the agro-climatic factors which are congenial for the outbreak of the disease in an epiphytotic form. During the year under report, experimental plots were selected and suitable plants marked.

Quick wilt disease of pepper - Survey of collateral hosts of Phytophthora palmivora, especially the weeds and other economic plants usually seen in pepper gardens of Kerala [Vellanikkara]

Work on finding out the host range of the pathogen was started during the year.

Quick wilt disease of pepper - Symptomatological studies Ag 4 (a) 19th Path. 2.05 [Vellanikkara]

The object of the trial was to describe the symptoms expressed during the pathogenesis starting from the early stages of infection on the different parts of the plant root, stem, branch, leaf, and to find out the proper time of fungicide application. *Phytophthora palmivora* was isolated and studied in culture and on host tissue. The symptom expression on leaves, stems, branches and root was described. Bio-assay of seven fungicides revealed that, Bordeaux mixture, Agallol, Bayer 5072 and Thiride were effective in completely checking the growth of the fungus at the concentrations tried. All the fungicides, except Dithane M 45, when sprayed or drenched two hours before inoculation completely checked the development of the disease. On aerial parts, the disease control was better when the fungicides were applied prior to inoculation. When the vines were treated with different fungicides, Bordeaux mixture and Bayer 5072 completly checked the disease on the third day. Soil drenching controlled the disease up to nine days. The results showed that drenching the soil was preferable to spraying during rainy season. None of the fungicides was effective in eradicating established infection, but Bayer 5072 arrested the growth of the lesions considerably.

The studies indicated that emphasis should be on prophylactic measures Detailed studies with systemic fungicides under field conditions, working out cost/benefit ratio, etc. are indicated as future lines of work.

Studies on spike shedding in pepper Ag 4 (a) 11 Path 3.01 [Panniyur]

Under this experiment, percentage of spike shedding was recorded from plants receiving different fertiliser doses, cultural treatments and plant protection

measures. Application of potash @ 150g/plant per year significantly reduced the percentage of shedding. This effect was observed only during one year (1979–80) and requires confirmation by further studies.

Mulching the basins of plants at the onset of the dry period seemed to be effective in controlling spike shedding in pepper as indicated by the following data (Table 3.18).

Table 3.18 Effect of mulching on spike shedding

Treatments	Mean percentage of spikes shed during 1978–'79	1979–'80
(mulching materials)		
Saw dust	3.93	23.91
Polythene sheet	5.80	23.41
Coconut husk	12.71	24.74
Arecanut husk	7 81	24.68
Dry leaves	2.50	24.23
Control	8.71	31.45

Investiagation on spike shedding in pepper Ag. H. 4 (a) 19 Path, 3.02 [Vellanikkara]

The studies were aimed at finding out the extent of spike shedding in different cultivars and for determining the physiological causes responsible for the shedding. Role of external application of growth regulators in reducing/eliminating the spike shedding were to be investigated upon. Role of imbalance in major nutrients on spike shedding were also to be ascertained. The studies were initiated as a PG project during the year.

Bacterial leaf spot of pepper (Piper nigrum L.) incited by xanthomonas betlicola Ag. 4 (a) 18 Path. 6.81 [Vellayani)

The project aimed at the characterisation of the pathogen, collection of isolates from different pepper growing areas of the State, assessment of the pathogenic variability in the bacterium, description of the symptoms, screening of pepper cultivars, etc. with reference to the new disease reported.

From the diseased specimens collected from different localities, nine isolates were obtained. Of these, six could initiate the disease. Variations in the symptoms produced by the different isolates were recorded.

CARDAMOM

PROJECTS IMPLEMENTED

		Locations
CROP IMPROVEMENT		
1	Germplasm collection in cardamom (Ag 4 (b) 17 Breed. 1.01)	Pampadumpara
2	Hybridisation of cardamom (Ag. 4 (b) 17 Breed 1.02)	Pampadumpara
3	Comparative yield trial of promising types of cardamom (Ag. 4 (b) 17 Breed. 2.01	Pampadumpara
4	Irradiation trial on cardamom	Pampadumpara
5	Studies on the blossom biology of cardamom (Ag. 4 (b) 17 Bot. 1.01)	Pampadumpara
6	Study on the initiation of flowering by hormonal treatments in selected cardamom varieties grown in coconut gardens	Vellayani
CROP MANAGEMENT		
7	Nursery practices in cardamom (Ag. H. 4 (b) 19 Hort. 1.01)	Pampadumpara Vellayani
8	Evaluation of different cultural practices on cardamom (Ag. 4 (b) 17 Agron. 1.01)	Pampadumpara
9	Effect of plant growth regulators on flowering and fruit set in cardamom (Ag.4 (b) 17 Hort. 1.02)	Pampadumpara
10	Studies on the effect of different chemicals on the germination of cardamom seeds (Ag. 4 (b) 17 Hort. 2.01)	Pampadumpara
11	Fertilizer trial in cardamom	Pampadumpara
12	Role of honey bees in the pollination of cardamom	Pampadumpara
CROP PROTECTION		
13	Studies on insects and nematodes associated with cardamom	Pampadumpara
14	Evaluation of newer insecticides against cardamom thrips	Pampadumpara
15	Evaluation of insecticides against cardamom shoot & capsule borer	Pampadumpara
16	Evaluation of granular systemic insecticides against insect pests, nematodes and vectors of virus diseases of cardamom	Pampadumpara
17	Field control of nematodes attacking cardamom (Ag. 4 (b) 18 Ent. 2.01)	Vellayani & Pampadumpara
18	Testing lines of cardamom for disease resistance (Ag. 4 (b) 11 Path. 1.01)	,,
19	Studies on 'Katte' disease-I (Ag 4 (b) 17 Path. 4.01)	,,
20	Studies on 'Katte' disease-II (Ag 4 (b) 17 Path 4.02)	,,
21	Studies on 'Azhukal' disease of cardamom (Ag 4 (b) 17 Path 5.01)	,
22	Synergistic effect of fungicide—insecticide mixtures against important plant pathogens.	

Germplasm collection in cardamom Ag 4 (b) Breed 1.01 [Pampadumpara]

The objective of the project was to collect and evaluate the varieties-types as well as wild relatives of cardamom. The collection availabe included the following:

Mysore; Malabar; Vazhukka; Ceylon; Kanni Elam; Manjarabad; Type 4; Type 6; Type 7; Type 17; PV_1; PV_2; PV_3; PV_4; PV_5; PV_6; PV_7 PV_8; PV_9 *Ammomum subulatum; Ammomum microstephanum; Aframomum melegueta; Alpinia galanga Hedychium coronarium;* Mini cardamom; Mini cardamom (Pink shoot) and cardamom with pink colour at the basal portion of stem.

During the year, a high yieid ng type af the Vazhukka variety was selected. Seeds of large cardmom, *Ammomum subulatum* were collected from Sikkim.

Hybridisation of cardomam Ag 4 (b) 17 Breed 1.02 [Pampadumpara)

The project was intended to study the polycross seedling progeny for their yield potential so as to select the parents that can be used for producing synthetic varieties and hybrids. Work was in progress.

Comparative yield trial of promising types of cardamon Ag 4 (b) 17 Bot.2.01 [Pampadumpara]

Promising types were selected from the germplasm collection of the Station and the progeny of these types were planted in a 7 x 5 replicated trial. Their performance during 1978-79 and 79–80 were as follows (Table 3.10). The types7, 107 and 17 performed best during the year

Table 3.19: Performance of cardamom type selectioos

Types	Mean yield during the first four years of bearing * (kg)	Weight of green capsules in g/plot of six plants (Mean over five replications) During 1978-79	During 1979-80
4	729.00	1542.00	2169.00
6	1102.70	2052.00	1684.00
7	1396.96	2312.00	2454.00
17	1621.95	1953.00	2186.00
103	1164.75	2160.60	2013.00
107	1237.00	1538.40	2304.00
149	737.10	1024.80	1242.60

* year of planting—1971

The plants started yielding only during 1974—75

Irradiation trial on cardamom (Pampadumpara)

The object of the experiment was to generate variability for exploitation. Different groups of seeds (fresh seeds, seeds with capsules and seeds sown 15 to 30 days prior to treatment) were irradiated by exposure to gamma rays at dosages ranging from 2 to 3 kr. Seedlings and rhizomes received dosages at 2 to 4 kr.

The plants raised from the irradiated seeds were maintained. The plants have not started yielding.

Studies on the biossom biology of cardamom Ag.4 (b) 17 Bot. 1.01 [Pampadumpara]

Studies aimed at gathering information on the various aspects of floral biology of cardamom were in progress, Pollen viability was observed to be maximum during the period bafore 10.00 a.m.

Study on the initiation of flowering by *hormonal treatment in selected cardamom varieties grown in cocount gardens* [Vellayani]

One hundred and sixty seedlings belonging to seven different varieties were planted in a coconut garden. During the first year, 50% of the plants dried up in spite of good care. At the end of the year, only 20 clumps remained. It seemed that the intensity of shade in the coconut garden was insufficient and/or the elevation of Vellayani was unsuitable for cardamom. During the year 1978–79, nine clumps flowered; but there wes no fruit set, even on assisted pollination (selfing or crossing).

Nursery practices in cardamom [Vellanikkara]

Effect of harvesting cardamom seed capsules at different months on germination of seeds and vigour of seedlings was studied for determining the bes stage and season of harvest. September harvested and sown seeds gave equal germination as those of November (Table 3.20). However, September harvest would be advantageous as it gives more time in the nursery and in view of the maximum seedling vigour.

Table 3.20: Germination as influenced by season of harvest

Harvest period	% germination 90 days after sowing
September	38.30
October	30.78
November	38.41
CD (0.05)	2.40

It was also observed that ripe seeds gave higher germination than fully ripe or just ripe seeds. Among the seed treatments, gibberellic acid, scarification + hot water treatment and cowdung slurry recorded higher germination percentage (Table 3.21).

Table 3.21 : Germination as influenced by stages of harvest and seed treatments.

Seed treatments	Percentage germination 90 days after sowing			
	Fully ripe seeds	Just ripe seeds	Over ripe seeds	Mean
Local practice	22.94	14.58	29.27	22.26
Hot water treatment	25.39	11.37	37.02	24.59
Nitric acid	35.86	19.80	39.23	31.63
Scarification	36.24	30.64	41.93	36.27
Gibberllic acid	43.47	29.70	47.68	40.28
Cowdung slurry	43.47	26.71	41.14	37.11
Ether 50%	29.24	24.57	39.40	31.07

Ether followed by HNO_3	36.25	17.90	41.93	32.03
Scarification + hot water	42.50	28.39	49.63	40.17
Soaking in water	40.01	21.44	47.73	34.39
Mean	35.54	22.51	40.80	—

CD (0.05) for stage of harvest (90 days) = 1.820

CD (0 05) for seed treatment (,,) = 3.324

Capsule form and polythene lined gunny bags were identified as the best methods of storage.

Row spacing at 6 cm, 8 cm and 10 cm using a constant seed rate of 10g/m^2 gave seedlings of higher vigour than the wider spacings of 12 cm and 14 cm.

Evaluation of different cultural practices on cardamom:- Ag 4 (b) 17 Agron 1.01 [Pampadumpara]

Field experiment was conducted to find out the effects of various cultural treatments (terracing, trenching, pit method, basin method and control) on the growth and yield of cardamom. The plants started yielding during 1979-80. The yield data are given in Table 3.22.

Table 3.22: Yield/plot (net weight in g)

	Control	Terracing	Forming trenches	Pit method	Forming basins around the plant
R I	13870	7350	13705	9150	10150
R II	11625	11050	13550	10300	1300
R III	900	1650	2800	2635	750
R IV	400	7450	400	—	1200
Total	26795	27500	30455	22085	13400

Forming trenches seemed to have advantage over the other methods.

Effect of plant growth regulators on flowering and fruit set in cardamom- Ag. 4 (b, 17 Hort. 1.02 [Pampadumpara]

The experiment was aimed at finding out whether fruit-set in cardamom could be increased by the application of the commonly available growth regulators.

Studies on the effect of different chemicals on the germination of cardamom seeds Ag. 4 (b) 17 Hort. 2.01 [Pampadumpara]

Work was initiated on soaking cardamom seeds in water, nitric acid, ether, sodium chloride, etc. at different concentrations for varying periods to find out their effect on germination of seeds.

Fertilizer trial in cardamom [Pampadumpara]

The trial was in progress sinKe 1976 at the Cardamom Research Station,

Pampadumpara. It aimed at determining the requirements of major and minor nutrients for cardamom. The yield data are presented in Table 3.23:

Table 3.23. Yield per shoot in grammes (wet weight)

Block I			Block II			Block III		
Treatments	Rep. I	Rep. II	Treatments	Rep. I	Rep. II	Treatments	Rep. I	Rep. II
$N_0P_0K_0$	58.86	67.62	$N_0P_0K_0$	75.90	69.64	$N_0P_0K_0$	70.09	67.62
$N_1P_1K_1$	31.19	33.02	$N_1P_1K_3$	43.28	21.59	$N_1P_1K_2$	35.18	57.92
$N_1P_1K_1$ (Foliar N)	58.75	77.34	$N_1P_2K_2$	55.81	48.59	$N_1P_2K_1$	81.44	49.84
$N_1P_1K_1$ (Ca+Mg)	24.47	51.55	$N_1P_3K_1$	66.31	43.63	$N_1P_3K_3$	60.55	36.25
$N_1P_2K_3$	104.42	33.03	$N_2P_1K_1$	64.21	36.33	$N_2P_1K_3$	123.30	85.62
$N_1P_3K_2$	215.00	47.60	$N_2P_2K_3$	43.60	74.77	$N_2P_3K_1$	62.93	53.28
$N_2P_1K_2$	39.25	48.51	$N_2P_3K_2$	37.59	23.9	$N_2P_2K_2$	47.67	92.74
$N_1P_2K_1$	25.83	33.23	$N_3P_2K_1$	41.59	58.61	$N_2P_2K_3$ (Foliar N)	33.74	56.20
$N_1P_3K_3$	62.54	67.19	$N_3P_1K_2$	40.10	44.89	$N_2P_2K_2$ (Ca+Mg)	40.31	44.39
$N_3P_1K_2$	35.88	86.80	$N_3P_3K_3$	60.80	30.73	$N_3P_1K_1$	56.24	80.09
$N_3P_2K_2$	45.13	57.51	$N_2P_2K_2$ (Foliar N)	76.47	45.26	$N_3P_2K_3$	60.14	38.24
$N_3P_3K_2$	50.47	58.25	$N_3P_3K_3$ (Ca+Mg)	56.18	79.11	$N_3P_3K_2$	65 35	33.21

Table of means

	P1	P2	P3	Mean		K1	K2	K3	Mean
n1	111.10	155.57	234.68	177.12	P1	150.55	132.93	183.24	155.57
n2	183.61	158.93	153.79	165.44	P2	145.27	173.73	173.61	164.20
n3	172.01	148.11	154.16	158.09	P3	167.69	211.35	163.59	180.88
Mean	156.57	164.20	180.88	500.65	Mean	154.50	172.67	173.48	500.65

	K1	K2	K3	Mean
n1	152.72	230.06	148.57	177.12
n2	137.91	144.85	213.57	165.44
n3	172.88	143.10	158.30	158.09
Mean	154.50	172.67	173.48	500.65

Statistical analysis of the 1979-80 data was in progress. Pooled analysis of the 1977-78 and 1978-79 data indicated that the treatments were not effective in increasing the yield.

Role of honey bees in the pollination of cardamom—(Pampadumpara)

Bee colonies were maintained at different rates and their effects on fruit set estimated. Results (Table 3.24) indicated that the fruit set was maximum in plots where four hives were colonised per hectare.

3.24: Role of honey bees in the pollination of cardamom

Treatments	Fruit set (%)	Transformed values
T1 No bee colony	27.869	(31.88°)
T2 Two colonies/ha	29.016	(32.58°)
T3 Four colonies/ha	31.808	(34.33°)
T4 Six colonies/ha	30.634	(33.58°)

T2—T1 is significant
T3—T2 is significant
T3—T4 is significant

Studies on the insects and nematodes associated with cardamom (Pampadumpara)

The shoot fly observed in the nursery was identified as *Formosina flavipes* (Chloropidae). Studies on the control of the shoot fly in the nursery indicated that spraying 0.1% Ekalux was the most effective treatment, as indicated in Table 3.25.

Table 3.25. Percentage of shoots infected by the cardamom shoot flies

Treatments	December	January	February	March	April	May	June
T1 (Furadan100g/ 6 sq.m.)	8.88	9.44	16.54	0	7.51	2.99	0
T2 (Temik 30 g)	15.32	12.29	8.27	0	0	3.40	3.01
T3 (Solvirex 60 g)	15.17	26.78	8.53	0	0	7.84	6.05
T4 (Thimet 30 g)	5.98	4.17	13.73	0	0	0	4.07
T5 (Phorate 30 g)	9.51	12.22	17.43	0	0	6.80	0
T6 (Dimecron 0.1%)	0	7.04	9.15	0	0	11.83	0
T7 (Monocrotophos 0.1%)	8.78	4.26	11.38	—	9.64	0	23.78
T8 (Carbaryl 0.2%)	8.21	17.30	12.72	—	5.55	13.57	13.38
T9 (Ekalux 0.1%)	0	0	0	—	2.87	0	0
T10 (Neem cake 2 kg/6 sq.m)	10.78	17.77	11.79	10.05	11.25		18.99
T11 (Control)	11.34	25.36	7.95	4.55	4.82	13.43	18.10
CD—(0.05)	—	13.67	—	—	—	—	—

Significant difference was noticed only during January and June. During the other periods, treatment difference failed to show significance. During January, T9, T4, T7, T6 and T1 were found to be effective against shoot fly. During June, the effective treatments were T9, T5, T6, T1, T2, T4, T3 and T10.

Evaluation of newer insecticides against cardamom thrips (Pampadumpara)

Two trials were laid out, one to evaluate the effect of skipping insecticide application after the formation of capsules and the other to determine the dose and method of application of three insecticide dusts (Quinalphos, Phenthoate and Methyl parathion).

Table 3.26: Effect of skipping insecticide application after capsule formation on the incidence of cardamom thrips

Treatments	Mean percentage of thrips infestation (after angular transformation,
Eight sprayings from June	22.22
Seven sprayings from June	20.86
Six sprayings from June	20.43
Five sprayings from June	13.90
Four sprayings from June	28.92
Control	61.24
CD (0.05)	4.686

The data (Table 3 26) indicated that five sprays from June gave effective control. Observations on the second experiment are furnished in Table 3.27.

Table 3.27: Evaluation of the effect of different doses and methods of application of insecticide dusts against thrips infestation

Treatments	Mean percentage of thrips infestation (After angular transformation)
Using duster	
Ekalux 10 g (Quinalphos)	20.45
Ekalux 15 g (")	18.80
Ekalux 25 g (")	20.76
Phendol 10 g (phenthoate)	23.87
Phendal 15 g (")	24.11
Phendal 25 g (")	26 51
Folidol 10 g (Methyl parathion)	26.79
Folidol 15 g (")	23.29
Folidol 25 g (")	26.52
Using cloth bag	
Ekalux 10 g	21.86
Ekalux 15 g	24.48
Ekalux 25 g	13.84
Phendal 10 g	25.41
Phendal 15 g	23.64
Phendal 25 g	24.34
Folidol 10 g	32.29
Folidol 15 g	22.87
Folidol 25 g	32.12
Control	60.60
CD (0.05)	7.875

The three dusts gave effective control. There was no significant difference between the two methods of application.

Evaluation of insecticides against cardamom shoot & capsule borer (Pampadumpara)

Eleven insecticides (0.1% spray) were evaluated against cardamom shoot and capsule borer. Observations on infestation by shoot and capsule borer were made at monthly intervals.

The results are presented in Table 3.28.

Table 3.28 Percentage of borer infested shoots (Mean values in angles)

Treatments	March	April	May	June	July	August	September-October	November	December	January
Control	3.77	7.16	6.01	10.31	10.95	1.57	3.33	3.35	7.03	7.83
Marvex Super	5.33	10.16	9.84	3.77	2.47	0.00	0.00	8.80	3.61	6.27
Monocrotophos	5.30	7.12	1.87	0.00	7.08	0.00	0.00	3.94	2.18	1.53
BHC—50%.	5.13	11.68	7.56	4.96	1.55	1.44	2.13	5.52	8.60	9.83
Sevin	8.53	7.56	6.91	7.72	1.83	0.00	1.76	3.21	7.21	5.22
Metacid	1.81	4.64	0.00	2.25	1.68	0.00	0.00	4.07	4.59	3.47
Zolone	9.70	11.64	6.34	0.00	1.61	2.84	0.00	5.80	5.57	6.82
Ekalux	0.00	0.00	3.50	0.00	0.00	1.78	2.99	2.95	1.50	1.72
Lebaycid	1.61	1.80	0.00	0.00	0.00	1.43	1.72	4.60	0.00	2.04
Dimecron	6.02	1.84	5.27	0.00	1.37	4.46	3.81	5.65	5.65	8.62
Sevimol	0.00	0.00	0.00	9.19	7.10	3.40	3.01	3.24	5.65	8.62
Thiodan	0.00	0.00	9.19	8.15	5.80	4.12	0.00	3.24	4.84	4.37
CD (0.05)	4.62	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS—Not Significant

The results showed that Thiodan Endosulfan) was effective in reducing the infestation of capsules.

Evaluation of granular systemic insecticides against insect pests, nematodes and vectors of virus diseases of cardamom (Pampadumpara)

Five insecticides were applied at bimonthly intervals @ 0.6g ai/per plant. The results (Table 3.29) showed that the treatments were effective in reducing the thrips population. Among the five insecticides, Disyston was the most effective.

Table 3.29: Number of borer infested shoots, population of aphids and thrips per plot

Treatments	Number of borer infested shoots		Population of aphids	Population of thrips	
	August 77 to July 78	August 78 to July 79		August 77 to July 78	August 78 to July 79
Control	9.76	9.76	11.84	13.54	9.84
Temik	8.50	10.51	14.19	9.65	10.72
Thimet	9.33	10.52	12.77	8.72	10.34
Solvirex	9.51	9.61	11.63	9.71	8.58
Disyston	8.24	9.17	10.39	10.80	8.81
Furadan 3 g	9.05	11.05	12.03	7.36	9.33
CD (0.05)	—	—	—	2.34	—

Field control of nematodes attacking cardamom:– Ag 4 (b) 18 Ent. 2.01 [Vellayani, Pampadumpara]

The project aimed at evolving suitable control measures for the nematodes attacking cardamom. The treatments consisted of application of Furadan, Temik, Nemacin, Methyl bromide as well as sun drying of soil and burning the stubbles. Fumigation of soil with Methyl bromide reduced the soil population of plant parasitic nematodes in the primary nursery. Field estimation of soil and root populations of nematodes in the secondary nursery was under way.

Testing lines of cardamom for disease resistance:– Ag. 4 (b) 11 Path. 1.01 [Pampadumpara]

The object was to test the resistance of cardamom varieties to katte disease. Seeds were collected from healthy plants growing adjacent to katte affected plants and sown in the glass house for inoculation studies. A total number of 5400 seedlings were raised and inoculated with viruliferous aphids @ 5 per plant during April-May, 1979. These seedlings were transplanted to the secondary nursery during August 1979. None of the plants showed the incidence of the disease.

Studies on Katte disease-I – Ag. 4 (b) 17, Path. 4.01 [Pampadumpara]

The objective was to identify different insects that are vectors of 'katte' disease. Suspected insect vectors of 'katte' disease were collected and identified. Their ability to transmit the virus was also assessed. No new insect could be identified as a vector.

Studies on Katte disease-II – Ag. 4 (b) 17. Path. 4.02 [Pampadumpara]

The object of this project was to demonstrate the effect of eradication of 'katte' affected plants in reducing the incidence of the disease. The percentage of infected plants was reduced as a result of continuous eradication of affected plants as shown in Table 3.30.

Table 3.30: Percentage of infected plants

Year	Plot – I		Plot – II	
	Total plants	Infected plants	Total plants	Infected plants
1974	218	34	298	113
1975	218	12	298	24
1976	218	4	298	17
1977	218	9	298	17
1978	218	4	298	5

The experiment was concluded during the year.

Studies on 'Azhukal' disease of cardamom – Ag. 4 (b) 17. Path. 5.01 [Pampadumpara]

The object of this project was to study the etiology of the pathogen, its collateral hosts and methods of control.

A fungicidal trial using seven fungicides was laid out at the Cardamom Research Station, Pampadumpara. The treatments were given thrice during the months of July, August and October '79. Quantity of fungicidal solution used for spraying was one litre per plant and for drenching two litres per plant. Observations on total number of healthy and infected shoots, panicles and capsules and the number of leaves infected per clump were recorded. The percentage of capsule infection and data on average yield are given in Table 3.31.

In the case of panicle, shoot and leaf infections, the percentage of incidence of the disease was less than 1% in all cases During the season, the incidence of the disease was very low. Hence the results obtained were not analysed. However, the trend showed that the spraying and/or drenching 1% Bordeaux mixture was effective in reducing the capsule and panicle infection.

Synergistic effect of fungicide-insecticide mixtures against important plant pathogens Ag. 12–17–8–3 [Pampadumpara]

The objective of the project was to study the combined effects of insecticides and fungicides against new pests and diseases of cardamom. Though a trial was laid out with the fungicides, Bavistin, Kitazin, Calixin and Hinosan and the insecticides Lebaycid, Phendal, Dimecron and Metacid during the previous year, it was discontinued due the non-occurrence of the disease. *In vitro* studies are proposed to be conducted at the College of Agriculture, Vellayani. Further field studies will be taken up later.

Table 3.31: Percentage of capsule infection and yield of cardamom

Treatments	% of capsule infection at stage					Average yield (g/plot) (wet weight)
	(1)	(2)	(3)	(4)	(5)	
Bordeaux mixture (1% spray)	1.13	0.56	0.00	0.01	0.00	814.1
-do- (1% drench)	0.21	0.09	0.00	0.00	0 00	673.9
-do- (1% spray & 1% drench)	0.09	0.18	0.00	0.00	0.00	342.2
Dithane M-45 (0.25% spray)	1.14	0.71	0.71	0.13	0.21	447.8
-do- (0.3% drench)	0 96	1.11	1.35	0.63	0.18	1816.8
-do- (0.25% spray & 0.3% drench)	0.08	0.28	0.04	0.02	0.00	1100.2
Bayer 5072 (0.1% spray)	0.19	0.09	0.04	0.08	0.00	1053.7
-do- (0.03% drench)	0.18	0.08	0.03	0.08	0.00	769.2
-do- (0.1% spray & 0.03% drench)	0.03	0.05	0.19	0.06	0.26	1151.1
Bavistin (0.03% spray)	2.39	0.45	0.03	0.04	0.17	669.3
Difolatan (0.3% spray)	0.66	0.09	1.85	0.08	0.13	592.9
Cuman L (0.3% spray)	1.03	0.08	0.00	0.25	0.07	743.5
Cheshunt compound (3.1 gm/lit of water drench)	0.68	0.07	0.03	0.23	0.27	470.0
Control	0.16	0.09	0 06	0.21	0.14	469.4

1) Pre treatment observation
2) 30 days after first spraying
3) 30 days after second spraying
4) 60 days after second spraying
5) 30 days after third spraying

NUTMEG & CLOVE

PROJECTS IMPLEMENTED

		Locations
CROP IMPROVEMENT		
1	Germplasm collection of nutmeg & clove (Ag. H. 4 (c) Breed 1.01)	Vellanikkara
CROP MANAGEMENT		
2	Studies on the effect of containers, potting mixtures on growth and survival of clove seedlings (Ag. H. 4 (d) 18 Hort. 1.01)	Vellanikkara
CROP PROTECTION		
3	Studies on the diseases of clove, nutmeg and cinnamon, as occurring in Kerala State (Ag. 4. (d) 19 Path. 1.01)	Vellayani
4	Studies on the leaf blight disease of clove, caused by *Cylindrocladium* sp. (Ag. 4 (d) 18 Path. 201)	Vellayani

Gemplasm collection of nutmeg and clove (Ag. H. (c) 19 Breed 1:01 [Vellanikkara]

A total of 48 nutmeg collections have been made and planted in 1976. Due to lack of irrigation facilities, only five survived. The growth parameters like height, girth, branching, spread etc. were recorded at six monthly interval.

Studies on the effect of containers, potting mixtures and growth regulators on growth and survival of clove seedlings Ag H. 4 (d) 18 Hort. 1.01 [Vellayani]

The studies were undertaken to find out the methods to increase the percentage germination of clove seeds, to accelerate the rate of growth of the seedlings and to improve the percentage survival of the seedlings transplanted to the main field.

The seeds collected and sown during the month of June recorded the highest percentage of germination However, the May seeds were found to be superior with regard to the rate of growth and vigour of the resultant seedlings. Heavy seeds recorded the highest percentage of germination; but heavy and medium seeds were on par with regard to the rate of growth of seedlings. The removal of pericarp increased the percentage germination; but did not influence the rate of growth of the resultant seedlings.

The clove seedlings from the primary nursery when transplanted to improvised coconut husk pots filled with a mixture containing one part sand, one part powdered cowdung and two tea spoons each of bone meal and powdered groundnut cake exhibited higher rate of growth. Spraying GA 200 ppm+urea 0.5 per cent to the clove seedlings transplanted to coconut husk pots enhanced their rate of growth. Transferring the seedlings from the primary nursery to coconut husk pots at the second month and transplanting them to the main field with the container intact at the ninth month gave higher rate of survival.

Studies on the diseases of clove, nutmeg and cinnamon, as occurring in Kerala state
Ag. 4 (d) 19 Path. 1,01 [Vellayani]

A survey was conducted on the occurrence of various diseases of clove, nutmeg and cinnamon and diseased specimens were collected for detailed studies. Studies on the following diseases were undertaken:

1 Leaf spot, twig blight and flower shedding of clove caused by *Colletotrichum gloeosporioides*

2 Leaf spot and shoot-rot disease of nutmeg

3 Leaf spot and die back disease of cinnamon caused by *C. gloeosporioides*

4 Sooty mould of clove and cinnamon

5 Little leaf disease of clove

It was observed that the clove pathogen survived in Clerodendron. Detailed studies on etiology and morphology of the diseases were undertaken. Fungicidal trials for the control of important diseases of the major tree spices were laid out at the District Agrl. Farm, Kozha and at Vellayani. Selected fungicides were sprayed. Studies on the physiology of persistance, host-pathogen relationship, physiological alterations on host metabolism, etc. were also initiated.

Studies on the leaf blight disease of clove caused by Cylindrocladium sp
Ag. 4 (d) 18 Path. 2.01 [Vellayani]

The fungus, *Cylindrocladium quinqueseptatum* infected clove leaves at all stages of maturity. The seedlings were found to be more easily susceptable to the disease. Injury of the host tissue was found to be a pre-requisite for the successful development of the disease. The fungus infected a wide variety of plants such as tapioca, cashew, eucalyptus, *Annona* and *guava*. The culture filtrate of the fungus inhibited the spore germination of *Colletotrichum gloeosporioides* and *Curvularia* sp. Spore germination of the fungus could be inhibited completely by all the eight fungicides tested. Deconil—2787, Dithane M-45, Fytolan and Thiride at the maximum concentration of 3000 ppm caused 94, 97, 94 and 95 percent inhibition of spore germination, respectively up to the 12th day. Bavistin and Thiride inhibited the growth of the fungus at the minimum concentration tested (250 ppm of Bavistin and 1000 ppm of Thiride).

GINGER

PROJECTS IMPLEMENTED

CROP IMPROVEMENT

		Locations
1	Germplasm collection of ginger (Ag. 4 (e) 12 Breed. 1.01)	Ambalavayal
2	Blossom biological and hybridisation studies in ginger. (Ag. 4 (e) 19 Breed. 3.01)	Vellanikkara
3	Screening of varieties of ginger for partially shaded conditions (Ag. 4 (e) 2 Breed. 4.01)	Mannuthy
4	Varietal trial to isolate high yielding, disease resistant/ tolerant varieties (Ag. 4 (e) 12 Breed. 4.02)	Vellanikkara
5	Selection of varieties suitable for the second crop of ginger (irrigated)	Ambalavayal

CROP MANAGEMENT

6	Standardisation of cultural practices for the second crop of ginger (irrigated) (Ag. 4 (e) 12 Agron. 2 01)	Ambalavayal

CROP PROTECTION

7	Field trial on control of nematodes attacking ginger (Ag. 4 (e) 12 Ent. 1.01)	Vellayani
8	Studies on nematode diseases of ginger (Ag. 4 (e) 18 Ent. 1 (i)	Vellayani
9	Studies on the control of lesion nematode, *Pratylenchus sp.* on ginger using organic amendments (Ag. 4 (e) 18 Ent. 1.02)	Vellayani
10	Studies on the control of soft rot disease of ginger–1 (Ag. 4 (e) 12 Path. 1.01)	Ambalavayal
11	Studies on the control of soft rot disease of ginger–1 (Ag. 4 (e) 19 Path. 1.02)	Vellanikkara
12	Studies on the symptomatology, etiology and control of the new bacterial disease of ginger in Wynad (Ag. 4 (e) 12 Path. 2.01)	Ambalavayal
13	Etiology of the bacterial wilt of ginger incited by *Pseudomonas solanacearum* and its control. (Ag. 4 (e) 18 Path. 3.01)	Vellayani
14	Studies on the *Phyllosticta* leaf spot of ginger (Ag. H. 4 (e) 19 Path. 4.01)	Vellanikkara

Germplasm collection of ginger (Ag 4 (e) 12 Breed 1.01) [Ambalavayal]

The objective was to establish a germplasm bank of exotic and indigenous types of ginger with a view to studying their yield potential and other economic characters.

Yield data during 1979-80 of the twenty five collections were as follows (Table 3.32:)

Table: 3.32: Performance of ginger types

Types	*Mean yield/plot (kg)*
Thingpuri	1.410
Valluvanad	0.285
Thodupuzha	1.625
Ernad Chernad	1.350
Narasapattam	2.500
Ernad Manjeri	0.420
Karakkal	0.600
Burdwan	0.535
Jugijan	2.225
Taiwan	0.080
Thinladium	0.400
Assam	1.125
Jorhat	2.285
Bajpai	1.445
Sierra-Leone	2.750
China	4.400
Vengara	2.350
Nadia	1.925
Uttar Pradesh	2.725
Wynad Kunnamangalam	5.500
Wynad Manantody	0.700
Himachal Pradesh	2.000
Kuruppampady	2.600
Tafengiva	2.000
Arippa	4.100

The difference between the types was significant. Wynad Kunnamangalam ranked first, followed by China and Arippa. The drastic reduction in yield observed during the year was caused by the heavy incidence of rhizome rot and bacterial wilt.

Blossom biological and hybridisation studies in ginger Ag 4 (a) 19 Breed. 3 01 [Vellanikkara]

Studies were in progress which aimed (i) collection of detailed information on floral structure and floral biology of ginger (ii) evaluation, through hybridisation of a good variety of ginger with desirable economic characters like high yield, high oil and oleoresin, low fibre content and resistance to soft rot disease.

Screening of varieties of ginger for partially shaded conditions (Ag. 4 (e) 2 Breed. 4.01 [Mannuthy]

An experiment in 5x5 lattice was laid out using twenty four ginger varieties procured from the Horticultural Research Station, Ambalavayal along with Mannuthy local. The crop was completely destroyed due to heavy incidence of soft rot disease.

Varietal trial to isolate high yielding disease resistant/tolerant varieties (Ag. 4 (e) 19 Breed. 4.02) [Vellanikkara]

Detailed study on 25 ginger types was conducted from April 1977 to June 1978. Length of leaf, leaf area index as well as number, length and girth of primary and secondary fingers were found to be correlated with yield.

Maximum incidence of soft rot (27.5%) was recorded in Rio-de-Jeneiro and minimum (3.2%) in Maran. Taiwan showed highest susceptibility to leaf spot and Tafengiva, the least. Maximum attack of shoot border (43.4%) was found in Valluvanad and minimum (21.3%) in Rio-de-Janeiro.

The type Wynad Kunnamangalam recorded the highest green yield 16,927kg/ha) followed by Thingpuri (16,667kg/ha), Wynad local (16,625kg/ha) and Arippa (kg/ha). Maximum yield of dry ginger (6453.16 kg/ha) was recorded in Nadia, followed by Bajpai (5074.28kg/ha), Maran (5042.05 kg/ha) and Narasapattam (4801.44kg/ha). Thodupuzha ranked first (25.2%) and Karakkal the least (15.2%) in dry ginger recovery.

Maximum oleoresin content was recorded by Rio-de-Janeiro, followed by Bajpai. Karakkal with an oil content of 2.4% topped the list, followed by Rio-de-Janeiro (2.3%) and Maran (1.9%). Fibre content was minimum (3.4%) in China and maximum (6.4%) in Kuruppampady. The percentage of oleoresin, oil and fibre were maximum at 165 days after planting, whereas the maximum yield per hectare of oleoresin and oil were at 270,245 and 225 days after planting in the varieties Rio-de-Janeiro, Maran, Kuruppampady and Wynad local.

Nadia, Bajpai and Maran were found suitable for obtaining high total yield of dry ginger, oleoresin and oil.

Selection of varieties suitable for the second crop of ginger (irrigated) [Ambalavayal]

The project aimed at selecting varieties of ginger suitable for the second crop of irrigated ginger. Seven types were put under a randomised replicated trial and the yield data are furnished in Table 3.33.

Table: 3.33: Performance of ginger varieties during second crop season (irrigated)

Types	Yield (kg/plot of 5 m^2) Mean over four replications
Rio-Janeiro	13.95
Ernad Chernad	8.10
Wynad Manantoddy	8.88
Thodupuzha	9.92
Valluvanad	7.76
Kuruppampadi	10.42

The type-Rio-de-Janeiro ranked first in respect of yield of green ginger.

Standardisation of cultural practices for the second crop of ginger (Irrigated) Ag 4 (e) 12 Agron 2.01 [Ambalavayal]

The project aimed at standardising the time and method of planting ginger under irrigated conditions.

Table 3.34: Yield of fresh rhizomes

Treatments*		Mean of four replication (kg/plot of 6m²)
T_1	S_1	4.45
	S_2	7.85
	S_3	7.90
T_2	S_1	2.53
	S^2	4.28
	S_3	5.10
T_3	S_1	3.73
	S^2	7.53
	S^3	7.30
T_4	S_1	3.95
	S_2	6.75
	S_3	10.05

T_1 — Planting on flat ground
T_2 — ,, on ridges
T_3 — ,, in furrows
T_4 — ,, on rased beds.

S_1 — Mid Jan. 1979
S_2 — Late Jan. 1979
S_3 — Mid Feb. 1979

The data (Table 3.34) revealed that planting in raised beds and by February gave the maximum yield for irrigated second crop of ginger.

Field trial on control of nematodes attacking ginger Ag. 4(e) 12 Ent. 1.01 [Vellayani]

The project aimed at evolving suitable field control measures for nematodes attacking ginger. Soil treatment was done with the following nematicides. The treatments were repeated after three months.

Furadan	: 5g, 10g, 15g/m²,
Temik	; 1.5g, 3.0g, 4.5g/m²
Furadan 4F	: 0.05% suspension
FMC 35001 (Posse 3G)	: 7g/m²
Thimet	: 1.5g, 3.0g, 4.5g/m²

All the treatments were found to be superior to the Control. Maximum yield was obtained from the plots treated with Temik @ 4.5g/m².

Studies on nematode diseases of ginger Ag. 4 (e) 18 Ent. 1 (i) [Vellayani]

M. incognita, Radopholus similis, Pratylenchus sp. and *Helicotylenchus* sp. were seen associated with ginger in all the areas showing disease symptoms. Twenty varieties were screened and all were found susceptible to *M. incognita*. At all levels of nematode inoculum, the top growth and the underground growth of ginger plants were reduced and they showed yellowing and wilting. Histopathological studies revealed that the xylem vessels and tracheids were disrupted by the nematodes. Xylem vessels disintegrated and formed giant cells, finally resulting in the deformation of roots. The three nematicides tested (Phenamiphos, Aldicarb and Phorate at 2.5, 5.0 and 7.5 kg ai/ha) gave good control of the

nematode and substantially increased the tiller production, height of plants, length of plants, length of leaves, weight of shoot and weight of rhizomes. Maximum control was obtained with Phorate treatment.

Studies on the control of lesion nematode, Pratylenchus sp. on ginger using organic amendments—Ag 4 (e) 18 Ent. 1.02 [Vellayani]

The objective was to evaluate the efficacy of organic amendments in the control of the lesion nematode attacking ginger. Saw dust and paddy husk (150 g & 250g each per plot) were added to ginger raised in pots. Thirty days after planting, uniform inoculum of 1000 lesion nematode larvae were given. Data on various growth characters and yield indicated that both saw dust and paddy husk @ 250g/ plot were effective in controlling the nematode.

Studies on the control of soft rot disease of ginger—Ag. 4 (e) 12 Path 1.01 [Ambalavayal]

Efficacy of five chemicals (Aureofungin Sol, Difolatan, Thiride, Agallol-3 and Cheshunt compound) against the soft rot disease of ginger was to be tested. The differential treatments could not be given, as the crop was severely by affected by the bacterial wilt.

Studies on the control of soft rot disease of ginger-II— Ag 4 (e) 19 Path 1.02 [Vellanikkara]

Six fungicides at three concentrations were made use of for drenching the soil. These fungicides were also used for treating the rhizomes before planting. Three varieties of ginger (a comparatively resistant one, a susceptible one and a resistant one) were used for the study. *in vitro* studies indicated more than 90 per cent inhibition of the fungus, *Pythium aphanidermatum* under Agallol, Thiride and Difolatan at 500 ppm concentration. Hundred percent inhibition was possible only with 2000 ppm cheshunt compound or Thiride with 500 ppm Agallol. Cheshunt compound, Agallol and Thiride was the best combination for inhibiting the mycelial growth. Soil drenching before planting with Cheshunt compound, Agallol and Thiride reduced the pre-emergence rotting considerably. A minimum of two post-emergence applications (one and three months after planting) of either cheshunt compound or Agallol, in addition to the pre-planting soil drenching was found necessary to control the disease.

Studies on the symptomatology, etiology and control of the new bacterial disease of ginger in wynad—Ag 4 (e) 12 Path. 2.01 [Ambalavayal]

Investigations on survival of the pathogen in soil and seed material were conducted. Rio-de-Janeiro seed rhizomes were treated with Plantomycin (500 ppm) and planted in beds in alternate rows. Another lot without the seed treatment served as the control. The data on germination and disease intensity were recorded. Germination counts revealed that the seed-treatment enhanced the germination. However, the disease intensity was more or less the same in treated and untreated rhizomes, revealing thereby that the primary source of inoculum was mainly through soil in which the pathogen survived.

In a pot cultute trial, soil was filled after fertilisation and one set of treated and another set of untreated rhizomes were planted. In another set of pots, unsterilized soil was filled for planting treated as well as untreated seeds. The indications obtained were that the primary source of inoculum can be through soil as well as through seed material as there was heavy incidence of disease in sterilzed and untreated seeds as well as in unsterilized and treated seeds.

Etiology of the bacterial wilt of ginger incited by Pseudomonas solanacearum and its control—Ag 4 (e) 18 Path. 3.01 [Vellayani]

Symptomatology under natural and artifical conditions were found to be more or less identical. Physiological and biochemical tests were conducted and the pathogen was characterized. The pathogen was identified as *Pseudomonas solanacearum*.

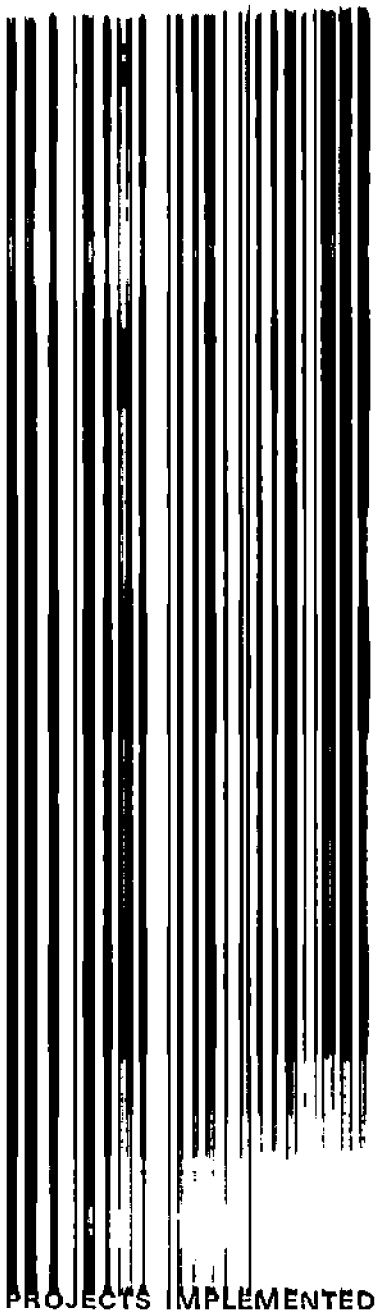
Infected seed rhizomes, plant debris and soil were found to play a role in in the survival of the pathogen. The pathogen was found to survive in infected seed rhizome for more than four months. In infected soil, it survived for more than six months under the laboratory conditions.

Screening of chemicals for the control of the pathogen and investigations on the role of nematodes were under way.

Studies on the Phyllosticta leaf spot of ginger Ag. H. 4 (e) 19 Path. 4.01 [Vellanikkara]

The causal organism of the leaf spot disease of ginger was confirmed to be *Phyllosticta zingiberi* Ramakr. The disease control trial in the field indicated that Cuman was the best fungicide. Bordeaux mixture was on par with Cuman. Out of the 22 types of ginger screened, Maran, Karakkal. Burdwan and Nadia were less susceptible to the disease as compared to the other types. None of types was found resistaet to the disease.

TURMERIC



PROJECTS IMPLEMENTED

CROP IMPROVEMENT	*Locations*
1 Germplasm collection of turmeric (Ag. 4 (f) 12 Breed. 1.01)	Ambalavayal
2 Screening of varieties of turmeric for partially shaded	

TURMERIC

PROJECTS IMPLEMENTED

		Locations
	CROP IMPROVEMENT	
1	Germplasm collection of turmeric (Ag. 4 (f) 12 Breed. 1.01)	Ambalavayal
2	Screening of varieties of turmeric for partially shaded conditions (Ag. 4 (f) 2 Breed. 2.01)	Mannuthy
3	Varietal trial on turmeric (Ag. H. 4 (f) 19 Breed. 3.01)	Vellanikkara
4	Multi-locational trial on turmeric	Multilocational
5	Varietal trial and maturity studies on turmeric (Ag. 4 (f) 18 Breed. 3.02)	Vellayani
6	Variability in the open pollinated progenies of turmeric, *Curcuma aromatica* (Ag. H4 (f) 19 Breed. 4.01)	Vellanikkara
	CROP MANAGEMENT	
7	Foliar diagnosis, yield and quality of turmeric in relation to N, P and K (Ag. H4 (4) 19 Chem. 1.01)	Vellanikkara
8	Effect of growth regulators on growth, yield and quality of turmeric (*Curcuma longa* Linn.) (Ag. 4 (f) 18 Hort. 1.01)	Vellayani
9	Effect of different planting materials on the yield and quality of turmeric (Ag. H. 4 (f) 19 Agron. 1.01)	Vellanikkara

Germplasm collection of turmeric:-Ag 4 (f) 12 Breed. 1.01 (Ambalavayal)

A collection of 34 types of turmeric was maintained by the Horticultural Research Station, Ambalavayal. The performance of the types was as follows (Table 3.35).

Table 3.35: Yield of fresh rhizome (kg/plot of 6m²)

Varieties	Mean yield	Varieties	Mean yield
Chayapasupa	3.75	Kuchipudi	11.95
Muvattupuzha	0.35	Nandyal	0.55
Dindigam	0.40	Ettamukkala	10.30
CLL-390 Rajpuri	1.85	GL Puram-I	1.35
CLL-324 Armoor	0.10	T-Sunder	12 00
CLL-327 Thekurpetta	0.10	Amrithapani Kothapetta	3.15
Kasthuri	0.80	Karhadi Local	3.00
Kodur	3.50	Arippa	0.60
Rajpuri	9.05	Thekurpetta	0.51
Duggirala	7.15	CA-66 GL Puram	0.08
Kasthuri Tanaka	1.80	CLL-316 Gorakpur	0.10
Vondimitta	5.95	GL Puram 3	0.15
Type I	4.05	CLL-328 Sugandam	0.05
Wynad Local	3.95	CA-68 Dhagi	0.25
Sugandam	10.05	CA-73 Amalpuram	0.05
Armoor	8.80	CLL-361 Ettamukkala	0.95
Chayapasupa	1.55	CLL-322 Vondimitta	1.40
CD (0.05)	1.76		

Screening of varieties of turmeric for partially shaded conditions-Ag 4 (f) 2 Breed. 2 01 (Mannuthy)

Fourteen varieties were screened to identify the best one for the partially shaded conditions of coconut gardens. The varieties showed statistically significant differences in yield. Table 3.36.

Table 3.36: Yield of turmeric types

Variety	*Mean yield over two replications (kg/ha)*
Amrithapani Kothapetta (A 72)	2483
Chayapasupa	3983
Amalpuram	3333
Amrithapani Kothapetta (C 317)	1550
Kasthuri Tanaka	9666
Nandyal	2583
Kodur	4466
Kuchipudi	9208
GL Puram	2083
Dindigam	3791
Vondimitta	3416
Armoor	1775
Duggirala	3983
Mannuthy Local	8042

Maximum yield was recorded by the variety Kasthuri Tanaka, closely followed by Kuchipudi with raw rhizome yields of 9666 kg/ha and 9208 kg/ha, respectively. Mannuthy local with 8042 kg/ha stood third. The study conducted during 1977–78 revealed that height of plant, length and breadth of leaf, leaf area index, petiole length, number of leaves/tiller, number of roots/plant, root lenth, length of primary fingers and girth of mother rhizomes were positively correlated with the yield.

All the types were susceptible to shoot borer, leaf spot and leaf blotch infection. Out of the 19 types, VK 5 (Mannuthy local) showed the highest degree of field tolerance to shoot borer, leaf spot and leaf blotch infection.

Significant variation was also observed among the turmeric types with regard to the green yield/plot, curing percentage, oleoresin and curcumin content. The type 'Chayapasupa' with an yield of 28.86 kg/plot stood first in green yield during 79–80 season. During the 1978–79 cropping season, Amrithapani–Kothapetta (317) with an yield of 24.25 kg/plot was first in green yield.

Maximum curing percentage (28.17) was recorded in Dindigam Co–69 The yield of cured produce/ha varied from 1504 kg to 8,558 kg among the types.

Mannuthy local with a curcumin content of 6.55 percent ranked first and was found to be significantly superior to rest of the types. Maximum oleoresin content 21.10% was observed in the type Duggirala C 11-325. The per hectare yield of curcumin and oleoresin varied from 360.6 kg (Mannuthy local) to 65.4 kg (Tekurpeta) and from 1470.3kg (Mannuthy local) to 249.7 kg (Tekurpetta), respectively.

The yield of green turmeric, dry produce, drying percentage, oleoresin and and curcumin were found to be maximum at 270 days after planting.

Varietal trial on turmeric-Ag. H. 4 (f) 19 Breed. 3.01 [Vellanikkara]

Turmeric types collected from different regions of India were grown in a randomised block design with four replications. In a separate trial, four types were grown for finding out the optimum stage of harvest.

Multilocational trial on turmeric

A trial was laid out during 1979-80 in seven locations representing the different agro-climatic zones, with the objective of evaluating the four promising types obtained from the Project entitled "Varietal trial on turmeric"- Ag. H4 (f) 19 Breed. 3.01. The yield data are furnished in Table 3.37.

Table 3.37: Performance of turmeric types in different locations

Types	Green yield (mean value in kg per plot of size 3m²) at						
	Vellani-kkara	Ambala-vayal	Pilicode	Odakka-li	Patta-mbi	Mannn-thy	Vella-yani
1 Mannuty Local	17.52	6.28	3.07	14.02	7.84	8.15	16.83
2 Chayapa-supa	15.56	11.52	2.86	18.10	2.40	7.00	14.77
3 Kuchipudi	17.50	12.36	3.03	20.94	2.40	7.96	14.81
4 Armoor	14.60	11.84	2.32	29.35	1.98	9.94	14.77
CD (0.05)	1.662	2.641	NS	NS	NS	NS	NS
Performance	1,3,2,4,3,4,2,1						

Mannuthy local and Kuchipudi were found to give maximum green yield per plot at three locations each. However, the superiority was statistically significant only at one location each. The experiment is being repeated to get confirmatory results.

Varietal trial and maturity studies on turmeric- Ag 4 (f) 18 Breed. 3.02 [Vellayani]

Twelve varieties were put under a randomised replicated trial with four replications for identifying the variety that will give higher yield of fresh rhizomes. The objectives also included estimation of the curing percentage, curcumin content of the varieties and the correct stage of harvest for maximum recovery of curcumin The yield data indicated thar the types Mannuthy local (VK-5) and Kodur were high yielding under Vellayani conditions. The chemical analysis of quality aspects was conducted at the Regional Research Laboratory, Trivandrum.

Variability in the open pollinated progenies of turmeric, Curcuma aromatica- Ag. H. 4 (f) 19 Breed 4.01 [Vellanikkara]

Studies were in progress which aimed at exploring the genetic variability in turmeric with a view to selecting superior types. The studies also aimed at evolving selection criteria based on morphological characters and yield.

Foliar diagnosis, yield and quality of turmeric in relation to N, P and Ag. H4 (19) Chem 1:01 (Vellanikkara)

A field experiment with three levels of N, P and K in confounded factorial design was conducted. N, P and K were applied in the form of urea, superphosphate and muriate of potash, respectively. Tissue samples were collected periodically and chemical analysis conducted with a view to standardising the tissue for foliar diagnosis and to study the uptake of nutrients, optimum dose and quality aspects. The data revealed that the number of tillers per clump increased with increasing levels of N, whereas, the number of leaves per tiller decreased with increasing levels of N. whereas, the number of leaves per tiller decreased with increasing levels of N. Levels of P and K did not influence the morphological characters. Maximum dry matter production was observed at K_2 level. Further work was in progress.

Effect of growth regulators on growth. yield and quality of turmeric Ag. 4 18 Hort. 1.01 (Vellayani)

The project aimed at studying the effects of Kinetin Cycocel and Maleic Hydrazide on the growth, yield and quality of turmeric. Assessment of the interrelationships between the different yield components with respect to their contributions to the total yield under the influence of the above growth regulators were also aimed at. The field experiment was laid out as an RBD with 11 treatments (three growth regulators at three concentrations each+waterspray +conrol) and data collected. Statistical analysis of the data was in progress.

Effect of different planting materiels on the yield and quality of turmeric Ag H. 4 (f) 19 Agron 1.01 (Vellanikkara)

An experiment was conducted to identify the best planting material for realising maximum yield per unit area. The effect of planting material on the growth and quality particularly curcumin content, also was to be assessed.

The data indicated that the whole rhizomes were the best planting material for realising maximum yield of green turmeric.

BETEL VINE

PROJECT IMPLEMENTED

CROP PROTECTION

Studies on the bacterial leaf spot of betel vine incited by *Xanthomonas betlicola* Ag 4 (g) 18 path 2.01 [Vellayani]

Studies on the bacterial leaf spot of betel vine incited by Xanthomonas betlicola Ag 4 (g) 18 Path 2.01 (Vellayani)

Symptomatology of the disease, both under natural and artificial conditions was studied. The initial symptoms of the disease appeared as small water soaked lesions which enlarged and turned dark brown at the centre with an yellow halo. The leisons were angular or without any angularity. In advenced stages of infection, the shot hole type of symptom was seen. Profuse bacterial ooze was found on the lower side of the lesion. Marginal infection was also seen, resulting in deformation. In severe cases, defoliation and stem infection occurred, resulting in death of the plant. There was some variation in the symptoms when different isolates were inoculated on the betel vines. Yeast-Glucose-Chalk-Agar and Potato-Sucrose-Peptone-Agar were found to be the best media for the growth of the bacterium. No variation was detected among the ten isolates with regard to their biochemical and physiological reactions. The result of this study coupled with pathogenecity confirmed the identity of the Pathogen as *Xanthomonas betlicola* Patel *et al.*

The pathogen was found to infect *Piper nigrum* L. *Piper longum* L. and *Peperomia pellucida* WB & K.

None of the following seven cultivars of betel vine was resistant to the disease. (Table 3.38).

Table 3.38: *Reaction of betel vine cultivars to Xanthomonas betlicola*

Cultivar	% defoliation (in angles) within			Disease grade of all leaves infected
	10 days of inoculation	20 days of inoculation	30 days of inoculation	
Chelanthivella	0	47.33	74.31	3.34
Pramuttan	0	43.55	57.05	2.86
Malamkodi	0	55.94	75.00	3.14
Pannivella	0	25.05	78.00	3.60
Chelanthikarpuram	0	40.16	61.03	3.46
Tulasivettila	0	20.75	43.84	2.10
Karilanchikarpuram	0	10.13	43.84	2.56
CD (0.05)	0	25.0074	17.9928	0.4605

After twenty days of inoculation, less defoliation was observed on Karilanchikarpuran and Thulasivettila, while Malamkodi recorded the maximum defoliation. After 30 days of inoculation, minimum defoliation was seen in the

cultivars Karilanchikarpuram and Thulasivettila, and maximum in Pannivella. Of the six antibiotics (Agrimycin-100, Streptocycline, Streptomycin, Chloramphenicol Ampicillin and Terramycin) tested, Chloramphenicol and Terramycin showed better inhibitory effects. (Table 3.39).

Table 3 39: Effect of antibiotics on *Xanthomona betlicola* sinfesting betelvine

Antibiotics	Inhibition zone (mm)			
	100 ppm	250 ppm	500 ppm	Mean
Agrimycin 100	19.33	25 33	29.00	24.55
Ampicillin	0.00	0.00	0.00	0.00
Chloramphenicol	28.00	30.33	36.33	31.55
Streptomycin	18 66	22.33	30.33	23.77
Streptocyclin	19.66	24.33	27 66	23.77
Terramycin	26.33	28.66	33.00	29.33

CD (0.05) for comparison between antibiotics = 1.513

CD (0.01) for comparison between antibiotics = 3.125

In the *in vivo* screening with Chloramphenicol, Terramycin and Agrimycin at 250 and 500 ppm each, none gave absolute control of the disease. One week after spraying, the percentage index of disease status was minimum in plants receiving Terramycin 500 ppm. After the second week, the percentage index was minimum in all the treatments and maximum in the control.

COCOA

PROJECTS IMPLEMENTED

CROP IMPROVEMENT		
1	Genetic variability and correlation studies in cocoa (Ag. 6 (a) 19 Breed. 2.01)	Pilicode
2	Studies on the floral biology and fruit set in cocoa (*Theobroma cacao L.*) Ag. 6 (a) 19 Bot. 1.01)	Vellanikkara
CROP MANAGEMENT		
3	The relationship between soil nutrient status and foliar analysis of cocoa of different age groups in the various soil types of Kerala (Ag. 6 (a) 18 Chem. 1.01)	Vellayani
4	Spacing-cum-manurial trial on cocoa (Ag. 6 (a) 15 Agron. 3.01)	Vellanikkara
5	Propagational studies in cocoa (Ag. H. 6 (a) 15 Hort. 1.01)	Vellanikkara
6	Studies to determine the optimum shade requirement for cocoa (Ag. 6 (a) 15 Agron. 4.01)	Vellanikkara
7	Effect of shade and moisture regime on the growth of cocoa seedlings (Ag. 6 (a) 19 Agron. 4.02)	"
8	Studies on training & pruning in cocoa (Ag. H. 6 (a) 15 Hort. 2.01)	"
9	Effect of raising cocoa as an intercrop in adult coconut plantations (Ag. H. 6 (a) 15 Hort. 2.01)	Piiicode
10	Nutritional studies in cocoa (Ag. 6(a) 19 Agron 1.01)	Vellanikkara
11	Effect of graded doses of N, P and K on the growth and leaf nutrient status in cocoa (Ag. 6(a) 19 Agron. 1.02)	Vellanikkara
CROP PROTECTION		
12	Investigations on insect pests of cocoa in Kerala with special reference to the mealy bug (Ag. 6 (a) 18 Ent. 1.01)	Vellayani
13	Control of attack of squirrels on ripe cocoa pods (Ag 6 (a) 8 Ent. 2.01)	Piiicode
14	Pest complex associated with cocoa, clove and nutmeg and their control (Ag. 6(a) 8 Ent. 3.01)	Pilicode
15	Control of insect pests of cocoa	Vellanikkara
16	Investigations on the etiology of fruit drop disease and its control	Vellanikkara
17	Studies on the die back disease of cocoa and its control	Vellanikkara
PROCESSING TECHNOLOGY		
18	Studies on the fermentation and curing of cocoa beans (Ag. 6 (a) 19 Proc. Tech. 1.03)	Vellanikkara
19	Small scale fermentation methods (Ag. 6 (a) 19 Proc. Tech. 1.02)	Vellanikkara

Genetic variability and correlation studies in cocoa Ag 6 (a) 19 Breed 2.01 [Vellanikkara]

The study aimed at (i) assessing the extent of genetic variability existing in the important plant, pod and bean characters (ii) determining the interrelation between yield and the contributing factors. (iii) Identifying superior genotypes and (iv) deriving criteria for selection of mother plants. The experiment was laid out and the scheduled observations were taken.

Studies on the floral biology and fruit set in cocoa (Theobroma cacao L.) Ag 6 (a) 19 Bot 1.01 [Vellanikkara]

A PG project was initiated to gather information on the basic floral biological aspects of cocoa under Kerala conditions. The factors influencing the fruit set, the methods for increasing the percentage set and ways to improve the percentage of fruits carried to maturity were also investigated upon.

The relationship between soil nutrient status and foliar analysis of cocoa of different age groups in the various soil types of Kerala Ag 6 (a) 18 Chem 1.01 [Vellayani]

A PG project was in progress which aimed at (i) correlating the nutrient levels in foliar samples with the soil test results of N, P & K, (ii) relating the foliar diagnostic tests and soil tests with yield data of bearing cocoa plants and (iii) locating deficiency/toxicity levels based on field observation and analysis.

Spacing-cum-manurial trial on cocoa: Ag 6 (a) 15 Agron. 3.01 [Vellanikkara]

The trial was laid out in the College of Horticulture, in a confounded factorial design with five replications. The treatments consisted of four spacings (2.5;m^2, 3.0m^2, 3.5m^2, 4.0m^2) and four manurial doses (50:20:70:7.5, 100:40:140:15, 150:60, 210:30, 200:80:280:45g/plant/year of NPK & Ca). The trial aimed at finding out the optimum spacing for cocoa as well as at standardising the economic and most suitable fertilizer level for cocoa. The plants started bearing.

Propagational studies in cocoa (Ag: H-(a) 15 Hort. 1.01) [Vellanikkara]

The seeds collected from pedicel and middle portion and distal end of big, medium and small pods were studied in detail to fix up the criteria for seed selection for obtaining vigorous seedlings. The mean number of beans per pod varied from 30 to 42 and there was not much difference in the number of seeds among the three classes of pods. In general, the maximum number of seeds per pod was recorded in peods harvested during February and March, followed by those harvested in April. Germination studies showed maximum percentage of germination in seeds collected during March, followed by those collected in February.

The pod size or the portion from which seeds were collected did not influence the percentage of germination or the growth of the seedlings. In general, better seedlings were obtained from seeds collected from large and medium sized pods. Medium sized pods weighing more than 350 g collected during February and March seemed better for quality seedling production. The germination percentage was affected with delay in sowing. The seedlings could be transplanted when they were three months old and had at least 30 cm height and 10 leaves

An experiment to assess the effect of hormones on rooting of cuttings was conducted The hormones used were IAA, IBA and NAA, individually and in combinations. The duration of the treatments varied from 10 to 60 seconds. Higher percentage of rooting and maximum number of roots were obtained by dipping the cuttings for 60 seconds in 4000 ppm NAA or 6000 ppm IAA. Mist chamber method was successful for production of rooted cuttings.

Four methods of budding namely 'T' budding, inverted 'T' budding, patch budding and Forkert budding were tried. Forkert method on 8 to 9-month old stocks or green budding on 3 to 4 month old seedlings were successful. The best time for budding was found to be February-March on older root-stocks and April-May on younger root stocks.

Studies to determine the optimum shade requirement of cocoa- Ag 6 (a) 15 Agron 4.01 [Vellanikkara]

The project aimed at determining the optimum shade requirement for cocoa for maximum production and economic life span under Kerala conditions. The selection of plants in the cultivators' fields was in progress.

Effect of shade and moisture regime on the growth of cocoa seedlings– Ag 6 (a) 19 Agron. 4.02]Vellanikkara]

An experiment was conducted at the College of Horticulture, Vellanikkara with shade levels ranging from 0 to 75% and available moisture levels, from 25 to 75%. Shade was provided using artificial materials and moisture levels were controlled by weighing of pots. The experiment involved combinations of four levels of shade and three of available moisture content. It was repiicated four times The experiment was started as a PG project during August, 1978 and completed by February, 1979. The data were processed.

Studies on training and pruning in cocoa– Ag H. 6 (a) 15 Hort. 2.01 [Vellanikkara]

The trial aimed at standardising the traintng and pruning method for cocoa was laid out at the Instructional Farm, Mannuthy. The treatments consisted of training the plants to a height of 1.0 to 1.5m, 1.5 to 2.0m under single tier system. In another set of treatments, the second tier would be formed 1.0 to 1.5m above the first formed as above. Unpruned control was also included. The treatments as per the schedule will be given during 1980–81.

Effect of raising cocoa as an intercrop in aduit coconut plantations– Ag. H. 6 (a) 15. Hort. 2.01 [Pilicode]

An experiment for comparing the systems of planting cocoa (single row, double row and control) in coconut plantations in a randomised block design with eight replications was in progress at the Coconut Research Station, Piiicode. The yield of coconuts and cocoa during the year was as follows (Table 3.40).

Table 3.40 Mean yield of coconuts and cocoa during 1978 and 1979

	Coconut yield/palm		Coconut yield	
Treatments	1978	1979	1978	1979
Single row of cocoa	62.1	54.5	461.2	232.0
Double row of cocoa	64.7	57.8	933.2	637.3
Control (no cocoa)	80.0	56.1	...	...

A reduction in the yield of both coconut and cocoa was observed as compared to 1978. The reduction is ascribed to the alternate bearing tendency of coconut and the prolonged drought conditions which occurred in 1979.

Nutritional studies in cocoa- Ag. 6 (a) 19 Agron 1.01 [Vellanikkara]

The project aimed at finding out the optimum requirements of N,P,K; Ca & Mg for cocoa as well as at determining the effect of Zn on the growth and production of cocoa. Standardisation of the leaf analysis technique for cocoa was also envisaged. During the period under report, two trials were laid out in the cultivators' field in Trivandrum. The first dose of fertilizers were applied in October 1979. A Project was also taken up for the standardisation of leaf analysis technique in cocoa

Effect of graded doses of N, P and K on the growth and leaf nutrient status in cocoa- Ag. 6(a) 19 Agron 1.02 [Vellanikkara]

A PG project was initiated to determine the effect of graded doses of N, P and K on the growth of cocoa seedlings. The relationship between leaf nutrients and production was also to be examined.

Investigations on insect pests of cocoa in Kerala, with special reference to the mealy bug - Ag. 6 (a) 18 Ent. 1 01) [Vellayani]

Twentysix species of insects (six of *Hemiptera*, six of *Coleoptera* 13 of *Lepidoptera* and one of *Thysanoptera*) were found to infest cocoa. October–January season was more favourable for these insects The mealy bug, *Planococcus lilacinus* was identified as the most common and destructive pest of cocoa. Basic information on the bio-ecology of the mealy bug was gathered. Rearing technique for the mealy bug was standardised Application of Fenthion, Monocrotphos, Quinalphos and Dimethoate (all at 0.05% concentration) as high volume spray during the peak period of infestation in summer months could control the insect, Two applications at an interval of 30 days were required.

Control of attack of squirrels on ripe cocoa pods - Ag. 6 (a) 8 Ent. 2.01 [Pilicode]

An experiment was in progress at the Coconut Research Station, Pilicode which aimed at formulating a programme to ward off the menace of squirrels on the ripe pods of cocoa. The trial with 16 treatments started in 1977 was continued during the year.

Covering the pods with (i) polythene bags alone (ii) polythene bags and smearing the outer surface with neem oil or (iii) polythene bags and smearing the outer surface with coaltar continued to exhibit superiority over the other treatments.

Pest complex associated with cocoa, clove and nutmeg and their control- Ag. 6 (a) 10 Ent. 3 [Vellanikkara]

The survey work was continued during the year and the following pests were recorded:

Cocoa.

Stem girdler, *Sthenias grisator* Feb. (Cerambycidae). Which was found to girdle the main stem causing serious damage. The pest was found to be relatively

more serious in parts of the Idikki district at higher elevations. Stem borer: *Sinoxylon* spp. (Bostrychidae) the adults and grubs of which were found to bore into the twigs causing die-back symptoms.

Clove;

Only pest recorded was an unidentified scale insect. This was found on the lower sides of the leaves. Infestation was not serious.

Nutmeg;

On twigs, the scale insects *Saissetia nigra* and *Aspidiotus destructor* were recorded. Due to de-sapping, the twigs showed die-back symptoms.

Control of insect pests of cocoa -- [Vellanikkara]

A sruvey was conducted in 1976-78 in the State to study the pest complex associated with cocoa. Six major and 14 minor pests were identified. The nature of damage and peak periods of activity of the pests were studied and management methods against the pests ascertained.

Investigations on the etiology of fruit drop disease and its control - [Vellanikkara]

Investigations on the etiology of the pod drop disease of cocoa revealed that about 10 per cent of the pods were affected by cherelle wilt, while six per cent and three per cent of pod infections were attributed to *Botryodiplodia* pod rot and *Colletotrichum* pod rot, respectively.

The pods affected by *Colletotrichum gloesporioides* showed small brownish round spots with a yellow halo on the surface of the pods. In advanced stages, the pods turned dark and the lesions were slightly depressed from the surface of the pod. Large irregular dark-brown areas were also seen on the pods due to the coalescence of numerous lesions. Mostly immature pods were found to be infected by this pathogen. The internal tissues were also infected and they turned brown. Numerous yellow to pink coloured pustules were seen on the surface of the pod

In the case of *Botryodiplodia* pod infection, brown lesions developed on the surface of the pod without any halo. The lesions produced masses of black spores and in the advanced stages, the pods were covered with sooty powder of black spores.

Studies on the die back disease of cocoa and its control - [Vellanikkara]

From the twigs dried due to die back, *Botryodiplodia* sp. and *Colletotrichum* sp. were isolated. They caused typical die back symptoms with withering of leaves. Drying up of twigs was also found in the case of *Cephaleures* sp. attack on the stem

Studies on the fermentation and curing of cocoa beans Ag 6 (a) 19 Proe. Tech· 1.03 (Vellanikkara)

A project was initiated to compare the different methods of fermenting cocoa beans in order to identify the most suitable method for small quantities. The chemical changes occurring during the fermentation of cocoa beans also were to be investigated upon.

Small scale fermentation methods Ag 6 (a) 19 Proc. Tech. 1.02 (Vellanikkara)

The objectives of the project were to develop a method of fermenation suitable for the small cocoa growers in the State, to compare the popular methods and to work out the cost/benefit ratio of the different methods:

Preliminary work was done on the fermentation of cocoa (2 kg to 5 kg) in three types of containers, viz., 'Mini basket' 'Mini box' and 'Mini-tray' during February to May 1979. The beans were collected from ripe cocoa pods and set for fermentation for varying periods; four days for mini tray and six days for mini box and mini basket methods. They were given extra insulation from the second day onwards by fully covering them with gunny sacking. The beans in the last two methods were turned once in 48 hours and were dried in the sun for 4–5 days (at 3–5 cm thickness with turning every 2–3 hrs. The experiments were repeated with the same treatments during the two seasons. The cured beans were tested based on colour of the cotyledons Results revealed that mini box and mini basket methods (which involved keeping the beans for six days and turning them in alternate days were suitable for properly fermenting small quantities of cocoa beans. Variations in temperature in the methods followed more or less the same trend as in the conventional methods using larger quantities of the beans. Among the containers, those made of wood were better than baskets as far as temperature retention and extent of aeration were concerned. The quality of the beans was judged by cut test. The acidity values were satisfactory in the first two methods of curing.

4. Cashew & Fruits

HIGHLIGHTS

The clonal types of cashew NDR-2-1, K-10-2, K-10-1, K-28-1 K-25-2, K-19-1 and NLR-2-1, the seedling types BLA-139-1 and the hybrid types H-4-7, H-3-14 gave mean yields exceeding 15 kg of nuts/ tree/year. The weight of nuts had positive correlations with height and number of leaves in cashew seedlings. The best season for side grafting, veneer grafting and budding was found to be May-October and the highest percentage of survival of these materials was from July to September. The growth regulators 2,4-D, IBA, NAA, IAA and GA were not effective in controlling post-fertilisation drop of fruits. *Colletotrichum gleosporioides* was recorded to cause the leaf blight disease who cashew. The only natural enemy associated with the tea mosquito bug *Helopeltis antonii* was a predatory ant *Crematogaster wroughtonii*.

The optimum stage of maturity of cashew apple for the preparation of unfermented products was 46-47 days after fruit set. Treatment of cashew apple juice with 0.4% gelatin or with a mixture of 0.4% gelatin and 0.1% calcium hydroxide was effective in the removal of phenolics.

Yield of the Palayankodan variety of banana was significantly increased up to a level of 200 g N/plant.

Soil application of Phorate was found to be quite effective against the banana rhizome weevil.

Storage of mature green banana inside polythene bags (200 gauge) containing potassium permanganate prolonged its storage life.

The post-harvest treatments of banana (c.v.Palayankodan) with 40 ppm 2,4 5-T, 100 ppm IAA, 50 ppm and 100 ppm of NAA increased the TSS contents.

Neelum, Suvarnarekha, Olour and Mundappa were found suitable for canning.

Foliar application of 150 ppm Ethrel was found to be the best for maximum induction of flowering in pineapple.

NAA at 300 ppm increased the fruit size in pineapple.

SUMMARY

CASHEW

The germplasm collection of cashew at the Anakkayam centre was enriched by the addition of 10 seedling types from SriLanka. At this centre, the clonal types K-10-2, K-10-1, K-28-1, K-25-2, K-19-1 and NLR-2-1 gave mean yields of more than 15 kg nuts/tree/year and these appeared to be promising. The germplasm collection at the Madakkathara centre was also maintained during the year and the evaluation of the material showed superiority of the clonal type NDR-2-1 which gave a mean yield of 24.78kg nuts/tree/year. Survey and collection of superior genotypes were carried out in the Malappuram District and the local selections UVP-1, UVP-2, CP-1, CP-2, MC-1 and MC-2 were made. The F_1 progenies of selected crosses were evaluated for yield, sex-ratio and other economic characters at the Madakkathara centre Among the seedling types, BLA-139-1 continued to maintain the lead with an yield of 23.062 kg nuts/tree/year. The hybrid types H-4-7, H-3-17 and H-3-13 were found to yield 16.89, 16.79 and 16.04 kg nuts/tree/year.

The programme of breeding improved varieties of cashew by hybridisation was taken up at the Anakkayam and Madakkathara centres. At Anakkayam, 12 types yielded more than 10 kg nuts/tree/year while at the Madakkathara centre, six hybrids yielded more than 15 kg nuts/tree/year. Studies on the F 2 progenies and double cross hybrids were continued. Seventy one progenies derived from selected crosses were planted at Madakkathara in order to study the variations in the quantitative and qualitative characters and to identify the promising ones.

In comparative yield trial of promising selections and hybrids, the types BLA-39-3, BLA-273-1, K-16-2 and BLA-139-1 have started manifesting their production potential.

Studies on the clonal progenies of promising types of cashew were in progress at the Anakkayam centre and the type H-3-9 recorded the highest yield of 5.916 kg of nuts/tree/year. Two comparative yield trials-one using layers of promising Anakkayam selections and the other using seedlings of the best yielders from four Cashew Research Stations were in progress at the Madakkathara Centre and these collections were evaluated for their yield performance.

Studies on the standardisation of seedling selection techniques indicated that the weight of nuts had positive correlations with height and number of leaves in seedlings. Multilocational fertilizer trials conducted in cultivators' fields did not give significant results during the year. However, pooled analysis for the period 1977-79 showed that the lowest level of nitrogen was inferior to other levels and that the application of P increased yield by 35%. Fertilizer trial in progress at

the Madakkathara centre did not show significant differences with reference to yield of nuts. Nutritional studies were taken up under the KADP programme in lateritic and sandy soils in cultivator's fields and the growth measurements of the experimental trees were recorded.

Trials on the effect of magnesium, copper and iron on yield were not conclusive. Trial on cultural practices in cashew was continued at the Anakkayam centre.

In propagation trials, it was found that May–October was the best time for conducting side grafting, veneer grafting and budding. The highest percentage of survival was obtained during July to September.

In order to explore the feasibility of controlling post-fertilization drop of fruits in cashew by spraying hormones, studies were conducted at the Madakkathara centre. Significant differences were not detected between the different concentrations of the hormones, 2, 4-D, IBA, IAA, NAA and GA.

Investigations on the vegetative propagation in cashew were continued under the KADP project during the year to evaluate the suitability of different media and types of containers.

Multilocational trials on orchard management practices and intercropping systems were continued.

Bordeaux mixture, Difolatan and Calixin were found to be effective in controlling the Die-back disease. Studies on the fungi associated with cashew trees revealed the susceptibility of the types BLA-273-1 and M-3-17 to immature fruit drop incited by *Colletotrichum gleosporioides*. This fungus was established to be responsible also for the leaf blight disease. Survey of the insect pests of cashew were continued.

Studies on the relative susceptibility of cashew types to infestation by *Helopeltis antonii* were concluded. The accessions 22, 1112, 1430,1097 were found to be least susceptible with reference to shoot damage. The tree No. 22 showed least damage to the floral branches, while the tree No. 650 showed the maximum damage intensity. The tannin content in vegetative shoots and the degree of infestation of the shoots by the insect were found to be negatively correlated. Studies on the pest complex infesting cashew inflorescence were initiated and the studies on the control of the cashew stem borer were continued.

While exploring the feasibility of biological control of the tea mosquito bug, it was found that the only natural enemy associated was a species of predatory ant *Crematogaster wroughtonl*.

The optimum stage of maturity of cashew apple for the preparation of different unfermented products was found to be 46–47 days after fruit set. Treatment of the cashewapple juice with 0.4% gelatin or with mixture of 0.4% gelatin and 0.1% calcium hydroxide was fairly effective to remove the phenolics for the clarification of juice.

BANANA

Suckers weighing 550–1250 g were found to be suitable for conducting *gamma* irradiation. To ascertain the natural genetic variability in the Nendran variety and to identify the promising clones, type collections were made from Trivandrum, Quilon, Kottayam, Calicut, Malappuram and Trichur Districts. Varietal collection was maintained at the Kannara centre and evaluation of the germplasm material for yield and qualitative characters continued.

Studies on the nitrogen nutrition in rainfed banana, cultivated variety Palayankodan revealed that the yield was significantly increased up to a level of 200 g N/plant but a further increase had decreased yield. The optimum and economic doses of nitrogen were worked out and these were 204.6 and 98 g/plant respectively. The maximum bunch weight was obtained in plots where banana-tapioca rotation was followed.

Phosphorus did not show significant differences in this respect. Graded doses of potash were effective in giving a significant increase in the number of fingers per bunch and the maximum number of fingers was produced at 200 g potash per plant.

Studies on the physiological basis of variation in yield between the two varieties Nendran and Zanzibar were continued.

Soil application of Phorate was found to be quite effective in the control of banana rhizome weevil. Evaluation of different foliar fungicides against the fungal diseases of banana were in progress.

Bordeaux mixture, Thiride, Ceresan wet and Cheshunt compound were found to be ineffective against the 'Kokkan' disease. In another experiment application of 100 g of Magnesium sulphate on the 180th day of planting gave maximum bunch weight in plants infested by the 'Kokkan' disease. The incidence of leaf spot disease caused by *Cordana musae* and *Cercospora musae* was found to be relatively lower in Pisanglilin, Sennachenkadali and Adakkakunnan.

Storage of mature green banana inside polythene bags (200 gauge) containing potasium permanganate prolonged the storage life of fruits.

The quality of banana (cv Palayankodan) was found to be significantly influenced by post-harvest application of growth regulators, 2, 4, 5-T, 2. 4,-D, IAA and NAA. The treatment with 40 ppm 2, 4, 5-T 100 ppm IAA, 50 ppm and 100 ppm of NAA treatments increased the TSS of fruits significantly. The treatments with 60 ppm 2, 4-5 T, 50 ppm NAA, 20 ppm 2, 4-D and 10 ppm IAA were effective in reducing the acidity of fruits significantly.

MANGO

The germplasm collection of mango varieties was maintained at the College of Horticulture. Three promising table varieties, Vellari, Kappalli and Thathachundan were located in the Alleppey District during the year, for accession to the KAU germplasm bank.

Survey on suitable pickle varieties were continued.

In studies on the regulation of flowering and fruiting in mango, pruning was carried out on seven varieties and these trees continued to be in the vegetative phase.

Nutritional studies were continued and conclusive results were not obtained.

Different methods were tried to extend the shelf life of mango fruits harvested at different stages of maturity by waxing, storage in polythene bags of different gauges etc.

In studies on the suitability of popular varieties of mango for canning, Neelum, Suvarnarekha, Olour and Mundappa were canned and these fruits retained their characteristics for a period of one year.

PINEAPPLE

The varietal collection of pineapple was maintained at the Kannara Centre.

The suckers were found to be better planting materials as compared to crowns with reference to yield attributing characters of the plants.

Experiments on the use of crown-splits for propagation were continued.

The experiments on potash requirements were initiated during the year.

Studies on the effects of shading on the growth, flowering and fruiting behaviour of pineapple variety Kew revealed that with 500 ppm Ethrel, the maximum percentage (86%) of flowering was obtained from plants grown under 25% shade.

Among the different growth regulators tried, Ethrel 250 ppm was found to be the best for maximum induction of flowering, Ethrel in combination with 2% urea and 0.04% Calcium carbide also gave similar results. NAA was evaluated for its effect on fruit size and maturity in pineapple and it was revealed that at 300 ppm, there was increase in fruit size.

Studies on standardisation of types and size of planting material were initiated.

CITRUS

The root stock trial in Coorg Mandarin oranges was continued and the root stocks of Carizo citrange, Rough Lemon, Troyer citrange were more promising.

The project for the identification of the best root stock-scion combination suitable for the agroclimatic conditions of Wynad was continued.

In adaptability trials of acid lime seedlings in the plains, it was found that the plants cross-protected with the mild strain of Tristeza virus were highly susceptible to the citrus Canker disease.

Trials on the economic cultural practices for Mandarin orange and the weedicidal experiment were continued.

Experiments on the chemical control of citrus leaf miner, aphids, psylla and white flies and the survey for the major pests of citrus were initiated.

Work on the fungal diseases of citrus was continued.

JACK

Survey and collection of the jack varieties in the State was continued and nine types were collected based on fruit quality considerations. Studies on the propagation techniques in jack fruit were continued.

PROJECTS IMPLEMENTED

CASHEW

	CROP IMPROVEMENT	Locations
1	Collection and maintenance of cashew types (Ag. H. 3-13. Breed. 1.01)	Anakkayam
2	Breeding improved varieties of cashew by hybridisation. (Ag. H. 3–15 Breed 1.02)	Anakkayam
3	Collection and maintenance of types (Ag. H. 3-15 Breed. 1.04)	Madakkathara
4	Breeding improved varieties by hybridisation in cashew (Ag. H. 3–15 Breed 1.0)	Madakkathara
5	Studies on the F_2 progenies and double cross hybrids in cashew (Ag. H. 3-13 Breed 1.08)	Anakkayam
6	Variability in the F_1 population of cashew (Ag. 3-19 Breed 2.06)	Madakkathara
7	Comparative yield trial of promising selections and hybrids of cashew (Ag. H. 3-13 Breed 2.01)	Anakkayam
8	Survey and collection of superior genotypes (KADP AG. 6.10.1)	Vellanikkara Madakkathara
9	Genetic improvement by hybridisation and selection (KADP Ag. 6.19.2)	Vellanikkara Madakkathara
10	Study of promising clonal types in cashew (Ag. 3-13 Breed 2.02)	Anakkayam
11	Comparative yield trial of Anakkayam selections and hybrid progenies (layers) (Ag. H. 3-15 Breed. 2.03)	Madakkathara
12	Comparative yield trial of existing high yielders of cashew (seedlings) (Ag- H. 3-15 Breed 2.04)	Madakkathara
	CROP MANAGEMENT	
13	Standardisation of seedling selection technique (Ag. H. 3–15 Hort. 1.01)	Vellanikkara
14	Multilocational fertilizer trial on cashew in cultivator's fields (Ag. H. 3-13 Agron 1.02)	Parappanangadi, Pilicode
15	Fertilizer trial on cashew (Ag. H. 3-15 Agron 1.03)	Madakkathara
16	Effect of magnesium, copper and iron on the yield of cashew (Agron. H. 3-13 Agron 2.01)	Anakkayam
17	Cultural trial on cashew (Ag. 4.3.13 Agron. 3.01)	Anakkayam
18	Propagation trials in cashew (Ag. H. 3–15 Hort. 1.02)	Madakkathara
19	Hormone application to increase fruit set in cashew (Ag. H. 3-15 Hort 3.01)	Madakkathara

20	Standardisation of vegetative propagation in cashew (KADP Ag. 6.19.3)	Vellanikkara Madakkathara
21	Spacing trial (KADP Ag. 6.19.7)	Vellanikkara Madakkathara
22	Cultural trial (KADP Ag. 6.19.6)	Vellanikkara Madakkathara
23	Multilocational trials on orchard management practices — intercropping (KADP Ag. 6.19.5)	Multilocational
24	Nutritional studies in cashew (KADP Ag. 6.19.4)	Vellanikkara Madakkathara

CROP PROTECTION

25	Die-back disease of cashew-studies on the contol of the disease by newer fungicides (Ag. H. 3-13 Path 2.01)	Anakkayam
26	Study of the fungi associated with cashew trees with special reference to immature fruit drop (Ag. H. 3-13 Path 1.01)	Anakkayam
27	Survey of insect pests of cashew Ag. 11-3-15 Ent. 2.91)	Vellanikkara
28	Relative susceptibility of cashew types to infestation by *Helopeltis antonii* (Ag. 3. 19. Ent. 102 and KADP Ag. 6.19.10)	Vellanikkara
29	Pest complex infesting cashew inflorescence (Ag. 11.3.19 Ent. 1.03)	Vellanikkara
30	Studies on the control of cashew stem borer *Plocaederus ferrugineus* (KADP. Ag. 19.8)	Anakkayam Parappanangadi
31	Exploration of the feasibility of biological control of the tea mosquito bug *Helopeltis antonii* (KADP. Ag. (6) 19.8)	Vellanikkara, Madakkathara

PROCESSING TECHNOLOGY

32	Studies on the optimum maturity and chemical composition of cashew apple for the preparation of different unfermented products (Ag. H. 3-19. Proc. Tech. 1.01)	Vellanikkara
33	Clarification of cashew apple juice by different methods (Ag. H. 3. 19 Proc. Tech. 1.04)	Vellanikkara

Collection and maintenance of cashew type Ag. H. 3-15 Breed 1.01 [Anakkayam]

This programme was initiated with the objective of surveying existing populations and collecting and maintaining the types and varieties of cashew to identify superior ones and for their multiplication for breeding work. During 1980, the types which gave high yields are indicated in Table 4.1.

Table 4.1: Promising cashew types in the KAU Germplasm Bank

Types	*Yield in 1980* (*kg*/tree)	*Average yield 1976-1780* (*kg*/tree)
NDR 2-1	24.78	18.190
NLR 2-1	17.88	15.040
K 10-2	17.71	16.410
K 10-1	16.28	14.982
K 28-1	15.84	10.644
K 20-1	15.43	12.072
K 25-2	15.39	16.164
K 19-1	15.25	16.929
K 4-1	14.91	10.315
K 27-1	14.64	10.013
K 3-2	13.56	10.162
NLR 2-2	13.11	10.740
BLA 139-1	23.62	34.477
BLA 273-1	16.18	19.891
UL 21-2	15.34	12.987
UL 15-1	14.33	13.973
UL 19-2	13.86	9.612
ABD 2-1	13.29	12.133
BLA 39-4	12.44	16.460

The clonal type K-10-2, K-10-1, K-28-1, K-25-2, K-19-1 and NLR 2-1 recorded mean yield of more than 15kg nuts per tree par year and these appear to be promising.

During 1980, 10 seedling types have been collected from Sri Lanka.

Breeding improved varieties of cashew by hybridisation Ag. H-3-13 Breed. 1.02 [Anakkayam]

Progenies of 18 parental combinations were under observation for evaluation. The study was initiated to evolve high yielding types with medium sized nuts, high shelling recovery and other desirable attributes. Out of 199 hybrids planted in 1973, twalve types (Table 4.2) yielded more than 10kgnuts/tree/year.

Table 4.2: Promising hybrid cashew types

	Yield in 1980 kg/tree/year	Average yield 1976 to 1980 (kg/tree)
H-4-7	16.89	14.927kg
H-3-17	16.79	19.183
H-3-13	16.04	13.917
H-3-7	15.24	15.908
H-4-6	14.94	9.767
H-3-4	13.45	13.406
H-3-19	12.40	26.514
H-9-5	11.13	Not stabilized
H-3-9	10.79	12 541
H-8-1	10.71	9.023
H-7-1	10.46	Not stabilized
H-9-1	10.31	-do-

Collection and maintenance of types Ag. H-3-15 Breed. 1.04 [Madakkathara]

The germplasm collection of 90 types consisting of 47 clonal and 43 seedling types were maintained at the Cashew Research Station Madakkathara.

The above collections which includes types from various parts of the country and exotic types, are maintained to isolate superior ones for further multiplication and for breeding work.

Table 4.3: Performance of clonal types, seedling and hybrid progenies of cashew

Type no.	Year of planting	Flowering season	Yield kg/year 1979-80	Mean yield 1974-80	Shelling percentage
(a) Clonal types					
NDR-2-1	1966	Late	24.780	17.897	26.19
NLR-2-1	1964	Middle	17.810	15.036	26.08
K-10-2	1964	Late	17.710	14.089	26.96
K-10-1	1964	Late	16.250	13.398	24.40
K-25-2	1963	Late	15.390	14.914	25.78
K-19-1	1964	Late	15.250	14.357	26.18
(b) Seedling progenies					
BLA-139-1	1963	Early	23.620	33.154	27.99
BLA-273-1	1963	Early	16.150	20.437	28.33
BLA-39-4	1963	Middle	12.440	14.941	26.80
(c) Hybrid progenies					
H-4-7	1963	Middle	16.890	12.917	25.25
H-3-17	"	"	16.790	17.643	26.19
H-3-7	"	"	15.240	13.215	27.00
H-13-4	"	"	12.400	12.649	29.83

Among the clonal types, NDR-2-1 recorded the maximum yield during the year under report (24.780kgnuts/tree), followed by NLR-2-1 (17.810kg) and K-10-2 (17.71kg). In the seedlings progenies, BLA-139-1 continued to maintain the lead with an yield of 23.62kg nuts/tree. BLA-273-1 and UL-21-2 recorded the second and third highest yields among the seedling progenies with yields of 16.150kg and 15.340kg nuts/tree respectively. Among the hybrid progenies, the highest yields were obtained from H 4-7, H 3-17 and H 3-13, the yield being 16.890kg, 16.790kg and 16.040kg per tree respectively.

Out of the 101 types maintained at Madakkathara, 29 trees have flowered so far.

The yield data and other particulars of some of the promising types are furnished in Table 4.3 in Page 197.

Breeding improved varieties by hybridisation in cashew-Ag. H. 3.15 Breed. 1.07 [Madakkathara]

The object was to evolve new high yielding varieties with high shelling percentage, medium size of nuts, high sex-ratio and disease and pest resistance.

Hybridisation was first initiated in this Centre during 1976. At present there are a total number of 289 hybrid progenies including the 199 ones obtained from crosses made at Anakkayam.

Out of the 199 hybrid materials planted in 1973, the following promising selections yielded more than 15 kg nuts/tree/year during 1979-80

Tree No.	*Yield of nuts*
644	17.850 kg/tree/year
640	17.150 " "
662	16.450 " "
663	16.300 " "
718	15.560 " "
753	15.400 " "

Studies on the F2 progenies and double cross hybrids in cashew Ag. H. 3-13 Breed 1.08 [Anakkayam]

This experiment was initiated to produce double cross hybrids by selecting F_1 plants as parents and to find out the combining ability among cashew types.

Selfed seeds of superior F_1 SH-4-7, H 3-17, H 3-13, H 3-19 and H 3-7 were collected and compared for their economic characters. The seeds produced were planted along with air-layers of the same type for comparison. The following double cross hybridisations were carried out:

H 4-7 x H 3-13	H 3-17 x H 3-13
H 4-7 x H 3-17	H 3-17 x H 3-19
H 4-7 x H 3-19	H 3-17 x H 1-4
H 4-7 x H 1-4	H 3-19 x H 1-4

The hybridisation as per the above combinations have been done @ 50 flowers in each combination and the nuts were collected.

Variability in the F_1 populations of cashew Ag H.3.19 Breed 2.06 [Madakkathara]

The objective of the project was to study the variation in the qualitative and quantitative characters of 715 progenies of selected crosses with a view to identifying superior hybrids in cashew.

Crosses were made between selected types of cashew for large nut size, high sex-ratio, high fruit-set, short flowering phase and high shelling percentage.

Seventy one F_1 progenies derived from the above crosses have been planted in the Cashew Research Centre, Madakkathara and the trees are now about 6 years old. The detailed evaluation of these progenies were undertaken with a view to select superior ones.

Comparative yield trial of promising selections and hybrids of cashew Ag. 4.3—13 Breed. 2.01 [Anakkayam]

Main objective of this experiment was to study the progenies of the 16 promising selections of cashew, including hybrids. The selections included in the trial were:

K 19—1	BLA 273— 1
K 22—1	K 10— 2
UL 28—1	BLA 39— 4
K 18—2	H 4— 7
K 28—2	BLA 139— 1
K 25—2	H 3—17
K 16—1	H 3—13
NLR 2—1	Tree —20

The plants are in the juvenile stage. Out of the 22 gaps filled in June, 1980, 14 plants are surviving, leaving a gap of 8 plants. Harvesting was in progress. The types BLA 29—3, BLA 273—1, K 16—2 and BLA 139—1 have started manifesting their production potential.

Survey and collection of superior genotypes KADP Ag. 6.19.1 [Vellanikkara, Madakkathara]

During March 1980 a survey was conducted in Malappuram District and the selection UVP-1, UVP-2, CP-1, CP-2, MC-1, M-2 were made Steps were taken for the introduction of *Anacardium corymbosm, A excelsum, A gigantium, A humile, A microsepalum, A. microcarpum, A parvifoiium, A punilum* from Brazil.

Genetic improvement by hybridisation and selection KADP Ag. 6.19.2 [Vellanikkara, Madakkathara]

The F_1 progenies of the following crosses were evaluated for yield, sex ratio and other economic characters. H-19 (ALGD x K-30-1), H-20 (H-3-13 x K-30-1), H-21 (BLA-139-1 x K-30-1), H22 (BRZ-9-1 x K-30-1), H-23 (ALGD-1-1 x B-3-13), H-24 (ALGD-1-1 x BLA-139-1), H-25 (ALGD-1-1 x BRZ-9-1), H-26 (BLA-139-1 x H-3-13), H-27 (BRZ-9-1 x BLA-139-1) and H-28 (BRZ-9-1 x H-3-13). The following fresh crosses were made during the year with objective of improving the nut size and flowering period.

Table 4.4: Details of crosses made during 1979-80

Sl no	Female parent tree no.	Male parent tree no.	No. of crosses made	No. of F_1 seeds obtained
1	1599	745	113	13
2	730	1589	114	17
3	1589	730	204	17
4	1663	1589	72	9
5	1672	1589	85	5
6	1140	855	57	3
7	1089	1589	52	5
8	662	885	150	4
9	657	1588	99	—
10	514	1588	83	3
11	1588	514	47	3
12	855	1140	98	1
13	1598	1537	131	6
14	1589	1663	34	1
15	1602	855	117	7
16	1589	1098	109	6
17	745	657	113	11
18	1550	1598	38	1
19	855	662	131	3

Study of promising clonal types in cashew - Ag. 3.13. Breed 2.02 [Anakkayam]

This programme was initiated in the Cashew Research Station, Anakkayam with the objective of evaluating the performance of the clonal progenies of promising types in the germplasm collection and the first set of hybrids which were planted during 1963–64.

Clonal progenies of 12 types were planted during 1967. One type H 3–9 recorded the highest yield of 5.916 kg of nuts/tree followed by H 3–6 with a mean yield of 3.780 kg/tree. Previous year's results showed that H 3–6 was the best among the 12 types giving a mean yield of 7.765 kg/tree followed by H 3–9 giving 7.094 kg/tree.

Among the clonal progenies of 9 types planted during 1968, progenies of hybrid selection H. 3–17 recorded the maximum mean yield of 3.977 kg followed by the Kottarakkara selection K 22–1 which gave 3.7 kg/tree during the previous year. The crop from this plot was very poor during the year under report due to severe incidence of the tea mosquito bug and hence the yield data could not be taken for comparison of yield potential

Five clonal progenies of 10 types were planted during 1974. Out of 50 progenies, only 40 plants were established in the field. The 10 gaps in the plot have been filled. Out of the 40 plants established, 29 plants started yielding. The highest yield of 2.2 kg/tree was recorded by a progeny of the type K–25–2.

Comparative yield trial of Anakkayam selections and hybrid progenies (Layers) – Ag. H.3.15 Breed 2.03 [Madakkathara]

The object was to compare the performance of 16 promising types including some hybrids evolved at the Cashew Research Station, Anakkayam.

The trial was laid out during 1975 in RBD with 16 treatments and three replications, with 4 nos of plants per treatment. The spacing given was 7 5 x 7.5 m.

The yield data for 1979–80 are presented in Table 4.5.

Table 4.5: Comparative performance of Anakkayam selections (layers)

Types	*Mean nut yield (kg/tree)*
H–4–7	2.608
K–22–1	2.590
H–3–13	2.430
BLA–39–4	1.638
BLA–273–1	1.175
NDR–2–1	1.174
K–28–2	1.480
K–16–1	1.085
H–3–17	0.961
BLA–139–1	0.840
K–19–1	0.816
K–10–2	0.663
UL–28–1	0.432
NLR–2–1	0.371
K–18–2	0.325
K–25–2	0.301

Comparative yield trial of existing high yielders of cashew (seedlings) - Ag. H. 3.15 Breed 2.04 [Madakkathara]

The aim was to identify types suited to the locality based on the field performance of the most promising types collected from four Research Stations, viz., Anakkayam, Vridhachalam (Tamilnadu), Bapatla (Andhara Pradesh) and Venguria (Maharashtra).

In this trial, 16 types, have been included for comparison in a RBD with 3 replications. The number of plants per plot is 9 with a spacing of 8 x 8 m. The trial was planted in 1973 September with the following types:

Anakkayam – Types H–4–7, K–10–2, BLA–256–1, BLA–139–1 and K–27–2

Bapatla – BLA–1, BLA–40, BLA–56 and BLA–273

Vridhachalam – M–10/4, M–6/1 and M–76/1

Vengurla – Sawantwadi, Angur–1, Veng–36–3 and Veng–37–3

The yield data for 1979–80 are presented in Table 4.6

Table 4.6: Comparative performance of high yielding cashew types

Types	*Mean yield of nuts (kg/tree)*
K–27–1	5.829
BLA–139–1	5.176
M–76/1	4.342
M–6/1	4.151
M–10/4	4.150
Veng–36–3	3.882
Angur–1	3.370
Sawantwadi	3.200
Veng–37–3	3.056
BLA–256–1	3.309
H–4–7	2.946
BLA–40	2.700
BLA–273	2.554
BLA–56	2.335
K–10–2	2.330
BLA–1	1.880

Standardisation of seedling selection technique- Ag M-3–15–Hort1.01 [Vellanikkara]

The object was to correlate the size, weight, volume etc, of nuts to seedling vigour, precocity, yield and other economic attributes.

Ten types with 15 seedlings in each type were used for the trial. In this study, the date of harvest, weight of nuts after drying, volume, length, width, thickness, shelling percentage etc. of individual nuts were recorded before sowing. In the nursery, the nuts were sown separately in polythene bags under uniform conditions. Observations on date of germination, height, girth and number of leaves of seedlings were recorded in the nursery.

Out of 150 seedlings of the 10 types planted in field in 1978, only 111 Nos were got established. Twenty seven trees had flowered and borne fruits during the year under report.

The data from the studies in the nursery indicated that the weight of nuts had positive correlation with height and number of leaves in seedlings. It was also indicated that the weight of nuts had negative correlation with girth and internodal length of seedlings.

Multilocational fertilizer trial on cashew in cultivator's field-
Ag H-3–13 Agron 1.02 [Prappanangadi; Pilicode]

The trial was initiated to gather basic information regarding the manurial requirements of cashew under different agro-climatic conditions of the State. One plot each was selected at Parappanangadi and Pilicode.

Previous year's results from the plot at Parappanangadi showed that application of P increased yield by 26% and the pooled analysis for 1977-79 indicated that the main effects of N P & K did not differ significantly.

Statistical analysis of the previous year's data from the plot at Pilicode did not show any statistical significance with reference to treatments. Pooled analysis for the period from 1977 to 1979 showed that lowest level of N was inferior to other levels and that the application of P_2O_5 increased yield by 35%.

Fertilizer trial on cashew- Ag H 3-15 Agron. 1.03 [Madakkathra]

The objective is to find out a manurial schedule for cashew for increased production. The trial was laid out in 1973 using seedling progenies of the Tree-20 as planting material.

The layout is in RBD with 27 treatments and 2 replications. The number of trees per treatment is one, the spacing being 8 x 8 m. The treatments consisted of 3 levels of N at 0,500 & 1000 g/tree, 3 levels of P 0,200 & 400 g P_2O_5/tree and 3 levels of K at 0,500 and 1000 g K_2O/tree.

The trees were uniformly fertilized at 500 g N, 250 g P_2O_5 and 250g K_2O/tree during the first 5 years after planting. The differential doses of fertilizers were given during 1979. The statistical analysis of yield data obtained in 1979-80 indicated that the treatment differences were not significant.

Effect of magnesium, copper and iron on the yield of cashew—Ag H 3.13 Agron 2 01 [Anakkayam]

The main objective of this experiment was to study the effects of, Mg. Cu and Fe on the yield of cashew.

Results obtained from the previous year's data showed no significant difference between treatments. Preliminary analysis of the yield data of the current year indicated increased yield from the micro nutrient plots.

Cultural trial on cashew—Ag.4.3.13. Agron 3.01 [Anakkayam]

This experiment, laid out at the Cashew Research Station, Anakkyam was aimed at the evaluation of the various cultural practices on growth and yield of cashew.

Statistical analysis of the data on growth parameters and yield of the previous years showed no significant difference between treatments. During the year under report the yield obtained was very poor due to erratic flowering and severe incidence of the tea mosquito. Most of the trees did not produce any nuts.

Propagation trials in cashew—Ag.H.3-15-Hort.1.02 [Madakkathara]

The object of this project was to standardise the techniques of budding, veneer grafting, stone grafting and side grafting by conducting monthly trials and to work out the survival percentages.

The results so far obtained indicate that the best time for conducting side grafting, veneer grafting and budding was from May to October. The highest survival percentages were obtained during July, August and September.

In the case of stone grafting, March, April and May were found to be the ideal months for ensuring maximum survival. The data are furnished in Table 4.7.

Table 4.7: Relative efficiency of different propagation methods in different seasons,

Month	*Side grafting*		*Veneer grafting*		*Patch budding*		*Stone grafting*	
	No. done	Success (%)	No. done	Success (%)	No. done	Success (%)	No. done	Success (%)
July 1979	25	52	25	56	25	60	—	—
August ,,	25	48	25	40	25	56	—	—
September ,,	25	56	25	44	25	40	—	—
October ,,	25	28	25	20	25	24	—	—
March 1980	—	—	—	—	—	—	50	78
April ,,	—	—	—	—	—	—	50	72
May ,,	25	32	25	24	25	44	50	56
June ,,	25	48	25	40	25	48	50	36

Hormone application to increase fruit set in cashew Ag. H. 3.15 Hort 3 01 [Madakkathara]

The object of the trial was to reduce post-fertilization drop of fruits in cashew by spraying different hormones in various concentrations during the the flowering period of cashew trees.

The hormones tried as water sprays were NAA 10 & 20 ppm, IAA 50ppm, 2, 4-D, 5 & 10 ppm. IBA-25 ppm, GA 50 ppm.

Aqueous solutions of the above plant regulators were sprayed on whole trees after the opening of the hermaphrodite flowers. Twenty five panicles were selected per tree at random and there were 6 replications. The spray was repeated after a fortnight. Daily counts were taken on the total number of hermaphrodite flowers, fruit set, number of flowers dropped and the number of maturing nuts.

The results for the 1979-80 season are given in Table 4.10

Table 4.10: Effect of hormones on the flowering and fruit-set in cashew

Treatments	No. of flowers per panicle	% of fruit set	Mean weight of nuts(g)	Mean yield of nut (g) per pancile	Percentage of post-fertilization drop based on total no o fruits.
2, 4-D 5 ppm	30.10	4.6	4.20	9.00	1.36
2,4-D 10 ppm	27.30	5.2	4.25	10.21	0.82
IBA 25 ppm	29.10	5.1	5.04	11.57	1.26
IAA 50 ppm	29.01	6.6	3.62	9.45	0.43
NAA 10 ppm	29.25	3.3	3.98	6.48	0.54
NAA 20 ppm	27.30	4.7	3.52	7.24	1.11
GA 50 ppm	23.10	3.7	4.31	6.21	0.62
Water spray	29.50	5.1	3.94	8.18	1.62
No spray	33.90	7.5	4.09	13.05	2.84

As in previous year, significant differences were not detected between the different treatments.

Standardisation of vegetative propagation in cashew KADP Ag. 6-19-3 [Vellanikkara, Madakkathara]

Under this project, a trial was started to evaluate the suitability of different rooting media such as sand + sawdust, Spagnum moss, wood shavings, sand + rockphosphate + saw dust and wood shavings + rockphosphate. The separated layers were to be grown in different types of containers, viz., poly-bags, coconut husk and paddy straw. Different potting mixtures like coconut pith, wood shavings and the common potting mixture are also evaluated.

Trials on stone grafting and budding by forkert method were commenced to study the seasonal influence on the success of these methods of propagation.

Spacing trial KADP Ag. 6. 19 [Vellanikkara, Madakkathara]

To determine the optimum spacing for seedling plants and air-layered plants of cashew seedlings were planted in Aug 1979. The layers were planted in Aug. 1979. The establishment of the layers was poor.

Cultural trial- KADP. Ag. 6. 19.6 [Vellanikkara, Madakkathara]

In order to determine the best orchard management practices, this trial was laid out in 1978. The treatments included sickle weeding, light weeding around the plant to 2 m radius, light digging with mulching, covering with polysheet for 2 m radius and cover cropping. The growth measurements were recorded for all the trees.

Multilocational trials on orchard management practices-intercropping KADP. Ag. 6-19.5

The trial was laid out with five treatments including the inter-crops of lemongrass, tapioca, cowpea, horsegram and pineapple to assess the most promising and economical one for cashew in the pre-baering period.

Nutritional studies in cashew- KADP-Ag 6.19-4 [Vellanikkara, Madakkathara]

To ascertain the nutritional requirements of cashew in lateritic and sandy soils and to suggest a proper manurial schedule, trials were initiated. An experiment with three levels of NPK, namely, N-250 g, 500g and 1000g;P-125g, 250g and 500g and K-250 g, 500 g and 1000g per plant with 27 treatments was laid out with seedlings in 1979. The growth measurements of the experimental plants were recorded.

Two cultiator's plots were selected one at Peramangalam and other at Vellanikkara, both in the Trichur District.

Die-back disease of cashew-Studies on the control of the disease by newer fungicides—Ag.H.3.13 Path 2.01 [Anakkayam]

The main objective of this experiment was to select the most suitable fungicide for the control of the die-back disease.

Studies on the intensity of disease in different types and the application of the fungicides Calixin–0.1%, Bavistin–0.1% Vitavax–0.1%, Brodeaux mixture–1% Dithane M–45–0.2%, Difolatan-0.2%, Chawbathia paste and Thiride 0.3% were carried out.

The results showed that there were significant differences between treatments. Calixin reduced the disease incidence considerably. Bordeaux mixture and Difolatan were also found to be very effective.

Study of fungi associated with cashew trees with special reference to immature fruit drop—Ag.H.3–13 Path 1.01 [Anakkayam]

This experiment was started with the object of studying the fungal infections on cashew with special reference to immature fruit drop and evolving suitable control measures.

The programme includes isolation and culturing of fungi infesting cashew, their identification, pathogenecity and estimation of loss due to infection.

From the observational trial conducted to study the effect of fungicides on the control of immature fruit drop caused by *Colletotrichum gleosporioides*, no definite conclusions could be drawn because the incidence of the disease was quite mild.

The types BLA–273–1 and M–3–17 were found to be highly susceptible while K–22–1 was moderately resistant.

Pathogenecity of *Pestalotia* sp and *Colletotrichum gleosporioides* was established and the latter was found to be responsible for leaf blight and immature fruit drop to a certain extent. This fungus was estimated to cause about 3% fruit drop at the peanut stage of fruit development.

Survey of the insect pests of cashew. Ag. 11.3.15. Ent.2.01 [Vellanikkara]

The project was concluded during the year. The pests recorded during the year include the *Nephopteryx* sp (Phycitidae) on apples *Monolepta longitarsus* (Chrysomelidae) on tender foliage, *Apion ampulum* (Apionidae) on shoots, *Apoderus tranquebaricus* (Curculionibae) on leaves and *Catacanthus* sp (Pentatomidae) on the leaves and shoots. The tea mosquito population comprised mostly of *Helopeltis antonii* and to a lesser extent other undetermined species of *Helopeltis* complex.

Relative susceptibility of cashew types to infestation by Helopeltis antonii

KADP Ag 6.19.10 [Vellanikkara–Madakkathara]

It was found that the tree No 665 was significantly less susceptible than trees H–4–7–1111, 650, K–10–2–1287 and K-10-2-1218 on the basis of shoot damage. The tree No K–10-2 1218 was found to be more susceptible than most of the types evaluated in the trial with reference to the shoot damage. Based on lesions on the floral branches also the tree No. 665 was significantly less susceptible than the types K–10–2–12321, K–10–2-1278, BLA–139-1 and H–4–7-1098. The trees K-10-2–1232 and K–10–2–1218 were the most susceptible among the types.

Ag. 3.19.Ent. 1.02 [Vellanikkara, Madakkathara]

The studies were continued as a PG programme and this was completed during the year. The objectives of this project was to screen diffrent accessions

of cashew for resistance to the tea moisquito bug *Helopeltis antonii* and to study the influence of plant canopy architecture and chemical compositon of shoots and floral branches on the relative susceptibility.

The intensities of damage inflicted to the vegetative shoots are furnished in Table 4.11.

Table 4.11: Mean score values indicating the intensity of natural field infestation of vegetative shoots and floral branches by *H. antonii*

Sl. No.	Accession number	Mean scores	
		Vegetative shoots	Floral branches
	T 20-22	0.42	0.42
	Vengurla 37-3-112	1.00	1.33
	BLA-256-1-1430	1.33	2.25
	Vengurla 37-3-1097	1.42	1.50
	Vengurla 36-3-1469	1.58	1.42
	Ansur 1-1352	1.83	1.33
	Tree 56 of BLA-1219	2.50	2.83
	BLA-139-1-1431	2.58	2.00
	H 27-650	2.83	4.50
	BLA-139-1-1391	3.08	2.92
	Vengurla 36-3-1548	3.17	3.83
	H 27-665	3.27	4·17
	Ansur-1-1547	3.50	3.67
	H 4-7-1111	4.00	3.59
CD = (P=05)		1.15	1.39

The damage intensities ranged from 0.42 in the accession No.22 to 4.00 in the tree no. 1111. The accessions 22, 1112, 1430 and 1097 were found to be the least suscetptible. The intensities of damage to the floral branches by *H, antonii* are given in Table 4.12. The tree no.22 showed the least damage (0.42) while the tree 650 showed the maximum damage intensity of 4.50. Regarding the intensity of field infestation of the floral branches, the accessions 22, 1112, 1352, 1469 and 1097 were significantly less susceptible than the other types. With regard to the intensity of damage to the vegetative shoots consequent on confinement, none of the accessions was found to be promising. The accession nos, 1219, 1469 and 1431 were found to be the least susceptible to *H. antonii* infestation under confinement of floral branches. Simple correlation coefficients were worked out to ascertain the nature of relationship between the biochemical constituents on the one hand and the extent of susceptibility on the other. All the correlation coefficients except the one between tannin content in shoots and the degree of infestation of the shoots due to confinement of the insects were not found to be significant Negative correlation was detected between tannin content of the shoots and damage intensity scores

recorded on the shoots. Correlation studies revealed that the shade intensities within the canopies of trees or their architecture patterns had no influenc on the extent of susceptibility to infestation by the tea mosquito bug.

Pest Complex infesting cashew inflorescence Ag. 11.3.19 Ent 1.03 [Vellanikkara]

For a detailed survey on the pest complex infesting cashew infloresence the State was divided into six zones around Kottarakkara, Kalady, Madakkathara, Anakkayam, Ramanattukara and Kasaragod. The trees for sampling were selected and arrangements for the survey work completed.

Studies on the control of cashew stem borer Plocaederus ferrugineus

KADP–Ag6-19-9 [Madakkathara, Anakkayam, Parappanagadi]

The studies were continued.

Exploration of the feasibility of biological control of the tea mosquito bug Helopeltis antonii KADP–Ag (6) 19.81 [Vellanikkara–Madakkathara]

The study was continued and the only predatory insect recorded was the ant *Crematogaster wroughtoni* which fed on Ist to 3rd intars of *H. antonii*. Attempts for rearing these ants in captivity were not successful. Parasitoids and microbial pathogens were not recorded. The project was concluded during the year.

Studies on the optimum maturity and chemical composition of cashew apple for the preparation of different unfermented products

Ag. H. 3. 19 Proc. Tech. 1.01 [Vellanikkara]

The main objective of this project was to find out the optimum maturity of cashew apple for preparing squash, soft drinks etc.

Results of the experiment showed that cashew apple should be collected 46–47 days after fruit set. This stage has the required crispness and tightness of flesh. Not much variation was observed in the total bio-chemical constituents of cashew apple after 41 days of fruit set, except tannin and sugar. Estimation of amino acids, calcium and β carotene was carried out.

Clarification of cashew apple juice by diiferent methods-

Ag. H. 3 19 Proc. Tech. 1.04 [Vellanikkara]

The main objective of the project was to find out the most effective treatment for the removal of the phenolic compounds and other astringent material for the clarification of cashew apple juice Treatement with 0.4% gelatin and with 0.4% gelatin + 0.1% calcium hydroxide was found to be fairly effective in removing the above materials and to give a fairly acceptable juice. The phenolic contents in the untreated juice and treated juice were as follows:

Untreated juice	— 0.30 to 0.35%
Juice clarified with 0.4% gelatin	— 0.023 to 0.026%
Juice clarified with 0.4% gelatin + 0.1% calcium hydroxide	— 0.011 to 0.016%

FRUITS

PROJECTS IMPLEMENTED

BANANA

		Locations
1	Induced mutagenesis in banana (Ag. 5 (a)–14–Bot 4)	Kannara
2	Clonal variation studies in banana (Ag.5(a)-14-2-12)	Kannara
3	Varietal collection in banana (Ag. 8 (a)–14–2-5)	Kannara
4	Nitrogen nutrition in rainfed banana c v. Palayankodan (Ag. H. (a)-19-Agron. 2.03)	Vellanikkara
5	Effect of water stress on banana and critical growth stages of the Nendran variety	Kannara
6	Effect of different ratios and levels of NPK on the growth, yield and quality of banana variety Nendran	Kannara
7	Effect of crop rotation on the growth and yield of the banana variety Nendran	Kannara
8	Water requirement of banana (Ag.5 (a)-Agron 11 (ii)	Kannara Kannara
9	Nutritional requirement of banana Var (Palayankodan under rainfed conditions)	Kannara
10	Physiological deterioration of seed material in the banana variety Nendran (Ag.5(a)–14–Bot. 6)	Kannara
11	Physiological basis of variation in yield between two varieties of banana - Nendran and Zanzibar (Ag. 5 (a)–14–Bot.)	Kannara
12	Control of banana rhizome weevil by soil application of insecticides (Ag.5 (a)-Ent.2 (iii)	Kannara
13	Control of banana rhizome weevil by insecticidal application (Ag. 5(a)–14–Ent. 2 (ii)	Kannara
14	Fungal diseases of banana and their control (Ag. 5(a)–Path. 4 (ii)	Kannara
15	Studies on 'Kokkan' disease of banana (Ag.5 (a)–14–Path. 3)	Kannara
16	Studies on Kokkan disease of banana (Ag.5 (a)–14–Path.)	Kannara
17	Screening banana varieties against leaf spot disease (Ag.5 (a)-14–Path.2 (i)	Kannara Kannara
18	Studies on the effect of pre and post-harvest treatments on storage and quality of the banana variety Nendran (Ag-5 (a)–19–Proc. Tech.1.01)	Vellanikkara
19	Studies on post-harvest physiology, pathology and storage of fruits	Vellanikkara

Induced mutagenesis in banana Ag. 5 (a) 14 Bot. 4. [Kannara]

With the objective of standardising the correct size of suckers for irradiation and to screen out new Nendran type Banana having short stature, the Project was implemented at Kannara. It was found that suckers weighing 550–1250g were optimum for *gamma* irradiation. One of the segregants has been located and this is under observation.

Clonal variation studies in banana Ag. 8 (a)-14-2-12 [Kannara]

To ascertain the natural genetic variability in the popular banana variety Nendran and to identify the promising clones, a collection was made of types from Trivandrum, Quilon, Kottayam, Calicut, Malappuram and Trichur districts. These were planted at Vellanikkara and Kannara.

Varietal collection in banana Ag. 8 (a) 14–2–5 [Kannara]

In order to evaluate the germplasm materials of different varieties and clones of banana for yield and quality characters and to study their cyto-taxonomical and morphological attributes, a varietal-cum-clonal collection was maintained. A total of 180 varieties were grown during the year. This include *Musa acuminata*, *M. balbisiana* and *M. Oranta.*

Nitrogen nutrition in rainfed banana C. V. Palayankodan Ag. H (a) 19 Agron 2.03 [Vellanikkara]

Studies were carried out in 1979-80 on the effect of different levels of nitrogen on growth, yield and quality of fruits, uptake and distribution of nutrients at different phases of growth and development and also to assess the most economic dosage of nitrogen for banana C. V. Palayankodan under rainfed conditions.

The results revealed that among the morphological characters, only the height, girth and length of petiole of the plants were markedly influenced by levels of nitrogen. Application of nitrogen significantly increased the duration of the crop. The highest level of nitrogen (400g/plant) resulted in the maximum crop duration. The yield was significantly increased up to a level of 200g N/plant but a further dose increase had decreased yield. The optimum and economic dosage of N worked out from the experiment was 244.6g and 96g/plant respectively. Nitrogen application significantly increased the TSS reducing sugars, non-reducing sugars, total sugars and sugar/acid ratio. Acidity and ascoric acid content of the fruits were not, however, influenced by the treatments. The total dry matter production increased with increasing levels of N at all stages of growth. The uptake pattern of major nutrients also was greately influenced by nitrogen application.

Effect of water stress on banana and critical growth stages of the Nendran variety [Kannara]

The maximum bunch weight was obtained under irrigation given once in 10 days during January-April (Table 4.13)

Table 4.13: Effect of waterstress on the growth and yield of banana var. Nendran

Treatment	Height of plant (cm)	Girth of plant (cm)	Total no. of leaves	Weight of bunch (kg)	No. of hands per bunch	No. of fingers per bunch
1*	235.0	48.5	27.5	1 62	3.5	23.0
2	233.8	49.0	27.8	3.12	3.8	31.3
3	245.0	47.7	26.0	3.20	4.0	32.0
4	240 0	46.0	26.3	2.43	3.7	21.3
5	240.0	49.8	25.0	1.10	3.6	21.2
6	265.0	49.0	26.8	3.38	4.5	34.8
7	243.8	51.5	27.5	2.75	4 3	32.5
8	245.0	50.0	26.0	1.70	2.3	13.3
8	235.0	47:7	25.0	2.80	4.8	24.3
10	227.5	41.5	26.5	1.50	4.0	24.5

1. No irrigation during January and afterwards once in 10 days irrigation.
2. Irrigation once in 10 days from January to May except during February.
3. Irrigation once in 10 days from January to May except during March
4. Irrigation once in 10 days from January to May except during April
5. Irrigation once in 10 days from January to May except during May
6. Irrigation once in 10 days from January, March and May and no irrigation during February & April
7. Irrigation once in 10 days from January to May
8. No irrigation during January and afterwards once in 15 days upto May
9. Irrigation once in 15 days from January to May except during February
10. Irrigation once in 15 days from January to May except during March

Effect of different ratios and levels of NPK on the growth, yield and quality of banana var. Nendran [Kannara]

The experiment was conducted to find out the optimum levels und ratios of fettilizer nutrients for Nendran banana. Significant differences were found only with respect of bunch weight. The maximum bunch weight was recorded under N_1K_2 (200 g N and 500 g K_2O/plant)

Effect of crop rotation on the growth and yield of banana variety Nendran [Kannara]

The maximum bunch weight was obtained in banana—banana—tapioca ratation fields, but the treatment differences were not significant (Table 4.14)

Table 4.14: Effect of crop rotation on the growth and yield of var. Nendran

Treatment	Heigh of plant (cm)	Girth (cm)	No. of leaves produced	Weight of bunch (kg)	No. of hands/ bunch	No. of fingers/ bunch
1*	315.70	60.80	27.05	6.52	5.20	48.30
2	316.80	62 30	27.40	6.80	5.20	49.10
3	298.05	58.91	27.88	5.84	5.03	45.55
4	309.95	60.40	28.45	6.70	5.25	49.35
F test	NS	NS	NS	NS	NS	NS

1* Banana—tapioca—banana
2 Banana—banana—tapioca
3 Banana and green manure + tapioca and groundnut "
+ Banana and green manure "
4 Banana—Paddy—pulses—tapioca

Water requirement of banana Ag. 5 (a) Agron 11 (ii) [Kannara]

With the aim of fixing of water repuirement of banana in relation to physiological stages of crop growth, the project was implemented. The second season experiment was harvested in September, 1979. The results showed that the treatment differences were not significant in respect of yield or morphological characters.

Nutritional requirements of banana (Palayankodan variety) under rainfed conditions (Kannara)

The project was taken up in 1979 with the objective of finding out the optimum NPK requirement for banana. The data on the yield and growth characters are presented in Table 4:14.

The maximum bunch weight of 8.12 kg was given by the highest dose of nitrogen (300 g/plant). Phosphorus did not show significant differences in the bunch weight or any of the growth characters. Graded doses of potash was effective in giving a significant increase in the number of fingers per bunch. The maximum number of 146.36 fingers/bunch was obtained by the application of 200 g of potash per plant.

Physiological deterioration of seed material in the banana variety Nendran Ag. 5 (a)-14 Bot. 6 [Kannara]

To assess the yielding potential of rhizomes of the same mother plant, this experiment was carried out. Suckers of mother plants were planted in separate progeny rows. It was found that out of 21 plants obtained from 6 mother plants, only five showed the same level of productivity, while the rest were poor yielders.

Table 4.15: Effect of N, P and K on yield and morphological characters of banana Var. Palayamkodan under rainfed conditions

Treatment	Height (cm)	Girth (cm)	No. of leaves produced	Weight of bunch (Kg)	No. of hands/ bunch	No. of fingers/ bunch
Nitrogen gm plant						
0	221.55	55.13	21.04	7.14	8.38	137.58
150	242.44	58.62	21.69	8.02	8.69	138.45
300	246.22	58.79	22.19	8.12	8.88	144.36
F test	Sig.	Sig.	NS	Sig.	NS	NS
CD (0.05)	8.98	2.03	—	0.49	—	—
Phosphorus g / plant						
0	236 58	57.93	21.68	7.94	8.75	139.88
50	238.37	57.51	21.81	7.46	8 58	139.23
100	235.26	57.11	21.43	7.88	8.58	141.27
F test	N.S	N.S	N.S	N.S	N.S	N.S
CD (0.05)	—	—	—	—	—	—
Potash g/plant						
0	235.08	57.23	21.73	7.71	8.61	137.37
200	237.54	58.16	21.41	8.00	8.84	146.36
400	237 52	57.15	21.77	7.58	8 45	136.66
F test	N.S	N.S	N.S	N.S	N S	Sig
CD (0.05)	—	—	—	—	—	8.03

Physiological basis of variation in yield between two varieties of banana- Nendran and Zanzibar– (Ag 5 (a)– 14 Bot. 7)– [Kannara]

To ascertain the physiological parameters, NAR (Net Assimilation Rate), RGR (Relative Growth Rate) and LAI (Leaf Area Index) associated with productivity and to correlate these parameters with biomass, production this project, was taken up. The studies are progressing.

Control of Banana rhizome Weevil by soil application of insecticides Ag 5 (a) Ent. 2 (iii) [Kannara]

Significant differences were detected among the treatments and the highest mean bunch weight was obtained in the case of Phorate followed by Carvint, Solvirex and Carbofuran,

Control of Banana rhizome weevil by insecticidal application Ag. 5 (a)–14-Ent 2 (ii) [Kannara]

In order to find out how far external treatment of banana suckers with insecticides will be helpful to check infestation by the rhizome weevil, an experiment was carried out. Insect free suckers were selected and these were dipped in cowdung slurries containing qinalphos 1%, BHC 2%, Cabarvl 2%, monocrotophos 2%, phosphamidon 2% and Methyl demeton 1%. Among the insecticides tried, phosphamidon 2% was found to be most effective with reference to mean bunch weight. This was followed by monocrot ophos and methyl demeton.

Fungal diseases of banana and their control Ag 5 (a) Path-4 (ii) [Kannara]

A field experiment was laid out in October 1979 for evaluating the relative efficiency of the foliar fungicides Dithane M-45, Thirid 0.5%, Bavistin 0.1%, Power oil 1% + Dithane M-45 0.2% and Power oil 1%. The fungicides were applied at fortnightly intervals soon after the appearance of the first symptom. The experiment is in progress.

Studies on Kokkan disease of banana Ag 5 (a) 14 Path. 3– [Kannara]'

With the object of finding out whether there is any reduction in the percentage of infection of Kokkan disease with fungicidal treatments, experiments were carried out. The fungicides tested were Bordeaux mixture, Thiride, Ceresan wet and Cheshunt compound. Conclusive results were not obtained during tha year.

Studies on Kokkan disease of Banana Ag. 5 (a) 14–Path–[Kannara]

The experiment involving 12 treatments of graded doses of $MgSO_4$ and control was laid out in 1978–79. Kokkan infested plants were used for the treatments except for the control and it was found that the application of 100 g of Mg SO_4 on 180th day after planting gave the maximum bunch weight and this treatment was found to be on par with the yield obtained from healthy plant (control).

The experiment was repeated during 1979–80.

Screening banana varieties against leaf spot disease Ag. 5 (a) 14. Path 2 (i) [Kannara]

Cercospora musae and *Cordana musae* were found to be associated with the leaf spot disease. The incidence of the disease was low in the varieties Pisanglilin, Sennachenkadali and Adakkakunnan.

Studies on the effect of pre and post–harvest treatments on storage and quality of banana variety Nendran Ag. 5 (a)–19–Proc. Tech. 1.01. [Vellanikkara]

With the objective of studying the effect of pre and post-harvest treatments on storage and quality of banana variety Nendran, an experiment with 3 growth regulators, viz., NAA, 2, 4–D and at three levels and another with 3 fungicides viz., Bavistin, Anthracol and Thiride at 2 levels and 4 different storage methods were conducted during the year. Preliminary observations revealed that NAA had positive effect in respect of quality and finger size. Storage inside polythene bags (200 gauge) containing potassium permanganate prolonged storage life of mature green bananas.

Studies on post harvest physiology, pathology and storage of fruits [Vellanikkara

The project is undertaken with the objective of studying the storage behaviour of major tropical fruits grown in the state of Kerala. During the period under report, studies were conducted on the effect of post-harvest application of certain growth regulators like 2, 4, 5–T, 2, 4–D, IAA and NAA on fruit quality of Banana C. V, Palayankodan. The quality of the fruits was found to be significantly influenced by the treatments. Treatments of 100 pom IAA and 40 and 60 ppm 2, 4–D were found to increase the loss in weight on ripening, ascorbic acid content and sugar concentration. 40 ppm 2, 4, 5–T, 100 ppm IAA, 50 ppm and 100 ppm NAA treatments increased the TSS of the fruits significantly. Treatments with 60 ppm 2, 4, 5–T, 50 ppm NAA, 20 ppm 2, 4–D and 100 ppm IAA were found to be effective in reducing the acidity of the fruits significantly. The sugar acid ratio was increased by IAA 100 ppm and 2, 4–D 60 ppm. No significant variation was noticed with regard to the peel pulp ratio due to the treatments.

MANGO

PROJECTS IMPLEMENTED

		Locations
CROP IMPROVEMENT		
1	Germplasm collection in mango	Vellanikkara
2	Survey and selection of pickle varieties of mango and their propagation by vegetative means	Vellanikkara
CROP MANAGEMENT		
3	Regulation of flowering and fruiting in mango (Ag. 8 (c) 19-7-3)	Vellanikkara
4	Nutritional studies in mango	Vellanikkara
POST-HARVEST TECHNOLOGY		
5	Maturity and post-harvest studies in mango (Ag. H. 5 (d) 19. Hort. 6·01)	Vellanikkara
6	Studies on suitability of popular varieties of mangoes of Kerala for canning (Ag. H.5 (d) 19 Proc. Tech. 1.01)	Vellanikkara

MANGO

Germplasm collection in mango [Vellanikkara]

The project was started in the year 1976 with an objective of establishing a collection of Inidan mango varieties and to find out their comparative performance under Kerala conditions. Twenty seven table varieties and forty one hybrid combinations collected earlier (1976 and 1977) were maintained in the Instructional Farm and the observations were recorded. During the year, three more table varieties were located in Karthikappally, Elepekulam and Haripad villages of Alleppey district. The mother plants were examined and the tree characters and fruit characters were recorded. The types selected were Vellari, Kapally and Thathachundan. The data on growth and flowering are being collected. Steps were taken for the propagation of these materials for accession in the germplasm collections.

Survey and selection of pickle varieties of mango and their propagation by vegetative means [Vellanikkara]

During the previous years, 26 pickle types have been located in the districts of Trichur and Palghat and collections were made.

Regulation of flowering and fruiting in mango—Ag 8 (c) 19.7.3 [Vellanikkara]

The project was started during 1976 with the objective of finding out the effect of pruning on flowering and crop production in mango. Earlier trials conducted at Mannuthy have shown that flowering and fruit-set could be improved by pruning the central branches and opening up the canopy. Of the different seasons of pruning, late October running was found to be the best.

During 1979, seven varieties, viz., Alphonso, Bennet Alphonso, Bangalora, Bengenappilly, Pairi and Neelum were selected for pruning trials. Pruning was conducted in trees with thick canopy during December by removing the cris-cross branches of more than 30 cm diameter. The weak, unhealthy shoots and Loranthus infectedones were removed.

All pruned trees were observed to be completely in the vegetative phase without any flowering.

Nutritional studies in mango [Vellanikkara]

The trial was laid out in the year 1976 with the objective of finding out the optimum requirement of N, P, K for the two varieties of mango, Neelum and Prior. The experiment was laid out in RBD with 3 replications. The trees were planted at spacing of 8 x 8 m. The 4th year application of fertilizers as per the following schedule was given in November, 1979.

	N	P	K
	(g/tree)		
Treatment—1	50	18	50
Treatment—2	100	36	100
Treatment—3	200	72	200

The growth measurements namely, plant height, girth and spread of the plants in N—S and E—W directions were recorded. The trees have not commenced flowering although stray flowering, was noticed in the Prior variety. The observations showed that as in the previous years, the treatments did not show any significant difference in the pre-bearing stage.

Maturity and post harvest studies in mango Ag. H 5 (d), 19 Hort. 6.01 [Vellanikkara]

The objectives were to standardise the maturity index for mango and to prolong shelf-life by adopting different storage methods and also to find out the suitability of five varieties of mango for canning purposes.

Five mango varieties. viz., Neelum, Mundappa, Suvarnarekha' Olour and Bennet Alphonso were selected and physical characteristics such as length, girth, width, volume and specific gravity and the chemical characteristics such as TSS, acidity, Vitamin C, Vitamin A, total sugar, reducing sugar and non-reducing sugar were recorded at weekly intervals. Different methods were tried to extent the shelf-life of mango fruits harvested at different stages of maturity. The methods tried were waxing, storage in polythene bags of different guages and storage in palythene bag contoining potassium permanganate and keeping these at room temperature as well as at low temperature.

Quality of the canned fruits of the above five varieties were evaluated at monthly intervals commencing from six months after canning.

To draw confirmatory results, the experiment is being repeated.

Studies on suitability of popular varieties of mango in Kerala for canning—Ag.H 5 (d), 19-Proc. Tech. 1.01. [Vellanikkara]

The project aimed at the testing of popular varieties of mango in Kerala for preservetion by canning. Four varieties of mango, Viz., Neelum, Suvaranarekha, Olour and Mundappa were canned as slicus in syrup. Samples were drawn at inter vals and tested for physical as well as chemical qualities. It was found that all the varieties retained most of their characteristics for a period of one year.

PINEAPPLE

PROJECTS IMPLEMENTED

CROP IMPROVEMENT

		Locations
1	Varietal studies in pineapple (Ag. (5) 15. Agron. 4)	Kannara Vellanikkara

CROP MANAGEMENT

2	Standarisation of time of application of growth regulators on materials raised from suckers and crowns (Ag. 5 (f)–15–Hort–3)	Vellanikkara Vellanikkara
3	Use of crown–splits in pineapple progapation	Kannara Vellanikara
4	Adaptive trial in pineapple to compare the results of research with local practice	Kannara Vellanikkara
5	Potash requirement of pineapple	Kannara
6	Effect of shade on growth and fruiting in pineapple	Vellanikkara
7	Effect of different growth regulators on flowering and fruit development in pineapple	Vellanikkara
8	Regulation of fruit size and maturity in pineapple	Vellanikkara
9	Standardisation of types and size of planting material in pineapple	Kannara, Vellanikkara

Varietal studies in Pineapple– Ag (5) f. 15–Agron 4 [Kannara, Vellanikkara]

With the aim of maintaining most of the available varieties and to study their vegetative and fruit characters, the project was operated. The varietal collection included Rapley queen, Queen, Alexandria, Charlotte, Rothschild, Macgregor, Pulimath local, Selengore green, Cayenalisia, Conical, Smooth, Cayene, Kew, Irradiated Kew, Kallora local, Mauritious, Espinola roja, Thaliparamba local, Valera blance Jaldhup, Simhachulum, Lakhat, Assam, local, Variegated Kew and HIJHU.

Standardisation of time of application of growth regulators on materials raised from suckers and crowns– Ag 5 (f)–15–Hort–3 [Kannara, Vellanikkara]

This experiment was laid out in 1976 to find out the best stage of application of growth regulators for getting optimum fruit size. The trial was continued in 1979–80 also. The results indicated that with regard to yield attributing characters, suckers were the better planting materials than crowns. In order to get maximum yield, it was found better to treat the plant with growth regulators on the 18th month after planting the crowns.

Use of crown–splits in pineapple propagation– [Kannara, Vellanikkara]

The experiment with a modified technical programme was laid out in March, 1980 The objective of this project was to explore the feasibility of using, crown-splits for pineapple propagation.

Adaptive trial in Pineapple to compare the results of research with local practice Ag. 5 (f) 15 Agron-4 [Kannara, Vellanikkara]

This trial was continued during 1979-80 to study the effect of fruit size and productivity in the first ratoon crop. Flowering was almost uniform in the treatments getting improved techniques and the fruits could be harvested in the summer season itself. Flowering in the plants receiving local treatments was sparse. There was no significant difference in fruit weight without crown, length of fruit and mean diameter of fruit between the local and the improved practices. The previous year's results indicated that the improved practice was highly beneficial since 91.95% flowering was recorded in the 16th month as compared to 67.2% in the 19th month.

Potash requirements in pineapple [Kannara]

The response of pineapple to potassium has been reported to be variable and the present studies were carried out with the above desideratum. The experiment has been laid out in June, 1979.

Effect of shade on growth and fruiting in pineapple [Vellanikkara]

The studies were carried out to find out the effects of shading on the growth, flowering and fruiting behaviour of the pineapple variety kew. There were four treatments, viz., 0,25,50 and 75% shade. In respect of the number of leaves produced per plant, the treatments did not show any significant variations. The percentage of flowering in the case of open grown plants was only 24 without any growth regulator treatment, while it was 83 under 50% shade. With Ethrel treatment (500 ppm) the maximum percentage of feowering was obtained from plants g.own under 25% shade (86%) which was only, 75% without the ethrel treatment (Table 4.16).

Table 4.16: Effect of shading on flowering percentage, time taken for flowering and time taken for fruit maturity of Ethrel treated and untreated plants.

Treatments	Without Ethrel treatment			Ethrel treated plants		
	Time taken for flowering (days)	% flowering	Time taken for fruit maturity (days)	Time taken for flowering (days)	% flowering	Time taken for fruit matmaturity (days)
0 % shade	565.6	24.0	138.8	546.64	80.0	138.7
25% „	527.9	75.0	123.8	529.84	86.0	123.6
50% „	523.1	83.0	123.9	529.06	64.6	123.7
75% „	527.9	59.6	123.7	528.90	58.0	123.9
CD (0.05)	5.14	1.14	1.92	5.21	3.05	1.20

The weight of fruits with crown did not show any significant differences between the treatments. The fruits from plants grown under 50% and 75% shade showed lower values of reducing and non-reducing sugars.

Effect of different growth regulators on flowering and fruit development in pineapple [Vellanikkara]

Application of growth regulators and chemicals were done in two seasons and January application resulted in earlier flowering than November application. Among the different growth regulators tried, Ethrel 250 ppm was found to be the best for maximum induction of flowering. Ethrel at all concentrations was found to reduce the duration of flowering. Ethrel in combination with 2% urea and 0.04% $CaCO_3$ also gave similar effects. Planofix 20 ppm was found to give the maximum fruit size. None of the growth regulator chemicals and combinations, resulted in an overall improvement in quality of fruits.

Regulation of fruit size and maturity in pineapple
[Vellanikkara]

The study was started in 1979 with the objective of finding out the effect of growth regulator NAA at different concentrions at different stages of fruit growth and also to study the effect on fruit size, matuity and quality of fruits.

There was an increase in fruit size due to the application of 300 ppm NAA, one month after flowering.

Standardisation of types and size of planting material in pineapple [Kannara, Vellanikkara]

To find out the optimum type and size of suckers for planting, the experiment was laid out during 1979-80. The leaf number and length and width of D leaves were recorded 6 months after planting. The results indicated that the number of leaves per plant and length and width of D leaf were higher in suckers with a weight range of 751-1000 g, followed by 501–750 g,

CITRUS

PROJECT IMPLEMENTED

CROP MANAGEMENT

		Locations
1	Manuriai trial on Coorg mandarin orange with N&K	Ambalavayal
2	Root stock trial in Coorg mandarin under Wynad conditions	Ambalavayal
3	Varietal–cum–rootstock trial	Ambalavayal
4	Adaptability trial on acid lime seedlings	Vellanikkara
5	Standardisation of agro–techniques in Mandarin organges–Moisture conservation trial	Ambalavayal

CROP PROTECTION

6	Weedicidal trial with modern herbicides in citrus orchards in Wynad	Ambalavayal
7	Chemical control of aphids, psylla and white flies (Ag 5 (i) 12 Ento. 1.01)	Ambalavayal
8	Chemical control of leaf miner (Ag 5 (1) 12 Ento. 1.01)	Ambalavayal
9	Investigations on the major pests affecting citrus (Ag 5 (6) 12. Ent. 1.01)	Ambalavayal
10	Studies on the fungal diseases of citrus and their control (Ag. 5 (b)–12. Path 2.01)	Ambalavayal

Manurial trial on Coorg mandarin orange with N&K [Ambalavayal]

This programme was initiated with the objective of finding out the economic optimum dose of N and K (P kept constant) for Coorg Mandarin oranges under Wynad conditions. The planting was done in 1976 using Trifoliate orange as root stock.

The growth of the plants were highly irregular due to the gap filling of the plants during 1977 and '78. Due to the lack of uniform growth, the present plant population was inadequate for manurial trial.

Root stock trial In Coorg Madarin under Wynad conditions [Ambalavayal]

An experiment was started during 1974–75 to find out the best root stock for Coorg Mandarin variety under Wynad conditions. The six root stocks tested for their suitablity for Coorg mandarins were Rangpur lime, Rough lemon, Trofoliate orange, Cleopatra Mandarin, Troger Citrange and Carizo Citrange.

From the data collected during the previous year, it was observed that the root stocks of Carizo citrange, Rough lemon and Troyer Citrange had given better performance over the others. Carizo Citrange root stocks gave the maximum mean number of fruits, followed by rough lemon and Troyer Citrange.

Varietal–cum–root stock trial in Mandarin orange [Ambalavayal]

The aim of this project was to find out the best rootstock-scion combination suitable for the agroclimatic conditions of Wynad.

The scions tested were Kinnow mandarins, Satsuma Mandarins, Nagpur Mandarins, Coorg Mandarins, and Khasi Mandarins. The root stocks were Rough lemon, Trifoliate orange, Troyer citrange and Cleopatra mandarins.

The trial was laid out, but this being the first year of planting, there were a number of casualities for replacement. After the plants have established in the field, data on stalk girth, scion girth, stock–scion ratio, volume of the trees and the yield are to be recorded.

Adaptability trial on acid lime seedlings [Vellanikkara]

The trial was laid out in 1978 with tha object of finding out the adaptability of acid lime in the plains of Kerala.

Observations taken during 1979 showed that Bacterial canker disease seriously affected the protected and unprotected seedlings. 78% of the plants cross-protected with the mild strain of Tristeza virus were completly killed by the severety of the disease and in the case of unprotected plants, the percentage of mortality was 59.4%.

Standardisation of agro-techniques in Mandarin oranges—Moisture conservation trial [Ambalavayal]

The main objective of this trial was to find out the most economic cultural practices for conservation of moisture in Mandarin orange orchards in Wynad.

In order to suppress weed growth, three weedlings were given in plots which neither had mulchings nor cover cropping. The data recorded on height, spread and volume showed that the plants mulched with green leaves gave better performance over the others.

Weedicidal trial with modern herbicides in citrus orchards in Wynad [Ambalaval]

The objective of this trial was to find out the most economic method of controlling weeds in citrus orchards and to identify the most effective herbicide against weed flora in orchards. Pre and post-emergence weedicides were sprayed and observations taken on 60th, 90th and 120th days after spraying.

Chemical control of aphids, psylla and white flies–

Ag. 5 (1) 12. Ento. 1.01 [Ambalavayal]

This programme was initiated to study the seasonal abundance of these pests and to evolve suitable control measuress.

The work on the study of seasonal abundance of the pests was in progress.

Chemical control of leaf miner–

Ag.5(1) 12 Ento. 1.01 [Ambalavayal]

The objective of this experiment was to study the seasonal abundance of the leaf miner and the varietal susceptibility and also to evolve suitable control measures. The experiment was laid out with eight treatments.

Data on the seasonal incidence of the pest was recorded. Insecticidal treatments will be given in 1981.

Investigations on the major pests affecting citrus–

Ag. 5 (b) 12. Ento. 1.01 [Ambalavayal]

Main objectives of this investigation were to study the seasonal abundance of major pests of citrus and to evolve suitable control measures. Three separate trials were laid out to study the pests and their control measures. Data on the seasonal abundance of the pests were being recorded.

Studies on the fungal diseases of citrus and their control–

Ag. 5 (b) 12. Path. 2.01 [Ambalavayal]

This study aimed at the identification of the pathogens responsible for the incitation of powdery mildew, leaf fall and fruit rot diseases and to formulate suitable control measures and to evaluate the various fungicides against the diseases. Work on this was continued.

5. Vegetables & Tuber crops

HIGHLIGHTS

Two hybrids in chilli, purple round X Vellanotchi and Pant C_1 X Purple cluster were identified to be heterotic. In brinjal, the line SM-6 from Annamalai was observed to possess resistance against Bacterial wilt. The bitter-gourd variety MC-23 performed consistently better in the multilocational trials. Eighteen winged bean lines were collected and maintained in the germplasm bank. Two vegetable types of cowpea, Pusa barsathi and No. 5269 were found to be promising. Da 60 variety of larger yam gave the highest yield of 15.9 t/ha. The culture No. V 6 in sweet potato was found to be high yielding. Up to five harvests could be obtained in amarantus in certain seedling age-spacing combinations (15 days-15 x 10cm; 15 days-20 x 10 cm; 20 days-15 x 10 cm; 20 days-20 x 10 cm). The highest yield of bitter gourd was obtained at 50: 25: 50 kg NPK/ha. The maximum tuber yied from the tapioca hybrid H 2384 was obtained when N &K were applied each at 120 kg/ha. Ethrel at 300 ppm and CCC at 1000 ppm gave the maximum net profit from sweet potato crop. In colocasia, the highest tuber yield was obtained when the crop was mulched first at the time of planting and once again at the time of first earthing up. The tomato line CL 32-0-0-0-1-1965 obtained from AVRDC, Taiwan showed remarkable resistance to Bacterial wilt. The population of the white fly *Bemisia tabaci* which is the vector of the cassava mosaic, attained peak during the period July-September.

SUMMARY

Studies on the selection of superior types of *Capsicum annum* from segregating populations of intervarietal crosses showed that the F1 hybrids from Purple round X Vellanotchi and from Pant C_1 X Purple cluster were highly heterotic.

Evaluation of chilli germplasm with reference to high yield and quality attributes led to the identification of Picora as quite promising.

The germplasm collections of brinjal, cucurbits and their wild relatives were maintained in the Department of Olericulture College of Horticulture and these included 76 lines of brinjal 56 of bitter gourd, 26 of water melon, 62 of cucumber, 15 of ash gourd and 34 of pumpkin.

Seventy six lines of brinjal were screened for resistance to Bacterial wilt and the line SM-6 from Annamalai, Tamil Nadu, was found to be moderately resistant and high yielding.

Experiments involving selection and breeding in bhindi were in progress.

Eighteen Pumpkin lines were evaluated for fruit yield and fruit quality attributes. The fruit yield per plant varied from 5.45 kg in CM-16 to 16.10 kg in (M-17). The protein content ranged from 5.26% in CM-11 to as high as 9.49% in CM-15, on a dry weight basis.

Hot weather cauliflower types were evaluated for their adaptability to local conditions.

In order to exploit hybrid vigour in bhindi, twenty eight F1 hybrids developed through diallel mating of 8 selected varieties were studied. The genotypes were not significantly different in respect of fruit yield.

The bitter gourd line MC-23 and the snake ground line TA-19 were selected for high yields and fruit quality. Multilocational trials indicated their superiority.

Eighteen winged bean lines were collected and maintained in the germplasm bank.

Varietal trials in cowpea, musk melon and cucumber led to the identification of K. 1552 variety of cowpea, Maramadhu type of musk melon and Pandex variety of cucumber as promising.

Among the vegetable types of cowpea, the lines Pusa Barsati and No.5269 were found to be promising with mean yields of 3.02 t/ha. and 3.47 t/ha respectively.

The progenies from Malavella X M4 were not found to be suitable for Wynad conditions.

Of the five varieties of *Diascorla alata*, D a 60 gave 15.9 t/ha.

The sweet potato line V 6 was observed to be high yielding and promising (0.495 kg tubers/hill).

N, P, K dose of 50, 25, 50 kg/ha gave maximum yield in bitter gourd.

Up to five harvests was obtained in amarantus in certain seedling age–spacing combinations (15 days–15 x 10cm; 15 days-20 x 10cm: 20 days-15 x 10cm; 20days–20x 10cm).

Studies on the N, P, K requirements of tapioca and on the optimum stage of harvest of the crop were continued.

The hybrid variety of tapioca, H 2384 gave the maximum yield of 30.25 t/ha when N and K were applied each at 120 kg/ha.

The effect of growth regulator Ethrel and CCC on the growth and yield of sweet potato showed that Ethrel at 300 ppm and CCC at 1000 ppm gave the maximum net profit

Fertilizer trials in sweet potato indicated that the maximum yield of tubers was obtained at 60 kg N and 60 kg P_2O_5/ha.

The highest yield of tubers in sweet potato was obtained when the crop was harvested 4 months after planting.

Different methods of planting, namely, in pits, in ridges and in furrows, did not influence tuber yield from colocasia. The maximum tuber yield was obtained from plots mulched at planting and at the time of first earthing up.

Maximum tuber yield from colocasia was obtained under 120 kg/ha N,75 kg/ha P_2O_5 and 150 kg/ha of K_2O.

The tomato line CL–32–0–0–0–1–1965 obtained from the Asian Vegetable Research and Development Centre, Taiwan showed remarkable resistance to the Bacterial wilt.

Seed mycoflora associated with vegetable seeds were isolated and identified.

Studies on symptomatology, histopathology and transmission of the Cassava mosaic disease were in progress.

Survey of the whitefly (*Bemisia tabaci*) populations revealed that the flies start building up their populations from June, the peak being attained in July–September.

PROJECTS IMPLEMENTED

	CROP IMPROVEMENT	*Locations*
1	Selection of superior types of *Capsicum annum* with economic attributes from segregating generation of inter-varietal crosses (Ag. 7-18-Breed-4-02)	Vellayani
2	Studies on heterosis and combining abilities with respect to important economic traits in chillies (Ag-7-18--Bot-2)	Vellayani
3	Collection, evaluation and selection of improved chilli varieties (Ag. H-7-19-Breed-5-04).	Vellanikkara
4	Breeding for polygenic resistance in chilli against leaf curl and mosaic complex (Ag. H-7-19-Breed-5-07)	Vellanikkara
5	Survey, collection and maintenance of germplasm in brinjal, cucurbits and their wild relatives (Ag. H 7-19-Breed-1-05)	Vellanikkara
6	Isolation and release of bacterial wilt resistant brinjal, varieties (Ag. H-7-19-Breed-1-08)	Vellanikkara
7	Selection and breeding in bhindi (Ag-7-8-Bot-1-01)	Mannuthy
8	Genetic variability and correlation studies in pumpkin	Vellanikkara
9	Evolving hot weather cauliflower varieties suited for cultivation in Kerala State (Ag-7-2-Breed-5-08)	Vellayani
10	Selection of suitable cucurbit varieties (Ag-7-2-Breed-5-06)	Vellanikkara
11	Collection, survey and maintenance of germplasm in winged bean	Vellanikkara
12	Varietal trials in brinjal, bhindi, cowpea, amarantus, dolichos bean, pumpkin, cucumber etc,	Vellanikkara
13	Breeding for long poded vegetable types of cowpea (Ag-9 (b)-1-Breed-2-01)	Pattambi
14	Comparative yield trial of the progenies of Malavella × M 4 (Ag-8 (a)-12-Agron-2-02)	Ambalavayal
15	Multilocational trial on *Dioscoria alata* (Ag.8(e)-8-Breed-2-01)	Nileswar
16	Evolving high yielding sweet potato through inter-varietal hybridisation (Ag-8-(d)-18-Breed-2-01)	Vellayani
	CROP MANAGEMENT	
17	Studies on the effect of graded doses of N, P and K on growth, and yield of bitter gourd (Ag-7-2-Agron-1-04)	Mannuthy
18	Studies on the effect of graded doses of N, P and K on growth, yield and quality of bhindi (Ag-7-19 Agron-1-01)	Vellanikkara

19	Studies on the effect of plant population density and age of transplanting on growth, frequency of harvest and vegetative yield in amarantus (Ag–7–2 Agron–1–05)	Mannuthy
20	Studies on water use by crops grown in pure and mixed stands (Ag-1-2(1–6)	Chalakudy
21	Control of weeds in tapioca with herbicides	Vellayani
22	Assessment of N, P, K requirement of tapioca (Ag–8 (a)–12–Agron–1–02)	Ambalavayal
23	Crop management studies on the optimum stage of harvest in tapioca (Ag-8 (a)–8–Agron–3–01)	Nileswar
24	Fertiliser trial on tapioca (Ag–8 (a)–8–Agron–1–01)	Nileswar
25	Effect of growth regulators on growth, yield and quality of sweet potato (Ag–8 [d]–18–Hort–1–01)	Vellayani
26	Fertilizer trial on sweet potato (Ag–8 [d]–8–Agron–1–01)	Nileswar
27	Studies on the stages of harvest of sweet potato (Ag–8–[d]–Agron–2–01)	Nileswar
28	Cultural trials on colocasia (Ag-8 [c]–18–Agron–2–01)	Vellayani
29	Effect of graded doses of N P and K on growth, yield and quality of colocasia var, Thamarakannan (Ag–8 [c]–18–Agron–1–02)	Vellayani
30	Propagation methods and cultural practices in sapogenin bearing yam *Dioscorea floribunda*	Nileswar
CROP PROTECTION		
31	Evolving high yielding tomato varieties with resistance to bacterial wilt (Ag–7-19–Path–1–02)	Vellanikkara
32	Seed mycoflora of some vegetables in Kerala	Vellayani
33	Studies on the cassava mosaic disease (Ag–8 (a)–18–Path–2–01)	Vellayani
34	Survey for the population of whitefly *Bemisia* sp, (Ag–8 (a)–18–Ent–1–01)	Vellayani

Selection of superior types of Capsicum annum with economic attributes from the segregating generation of intervarietal cross–Ag-7.18 Breed 4.02 [Vellayani]

The experiment was designed to select superior types of chilli with good economic attributes, from segregating populations derived from inter-varietal crosses. The F_2 generations were raised from the crosses CA 1068 x Vellanotchi, G4 x Pusa Jwala, Purple round x Vellanotchi, Purple round x Pant C-1, Vellanotchi x Pusa Jwala and Pant C–1 x Purple Cluster. From the segregating generations, the following 54 plants were selected for carrying over to the F_3 generation

G4 x Pusa Jwala	— 20
Vellanotchi x Pusa Jwala	— 4
Pant C–1 x Purple cluster	— 30

The heterosis exhibited by two promising F1 hybrids is furnished in Table 5.1.

Table 5.1: Heterosis exhibited by two promising F1 hybrids parents & hybrids (percentage)

Characters	Purple Ronud	Vella notchi	Purple Round x Vella notchi	Heterosis percentage	Plant C-1	Purple cluster	Plant C-1 x Purple cluster	Hetetosis percetage
Number of days taken for blooming	97.1	74.4	76.9	—10.320	78.3	75.4	75.6	-1.626
Number of fruits	32.7	19.7	334.0	1174.809	74.9	25.6	142.8	184.129
Weight of fruits (g)	4 6	8.1	6.3		1.2	2.0	1.4	—
Number of seeds/ fruit	23.2	100.1	26.7	-56.69	45.2	27.8	44.2	—
Total yield/ plant (g)	107.2	89.7	1443.8	1366.531	88.3	17.9	162.3	205.649
Life span (days)	168.3	139 8	230.2	49.432	133.8	167.3	194.3	29.060
Vitamin A (I. U/ 100 g)	5503.7	6037.0	6761.5	17.177	10925.3	885.7	8162.9	—
Vitamin C (mg/ 100 g)	108.1	165.8	307.6	124.854	119.6	61.5	139.7	54.279
Capsicin(%)	0.15	0.048	0.897	806.061	0.519	0.214	0.426	16.076
10 Oleoresin (%)	6.0	4.5	11.9	126.667	8.9	7.8	14.9	78.143

Studies on heterosis and combining abilities with reference to important economic traits in chillies (Capsicum annuum)–Ag. 7.18 Bot.2 [Vellayani]

Sixty three varieties of chilli representing different agroclimatic zones of the Country formed the base materials for this project. The work was in progress.

Collection, evaluation and selection of improved chilli varieties-

The experiment was aimed at the collection and evaluation of chilli germplasm in order to select out high yielding and locally adaptable types for dry chilli.

high capsicin content and for vegetable purpose. Thirteen Capsicum lines used for vegetable purpose were grown. The lines were Bharathi F1 hybrid, Express ball, New ace, Ace hybrid, Firework, Scarlet Pinpernel, Little Beauty, Chamelion, Lamucy F1, Large Ball, Giant Ball, Long Sweet, Yellow and Picora. The line Picora was found promising.

Breeding for polygenic resistance in chilli against leaf curl and mosaic complex– Ag.H.7.19 Breed 5.07 [Vellanikkara]

The experiment was planned to evolve chilli variety (ies) resistant ro leaf curl and mosaic complexes and to study the inheritance of resistance if any to the diseases. Initially, 22 varieties of chilli collected from different centre were grown. The lines included Pant C–1, 6–1, B4, 42–0, 43–3, 451, 54–1, 56–1, 30–2, 30-1, Jwala and 36–1. Selections were being made of lines(s) resistant to leaf curl and mosaic. Studies were in progress to evolve clustered, destalked and deep red coloured chilli lines which are resistant to leaf curl and mosaic diseases.

Survey, collection and maintenance of germplasm In brinjal, cucurbits and their wild relatives–Ag H.7.19 Breed 1.05 [Vellanikkara]

The programme aimed at the collection and maintenance of available variabiltty in brinjal, cucurbits and their wild relatives The germplasm collections available were as follows:

Crops	*No.of lines*	*Crops*	*No.of lines*
Brinjal	76	*Solanum torvum*	2
Solanum khasianum	1	*Solanum* sp	1
Ashgourd	15	Bittergourd	57
Snake gourd	10	Water melon	26
Cucumber	62	Ridge gourd	13
Musk melon	2	Summer squash	2
Bottle gourd	12	Round gourd	5
Pumpkin	34	Smooth gourd	1
Winter squash	4	*Momordica tuberosa*	1
Coccinia indica	3	Buffaloe gourd	1
Buffaloe gourd	1	Acid melon	1
Rock melon	1	Nettled melon	1

Evaluation of the ditferent lines for their yield potential and general perfomance was continued.

Isolation and release of bacterial wilt resistant brinjal varieties– Ag. H, 7. 19 Breed. 1.08 (Vellanikkara)

Seventy six lines of brinjal were collected for screening against the Bacterial wilt. Out of 76 lines, 29 ones and two related wild species were raised durng May–July 1979. The varieties grown were Suphal, SM 3, 701

Ping tong long, Arka sheel, SM-6, Pusa purple round, Pusa Kranti, Pant Hybrid 61, S-5, Pant brinjal 91-2, SM-213, Burpee hybrid, hybrid egg plant, Black beauty Mukthakeshi, S-1 P-8, Azad Kranti, Pusa brinjal 121-5, S-16, Pusa purple cluster S-4, Pusa purple long, Arka navaneata, Pant brinjal 91-1, H4, Vijay hybrid and T3. The related species tried were *Solanum torvum* and *Solanum khasianum*. The sceening of germplasm indicated that the varieties SM-6 and Pusa Purple cluster possessed remarkable resistance to Bacterial wilt. In the variety SM-6 from Annamalai, not even a single plant wilted. Out of the 25 plants initially transplanted, only 5 plants wilted in the variety Pusa purple cluster. All the other varieties and the related species fully succumbed to the disease.

Selection and breeding in bhindi

Ag 7.2 Bot 1.01 (Mannuthy)

Forty eight bhindi varieties were collected and these were grown for an initial evaluation trial. Fourteen varieties were observed to be promising The selected varieties were to be further tested for higher yield and local acceptability.

Genetic variability and correlation studies in pumpkin- (Vellayani)

Eighteen pumpkin lines were grown in a randomised block design with 3 replications. Observations were recorded on the vegetative characters and their components, earliness and its components, flower and fruit characters and qualitative characters

The 18 genotypes were found to be significantly different with respect to yield and its component characters (Table 5.3).

The range in fruit yield/plant varied from 5.45 kg in CM-18 to 16.10 kg in CM-17. The maximum value of genotypic coefficient of variation was observed for the male flowers/plant followed by the character fruits/plant. The highest heritability estimate of 99.14% was observed for male flowers/plant followed by female flowers/plant. The fruit yield/plant had an expected genetic advance of 52.32% in the next generation of selection when the intensity of selection was 5%.

Female flowers/plant had no correlation with fruit yield/plant. Length of main vine appeared to have the maximum direct effect on fruit yield/plant followed by average fruit weight.

Selection of plants with more average fruit weight and length of main vine seemed not as effective as straight selection of plants based on yield as such.

The weight of first mature fruit ranged from 1.65kg in CM-18 to 9.95kg in CM-17.

The eighteen pumpkin genotypes were found to be significantly different among themselves with reference to protein, phosphorus, potassium, calcium and carotene contents. The protein content ranged from 5.26% on dry weight basis in CM-11 to as high as 9.49% in CM-15.

Table 5.3 Performance of eighteen pumpkin genotypes with respect to yield and its component characters

Acc. No	Days to first female flower anthesis	Days to first male flower anthesis	Length of main vine	Female flowers/ plant	Average fruit weight	Weight first fo fruit (kg)	Fruits/ plant	Fruit yield/ plant/kg
CM–1	48.57	50.56	7.60	5.33	6.59	8.21	2.11	14.20
CM–2	48.23	57.78	8.10	8.22	6.40	6.58	1.67	11.32
CM–3	47.53	47.22	5.90	5.00	4 55	7.53	1.89	7.98
CM–4	47.03	49.89	6.98	12.00	7.46	6 80	1.76	13.22
CM–5	46.90	47.78	6.49	7.00	5.87	6.51	1.78	11.75
CM–6	48.20	53.33	7.03	6 77	6.39	6.79	2.00	12.78
CM–7	43.57	45.33	5.79	6.00	4.59	4.58	2.00	11.12
CM–8	56.00	57.00	9.63	16.28	1.52	2.01	2.44	8.61
CM–9	48.33	51.11	6.38	4.67	8.67	9.40	5.67	12.96
CM–10	51.67	50.22	7.41	9.33	6,92	9.29	1.55	9.20
CM–11	47.57	51.55	6.77	10.83	9.95	9.77	1.33	14.20
CM–12	46.90	53 66	6.35	5.33	6.23	6.58	1.44	12.91
CM–13	49.23	48.22	8.08	4.77	9.63	9.12	2.11	13.79
CM–14	48.57	48.00	9.31	5.44	6.41	9.36	2.45	15.38
CM–15	45.90	47.67	4.75	3.33	3.22	3.95	1.78	5.64
CM–16	49.00	55 45	5.89	10.78	6.36	7.87	1.44	8.96
CM–17	48.57	48.67	9.57	10.83	8.21	9,95	2.00	16.10
CM–18	37.57	46.56	6.37	7.83	1 21	1.85	4.56	5.45
CD (p=0.05)	1.91	1.64	0.94	0.88	1.85	1.21	0.52	1.81

Evolving hot weather cauliflower varieties suited for cultivation in Kerala state Ag. 7.18 Breed 5.08 [Vellayani]

Five lines obtained from the IARI were evaluated for their suitability under Kerala conditions. The lines were 328–5–10–5–1, 351–4–1–, 395-2, 424–2 and 327–14–8–3.

Exploitation of hybrid vigour in bhindi [Vellayani]

Twenty eight F1 hybrids were developed through a diallel mating of 8 selected varieties. The varieties used were Pusa sawani, Pusa red, Ladies finger green, Perkin long green, Pusa makhmali Kilichundan, Local, and new white. The 28 F1 hybrids along with the 8 parents were grown in a triple lattice design with 3 replications. Observations were recorded on height, no. of branches, days to flower, fruits/plants and weight of fruits. The analysis of data revealed that the genotypes were significantly different only for plant height, branches/plant and days to flower. The genotypes were not significantly different for fruits/plant and weight of fruits.

Selection of suitable cucurbit varieties Ag. 7.2. Breed 5.06 [Vellanikkara]

Bittergound:

Twenty five varieties were grown during 1977–78. Based on yield, the line MC–23 was selected in the green fruited types and MC-10 was selected in the white fruited types. The line MC-23 was put under multilocational trials during 1978 at Vellanikkara and Mannuthy. During March-July, 1979, this variety was grown at Mannuthy and Kannara. The variety performed well in the above stations (Table 5.4)

Table 5.4: Multilocational trials in bittergourd fruit yield t/ha

Locations		*MC–23*	*Control*
BRS, Kannara	(1979 Mar.–July)	40.27	26.44
IF Vellayani	(1979 Mar.–July)	15.76	13.78
IF Mannuthy	(1979 Sept.–Jan.)	15.63	—
RRS Pattambi	(1980 Dec.–April)	10.07	7.89

Snakegourd:

Twenty five varieties were grown during 1978–79. Based on yield, the line TA–19 was selected. This line was put under the multilocalional trials since 1978. The line showed promise (Table 5.6).

Table 5.6: Performance of TA–19 at Research Stations and farmers plots

Location	*Varieties*	*Yield*
BRS Kannara	TA–19	28.71 t/ha
KESS centre Mannuthy	TA–19	160kg/80 sq. ft.

Survey, collection and maintenance of germplasm in winged bean [Vellanikkara]

Eighteen lines were collected during 1979–80. These lines were grown in a randomised block design with 3 replications during May–February 1979–80. Observations were recorded on dry pod weight/plant, pods/plant, pod length, dry pod weight, weight of seeds/plant, % of wrinkled seeds, 100 seed weight, carbohydrate content in immature pods and seeds, protein content in seeds and calcium content and Vitamin C in immature pods. (Table 5.7).

Table 5.7: Performance of eighteen winged bean lines

Lines	Dry pod weight per plant (g)	Pods per plant	pod length (cm)	Dry pod weight (g)	Weight of seed per plant (g)	Seeds per plant	Seeds per pod	Weight of seeds per pod (g)	% of wrinkled seed	100 seed weight	Carbohydrate content in immature pods	Carbohydrate coe-tent in seed	Protein content in seed	Protein content in laves
PT– 1	660.3	97.7	18.8	5.76	269.7	1703.7	17.5	2.77	17.7	20.6	3.57	24.6	29.1	10.2
PT– 2	449.9	72.8	16.1	6.13	196.5	600.0	9.2	2.71	10.7	26.2	3.71	30.6	31.2	13.3
PT–19	208.0	36.2	19.7	5.90	95.4	651.3	17.4	2.72	20.3	21.1	3.02	29.1	32.0	12.1
PT– 4	166.9	29.2	15.8	5.92	57.0	354.3	11.9	9.14	9.3	26.9	3.45	26.4	32.6	11.6
PT– 5	108.8	22.2	18.8	6.37	49.4	245.9	13.6	2.85	5.7	26.2	3.50	27.3	29.7	14.0
PT– 6	192.3	28.0	15.2	6.30	70.3	344.3	11.4	2.22	16.4	21.6	3.66	26.1	27.7	13.5
PT– 7	22.0	4.0	14.6	5.50	8.5	44.0	11.0	2.13	23.6	19.3	—	—	—	—
PT– 8	454.5	92.2	18.8	4.94	170.0	1018.6	11.1	1.15	19.0	22.8	—	—	—	—
PT– 9	188.5	45.5	12.4	4.42	70.0	441.0	9.5	1.52	15.5	22.7	3.44	27.0	28.1	11.0
PT–10	508.0	112.0	80.2	4.54	234.0	940.0	8.1	2.09	9.0	29.8	—	—	—	—
PT–11	343.5	48.5	28.0	6.94	100.5	1803.5	22.4	2.03	22.0	21.1	—	—	—	—
PT–12	165.1	20.9	21.3	7.96	77.2	357.0	16.9	3.70	4.7	21.7	3.30	28.7	31.6	13.6
PT–13	47.5	4.5	17.1	10.56	20.5	72.0	16.0	4.56	4.0	24.3	—	—	—	—
PT–14	129.0	18.5	16.8	8.36	53.0	253.0	14.0	3.54	5.6	27.2	3.64	28.0	30.6	11.5
PT–15	246 0	49.9	17.8	4.94	102.8	662.9	13.1	2 03	16.5	19.3	3.52	26.3	38.1	12.0
PT–16	245.4	40.6	16.9	5.94	109.5	503.1	82.2	2.45	14.7	24.8	3.73	26.6	34.0	11.1
PT–17	203.7	38.8	16.4	5.08	84.0	496.5	12.3	2.16	16.0	22.0	3.40	24.7	33.8	12.1
PT–18	366.9	74.2	16.5	5.27	143.8	908.0	12.6	2.00	14.7	20.9	3.39	30.2	29.6	12.1

Varietal trials in brinjal, bhindi, cowpea, amaranthus, Dolichos bean, pumpkin musk melon, cucumber, water melon, bottle gourd and round gourd [Vellanikkara]

Cowpea:

Eight varieties were grown in a randomised block design with 3 replications. The plot size was 3x1.5m. Observations were recorded on days to harvest, pods/plant, yield/plant, pod length and weight of 10 pods. The variety K1552 was found to be superior to other varieties (Table 5.8).

Table 5.8: Performance of cowpea varieties

Varieties	Days to first harvest	Pods/ plant	Yield/ plant (g)	Pod length (cm)	Weight of 10 pods (g)
V. 6008	81.00	1.07	8.97	17.40	43.00
Pusa dofasli	51.00	2.20	30.38	17.80	43.67
K. 779	51.00	2.00	39.39	17.83	42.00
K. 868	51.00	2.37	33.83	17.04	36.67
K. 1552	51.00	2.87	71.61	18.57	45.60
CP-1-77	61.33	1.47	38.14	18.50	43.30
No. 18	74 67	1.27	8.53	15.01	43.00
Kanakamony	53.00	1.33	30.02	16.92	53.33
CD (5%)	59.25	1.82	32.61	17.38	43.25

Muskmelon:

Four varieties were grown in a randomised block design. The plot size was 1x2.5m. The line CS-55 was observed as high yielding. The popular varieties Haramadhu, Hybrid and Punjab seed selection were found suitable under the agro-climatic conditions of Kerala. Haramadhu yielded on an average 4.5 fruits weighing 6.54 kg/plant (Table 5.9).

Table 5.9: Performance of muskmelon varieties

Variety	Fruits/ plant	Weight of fruits (kg)	Yield/ plant (kg)	Fruits length (cm)	Flesh thick-ness (cm)	Days to first harvest (days)
Haramadhu	4.5	1.46	6.54	15.66	2.72	39.0
Hybrid	11.0	0.57	6.20	17.00	2.08	39.5
Improved green	14.0	1.14	15.88	22.50	2.72	43.0
Punjab Selection (CS-55)	9.5	0.76	7.24	17.34	2.80	37.0
CD (0.05)	4.10	0.48	3.50	—	—	—

Cucumber:

Twenty four lines were grown in a randomised block design with 2 replications. Plot size was 1x2.5m². The lines consisted of 3 F1 hybrids and 21

varieties. Among hybrids, 'Progress' yielded 24 fruits/plant, the weight of fruit /pit being 30.64 kg. The fruit length in this variety was 29 cm and the content of vitamin C and reducing sugars were 3.20mg and 0.63g/100g respectively. Among the varieties 'Pandex' yielded 9.5 fruits/plant weighing 28.45 kg/pit, fruit length measuring 34.5 cm, Vit. C. content 3.158 mg/100 g and reducing sugar content 0.96 g/100 g (Table 5.10).

Table 5.10: Performance of cucumber varieties

Varieties	Fts/pl	Weight of fruits (kg)	yield pit (kg)	Fruit length (cm)	Vit. C. content (mg)	Reducing sugar (g/100g)
CS-1	5.5	1.54	8.45	25.0	3.71	0.63
CS-3	2.5	4.21	10.49	23.5	3.16	1.46
CS-4	4.0	4.21	4.69	22.5	3.24	1.00
Hocus	6.0	0.83	4.95	24.0	6.71	1.47
Pandex	9.5	3.00	28.45	34.5	3.15	0.96
Commander Hybrid	23.0	0.81	18.49	32.0	3.25	0.82
Progress Hybrid	24.0	0.57	30.64	29.0	3.20	0.63
Albil F-1	23.0	0 38	8.72	26.8	3.70	0.63
Dablin 137-A	16.0	0.72	11.48	24.2	3.22	0.86
County fair	28.0	0.83	23.21	21.6	3.13	0.92
Poona khira	5.5	0.31	1.71	15.5	3.83	0.50
CS-28	11.5	0.96	11.07	25.5	5.41	0.58
CS-31	4.0	0.99	7.87	26.0	7.99	1.27
CS-35	12.0	1.74	20.80	14.7	4.38	1.33
CS-36	8.0	1.60	12.70	23.0	2.99	0.73
CS-38	11.5	1.79	20.65	25.9	2.90	1.54
CS-43	11.5	1.74	20.07	25.1	2.63	1.56
CS-44	10.0	1.32	13.16	25.6	7.84	0.59
CS-46	8.0	1.30	10.30	24.2	3.82	1.28
Gemini-7	14.0	0.67	9.32	16.6	2.92	0.69
Pusa Sanyok	18.0	0.71	11.77	27.3	2.42	0.67
CS-51	12.5	1.60	20.05	20:7	3.10	0.58
Avodai	12.5	0.97	12.12	27.8	2.75	0.84
Lemon	28.5	0.18	5.11	11.8	2.73	0.95
CD (p=0.05)	9.14	0.90	3.98	—	—	—

Watermelon:

Varietal trial in water melon was conducted to identify a good variety suitable for the locality. 13 varieties including 3 exotic varieties were evaluated in randomised block design with 3 replications. Madhu hybrid from IIHR, had a value of 10.67 Brix. Sugar baby closely followed the Madhu hybrid. Considering yield, the variety Sugar baby out-yielded all the other 12 varieties (Table 5.11).

Table 5.11: Performance of water melon varieties

Varieties	No. of days to first female or hermaphodite flower production	No. of female or hermaphro-dite flowers per pit (2 pl)	100 seed weight (g)	TSS Brix	Fruit shape	No. of fruit/ pit	Fruit weight (kg)
V—5 Local	25.67	7.33	11.67	5.33	Bound	9.3	3.850
V—7 H. 4 From NSC	23.67	13.33	4.02	5.67	Round	8.67	4.450
V—8 Madhu Hybrid from IIHR	21.00	11.00	5.02	10.67	Round	9 33	2.950
V—15 Sugarbaby	16.67	19.00	7.23	10.33	Oblong	13.00	3.282
V—16 Candy red	24.33	21.00	7.45	9.00	Oval	8.33	1.725
V—17 Candy red Hawkesbury	25 00	29.33	9.47	8.67	Oval	9 00	2.017
V—18 Local	29.00	33.33	10.07	5.33	Round	7.33	2.417
V—19 Local	28.67	10.33	3.42	9.33	Round	8.00	1.908
V—20 Local	25.67	8.33	4.82	8.67	Round	9.00	1.473
V—21 Local	27.00	10.67	11.50	5.00	Round	10.67	2.267
V—24 Local farm Taliparamba	24.33	22.67	9.12	4.33	Round	9.67	2.042
V—25 Local ,,	26.00	23.33	7.57	6.00	Round	7.33	1.642
V—26 Local ,,	25.33	19.67	9.02	5.67	Round	8.33	1.342
CD (p=. 0.01)	2.797	11.05	0.62	2.15	—	NS	NS

NS : Not significant

Breeding for long poded vegetable types of cowpea
Ag 9 (6). 1 Breed. 2.01 (Pattambi)

Twelve vegetable types of cowpea varieties were grown in a randomised block design with 4 replications. The varieties Pusa barsathi and No. 5269 were found superior, yielding 3.02 and 3.47 t/ha respectively of vegetable pods (Table 5.12).

Table 5.12: Flowering duration and yield of vegetable cowpea varieties grown during Kharif 1979-80

Variety	Duration in days (flowering duration)	Yield of vegetable pods kg/ha
Pusa Barsathi	24.25	3021.16
No. 5225	42.25	3473.54
Vayalathur Red	47.75	841.27
Vayalathur White	48.75	835.98
Mayyanadu local	46.50	1708.99
Manjeri local	43.35	2121.69
C-5-7	44.00	1732.80
Calicut-78	49.50	1246.03
Calicut-51	48.75	944.44
Kayamkulam	46.50	1140.21
Culture-1	52.25	1410.05
CO 2	46.50	1521.16
CD (0.05)		814 41

Comparative yield trial of the progenies of Malavella X M4
Ag. 8 (a) Agro. 2.02 [Ambalavayal]

Malavella is a popular variety of tapioca in the Wynad. The quality of tubers is not as good as that of M4. In order to combine the desirable qualities of M4 with the local adaptability of Malavella, a hybridisation programme was initiated. Nine progenies thus obtained were grown along with parents and 3 promising hybrids. Observations were recorded on plant height, time of branching branching habit, date of flowering, tuber yield and tuber quality. Scoring was also done for disease infestation. The nine progenies were not superior to parents and hence the experiment was discontinued.

Multilocational trial on Dioscoria alata Ag 8 (e) 8 Breed 2.01 (Nileshwar)

Five varieties Da 42, Da 60, Da 48, Da 122 and Da 80 were grown in a randomised block design with 4 replications. The plot size was 5x5 m^2. Statistically significant differences were not detected among varieties. Da 60 gave the highest yield of 15.8 t/ha, while Da 122 yielded 12.6 t/ha (Table 5.13).

Table 5.13: Tuber yield from *Dioscorea alata* varieties

Varieties	Mean yield per plot of size 5x5m	Tuber yield (kg/ha)
Da 42	32.26*	12900
Da 60	39.50	15800
Da 122	31 75	12700
Da 80	37.00	14800
Da 48	34.50	13800

* NS – Not significant

Evolving high yelding sweet potato through intervarietal hybridisation Ag. 8 (d) Breed 2.01 [Vellayani]

Seven superior F_1 lines obtained from crosses between 8 selected perents on the basis of D2 analysis were put under multilocational trial at Chungathara and Taliparamba. The trial at Taliparamba revealed the superiority of the culture No. V 6 which yielded 0.495 kg of tubers/hill (Table 5.14).

Table 5.15: Mean yield of tubers, roots and vines from eight lines of sweet potato

Items	Average yield/hill (kg)		
	Tuber	Root	Vine
V1	0 432	0.004	0.203
V2	0.344	0.004	0.266
V3	0.435	0.010	0.470
V4	0.486	—	0.329
V5	0.207	0.008	0.151
V6	0.495	0.013	0.595
V7	0.204	0.009	0.218
V8	0.493	0.014	0.466

Studies on the effect of graded doses of NPK on growth and yield of bitter gourd–Ag.7.2. Agron. 1.04 [Mannuthy]

An experiment was laid out in the randomised block design in 3^3 confounded factorial with 27 treatments to find out the optimum N, P, K requirements of of bitter gourd variety MC–23. The levels of N, P and K were 0,25 and 50 kg/ha. The maximum yield was recorded when N, P, K were given at the rate of 50:25:50 kg/ha. This experiment would be repeated to confirm the results.

Studies on the effect of graded doses of N, P and K on growth, yield and quality of bhindi–Ag.7.19 Agron. 1.01 [Vellanikkara]

The variety Co.1 was grown in a 3^3 confounded factorial design in RBD with 2 replications to study the effect of graded doses of N, P and K on yield and and quality attributes of bhindi. The different treatments tried were the 27 combinations of N (0,30,60 kg/ha), P (0,25,50 kg/ha), and K (0,25,50 kg/ha).

Studies on the effect of plant population density and age at transplanting on growth, frequency of harvest and total vegetative yield in Amaranthus (Amaranthus gangeticus)–Ag.7.2.Agron.1.05 [Mannuthy]

The trial was laid out in a 3^2 factorial randomised block design with 3 replications using a local red variety of amaranthus. The levels of spacing were 10x10, 15x10 and 20x10 cm with corresponding population densities of 80,320 and 240 plants/plot of size 2.4x2.0 m. The three levels of age at transplanting were A1–15 days, A2–20 days and A3–25 days after sowing. Observations were recorded on height of plant, girth of main stem at collar region, number of branches, number of leaves, plant spread, individual leaf area, frequency of harvest, yield/plant, yield/m^2, weight of leaves/plant, weight of stem/plant, leaf: stem ratio, dry weight of leaves and stem, moisture content of leaves and stem, and vitamin A content in leaves.

It was observed that plants at medium density (15x10 cm) were taller than at low density (20x10 cm) or high density (10x10 cm) plants (Table 5.15).

Table 5.15: Growth parameters of amaranthus plants transplanted at different spacings

	Spacings	Days after transplanting			At harvest
		10	15	20	
Height (cm)	S_1	16.29	26.45	38.34	46.98
	S_2	17.51	26.00	38.87	48.32
	S_3	17.07	24.23	35.73	46.86
Girth (cm)	S_1	1.54	2.62	3.55	3.95
	S_2	1.56	2.84	3.80	4.40
	S_3	1.53	2.64	3.72	4.59
No. of branches	S_1	1.80	6.02	7.34	8.86
	S_2	1.87	6.66	8.28	10.16
	S_3	1.67	6.03	8.26	9.64
No. of leaves	S_1	13.27	28.89	35.30	39.44
	S_2	13.49	33.97	42.29	49.26
	S_3	12.60	30.02	41.46	46.52
Spread of plant (cm^2)	S_1	335.78	920.26	1201.50	1230.12
	S_2	342.80	1012.22	1373.14	1545.71
	S_3	299.45	961.53	1374.97	1715.29

S_1 — 10x10 cm^2
S_2 — 15x10 cm^2
S_3 — 10x10 cm^2

With respect to the growth characters like height, girth, number of branches, number of leaves and plant spread, the 25 days old seedlings performed better (Table 5·16).

Table 5.16: Growth parameters of amaranthus plants belonging to different age groups

	Age groups	Days after transplanting 10	15	20	At harvest
Height (cm)	A_1	15.19	22.10	34.10	44.47
	A_2	15.40	23.90	37.01	47.17
	A_3	20.28	30.68	41 83	50.52
Girth (cm)	A_1	1.44	2.43	3.49	4.08
	A_2	1.42	2.57	3.65	4.33
	A_3	1.78	3.13	3.93	4.54
No· of branches	A_1	1.36	5.19	7.24	8.61
	A_2	1.44	5.89	7.72	9.21
	A_3	2.54	7.43	8.91	10.38
No. of leaves	A_1	11.28	26.71	35.40	38.50
	A_2	12.28	27.87	37.67	43.68
	A_3	14.80	38.31	45.98	53.04
Spread of plant (cm^2)	A_1	260.63	825.66	1203.78	1449.94
	A_2	287 98	900.81	1329.73	1526.76
	A_3	429.43	1167.53	1416.11	1514.42

A_1 — 15 days old
A_2 — 20 days old
A_3 — 25 days old

S_1 — 10 x 10 cm
S_2 — 15 x 10 cm
S_3 — 20 x 10 cm

The characters contributing to yield, revealed that the low density of plants yielded more leaves/plant, more stem/plant and yield./plant. The yield/plant of low, medium and high density was 99.4,76.77 and 62.82 g respectively (Table 5.17).

Tabie 5.17: Average weight of leaves/plant belonging to three age groups planted at three population densities (g)

Treat-ment	Mean of first cut	Mean of second cut	Mean of third cut	Total of three cuts	Fourth cut	Fifth cut	Mean of all cuts
1	2	3	4	5	6	7	8
S_1	16.41	11.68	8.39	36.49	—	—	36.49
S_2	20.31	10.41	8.49	39.21	5.50	—	44.71
S_3	25.76	12.72	9.20	47.67	7.93	6.52	61.01
A_1	18.39	13.21	9.77	41.37	7.43	3.40	51.15
A_2	20.44	11.51	8.71	40.67	6.00	3.06	49.72
A_3	23.65	10.09	7.59	41.33	—	—	41.33
CD (0.05)	4.99	3.53	1.18	2.03	—	—	8.26

1	2	3	4	5	6	7	8
			Average Weight of stem/plant (cms)				
S_1	19.44	4.34	2 54	26.33	—	—	26.33
S_2	24.44	3.61	2.37	30.43	1.64	—	32.06
S_3	27.33	5.14	2.66	35.13	1.79	1.47	38.39
A_1	22.36	4.45	2.68	29.48	1.71	0.72	31.92
A_2	26.36	3.98	2.73	33.06	1.72	0.75	35.53
A_3	22.50	4.66	2.18	29.34	—	—	29.34
CD (0.05)	5.97	1.40	0.78	6.66	—	—	6.85
			Yield/plant (g)				
S_1	35.86	16.03	10.94	62.82	—	—	62.82
S_2	44.75	14.02	10.86	69.63	7.14	—	76.77
S_3	53.08	17.85	11.86	82.79	8.61	7.99	99.40
A_1	40.75	17.66	12.44	70.85	8.03	4.19	83.06
A_2	46.79	15.20	11.44	73.73	7.72	3.81	85.26
A_3	46.14	14.75	9.78	70.67	—	—	70.67
CD (0.05)	10.48	4.77	1.75	13.80	—	—	14.17

The yield/m^2 for each harvest as well as for all the possible cuts taken together was the highest in the case of high density planting. The high density (S1) planting have a total yield of 6.28 kg/m^2 (62.80 tons of vegetative yield/ha) (Table 5 18).

Table 5.18 : Yield/m^2 (kg) of amaranthus

Treatment	Mean of Ist cut	II cut	Third cut	Total of three cuts	Fourth cut	Fifth cut	Mean of all cuts
S_1	3.59	1.60	1.09	6.28	—	—	6.28
S_2	2.99	0.94	0.72	4.64	0.46	—	5.12
S_3	2.65	0.89	0.59	4.14	0.43	0.40	4.97
A_1	2.86	1.22	0.88	4.96	0.46	0.21	5.63
A_2	3.21	1.14	0.84	5.20	0.45	0.19	5.83
A_3	3.15	3.15	0.69	4.94	—	—	4.91
CD (0.05)	0.815	0.393	0.123	1.140	—	—	1.140

Studies on water use by crops grown in pure and mixed stands-Ag.1.3.1.6 [Chalakudy]

The experiment was designed to find out the most economic and productive crop rotation for the sandy-loam soils in command areas. The two cropping systems tried were tapioca as a pure crop in ridges and tapioca on ridges with groundnut on both sides of the ridges in 2 rows. The four IW/CPE ratios tested were R1=0 75 and 1.00. The experiment were in progress.

Control of weeds in tapioca with herbicides- [Vellayani]

The results indicated that grasses and broad leaved weeds occuring in tapioca crop can be controlled effectively with Delepon at 1 kg ai/ha followed by the application 0.5 litre of Gramaxone 10 days later.

Assessment of N, P, K requirement of tapioca in Wynad– Ag 8 (a) 12 Agron. 1.02 [Ambalavayal]

The treatments consisted of four levels of potassium (0.50,100 and 150 kg/ha) along with fixed doses of nitrogen and phosphorus (50 kg each/ha). The variety used was Malavella. The treatment differences were not found to be significantly different. The experiment was discontinued.

Crop management studies on the optimum stage of harvest in tapioca- Ag.8 (a) 8. Agron.3.01 [Nileswar]

The experiment was laid out to ascertain the optimum stage of harvest of two varieties of tapioca. One genotype was the variety Vellayani local and the other was a hybrid H–2304. The treatment consisted of harvesting at 6, 7, 8, 9, 10, 11 and 12 months after planting. The experiment was laid out in RBD with 3 replications. Spacing given was 90 cm x 90 cm. The experiment was in progress.

Fertilizer trial on tapioca– Ag 8 a 8 Agron.1.01 [Nileswar]

The experiment was laid out to find out the response characteristics of local and hybrid varieties of tapioca to combinations of graded doses of nitrogen 65,120,180 kg/ha and potassium 60, 120, 180 kg/ha. The varieties used were local and H 2304.

The highest yield in the hybrid variety 30.25 t/ha was obtained when N and K were applied at 120 kg/ha each. The local variety gave the maximum yield of 20.875 t/ha when N and K were applied at 60 kg/ha each (Table 5.19).

Table 5.19: Response of tapioca varieties to nitrogen and potassium

Treatments	Yield kg/ha	Treatments	Yield kg/ha
$V_1N_0K_0$	19500	$V_2N_0K_0$	18250
$V_1N_1K_1$	16500	$V_2N_1K_1$	28875
$V_1N_1K_2$	17250	$V_2N_1K_2$	24750
$V_1N_1K_3$	20875	$V_2N_1K_3$	27500
$V_1N_2K_1$	22125	$V_2N_2K_1$	27375
$V_1N_2K_2$	19625	$V_2N_2K_2$	30250
$V_1N_2K_3$	17250	$V_2N_2K_3$	21125
$V_1N_3K_1$	23625	$V_2N_3K_1$	22000
$V_1N_3K_2$	24625	$V_2N_3K_2$	28125
$V_1N_3K_3$	22750	$V_2N_3K_3$	25750

V_1 — Local variety (Vellayani)
V_2 — Hybrid H 2304
N_1 — 60 kg/ha
N_2 — 120 kg/ha
N_3 — 180 kg/ha
K_0 — No potash
K_1 — 60 kg/ha
K_2 — 120 kg/ha
K_3 — 180 kg/ha

Effect of growth regulators on growth, yield and quality of sweet potato
Ag· 8 (d)–18 Hort. 1.31 [Vellayani]

The studies were taken up to evaluate the effect of Ethrel (2, Chloroethyl phosphoric acid) and CCC (2, Chloroethyi trimethyl ammoninm chloride) on the morphological characters, yield and quality of sweet potato tubers. The doses for Ethrel were 150,300 and 450 ppm and those for CCC were 250,500 and 100 ppm. A control with no treatments and another treatment with water spray were also run.

There was significant reduction in the weight of tops by Ethrel at a l concentrations. CCC did not cause reduction in weight of tops. The maximum reduction was obtained at the highest level of Ethrel (Table 5.20).

Table 5.20: Effect of Ethrel and CCC on the fresh weight of shoot

Treatments	Fresh weight of shoot in g (mean)				
	On 45th day	On 60th day	On 75th day	On 90th day	On 105th day
Control	75.24	101.61	149.17	140.46	99.67
Water spray	76.17	102 99	154.65	140.74	104.77
Ethrel 150 ppm	73.77	99.30	141.58	131.08	90.94
Ethrel 300 ppm	72.10	96.12	143 23	124.50	78.61
Ethrel 450 ppm	72.71	93.62	134.60	121.38	72.50
CCC 250 ppm	77.73	111.53	165.67	158.75	107.89
CCC 500 ppm	76.86	115.60	160.50	141.05	103 96
CCC 1000 ppm	75.53	100.65	149.15	139.90	105.98
CD (0.05)	2.49	3.27	3.61	3.43	6.53

The highest yield of tubers per plant was obtained with Ethrel 300 and 450 ppm. Among the different levels of CCC, the highest level of 1000 ppm gave the highest yield (Table 5 21).

Table 5 21: Effect of Ethrel and CCC on the fresh weight of tubers/plant

Treatments	Fresh weight of tubers in g (mean)				
	On 45th day	On 60th day	On 75th day	On 90th day	On 105th day
Control	51.13	86.00	154.81	179.76	264.33
Water spray	62.33	84.36	152.32	180.00	202.33
Ethrel 150 ppm	50.00	100.81	205.35	266.30	280.25
Ethrel 300 ppm	50.65	105.45	216.51	281.56	301.98
Etherl 450 ppm	54 00	105.16	178.48	278.83	302.05
CCC 250 ppm	48.11	93.96	182.18	321.25	250.80
CCC 500 ppm	51.11	93·08	184.38	240.26	263.13
CCC1000 ppm	47.73	85.85	192.65	259 71	277.70

There was a significant reduction in the protein content of tubers due to application of the two growth regulators. All levels of ethrel and the two highest levels of CCC brought about a significant increase in the sugar content of tubers (Table 5.22).

Table 5.22: Effect of Ethrel and CCC on the sugar ond protein contents of the tubers

Treatments	Protein content of tubers in %	Sugar content of tubers in %
Control	2.83	2.77
Water spray	2 82	2.90
Ethrel 150 ppm	2.52	3.17
Ethrel 300 ppm	2.48	3.88
Ethrel 450 ppm	2.43	3.70
CCC 250 ppm	2.49	2.78
CCC 500 ppm	2.55	3.25
CCC 1000 ppm	2.37	3.58
CD (0.05)	0.11	0.30

Though the cost of cultivation per hectare increased with the application of both Ethrel and CCC, the net profit was appreciably increased by both Ethrel and CCC applications. The cost of cultivation by using Ethrel 300 ppm, which gave the maximum profit was found to be Rs. 4900/–per hectare as against Rs. 3500/–for the Control. Among the different levels of CCC, 1000 ppm gave the maximum net profit, the cost of cultivation being Rs. 4700/- per hectare. Ethrel 300 ppm gave an increase of 75.52 per cent over the Control in the net profit, followed by 150 ppm and CCC 1000 ppm. In general, application of Ethrel was found to be more economic in sweet potato cultivation.

Response to fertilizers in sweet potato Ag. 8 (d) 8 Agron 1.01 [Nileswar]

The experiment was laid out to study the response characteristics of sweet potato to graded doses of nitrogen and potassium. The treatments consisted of factorial combinations of 3 levels of nitrogen (30, 60, 90 kg ha) and potassium (30. 60. 90 kg/ha) and a Control. The plot size was 3.6m² and the design RBD. The crop was planted during July 1979 and harvested in November. The results showed that the maximum yield of tubers was obtained when 60 kg nitrogen and 60 kg potassium were applied. The difference between yields at 30 kg level and 60 kg level was not significant. Yield of marketable tubers was increased due to effect of potassium.

Studies on the stages of harvest of sweet potato Ag. 8 (d) 8. Agron. 2.01 [Nileshwar]

The study was conducted to find out the optimum stage of harvest of sweet potato. Harvesting was done at 2½ months, 3 months, 3½ months and 4 months after planting. The variety Kanjangad local was used. Plot size was 3.6 x 3.6 m and the spacing was 60 x 20 m. Significant difference between stages of harvest were observed (Table 5.23).

The highest yield was obtained at 4 month stage after planting (Table 5.23).

Table 5.23: Effect of stages of harvest of sweet potato on tuber yield

Stage of harvest	yield/plot (kg) (*)	yield t/ha
Harvesting at 2½ months after planting	15.35	11,844
Harvesting at 3 months after planting	23.03	17,770
Harvesting at 3½ months after planting	32.33	24,946
Harvesting at 4 months after planting	36.00	27,778

(*) Plot size 3x6m²

Cultural trials on colocasia (*Colocasia esculenta* Ag. 8. (c) 18 Agron. 2.01 [Vellayani]

The experiment was laid out to evaluate the effects of different sizes of planting materials of colocasia on the performance of the crop and to find out the optimum size of seed material for planting in uplands. The influence of different methods of planting on the growth and yield of colocasia and the relative merits of mulching were also studied. The treatments consisted of the three methods of planting (planting in pits-P1; planting in ridges-P2; planting in furrows-P3), three types of mulching (no mulching-Mo; mulching at planting-M1; mulching at planting and once again at first earthing up-M2). The different sizes of planting materials tried were corms weighing 15-25g (S1); 35-45g (S2); (55-65g-S3) and 60-70g-(S4). The design was split plot with 3 replications, the plot size being 12.6x3m for the main plot and 3.15 x 3.0m for the sub-plot.

The different methods of planting did not influence the total tuber yield significantly. The maximum yield was obtained from the furrow method of planting (12.40 t/ha: (Table 5.24). The maximum tuber yield was obtained from double mulched plots and the minimum from non-mulched ones Size of planting meterial significantly influenced the total yield of tubers. The maximum yield (12.80 t/ha) (Table 5 24) was obtained from the medium sized cormels and this was not significantly superior to the small sized cormels (9.21 t/ha).

Table 5.24: Effect of method of planting, mulching and size of planting materials on tuber yield of colocasia

	P_1	P_2	P_3	Mean
M_0	11.94	9.65	11.85	11.15
M_1	10.58	10.01	13 98	11.52
M_2	11.45	11.93	11.37	11.58
S_1	8.69	8.28	10.65	9.21
S_2	14.01	11.54	12.86	12.80
S_3	10.61	11.18	14.11	11.97
S_4	11.99	11.12	11.99	11.70
Mean	11.32	10.33	12.40	
	m_0	m_1	m_2	
S_1	7.99	10.26	9.37	
S_2	13.27	12.94	12.20	
S_3	12.06	12.12	11.72	
S_4	11.28	10.77	13.05	

CD=(p=0.05) for comparision between levels of S – 1.643.

Effect of graded doses of N, P, K on growth, yield and quality of colocasia (Colocasia esculanta L.)-Var. Thamarakannan.

The experiment was laid out in a 3^8 factorial randomised block design with 2 replications. The details of layout were as follows:

Total number of plots–54
Gross plot size-3x2.25m
Net plot size–1.8 x 1.35m
Spacing-60 x 45cm
Plants/plot–36

Nitrogen–40,80 and 120kg/ha.
Phosphorus–25,50 and 75kg/ha
Potassium–90,120 and 150kg/ha
FYM–12 tons/ha.

Maximum tuber yield was recorded from plants supplied with 120kg nitrogen, 75kg phosphorus and 150kg potassium per hectare (Table 5.25).

Table 5.25: Effect of graded levels of N, P and K on tuber yield, corm yield and total yield of colocasia (kg/ha)

Treatments	Tuber yield	Corm yield	Total yield
Nitrogen (N)			
V_1—40kg/ha	8159.59	2521.58	10681.17
V_2—80kg/ha	12959.52	3285.57	16245.09
V_3—120kg/ha	13104.51	3657.21	16761.72
'F' test	S	S	S
Phosphorus (P_2O_5)			
P_1—25kg/ha	9365.51	2725.09	12090 60
P_2—50kg/ha	12052.90	3239.60	15292.50
P_3—75kg/ha	12805.20	3499.67	16304.87
'F' test	S	S	S
Potassium (K_2O)			
K_1—90kg/ha	9978.36	2789.69	12768.05
K_2—120kg/ha	12129.76	3289.47	15419.24
K_3—150kg/ha	12115.49	3385.20	15500.70
'F' test	S	S	S
CD (P 0 05)	777.20	193.38	934.95

Increased levels of nitrogen progressively reduced the percentage of starch. Maximum starch content was obtained by application of 40 kg nitrogen, 75 kg phosphorus and 150 kg potassium Higher the quantity of nitrogen applied, higher was the protein content of tubers. Increased application of phosphorus reduced the protein content of tubers. (Table 5.26)

Table 5·26: Effect of graded levels of N, P and K on percentage of drymatter, starch and protein content of colocasis tubers

Treatments	Dry matter	Starch (Expressed on dry wt basis)	protein (Expressed on dry wt. basis)
Nitrogen (N)			
N_1–40 kg/ha	20.88	64.88	5.59
N_2–80 kg/ha	20.00	62 55	8.03
N_3–120 kg/ha	20.04	60.53	9.32
'F' test	S	S	S
Phosphorus (P_2O_5)			
P_1–25 kg/ha	19.33	61.92	7.10
P_2–50 kg/ha	19.80	62.14	7.52
P_3-75 kg/ha	21.79	63.89	8.31
'F' test	S	S	S
Potassium (K_2O)			
K_1-90 kg/ha	20.87	62,42	7.39
K_2–120 kg/ha	20.53	62.37	7.79
K_3–150 kg/ha	19.52	63.17	7.75
'F' test	S	S	NS
CD = (P = 0.05)	0.55	0.67	0.41

Propagation methods, and cultural practices in Sapogenin bearing yam Dioscorea floribunda–(Nileswar)

The experiment was designed to determine the optimum spacing of plants and to determine a suitable fertilizer and manurial schedule under Kerala conditions. Three levels of spacing 30 x 30 cm, 30 x 45 cm 30 x 60 cm were tried in the project.

A basal dressing of 10 t/ha of FYM was given. Three levels of nitrogen (50, 75, 100 kg/ha) were tried the P and K levels being kept constant at 50 kg/ha each. The experiment was in progress.

Evolving high yi lding tomato varieties with resistance to bacterial wilt Ag–7.19. Path. 1.02 (Vellanikkara)

Thirty six tomato varieties collected from different parts of the Country were screened during May–July 1979 to identify sources of resistance. The variety La Bonita expressed tolerance to wilt. A heavy incidence of vertical cracking was observed in the variety La Bonita. The wilted plants were tested for bacterial exudation and thirty six lines were rejected.

Nineteen lines obtained from Asian Vegetable Research and Development Centre, Taiwan, along with La Bonita were grown during May-September 1979. Tne line CL 32-0-0–0-1 10GS showed tolerance to bacterial wilt

The lines CL 32-0-0-0-1-19 GS and La bonita were grown along with the germplasm not so far screened. The lines were *Lycopersicum pimpinellifolium* SL-120, Punjab chuvera, Annanji, *L. glandulosum, L. peruvianum,* CRA-66-Selection A, V.687, EC. 108759, EC-110176 and Gamed. Complete seedling mortality was observed for all the varieties except for CL 32-0-0-0-1-1965. The resistance of this line would be further studied through multilocational trials.

Seed mycoflora of some vegetables in Kerala-(Vellayani)

The following fungi were isolated from various vegetable seeds:

Amaranthus
- *Fusarium sp*
- *Aspergillus flavus*
- *Aspergillus niger*
- *Curcularia sp.*
- *Myrothecium sp.*

Bhindi
- *Aspergillus niger*
- *Aspergillus flavus*
- *Colletotrichum sp.*
- *Fusarium sp.*
- *Botryodiplodia sp,*

Brinjal
- *Aspergillus flavus*
- *Aspergillus niger*
- *Rhizopus sp.*

Bitter gourd
- *Aspergillus flavus*
- *Colletotrichum sp*
- *Aspergillus niger*
- *Rhizopus sp.*

Cowpea
- *Rhizopus sp.*
- *Helminthosporium sp.*
- *Fusarium sp.*
- *Aspergillus flavus*
- *Botryodiplodia sp*

Cucumber
- *Aspergillus flavus*
- *Aspergillus niger*
- *Rhizopus sp.*

Tomato
- *Aspergillus niger*
- *Aspergillus flavus*

Studies on the cassava mosaic disease—Ag.8 (a) 11 Path.2.01 [Vellayani]

The experiment consisted of studies on symptomatology, histopathology, electron microscopy and different methods of transmission (sap, seed, grafting, insects other than whiteflies). Detailed studies on vector-virus relationship of *Bemesia tabaci,* pattern of field spread of disease, host range of virus, resistance/tolerance of common cultivars of tapioca and estimation of crop losses were to be conducted.

The research was in progress.

Survey for the population of whitefly Bamesia sp. and spread of cassava mosaic --Ag.8 (a)-11 Ent. 1.01 [Vellayani]

This is a KAU-CTCRI collaborative project with locations at Kayamkulam, Ambalavayal and Vellayani.

Kayamkulam

Monthly observations on the population of whitefly and spread of cassava mosaic were recorded from 2 locations. In each location, there were 2 plots. In Kayamkulam, the varieties M4 and H 1687 were planted. A local variety was planted in the other locality. Number of mosaic affected plants and mean number of white flies/plant from May 1979 to November 1979 are given in Table 5.28. The population build up of white flies started from June to November with a peak in August

Ambalavayal

The mean number of white flies/leaf was fairly large during the months July, August and September (Table 5.29). The tapioca crop was free from the mosaic disease and there was no source of inoculum. Primary infection was absent in all the plots. During the period of high activity of the vector, there was no secondary spread in the plots under observation.

Table 5.28: Number of Mosaic affected plants and mean no. whiteflies/plant from May 1979 to November 1979

	No. of Mosaic affected plants											Mean no. of white flies/plant			
	Kayamkulam (L1)						Oachira (L2) Variety-Local					Kayamkulam (L1)		Oachira (L2)	
	Plot–1			Plot–2			Plot–1			Plot–2					
	Primary Infection	Secondary Infection	Total plants	Primary Infection	Secondary Infection	Total plants	Primary Infection	Secondary infection	Total plants	Primary Infection	Secondry Infection	Total plants	Plot 1	Plot 2	Plot 1	Plot 2
5/79	—	—	540	49	—	300	100	—	300	105	—	300	—	—	—	—
6/79	—	—	,,	49	—	,,	,,	—	,,	105	—	,,	—	0.232	0.100	1.533
7/79	—	—	,,	49	—	,,	,,	—	,,	105	—	,,	1.201	1.400	1.866	3 268
8/79	—	2	,,	49	—	,,	,,	—	,,	105	15	,,	1.967	4.167	3,567	3.400
9/79	—	3	,,	27	—	,,	,,	15	,,	105	15	,,	1.934	2.634	2.134	1.666
10/79	—	3	,,	27	—	,,	,,	17	,,	105	16	,,	3,467	1.766	4.700	3.501
11/79	—	3	,,	27	—	,,	,,	17	,,	105	16	,,	8.002	2.734	3.600	3.201

Table 5.29: Mean no. of whitefly populations during the different periods of observation in the localities at Ambalavayal (Mean of 30 leaves)

Location	Plots	Period of observation							
		June	July	August	September	October	November	December	January
1	1	0.166	2.19	1.49	1.96	0.99	0.43	1.53	0.19
	2	0.133	1.49	5.16	2.43	1.79	9.66	0.39	0.10
2	1	3.13	3.43	9.23	1.63	1.86	0.46	NR	NR
	2	1.46	2.56	5.96	1.66	0.99	0.49	0.49	0.3

6. Pulses & Oil Seeds

HIGHLIGHTS

COWPEA

Two promising cultures of cowpea with synchronised flowering and early maturity were isolated from the cross between P. 118 and Kolinji payar. Pusa barsathi and Culture No. 5269 were found to be good vegetable types with high pod yield. Cowpea variety V38 gave the highest yield of grain among the grain types tested at Pattambi. Application of half nitrogen as basal and two foliar sprays of 2% diammonium phosphate solution on the 20th and 30th days ofter sowing was quite effective in increasing cowpea yields. Germination of cowpea seeds was improved when rock-phosphate was applied as coating material after pelletting.

GREENGRAM

The varieties PIMS-5, MI.5 and PIM-4 recorded the highest grain yields Under upland conditions at Vellayani, the variety PLM-501 recorced the highest yield.

BLACKGRAM

The black gram variety C 5-6 I-1 was the best yielder among the six varieties tested at Pattambi. The variety S-1 was found to be promising for cultivatiion in rice fallows of Onattukara. The NPK level of 20;50;40 kg/ha was the best for black gram in the rice fallows of Onattukara.

HORSEGRAM

Single plant selection in the local variety of horsegram was progressing at Pattambi. The NPK level of 20:25:10 kg/ha gave the highest grain yield in horsegram.

SOYBEAN

The soybean variety EC 39824 recorded the highest yield in rice fallows at Vellayani.

PULSES-GENERAL

A trial to find out the economics of nitrogen fertilization to the first crop rice by growing a pulse in the summer fallows was in progress at Pattambi A trial to ascertain the scope for cultivating a pulse crop between the two rice crops in Kuttanad was in progress at Moncompu.

Five promising strains of *Rhizobium* effective in green gram were isolated at Vellayani. Final screening for culture efficiency of 22 strains of *Rhizobium* specific for cowpea was in progress at Vellayani. Polythene lined gunny bags gave complete protection to gram seeds against *Bruchus* sp. Seed treatment with insecticide emulsions of phoxim and etrimphos at 10 ppm gave protection against *Bruchus* sp. in cowpea.

SESAMUM

The culture No. 8 of sesamum was found to be significantly superior to Kayamkulam-1 at all locations in Onattukara. NPK at 40:15:30 kg/ha along with cattle manure at 5 tons/ha, produced the highest yield in the muitipoded mutant and Kayamkulam-1 varieties of sesamum in Onattukara. Different levels and methods of application of K did not differ appreciably in sesamum grown under rice fallow conditions.

GROUNDNUT

The different dates of sowing groundnut as intercrop in tapioca did not influence the yield of groundnut. Highest yield of pods and haulms was recorded by Pollachi-1 under partially shaded conditions in coconut gardens.

SUMMARY

COWPEA

Two promising cultures with synchronised flowering and early maturity were isolated from the cross between P. 118 and 'Kolinji payar'.

Twelve vegetable types of cowpea were evaluated at Pattambi and the culture No. 5269 and Pusa Barsathi were significantly superior to others in pod yield.

The cowpea variety V 38 gave the highest yield of grain among the types tested at Pattambi.

Significant differences in yield were not detected among elite cowpea varieties tested for grain yield.

Genetic divergence studies in cowpea germplasam led to the identification of 17 clusters. Fifteen hybrid combinations involving these clusters were evaluated for pod yield and the F_1 progeny of P 118 x GPMS 139 was adjudged as the best.

Application of P_2O_5 in the form of Mussorie rock phosphate gave higher grain yield than superphosphate. Placement of Rock phosphate in the root zone of the seedlings was found to be better than broadcasting.

Nitrogen at 20 kg/ha increased grain yield and nodulation in the variety P 118. Potassium did not show any influence on the yield components.

The relative efficiency of foliar spray of urea and diammonium phosphate as compared to soil application, on growth and yield was estimated. Application of half nitrogen as basal and the other half as two foliar sprays of 2% DAP solution on the 20th and 30-th days after sowing was found to be the best.

A study of the effect of micronutrients used as seed coats revealed that germination was adversly affected when more than two micronutrients were appiied jointly. But germination improved when rockphosphate alone was applied as a coating material after pelletting.

GREENGRAM

Twelve varieties were evaluated at Pattambi for their yielding potential. The varieties did not differ significantly in yield.

A co-ordinated varietal trial with 20 varieties conducted at the Vellayani centre indicated that the varieties were significantly different in respect of their yield potential. The variety PIMS-3, MI-5 and PIM-4 recorded higher yields of 592, 527and 519 kg/ha respectively. PLM-501 recorded the highest yield of 363kg/ha under upland conditions.

BLACKGRAM

Screening varieties suitable for the summer fallows of North Kerala led to the identification of M-3 and KMU-3 as better performers.

Six varieties were tested in a CYT at Pattambi and the maximum yield of 1222 kg/ha was recorded by C-5-61-1.

Five varieties were tried in a CYT at Kayamkulam in the rice fallows and the variety S-1 gave the highest yield of 2211 kg/ha.

HORSEGRAM

Single plant selections were made from the local variety to evolve a high yielding short duration variety suited to local conditions. Two hundred promising single plants were selected and these will be advanced to progeny row trials.

In studies on the nutritonal repuirement of horsegram, highest grain yield was obtained at 20:25:10 kg. NPK per hectare.

SOYBEAN

Comparative evaluation of five soybean varieties was made in rice fallows and EC 39824 was found to be the best yielder.

Screening of soybean varieties led to the indentification of the varieties EC 92814, Ankur, PLSO-18, Monetta, Davis and JN 2720 to be suitable for cultivation during the SW monsoon season. Varieties suitable for the NE monsoon and for summer seasons were also identified.

PULSES—GENERAL

An experiment to evaluate the scope for cultivating a pulse crop between the two rice crops in Kuttanad was in progess.

The germplasm collection at the Pattambi centre comprising of 149 grain types and 57 vegetable types of cowpea, 48 types of green gram and 21 types of blackgram was maintained.

A trial to increase the production of cowpea in Kuttanad by seed treatment with *Rhizobium* culture was in progress.

Five out of the 17 strains of *Rhizobium* isolated at the Vellayani centre were found to be promising for greengram.

Twenty two strains of *Rhizobium* specific for cowpea were isolated from different locations.

Phoxim and Etrimphos at 10 ppm gave protection against *Bruchus* sp. infesting cowpea Polythene lined gunny bags gave complete protection against these beetle pests.

SESAMUM

A germplasm of sesamum varieties and cultures was maintained and evaluated at Kayamkulam.

A multilocational trial with three cultures and Kayamkulam-1 as standard was conducted at 5 locations in Onattukara. The culture no. 8 was the best yielder and was significantly superior to Kayamkulam-1 at all the locations.

Neither phosphorus nor potash increased the seed yield under upland conditions. Highest yield was obtained at 15 kg each of P_2O_5 and K_2O per hectare.

The effect of different levels and practices of manuring on the yield of the multipoded mutant as compared to Kayamkulam-1 was studied at Kayamkulam. Highest yield in both the varieties was recorded at the NPK level of 30:15:30 kg/ha with 5 tons cattle manure par hectare.

An intercropping trial to find out the optimum seed rate and spacing for groundnut in tapioca was in progress at Mannuthy. Single rows at a spacing of 30 cm appeared to be suitable for groundnut.

Attack of aphids during early stages and shoot and pod borer at flowering stage was noticed on the sesamum crop in rice fallows.

Mild incidence of phyllody and powdery mildew was noticed during the later stages of the crop at Kayamkulam.

A seed storage trial was initiated at Kayamkulam to study the effect of different storage containers and storing methods on germination.

GROUNDNUT

A varietal trial using seven varieties of groundnut to identify the most suitable one for the rice fallows of Onattukara was continued at Kayamkulam.

Four varieties were tried at Mannuthy to identify the most suitable one for the partially shaded conditions in coconut gardens. Highest yield of pods and haulms was recorded by the variety, Pollachi-1.

A manurial trial employing three levels each of N, P and K was conducted in the rice fallows at Kayamkulam using the variety TMV-2. Highest pod yield of 3320 kg/ha was obtained at the NPK level of 10:40:50 kg/ha.

A trial to evolve an appropriate technology for the effective utilisation of the time interval between the two rice crops in Onattukara by cultivating a groundnut crop was progressing at Kayamkulam.

An irrigation experiment to find out the effect of timing and frequency of irrigation on growth and yield of groundnut and to fix up the optimum number of irrigations by identifying the critical stages was in progress at Chalakudy.

PROJECTS IMPLEMENTED

COWPEA

CROP IMPROVEMENT

		Locations
1	Breeding high yielding cowpea varieties with short flowering phase (Ag.9(a) 1. Breed. 1.01)	Pattambi
2	Breeding for long poded vegetable type of cowpea (Ag. (9) a. 1 Breed 2.01)	—do—
3	Screening elite cowpea varieties for local adaptability and high grain yield potential (Ag.9 (a) 1. Breed. 6.02)	—do—
4	Cowpea coordinated varietal trial (Ag.9 (9) 1. Breed 5.03)	—do—
5	Screening cowpea genotypes suitable for mixed cropping with tapioca (Ag.9 (a) 1. Breed. 5.05)	Vellanikkara
6	Screening cowpea genotypes suitable for mixed cropping with tapioca (Ag. 9 (a) 1. Breed 5.05)	Pattambi
7	Cytological studies on the varieties and hybrids of cowpea (Ag. 9 (a) 19. Bot. 3.01)	Vellanikkara
8	Screening cowpea varieties for local adaptability and high grain yield potential	Vellayani
9	Study on the effect of different posphatic fertilizers and efficiency of their method of application on the growth and yield of cowpea (Ag.9 (a) 1, Agron. 1 02)	Pattambi
10	Effect of different levels of phosphorus and potash on the growth and yield of cowpea variety P-118 (Ag.9 (a) 19. Agron. 1.03)	Vellanikkara
11	Foliar application of phosphorus in cowpea (Ag.9 (a) 18. Agron. 2.01)	Vellayani
12	Effect of magnesium and molybdenum on growth yield, protein content and nitrogen fixing capacity of high yielding cowpea varieties, Calicut-78, Calicut-51 New era and Co.1 (Ag.9 (a) 18/19. Agron. 4.01)	Vellayani
13	Methods to increase the efficiency of seed treatment with *Rhizobium* in cowpea (Ag.9 (a)18 Agron.5.02)	Vellayani
14	Study on the effect of foliar spray of urea and diammonium phosphate on cowpea (Ag.9. 1. Chem. 2)	Pattambi
15	Response to application of sulphur (Ag.9 (a) 18. Che. 2.01	—do—
17	Effect of Pelleting of cowpea seed with micronutrients on nodulation, nitrogen fixing capacity, yield and quality of seed (Ag. 9 (a) 18. che.2.01)	—do—

CROP PROTECTION

17	Assessing the suitability of different containers for storing cowpea seeds under Kerala conditions (Ag. 9 (a) 1. Path. 1.01)	Pattambi
18	Screening cowpea varieties for resistance against collar rot and web blight disease (Ag.9 (a) 18. Path 2.01)	Vellayani

GREENGRAM

CROP IMPROVEMENT

19	Evaluation of yield potential of local adapted varieties of green gram (Ag.9 (b) 1. Breed. 1.01)	Pattambi
20	Screening of green gram varieties for local adaptability and grain yield (Ag.9 (b) 18. Breed.1.02)	Vellayani
21	Co-ordinated varietal trial on Moong	Pattambi

CROP MANAGEMENT

22	Effect of graded doses of lime and phosphorus on the growth, yield and quality of green gram (Ag. 9 (b) 18. Agron. 1 02)	Vellayani

BLACKGRAM

CROP IMPROVEMENT

23	Blackgram co-ordinated varietal trial (Ag. 9 (c) 1. Breed. 1.01)	Pattambi
24	Screening promising varieties of blackgram for summer rice fallows (Ag.9 (c) 1. Breed. 1.03)	—do—
25	Varietal trial on blackgram (Ag.9.6 Bot. 1.3)	Kayamkulam

CROP MANAGEMENT

26	Manurial trial on blackgram (Ag.9 (c) 6 Agron. 1.01)	Kayamkulam
27	Effect of graded doses of lime and phosphorus on the growth, yield and quality of blackgram (Ag.9(c) 18.Agron. 1.03)	Vellanikkara
28	Scheduling irrigation to blackgram (Ag.9 (c) 3. Agron. 2.01)	Chalakudy
29	Effect of different methods of irrigation and cultural practices	Pattambi

HORSEGRAM

CROP IMPROVEMENT

30	Breeding horsegram varieties suited to the locality through single plant selection from cultivators' field (Ag. 9 (d) 1 Breed, 1.01,	Pattambi
31	Horsegram co ordinated varietal trial (Ag. 9 (d) 1 03)	-do-
32	Horsegram germplasm maintenance	-do-

CROP MANAGEMENT

33 Manurial trial on horse gram (Ag. 9 (d) 2. Agron. 1.02) — Mannuthy

SOYBEAN

CROP IMPROVEMENT

34 Performance of soybean in rice fields during third crop season (Ag. 9 (e) 18. Bot. 1.01) — Vellayani

CROP MANAGEMENT

35 Screening of soybean varieties (Ag. 9 (e) 19. Bot 2.01) — Vellanikkara

36 Coordinated varietal trial on soybean (Ag. 9 (e) 19. Bot. 3.01) — Vellanikkara

37 Studies on the time of sowing of soybean varieties (Ag. 9 (e) 19 Agron 1.01) — Vellanikkara

REDGRAM

38 Genetic improvement in Redgram (*Cajanus cajan L*) (Ag. 9 (f) 19. Bot. 1) — Vellanikkara

PULSES-GENERAL

CROP IMPROVEMENT

39 Comparative study of the yield performance of different pulse varieties by altering the sowing seasons (Ag. 9 (g) 6. Bot 1.01) — Kayamkulam

40 Selection of suitable varieties of pulses for Kuttanad region (Ag. 9 (g) 5 Bot. 2.01) — Moncompu

41 Germplasm maintenance in pulse crops — Pattambi

CROP MANAGEMENT

42 Effect of pulses in summer rice fallows on the fertilizer nitrogen requirement of khariff rice (Ag. 9 (g) 1. Agron. 1.02) — Pattambi

43 Scheduling of irrigation for pulse crop based on critical growth stages (Ag. 9 (g) 3 Agron. 2.01) — Chalakudy

CROP PROTECTION

44 Evolving suitable techniques to increase production of pulses by adding *Rhizobium* culture in Kuttanad soils (Ag. 9 (g) 5 Che. 1.01) — Moncompu

45 Studies on *Rhizobium*–Selection of suitable strains for blackgram and greengram in Kerala (Ag. 9 (g) 18. Path 1.01) — Vellayani

46 Studies on the rhizobia isolation and mass production of efficient cultures of Rhizobium (Ag. 25.18 Micro 3.02) — Vellayani

47	Relative susceptibility of different varieties of pulses to infestation of pulse beetle [Ag. 9 (g.) 5 Ent. 1.01]	Moncompu
48	Chemical control of pests of pulses [Ag. 9 (g) 18 Ent. 2.01]	Vellayani
49	Control of pests of gram seeds using insecticides [Ag. 9 (g) 18 Ent. 3.01]	Vellayani
50	Control of pulse beetle [Ag. 9 (g) 2 Ent. 3.02]	Mannuthy

SESAMUM

CROP IMPROVEMENT

51	Genetic investigation in sesamum [Ag. 10 (a) 18 Breed. 3.01]	Kayamkulam
52	Collection and maintenance of available varieties and evolution of a high yielding variety of sesamum [Ag. 10 (a) 6 Breed 1.01]	Kayamkulam
53	Initial evaluation of sesamum hybrid cultures [Ag. 10 (a) 6 Breed 4.01]	Kayamkulam
54	Screening sesamum varieties in single crop rice fallows [Ag. 10 (a) 1 Breed. 6.02]	Pattambi
55	Comparative yield trial of promising sesmum varieties [Ag. 10 (a) 6 Breed 6.03]	Kayamkulam
56	Multilocational trial with the high yielding multipoded cultures of the cross pt. 58–35 x Kayamkulam–1 in different locations of the Onattukara tract. [Ag. 10 (a) 6 Breed. 6.03]	Kayamkulam

CROP MANAGEMENT

57	Fertilizer management practices for the multipoded mutant of Kayamkulam [Ag. 10 (a) 6 Agron. 1.01]	–do–
58	Studies on the effect of graded doses of P and K on the yield and oil content of sesamum [Ag. 10 (a) 18 Agron 1.02]	Vellayani
59	Effect of graded levels of nitrogen, phosphorus and potassium an the growth and yield of sesamum grown under upland conditions [Ag. 10 (a) 1 Agron. 1.04]	Pattambi
60	Studies on the effect of potassium and magnesium on the yield of oil and protein content of sesamum [Ag. 10 (a) 18 Agron. 1.03]	Vellayani
61	Effect of potash on the yield and oil content of sesamum	Kayamkulam
62	Studies on the suitable agronomic methods for obtaining uniform populations in the bulk crop of sesamum [Ag. 10 (a) 6 Agron 2 01]	Kayamkulam
63	Chemical weed control in sesamum [Ag. 10 (a) 6 Agron 4.01]	Kayamkulam

CROP PROTECTION

64	Studies on the pests of sesamum and their control [Ag. 10 (a) 6 Ent. 1.01]	Kayamkulam
65	Investigations on the diseases of sesamum [Ag. 10 (a) 6 Path. 1.01]	Kayamkulam
66	Investigations on the diseases occurring in sesamum in upland areas of Kerala [Ag. 10 (a) 1 Path. 1.02]	Pattambi

POST HARVEST TECHNOLOGY

67	Storage trials in sesamum [Ag. 10 (a) 6 Pro. Tech 1.01]	Kayamkulam

GROUNDNUT

CROP IMPROVEMENT

68	Evolution of short duration groundnut variety by mutation breeding [Ag. 10 (b) 18 Breed 1.01]	Vellayani, Kayamkulam
69	Comparative evaluation of groundnut varieties under rainfed conditions in coconut gardens [Ag. 10 (b) 6 Breed 2.01]	Mannuthy
70	Varietial trial in groundnut	Mannuthy

CROP MANAGEMENT

71	Manurial trial in groundnut [Ag. 10 (b) 6 Agron 1.01]	Kayamkulam
72	Studies on the cultural and management practices in groundnut in the sandyloam soils of Onattukara paddy fields [Ag. 10 (b) 5 Agron 1.03]	Kayamkulam
73	Scheduling irrigation to groundnut [Ag. 10 (b) 3 Agron 2.01]	Chalakudy
74	Effect of date of planting of groundnut as an intercrop on the yield of groundnut and tapioca (Ag 8 (a) 2. Agron. 4.01)	Mannuthy
75	Studies on the optimum seed rate and spacing of groundnut as intercrop in tapioca	,,

CASTOR

76	Evaluating the prospects of popularising large scale cultivation of castor in Kerala (Ag.10 (d) 18. Breed. 1.01)	Vellayani

COW PEA

Breeding high yielding cowpea varieties with short flowering phase

Ag. 9 (a). 1: Breed. 1.01 (Pattambi)

This project was started at Pattambi during the year 1975–76 with the objective of evolving high yielding grain type varieties of cowpea with a short flowering phase.

The Cross P. 118 x "Kolingipayar" was made and carried forward up to the F6 generation. Twelve single plants were selected from F_6 generation and since they segregated for plant and seed characters, further selection of 29 single plants was made. From the 29 lines raised during kharif 1979, 20 promising plants were selected for trial during the Rabi season. Two lines that showed synchronised flowering and maturity were selected from the Rabi crop for yield trial. During summer '79-80, the two promising lines were tried with the parents and 2 checks (Pusa phalguni and EC 43721) in RBD with 4 replications. The two selections seemed to be early and exhibited synchronised flowering. These selections are to be tested further.

Breeding for long poded vegetable type of cowpea

Ag.9 (a) 1; Breed. 201 (Pattambi)

The experiment was started during the summer season of 1977-78 with 12 varieties and 4 replications in an RBD to identify a high yielding vegetable type of cowpea. The result of previous years indicated that among the 12 varieties tried, the varieties No. 5269, Pusa barsathi and Calicut–78 were superior. The results of 79-80 with respect to flowering duration and yield of vegetable pods are presented in Table. 6.1.

Table. 6.1: Performance of vegetable varieties of cowpea

Sl no.	Variety	Duration (days)	Yield (Vegetable pods) kg/ha
1	Pusa Barsathi	42.3	3021
2	No. 5269	42.3	3474
3	Vayalathur Red	47.8	841
4	,, White	48.8	836
5	Mayyanad local	46.5	1709
6	Manjeri local	43.4	2122
7	C-5-7	44.0	1733
8	Calicut-78	49 5	1246
9	,, 51	48.8	944
10	Kayamkulam	46.5	1140
11	Culture-1	52.3	1410
12	Co.2	46.5	1521
	CD (0.05)	—	814 kg/ha

The varieties No. 5269 and Pusa Barsathi were significantly superior to others in pod yield. These two varieties had the shortest durations. The performance of Calicut–78 was very poor

Screening elite cowpea varieties for local adaptability and high grain yield potential Ag.9 (a) 1: Breed 5.02 (Pattambi)

The experiment was started during the kharif season of 1978–79 with the objective of assessing the adaptability and yield potential of newly evolved cowpea varieties. Twelve varieties were tried employing an RBD with four replications. The preliminary trial conducted during 1978–79 revealed that S.488-9-1 (970 kg/ha) was the best yielder followed by Co–Pusa-1 (772 kg/ha) and Culture–2 (756 kg/ha).

The data relating to 79–80 are furnished in Table 6.2.

Table.6.2: Performace of elite cowpea varieties

Sl. no.	Variety	Days to flowering	Plant ht. (cm)	Yield of haulm (kg/ha)	Yield of grain (kg/ha)
1	No 104	41	55	2233	350
2	V.16	48	55	2283	371
3	V.37	48	56	1042	179
4	V.38	43	51	2017	425
5	Culture–2	46	56	3318	388
6	Co–Pusa–1	46	52	5358	404
7	Sel.1476	48	49	2848	263
8	P.118	39	46	1250	392
9	New era.	47	49	2325	315
10	C.152	46	48	1650	210
11	Ptb.1	46	42	1167	423
12	S.488–9–1–1	43	50	5433	269

The yield data did not reveal any significant difference between the varieties. However, V_{38} yielded the maximum (425 kg/ha) followed by Pattambi-1 (423 kg/ha) and Co-Pusa–1 (404 kg/ha) varieties

Cowpea co–ordinated varietal trial—Ag.9 (a) 1. Breed 5.03 [Pattambi]
Progress not reported.

Evolution of high yielding short duration varieties of cowpea—Ag.9 (19: Breed 5.04 [Vellanikkara]

The objectives of the project were to evolve vegetable types suitable for growing in homesteads of Kerala and for developing grain and vegetable types for cultivation in the rice fallows. Studies on the genetic divergence of cowpea germplasm was conducted during the previous year and it was found that the 56 genotypes belonged to 17 clusters. 15 genotypes one each from different clusters were sown in Sept. 1979. Inter–varietal cross in the following combinations were effected and the F_1 were evaluated with respect to 15 economic traits.

1 Manjeri black x Kolinji payar white
2 Kolinji payar white x Manjeri black
3 Pannithodan early x Kolinji payar white
4 Manjeri black x Kolinji payar
5 N.62 x IC 20729
6 IC 20729 x Red seeded selection
7 Red seeded selection x Kolinji payar
8 Red seed selection x Kolinji payar

9 Red seeded selection x GPT 536
10 Pattambi local x Kolinjipayar white
11 P 115 x C 132 x NE 1
12 E 115 x GPMS 139
13 GPMS 139 x P 115
14 GPMT 9314 x P 116
15 Pusa Phalguni x Kolinjipayar
16 Pusa Phalguni x GPMS 63

Statistical analysis of the data revealed varying degrees of heterosis for the characters studied. The hybrid P 118 x GPMS 139 was adjudged as the best among the 15 hybrids. Maximum heterosis of 430.35% was shown by the hybrid P 118 x C 152 x NS 8 with respect to pod yield. Interestingly, heterosis was noticed to the same extent in hybrids of both gentically related and unrelated parents.

Screening cowpea genotypes suitable for mixed cropping with tapioca—Ag.9 (a) 1: Breed 5.05 [Pattambi]

The project was started at Pattambi during July, 1979 with a view to screen some of the high yielding bushy genotypes for inter-cropping with tapioca. Six varieties of cowpea were interplanted in tapioca variety M-4, planted on ridges at a spacing of 1 m x 1 m. But the crop stand was poor and hence the experiment was abandoned.

Cytological studies on the varieties and hybrids of cowpea—Ag.9 (a) 19: Bot.301 [Vellanikkara]

The aims of the project were to study the chromosomal numbers in the cultivated varieties and hybrids of cowpea and to study the cytological abnormalities in relation to pollen sterility. This project was not started.

Screening cowpea varieties for local adaptability and high grain yield potential—[Vellayani]

The work was not taken up during 1979–80.

Study of the effect of different phosphatic fertilizers and efficiency of their method of application on the growth and yield of cowpea Ag 9. (a) 1: Agron. 1.02 [Pattambi]

The project was started during 1978–79. An experiment was laid out in split plot design in RBD with 5 main plot treatments, 4 sub-plot treatments and 4 replications, using the variety C-152 to find out the optimum dose, best source and methods of application of phosphatic fertilizer for cowpea. Levels of P_2O_5 were the main plot treatments. The P_2O_5 sources and methods of application constituted the sub-plot treatments. During 1971-79 there was positive response to P_2O_5 application up to 50 kg/ha. Application of P_2O_5 in the form of Mussorie rock phosphate has given better yield than super phosphate. Placement of phosphatic fertilizer in the form of rock phosphate at seeding stage was found to be better than application by broadcasting. In the case of superphosphate, there was no significance in yield due to different methods of application.

During 1979-80, the crop stand was very poor due to poor germination caused by ill drained condition.

Effect of different levels of phosphorus and potash on the growth and yield of cowpea variety P. 118

Ag. 9 (a). 19: Agron. 1 03 [Vellanikkara]

With the aim of finding out the optimum NPK requirements for the cowpea variety P 118, this project was implemented. Nitrogen at 20 kg/ha contributed

to increased nodulation and increased grain yield. Phosphorus also had significant positive effect on nodulation. However, potassium did not show any significant influence on the yield components and the growth characters.

Foliar application of phosphorus on cowpea

Ag. 9 (a) 18: Agron. 2.01 [Vellayani]

The project has been concluded.

Effect of magnesium and molybdenum on growth, yield, protein content and nitrogen fixing capacity of high yielding cowpea varieties Calicut–78, Calicut–51, New Era and Co. 1.

Ag. 9. (a) 18/19: Agron. 4.01 [Vellayani, Mannuthy]

Progress not reported during the year.

Methods to increase the efficiency of seed treatment with Rhizobium in cowpea

Ag' 9. (a) 18 Agron. 5.02 [Vellayani]

Progress not reported during the year.

Study on the effect of foliar spray of urea and diammonium phosphate on cowpea

Ag. 2. 1. Chem 2 [Pattambi]

This was started during 1978–79 with 11 treatments and 4 replications in RBD, using the variety C–152, to assess the comparative efficiency of foliar spray on the growth and yield of cowpea. The results of 78–79 indicated that application of N and P (20:30 kg/ha) through soil as per the package of practices gave better yield than application of N & P as foliar spray in the form of urea and DAP at varying proportions.

The results obtained during 1979–80 are given in Table 6.3.

Table. 6.3: Effect of foliar spray of urea and diammonium phosphate

Treatment No.	Plant ht. (cm)	No. of pods per plant	Length of pod (cm)	No. of grains per pod	Yield kg/ha
1	62.8	5.2	15.2	14.6	615
2	59.6	4.2	14.0	14.1	645
3	55.6	3.3	14.9	12.8	475
4	57.6	4.4	14.1	13.7	600
5	56.6	3.9	14.6	14.1	390
6	58.9	4.5	14.7	14.1	765
7	54 6	3.4	14.8	14.5	545
8	55.3	3.8	14.1	13.3	475
9	58.9	3.8	14,5	13.8	550
10	51.5	3.4	13.9	12.2	505
11	53.2	3.1	14.2	12.2	303
	CD (4.05)				175

The treatment no 6, viz. half nitrogen as basal and two foliar spray of 2% DAP solution on the 20th and 30th days after sowing was found the best. This, however, does not agree with the results of the previous year.

Response to application of sulphur by cowpea

Ag. 9 (a) 18 Che. 2.01 (Vellayani)

The experiment was programmed to study the effect of free sulphur and sulphur containing fertilizers on the yield and quality of cowpea. A field trial with 4 treatments and 5 replications employing an RBD with New era variety was to be conducted in April 1980 onwards. Soil samples were collected initially to determine the available sulphur and total nitrogen content.

Effect of pelleting of cowpea seed with micronutrients on nodulation, nitrogen fixing capacity, yield and quality of seed—

Ag. 19 (a) 18: Che. 2.02 (Vellayani)

The experiment was carried out to study the effect of micronutrients like Mo, B, Cu and Zn at 2 levels individually and in combination used at the time of pelleting, on germination of seeds, nodulation, grain yield and quality of cowpea. Sixteen treatments of micronutrients were employed. Germination was found to be poor when more than 2 micronutrients were applied in conjunction. However, germination improved when rock phosphate was applied as a coating material after pelleting.

Assessing the suitability of different containers for storing cowpea seeds under Kerala Conditions

Ag. 9 (a) 1. Path. 101 (Pattambi),

Project to be taken up in 1980-81.

Screening cowpea varieties for resistance against collar rot and web blight disease

Ag. 9 (a) 18. Path. 2.01 [Vellayani]

This project was started during February 1980 to identify varieties resistant to the two important diseases of cowpea.

Different isolates of collar rot, web-blight and sheath blight organisms associated with cowpea were prepared and mass culturing done.

GREENGRAM

Evaluation of yield potential of locally adapted varieties of Greengram–

Ag. 9 (b) 1: Breed. 1.01 (Pattambi)

The experiment was started during 1978–79 to assess the yield potential of green gram varieties and to select the best variety possessing high yield potential and short duration. Twelve varieties were compared in an RBD with four replications. The preliminary trial indicated no significant differences between varieties. The variety PS. 10, however, recorded the highest yield (1292 kg/ha)

The trial with 12 varieties was repeated during 1979-80. The data are presented in Table 6.4.

Table 6.4: Performance of greengram varieties

Varieties	Days to follow-ering	Days to maturity	Plant ht (cm)	No. of pods per plant	No. of seeds per pod	100 grain wt. (g)	Yield kg/ha
Phillipines	39	68	34	2.7	8.7	6.2	117
Madira	36	65	29	3.7	8 5	4.5	440
S-8	36	66	26	6.4	8.8	3.6	515
Pusa Baisakhi	36	65	30	5 3	10.0	3.5	423
NP-40	34	68	32	4.6	7.2	4.4	549
NP-36	35	66	31	3.2	9.3	4.9	444
Co-2	36	68	29	4.9	8.6	3.3	590
PS-10	36	68	30	5.7	9.2	4.5	513
288-8	39	69	36	6.6	9.6	3.6	133
ML-4	37	69	30	4.2	8.7	3.2	394
ML-26	34	68	27	4.4	7.5	3.4	404
ML-5	35	68	34	6.9	9.3	2.6	467

The varieties did not differ significantly in yield. However, Co. 2 recorded the highest yield of 590 kg/ha.

Screening of green gram varieties for local adaptability and grain yield

Ag. 9. (b) 18: Breed 1.02 [Vellayani]

The trial was undertaken to identify improved varieties of green gram possessing adaptability to local conditions. Eleven varieties were compared in an RBD with three replications. Table 6.4 gives the data on grain yield from the different varieties.

Table. 6.5: Grain yield of green gram varieties

Variety	Grain yield kg/ha
S-8	203
NP-40	196
Phillipines	283
NP-36	325
PLM-93161	141
PLM-501	363
PLM-242	283
Madira	246
PLM-39	165
PS-16	191
CO-2	236

The varieties did not show any significant difference in yield. However variety PLM-501 recorded the nighest yield of 363 kg/ha, followed by NP-36 with 325 kg/ha.

Co-ordinated varietal trial on Moong [Pattambi]

The experiment was started during 1979-80 with the objective of selecting the most promising variety by estimation of the yield potential of different greengram varieties. Twenty varieties of green gram were grown with 4 replications adopting on RBD.

The important characteristics of the 20 varieties are presented in Table 6.6.

Table 6.6: Performance of greengram varieties

Variety	Plant ht (cm)	Days to flowering	No. of pods/ plant	No. of seeds/ pod	Seed yield kg/ha
ML.33	26	36	5.8	9.5	444
ML.26	17	33	4.1	8.9	354
PS.16	24	37	4.5	8.2	473
ML. 12	23	35	5.1	9.6	417
K. 851	19	34	4.0	9.6	392
PIMS. 3	20	37	4.3	9.0	592
T. 44	19	34	3.8	10.7	394
MI. 5	23	35	4.2	9.2	527
ML. 62	19	35	4.7	9.3	363
Cal. 1	27	35	4.2	8.9	427
MH. 1	18	38	4.0	9.0	288
PIMS. 4	20	37	5.5	9.5	519
PIMS. 1	20	36	4.8	9.0	417
ML. 80	22	35	3.4	9.7	408
ML. 65	22	36	4.2	8.4	425
M. 2	20	41	3.7	8.3	219
CO-2	19	40	4.7	9.6	504
CO-3	26	36	3.6	8.9	394
PS-10	26	36	5.6	9.7	319
NP-40	22	35	3.5	7.7	319

The varieties were significantly different in yield. PIMS-3, ML-5 and PIMS-4 recorded higher yields of 592, 527 and 519kg/ha respectively.

Effect of graded doses of lime and phosphorus on the growth, yield and quality of green gram Ag. 9 (b). 18: Agron. 1.02 [Vellanikkara]

In order to study the response to and requirements of lime and phosphorus on green gram, this project was formulated. The treatments consisted of 3 levels of lime (0,500,1000kg/ha) and 3 levels of P (0,30,60kg P_2O_5/ha)

The experiment was laid out in May 1980.

Black gram coordinated varietal trial [Pattambi]

The experiment was started during kharif 1977 to estimate the yield potential of the varieties and to identify the most suitable one. 18 varieties tested during 1978–79 showed significant difference in yield and the maximum yield of 911kg/ha was recorded by H. 76-1. During 79–80, six varieties were tried in RBD with 4 replications. The yield data are presented in Table 6.7. Maximum yield o 1222 kg/ha was recorded by C. 5–61–1.

Table 6.7: Grain yield from black gram varieties

Variety	Grain yield kg/ha
BP–3	875
H.21–40–14	1142
H.21–40–17	1092
C.5–61–1	1222
Co–4	1012
T–9	995

Screening promising varieties of black gram for summer rice fallows Ag. 9 (e) 1: Breed 1.03 [Pattambi]

The project was undertaken to identify a high yielding short duration, drought tolerant variety of black gram suitable for the summer rice fallows of Northern districts of Kerala. The experiment was started during 1978–79 and the yield and other attributes of the varieties are presented in Table 6.8.

Table 6.8; Performance of black gram varieties

Sl. No.	Variety	Days to maturity	No. of pods per plant	No. of grains per pod	Grain yield (kg/ha)
1	KMU–3	72	8.6	6.4	1235
2	M–3	65	10.6	6.1	1308
3	UG–157	72	11.2	4.9	679
4	JU–1	65	14.0	4.4	617
5	4–5–2	72	11.1	5.3	692
6	Pant u-30	72	6.4	5.4	1058
7	Pant u-19	68	11.5	6.9	929
8	Co. 2	68	8.5	5.8	838
9	T. 9	68	9.5	6.2	972
10	S–1	65	6.4	5.7	942
11	Edakkad	70	9.4	6.3	1181
12	Ajanu	70	14.0	7.1	1015
13	Peralampther	70	11.15	6.4	904
14	Velloor	65	11.2	7.0	791
15	Pulloor	65	7.9	6.2	867
16	B. P-3	72	13.1	6.7	975
17	U.G-152	65	10.3	6.5	688
18	Culture-1	65	7.4	6.3	885

The analysis of yield data indicated that varieties M_3, KMU-3 and Edakkad were relatively better yielders. The highest yielder was M_3 which gave 1308kg/ha.

The trial with 18 varieties was repeated during 1979-80 and this is in progress.

Varietial trial on Blackgram Ag. 9.6: Bot. 1 3 (Kayamkulam)

The experiment was started during 1977–78, with the objective of studying the performance of different blackgram varieties in Onattukara during the third crop season in rice fields. During 1977-78 and 1978-79, maximum yield was recorded by Co–2 followed by KM–1-

Comparative trial of 5 varieties was repeated during 1979–80 in an RBD with 4 replications and the data are furnished in Table 6.9.

Table 6.9: Performance of blackgram varieties during the third crop season in rice fallows

Sl-no.	Varieties	No. of pods per plant	Grain yield (kg/ha)
1	Co–2	20.5	1688
2	T–9	25 2	1894
3	S–1	20.8	2211
4	KM–1	19.7	2111
5	Local	20.6	1750

Variety S-1 gave the maximum yield of 2211 kg/ha followed by KM–1:

Manurial trial on blackgram

Ag.9 (c) 6: Agron. 1.01 (Kayamkulam)

The experiment was started during 1978-79 with the objective of finding out the optimum level of NPK for black gram in rice fallows. The layout was of 3^3 (3 levels each of N, P and K) partially confounded factorial design with 2 replications using the variety Co-2. During 1978–79 maximum yield of 1847 kg/ha was recorded by T_3 (N P K 20:30:40)

The results obtained during 1979-80 are summarised in Table 6.10. The highest yield of 1693 kg/ha was recorded in the treatment No. 9 (NPK 20:50:40).

Table 6.10: Results of manurial trial in blackgram variety Co.2

Treatment No.	N P K levels (kg/ha)	Grain yield (kg/ha)
1	2	3
1	20 30 20	343
2	20 30 30	813
3	20 30 40	752
4	20 40 20	1105
5	20 40 30	634
6	20 40 40	776
7	20 50 20	437

1	2			3
8	20	50	30	681
9	20	50	40	1693
10	30	30	20	728
11	30	30	30	987
12	30	30	40	1199
13	30	40	20	823
14	30	40	30	837
15	30	40	40	446
16	30	50	20	964
17	30	50	30	799
18	30	50	40	931
19	40	30	20	1128
20	40	30	30	954
21	40	30	40	766
22	40	40	20	940
23	40	40	30	752
24	40	40	40	776
25	40	50	20	846
26	40	50	30	823
27	40	50	40	917

Effect of graded doses of lime and phosphorus on the growth, yield and quality of blackgram

Ag.9 [c] 18: Agron. 1.03 [Vellanikkara]

To study the response to and requirements of lime and phosphorus on blackgram, this project was taken up with 3 levels of lime [0,500, 1000 kg/ha] The crop was raised in May 1980.

Scheduling Irrigation to Blackgram- Ag. 9 (c). 3: Agron. 2.01 [Chalakudy]

The experiment was undertaken to find out the effect of timing and frequency of irrigation on growth and yield of blackgram. Two varieties were tried at 3 different water management levels. The analysis of grain yield during 1978-79 indicated that the water management treatments differed significantly while the varieties did not. The highest yield was recorded when irrigation was given at IW/CPE of 0.50. This irrigation level had the highest water use efficiency also.

The trial during 1979-80 is in progress.

Effect of different methods of irrigation and cultural practices on the growth and yield of blackgram- [Pattambi]

The experiment was undertaken to study the effect of different methods of irrigation and cultural practices on the growth and yield of blackgram in summer fallows. The trial was laid out with 8 treatments and 4 replications in RBD during 1979-80,

HORSE GRAM

Breeding horsegram varieties suited to the locality through single plant selection from cultivators field– Ag. 9 (d)1. Breed. 1.01 [Pattambi]

The experiment was started during Rabi 1978 with the objective of evolving a high yielding, short duration, locally adapted horsegram variety through single plant selection. Seventy two plants were selected from the lines and sown. Two hundred single plants were further selected from the lines and sown during the season. Progeny rows will be raised for subsequent studies.

Horsegram co-ordinated varietal trial– Ag. 9 (d) 1: Breed. 1.03 [Pattambi]

This project was formulated to estimate the yield potential of horsegram varieties evolved in India and to identify the promising ones which are suitable for Kerala. The trial was not conducted during the year for want of seeds of the different varieties.

Horsegram germplasm maintenance- [Pattambi]

The project was started during 1979 with the object of maintaining germplasm collection of horsegram.

Twelve varieties have been collected and are being maintained.

Manurial trial on horsegram– Ag. 9 (d) 2: Agron. 1.02 [Mannuthy]

The project was started during 1979–80 in order to assess the nutritional requirement of horsegram. The experiment consisted of 3^3 factorial RBD with 3 replications. N,P and K each at 3 levels in all the 27 possible combinations were tried. It was found that the various levels of NPK had no effect on the yield of horse gram. However, the highest yield of 69.4 kg/ha was obtained from the treetment receiving 20,25,10 kg/N,P and K per hectare.

SOYBEAN

Performance of soybean in rice fields during third crop season- Ag. 9 (e) 18: Bot. 1.01 [Vellayani]

The project was undertaken at the College of Agriculture during 1977 but not repeated. Five varieties were compared in an RBD and EC 39824 gave the highest yield of 2233 kg/ha. This project was concluded.

Screening of soybean varieties– Ag. 9 (e) 19: Bot. 2.01 [Vellanikkara]

Twenty five varieties of Soybean were cultivated during three South West monsoon seasons, one North East monsoon season and during one summer season and it was found that the performance varied markedly in the different seasons. Based on general performance, the varieties were rated as follows:

Suitable for SW monsoon season.

EC 92814; Ankur; PLSO 18; Monetta; Davis and JN 2750.

Suitable for NE monsoon season:

EC 14437; EC 26691; Improved pelican; EC 92814;
EC 39824; EC 63298

Suitable for both seasons

EC 39821; Improved pelican.

Co-ordinated varietal trial on soybean Ag. 9 (e) 19: Bot. 3.01 [Vellanikkara]

Progres not reported during the year.

Studies on the time of sowing of soybean varieties Ag. 9 (e) 19 Agron 1.01 [Vellanikkara]

Progress not reported during the year.

REDGRAM

Genetic Improvement in Redgram Ag. 9 [f] 19 Bot. 1 [Vellanikkara]

No work carried out on this project during the year.

PULSES—GENERAL

Comparative study of the yield performance of different pulse varieties by altering the sowing seasons Ag. 9 [g] 6: Bot 1.01 [Kayamkulam]

Project concluded in 1978.

Selection of suitable varieties of pulses for Kuttanad Region Ag· 9 [g] 5 Breed 2.01 [Moncompu]

The project aimed to find out a pulse crop variety that can be successfully grown under the Kuttanad conditions. An experiment with 7 varieties was laid out during February 1978. The yield could not be recorded on account of the severe attack of rodents and birds. During 1979 also the experiment could not be conducted properly since the rice fallow period was very short. The experiment was once again laid out in March 1980.

Germplasm maintenance in Pulse crops [Pattambi]

One hundred and forty nine grain types and fifty seven vegetable types of cowpea, 48 green gram types and twenty one blackgram types were maintained at the Rice Research Station, Pattambi.

Effect of pulses in summer rice fallows on the fertilizer nitrogen requirement of Kharif rice Ag. 9 [g] 1 Agron 1.02 [Pattambi]

The project was started during 1978-79 to ascertain the economics of N fertilization to the first crop rice by growing a pulse during summer fallows. The trial was laid out in a split plot in RBD with 4 main plots (Pulses) and 4 sub-plots (levels of N to first crop rice). However, it had to be rejected for want of uniform germination of the pulse crop due to moisture stress following drought conditions. This trial was laid out during 1979-80. The crop stand was normal and the experiment is continuing.

Scheduling irrigation for pulse crop based on critical growth stages Ag. 9 [g] 3 Agron 2.01 [Chalakudy]

Not taken up during the year.

Evolving suitable technibues to increase production of pulses by adding Rhizobium culture in Kuttanad soils-Ag. 9(g) 5: Chem. 1.01 (Moncompu).

The experiment was started during March, 1980 to evolve a suitable technique to increase the production of pulses by adding *Rhizobium* culture in the Kuttanad soils using the New Era variety of Cowpea. The trial was in progress.

Studies on Rhizobium–Selection of suitable strains for blackgram and greengram in Kerala Ag. 9 (g) 18: Path. 0.01 (Vellayani)

The objective of the project was to identify suitable strains of *Rhizobium* for blackgram and greengram, to study the survival of the strain in different carrier materials and to study the effect of different plant protection chemicals on nodulation and nitrogen fixation. Seventeen strains isolated from different parts of Kerala were screened. Five strains were promising for greengram. In blackgram, however, the strains did not show significant differences. Studies on the survival of the selected strains in different carrier materials such as lignite, coir dust and their combinations in various proportions is in progress

Studies on Rhizobia-Isolation and mass production of efficient culture of Rhizobium Ag. 25. 18: Micro. 3.02 (Vellayani)

The project was undertaken to isolate different strains of *Rhizobia* for different fodder and grain legumes of Kerala, to produce and distribute such cultures on a large scale and to standardise the conditions for nodulation in acid soils. Twentytwo strains of *Rhizobium* specific for cowpea were isolated from different locations. Preliminary screening for culture efficiency was done by using the criteria such as the number of nodules per plant, dry weight of nodules and fresh and dry weight of plant. Final screening of cultures the study of the effect of pH on their growth and the effect of nitrogen application on nodulation in cowpea are in progress.

Relative susceptibility of different varieties of pulses to infestation by pulse beetle Ag. 9 (g) 5: Ent. 1.01 (Moncompu)

The project was undertaken to study varietal sensitivity to the pulse beetles under storage conditions. Seeds of 25 cultivars of pulses (250 g/each) were exposed to pulse beetle infestation. Percentage of damage was assessed at monthly intervals. After 30 days of storage, the damage varied from 0 to 27%. At 60 days of storage, the damage varied from 25 to 84%. In three months time all the varieties showed heavy damage.

Chemical control of pests of pulses. Ag. 9 (g) 18: Ent. 2.01 (Vellayani)

Progress not reported during the year.

Control of storage pests of gram seeds using insecticides Ag. 9 (g) 18: Ent. 3.01 (Vellayani)

The project was undertaken to find out the effectiveness of insecticides and other materials on the control of storage pests associated with gram seeds and on the viability of seeds. Earlier studies indicated that spraying insecticides such as Phoxim 0.3% and isofenphos 0.3% on the outer surface of gunny bags gave protection from attack of the pulse beetle for five months after treatment. Phoxim 0.2% isofenphos 0.2%, fenthion 0.1% and quinalphos at both 0.1% and 0.15% gave protection up to three months.

Control of pulse beetle Ag. 9 (g) 2: Ent. 3.02 (Mannuthy)

No work was done during 1979–80.

SESAMUM

Collection and maintenance of available varieties and evolution of a high yielding variety of sesamum Ag. 10. (a) 6. Breed 1.01 (Kayamkulam)

Fiftyfive varieties were maintained in the gremplasm collection. During 1979–80, 47 varieties were grown and selected plants were selfed for purifying the stock. Fifteen cultures of the cross Pt. 58-35 x Kayamkulam-1 were also maintained in the collection.

Genetic imvestigation in sesamum-Ag. 10 [a] 18: Breed. 3.01 [Vellayani]

Progress not reported during the year.

Initial evaluation of sesamum hybrid cultures-Ag. 10 [a] 6 Breed 4.01 [Vellayani].

The project was concluded during 1978-79.

Screening sesamum varieties In single crop rice fallows Ag. 10 [a] 1: Breed. 6.02 [Pattambi]

Work not taken up during the year.

Comparative yield trial of promising sesamum varieties Ag. 10 [a] 6. Breed. 6.03 [Kayamkulam]

The project was started during the third crop season of 1978-79 with 9 varieties and 4 replications. Maximum yield was recorded by GP–iii-2 [676 kg/ha] followed by No. 42 [623 kg ha].

During 1979-80, the trial was repeated with all the nine varieties with 3 replications. The yield data are presented in Table. 6,11.

Table 6.11: Performance of sesamum varieties

Variety	Seed yield kg/ha.
No.42	477
UT–43	436
IS–614	395
IS–26	312
GP. iii–2	452
KRR-2	493
IS–50	430
E–8	345
Kayamkulam–1	477
CD (0.05)	146.7

Highest yield was recorded by KRR.2, but this was found to be on par with Kayamkulam–1.

Multilocational trial with the high yielding multipoded cultures of the cross Pt· 58-35 x Kayamkulam–1 in different locations of the Onattukara tract [Kayamkulam.]

The trial was conducted during the third crop season of 1979–80 with four varieties replicated 5 times in an RBD at 5 different locations in the Onattukara tract.

Location-1

Culture–8 was on par with the muitipoded mutant of Kayamkulam–1 and was significantly superior to the culture 7–1 and Kayamkulam–1.

Location-2 & 5

Culture-8 was on par with culture7-1 and was significantly superior to the other varieties.

Locations-3-4

Culture 8 was significantly superior over the other varieties at both the locations. The yield data for the four varieties at the 5 locations are indicated in Table 6.12.

Table 6.12: Performance of the multipodep cultures of sesamum.

Sl. No.	Variety	Seed yield kg/ha at locations					Mean
		1	2	3	4	5	
1.	Cul. No, 7-1	422	363	313	218	301	323
2.	Cul. No. 8	510	430	407	354	350	410
3.	MP Mutant	488	311	288	201	224	302
4.	Kayamkulam-1	422	247	231	182	248	266
	CD (0.05)	59.6	69.8	67.2	65.0	100.3	—

The culture no.8 was the highest yielder and this was significantly superior to Kayamkulam-1 at all the five locations.

Fertilizer management practices for the multipoded mutant of Kayamkulam

Ag. 10 (a). 6 Agron. 1.01 (Kayamkulam)

The project aims at the study of the effect of different manurial levels and practices on the yield of the multipoded mutant and Kayamkulam-1. The experiment consisted of a split plot in RBD with 6 main plot treatments, 2 sub-plot treatments and 4 replications. The trial was started during 1978-79. During the first year, maximum yield of 1067 kg/ha was recorded by T_5 V_2 (NPK 60:30:60 and multipoded mutant) followed T5 V_1 [NPK 60:30:60 and Kayamkulam-1] which gave an yield of 972 kg/ha.

The trial was continued during 1979-80 and the results are given in Table 6.13.

Table 6.13: Fertiliser responsiveness of multipoded and Kayamkulam-1 varieties of sesamum

Treatment No.	Main plot treatments (N, P & K kg/ha)	Seed yield (kg/ha)	
		V_1 Kayamkulam-1	V_2 Multipoded mutant
T_1	30:15:30 Full basal	314	329
T_2	15:15:15 basal + 15:0:15-at interculture	309	280
T_3	15:15:15 basal + 15:0:15-at interculture + cattle manure 5 tons	421	421
T_4	30:15:30-basal + 15:0:15-at interculture	343	305
T_5	40:30:40-basal + 20:0:20-at interculture	406	319
T_6	0:0:0-(control)	261	834

The highest yield at 421 kg/ha was recorded by T_3V_1 and T_3V_2. The performance of the crop was comparatively poor this year.

Studies on the effect of graded doses of P and K on the yield and oil content of sesamum-Ag.10 (a). 18. Agron. 1.02]Vellayani]

Progress not reported.

Studies on the effect of potassium and magnesium on the yield, oil and protein content of sesamum- Ag. 10 (a). 18. Agron. 1.03 [Vellayani]

The project was implemented in the Department of Agricultural Chemistry. A pot culture experiment in RBD with 8 treatments comprising of graded levels of K with and without magnesium along with a uniform level of N and P was conducted with four replications. The results are awaited.

Effect of graded levels of nitrogen, phosphorus and potassium on the growth and yield of sesamum grown under upland conditions- Ag. 10 (a) 1. Agron. 1.04 [Pattambi]

Progress not reported during the year.

Effect of potash on the yield and oil content of sesamum- [Kayamkulam]

The project was started at the Rice Research Station, Kayamkulam during the third crop season of 1978-79 to study the effect of potassium at different levels on the yield and oil content in sesamum. The experiment comprised of an RBD with 6 treatments and 4 replications, the variety being Kayamkulam-1. During the first year, maximum yield of 644 kg/ha was recorded by T_6 (NPK 30:15;30 basal and 30 kg K_2O/ha at interculture, followed by T_5 (NPK 30:15:60 basal). The trial was repeated during 1979-80. The yield data are presented in Table 6.14.

Table 6.14: Effect of potash on yield of sesamum

Levels of K	Method of application	Yield in Kg/ha		
		Full basal	½ basal, ½ at inter-culture	Mean
30 kg/ha		330	359	344.5
40 kg/ha		343	330	336.5
60 kg/ha		351	339	345.0
Mean		341.3	342.7	342

The treatments did not differ significantly.

Studies on the suitable agronomic method for obtaining uniform population in the bulk crop of sesamum- Ag.10 (a). 6. Agron.2.01 [Kayamkulam]

The experiment was started during the third crop season of 1978-79 to study the effect of different times and methods of sowing sesamum on yield. It consisted of an RBD with 15 treatments and 3 replications, using the variety Kayamkulam-1. During 1978-79, T_1 (sowing and ploughing) recorded the maximum yield. During 1979-80, the work was continued as a PG project.

The data on the trial have not yet been made available.

Chemical weed control in sesamum- Ag. 10 (a) 6: Agron. 4.01 [Kayamkulam]

The project aims to compare the efficiency of 3 chemical weedicides in relation to hand weeding. Due to the non-availability of weedicides, the trial was not conducted during 1979-80. This will be conducted during 1980-81.

Studies on the pests of sesamum and their control

Ag. 10 (a) 6 Ent. 1.01 [Kayamkulam]

The project was started during 1978–79. During the early stages (3 weeks after sowing) aphid attack was observed. Shoot and pod borrer attack was observed in the pre-flowering and post-flowering stages. Dusting of BHC 10% and spraying of Phosphamidon 0.02% were not effective in controlling the shoot and pod borer.

Investigation on the diseases of sesamum

Ag. 10 (a) 6: Path. 1.01 [Kayamkulam]

The project was started during January, 1978. During 1978–79 and 1979-80 incidence of phyllody and powdery mildew was observed during the later growth stages.

Investigation of the diseases occurring on sesamum in upland areas of Kerala

Ag. 10 (a) 1: Path. 1.02 [Pattambi]

Progress not reported.

Storage trials in sesamum Ag. 10 (a) 6. Pro: Tech. 1.01 [Kayamkulam]

The project was undertaken to study the effect of different containers and storing methods on the germination of sesamum seeds. A trial involving six treatments was conducted during 1977-78 and 1978–79. Subsequently, the treatments were revised and the new experiment is to be taken up during 1980–81.

GROUNDNUT

Evolution of a short duration groundnut variety by mutation breeding

Ag. 10 (b) 18: Breed 1.01 [Vellayani, Kayamkulam].

Progress not reported during the year.

Comparative evaluation of groundnut varieties under rainfed conditions in coconut gardens — [Mannuthy]

The project aimed at the identification of varieties of groundnut suitable for partially shaded conditions in coconut gardens, Four varieties were tried in 1978–79. Results of the trial conducted during 1979–80 was not conclusive. However, the highest yield of pods and haulms was recorded by Pollachi I followed by Pollachi II.

Varietal trial on groundnut Ag. 10 (b) 6: Breed. 2.01 [Mannuthy]

The project aimed to identify a suitable variety of groundnut for the rice fallows of Onattukara. The experiment was started during the third crop season of 1977-78.

Maximum pod yield of 8733 kg/ha was recorded by Gangapuri followed by TMV–2 with 7844 kg/ha. However, during 1978–79, TMV–2 recorded maximum yield followed by Gangapuri. The trial with all the 7 varieties was repeated during 1979–80. The population in many plots was uneven due to poor germination of seeds. Hence yield data are not available, for all the plots.

CROP MANAGEMENT

Manurial trial on groundnut- Ag. 10 (b). 6: Agron. 1.01 [Kayamkulam]

The project was started during 1978–79 to find out the optimum level of N, P and K for groundnut in sandy tracts– The trial was laid out employing a 3^3 partially confounded factorial design with 2 replications, using the variety TMV–2. The treatments consisted of the following 3 levels of N, P and K

N–10, 20 and 30 kg/ha
P–30, 40 and 50 kg P_2O_5/ha.
K–40, 50 and 60 kg K_2O/ha.

During 1978–79 maximum pod yield of 4425 kg/ha was obtained in T_8 i.e., NPK at 10:50:50 kg/ha. The trial was continued during 1979–80. The data on yield of pods and haulms are furnished in Table 6.14.

Table 6.14: Groundnut yield as influenced by NPK fertilization

Tr. No.	NPK dose (kg/ha)	Yield of pous (kg/ha)	Yield of haulms (kg/ha)
1	10.30.40	2492	6896
2	10.30.50	2962	9961
3	10.30.60	2324	9067
4	10.40.40	2809	9323
5	10.40.50	2320	9578
6	10.40.60	2426	5747
7	10.50.40	2630	10472
8	10.50.50	2758	9450
9	10.50.60	2375	9706
10	20.30.40	2477	8556
11	20.30.50	2748	9323
12	20.30.60	1915	7535
13	20.40.40	2222	7918
14	20.40.50	2324	6130
15	20.40.60	2707	7662
16	20.50.40	2605	7662
17	20.50.50	2595	6768
18	20.50.60	2722	7279
19	30.30.40	2886	8045
20	30.30.50	2120	9195
21	30.30.60	2503	8939
22	30.40.40	2375	9833
23	30.40.50	2707	7535
24	30.40.60	2707	8429
25	30.40.60	2707	8489
26	30.50.50	3065	9706
27	30.50.60	2196	10089

Highest pod yield of 3320 kg/ha was obtained in T_5 i. e , NPK at 10.40.50 kg/ha. The trial is being continued.

Studies on the cultural and management practices on groundnut in the sandy loam soils of Onattukara paddy fields Ag. 10 (b) 6: Agron. 1.03 [Kayamkulam]

The project was started during 1978–79 with the objective of evolving an appropriate technology for the effective utilisation of the time interval between the two rice crops in Onattukara during the third crop season, by cultivating groundnut as a catch crop.

The experiment consisted of a split plot in RBD with 4 main plots, 5 sub-plots and 5 replications using the variety TMV–2 During the third crop season 1978–79, maximum yield of 4162 kg/ha was recorded by V_3T_4 (Dibbling groundnut in stubbles of rice + lime at 1000 kg/ha and hoeing on the 5th day and 30th days after dibbling) followed by V_2T_4 (dibbling after regular land preparation and hoeing on the 15th day and 30th days after dibbling) which gave 4116 kg/ha

During 1979–80 the project was implemented as a PG research work.

Scheduling irrigation to groundnut Ag.10 (b) 3; Agron.2.01 [Chalakudy]

The project was started during 1978–79 with the main objective of finding out the effect of timing and frequency of irrigation on growth and yield of groundnut. It was also aimed to identify the critical stages of irrigation and to fix up the number of irrigations required. An experiment was laid out during 1978–79 with 12 treatments (combination of 4 varieties and 3 water management practices) in an RBD with 3 replications.

The yield differences due to water management practices were not significant. The varieties Pollachi 1 Pollachi 2 and TMV–2 were statistically on par but significantly superior to Gangapuri.

The experiment was repeated during 1979–80.

Effect of date planting of groundnut as an inter-crop on the yield of groundnut and tapioca—Ag.8 (a) 2: Agron.4.01 [Mannuthy]

The experiment was laid out in RBD with 13 treatments during 1978–79. None of the treatments significanfly influenced the yield of tapioca or groundnut. The trial was repeated during 1979-80. The intercrop of groundnut was harvested. None of the treatments had significant effects on the yield of groundnut. The main crop (tapioca) could not be harvested due to severe attack of wild pigs and rats.

The experiment will be repeated during 1980–81.

Studies on the optimum seed rate and spacing of groundnut as intercrop in tapioca [Mannuthy]

It was started during 1979–80. Tapioca will be harvested only in May 1980. Intercropping tapioca with groundnut in single rows at a spacing of 30 cm appears to be promising. The experiment will be repeated in subsequent years to get confirmatory results.

CASTOR

Evaluating the prospects of popularsing large scale cultivation of castor in Kerala Ag. 10 (d) 18; Breed 1.01 [Vellayani]

Progress not reported.

8. Sugarcane, Jute & Mesta

HIGHLIGHTS

In varietal evaluation trial, CO 62175 outyielded the popular variety CO 997 by 48% in the plant crop and 24.2% in the first ratoon and 32% in the second ratoon. CO 771 recorded the highest yield among the 22 short duration varieties in a comparative yield trial. CO 779 was found to be superior among the 16 midlate varieties. In studies conducted at Thakazhi to identify suitable early varieties with saline tolerance, the performance of CO 6806 was found to be quite good. In a fertilizer trial for 3 seasons, the effects of N and P were significant during the first year, bur the effects of K was not significant. In the first ratoon crop, there was significant difference in yield due to levels of nitrogen and there was no responce to P and K. In the second ratoon crop, the effect of nitrogen was significant only for the millable cane output and yield. Plant crop of CO 62175 gave the highest yield at the fertilizer level of 240 kg N/ha and the optimum level was 164 kg/ha.

SUMMARY

SUGARCANE

Comparative evaluation of twelve varieties led to the identification of CO 62175 as quite promising. This variety outyielded CO 997 by 48% in the plant crop, 24.2% in the first ratoon and 32% in the second ratoon. CO 62175 was also found to ba the best yielder in the zonal trials, the average yield of the cane being 129.77 t/ha equivalent to commercial sugar output of 15.76 t/ha as compared to he popular variety CO 997 which gave cane yields of only 92 66 t/ha with sugar out turn potential of 12.69 t/ha.

COC 771 recorded the highest yield among the 22 short duration varieties evaluated.

Among the 16 varieties of the midlate group which were screened, CO 779 gave the highest yield.

In studies conducted at Thakazhi to identify suitable early varieties with saline tolerance, CO 6806 recorded the maximum number of shoots and millable canes. As regards Brix and pol percentages CO 997 recorded the maximum values of 22.68 and 20.78% respectively. Among the 13 varieties under midlate group, CO 62175 recorded the maximum yield and the varieties CO 1307 was on par. CO 1307 recorded the highest yield among 12 midlate varieties screened. In the case of sugar recovery, CO 62175 gave the highest value. Similar studies at the Chittoor factory area indicated the superiority of COC 77-1.

In a fertilizer trial, conducted for three consecutive seasons, the effects due to N & P were significant in the first season and there was no response to K. The optimum level of N was 154 kg/ha. The response to P was linear up to 100 kg P/ha.

In spacing cum-manurial trial to determine the optimum spacing and manurial requirements, there was no significant difference for yield or sucrose percentage for the variety CO 997. But with respect to short counts and number of available canes, 60 cm spacing was superior to 75 and 90cm spacings. In the case of mid late variety CO 62175, the 75 cm spacing was superior to 90 cm in respect of these characters. Results of observational trials on the cultivation of jute as a seed and fibre crop in the Onattukara and Kuttanad areas as an intercrop in sugarcane fields were quite encouraging. As a fibre crop, mesta was found to come up very well as an intercrop in tapioca, cashew and pineapple gardens.

In the first ratoon crop. there was significant difference for yield only with levels of nitrogen, but no response for P and K. But an increasing trend in yield due to the effect of K was noticed from 0 to 120 kg K_2O/ha. As regards sucrose, significant differences were not observed between levels of N, P, and K

In the case of second ratoon studies, the effect of nitrogen was significant only for millable canes and yield. The two higher doses of 100 and 200 kg N/ha were on par but superior to 0 level. The number of millable canes obtained with 100 kg P_2O_5 and 120 kg K_2O were significantly superior to the lower levels.

In the study of response of promising early and midlate cane varieties (CO.797, CO.449, CO.685, CO.62175) to graded doses of nitrogen the treatment effects were significant in all the three seasons studied.

In the plant crops, the variety Co.62175 was found to be the best, the optimum level of nitrogen being 164 kg/ha. Manurial levels and varietal differences had no effect on sucrose percentages.

The first ratoon studies revealed that the varieties and levels of 'N' were significant. CO 62175 gave the highest yield at the fertilizer level of 240 kg/ha. Optimum level could not be fixed since the response was linear.

In the second ratoon studies also, it was indicated that CO 62175 gave the highest yield, but, this was on par with CO. 997. The '0' level of 'N' was significantly inferior to all others. The optimum level of N was 167 kg/ha. There was no significant difference between levels of N for Brix, pol and purity percentages.

Experiments to study the effect of silicate slag and lime did not give significant results either in yield or sucrose percentages in sugarcane.

In the spacing-cum-manurial trial to determine the optimum spacing and manurial requirements, there was no significant difference for yield or sucrose percentage for the variety CO.997. But for short counts and number of millable canes, 66 cm spacing was superior to 75 and 90 cm spacing. In the case of the midlate variety CO.62175, treatments differed significantly for number of millabie canes and yield. For these two characters, 75 cm spacing was superior to 90 and 105 cm at the highest level of fertilizer, namely, 200:60;100 NPK/ha indicating that plant population played an important role in yield.

Similar studies conducted at Punalur with the variety CO.997 gave the result that the maximum yield was at 115:75:90 NPK/ha at the present recommended spacing of 90 cm. In the case of midlate variety CO. 62175, the maximum yield was obtained at the highest level of ferilizer, namely, 150;90:120 NPK/ha and at the minimum spacing of 75 cm.

Experiments were laid out to study the effect of altitude on sugarcane seed materials both at Thiruvalla and Chakkupallom in Idukki District.

Another major project taken up at Thiruvalla was on the evolution of varieties suited to different agroclimatic situations by hybridization and selection. Ten crossess were done at the National Hybridization Garden at Coimbatore and the seedlings were planted at the Sugarcane Research Station, Thiruvalla.

JUTE

Observational trials conducted in the Onattukara tract showed that *capsularis* jute had better adaptability than *olitorius* types. The capsularis type JRC–321 flowered early and did set seeds profusely. For seed production the crop will have to be sown in May. In the Kuttanad area, the observational trials were quite promising. With respect to germination and growth the *capsularis* type was more promising in this region.

MESTA

The two mesta varieties AMV–1 and HS 4288 were tried at Punalur as intercrops in pineapple, tapioca, cashew. The indications were promising.

SUGARCANE

PROJECTS IMPLEMENTED

	CROP IMPROVEMENT	Locations
1	Evolution of varieties suitable for the different sugarcane tracts of Kerala	Thiruvalla
2	Zonal varietal trials (two series)	Thiruvalla
3	Varietal trial on sugarcane	Thiruvalla
4	Screening of sugarcane vatieties for early and midlate groups	Thiruvalla Thakazhi Idukki Punalur Chittur
5	Germplasm collection	Thiruvalla
6	Spacing-cum-Manurial trials, one series for short duration varieties and another for midlate varieties	Thiruvalla, Punalur, Chittur
7	Ratoon management studies	Thiruvalla, Punalur
8	Studies on companion crops in sugarcane fields	Thiruvalla, Punalur
9	Effect of altitude on sugarcane seed material	Thiruvalla, Idukki, Ambalavayal
10	Introduction of sugarcane in Wynad on commercial basis	Ambalavayal
11	Experiment to find out the best time of planting sugarcane	Thiruvalla, Punalur
12	Fertilizer trial on sugarcane	Thiruvalla, Punalur
13	Response of promising early and midlate cane varieties to the rate of nitrogen application	Thiruvalla
14	Soil application of silicate slag	Thiruvalla
15	Effect of soil amendment on yield of planted and ratoon surgarcane in acid soils	Thiruvalla

JUTE

1 Observational trial on the possibilities of raising jute in Onattukkara region (Kayamkulam)

2 Observational trial on the variety-cum-date of sowing with *capsularis* and *olitorius* jute (Moncompu)

3 Exploring the possibilities of cultivating Mesta as a fibre crop in the pineapple and tapioca growing regions (Punalur)

Evolution of varieties suitable for the different tracts of Kerala [Thiruvalla]

Hybridization work was done at the National hybridization Garden, Sugarcane Breeding Institute, Coimbatore with the following crosses.

Parentage	*No. of tassels crossed*
CO 62174 x CO 453	4
CO 62174 x IA 1367	4
CO 775 x CO 453	4
CO 775 x IA 1367	4
CO 7230 x CO 453	4
CO 7230 x IA 1367	4
CO 1148 x CO 453	4
CO 1148 x IA 1367	4
CO 7314 x CO 453	4
CO 7314 x IA 1367	4

The seeds were sown at SBI, Coimbatore during February, 1980 and the seedlings collected in May 1980 were planted at SRS, Thiruvalla for further studies and seedling selection.

Zonal varietial Trials: ICAR trials [Thiruvalla]

This trial was laid out to evolve suitabla varieties for the region by making selections from the varieties suggested by the Zonal leader of ICAR. The experiment was laid out in a 7 x 4 RBD with gross plot size 12 x 5.4m and net plot 10 x 3.6 m.

Observations on germination, shoot count, yield, millable canes, cane analysis at 10th and 12th month were collected and are presented in the Table 7.1.

The varieties differed significantly for all the characters excepting the Brix and pol percentages at 12th month. CO 62175 recorded the highest yield of 129.77 t/ha which is 40.15% over the standard CO 997, which yielded 92.66 t/ha. The sucrose percentage when converted to commercial cane sugar in tons/ha recorded the highest value of 15.67 t for CO 62176 which was significantly superior to CO 997 which yielded 12.61 t/ha.

A second series of trials with 14 varieties were also laid out during the year under report and the data will be available only in 1981.

Varietal trial on sugarcane [Thiruvalla]

This experiment was started in the year 1976 with the object of identifying cane varieties superior to the existing popular varieties of the region. The experiment was concluded during the year after three seasons. Data on millable cane, yield and sucrose percentage were recorded (Table 7.2).

Table 7.1: Mean values of germination, shoot count yield. millable canes and quality analysis

Treatment	Germ. % 30 DAP	Germ. % 45 DAP	Mean squares					Mean squares				
			Shoot count 000/ha	Yield/ha (tons)	Millable cane 000/ha	Brix (10th month)	Brix (12th month)	Pol (10th month)	Pol (12th month)	Purtiy (10th month)	Purity (12th month)	CCS (tons/ha)
KHS 3296	51.53	74.91	75.85	96.39	73.26	17.87	20.79	15.77	18.99	88·19	91.28	11.970
CO 62198	34.17	68.87	92.09	78.88	93.35	17.67	18.23	15.84	16.77	89.62	92.32	8.460
COC 67–1	32.20	51.96	75.19	78.77	72.16	15.20	18.17	12.30	15.89	81.33	87.26	9.880
CO 740	39.24	72.36	93.49	89 47	104.55	18.47	19.45	16.54	17.74	89.46	91.19	11.110
CO 6304	43.79	61.27	93.16	82.33	82.55	19.05	20.09	17.07	18.30	89.56	91.10	9.140
CO 62175	39.25	53.67	87.09	129.77	102.34	17.52	18.55	15.61	16.73	88.95	90.13	15.670
CO 997	44.45	79.60	134.83	92.66	108.03	15.70	18.92	13.42	17.43	85.15	91.97	12.610
CD (P-0.05)	4.94	12.18	29.44	19.95	15.85	1.72	—	1.91	—	2.61	2.57	2.710

Table 7.2: Mean number of millable canes per plot, cane yield and sucrose percentage

Treatments	Millable cane nos/plot	Yield in kg/plot	Sucrose Percentage
CO 997	485.0	261.0	17.23
CO 62175	457.7	345.7	16.33
CO 785	394.0	231.2	15.24
CO 6415	138.7	147.3	17.37
CO 1254	445.0	225.3	17.59
FR 64-17	465.7	203.8	16.42
CO 775	210.7	164.3	15.75
CO 6602	405.7	231.2	17.57
CO 7302	466.7	282.0	15.86
CO 62174	348.7	251.8	16.01
CO 449	423.0	256.7	16.24
CO 7106	454.7	289.7	17.21
CD (P=0.05)	132.3	77.0	—

The maximum yield was recorded by CO.62175 which is 32% over the standard CO. 997. No significant difference was observed between the varieties in respect of sucrose percentage. The varieties CO 7302 and CO 7106 were also found to be superior to CO 997 with respect to yield.

Screening of sugarcane varieties:(Multilocational)

This project was started with the objective of identifying early and midlate cane varieties with tolerance to flooded situations encountered in the river tanks of Thiruvalla and Pandalam Factory areas and with tolerance to salinity and flood conditions experienced at Thakazi. It was also aimed to identify varieties with toler ance to drought prevalent in Punalur and with tolerance to high altitude situation in the Idukki district.

Twenty two varieties belonging to early duration group and 16 varieties belonging to midlate group were tried at the Sugarcane Research Station, Thiruvalla. The data collected are presented in Tables 7.3 and 7 4.

In the case of the 22 early duration varieties studied, there were significant differences for all the characters. COC 771 recorded the maximum yield which was on par with CO 997, CO 449 and COM 7114. The maximum brix and pol percentage were recorded in CO 6806 with values of 21.08 and 18.26 and the minimum in CO 1340 with values 12.38 and 8.07 respectively.

Table 7.3: Performance of sugarcane varieties–early group

Treatments	Germination % (angles)	Shoot count per plot (sq.root)	No. of millable canes/plot (sq.root)	Weight of cane in kg/plot
COA 7601	50.40	6.61	7.32	42.00
CO 62101	39.68	7.03	7.65	55.40
CO 995	50.20	7.84	7.91	48.80
MS 6847	46.21	6.82	6.81	49.75
COC 771	74.72	8.66	9.51	89.40
CO 449	57.04	9.02	10.67	75.35
CO 62198	42.00	6.35	6.36	27.30
CO 7704	43.01	6.26	6.47	32.85
CO 773	missing	6.99	7.66	46.00
COC 671	44.19	6.27	6.44	34.20
CO 1305	67.34	9.05	9.02	51.60
CO 6806	51.43	8.30	8.04	35.70
CO 6407	43.01	7.16	6.00	22.05
CO 62174	35.51	6.70	6.63	43.75
CO 997	72.63	9.68	10.12	87.40
KHS 3296	46.20	5.57	4.08	13.85
CO 6907	58.45	8.17	8.55	59.90
COM 7125	49 05	7.21	7.65	56.65
CO 7219	33.16	6.09	5.87	28.90
DO 772	49.39	6.86	7.68	59.65
DO 7114	53.10	7.74	8.06	70.35
DO 1340	62.63	8.47	9.62	63.50
CD (P=0.05)	13.60	1.10	1.64	23.04

Table 7.4: Performance of sugarcane varieties–midlate group

Treatments	Germination % (angles)	Shoot count per plot sq. root	No.of millable canes/ plot (sq. root)	Weight of cane in kg plot
COA—7602	48.20	6.47	6.20	34.75
CO—1307	42·99	6.96	6.20	65.70
COB—7717	35.60	6.35	7.03	42 75
COB—6304	46.20	6.93	6.81	43.00
CO—62175	42.20	6.70	8.01	61.35
CO.419	20.61	5.08	6.14	31.05
COC—774	53.48	7.87	7.74	56.27
COC—775	32.28	5.74	6.61	31.75
COC—778	51.44	6.55	7.52	45.20
COC—779	48.99	6.90	8.12	62.55
B—37172	57.27	8.20	7.39	26.20
T—67172	43.83	7.48	7.14	49.10
CO—453	42.16	7.31	7.53	43.05
IC—225	60.93	8.42	8.53	64.80
CO—658	58.54	7.96	7.93	54.10
COB—777	60.21	8.00	7.99	65.35
CD (P 0.05)	12·82	—	—	25.20

Table 7.5: Performance of sugarcane varieties–early group

Varieties	Germination % (angles)	Shoot count (sq. root)	Millable canes (sq. root	Yield in kg perplot
COA—7601	41.27	6.37	5.99	39.75
CO—1340	35.76	6·70	6.46	25,50
CO—6907	43.00	7.06	6.99	42.75
CoC-772	21.24	4.62	4.18	12.00
CoM-7125	35.76	7.61	7.44	33.50
Co-7704	10.69	2.99	2.82	8.25
CoC-771	31.78	6.85	6.85	39.25
Co-997	41.27	8.57	8.56	45.50
Ms-6847	25.77	5.43	4.58	23.75
Co-449	34.48	7.61	7.44	34.25
Co-62101	12·48	3.04	3.23	7.30
Co-995	31.27	7.18	7.10	30.25
Co-6407	27.57	5.51	5.09	22.25
CoC-671	29.23	5.94	6.03	32.75
Co-62198	26.11	6.28	5.90	20.25
CoM-7114	38.54	7.41	7.44	44.00
Co-62174	21.78	5.23	4.78	22.50
Co-1305	36.09	8.25	7.64	27.00
Co-7219	40.99	7.46	6.92	40.50
KHS-3296	26.26	5.02	4.28	15.00
Co-6806	41.37	9.16	9.08	47.00
CD (P=0.05)	14.96	1.99	1.938	22.28

Among the 16 midlate varieties, the highest yield was recorded by COC779 but the sucrose percentage in this variety was found to be lower. The maximum brix and pol values respectively were given by the variety B.37172 with values 22.41 and 20.96 with a high purity percentage of 93.53. The minimum brix, pol and purity percentages were recorded in the variety COC778, with values 12.9, 10.14 and 78.54 respectively.

The results of screening trials conducted at Thakazhi are presented in Tables 7.5 and 7.6.

Table 7.6: Performance of sugarcane varieties – midlate group

Treatment	Germination % (Angles)	Shoot count	Millable cane	weight of cane in kg/plot
C–658	41.75	9.16	74.0	46.00
Co–453	20.59	6.08	36.5	22.25
B–37172	66.45	9.58	72.5	42.00
T–67172	44.60	7.87	43.5	41.50
CoC–779	48.67	8.88	65.5	44.00
Co–7717	30 90	7.38	47.5	36.50
Co–62175	48.18	7.99	62.0	65.25
IC–225	42.56	8.12	61.5	41.25
CoC–774	31.86	8.09	32.0	23.00
CoA–7602	48.16	7.70	57.0	44.00
CoC–777	67.56	9.03	72.0	44.75
Co–419	10.69	2.81	6.5	3.63
Co–1307	42.61	7.58	55.0	59.50
CD (P=0.05)	14.528	0.97	20.32	19.5

The screening trials with 21 early duration varieties at Thakazhi revealed that Co 6806 was the best yielder followed by Co 997. The variety which recorded the highest yield had given the brix and pol percentages of 20.18 and 17.43 respectively.

The 13 varieties under midlate group when evaluated for the various characters, revealed that the best cane yielder was Co 62175 which was on par with Co 1307. The highest Brix and pol values were recorded by Co 658 with values of 21.58 and 19.86 respectively. Co 1307 gave the minimum values for these characters.

Data collected from screening trials concluded at Punalur are given in Tables 7.7 and 7.8.

Among the 21 varieties under early duration group studied at Punalur, Co 997 recorded the highest yield closely followed by Co 62198 and Co 62101. In the case of brix and sugar recovery CoC 671 and Co 62174 recorded the highest. Based on the preliminary results, 8 varieties have been carried forward for an yield trial with the varieties Co 62198, Co 62101, CoC 671, Co62174, CoM 7125, MS 6847, W 6907 and Co 997.

The 12 varieties under midfate group when evaluated for the various characters revealed that Co 1307 was the highest yielder followed by Co 62175. Co 62175 recorded the highest values for sugar recovery followed by CoC 775. Based on yield and other characters, 8 varieties viz , CoA 7602, Co 1307, Co 6304, Co 7717, Co 774, Co 775, IC 225 and Co 62175 were carried forward for an yield trial. The study conducted at Idukki District with 20 short duration varieties and 14 midlate varieties gave the following information.

As regards germination and no. of shoots Co 997 recorded the highset values. In the case of midlate group Co 62175 recorded the maximum tiller counts. The crop was not harvested during the year since maturity was not obtained. Sugarcane takes 14-18 months in this area for maturity. The screening trials at the Kanjikode farm of the Chittur sugar mills with 16 varieties revealed that CoC 77-1, the early maturing variety was the best yielder with an yield of 116 tonnes/ha having Brix, pol and recovery percentages 21%, 19% and 11% respectively. The trial is to be repeated afresh since the experimental site has been shifted to Menonpara.

Germplasm collection [Thiruvalla]

A total number of 65 varieties is being maintained at the S.R.S., Thiruvalla.

Table 7.7: Performance of sugarcane varieties – early group

Variety	Length (metre)	Girth (cm)	No. of inter-node	No. of canes	Yield (kg)	Brix (%)	POL (%)	Purity (%)	Recory (%)
Co.62198	2.42	9.0	17	48	48	15.95	13.00	81.50	6.91
Co.62101	2.68	9.1	23	45	48	16.05	13.74	85.56	7.55
CoC.671	2.48	8.4	22	48	41	18.35	16.26	88.61	9.13
Co 62174	2.40	9.4	23	38	41	16.71	14.54	87.01	8.07
Co.997	2.64	9.1	27	52	50	17.85	14.59	81.73	7.77
Com.7125	2.94	8.3	21	55	45	15.51	12.53	80.78	6.62
MS.6847	2.48	10.6	21	32	36	13.21	10.40	78.72	5.40
Co.6907	2.68	9.3	24	61	41	15.65	12.73	81.34	6 76
CoA.7601	2.62	9.6	23	41	24	15.03	13.03	86.82	6.64
Co.7704	2.38	9.4	22	56	30	17.45	15.25	87.39	8.49
Co.1305	2.28	8.7	17	80	38	15.81	12.50	79.06	6.51
CoC.771	2.56	9.0	20	56	50	13.15	9.93	75.51	4.99
CoC.772	2.80	9.8	26	34	38	11.65	8.96	76.90	4 57
Co.449	2.84	8.2	25	32	42	15.85	12.63	79.68	6.61
Co.6407	3.04	9.8	23	32	27	12.35	9.17	74.25	4.54
Com 7114	2.66	8.7	26	45	44	14.45	11.85	82.00	6.03
KHS.3296	1.74	8.3	16	52	22	16.21	13.45	82.97	7.24
Co.1340	2.12	8.5	19	37	32	12.51	9.42	75.29	4.72
Co.7219	2.30	8.2	23	32	27	14.81	12.34	83.32	6.66
Co.995	2.36	7.9	23	25	28	12.61	9.67	76.88	4.92
Co.6806	2.52	8.3	17	24	17	14.05	11.73	80.92	6.20

Table 7.8: Performance of sugarcane varieties – midlate group

Variety	Length (Metre)	Girth (cm)	No. of inter-nodes	No. of canes	yield	Brix (%)	POL (%)	Purity (%)	Recovery (%)
CoA. 7602	2.85	9.7	22	49	42	16.94	14.17	83.64	7.67
Co 1307	2.94	9.1	25	62	67	13.14	9.65	73.43	4.79
Co. 7717	2.83	9.8	23	49	51	15.18	12.31	81.09	6.53
Co. 6304	2.96	9.5	23	31	43	14.84	11.83	79.71	6.20
Co. 62175	3.04	8.0	25	45	50	16.29	13.45	82.56	7.21
Coc. 774	3.08	9.1	19	38	41	16.08	14.22	88.43	7.97
Coc. 775	3.08	8.6	24	48	50	17.39	15.25	87.69	8.50
K 225	2.86	9.3	25	45	51	16.05	13.00	80.99	6.88
Coc. 777	2.84	8.0	23	50	48	9.76	7.27	74.48	3.61
Coc. 779	2.60	10.2	20	39	42	12.05	8.69	72.11	4.16
Co. 453	2.86	8.4	21	51	48	13.75	10.67	77.60	5.47
Co. 658	2.58	8.4	21	51	43	14.61	11.85	81.10	6.28

Spacing–cum-manurial trials- (Thiruvalla, Punalur, Chittur)

The project was implemented to determine the optimum spacing of sugarcane for maximum productivity and to find out the relationship between spacing and nutritional requirements in sugarcane. The trials were laid out separately for the early variety Co 997 and midlate variety Co 62175 in a 9 x 3 randomised block design with plot sizes 9 x 9m² for the former and 12.6 x 6.3m² for the latter. The treatments were as follows for the Thiruvalla Station:

Fertilizer	*Spacing for Co 997* (between rows)	*Spacing for Co 62175* (between rows)
F_1–200:100:100 NPK/ha	S_1–60 cm	S_1–75 cm
F_2–165:82.5:82.5 ,,	S_2–75 ,,	S_2–90 ,,
F_3–130:65:65 ,,	S_3–90 ,,	S_3–105 ,,

The results are presented in Tables 7.9 and 7.10.

Table 7.9 : Results of spacing cum manurial trial – early variety

(a) Germination (%)

	F_1	F_2	F_3	Mean
S_1	46.26	47.60	51.93	48.60
S_2	49.35	52.96	46.01	49.44
S_3	53.39	50.11	50.21	51.24
Mean	49.67	50.23	49.39	—

(b) Shoot count (sq. root values) per hectare

	F_1	F_2	F_3	Mean
S_1	443.3	442.7	443.8	443.20
S_2	419.1	414.3	418.6	417.31
S_3	408.6	411.9	402.9	407.80
Mean	423.64	423.0	421.7	—

CD for S means – 12.85

(c) Brix

	F_1	F_2	F_3	Mean
S_1	20.67	19.35	19.83	19.95
S_2	20.53	20.30	19.43	20.09
S_3	20.06	20.30	19.69	20.02
Mean	20.42	19.98	19.65	—

(d) Pol

	F_1	F_2	F_3	Mean
S_1	18.89	17.44	18.04	18.12
S_2	18.73	17.57	18.73	18.35
S_3	18.29	18.60	17.95	18.28
Mean	16.64	18.20	17.91	—

(e) Purity

	F_1	F_2	F_3	Mean
S_1	91.40	90.16	90.93	90.85
S_2	91.25	91.47	91.29	91.34
S_3	91.20	91.61	91.15	91.32
Mean	91.28	91.08	91.14	—

(f) No. of millable canes per plot

	F_1	F_2	F_3	Mean
S_1	440.3	510.7	513.0	488.0
S_2	436.3	433.3	450.0	440.0
S_3	449.3	444.7	418.3	437.44
Mean	441.96	496.23	460.43	—

(g) Yield in Kg. per plot

	F_1	F_2	F_3	Mean
S_1	467.5	555.8	563.0	528.77
S_2	510.8	473.0	503.0	495.67
S_3	444.7	528.8	509.8	494.44
Mean	474.3	519.2	525.3	—

Table 7.10: Results of spacing cum-manurial trial-midlate variety

(a) Germination (%)

	F_1	F^2	F_3	Mean
S_1	40.66	42.74	39.09	40.83
S_2	41.13	39.42	38.99	39.85
S_3	39.51	40.21	38.68	39.47
Mean	40.43	40.79	38.92	—

(b) Shoot count (sq. root values) per hectare

	F_1	F_2	F_3	Mean
S_1	272.11	348.17	340.20	320.16
S_2	331.84	304.68	303.82	313.45
S_3	343.08	343.44	335.30	340.61
Mean	315.68	332.10	326.44	—

(c) Brix

	F_1	F_2	F_3	Mean
S_1	18.67	19.20	18.68	18.85
S_2	19.49	18.64	17.81	18.65
S_3	17.85	17.27	17.74	17.62
Mean	18.67	18.37	18.08	—

(d) Pol

	F_1	F_2	F_3	Mean
S_1	17.00	17.62	16.97	17.22
S_2	17.93	17.13	16.08	17.05
S_3	16.33	15.58	16.14	16.02
Mean	17.11	16.78	16.40	—

(e) Purity

	F_1	F_2	F_3	Mean
S_1	91.39	91.71	90.84	91.31
S_2	92.24	91.83	90.22	91.43
S_3	91.53	90.02	90.81	90.79
Mean	91.72	91.18	90.62	—

(f) No. of millable canes

	F_1	F_2	F_3	Mean
S_1	444.7	470.0	534.0	482.88
S_2	381.7	426.7	393.3	400.55
S_3	376.0	372.0	390.7	379.55
Mean	400.8	422.9	439.3	—

(g) Yield in kg per plot

	F_1	F_2	F_3	Mean
S_1	604.8	559.8	535.0	566.44
S_2	524.0	507.5	473.0	501.5
S_3	445.5	484.7	415.0	448.38
Mean	524.8	517.3	474.3	—

Statistical analysis of the data for the early variety Co 997 did not show significant difference excepting shoot count, for which 60 cm spacing was superior to 75 and 90 cms. Even though there was no significant difference in the yield for the treatments, the maximum yield was recorded for 90cm spacing at a fertilizer level of 200:100:100 NPK/ha.

In the case of midlate variety Co 62175, treatments differed significantly only for number of millable canes and yield. For these two characters 75 cm spacing was superior to 90 and 105 cms. Maximum yield was recorded at the highest level of fertilizer and the minimum at the lowest level of fertilizer and spacing. The trials were continued for studying the ratoon crops also.

At Chittur, the trials were being continued with the early variety Co 62174 and midlate variety Co 419. The trials were laid out only in Jan 1980 and hence results are not reported.

The results of the trials done at Punalur were not available.

Ratoon management studies (Thiruvalla, Punalur)

This experiment was laid out to standardise the ratoon management practices in sugarcane.

The treatments were removal of trash, burning trash, shaving stubbles, no stubble shaving, first manuring after 25 days, first manuring after 45 days and second manuring after 75 days.

The variety planted was Co 997 with a plot size of 12 x 5.4m^2. The actual treatments will start only in 1980-81 in ratoon crop.

Similar trial was laid out at Punalur also.

Studies on companion crops in sugarcane fields (Thiruvalla, Punalur)

This trial was laid out during the year at Thiruvalla and Punalur centres with a view to identify suitable companion crops in sugarcane fields and to work out the economics of the system.

The companion crops tried were greengram, blackgram, horsegram, cowpea, daincha, sunhemp, bhindi and jute.

The companion crops excepting jute were raised one month before planting sugarcane. At Punalur instead of jute, mesta was planted. The growth of bhindi, sunhemp, mesta and jute were quite satisfactory and that of blackgram, horsegram, daincha and greengram was poor. The data on the yield of cane will be availble only in 1980-81.

Effect of altitude on sugarcane seed material [Multilocational]

To study the seedling vigour and performance of progenies of seed materials brought from high ranges, the trials were laid out at Chakkupallom in Idukki District, Sugarcons Research Station Thiruvalla and at the Horticultural Research Station, Ambalavayal. The varieties tried were Co 997, Co 449 and Co 785. Seed materials were raised in all these centres and the experiment was laid out at Thiruvalla in a 4x3 RBD with plot size 5x4.5 m. Two sets of trials were laid out using the materials brought from Idukki and Ambalavayal. The data on the performance of the progenies will be available only in 1980-81.

Introduction of sugarcane in Wynad for commercial cultivation [Ambalavayal]

To find out the possibilities of introducing sugarcane cultivation on a commercial basis under wynad conditions, a project was taken up as an observational trial in the first instance. Four varieties, viz., Co 997, 62175, Co 785, Co 449 were cultivated in 5 cent plots each.

The performance of all the varieties in general was satisfactory.

Experiment to find out the best time of planting sugarcane. [Multilocational]

To find out the best time for planting sugarcane in different tracts and to examine the feasibility of extending the crushing season by staggering the time of planting, an observational trial with fortnightly planting dates was taken up at Thiruvalla, Punalur and Chittur. The plantings at fortnightly intervals at Thiruvalla were done in 15th Nov. 1979, Ist Dec. 1979, 15 th Dec. 1979, Ist Jan. 1980, 15 th Jan. 1980, Ist Feb. 1980, 15 th Feb. 1980, Ist March 1980, 15 th March 1980. The varieties tried were Co. 997, Co. 785, Co. 449 and Co. 62175. The results of the trials will be available only in 1980-81.

At Punalur, the planting was started on Ist October, 1979 at fortnightly intervals and continued up to Ist June, 1981 and thus there were 17 plantings.

Eventhough the trial was taken up at Chittur, the same had to be abandoned due to shifting of experimental site. The experiment was laid out in the new site from Ist Feb. with the varieties Co 419, Co 6304, Co 62174 and Co 62175.

Fertilizer trials on sugarcane [Thiruvalla]

The object of the trial is to find out the optimum requirements of nutrients for sugarcane and to formulate fertilizer recommendation for the crop to get maximum yield and sugar recovery.

The experiment which was laid out at Thiruvalla in December 1979 was concluded during the year. The details of technical programme were as follows;

Layout	:	3^3 confounded factorial design
Replications	:	2
Treatments	:	Nitrogen 0,100,200 kg N/ha. Phosphorus 0,50,100 kg P_2O_5/ha Potash 0,60,120 kg K_1O/ha
Plot size	:	12x5.4 m [gross] 10x3.6 m [net]
Variety	:	Co 997

Data on millable canes, yield and sucrose percentage were collected and analysed and are presented in Table 7.11.

Table 7.11: *Results of fertilizer trial on sugarcane*

a] Table of means [Millable canes-No/plot]

	P-0	P-1	P-2	K-0	K-1	K-2	Mean
N-0	311.83	323.33	360.33	288.50	340.67	366.33	331.83
N-1	362.33	363.17	397.00	358.17	373.00	391.33	371.17
N-2	383.00	373.50	407.50	379.17	381.17	403.67	388.00
Mean	352.38	353.33	388.28	341.94	364.94	387.11	—

	K-0	K-1	K-2	Mean
P-0	334.33	353.5	369.33	352.38
P-1	325.67	347.0	387.33	353.33
P-2	365.83	394.3	404.67	388.28
Mean	341.94	364.94	387.11	—

CD for N, P or K marginal mean: 26.27

b] Table of means [Yield in kg/plot]

	P-0	P-1	P-2	K-0	K-1	K-2	Mean
N-0	162.25	155.33	147.25	154.92	146.83	163.08	154.94
N-1	190.33	196.67	207.08	179.75	194.75	219.58	198.03
N-2	176.62	203.83	237.00	177.67	220.92	219.17	205.92
Mean	176.50	185.28	197.10	170.78	187.50	200.61	

	K-0	K-1	K-2	Mean
P-0	182.83	175.33	171.33	176.50
P-1	155.42	197.83	202.58	185.28
P-2	174.08	189.33	227.92	197.11
Mean	170.78	187.50	200.61	

CD for N marginal means: 25.91

c] Table of means [sucrose percentage]

	P-0	P-1	P-2	K-0	K-1	K-2	Mean
N-0	18.82	19.01	19.19	19.32	18.85	18.86	19.00
N-1	17.71	18.86	18.62	18.41	18.10	18.67	18.39
N-2	18.83	18.59	18.46	19.09	18.46	18.33	18.63
Mean	18.45	18.82	18.75	18.97	18 47	18.62	

	K-0	K-1	K-2	Mean
P-0	19.20	17.79	18.55	18.45
P-1	18.72	19.16	18.59	18.82
P-2	19.08	18.46	18.73	18.75
Mean	18.94	18.47	18.62	

The results of analysis showed that the optimum level of N for maximising the number of millable canes was 198 kg/ha. The effect of N was significant for millable cane and yield. The two higher doses were on par and superior to lower dose. The number of millable canes obtained by 100 kg/ P_2O_5 was superior to the other doses which were on par. The number of millable canes obtained by 100 kg/P_2O_5 was superior to the other doses which were on par. The number of millable canes by applying 120 kg. was significantly superior to that obtained without K_2O. The treatments did not differ significantly in respect of sucrose.

The first season studies showed that the effect due to N and P were significant, but K had no effect on the yield of cane. The optimum level of N was found to be 154 kg/ha. The optimum level of P could not be obtained since the response was linear.

For the first ratoon, treatments could not be given in time due to circumstances beyond control. The results obtained revealed the following: As regards yield, there was significant difference between levels of N. An increasing trend in yield was not noticed as the level of N increased. The difference between N_0 and N_1 was significant, but not between N_1 and N_2. From N_0 to N_2 levels the difference was significant. P and K had no effect on yield, but an increasing trend in yield was noticed as the level of K_2O increased from 0–120 kg/ha.

With respect to sucrose, no significant difference could be observed between the levels of N, P and K.

Response of promising early and midlate cane varieties to the rate of nitrogen application [Tiruvalla]

The object of the experiment was to study the response of early and midlate cane varieties to the graded doses of nitrogen over an optimum level of phosphorus and potash.

The trial was started in Jan. 1977 and concluded in Jan, 1980. The layout was 4x3 RBD with four levels of nitrogen as follows:

	Varieties
N_1 0 kg N/ha	Co 997
N_2 0.5 X kg N/ha	Co 449
N_3 X kg N/ha	Co 785
N_4 1.5 X kg N/ha	Co 62175

X—optimum level (160 kg N/ha)

Plot size 12 x 5.4 m^2 (gross)
10 x 3.6 m^2 (net)

Observations like germination %, shoot count, yield, no. of millable canes Brix, pol and purty were recorded and data were analysed and presented in Table 7.12.

Table 7.12: Response of early and midlate cane varieties to the rate of N application

(a) Germination count at 45 days harvesting (2nd ratoon)

Varieties	N1	N2	N3	N4	Mean
V1	695.33	623.0	541.33	569.0	607.17
V2	323.66	687.0	513.0	596.3	530.0
V3	288.00	402.6	319.0	276.3	321.5
V4	369.60	367.0	373.0	508.0	404.42
Mean	419.17	519.91	436.58	487.42	

CD for comparison of varietal means—114.15

(b) Shoot count (1000/hectare)

Varieties	N1	N2	N3	N4	Mean
V1	710.00	797.67	823.33	815.33	786.58
V2	418.67	666.33	591.67	647.00	580.92
V3	439.67	644.0	570.33	599.67	563.42
V4	470.67	589.0	602.67	629.00	572.83
Meau	509.75	674.25	647.00	682.75	—

CD for comparison of varieties or nitrogen—63.733

(c) Millable cane

Varieties	N1	N2	N3	N4	Mean
V1	351.0	496.67	493.67	436.67	444.50
V2	311.33	370.67	323.33	289.33	323.67
V3	276.0	358.00	350.0	305.33	322.33
V4	229.67	338.67	307.0	317.00	298.25
Mean	292.0	391.0	368.5	337.25	—

CD for comparison of varieties or nitrogen—42.91

[d] Yield

V1	191.5	295.17	295.67	278.50	265 20
V2	148.0	232.67	256.83	228.83	216.58
V3	136.83	245.5	267.50	278.67	232.13
V4	192.67	301.17	322.83	307.83	281.13
Mean	167.25	268.63	285.71	275.43	—

CD for comparison of varieties or nitrogen—37.96

[e] Sucrose percent at harvest

V1	19.48	18.22	17.75	18.45	18.48
V2	17.07	15.99	17.19	16.94	16.50
V3	16.58	16.61	15.50	16.81	16.38
V4	16.18	16.32	17.78	16.78	16.64
Mean	17.32	16.79	16.93	17.25	

CD for varietal mean—1.02

Co 997 recorded the highest germination which was on par with Co 449. Shoot count was minimum at the N_1 level. The optimum level of N for maxising shoot count was found to be 173 kg/ha.

As regards yield, the highest value was recorded by the Co 62175 which was on par with Co 997. N1 levels of nitrogen was significantly inferior to al others and the optimum levels of N worked out to 167 kg/ha.

Co 997 produced the maximum millable canes. The levels of N2 and N3 are on par and the optimum level for millable canes worked out to 162 kg/ha.

In the previous year, the plant crop Co 62175 was found to be the best and the optimum level for maximising production was 164 kg/ha. Manurial levals and varietal differences had no effect on sugar content.

The first ratoon studies also indicated that Co 62175 was the best. But the response due to levels of nitrogen was linear and hence optimum could not be worked out.

Soil application of silicate slag on the yield and juice quality of Sugacane: [Thiruvalla]

The object of the study was to ascertain the effect of silicate slag on yield and juice quality of sugarcane. Two varieties, viz. Co 997 and Co 62175 were tested at 5 levels of 0,2,4,6,8 tons/ha. The silicate slag was incorporated about a month in advance of planting.

The experiment was started in 1979 and observations on germination, shoot count, millable canes, yield and sugar percentages were recorded. The data are presented in Table 7.13.

Table 7.13: Results of soil application of silicate slag on juice quality

a) Germination percentage

Variety	T1	T2	T3	T4	T5	Mean
V1	35.57	34.97	35.88	37.61	36.41	30.09
V2	44.06	45.36	48.34	48.27	43.90	45 99
Mean	39.81	40.17	42.11	42.94	40.16	

CD (P0.05) — 7.31

The germination percentage of V2 was greater than that of V1.

(b) Shoot count (1000/ha)

Variety	T1	T2	T3	T4	T5	Mea
V1	121.48	121.43	121.16	126.23	117.40	121.6
V2	108.17	105.77	111.18	106.34	104.19	107.13
Mean	114.83	113.60	116.52	116.28	110.80	

Treatment effects are not significant.

(c) Millable cane at harvest (1000/ha)

Variety	T1	T2	T3	T4	T5	Mean
V1	100.64	79.41	111.91	97.87	107.11	99.39
V2	104.52	71.97	92.70	110.07	93.26	94.50
Mean	102.58	75.69	103.31	103.97	100.18	

CD P (0.05) Treatments – 17.28

T2 gave the lowest value which is inferior to all others which are on par.

(d) Yield

Variety	T1	T2	T3	T4	T5	Mean
V1	104.61	92.70	102.35	103.58	107.01	102.5
V2	149.30	141.68	147.92	145.33	147.59	146.37
Mean	126.96	117.19	125.13	124.46	127.30	—

(e) Pol percentage

Variety	T1	T2	T3	T4	T5	Mean
V1	16.90	16.72	17.12	17.72	17.21	17.14
V2	15.81	15.25	14.60	16.15	14.59	15.28
Mean	15.36	15.99	15.86	16.94	15.90	—

Co 62175 recorded the maximum germination %. Shoot counts did not show significant difference between treatments. With regard lo millable canes, T2 recorded the lowest value. The analysis of yield data indicated that Co 62175 was superior to Co 997, but the treatments had no effects in increasing sucrose percentage of the varieties. The experiment is being continued to study the ratoon effects.

Effect of soil amendment on yield of plant and ratoon sugarcane in acid soils- [Thiruvalla]

The object of the experiment was to find out the effect of soil amendment on yield of plant and ratoon crop of sugarcane in acid soils.

The experiment was started in 1979 with the varieties Co 997 and Co 785, the treatments being T1–No lime and T2, T3 and T4 with 50%, 100% & 150%of the lime requirements respectively.

The results of analysis are presented in Table 7.14.

Table 7.14: Effect of soil amendment on yield of plant and ratoon sugarcane in acidsoils

(a) Germiation (%)

Variety	T1	T2	T3	T4	Mean
V1	67.83	62.03	68.57	68.07	66.63
V2	68.90	64.67	60.38	57.99	62.99
Mean	68.37	63.35	64.47	63.03	

Co 997 recorded the highest germination which was on par with Co 449, Shoot count was minimum at the N_1 level. The optimum level of N for maxising shoot count was found to be 173 kg/ha.

As regards yield, the highest value was recorded by the Co 62175 which was on par with Co 997. N1 levels of nitrogen was significantly inferior to al others and the optimum levels of N worked out to 167 kg/ha.

Co 997 produced the maximum millable canes. The levels of N2 and N3 are on par and the optimum level for millable canes worked out to 162 kg/ha.

In the previous year, the plant crop Co 62175 was found to be the best and the optimum level for maximising production was 164 kg/ha. Manurial levels and varietal differences had no effect on sugar content.

The first ratoon studies also indicated that Co 62175 was the best. But the response due to levels of nitrogen was linear and hence optimum could not be worked out.

Soil application of silicate slag on the yield and juice quality of Sugacane: [Thiruvalla]

The object of the study was to ascertain the effect of silicate slag on yield and juice quality of sugarcane. Two varieties, viz. Co 997 and Co 62175 were tested at 5 levels of 0,2,4,6,8 tons/ha. The silicate slag was incorporated about a month in advance of planting.

The experiment was started in 1979 and observations on germination, shoot count, millable canes, yield and sugar percentages were recorded. The data are presented in Table 7.13.

Table 7.13: Results of soil application of silicate slag on juice quality

a) Germination percentage

Variety	T1	T2	T3	T4	T5	Mean
V1	35.57	34.97	35.88	37.61	36.41	30.09
V2	44.06	45.36	48.34	48.27	43.90	45 99
Mean	39.81	40.17	42.11	42.94	40.16	

CD (P0.05) — 7.31

The germination percentage of V2 was greater than that of Vl.

(b) Shoot count (1000/ha)

Variety	T1	T2	T3	T4	T5	Mea
V1	121.48	121.43	121.16	126.23	117.40	121.6
V2	108.17	105.77	111.18	106.34	104.19	107.1
Mean	114.83	113.60	116.52	116.28	110.80	

Treatment effects are not significant.

(c) Millable cane at harvest (1000/ha)

Variety	T1	T2	T3	T4	T5	Mean
V1	100.64	79.41	111.91	97.87	107.11	99.39
V2	104.52	71.97	92.70	110.07	93.26	94.50
Mean	102.58	75.69	103.31	103.97	100.18	

CD P (0.05) Treatments – 17.28

T2 gave the lowest value which is inferior to all others which are on par.

(d) Yield

Variety	T1	T2	T3	T4	T5	Mean
V1	104.61	92.70	102.35	103.58	107.01	102.5
V2	149.30	141.68	147.92	145.33	147.59	146.37
Mean	126.96	117.19	125.13	124.46	127.30	—

(e) Pol percentage

Variety	T1	T2	T3	T4	T5	Mean
V1	16.90	16.72	17.12	17.72	17.21	17.14
V2	15.81	15.25	14.60	16.15	14.59	15.28
Mean	15.36	15.99	15.86	16.94	15.90	—

Co 62175 recorded the maximum germination %. Shoot counts did not show significant difference between treatments. With regard lo millable canes, T2 recorded the lowest value. The analysis of yield data indicated that Co 62175 was superior to Co 997, but the treatments had no effects in increasing sucrose percentage of the varieties. The experiment is being continued to study the ratoon effects.

Effect of soil amendment on yield of plant and ratoon sugarcane in acid soils- [Thiruvalla]

The object of the experiment was to find out the effect of soil amendment on yield of plant and ratoon crop of sugarcane in acid soils.

The experiment was started in 1979 with the varieties Co 997 and Co 785, the treatments being T1–No lime, and T2, T3 and T4 with 50%, 100% & 150%of the lime requirements respectively.

The results of analysis are presented in Table 7.14.

Table 7.14: Effect of soil amendment on yield of plant and ratoon sugarcane in acid soils

(a) Germination (%)

Variety	T1	T2	T3	T4	Mean
V1	67.83	62.03	68.57	68.07	66.63
V2	68.90	64.67	60.38	57.99	62.99
Mean	68.37	63.35	64.47	63.03	

(b) Shoot count (1000/ha)

Variety	T1	T2	T3	T4	Mean
V1	128.98	127.91	125.77	126.03	126.03
V2	75 22	71.70	75.02	72.72	73.54
Mean	102.10	99.81	100.39	98.65	

(c) Millable canes (100/ha)

Variety	T1	T2	T3	T4	Mean
V1	119.48	105.26	115.60	115.96	114.08
V2	65.74	66.94	66.11	64.63	65.86
Mean	92.61	86.10	90.86	90.30	

(d) Yield (tons/ha)

Variety	T1	T2	T3	T4	Mean
V1	114.58	100.78	108.49	109.87	108.43
V2	64.21	65.69	60.97	64.17	63.76
Mean	89.39	83.24	84.73	87.02	

(e) Brix %

Variety	T1	T2	T3	T4	Mean
V1	19.14	20.28	20.33	19.48	19.81
V2	19.30	18.42	17.06	16.63	17.85
Mean	19.22	19.35	18.70	18.06	

CD for treatments—0.64.

CD for difference berween 2 sub plot means at the same level of main plot—1.10.

CD for the combination means—1.09.

(f) Pol (%)

Variety	T1	T2	T3	T4	Mean
V1	19.14	20.28	20.33	19.48	19.81
V2	19.30	18.42	17.06	16.63	17.85
Mean	19.22	19.35	18.70	18 06	—

CD for treatments—0.96.

CD for combinations—1.36.

The analysis of data on germination, shoot counts, millable canes, yield and quality revealed the following:

Application of lime had no effect on germination. In the case of shoot count, millable canes, and yield, Co 997 was superior to Co 785 and the treatments with lime had no effect on the above characters. Co 997 gave a higher value for sucrose percentage than Co 785. Treatment T1, T2 and T3 were on par. T3 and T4 were also on par recorded the lowest values.

JUTE

Observational trial on the possibilities of raising jute in Onattukara regions [Kayamkulam]

The trial was started in March 1979 at RRS Kayamkulam. Seeds of six varieties (3 from *capsularis* and 3 from *olitorius)* were sown in 100 sq m. Following were the varieties tested.

Capsularis jute	*Olitorius jute*
JRC — 321	JRO — 524
JRC — 212	JRO — 878
JRC — 7447	JRO — 7835

The data collected are presented in Table 7.15

Table 7.15: Results of observational trial on Jute

Name of variety	Date of sowing	Date of flowering	Time taken for flowering in days	Average height in cms	Average girth in cms	Date of harvest	Yield of fibre in kg/ha
JRO–7835	3–3–79	25–4–79	53	115.2	2.4	16–7–79	860
JRO– 878	3–3–79	15–5–79	73	151.0	2.6	16–7–79	890
JRO– 524	3–3–79	25–4–79	53	226.5	3.5	16–7–79	1065
JRO–212	8–3–79	12–5–79	70	175.4	5.9	16–7–79	1270
JRC–7447	3–3–79	15–5–79	73	16R.0	3.5	16–7–79	900
JRC– 321	3–3–79	20–4–79	48	140.0	2.6	22–6–79	940

The results indicated that *capsularis* jute had better adaptability than *olitorius* jute. Among the *capsularis* sp JRC 321 was found to flower very early and to set seed profusely. The seeds collected during rainy season lost viabilityy immedietely after harvest. For seed production, the crop had to be raised during Feb.—March.

Observational trial on variety-cum-date of sowing with capsularis and olitorius jute [Moncompu]

The trial was laid out to find out the performance of different standard varieties at different dates of sowing with *capsularis* and *olitorius* jute. The trial was started in March '79 with 6 varieties and four sowing dates as follows:

Dates of sowing	*Varieties*
D1 — 13–3–79	V1 — JRC 321
D2 — 20–3–79	V2 — JRO 212
D3 — 27–3–79	V3 — JRO 7447
D4 — 3–4–79	V4 — JRO 7838
	V5 — JRO 879
	V6 — JRO 524

The germination and growth of *capsularis* jute were better than *olitorius* jute. Data on the time taken for flowering, average height in cm, average girth in cms and yield of fiber recorded, are presented in Table 7.16.

Table 7.16 Results of observational trial on jute

Name of variety		Date of sowing	Date of folow-ering	Time taken for flow-ering (in days)	Average height in cm	Average girth in cm	Date of harvest	Yield of fibre/ha (kg)
V1	D1	13-3-79	10-5-79	58	152.4	2.0	17-7-79	651
V2	D1	13-3-79	25-5-79	73	148.8	2.5	23-7-79	697
V3	D1	13-3-79	26-5-79	74	175.0	1.8	17-7-79	696
V4	D1	13-3-79	14-5-79	62	70 1	1.5	23-7-79	—
V5	D1	13-3-79	24-5-79	72	87.0	1.7	23-7-79	—
V6	D1	13-3-79	25-5-79	73	89.6	1.6	17-7-79	—
V1	D2	20-3-79	14-5-79	62	149.0	1.66	7-7-79	590
V2	D2	20-3-79	1-6-79	79	150.0	3.30	23-7-79	768
V3	D2	20-3-79	2-6-79	80	172.4	2.70	28-7-79	999
V4	D2	20-3-79	20-5-79	63	149.8	2.0	17-7-79	—
V5	D2	20-3-79	2-6-79	80	102.0	1.9	23-7-79	—
V6	D2	20-3-79	28-5-79	76	96.0	1.7	17-7-79	—
V1	D3	27-3-79	21-5-79	69	180.0	2.62	17-7-79	783
V2	D3	27-3-79	7-6-79	86	195 6	2.80	23-7-69	1004
V3	D3	27-3-79	5-6-79	83	212.0	3.40	23-7-79	8138
V4	D3	27-3-79	20-6-79	74	89.0	1.30	17-7-19	—
V5	D3	27-3-79	8-6-79	86	92.0	1.50	23-7-79	—
V6	D3	27-3-79	1-6-79	79	120.8	1.90	17-7-79	—
V1	D4	3-4-79	25-5-79	73	128.0	2.1	17-7-79	802
V2	D4	3-4-79	15-6-79	94	201.0	3 5	23-7-79	975
V3	D4	3-4-79	9-6-79	87	207.0	3.04	23-7-79	993
V4	D4	3-4-79	9-6-79	87	96.0	1.30	23-7-79	—
V5	D4	3-4-79	15-6-79	94	88.6	1.30	23-7-79	—
V6	D4	3-4-79	7-6-79	86	104.0	1.70	23-7-79	—

Remarks: Yield data of V4, V5 and V6 were not collected since the growth of the crop were poor and population scanty.

Exploring the possiblities of cultivating mesta as a fibre crop in the pineapple growing regions: [Punalur]

The trial was laid with the objectives of finding out the possibilities of cultivating mesta as an intercrop in pineapple areas.

Two varieties, viz. AMV-1 and HS 4288 were cultivated in an area of 500m on two sowing dates on 10-5-79 and 1-6-79 at the Chithalvetty farm of the State Farming Corporation. The growth of the May sown crop was better than June sown crop.

The results obtained are presented in Table 8 16.

Table 8.16: Performance of mesta varieties

Variety	Population	Height (m)	girth (cm)	Date of sowing	Date of harvest	Yield ha.
AMV-1	20	3.4	5.6	10-5-79	27-10-79	4280 kg
HS 4288	20	2.8	5.2	10-5-79	27-10-79	3230 kg

The results were quite promising

8. Essential Oil Crop and Medicinal Plants

HIGHLIGHTS

The vetiver varieties ODV-12, ODV-13, ODV-23 and ODV-3 were least affected by the leaf blight caused by *Heiminthosporium*. In lemongrass, 95% oil was recovered in 1½ hours at 15 lb/sq. in. pressure and 99% at 25 lb pressure. A medicinal plants herbarium was established in the College of Horticulture, Vellanikkara. Maximum herbage yield in palmarosa was obtained under the treatment with 80kg N, 40kg P_2O_5 and 40kg K_2O/ha.

SUMMARY

In comparative yield trials, the palmarosa variety ODP–2 was found to be superior to ODP–1.

Attempts for developing high yielding palmarosa varieties by mutation breeding were continued.

In comparative yield trials involving lemongrass varieties, OD-410 gave maximum oil yield but the citral content of oil in this variety was relatively less.

Performance studies of irradiated lemongrass slips were continued and the line No. 8 from 2.5 krad irradiated stock gave the maximum yield.

Adaptability studies of Northern India vetiver varieties indicated that the varieties ODV–12, ODV–13, ODV–23 and ODV–3 were least affected by the *Helminthosporium* blight.

Studies on uptake of nutrients by lemongrass were continued.

In a manurial trial with palmarosa, maximum herbage yield was obtained under the treatment with 80kg N, 40kg P and 40kg K_2O/ha.

Studies on the fungal parasites of lemongrass were continued.

The recovery of essential oil from vetiver with solvents was found to be too low.

In lemongrass, 95% oil was recorded in 1½ hours at 15 lb/sq. in pressure.

Studies on the manurial requirements of *Dioscorea floribunda* were continued.

A medicinal plants herbarium was established in the College of Horticulture, Vellanikkara.

PROJECTS IMPLEMENTED

		Locations
1	Varietal trial of Palmarosa	Odakkali
2	Performance studies of the MV2 generation of the irradiated selection of palmarosa (Ag. 11.16. Bot. 1)	Odakkali
3	Induction of mutation and polyploidy in lemon-grass (Ag. 11 (a) 16 Bot. 1.01)	Vellayani
4	Comparative yield trial of promising types of lemongrass collections with OD-19 (Ag. 11.16 Bot. (1)	Odakkali
5	Performance studies of the MV1, V2 rradiated lemongrass slips and some superior type of lemongrass from germplasm with OD-19.	Odakkali
6	Adaptability studies on North Indian Vetiver hybrids.	Odakkali
7	Studies on the uptake of nutrients by lemon-grass (Ag. 11 Chem-1.02)	Odakkali
8	Varietal-cum-manurial trial on lemongrass (Ag. 11.16. Bot.6)	Multilocational
9	NPK trial on palmarosa	Multilocational
10	Studies on the fungal parasites of lemongrass (Ag. 11 (1) 18 Path. 1.01)	Vellayani
11	Feasibility of solvent extraction of essential oil from vetiver	Vellanikkara
12	Effect of time and pressure of steam in the distillation of essential oil yielding plant parts	Odakkali
13	Studies on the medicinal plant parts *Dioscorea floribunda*	Multilocational
14	Germplasm collections of medicinal plants	Vellanikkara

Varietal trial of pamlarosa [Odakkali]

In order to find out the best variety of palmarosa with better oil yield and geraniol content, a trial was conducted with the varieties ODP 1 and ODP 2. Observations on plant height, inflorescence length, tiller count. grass yield, oil yield and geraniol percentage were recorded. The data on grass yield and oil yield are presented in Table 8.1.

Table 8.1: Yield of grass and recovery of oil from palmarosa varieties

Grass yield in kg		Oil yield (ml)	Geraniol (%)
ODP-2	214.14	398.53	92
ODP-1	247.19	289.69	86

The variety ODP-2 was found to be superior to ODP-1 with regard to oil yield and percentage of recovery of oil. In the previous year also ODP-2 had recorded the highest oil yield.

Performance studies of the MV-2 generation of the irradiated selection of palmarosa Ag. 11.16 Bot. 1 [Odakkali]

To develop a high yielding variety of palmarosa by mutation breeding the selected line numbers III and IV (under 2 K-rad) and the line numbers XVIII and XX (under 8 K-rad) were further multiplied vegetatively. The performance of these with ODP-1 and ODP-2 were evaluated. The experiments were in progress.

Induction of mutation and polyploidy in lemongrass Ag. 11 (a) 16 Bot. 1 1.01 [Vellayani]

The project was in progress.

Compararive yield trial of promissing types of lemongrass collections with OD-19- Ag. 11.16 Bot. (1) [Odakkali]

To find out the comparative merits of the promising types of lemongrass screened out through PYT and OD-19, OD-56, OD-106, OD-370, OD-406, OD-410, OD-417 and OD-19, this project was taken up.

Data on grass yield, oil out turn and citral content of oil were recorded (Table 8.2).

Table 8.2: Grass yield, oil out turn and citral content of oil in lemongrass varieties

Treatments	Grass yield in kg	Oil yield in ml	Citral% (Mean)
T_1	41.4	44.8	77.7
T_2	27.9	49.6	81.5
T_3	27.1	43.7	66.5
T	16.8	50.0	75.3
T_5	39.4	78.8	66.0
T	35.7	52.0	63.3
T7 (OD-19) Check	29.9	62.0	84.0

The data indicated that the variety OD-410 gave maximum oil yield. But, citral content of oil in this variety was relatively less. Herbage yield was maximum in the variety OD-56. The highest citral content was recorded in thevariety OD-19

Performance studies of the MV1, V2 irradiated lemongrass slips and some superior types of lemongrass from germplasm, with OD-19 [Odakkali]

The object of the project was to develop a high yielding variety of lemongrass superior to OD-19 by mutation breeding. The three selected M2 lines were planted in the field with OD-19 for evaluating their comparative performance. During the period, three harvests and distillations were done. The data on grass yield, oil yield, citral content are furnished in Table 8.3.

Table 8.3: Grass yield, oil yield and citral percentage of iradiated lemongrass lines

Treatments	Grass yield in kg	Oil yield in ml	Citral content (%)
Line 15 (1.5krad)	5.68	24.2	89.0
Line 9 (18 Krad)	6.55	30.8	85.5
Line 1 (6.0 Krad)	5.50	15.3	86 0
Line 8 (2.5 Krad)	12.85	31.1	87.0

Table 7.16 Results of observational trial on jute

Name of variety		Date of sowing	Date of folow-ering	Time taken for flow-ering (in days)	Average height in cm	Average girth in cm	Date of harvest	Yield of fibre/ha (kg)
V1	D1	13-3-79	10-5-79	58	152.4	2.0	17-7-79	651
V2	D1	13-3-79	25-5-79	73	148.8	2.5	23-7-79	697
V3	D1	13-3-79	26-5-79	74	175.0	1.8	17-7-79	696
V4	D1	13-3-79	14-5-79	62	70 1	1.5	23-7-79	—
V5	D1	13-3-79	24-5-79	72	87.0	1.7	23-7-79	—
V6	D1	13-3-79	25-5-79	73	89.6	1.6	17-7-79	—
V1	D2	20-3-79	14-5-79	62	149.0	1.66	7-7-79	590
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V1	D3	27-3-79	21-5-79	69	180.0	2.62	17-7-79	783
V2	D3	27-3-79	7-6-79	86	195.6	2.80	23-7-69	1004
V3	D3	27-3-79	5-6-79	83	212.0	3.40	23-7-79	8138
V4	D3	27-3-79	20-6-79	74	89.0	1.30	17-7-19	—
V5	D3	27-3-79	8-6-79	86	92,0	1.50	23-7-79	—
V6	D3	27-3-79	1-6-79	79	120.8	1.90	17-7-79	—
V1	D4	3-4-79	25-5-79	73	128.0	2.1	17-7-79	802
V2	D4	3-4-79	15-6-79	94	201.0	3.5	23-7-79	975
V3	D4	3-4-79	9-6-79	87	207.0	3.04	23-7-79	993
V4	D4	3-4-79	9-6-79	87	96.0	1.30	23-7-79	—
V5	D4	3-4-79	15-6-79	94	88.6	1.30	23-7-79	—
V6	D4	3-4-79	7-6-79	86	104.0	1.70	23-7-79	—

Remarks: Yield data of V4, V5 and V6 were not collected since the growth of the crop were poor and population scanty.

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Varietal trial of pamlarosa [Odakkali]

In order to find out the best variety of palmarosa with better oil yield and geraniol content, a trial was conducted with the varieties ODP 1 and ODP 2. Observations on plant height, inflorescence length, tiller count. grass yield, oil yield and geraniol percentage were recorded. The data on grass yield and oil yield are presented in Table 8.1.

Table 8.1: Yield of grass and recovery of oil from palmarosa varieties

Grass yield in kg		Oil yield (ml)	Geraniol (%)
ODP-2	214.14	398.53	92
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The variety ODP-2 was found to be superior to ODP-1 with regard to oil yield and percentage of recovery of oil. In the previous year also ODP-2 had recorded the highest oil yield.

Performance studies of the MV–2 generation of the irradiated selection of palmarosa Ag. 11.16 Bot. 1 [Odakkali]

To develop a high yielding variety of palmarosa by mutation breeding the selected line numbers III and IV (under 2 K–rad) and the line numbers XVIII and XX (under 8 K–rad) were further multiplied vegetatively. The performance of these with ODP–1 and ODP–2 were evaluated. The experiments were in progress.

Induction of mutation and polyploidy in lemongrass Ag. 11 (a) 16 Bot. 1 1.01 [Vellayani]

The project was in progress.

Comparative yield trial of promissing types of lemongrass collections with OD–19– Ag. 11.16 Bot. (1) [Odakkali]

To find out the comparative merits of the promising types of lemongrass screened out through PYT and OD–19, OD–56, OD–106, OD–370, OD–406, OD–410, OD–417 and OD–19, this project was taken up.

Data on grass yield, oil out turn and citral content of oil were recorded (Table 8.2).

Table 8.2: Grass yield, oil out turn and citral content of oil in lemongrass varieties

Treatments	Grass yield in kg	Oil yield in ml	Citral% (Mean)
T_1	41.4	44.8	77.7
T_2	27.9	49.6	81.5
T_4	27.1	43.7	66.5
T	16.8	50.0	75.3
T_6	39.4	78.8	66.0
T	35.7	52.0	63.3
T7 (OD–19) Check	29.9	62.0	84.0

The data indicated that the variety OD-410 gave maximum oil yield. But, citral content of oil in this variety was relatively less. Herbage yield was maximum in the variety OD-56. The highest citral content was recorded in thevariety OD–19

Performance studies of the MVI, V2 irradiated lemongrass slips and some superior types of lemongrass from germplasm, with OD–19 [Odakkali]

The object of the project was to develop a high yielding variety of lemongrass superior to OD–19 by mutation breeding. The three selected M2 lines were planted in the field with OD–19 for evaluating their comparative performance. During the period, three harvests and distillations were done. The data on grass yield, oil yield, citral content are furnished in Table 8.3.

Table 8.3: Grass yield, oil yield and citral percentage of iradiated lemongrass lines

Treatments	Grass yield in kg	Oil yield in ml	Citral content (%)
Line 15 (1.5krad)	5.68	24.2	89.0
Line 9 (18 Krad)	6.55	30.8	85.5
Line 1 (6.0 Krad)	5.50	15.3	86 0
Line 8 (2.5 Krad)	12.85	31.1	87.0

The line No. 8 (2.5 K-rad) gave maximum yield of grass and oil out turn. But, citral percentage was found to be maximum in the line No. 15 (1.5 Krad).

Adaptability studies on north Indian vetiver hybrids [Odakkali]

With a view to evolve high yielding variety of vetiver with better root and oil yield, this project was taken up during the year. The varieties tried were ODV–12 to 23 and ODV-3. The hybrid varieties ODV–14 and ODV-15 were found to be highly susceptible to the leaf blight (*Helminthosporium*) disease The varieties ODV–12, ODV–13 and ODV–23 were least affected by the disease.

Studies on the uptake of nutriants by lemongrass Ag. 11 Chem. 1–02 [Odakkali]

The studies were initiated to ascertain the uptake of nutrients by lemongrass. The soil was analysed before planting for the total and available N, P and K. Fertilizers to supply N, P, K at 100, 70, 100kg/ha were applied. During the year, five harvests were made and the plant samples were distilled for estimating oil contents.

Varietal-cum-manurial trial on lemongrass Ag. 11.16. Bot. 6 [Multilocational]

To find out the comparative performance of OD–19. SD-68 and RRL–16 varieties of lemongrass under three levels of N (0, 50, 100kg N/ha), studies were taken up. Data on grass yield, oil yield and citral % of oil are furnished in Table 8.4.

Table 8,4: Performance of lemongrass va.ieties

Treatments	Grass yield in kg	Oil yield in ml	Mean citral %
V_1N_0	78.7	345.9	77.8
V_1N_1	72.4	394 9	75.9
V_1N_2	86.6	435.7	76.7
V_2N_0	130.3	367.4	81.4
V_2N_1	165.4	593.2	82.6
V_2N_2	213.1	745.5	81.5
V_3N_0	149.5	485.9	80.9
V_3N_1	184.0	545.9	80.4
V_3N_2	188.4	575.5	81.6

V_1-RRL–16 N_0-O Kg N/ha
V_2–SD–68 N_2,50 N/ha
V_3-OD-19 N_2 100 Kg N/ha

Under 100 kg N/ha, the variety SD-68 recorded the highest grass and oil yield. During last year also this variety gave the highest yield. With regard to citral content, SD-68 ranked first: The effect of levels of nitrogen on citral % was not significant. The performance of OD-19 was relatively better in treatments in which application of fertilisers were withheld.

NPK trial on palmarosa [Multilocational]

In order to find out the best combination of NPK for getting maximum yield of grass and oil, this experiment was conducted with 12 treatment combinations involving three levels of N, (0,40,80 kg N/ha), two levels of P (0,40 kg P_2O_5/ha

and two levels of K (0.40 kg K_2O/ha). The treatment no. 12 ($N_3P_2K_2$) gave the the maximum oil yield, but the grass yield was maximum in the treatment T_2 (Table 8.5).

During the previous year the yield trends were different and it was the treatment N_2P_2KO which gave the highest grass and oil yield.

Table 8.5: Response of palmarosa to NPK fertilization

Treatments	Grass yield in kg	Oil yield in ml
NO PO KO	63.45	55.4
NO PO K1	74.37	95.3
NO P1 K1	68.50	89.3
NO P1 K1	64.29	97.5
N1 PO KO	59.12	50.3
N1 P1 K1	56.39	53.4
N1 P1 KO	72.52	66.4
N1 P1 K1	55.87	54.5
N2 PO KO	52.05	58.8
N2 PO K1	69.95	100.4
N2 P1 KO	44.48	42.5
N 2 P1 K1	66.00	108.1

Studies on the fungal parasites of lemongrass Ag. 11 (1) 18/16 Path. 1.01 [Vellayani]

This project was in progress during the year.

Feasibility of solvent extraction of essential oil from Vetiver [Vellanikkara]

A pilot study was conducted on the possibility employing solvents for the extraction of essential oil from vetiver. It was found that even after prolonged extraction in a soxhlet apparatus, the recovery of oleoresin was very low. The oleoresin obtained after the recovery of the solvent was very viscous and contained very little essential oil It was, therefore, concluded that solvent extraction cannot be employed as an alternative to the steam distillation for the extraction of essential oil from vetiver.

Effect of time and pressure of steam on the distillation of essential oils yielding plant parts

To standardise the pressure of steam distillation of essential oils, the project was taken up. The treatments included 4 levels of time 3/4 hr, 1 hr, 1¼ hr, 1½ hour) and 4 levels pressure (10, 15, 20 and 25 lb/sq. in.) for lemongrass. The data are given in Table 8.6.

Table 8.6 Effect of pressure of steam and duration of distillation on the recovery of lemongrass oil

Pressure	Oil yield in ml. 3/4hour	1 hour	1¼ hour	1½ hour	Total
25 lb/sq. inch	203	17.2	9.0	2.8	262.0
20 ,,	208	16.2	14.7	5.9	243.6
15 ,,	192	27.4	18 4	10.8	248.1
10 ,,	172	25.2	21.3	19.9	238.4

In lemongrass, 95% of oil was extracted in 1½ hours at 15 lb pressure and 99% oil at 25 lb pressure. The experiments for cinnamon oil extraction were not taken up during the year.

Studies on the medicinal plant Dioscorea floribunda [Multilocational]

To find out the oprimum size of *D. floribunda* tubers for planting and to ascertain the optimum manurial requirements of the crop, studies were initiated during the year. The treatments involved 3 sizes of tubers (50, 75 and 100g) and three spacings (60 x 30 cm, 60 x 45 cm, 68 x 60 cm). In the manurial trial, there were 3 treatments of 50, 75 and 100 kg N/ha applied over a common basal dressing of FYM 10 tons and P_2O_5 at 50 kg /ha and K_2O at 75 kg/ha.

The trial on size of tubers was laid out in July 1979. The crown portions were not available for planting and hence the medium portion was used. The sprouting was found to be poor.

The spacing trial was laid out in July 1979. The medium and top portions were used as planting materials. The germination was very poor. Tubers were damaged due to heavy rains. The experiments could not, therefore, be continued.

Germplasm collections of medicinal plants [Vellanikkara]

During the year, a living herbarium was established in the College of Horticulture, Vellanikkara. The accessions included the following plants.

Azadirachta indica, Adhatoda zeylanica. Rauvolfia serpentina, Justicia gendarussa, Ocimum basilicum, Acalypha fruticosa, Commiphera caudata, Asparagus gonocladus, Rauvolfia canescens, Clifonia ternata. Catheranthus roseus, Cardiospe.mum halicabum, Solanum macranthum, Emblica officinalis. Tinospora crodefolia, Holostemma annulare, Plumbago rosea, Pongamia pinnata, Cocinia grandis, Puseudothria viscida, Dioscorea bullifera, Dioscorea floribunda, Cle;odendron inerema, Alpinia galanga, Naregamia alata, Ricinus communis, Vietex negundo, Sida spinosa, Aegle marmelos, Cissus guadrangularis, Sida rhombifolia Naravelia zeylanica, Strobilanthus sp., Eebolium viride, Zingiber officinalis,

9. Fodder Crops

HIGHLIGHTS:

Guinea grass variety Mackuenii was found to be suitable to Kerala conditions. *Stylosanthes gracilis* (perennial) was rated as the best among the soil conservation-cum-forage crops tried in coconut gardens. Among the dinanath grass varieties, PP-15 was found to give maximum herbage yield. The cowpea variety HFC 42-1 gave maximum green fodder yield. The sorghum variety JS-3 was outstanding in fodder production. Guinea grass was found to be superior to napier grass under partially shaded and open conditions. Dinanath grass variety PP-15 responded to 150 kg N/ha and 700 kg lime/ha. *Stylosanthes gracilis* had responded to the application of 120 kg P_2O_5/ha. Intercropping legumes significantly increased the fodder yield of grasses grown in association. Grasses grown with *Stylosanthes* produced the maximum total grass fodder yield of 37.69 tons/ha. The sweet potato variety Kottaramchuvala was found to be ideal as a fodder-cum-tuber crop. Application of 60 kg N/ha gave 10.72 tons/ha of fodder and 6.69 tons/ha of tuber. Application of 80 kg P_2O_5/ha to soil and 40 kg P_2O_5/ha as foliar and leaving the crop after two cuts was found to be advantageous to obtain maximum seed production in *Stylosanthes*. Growing rice-bean in the inter-row spaces of hybrid napier has increased the grass yield. This crop mixture reqnires 60 kg N/ha for optimum forage production. Koobabool + guinea grass + velvet bean combination was identified as the best silvipastural combination for the coconut gardens.

SUMMARY

Attempts for the development of improved varieties of guinea grass by mutation breeding were continued. The M_3V_2 progenies from irradiated stock were screened and 10 high yielding clumps were selected. The clone 10-1 gave the maximum herbage yield among the selected lines.

In evaluation of maize varieties, NLD-composite gave the maximum green fodder yield of 15.12 tons/ha.

In a project on the evaluation of indigenous and exotic forage crops, Mackuenii was identified as the most promising among the 31 varieties tried. The superior types of forage grasses identified were Kazungula (*Setaria anceps*) and Congo signal (*Brachiaria ruziziensis*).

The leguminous fodder tree koobabool was found to be ideally suited for silvipasturing in cocount plantations.

Among the sorghum varieties evaluated, JS-3 gave the maximum green fodder yield of 34.70 tons/ha.

The cowpea variety HFC–42–1 gave the highest fodder yield of 10.48 t/ha.

Comparative performance of guinea grass and hybrid napier in the coconut gardens and in the open under identical management practices was evaluated and guinea grass was found to be more promising

Three dinanath grass varieties were evaluated at 3 levels of nitrogen and 3 levels of lime and significant increase in fodder yield at increasing levels of nitrogen up to 150 kg/ha was registered.

The effect of phospho.us on green matter yield of *Stylosanthes gracilis* was significant and the yield obtained at 120 kg P_2O_5/ha was superior to all the other levels.

Intercropping legumes significantly increased the green fodder yield of grasses. Grasses mixed with *Stylosanthes* produced the maximum total green fodder yield of 37.69 tons/ha. *Centrosema* – grass mixture was found to be equally good.

Among the sweet potato varieties evaluated for fodder production potential, the local variety Kottaramchuvala was found to be the promising.

Soil application of 80 kg P_2O_5/ha followed by 40 kg P_2O_5 as foliar gave the maximum seed yield of 81.43 kg/ha in *Stylosanthes gracilis*.

The optimum row spacings of hybrid napier for accomodating legumes were found to be 100 and 150 cm. Green matter yield from hybrid napier was significantly increased in the presence of rice bean.

Koobabool - guinea grass - velvet bean and *Sesbania grandiflora*–guinea grass - velvet bean combinations were found to be suitable for silvipasturing in coconut plantations.

In koobabool, maximum fodder yield of 1388.87 kg/ha was obtained under spacing of 1.5 m x 20 cm.

Studies on the effect of row spacing and levels of phosphorus on the growth, yield and quality of *Sesbania aegyptica* were not conclusive.

PROJECTS IMPLEMENTED

		Locations
1	Induction of mutation in guinea grass (Ag. 14.18 Breed 2.01)	Vellayani
2	Final evaluation trial on 13 dinanath varieties (Ag. 14.18. Bot. 1.01)	Vellayani
3	Field evaluation trial on maize (Ag. 14.18. Bot. 2.01)	Vellayani
4	Collection and evaluation of indigenous and exotic varieties of forage crops (Ag. 14.18. Bot. 2.01)	Vellayani
5	Final evaluation trial on sorghum (Ag. 14.18. Bot. 1.01)	Vellayani
6	Final evaluation trial on 13 cowpea varieties	Vellayani
7	Comparative performance of guinea grass and hybrid napier in coconut gardens and in the open under varying levels of nitrogen (Ag. 14.18 Bot. 2.01)	Vellayani
8	Performance of dinanath grass as influenced by nitrogen and lime under Kerala conditions (Ag. 14.18 Agron 1.01)	Vellayani
9	Phosphorus nutrition in *Stylosanthes gracilis* (Ag. 14.18 Agron 1.01)	Vellayani
10	Fodder production potential of grass-legume mixtures (Ag. 14.18 Agron 1.07)	Vellayani
11	Fodder production potential of sweet potato under varying levels of nitrogen	Vellayani
12	Seed production potential of *Stylosanthes gracilis* (Ag. 14.18. Agron 1.08)	Vellayani
13	Effect of nitrogen and row spacings on the yield and quality of hybrid napier grown with and without legumes (Ag. 14.18 Agron. 1 01)	Vellayani
14	Evaluation of production potential of grass-legumes under varying combinations with forage trees (Ag. 14.18. Bot. 1.01)	Vellayani
15	Effect of plant population on the yield and quality of Koobabool	Vellayani
16	Effect of row spacing and levels of phosphorus on the growth yield and quality of *Sesbania aegyptica*	Vellayani

Breeding improved varieties of forage corps - Mutation breeding in guinea grass Ag. 14.18. Bot. 2.01. [Vellayani]

The experiment was started during the year 1977–78 with the objective of breeding improved varieties of forage crops suitable for Kerala. Based on evaluation of 15 $M1V_3$ progenies and the control (Mackuenii), 10 high yielding clumps were selected along with a non-flowering mutant and these 11 selected clones were tried in a field experiment. The mean data on green fodder yield of 4 cuttings during the year, height and tiller counts of the 12 treatments are given in Table 9.1.

Table 9.1 : Performance of guinea grass mutants

Treatments	Green fodder g/hill/cut	Height (*) cm	Tiller (*) count
(Control)	1253	55.10	42.80
(Clone 3-17)	1480	56.92	53.15
(Clone 10–12)	999	56.04	45.20
(„ 11–11)	916	56.55	47.10
(„ 12–10)	1376	55.80	51.41
(„ 13-17)	1504	58.99	46.10
(„ 14-10)	1304	56.20	45.37
(„ 14-14)	1470	54.76	43.94
(„ 15-11)	1252	45.55	44.10
(„ 16–19)	1216	55.65	46.52
(„ 16-1)	1300	56.46	48.87
(„ 10-1)	1794	59.90	57.70

* The height and tiller counts were taken on the 6th month of planting.

The clone no. 10-1 gave maximum yield which was 40% more than the control variety.

Final evaluation trial on 13 dinanth grass varieties Ag. 14.18. Bot. 1.01 [Vellayani]

Table 9.2 : Fodder yield and leaf/stem ratio of dinanath grass

(Varieties)	Green fodder yield (t/ha)	Dry fodder yield (t/ha)	Leaf stem/ ratio
IGFRI-852	10.48	3.64	0.40
„ 860	9.87	2.91	0.76
„ 866	11.41	3.41	0.40
„ 869	10.18	2.47	0.36
„ 870	15.42	4.54	0.46
„ 3808	11.10	3.47	0.53
„ 32–1	8.02	2.95	0.66
„ 43–1	10.68	3.08	0.47
PP–3	10.68	3.14	0.60
PP–5	11.10	2.94	0.74
PP–15	18·50	5.67	0.48
PP–38	11.72	2.94	0.53
JP–12	12.33	3.69	0.67
CD (P=0.05)	4.945	NS	NS

The objective of the experiment was to evaluate the performance of 13 varieties of dinanath grass. The different varieties collected were experimented under a uniform basal dose of 120:50:20 kg/ha of NPK. The data collected from one harvest on the yield and yield attributes are presented in Table 9.2.

The varieties were found to differ significantly with respect to green fodder yield. The maximum green matter yield (18.5 t/ha) and dry matter yield (5.67 t/ha) were recorded by PP-15 within a period of 3 months. This was followed by IGFRI-870.

Final evaluation trial on maize- Ag. 14.18 Bot. 2.01 [Vellayani]

The experiment was laid out to evaluate the performance of 10 varieties of maize collected from different locations in India. The varieties were given a uniform dose of 120:60:40 kg/ha of NPK and fodder production was evaluated at the milk stage. Data collected on various characters are given on Table 9.3.

Table 9.3: Fodder yield and growth attributes of maize

Varieties	Height (cm)	Green matter (t/ha)	Dry matter (t/ha)	Leaf/stem ratio
Vikram	104.50	14.22	4.97	0.67
Ganga-5	133.10	14.10	5.45	0.65
EH.400/75	154.73	12.96	4.67	0 47
Kissan	125.93	13.57	4.55	0.38
Vijay	146.30	14.81	5.07	0.40
Sona Recon	117.13	13.27	4.17	0.40
Ganga-2	137.43	15.12	5.50	0.38
NLD	139.96	15.43	5.25	0.36
Moti	133.00	14.83	5.37	0.38
J-54	123.00	12.36	4.01	0.48
	NS	NS	NS	NS

The varieties did not differ significantly in any of the characters studied. However, maximum green fodder yield of 15.4 tons/ha was recorded by NLD-Composite followed by Ganga-2 (15.12 tons/ha).

Collection and Evaluation of indigenous and exotic varieties of forage crops- Ag. 14. 18. Bot. 2.01 [Vellayani]

Guinea grass (*Panicum maximum*): Thirty one types were evaluated and 3 clones, i. e., FR-599, FR-600 and Mackuenii were found superior. Mackuenil was identified as the best among these three types.

Setaria grass (*Setaria anceps*): Among the cultivars studied Kazungula was found to be best both in open and in cocount garden conditions.

Congo signal (*Brachiaria ruziziensis*): This was identified as the best grass for soil conservation purposes. This had drought resistance and shade tolerance.

Signal grass (*Brachiaria brizantha*): Its performance under open and coconut garden condition was under evaluation.

Hybrid napier: The strains were found to be extremely susceptible to drought and the regeneration was unsatisfactory.

Cowpea: The variety C–152 was found to be the best with an average herbage yield of 20 t/ha.

Stylosanthes: Perennial (*S. gracilis*) and annuals (*S. humilis*) were tried and both were coming up well.

Koobabool: This leguminous fodder tree was found to be ideally suited for silvipasture under coconut garden conditions.

Siratro *Macroptirium attropurpureum:* This is a leguminous fodder having good potential for fodder production.

Sweet potato: The locally available materials were evaluated and variety Kottaram chuvala was found to be the best.

Legumes: Some of the leguminous crops tried were rice bean (*Phaseolus calcaratus* and velvet bean (*Styzolobium deeringianum*). They were found to give good yields during 1st crop season.

Final evaluation trial on sorghum– Ag. 14.18. Bot. 1.01 [Vellayani]

The objective of the experiment was to evaluate the performance of sorghum varieties.

Seven cultivars of sorghum were evaluated under a uniform dose of 60:40:20 kg/ha of NPK as basal. The crop was harvested after flowering stage. The green fodder yield are given in Table 9.4.

Table 9.4: Green fodder yield of sorghum varieties

Vatieties	Green fodder yield (t/ha)
MP–Chari–1	13.58
MP–Chari–2	8.33
MPKV–1	32.50
JS–20	17.70
S-1049	20.00
JS-3	34.79
A1–14–8	17.29
CD (P=0.05)	4.34

Variety JS-3 gave the maximum green fodder yield of 34.70 t/ha which was significantly superior to all other varieties and on par with MPKV-1.

Final evaluation trial on 13 cowpea varieties [Vellayani]

The experiment was taken up to ascertain the fodder production potential of cowpea varieties.

The cowpea varieties collected from different locations in India were evaluated under a uniform dose of 40:30:30 kg NPK/ha. The crop was harvested at the flowering stage. Data collected on fodder yield and leaf–stem ratio are given in Table 9.5.

Table 9.5: Fodder yield and leaf/stem ratio of cowpea varieties

(varieties)	Green fodder yield (t/ha)	Dry fodder yield (t/ha)	Leaf/stem ratio
UPC–42	9.67	1.78	0.51
UPC–287	8.02	1.33	0.65
UPC-5286	7.40	1.24	1.00
UPC–9020	9.26	1.63	0.75
UPC–9805	4.93	0.81	0.73
Russian Giant	4.32	0.89	1.19
HFC–42–1	10.48	1.59	0'50
C–26	8.63	1.74	0.50
C–30	8.63	1.53	1.67
C-21	6.78	1.27	1.04
MPKV–1	9.87	1.42	1.04
C–14	9.87	1.64	0.46
C–25	3.70	0.59	1.09
CD (P-0.05)	1.27	NS	NS

Varieties differed significiantly in green fodder field. The maximum green fodder yield of 10.48 t/ha was recorded by the variety HFC–42–1.

Comparative performance of guinea grass and hybrid napier in coconut garden and in the open, under varying levels of N and cutting intervals. Ag 14.18 Bot 2.01 [Vellayani]

The experiment was laid out during the year 1976-77 with an objective of finding out the fodder production potential of guinea grass and hybrid napier, as an intercrop in coconut garden and as a pure crop under identical

Table 9.6 ; Yield of green fodder (t/ha) for rhe grasses grown in open and coconut gardens

Treatment	open			Coconut garden		
	I year	II year	Mean	I year	II year	Mean
Varieties						
Guinea grass	73.00	47.58	60.29	57.64	31.30	44.47
Hybrid–Napier	56.00	32.48	44 24	48.11	20.42	34.26
Levels of N						
150 kg N/ha	60.86	32.66	46.76	51.23	24.46	37.84
200 ,,	65.56	42.40	53.98	53.99	26 03	39.99
250 ..	67.24	44.91	56.07	53.41	27.21	40.31
Intervals of harvest						
30 days	63 27	36.76	50.01	50.66	22.01	36.33
45 days	65.83	43.21	54.52	55.08	29.81	42.44

management practices. Two grass varieties, 3 levels of nitrogen and 2 cutting intervals constituted the treatment combinations. The results obtained during the year 1979–80 are presented in Table 9.6 .

In both the conditions, guinea grass was superier to hybrid napier with respect to green matter production. Regarding the effect of nitrogen, a progressive increase in yield of green fodder up to 250 kg N/ha was obtained. With respect to cutting intervals, longer interval of 45 days was superior to 30 days.

Performance dinanath grass as influenced by N and lime under Kerala conditions. Ag 14.18 Agron 1.01 [Vellayani]

The experiment was laid out with 27 treatment combinations, (3 varieties, viz., Pusa–1, PP–15, JP–12, 3 levels of N–50, 100, 150 kg/ha and 3 levels of lime – no lime, 375, 750 kg/ha. The results of the experiment are given in Table 9.7.

Table 9.7: Green fodder yield of dinanath grass as influenced by different levels of lime and N

	Varieties			
N kg/ha	Pusa–1	PP–15	JP-12	Mean
50	28.02	28.49	28.14	28.21
100	30.56	39.47	35.24	35.05
150	36.75	37.14	41.35	38.29
Lime–kg/ha				
0	31.51	33.10	34.25	32.95
375	31.43	34.60	34 56	33.53
750	32.28	37.30	35.55	35.08
Mean	91.77	35.00	34.79	

	Lime kg/ha			
N–kg/ha	0	375	750	Mean
50	27.70	28.14	28.81	28.21
100	31.98	33.73	39.45	35.05
150	39.17	38.73	36.98	38.29
Mean	32.95	33.53	35.08	—

CD ($P=0.05$) for marginal means – 1.584
CD ($P=0.05$) for combinations – 2.743

Results showed that there was significant increase in yield with increase in nitrogen levels up to the maximum of 150 kg/ha. The variety PP–15 was found to be the best. The crop has responded to lime application up to 750 kg/ha.

Phosphorus nutrition in Stylosanthes gracilis– Ag. 14.18. Agron. 1.0) [Vellayani]

The objective of the experiment was to find out the optimum level of phosphorus for *Stylosanthes*. The experiment was laid out with 20 treatment combinations, namely, 5 levels of phosphorus (0,40,80,120,160 kg/ha), 2 cutting intervals (30,45 days) and 2 levels of lime (0,500 kg/ha).

Results showed (Table 9.8) that the effect of phosphorus on green matter yield was significant and the green fodder yield obtained with 120 kg P_2O_5/ha was significantly superior to all the other levels. The effect of lime was not significant.

Table 9.8: Green matter yield (t/ha) as influenced by the levels of phosphorus, lime and cutting intervals

Phosphorus levels (kg/ha)	without lime application	with lime application	Mean
0	16.730	19.595	18.162
40	19.096	19.145	19.120
80	17.629	21.471	19.550
120	22.597	20.740	21.668
160	19.997	16.721	18.358
Cutting interval			
30 days	19.029	19.529	19.279
45 days	19.389	19.539	19.464
Mean	19.209	19.534	

	Cutting intervals		
Phosphorus levels	30 days	45 days	Mean
0	17.827	18.498	18.162
40	18.829	19.412	19.120
80	19.039	20.061	19.550
120	21.659	21.678	21.668
160	19.044	17.671	18.358
Mean	19.279	19.464	—

CD (p=0.05) for P intervals – 1.978

CD (p=0.05) for P x L combinations – 1.768

Fodder production potential of grass-legume mixtures- [Vellayani]

The objective of the experiment was to find out a suitable grass-legume mixture and the effect of graded doses of phosphorus.

There were twenty seven treatment combinations laid out in 3^3 partially confounded factorial design.

Data recorded on green matter yield are presented in Table 9.9.

Intercropping legumes significantly increased the green fodder yield of all the grasses. Grasses mixed with *Stylosanthes* produced the maximum total green fodder yield (grass + legume) of 37.69 t/ha, but it was on par with that of *Centrosema* (32.30 t/ha).

Table 9.9: Green fodder yield of grasses as influenced by intercropping & P levels

Treatments,	Guinea grass	Setaria grass	Congo signal	Mean
Intetcropping pattern				
No legume	27.52	23.00	29.56	26.69
Stylosanthes guyanensis	43.65	37.46	31.98	37.69
Centrosema pubescens	33.58	31.92	31.40	32.30
Phosphorus levels				
80 kg P_2O_5/ha	24.04	30.41	28.32	27.59
120 ,,	43.72	31.48	30.48	35.23
160 ,,	37.00	30.47	34,15	33.87
Mean	34.92	30.79	30,78	—

Intercropping pattern	Phosphorus levels-kg/ha			
	80	120	160	Mean
No legume	25.76	27.56	26.76	26.69
Stylosanthes guyanensis	30.31	46.66	36.08	37.69
Centrosema pubescens	26.71	31.45	38.74	32.30
Mean	27.59	35.22	33.87	—

CD (P=05) for marginal means – 0.838
CD (P=0.05) for combinations - 1.452

Significant increase in green fodder yield of grass'legume mixture was noted upto 120 kg P_2O_5/ha.

Fodder production potential of sweet potato under varying levels of N– [Vellayani]

The experiment was laid out to evaluate the fodder production potential of sweet potato under varying levels of nitrogen fertilization. The variety tried was Kottaramchuvala (local) and 4 nitrogen levels (0,30,60,90 kg/ha) were given. The crop was given uniform dose of P and K (50 kg each). The data are presented in Table 9.10.

Table 9.10: Fodder yield and tuber yield of sweet potato variety Kottaramchuvala as influenced by various levels of nitrogen fertilization

Levels of Nitrogen (kg/ha)	Length of vines (cm)	Green fodder (t/ha)	Dry fodder (t/ha)	Tuber yield (t/ha)
0	50.21	5.55	1.01	3.12
30	82.48	6.94	1.66	4.82
60	88.88	10.72	2.24	6.69
90	104.24	11.27	2.26	7.01
CD (P=0.05)	16.56	1.76	0.61	2.924

It was found that the effect of different levels of nitrogen on fodder production of sweet potato was significant. Maximum green fodder yield was recorded by 90 kg N/ha, but it was on par with 60 kg N/ha. In the case of dry fodder also the same trend was noted. Tuber production also responded up to 60 kg N/ha beyond which the increase was not significant.

Seed production potential of Stylosanthes gracilis– Ag.14.18. Agron. 1.08 [Vellayani]

The objective of the experiment was to find out the effect of number of cuts and phosphorus nutrition on the seed production potential of *Stylosanthes gracilis*. The data on seed yield is presented in Table 9.11.

Table 9.11: Seed yield (kg/ha) as influenced by phosphorus application and number of cuts

No. of cuts	Phosphorus levels (P_2O_5) (kg/ha)					
	P1	P2	P3	P4	P5	Mean
	40–soil application	80–soil application	120–soil application	40–soil application + 40–foliar	80–soil application + 40–foliar	
C_1–) 2 cuts)	38.67	46.84	77.34	83.33	107.30	70.70
C_2–) 3 cuts)	19.61	41.40	44.66	50.65	55.56	42.37
Mean	29.14	44.12	61.00	66.99	81.43	

CD (P=0.05) for P=12.42

CD (P=0.05) for C=7.86

The treatment P_5 (80 kg P_2O_5/ha in soil + 40 kg P_2O_5/ha as foliar) recorded the maximum seed yield of 81.43 kg/ha and this was superior to all the other phosphorus treatments. Two cuts gave the maximum seed production.

Effect of nitrogen levels and row spacing on the yield and quality of hybrid napier grown with and without legume– Ag. 14. 18. Agron. 1.01 [Vellayani]

The objective of the experiment was to find out the optimum row spacing of hybrid napier so as to accommodate legumes in the interrow space for maximum production of good quality fodder and to assess the beneficial effect of intercropping legume and hybrid napier with supplemental nitrogen.

The intercrop tried was rice bean. Data on green fodder yield are furnished in Table 9.12 (a) and (b).

Table 9.12 (a): Green fodder yield (t/ha) of hybrid napier as influenced by intercropping and row spacing

Intercropping with N levels	Spacing 100 x 50 cm	150 x 50 cm	200 x 50 cm	Mean
Grass alone	30.29	28.53	25.54	28.12
Grass + legume	37.89	36.23	30.08	34.73
Grass + legume + 60 kg N/ha	47.41	46.66	42.81	45.63
Grass + legume + 120 kg N/ha	51.86	50.76	45.55	49.69
Mean	41.86	40.55	36.07	
CD (P=0.05) for spacing	— 1.32			
CD (P=0.05) for intercropping with N levels	— 7.39			
CD (P=0.05) for combinations	— 2.64			

It was found that the 100 and and 150 cm row spacings of grass recorded significantly higher green matter yield than 200 cm, even though the former two were on par. Green and dry matter yields of hybrid napier were increased significantly in the presence of rice bean. Intercropping along with nitrogen application at 60 kg N/ha has given optimum production of green and dry fodder yield.

Table 9.12 (b): Dry matter yield of hybrid napier (t/ha) as influenced by intercropping and spacing

Cropping pattern and N levels	Spacing 100 x 50cm	150 x 50cm	200 x 50cm	Mean
Grass alone	5.94	6.10	4.95	5.63
Grass + legume	7.32	7.30	5.73	6.78
Grass + legume + 60 kg N/ha	9.26	8.93	7.92	8.70
Grass+legume+120kg N/ha	9.88	9.03	8.31	9.07
Mean	8.10	7.82	6.73	—
CD (p=0.05) for spacing	— 0.230			
CD (P=0.05) for intercropping with N levels	— 0.270			
CD (P=0.05) for combinations	— 0.460			

Evaluation of production potential of grasses and legumes under varying combination with forage trees– Ag· 14. 18. Bot. 1.01 [Vellayani]

The objective of the experimant was to select the best silvipastural combination in coconut gardens, The trees were planted at a spacing of 3.0m x 50 cm, grasses at 50 x 25 cm and legumes at 50 x 10 cm.

Significant difference in green matter and dry matter yield was noted for the various combinations. The treatment combination 'Koobabool + Guinea grass + Velvet bean' and '*Sesbania grandiflora* + Guinea grass + Velvet bean' were on par and these gave the maximum fodder yield (Table 9.13).

Tabla 9.13: Fodder yield (t/ha) under different silvipastural combinations

Treatments	Creen fodder yreld t/ha	Dry fodder yield t/ha
Koobabool + Guinea + Velvet bean	16.30	5.11
,, + Cowpea	10.55	3.15
,, + Rice bean	9.91	2.68
,, + Setaria + Velvet bean	8.52	2.35
,, ,, + Cowpea	6.30	1.96
,, ,, + Rice bean	4.63	1.30
Sesbania grandiflora + Guinea + Velvet bean	16.30	4.82
,, ,, + Cowpea	10.13	3.25
,, ,, + Rice bean	10.76	3.21
,, + Setaria + Velvet bean	6.31	1.80
,, ,, + Cowpea	4.81	1.34
,, ,, + Rice bean	6.94	1.91
Sesbania aegyptica + Guinea + Velvet bean	13.81	4.40
,, ,, + Cowpea	11.30	3.42
,, ,, + Rice bean	11.30	3.30
,, + Setaria + Velvet bean	6.48	1.67
,, ,, + Cowpea	4.72	1.20
,, ,, + Rice bean	6.13	1.64
CD (P=0.05)	1.003	0.337

Effect of plant population on the yield and quality of Koobabool [Vellayahi]

The treatments were three row spacings (1 0, 1.5 and 2.0 m) and three plant spacings (10, 20, 30 cm). The crop was given 20 kg N/ha and 50 kg. P_2O_5/ha uniformly as basal. The data on green fodder yield, leaf–stem ratio and dry–fodder yield, obtained during the year are presented inTable 9.14.

Table 9.14 : Green fodder yield, dry fodder yield and leaf–stem ratio of Koobabool under varying plant densities.

Treatments	Green fodder yield kg/ha	Dry fodder yield kg/ha	Leaf/stem ratio
1. 1.0m x 10 cm	1222.22	542.22	1.82
2. 1.0m x 20 cm	933.33	331.11	1.81
3. 1.0m x 30 cm	422.22	164.44	1.81
4. 1.5m x 10 cm	1222 22	420.00	2.03
5. 1.5m x 20 cm	1888.87	1266.67	1.69
6. 1.5m x 30 cm	622.22	240.00	1.13
7. 2.0m x 10 cm	1422.21	506.67	1.63
8. 2.0m x 20 cm	1119.99	466.67	1.76
9. 2.0m x 30 cm	1755.55	655.57	1.59

The results indicated that the maxium green fodder yield of 1888.87 kg/ha was obtained under the spacing of 1.5m x 20 cm. The maximum dry matter yield was recorded in the spacing 1.5 m x 20 cm (1266.67 kg/ha).

Effect of row spacing and levels of phosphorus on the growth, yield and quality of Sesbania aegyptica [Vellayani]

The experiment was started with 12 treatment combinations (3 row spacing– 25 cm, 50 cm, 75 cm and 4 levels of phosphorus 0, 30, 60, 90 kg P_2O_5/ha). Uniform doses of N (@ 20 kg/ha) and K (@ 30 kg/ha) were given to the crop The green matter yield, dry matter yield, leaf–stem tatio are presented in Table 9.15.

Table 9·15: Fodder yield and leaf–stem ratio of *Sesbania aegyptica* under varying spacing and levels of phosphorus

Treatments	Green matter yield (kg/ha)	Dry matter yield (kg/ha)	Leaf–stem ratio
O P x 25 cm	243.05	70.83	2.23
O P x 50 cm	499.97	183.33	2.35
O P x 75 cm	451.39	151.39	2.82
30P x 25 cm	243.05	93 05	2.71
30P x 50 cm	416.66	131.94	2.33
30P x 75 cm	244.42	152.78	2.49
60P x 25 cm	395.83	159.72	2.36
60P x 50 cm	555.55	191.67	3.10
60P x 75 cm	458.33	159.72	2.21
90P x 25 cm	381.94	209.72	2.33
90P x 50 cm	277.78	74.99	2.00
90P x 75 cm	361.11	81.94	1.93
CD (P–0.05)	NS	21.110	NS

Results showed that differences in green matter yield were not significant. However, maxium yield of 555.55 kg/ha was recorded by the treatment 60 P x 50 cm. Maximum dry matter yield was recorded by the treatment 90 P x 25 cm.

10. Soils & Agronomy

HIGHLIGHTS

Clay, silt, sesquioxide, iron and calcium content of soils of Kerala were found to influence their P fixing capacity. Half the recommended dose of K was sufficient if applied at active utilization periods of rice. Laterite and Kayal soils need only half the lime requirement for maximum production. Magnesium silicate application increased grain and straw yield of rice in Kuttanad. Post monsoon yellowing of coconut leaves was not related to nitrogen availability. Solubilisation of iron in Kerala soils increased with the period of submergence. Solution paper technique was standardised for screening Aluminum tolerant varieties of rice. Increasing levels of N were found to favour tiller production in turmeric. Available P status of Kerala soils was best assessed through double acid extraction method. Rice did not respond to P application in soils containing more than 5.69 ppm available P. Laterite soils were found to be more acidic and less fertile than red soils. Physiographic situations brougnt about diverse soil groups in lateritic catenary sequences of Kerala.

SUMMARY

The phosphorus fixing capacity of the soils of Kerala was observed to have positive correlation with the soil characteristics like clay and silt content, sesquioxide, iron and calcium content, while the soil reaction had little influence on the P fixing capacity.

Studies on potash nutrioperiodism revealed that half the recommended dose of potash applied at periods of active utilization in split doses gave as much yield as that of full dose of potash in the case of both medium and short duration varieties of rice.

In 'Kari' and 'Kole' soils, maximum grain yield was obtained when full lime requirement was met. In laterite and 'Kayal' soils, half the lime requirement was sufficient to obtain maximum yield.

Application of magnesium silicate was found to have beneficial effects on grain and straw yield of rice in Kuttanad soils.

Yellowing of the coconut palms observed during post monsoon periods in Cannanore district was found to have little relationship with the forms and availability of nitrogen in soils.

The solubilisation of iron in soils of Kerala under submerged conditions was observed to start from one week after submergence and the rate of solubilization was found to increase with the progress of submergence, till four weeks, after which it declined.

A method for screening aluminium tolerant varieties by solution paper technique was standardised.

Studies on the zinc and manganese status of the rice soils of Kerala and their transformations under moisture saturated condition has been initiated employing Atomic absorption spectrophotometer.

Tissue test technique was employed to detect nutrient deficieneies in agricultural and horticultural crops. Observation made from the studies on turmeric revealed that increasing levels of N favoured the multiplication of tillers per clump while it decreased the number of leaves per tiller. The levels of P and K were found to have little influence on the morphological characters of turmeric.

Soil testing methods for assessing the potash requirement of cassava has been attempted.

Among the various extractants tried for estimation of available phosphorus in soils of Kerala, the double acid (0.45 N HCl and 0.025 N H_2SO_4) reagent was found to the best in determining available P values with significant correlation with the P uptake of rice. The critical value for P response to rice in Kerala soils was found to be 5.69 ppm of available P as determined by this method at the time of planting. Above this, the response to P application was found to be meagre.

Studies on laterite and red soil associations of Kerala indicated that laterite soils are more acidic, have a lesser organic carbon content, C/N ratio. lower N, P, K, Ca and Mg content, C E C. and exchangeable cations than the red soils. The laterite–red soil associations were found to occur in undulating terrain with the laterite in the slopes and red soils in the foot slopes.

Pedologic studies on lateritic catenary sequences occurring in Kerala brought out the formation of four diverse groups of soils of the toposequence as a result of macro and micro pedogenic processes acting on the different physiographic situations.

PROJECTS IMPLEMENTED

		Locations
SOIL CHEMISTRY AND PLANT NUTRITION		
1	Phosphorus and potassium fixing capacity of Kerala soils (Ag. 21. 18–Che-2)	Vellayani
2	Potash nutrioperiodism in rice (Ag. 1–18-Che–7–02)	Vellayani
3	Carbon–nitrogen relationship in Kerala soils (Ag.21-19–Che. 1.02)	Vellanikkara
4	Studies on the response of paddy to lime application in acid soils of Kerala (Ag. 21-18–Che–7.01)	Vellayani
5	The utility of an indigenous source of magnesium silicate for rice in Kuttanad soils (Ag 21–18–Che.16–03)	Vellayani
6	Forms of nitrogen in coconut soils before and after monsoon with reference to occurrence of post–monsoon yellowing in coconut (Ag.2-8-3–1)	Pilicode
SOIL TOXICITY AND PROBLEM SOILS		
7	Studies on the solubilisation of iron in the submerged rice soils and methods to minimise its solubility (Ag. 1–18–Che.12.04)	Vellayani
8	The release of soluble aluminium in soils under submerged conditions and its effect on rice (Ag. 1–18-Che. 12–03)	Vellayani
9	Fertility investigations in the 'Poonthal padam' soils of of Kerala (Ag.21–18-Che. 11-02)	Vellayani
TRACE ELEMENT NUTRITION		
10	Zinc and manganese status of rice soils of Kerala (Ag. 21–18-Che., 16–02)	Vellayani
11	The effect of varying levels of zinc on the growth and yield of rice (Ag.1-18-Che., 11.08)	Vellayani
SOIL AND TISSUE TESTING		
12	Tissue testing with a view to detecting nutrient deficiencies in agricultural and horticultural crops (2) Foliar diagnosis, yield and quality of turmeric in relation to N,P and K (Ag. H 4 (f) 19 Chem–1.01	Vellanikkara
13	Tissue testing with a view to detecting nutrient deficiencies in agricultural and horticultural crops (2) Foliar diagnosis and yield of coconut in relation to N,P and K (Ag.2–19–Chem. 2–01)	Vellanikkara
14	Soil testing methods for potassium in relation to cassava (Ag. 8 (a)–18. Che. 2–01)	Vellayani
15	Soil test–crop response studies for phosphorus in Kerala soils (Ag. 21–18–Che. 3–01)	Vellayani

PEDOLOGICAL STUDIES

16 Studies on the laterite and red soil associations in certain locations of Kerala (Ag. 12-18-6-1) Vellayani

17 Pedologic studies on lateritic catenary sequences occurring in Kerala Vellayani

MANAGEMENT OF FERTILIZERS AND MANURES

18 Studies on the rate of decomposition of *Salvinia* as influenced by chemical agents (Ag. 21-19-Che. 20-01) Vellanikkara

Phosphorus and potassium fixing capacity of Kerala soils Ag. 21-18-Che. 2. [Vellayani]

The phosphorus fixing capacity and physical and chemical properties of 12 soil samples representing the major soil types of Kerala were determined. It was observed that there was positive correlation between phosphorous fixing capacity of soils with physical properties like silt and clay content and chemical characteristics like total sesquioxide content, and iron and calcium content of soils. The soil reaction was found to have little influence on the phosphorus fixing capacity of soils of Kerala.

Potash nutrioperiodism in rice Ag. 1-18-Che. 7-02 [Vellayani]

This study was taken up with with objective of fixing the active periods of utilization of potassium by medium and short duration varieties of rice (Jaya and

Table 11.1: Grain yield as influenced by the levels and time of application of K (Mean grain yield g/pot)

Treatments		Jaya		Triveni	
		Pattambi soil	Vellayani soil	Pattambi soil	Vellayani soil
	B AT PI				
T1	0 + 0 + 0	15.0	14.2	20.5	14.5
T2	1/2 + 1/4 + 1/4	20.0	16.2	28.5	15.2
T3	1/2 + 1/2 + 0	24.0	12.0	15.1	16.5
T4	1/4 + 1/4 + 1/2	26.0	11.2	19.5	18.0
T5	1/4 + 1/2 + 1/4	21.0	15.2	22.5	14.0
T6	0 + 1/2 + 1/2	32.0	10.2	20.0	10.5
T7	0 + 1/4 + 3/4	25.0	11.5	19.5	14.5
T8	1/4 + 1/8 + 1/8	27.5	8.9	23.9	17.0
T9	1/4 + 1/4 + 0	28.0	12.2	14.0	26.0
T10	1 8 + 1/8 + 1/4	29.0	14.6	19.5	12.5
T11	1/8 + 1/4 + 1/8	14 0	11.5	25.5	22.5
T12	0 + 1/4 + 1/4	18.0	9.1	19.5	11.5
T13	0 + 1/8 + 3/8	20.0	10.6	17.7	18.0

* B-Basal
AT-Active tillering stage
PI-Panicle initiation state

K_2O @ 45 kg/ha for medium duration and @ 35 kg/ha for short duration

Triveni) and for probing the possibilities of skipping the basal application of potassium to rice crop. A pot culture experiment was laid out employing soil samples from Pattambi and Vellayani with 13 treatments of potash application at varying doses, given at different periods of crop growth. The mean grain yield obtained are presented in Table 11.1. It was observed that half the rocommended dose of K applied as 1/8 th as basal, 1/8th at active tillering stage and 1/4th at panicle initiation stage (T–10) gave as much yield as that of full dose of K (T 6) in the case of medium duration variety. Triveni, the short duration variety was found to yield maximum under half the recommended dose of K (T–11) when averaged over the two soils used. The results indicated that potassium was required in smaller amounts during early stages of growth of rice and that it was utilized to the maximum extent during the reproductive phase.

Carbon-nitrogen relationship in Kerala soils–Ag. 21-19–Chem. 1–02 [Vellanikkara]

Surface soil samples from 548 locations representing the various soil types of Kerala were collected under this study to work out the relationships between the organic carbon content and the total and available nitrogen content of soils and also to estimate the critical value of organic matter content of soils for economic returns. The chemical analysis of soil samples are in progress.

Studies on the response of paddy to lime application in acid soils of Kerala Ag. 21. 18 Che. 7.01 [Vellayani]

A pot culture experiment was conducted with four acid soil samples collected from areas representing laterite, Kayal, Kari, and Kole lands of Kerala to study the response of paddy (Annapoorna) to the application of lime at full, 3/4, 1/2, 1/4 and 1/8 of the lime requirement. It was observed that maximum grain yield was obtained in Kari and Kole soils when full lime requirement was met while in Laterite and Kayal soils half the lime requirement was found to register maximum yield.

The utility of an indigenous source of magnesium silicate for rice in Kuttanad soils Ag. 21. 18. Che. 16.03 [Vellayani]

A field study was conducted in farmer's fields at Kuttanad to investigate the effect of application of magnesium silicate on straw and grain yield of rice var. Jyothi. Four levels of application of magnesium silicate, i.e , 1000 kg, 2000 kg, 3000 kg and 4000 kg/ha were tested and observations on tiller count, plant height, number of spikelets, 1000 grain weight, extent of shattering of grains and straw yield were recorded. The statistical analysis of the data was in progress. The trend of results indicated that beneficial effects on grain and straw yield was obtained with the application of magnesium silicate in Kuttanad soils.

Forms of nitrogen in coconut soil before and after monsoon with reference to occurrence of post monsoon yellowing in coconut Ag. 2–8-3-1 [Pilicode]

Yellowing of coconut palms soon after the monsoons was frequently noticed in the northern region of the State. One of the possible reasons attributed for this phenomonon is the leaching out of available forms of nitrogen during the heavy monsoon period. Hence a study was undertaken to

determine the forms of nitrogen in the soils of coconut gardens where yellowing was noticed. The chemical analysis of the samples of soils collected before and after the monsoon periods did not reveal any significiant difference in quantity and proportion of ammoniacal and nitrate nitrogen. As forms of available nitrogen present around healthy and affected palms during pre–monsoon and post–monsoon periods were identical, the possibility of non availability of nitrogen as a cause of foliar yellowing was ruled out.

Studies on the solubilisation of iron in the submerged rice soils and methods to minimise its solubility Ag. 1–18–Chem. 12–04 [Vellayani]

The transformations in iron under submerged conditions in 20 soil samples indicated that the solubilisation of iron starts from one week after submergence and this was increased with the period of submergence until four weeks and later there is a decline in the rate of solubilization. The water soluble iron content ranged from 16 to 135 ppm and exchangeable iron from 11 to 145 ppm. The effect of application of $ZnSO_4$ at diiferent doses on the rate of solubilisation of iron was being determined in an incubation experiment.

The release of soluble aluminium in soils under submerged conditions and its effect on rice Ag. 1–18–Che. 12.3 [Vellayani]

A method for screening Aluminium tolerent varieties was standardised by the solution paper technique. This method was found to be useful to screen out rice varieties tolerant to Al concentrations in soil solution, from among the acid tolerant varieties of rice.

Fertility investigations in the 'Poonthal padam' soils of Kerala Ag. 21–18–Che. 16.02 [Vellayani]

Investigations were made to estimate the extent of nutrient fixation in the 'Poonthal padom' soils. Forty surface soil samples (0-15cm) and forty sub-surface (15-30cm) soil samples were collected from 40 locations of six villages of the 'Poonthal padam' tract. The samples were analysed for its physico–chemical properties. Its nutrient fixing capacity will be determined and correlated with its other soil characteristics.

Zinc and manganese status of rice soils of Kerala, Ag. 21–18–Che, 16.02 [Vellayani]

This study was taken up to assess the forms and distribution of Mn and Zn in the rice soils of Kerala and their transformations and availability under submerged conditions. A total number of 150 samples of rice soils representing laterite, kayal, karapadam, kari, kole, coastal sandy alluvinm and acid saline pokkali and kaipad tracts of Kerala were collected and extracted with five different extracting agents. The extracts were analysed for Zn and Mn employing the Atomic absorption spectrophotometer. The values of available Zn and Mn will be correlated with their total status in these soils and also with the values obtained through Neubaur's technique. The transformations of the forms of Zn and Mn under submerged conditions and also under drained and dried conditions will be studied and the availability of these trace elements under such conditions will be assessed.

The effect of varying levels of Zinc on the growth and yield of rice Ag. 1-18-Che-11.08 [Vellayani]

Rice soil samples were collected from various rice growing tracts of Kuttanad and analysed for assessing their status of Zn. A cultivator's field at Edathua was identified as deficient in Zn. A field experiment was conducted in this field using the rice variety Jaya and employing treatments of zinc at the rates of 0, 10, 20 and 30 kg/ha. There were also treatments for comparing the method of application, viz., soil application, foliar application and root dip of seedings. The experimental plots were harvested.

Tissue testing with a view to detecting nutrient deficiencies in agricultural and horticultural crops (2) Foliar diagnosis, yield and quality of turmeric in relation to N, P and K Ag. H4 (f) 19 Chem. 1.01 [Vellanikkara]

A field experiment on turmeric with 3 levels of N, P and K in confounded factorial randomised block design was conducted at the Instructional farm, Vellanikkara with a view to develop foliar diagnosis technique in turmeric for predicting nutrient deficiencies and yield in relation to N, P and K. Levels of N, P and K were as follows :

N — 0, 20, and 40 kg/ha
P — 0, 20 and 40 kg/ha
K — 0, 40 and 80 kg/ha.

Total number of treatment combinations tried were 27 and these were laid out in 12 blocks with plot size of 3 x 1.2 m. The field experiment was conducted during May 1979 to January 1980. Observations on morphological characters revealed that the number of tillers per clump increased with increasing levels of N, whereas the number of levels of P and K were found to have little influence on the morphological charactors.

Tissue testing with a view to detecting nutrient deficiencies in agricultural and horticultural crops. (3) Foliar diagnosis and yield of coconut in relation to N, P and K. – Ag. 2. 19 Chem. 2.01 [Vellanikkara]

The study was initiated to develop foliar diagnosis technique in coconut with a view to predict nutrient deficiencies and yield in relation to N, P and K content under varying soil fertility gradients. The leaf lamina and petiole samples from first to last leaf of the coconut palms under the N, P, K trial at C. R. S. Balaramapuram were collected and analysed for nutrient contents. This was to be correlated with the corresponding soil nutrient content and yield of nuts for working out the tissue test-crop response relationships.

Soil testing methods for potassium in relation to cassava – Ag 8(a)18 Che.2.01 [Vellayani]

The study was initiated to evolve a suitable soil testing method for determining available K in the laterite and red loam soils where cassava is grown extensively and with a view to work out soil test crop response relationship of cassava with regard to K nutrition. Soil samples were collected from an

experimental field at the Instructional farm, Vellayani, where exhaustion of soi K was attempted by continuous cropping. The forms of residual soil K were determined using various extractants and the values obtained for available K were to be correlated with the K uptake studies using Neubaur technique.

Soil test crop response studies for phosphorus in Kerala soils – Ag. 21-18 Che. 3-01 [Vellayani]

Pot culture experiments were conducted with eight typical soils of the State, having wide variations in the physical and chemical properties with four graded levels of P, viz., 0, 20, 35 and 50 kg P_2O_5/ha. Available P in soil samples were extracted by using the following six extractants and the correlation coefficients were worked out between grain yield and crop uptake of P:

Brays' reagent No. 1 (0.03 N NH_4F in 0.025 N HCl)
Brays' reagent No. 2 (0.03 N NH_4F in 0, 0.025 N HCl)
Olsen's reagent (0.5 N Na HCO_3-pH adjusted to 8.5)
Truog's reagent (0.002 N H_2SO_4)
buffered to pH 3.0 with $(NH_4)_2$ SO4
William's reagent (N/2 Acetic acid, pH 2.8)
Double acid reagent (0.05 N HCl and 0.025 NH_2SO_4)

Highly significant correlations were obtained between available phosphorus extracted from soil by the double acid method at different stages of growth of rice plant and uptake of P by rice. The calculation of the critical values has shown that response to phosphatic fertilizers can be expected in Kerala soils, only if the available P as determined by double acid method is less than 5.69 ppm at the time of planting.

Studies on the laterite and red soil associations in certain locations of Kerala – Ag. 12-18-6-1 [Vellayani]

A study was undertaken to understand the genetic factors responsible for the development of laterite and red soils as an association in one and the same location in Kerala State. Three such locations were selected for the study, Varkala and Pachalloor region in Trivandrum district and Pilicode in Cannanore distrtct. Soil profiles from these locations were studied for profile morphology, physical, chemical and microbiological properties to obtain information on the genesis and pedo-chemical characteristics. It was observed that the characteristic indurated horizon (Plinthite) occurred in the laterite soil profiles of all the three locations while it was absent in the associated red soil. Irrespective of locations single value constants of laterite soils were found to be comparatively higher than those of the red soil. On the other hand, hydraulic conductivity values were found to be higher for red soils than laterite soils.

The laterite soils were observed to be slightly more acidic with lower organic carbon content and C/N ratio, lower total N, P, K, Ca and Mg content, C E C and exchangeable cations than the red soils. Based on the study it was observed that the laterite-red associations generally occur in undulating

terrain with the laterites in the back slope and the red soils in the foot slopes There was also an indication that the red soils in the foot slopes have developed from a parent material consisting of finer eroded soil materials from the solum of laterite in the back slope.

Pedologic studies on laterite catenary sequences occurring in Kerala – [Vellayani]

Three topos-equences in the midland laterite regions of Kerala were studied. Regular and gradational changes down the slope observed in the morphological and physio-chemical characteristics, followed the drainage scale with well drained upper slope member and poorly to imperfectly drained lower slope member of the catena. X-ray, DTA and TGA studies of clay showed abundance of Kaolinite. Chlorite and other expanding minerals were also observed in the lower slope members of the catena. Study revealed that the four diverse groups of soils of the toposequence were the product of catenary evolution as a result of macro and micro pedogenic processes acting on the different physiographic situations.

Studies on the rate of decomposition of Salvinia as influenced by chemical agents – Ag. 21-19-Che. 20-01 [Vellanikkara]

Salvinia, mechanically removed and dumped near fields can be economically utilized after composting. The present study was taken up to find out a suitable chemical agent to hasten the decomposition of *Salvinia*. A laboratory study was initiated with 12 treatments, with various chemical agents like lime, fertilizers etc. besides the organic starter cowdung.

II. Plant Protection

HIGHLIGHTS

Prawn dust was found to be the most attractive bait carrier for *Bandicota bengalensis*, while for the rice field rats *(Rattus norvegicus)*, the preference was to the lime shell flesh. The maximum fecundity of *Bracon brevicornis* was recorded at a host density level of 2 larvae/female parasite and when the parental sex-ratio was kept at 2:1 and 3:1 (female : male). In banana, disulfoton persisted longer than phorate and carbofuran when applied in soil / leaf axil. The results of studies on the feasibility of mulberry silk culture in Kerala were quite encouraging. When chopped leaves of neem / *Clerodendron* were mixed with cowdung at 0.75 kg/60 kg, the mortality of *Oryctes* grubs was complete. The nature of water pocket was found to influence the establishment and survival of the grasshopper *Paulinia acuminata*, the natural enemy of *Salvinia molesta*. *Cyrtorhinus lividipennis* occurred widely in Kerala as predators of the Brown plant hopper. Among the various substrates used for spawn production of the paddy mushroom, *Salvinia molesta* bio-mass was rated as quite good. Rice root infection by *Hirschmaniella oryzae* was considerably reduced under treatment with phenamiphos and vapam.

SUMMARY

In studies on the population dynamics of rice field rats, the peak populations were found in June, September and October.

Prawn dust was found to be the most attractive among the bait carriers evaluated for *Bandicota bengalensis*.

For the rice field rats *(Rattus norvegicus)*, lime shell flesh was more attractive to other materials.

In studies on the regulation of progeny production and sex-ratio of *Bracon brevicornis*, the maximum fecundity of the parasite was recorded consistenly at all the temperature-humidity combinations tried, at a host density level of 2 larvae/female parasite.

Taxonomic studies of crop pests and their parasites were continued.

Disulfoton persisted longer than phorate and carbofuran granules against the banana aphid.

Results of studies on the adaptability of sericulture in Kerala were quite encouraging. The average silk production was 51.3 g/100 layings.

Clerodendron and neem leaves showed biological efficiency against *Oryctes* adults. When any of these two types leaves were mixed with cowdung, the mortality to *Oryctes* grubs was complete in treated pits.

Studies on the virus diseases of lepidopteran crop pests were continued.

The polyhedroses virus of *Diacrisia obliqua* and *Spodoptera mauritia* and the granulosis of *Pericallia ricini* were not cross-infective to the larvae of the rice leaf folder.

The All India Co-ordinated Research Project on Biological control of crop pests was continued. The nature of the water pocket was found to influence the establishment and survival of *Paulinia acuminata* which fed on *Salvinia*. In fairly deep ponds and lakes, their establishment was adversely affected by predatory fishes. *Cyrtorhinus lividipennis* occurred throughout the State as predatory on the eggs of the Brown plant hopper. Survey of the pests of weeds was continued.

Among the various substrates tried for spawn production in the paddy straw mushroom, *Salvinia* mass was found to be quite good.

The All India Co-ordinated Research Project on Nematode pests and their control was continued. Phenamiphos and vapam treated plots gave better control of *Hirschmaniella oryzae* infesting rice roots.

PROJECTS IMPLEMENTED

		Locations
1	Population dynamics of different species of rats affecting paddy in Kuttanad (Ag. 23.5. Ent- 1.01)	Moncompu
2	Studies on the regulation of sex-ratio of *Bracon brevicornis* (Ag.23.18. Ent. 3.01)	Vellanikkara
3	Bait preference of different species of rats attacking paddy (Ag 23.5 Ent. 2.01)	Moncompu
4	Taxonomic studies of crop pests and their parasites in Kerala (Ag. 23.19 Ent. 8.01)	Vellanikkara
5	Studies on the persistence and dissipation of systemic insecticides in banana (Ag. 23. 18 Ent. 19)	Vellayani
6	Studies on the adaptability of sericulture in Kerala	Vellayani
7	Biological activity of different plant extracts with particular reference to their antifeedant action (Ag. 17. 18–8–2)	Vellayani
8	Studies of virus diseases (polyhedroses and granuloses) of lepidopterous crop pests. (Ag. 17.18 8.2)	Vellayani
9	Granulosis virus diseases of rice leaf folder	Vellayani
10	All India Co-ordinated Research Project on Biological Control of Crop Pests	Vellanikkara
11	Survey of the pests of important weeds in Kerala (Ag. 12.19.5.2)	Vellanikkara
12	Multiplication, release and field studies of *Paulinia acuminata* for the bio-control of *Salvinia molesta* (Ag. 17.18.8.9)	Vellayani
13	Synergistic effect of fungicide-insecticide mixtures against important plant pathogens and insect pests (Ag. 24. 17 Path. 3)	Vellayani
14	Studies on the effect of fungicides insecticides, and foliar nutrients on the phyllosphere microflora of crop plants (Ag. 24.17.19 Path 2.01)	Vellayani
15	Studies on the edible mushrooms of Kerala (Ag. 25.18 Micro. 1.6)	Vellayani
16	Monographic studies on edible species of *Pleurotus* and standardization of techniques for large scale cultivation. (Ag. 25.18 (Microb) 5.)	Vellayani
17	All India Co-ordinated Research Project on Nematode pests and their control	Vellayani

Population dynamics of different species of rats affecting paddy in Kuttanad Ag. 23.5 Ent. 1.01 (Moncompu)

For studying the population fluctuations of the dominant species of rice field rats, 60 nos of Moncompu type traps were fixed in three line series

of 25m apart for three consecutive nights in every month. The peak populations were obtained in June. The populations dwindled during March–May. During September and October additional peaks were recorded.

Management of Bandicota bengalensis Ag. 23.19. Ent. 1.02 (Vellanikkara)

In order to formulate effective methods of managing populations of *B. bengalensis,* burrows were opened at certain points and different types of traps were set. Among the different types of traps, the bamboo trap was found to be more effective. The bait preference of this species of rat was studied by opening the burrows at certain points and offering bait materials inside. Prawn dust was found to be the most attractive bait carrier for *B. bengalensis.*

Bait preference of different species of rats attacking paddy (Ag. 23.5. Ent. 2.01 (Moncompu)

This project was taken up to ascertain the relative acceptability and preference of bait carrier materials, to rice field rats. Twenty grammes each of fried broken rice, wheat, coconut kernel, dry fish/prawn dust, tapioca chips, lime shell flesh and ripe plantain fruits were placed in small earthen pots around live burrows and the consumption for the 12 hr period determined. It was observed that the rats preferred lime shell flesh to other materials. The order of preference was limeshell flesh, coconut kernel, dried prawn dust, tapioca chips, rice and wheat in that order.

Studies on the regulation of progeny production and sex ratio of Bracon brevicornis Ag. 23.18 Ent.3.01 [Vellanikkara]

To identify the factor/factors influencing progeny production and sex–ratio in *Bracon brevicornis,* studies were carried out at three temperature–humidity combinations, namely, 28°C-75% RH, 30°C–60% RH and 32°C–25% RH. The host larval densities tried were 1, 2 and 3 larvae per female parasite. Host larval weights of 30-35 mg, 8-10mg and an admixture of the two types (all of the same age group) in equal proporations were tried. The sex–ratios of the parental parasite populations tried were 1:1, 2:1, 3:1, 1:2 and 1:3.

The maximum fecundity of the parasite was recorded consistenly at all the T–H levels at a host density level of two larvae/female parasite and when the parental parasite sex–ratio was kept at 2:1 and 3:1 (female : male). The highest progeny production was attained at 28°C–75% RH and 32°C–50% RH under a host density level of two heavier larvae per female parasite.

The influence of host larval density on the proportion of females was pronounced only at 32°C and 50% RH.

The parental sex–ratios of 1:3 (female : male) produced highest proportion of females at 30°C–60% RH and 32°C–50% RH.

Data on mean fecundity, female progeny prodnction and female–male composition of the progeny are furnished in Tables 11.1, 11.2 and 11.3 respectively.

Table-11.1: Mean fecundity of *B. brevicornis* at different levels of the main factors and their ranking at different temperature- humidity levels

Levels of factors A, B & C	28°C—75% RH		30°C—60% RH		32°C—50% RH	
	Mean fecundity	Ranking	Mean fecundity	Ranking	fecundity	Ranking
*a_0	51.33		47.53		54.27	
a_1	63 20	a_1, a_0, a_2	56 84	a_1, a_0, a_2	68.18	a_1, a_2, a_0
a_2	49.50		45.86		57.00	
**b_0	50.98		53.47		81.31	
b_1	46.40	b_2, b_0, b_1	42.42	b_2, b_0, b_1	31.61	b_0, b_2, b_1
b_2	66.67		54 04		66.76	
***c_0	31.24		31.87		33.20	
c_1	42.56		37.47		44.33	
c_2	39.40	c_1, c_2, c_0, c_3, c_4	25.00	c_1, c_2, c_0, c_3, c_4,	44.78	c_2, c_1, c_0, c_4, c_3,
c_3	25.82		27.11		28.18	
c_4	25.02		18.49		28.96	

*a_0—1 host larva per female parasite
a_1—2 ,, ,,
a_2—3 ,, ,,
**b_0—larval weight 30—35 mg
b_1— ,, ,, 8—10 mg
b_2—half of the hosts of the 'b_0' type and the other half of the 'b_1' type.
***c_0—Sex-ratio of parent parasite population—1 : 1 (female : male)
c_1— ,, ,, —2 : 1 (,,)
c_2— ,, ,, ,, —3 : 1 (,,)
c_3— ,, ,, —1 : 2 (,,)
c_4— ,, ,, —1 : 3 (,,)

Table 11.2: Mean number of female progeny of *B. brevicornis* produced at different levels of the main factors and their ranking at different temperature-humidity levels

Levels of factors A, B, C	28°C—75% RH		30°C—60% RH		32°C—50% RH	
	Progeny production	Ranking	Progeny Production	Ranking	Progeny production	Ranking
a_0	11.22		12.78		17.36	
a_1	12.31	a_1, a_0, a_2	14.73	a_1, a_2, a_0	18 62	a_2, a_1, a_0
a_2	9.20		14.62		22.31	
b_0	12.11		15.78		23.76	
b_1	10.09	b_0, b_2, b_1	12.47	b_0, b_2, b_1	9.42	b_2, b_0, b_1
b_2	10.53		13.89		25.11	
c_0	6.53		10.71		14.69	
c_1	7.04		11.73		15.80	
c_2	6.53	c_3, c_1, c_0, c_2, c_4	7.16	c_1, c_0, c_2, c_3, c_4	10.33	c_1, c_0, c_2, c_3, c_4
c_3	7.31		7.00		10.11	
c_4	5.31		6.13		7.26	

Table 11.3: Female—male composition of *B. brevicornis* at different temperature—humidity combinations

Levels of main factors	28°%—75%RH			30°C—60%RH			32°C—50%RH		
	Females	Ranking	Males	Females	Ranking	Males	Females	Ranking	Males
a_0	251 (49.70)		254 (50.30)	239 (41.57)		336 (58.43)	393 (50.32)		388 (49.68)
a_1	248 (44.80)	NS	306 (55.20)	304 (45.85)	NS	359 (54.15)	445 (53.10)	a_1, a_0, a_2	393 (46.90)
a_2	187 (45.20)		227 (54.80)	291 (44.22)		367 (44.22)	407 (40.54)		597 (59.64)
b_0	243 (44.60)		302 (55.40)	333 (46.90)		377 (53 10)	583 (51.73)		516 (48.27)
b_1	195 (42.95)	b_2, b_0, b_1	259 (57.05)	248 (44.21)	NS	313 (55.79)	194 (45:75)	b_0, b_1, b_2	230 (54 25)
b_2	248 (52.32)		226 (47.68)	253 (40.48)		372 (59.52)	498 (44.07)		632 (55.93)
c_0	128 (43.54)		166 (56.46)	188 (39.00)		294 (61.00)	324 (49.02)		337 (53.02)
c_1	164 (34.10)		317 (65.90)	232 (46.31)	c_4, c_3, c_1	269 (53.69)	334 (46.98)	c_4, c_0,	377 (50.93)
c_2	136 (46.86)	NS	158 (53.74)	128 (39.75)		194 (60.25)	199 (42.80)	c_3, c_2,	266 (57.20)
c_3	141 (42.86)		188 (57.14)	151 (47.94)	c_2, c_0	164 (52.06)	205 (45.05)	c_1	250 (54.95)
c_4	116 (48.12)		124 (51.88)	135 (48.94)		141 (51.09)	183 (56.13)		143 (43.87)

Figures in parenthesis indicate the related percentage values

Taxonomic studies of crop pests and their parasites in Kerala– Ag. 23.19 Ent. 8.01 [Vellanikkara]

The project was aimed to survey, collect and to identify the insect pests occurring on various crops and to study the parasitoids and predators associated with these pests. The records during the year include *Dorylus* on groundnut roots, jewel beetles on citrus leaves, *Popilia* adults on cocoa leaves. Unidentified collections were made from different crops.

Studies on the persistence and dissipation of systemic insecticides in banana Ag. 23. 18 Ent. 19 (Vellayani)

In order to find out the minium number of applications of systemic insecticides for ensuring protection from the banana aphids and to monitor the terminal residues in fruits, these studies were carried out.

Among the toxicants tried, disulfoton persisted longer than phorate and carbofuran. Data on the mortality of the banana aphids exposed to insecticide treated banana plant parts are furnished in Table 1.4.

Studies on the adaptability of sericulture in Kerala Ag. 23.18. Ent. 5.01 (Vellayani)

The objectives of the study were to ascertain the adaptability of seri-culture under different climatic and topographical situations in Kerala and to evaluate the economic viability of sericulture as a cottage industry in the State. The trials were taken up at Vellayani, Pampadumpara and Ambalavayal centres. During the rainy season, growth of mulberry was quite satisfactory in all the three locations. The average cocoon production was 51.3 g/100 layings with 16% silk recovery. The general performance was encouraging.

Data on cocoon characters, leaf consumption, cocoon weight etc. are furnished in table 10.5.

Table 10.5 : Performance of the mulberry silk worms under Vellayani conditions

Particulars	Results obtained		
	Bivoltine strain	Multivoltine strain	Normal standards
Percentage of hatching	92.1	89.6	90
Larval periods in days	23.0	22.0	24.25
Cocoon characters:			
Single cocoon wt. (g)	2.07	1.90	1.5–1.7
Single shell wt. (g)	0.425	0.304	-
% of silk wt.	20.5	16.00	15–16
% of spinning	80	96	75
Leaf consumption per 100 layings (g)	700	650	600–70
Cocoon wt/100 layings (g)	48.68	51.30	35.00

Biological activity of different plant extracts with particular reference to their antifeedant action– Ag. 17.18 8.2 (Vellayani)

The aim of this project was to evaluate the biological activity of different plant extracts with particular reference to their insecticidal, hormonal

Table 1.4: Mortality of banana aphids exposed to insecticide treated banana plants at different intervals

Insecticide dosage/ha	Mode of application	Intervals in months								
		4	5	6	7*	8	9	10	11**	11
Phorate 9 kg	Slurry	76	37	0	3.0	10.0	6.6	0	66.7	60.0
	Base	63	50	0	33.0	10.0	0	0	6.6	0
	Base+axil	50	27	0	3.0	20.0	0	0	20.0	30.3
4.5 kg	Slurry	70	37	0	0	0	0	0	25.0	1.0
	Base	50	10	0	0.3	1.0	0	0	0	0
	Base+axil	63	7	3.0	11.0	6.6	0	0	15.0	13.3
Disulfoton 4.5 kg	Slurry	83	70	6.6	76.0	40.0	30.0	16.6	70.0	60.0
	Base	76	63	6.6	43.0	20.0	10.0	6.6	40.0	10.0
	Base+axil	90	60	13.3	40.0	25.0	23.3	10.0	33.3	30.0
2.25 kg	Slurry	90	47	3.3	16.0	45.0	10.0	0	30.0	16.6
	Base	80	47	10.0	30.0	20.0	20.0	0	40.0	30.0
	Base+axil	56	55	20.0	16.0	40.0	10.0	0	35.0	35.0
Carbofuran 4.50 kg	Slurry	0	13	0	0	6.6	3.3	0	3.3	0
	Base	3	10	0	0	5.0	3.3	0	3.3	0
	Base+axil	20	7	–	0	0	0	0	3.3	0
2.25 kg	Slurry	6	5	0	3	6.6	0	0	16,6	0
	Base	0	15	0	0	0	0	0	10.0	0
	Base+slurry	0	5	0	0	0	0	0	0	0
Control	—	0	0	0	0	0	0	0	0	0

* Observations after the 2nd application of insecticides on the 6th month.

** Observations after the 3rd application of insecticides on the 10th month.

and antifeedant properties. Growth retarding properties of *Clerodendron* and neem extracts on grubs of *Oryctes* were studied. Chopped leaves of *Clerodendron* and neem were mixed with cowdung at 6,3,1.5 and 0.75 kg/60 kg. There was complete mortality of grubs released in treated pits.

Effect of neem and *Clerodendron* in controlling pests of vegetables was studied by spraying water extracts of these leaves at 100 g/litre of water at fortnightly intervals. The persistence of the plant extracts in brinjal and bitter gourd was monitored by exposing grubs of Epilachna beetles. Eventhough the initial mortality was very low, there was complete inhibition of adul emergence in neem treated plants. The effect persisted for a week.

Studies on virus diseases (polyhedroses and granuloses) of iepidopterous crop pests Ag. 17.18.8.11 (Vellayani)

The studies envisaged survey of the virus diseases of lepidopterous crop pests of Kerala and exploration of the feasibility of using promising candidates for pest management. During the year, NPV was recorded on *Psara basalis, Phytometra peponis* and *Margaronia indica*.

Detailed studies on the NPV of *Nymphula depunctalis* covering symptomatology, susceptibility of different instars, nature of polyhedra and persistence of the virus under field conditions were made. All except the sixth instar were highly susceptible to the virus. The polyhedra dissolved completely in weak solutions of NAOH, KOH and Na_2CO_3. The virus had a high thermal inactivation point between 85–90°C.

During the previous year, granulosis virus was recorded on *Pericallia ricini*. The younger larvae of these were found to be more susceptible than older ones.

Granulosis virus diseases of rice leaf folder [Vellayani]

Regular field collections of the leaf folder larvae were made from different locations. Stock culture of the leaf folder was maintained. Different methods of inoculation were tried. Leaves of two month old rice plants were painted with virus suspension containing 0.1% Teepol as wetting agent. The larvae were introduced on the treated leaves and kept inside chimneys. In another method, the painted leaves were kept in specimen tubes and larvae introduced. It was found that the polyhedrosis virus of *Diacrisia obliqua* andt of *Spodoptera mauritia* and the granulosis virus of *Pericallia ricini* were no cross infective to the rice leaf folder.

All India Co-ordinated Research Project on Biological Control of Crop Pests [Vellanikkara]

The objectives of the KAU Centre of the project were to attempt bio-control of the aquatic weed *Salvinia molesta*, terrestrial weed *Eupatorium odoratum* and the Brown plant hopper *Nilaparvata lugens*.

Nucleus cultures of the Trinidad strain of *Paulinia acuminata* were maintained on *Salvinia molesta* in concrete aquaria and glass troughs. Inoculative releases were conducted in different parts of the State and a total of 1300 adults/nymphs were released.

Studies on the predatory fauna associated with *P. acuminata* were continued. The ovipositing females were more prone to predation since they dived in water to reach the lower aspects of the aerial leaf mats to deposit the oothecae.

The nature of water pocket was found to influence the establishment and survival of the grasshopper. In fairly deep ponds and lakes, the establishment was adversly affected by predatory fishes. In such conditions, the nymphs are also fed upon by frogs and spiders. In shallow perennial waters not inhabited by cat fishes, the chances of establishment of the grasshopper are relatively better.

In ecological studies, the maximum egg hatch was obtained at 90% RH at 25° and 28°C. The nymphal duration was the shortest (26 days) at 31°C and 90% RH.

A survey was conducted in parts of Trichur and Ernakulam districts to identify the natural enemies associated with the Brown plant hopper. *Cyrtorhinus lividipennis* occurred widely in all areas surveyed. The number of predatory bugs ranged from 8–51/m^2 as compared to the BPH population of 0 to 685/m^2. Feeding trials revealed that *C. lividipennis* adults fed at the rate of 5–10 BPH eggs per day while the nymphs devoured only 2 eggs per day.

The Coccinellid *Harmonia octomaculata* also occurred all over the rice growing areas of the State. These occurred after attainment of population peaks of the BPH and hence did not play major roles in host population regulation at critical stages.

The feeding capacity of *H. octomaculata* adults and grubs were studied. The adults prefer first, second and third instar nymphs of *N. lugens*. The first instar grubs fed on first and second instar hopper nymphs while the other stages fed on all nymphal stages of the prey.

Survey of the pets of important weeds in Kerala – Ag. 12.19.5.2 [Vellanikkara]

The survey was continued and the records during the year included tingids on *Triumpheta pilosa*, *Nisatra bowringi* on *Clerodendron* sp. and unidentified lepidopterans on *Alternanthera triandra* and *Nezara viridula* on *Cleome viscosa*.

Multiplication, release and field studies of Paulinia acuminata for the bio-control of Salvinia molesta – Ag. 17.18.8.9. [Vellayani]

Observations on the grasshopper populations at Jagathi, Muttom, Manipuzha, Kodimatha were continued. This project was discontinued.

Synergistic effect of fungicide - insecticide mixtures against important plant pathogens and insect pests – Ag. 2.4.17 Path 3 [Vellayani]

The experiment on the campatibility of insecticides and fungicides showed that quinalphos (Ekalux) and monocrotophos (Nuvacron) were compatible with Thiram, Fytolan and Dithane M-45. Mixtures of Ekalux and Fytolan, Dithane M-45 and Thiram were found to give better effect than when Ekalux alone was used.

Studies on the effect of fungicides, insecticides and foliar nutrients on the Phyllosphere microflora of crop plants – Ag. 24.17.19 Path 2.01 [Vellayani]

Periodic sprayings with common plant protection chemicals and foliar nutrients were conducted to monitor changes in the phyllosphere microflora.

Studies on the edible mushrooms of Kerala – Ag. 25.18 Micro. 1.6 [Vellayani]

Local surveys were conducted and different varieties of mushrooms were collected and preserved. Among them, two varieties of *Termitomya* were found to be edible. Few edible species of *Pleurotus* were also collected.

Among the various substrates used for spawn production of paddy straw mushroom, *Salvinia molesta* biomass was found to be quite good. Production of spawn in polypropylene bags were found to be successful.

Monographic studies on edible species of Pleurotus and standardization of techniques for large scale cultivation – Ag. 25.18 (Microb) 5. [Vellayani]

The project aimed at the survey and collection of different species of *Pleurotus*. It was also aimed at morphological studies of the species of *Pleurotus*.

The studies were in progress.

All India Co-ordinated Research Project on Nematode Pests and their Control- [Vellayani]

The experiments on the chemical control of nematodes infesting pepper were in progress.

Phenamiphos and vapam treated plots gave maximum grain yield of rice. Root infection by *Hirshmaniella oryzae* was considerably reduced under treatment with these nematicides. 110 rice soil samples, 83 banana soil samples and 18 from pepper were examined. The species of nematodes recorded in rice soils were *Heterodera oryzae, Hirschmaniella, Hoplolaimus* sp. and *Tylenchorhynchus* sp. The dominant species occurring in pepper and banana soils were *Helicotylenchus* sp., *Radopholus* sp., *Meloidogyne* sp., *Pratylenchus* sp., *Rotylenchulus* sp., *Hoplolaimus* sp. and *Hirschmaniella* sp.

12. Farm Economics, Extension & Agrl. Statistics

HIGHLIGHTS

Agricultural Extension

The farmers in the Package areas (Intensive Paddy Development-Coconut Package, Pepper Package) adopted improved agricultural practices better than their counterparts in control areas.

Studies on the tribals of Kerala revealed that the Kurichians had higher levels of adoption of agricultural practices than the other tribes, while Adiyans showed higher level of adoption of modern living practices. Adiyans had more favourable attitude towards settled agriculture and modern living practices while Paniyans had unfavourable attitude towards these objects.

The panchayat leaders and agricultural leaders had better perception of their agricultural development roles than other categories of leaders.

The Interview method of farm broadcasts was the best mode preferred. The 'Karshika Mekhala Varthakal' was the most preferred farm programme.

Agricultural Economics

A decline in Agmark packers in coconut oil, gingelly oil and ground spices was recorded in Trivandrum district due to the escalation of cost of grading and packing of these commodities.

Agricultural Statistics

New computation formula was developed for D^2 analysis. This is more convenient for programme calculations.

A new technique was developed for the computation of co-variance and for calculations with as many variables as 17 and any number of observations/variables for the Micro 2220.

SUMMARY

AGRICULTURAL EXTENSION

Studies on the impact of selected development programmes among the tribals of Kerala revealed that among the four tribes, Adiyans had high adoption of modern living practices and the Paniyans had an unfavourable attitude. Adiyans in general, had high knowledge level and Kurchians had low knowledge level.

The adoption rate of improved agricultutal practices was found to be more in farmers of the IPD, CP and PP areas than among farmers from the control areas.

In a study on the effectiveness of farm broadcasts through radio, it was revealed that the respondents preferred interviews as the best mode of farm broadcast. The Karshika Mekhala Varthakal was the most preferred farm programme followed by Karshika Rangam, Radio Grama Rangam and Vayalum Veedum in that order.

Studies on the impact of agricultural development programme among the tribals of Kerala showed that farm size, socio-economic status, indebtedness and use of information sources had positive and significant relationship with adoption of improved agricultural practices. Among the tribes studied, Adiyans had favourable attitude towards settled agriculture. The correlation analysis revealed that farm size had a positive and significant relationship with socio-economic status.

Panchayat leaders and leaders from the agricultural sector had better perception of agricultural development roles than other categories of leaders. Farm size, income, knowledge, contact with extension agency and adoption behaviour were correlated with role performance in a significant manner.

The methods of preparation and preservation of tubers revealed that the maximum number of respondents stored the tubers in soil. Roots and tubers were used daily as a main dish by 39 percent of the respondents. Boiling and steaming methods were used for preparing the dishes.

Data collection on the project for the study of the role of national demonstrators in the adoption of improved agricultural practices was completed. For the study on the training of agricultural officers, a questionnaire was prepared, pre-tested and revised.

Data collection on the effectiveness of the agricultural articles published in Kalpadhenu was in progress.

A questionnaire was finalised for the monitoring of the impact of ANP on the beneficiaries.

The projects on the relative effectiveness of selected extension methods in imparting knowledge about food and nutrition and on the attitude of extension personnel towards ANP were taken up for implementation.

Studies on the shelf life of preserved tapioca and sweet potato by different indigenous methods were in progress.

In order to identify leadership pattern and characteristics of leaders in progressive and non-progressive villages, a study was taken up.

The work was in progress in respect of the projects on "The credibility and utilisation pattern of information sources" and "An analysis of role of Junior Agricultural Officers in implementing agricultural development programmes".

To assess gain in knowledge of farmers due to selected training programmes, a project was taken up during the year.

Work was in progress on the role of rural youth in agricultural development of rural areas.

AGRICULTURAL ECONOMICS

The project on the "Income pattern of farm families" was completed during the year.

Details of default of short term credit of 55 Co-operative societies and medium term credit of 52 societies were collected.

In a study on the marketing of Agmark products in Trivandrum District, it was found that the number of packers of coconut oil, gingelly oil and ground spices had declined. This reduction was ascribed to increase in the Agmark label charges and prohibition of the use of second hand tins.

A questionnaire was formulated and finalised for the study of economic analysis of milk production.

The projects on intercropping of coconut and marketing of vegetables could not be taken up during the year.

Basic data on 100 agricultural holdings were collected in the project for area planning in the adopted village at Muttakkad.

Work was in progress to study the influence of labour efficiency on the adoption of improved agricultural practices.

The work was progressing on the project "Differential adoption of recommended agricultural practices of selected crops".

Techno-economic evaluation of utilisation of pump sets in Trichur district was taken up and the work was in progress.

The project on the production and marketing of milk in the Trichur District was taken up for implementation during the year.

AGRICULTURAL STATISTICS

New procedures were developed for regression analysis.

New computation formulae were evolved for D^2 analysis. This is more convenient for programmable calculations.

New Techniques were evolved for the computation of co-variance and for calculations with as many as 17 variables and any number of observations for the Micro 2200. Work was in progress to build up a data bank for the prediction of population, requirement of agricultural inputs, production of crops and other allied aspects.

Data collection and statistical analysis were completed for the project on the studies on the cost of cultivation of sugarcane.

A project on resource efficiency in paddy cultivation in the Kuttanad area was taken up and work was in progress.

PROJECTS IMPLEMENTED

	AGRL. EXTENTION	*Locations*
1	A study on the impact of selected development programmes among the tribals of Kerala (Ag. 16.18. Ext.12.01)	Vellayani
2	Response of special package programmes for agricultural development in Kerala (Ag. 16.18. Ext.8.01)	"
3	Effectiveness of farm broadcasts through radio in disseminating agricultural information to the farmers of Trivandrum District.	"
4	A study of the impact of agricultural development programmes among the tribals of Kerala (Ag.16.18.Ext.9.01)	"
5	A study on the role of leadership in agricultural development in rural areas in Kerala (Ag. 16.18 Ext.9.01)	"
6	A study on the current methods of preparation and preservation of tubers by indigenous methods in Kerala State (Ag. 18.18. Nut-2)	"
7	Study on the role of national demonstrators in the adoption of improved agricultural practices by farmers (Ag. 18.18 Ext. 6.01)	"
8	Study of the training of Agricultural Officers (Ag. 16.18 Ext. 1.01)	"
9	Study on the suitability of articles published in the popular agricultural periodical 'Kerala Karshakan'.	"
10	Study of the effectiveness of agricultural articles published in 'Kalpadhenu'	"
11	Impact of ANP on the beneficiaries (Ag.16.18.Ext.17.01)	"
12	Relative effectiveness of selected extension methods in imparting knowledge about food and nutrition among the rural and urban beneficiaries of nutrition programme (Ag.16 18. Ext 18.01)	"
13	A study on the attitude of extension personnel towards ANP	"
14	A study on the shelf life of preserved tapioca and sweet potato by different indigenous methods in Kerala State (Ag. 17.18. Nut. 1.01)	"
15	Influence of leaders in the development of rural areas	"
16	A study on the influence of labour efficiency on the adoption of improved agricultural practices by farmers and the factors related with it (Ag. 16.18. Ext. 28.01)	"
17	Differential adoption of recommended agricultural practices of selected crops (Ag 16.18. Ext. 27.01)	"
18	The credibility and utilization pattern of information sources by small farmers (Ag. 16.18. Ext. 23.01)	"

19	An analysis of the role of Junior Agricultural Officers in implementing Agricultural Development programmes in Kerala (Ag. 16.18. Ext. 25.01)	Vellayani
20	Effectiveness of the training programme for farmers (Ag. 16.18. Ext. 30.01)	"
21	Role of rural youth in agricultural development of rural areas (Ag. 16.18. Ext. 24.01)	"
AGRICULTURAL ECONOMICS		
22	Income pattern of farm families Ag. 15.18. Agri. Econ. 3.02.	"
23	Overdues of short term and medium term credit of co-operative credit institutions in Trivandrum District (Ag. 12.18.6.4)	"
24	Marketing of Agmark products in Trivandrum District (Ag. 12.18.4.2)	"
25	Economic analysis of milk production (Ag. 15.18. Agri. Econ. 10.01)	"
26	Intercropping of coconut – Maximization of returns (Ag. 15.18. Ag. Econ. 1.01)	"
27	Marketing of vegetables in Trivandrum city (Ag. 15.18 Ag. Econ. 6.01)	"
28	Medium term loans advanced by co-operative institutions in Cannanore District (Ag. 15.18. Ag. Econ. 6.01)	"
29	Area planning - Kerala Agricultural University village, Muttakkad (Ag. 15.18. Ag. Econ. 7.01)	"
30	Study of the cost of cultivation of sugarcane	"
31	Resource efficiency in paddy cultivation in Kuttanad area (Ag. 15.19. Ag. Econ. 15.01)	Vellanikkara
32	Techno-economic evaluation of utilisation of pumpsets in Trichur District (Ag. 15.19. Ag. Econ. 16.01)	Vellanikkara
33	Production and marketing of milk in Trichur District (Ag. 15.19. Ag. Econ. 16.01)	Vellanikkara
AGRI. STATISTICS		
34	Research on statistical methodlogy	Vellayani
35	Futurology studies (Ag. 25.18. Stat. 5.01)	"

AGRICULTURAL EXTENSION

A study on the impact of selected development programmes among the tribals of Kerala – No. AG. 16.18. Ext. 12.01 [Vellayani]

In order to study the personal, psychological, socio-economic and communication characteristics of selected tribes and to study the extent of adoption of modern living practices by the tribals, this study was taken up in the South and North Wynad Taluks of Kerala State. One hundred and fifty tribal families from less developed areas were selected from the four major tribes, viz., Kurumans, Kurichians, Paniyans, and Adiyans. The study revealed that among

the four tribes, Adiyans had high adotion of modern living practices and Paniyans had an unfavourable attitude towards modern practices. Among the eight independent variables (selected, farm size, income, socio-economic status and use of information sources had positive and significant relationship with adoption of modern living practices in the more developed areas. In the less developed area, level of aspiration revealed positive and significant relationship with adoption of modern living practices.

Adiyans in general had high knowledge level and Kurichians had low knowledge level.

Path analysis studies revealed that 87.84% of variation in adoption in more developed area could be explained by four factors, namely, farm size, income, socio-economic status and use of information sources and 85.82% of variation in adoption in less developed area could be explained by three factors, namely, level of aspiration (future) level of aspiration (past) and value orientation.

With regard to attitude towards modern living practices in more developed area, 87.58% of variation could be explained by the five factors, value-orientation, farm size, income, use of information sources and socio-economic status in the more developed area and 91.05% variation in attitude in less developed area could be explained by level of aspiration (future) and value orientation.

Response of special package programme for agricultural development in Kerala Ag. 16.18. Ext. 8.01 [Vellayani]

With the objective of studying the farmers' knowledge and attitude towards the package programme and to study the attitude of Junior Agricultural Officers towards this programme, the project was taken up. The aim was to measure the programme participation, programme knowledge of improved practices and adoption by farmers in the three Package programmes, viz., Intensive Paddy Development Programme (IPD). Coconut Programme (CP) and Pepper Package Programme (PP) functioning in Kerala. Samples from farmers in the three programme units and officials were selected in the study by random sampling.

There was no significiant difference in programme participation between the farmers of the IPD units implemented over five years and less than five years and also between farmers of the CP areas of disease free and disease affected areas. The farmers of PP areas showed better participation than the farmers of IPD areas. There was no significant difference in programme knowledge among the farmers of the IPD and CP areas. The farmers of IPD areas had better knowledge of seed rate, fertilizer requirement, nutrients, liming and high yielding varieties than the farmers of the control areas. The farmers of CP areas had better knowledge of the hybrid seedlings and spacing than control areas. The majority of JAOS and farmers had a favourable attitude towards the respective package programme. The adoption of improved agricultural practices was more in all the Package areas as compared to the control areas. The results of path analysis showed that in all the three programmes, knowledge of improved

practices had maximum direct effect on adoption behaviour. In all the three Package programmes, the major constraints perceived by the JAOs were heavy administrative work, non-reliability of data from village records, inadequate staff and high cost of plant protection chemicals.

Effectiveness of farm broadcasts through radio in disseminating agricultural information to the farmers of Trivandrum District- (Vellayani)

To study was conducted in three CD Blocks of Trivandrum District, viz., Varkala, Nedumangad and Vellanad, to find out the preference of the listeners to the different modes of farm broadcasts. The study revealed that the respondents preferred interviews as the best mode of farm broadcast and this was followed by discussions, question and answer sessions and success stories in that descending order. The 'Karshika Mekhala Varthakal' was the most preferred farm programme, followed by 'Karshika Rangam', 'Radio Grama Rangam' and 'Vayalum Veedum'. Majority of the farmer listeners suggested an increase in the duration of the Karshika Mekhala Varthakal.

Level of education, farm size, crops grown, radio ownership, social participation and discussion amongst the farmers were found to be positively and significantly associated with their mass media exposure behaviour.

A study of the impact of agricultural development programme among the tribals of Kerala– Ag. 17.18 Ext.9.01 (Vellayani)

To study the personal, socio-psychological, situational and communication characteristics of the the tribes in the selected less developed and more developed areas and to study the extent of adoption of improved agricultural practices by the tribes, their attitude towards settled agriculture and also to establish the relationship between the personal characteristics of the tribes, this study was taken up in the south and north Wynad Taluks.

Ten settlements each from less developed and more developed areas were selected randomly to constitute the sample for the studies from among the major tribes, vfz., Kurumans, Kurichians, Paniyans and Adiyans. One hundred and fifty tribal families from developed area and fifty tribal families from less developed area were selected. The study revealed that among the four tribes, Kurichians had high adoption of improved agricultural practices. Of the seven variables tested, only farm size, socio-economic status, indebtedness and use of information sources had positive and significant relationship with adoption of improved agricultural practices in the more developed area. In the less developed area, only farm size and socio-economic status revealed positive and significant relationship with the adoption of improved agricultural practices.

Among the tribes studied, Adiyans had favourable attitude towards settled agriculture and Paniyans had unfavourable attitude.

Inter-correlation analysis revealed that farm size had a positive and significant relationship with socio-economic status in the more developed and less developed areas. The socio-economic status had a positive and significant relationship with indebtedness and use of information sources in the more developed area.

A study on the role of leadership in agricultural development in rural areas in Kerala- Ag.16.18 Ext. 11.01 (Vellayani)

The study was taken up to identify the local leaders and to study their role perception in agricultural development. The objectives were also to study the role performance of identified leaders and to ascertain the factors related to the effective role performance of leaders in agricultural development. This study was conducted in the Arayoor IPD Unit in Trivandrum District and covered five categories of leaders, namely, agricultural. political, co-operative, Ela Committee and the panchayat leaders.

There was no significant difference among all categories of leaders in respect of their age, educational level, communication skill, attitude towards agriculture, and knowledge of the programme and improved agricultural practices. Agricultural and Ela committee leaders had higher farm size, higher income and had adopted more practices as compared to other categories of leaders. Agricultural, Panchayat and co-operattve leaders had high value orientation, high achievment motivation and had more favourable attitude towards high yielding varieties. Leaders in the Co-operative sector had more favourable attitude than other categories of leaders towards fertilizers. Panchayat, Agricultural and political leaders had more favourable attitude than other categories of leaders towards plant protection. Ela Committee leaders had more mass media exposure than other categories. Mass media exposure was significantly correlated with the role performance except in the case of political leaders. Farm size income, knowledge, mass media exposure, contact with extension agency and adoption behaviour were correlated with role performance in a significant manner. Farm size, had significant correlation with income, knowledge, mass media exposure, contact with extension agency and adoption behaviour. Income was found to be significantly cerrelated with knowledge, mass media exposure, contact with extension agency and adoption behaviour.

A study on the current methods of preparation and preservation of tubers by indigenous methods in Kerala State- Ag. 17.18. Nut. 2 [Vellayani]

A survey on the conventional methods of preparation and preservation of roots and tubers was conducted in Trivandrum and Quilon Districts. The survey was conducted in two hundred and fifty farm families randomly selected in the two districts and was intended to find out the pattern of consumption, conventional methods of preparatian and preservation of roots and tubers by income-wise segments of the rural population.

It was found that the roots and tubers used for home consumption by 69 per cent of the respondents were from their own gardens while 18 per cent had the materials from other cultivators. Thirteen per cent of the respondents obtained the materials from local markets. For domestic consumption, fresh tubers were harvested daily by 10 per cent of the respondents while the rest of them harvested the crops once in every 3-4 days.

The maximum number of respondents (30%) stored the tubers in soil. Roots and tubers were used daily as a main dish by 39 per cent of the respondents. Boiling and steaming methods were used for preparing the dishes.

Among the roots and tubers, cassava was found to be stored after chipping in slants and sun drying. In another method, cassava slant chips were dried after parboiling.

Study on the role of national demonstrators in the adoption of improved agricultural practices by farmers– Ag. 16–18 Ent. 6.01 [Vellayani]

This study was taken up to assess the extent of adoption by the national demonstrators on acceptance of demonstrated practices by farmers.

Data collection was completed and statistical analysis was in progress.

Study on the training of Agricultural Officers– Ag. 16.18. Ext. 1.01 [Vellayani]

In order to study the motivation pattern of the trainees and to evaluate the effectiveness of training in increasing knowledge, this project was taken up. The questionnaire was prepared, pre-tested and revised.

Study on the suitability of articles published in the popular agricultural periodical- "Kerala Karshakan"- [Vellayani]

With a view to study the easiness of reading and human interest value of the articles published in the Kerala Karshakan and to estimate the overall readability of the articles, a project was taken up. This was temporarily discontinued.

Study of the effectiveness of agricultural articles published in "Kalpadhenu"- [Vellayani]

The project was taken up to assess the readability of the articles published in Kalpadhenu and to study the preferance of Junior Agricultural Officers and progressive farmers to the nature and content of the articles. The data collection was in progress.

Impact of ANP on the beneficiaries– Ag. 16;18: Ext. 17.01 [Vellayani]

To investigate the extent to which the objectives of the ANP programme have been achieved and to identify the factors influencing the implementation of the programme, the project was taken up. The questionnaire for the study was finalised and data collection was completed.

Relative effectiveness of selected extension methods in imparting knowledge about food and nutrition among the rural and urban beneficiaries of nutrition programme– Ag.16.18. Ext. 18.01 [Vellayani]

In order to determine the most effective combination of selected extension methods for imparting knowledge to the beneficiaries of Nutrition programme and to find out the nature of association between the socio-personal characteristics of the participants on the one hand and the response on the other hand, this project was taken up. The questionnaire was finalised and data collection completed.

A study on the attitude of extension personnel towards ANP [Vellayani]

To find out the attitude of Extension personnel involved in the implementation of ANP towards the programme, studies were conducted. Data collection and statistical analysis were completed.

A study on the shelf life of preserved tapioca and sweet potato by different indigenous methods in Kerala State–Ag. 17.18. Nut. 1.01-[Vellayani]

This was taken up to find out the changes in moisture, colour, smell, taste, texture, presence of weevils and fungal growth in the processed tubers and the effect of these factors on the shelf life. The work was in progress.

Influence of leaders in the development of rural areas–[Vellayani]

To identify the leadership pattern and characteristics of leaders in progressive and non–progressive villages, this study was carried out. The work was in progress.

A study on the influence of labour efficiency on the adoption of improved agricultural practices by farmers and the factors related with it- Ag. 16.18 Ext. 28.01 [Vellayani]

In order to identify the relationship between the efficiency of agricultural labourers employed by the farmers and the extent of adoption of recommended practices of crops, this project was taken up. The work was in progress.

Differential adoption of recommended agricultural practices of selected crops Ag. 16.18 Ext.27.01 [Vellayani]

With the objectives of studying the differences in the extent of adoption of recommended agricultural practices in the selected crops and to understand the factors contributing to differential adoption of the practices, this project was taken up. The work was progressing.

The credibility and utilization pattern of information by small farmers Ag. 16.18.Ext. 23.01 [Vellayani]

The objectives of the project were to identify the source utilization pattern of small farmers at different stages of innovation decision process and to assess the credibility of the sources utilized by the small farmers. The work was in progress.

An analysis of the role of Junior Agricultural Officers in implementing Agricultural Development programmes in Kerala-Ag. 16.18. Ext. 25.01 [Vellayani]

This study was taken up to delineate the components of the role concept as applied to the role of Junior Agricultural Officers in the Department of Agriculture, Kerala and to determine the relevance and relationship between the components of the role concept as judged by the Officers in the Department of Agriculture. The work as in progress.

Effectiveness of the training programme for farmers–Ag. 16.18. Ext. 30:01 [Vellayani]

To assess the gain in knowledge of farmers due to the selected training programmes, this study was taken up. The work on this was in progress during the year.

Role of rural youth in agricultural development of rural areas- Ag. 16.18. Ext. 24.01 [Vellayani]

To study the role of rural youth clubs in Agricultural development as perceived by members of rural youth clubs, officials etc. and to study the factors related to the role performance of rural youth, this project was taken up and work was in progress.

Income pattern of farm families–Ag. 15.18. Agri. Econ. 3.02 [Vellayani]

With a view to ascertain the income of farmers from agricultural and non agricultural sources and to find out the relationship between the size of holdings and cropping pattern to the pattern of income, the project was implemented and this was completed during the year.

Overdues of short term and medium term credit of co-operative credit institutions in Trivandrum District-Ag. 12.18.6.4 [Vellayani]

To estimate the extent of overdues of short and medium term credit of co-operative credit institutions and to identify the factors responsible for overdues, this study was taken up. Details of default of short term credit of 63 Service Co-operative Societies and medium term credit of 52 Service Co-operatives were collected. Work on the processing of data was in progress.

Marketing of Agmark products in Trivandrum District-Ag. 12.18.4.2 [Vellayani]

In order to estimate the producer's margin of returns and the trader's margin of profit in marketing of Agmark products, the project was taken up. The commodities included in the study were coconut oil, gingelly oil honey and ground spices. There was a decline in the number of packers of these materials except honey. This was ascribed to the increase in Agmark label charges and prohibition of the use of second hand tins.

Economic analysis of milk production– Ag. 15.18. Agri. Econ. 10.01 [Vellayani]

This study was taken up to estimate the the cost of feed per cow/buffalo and the milk production per day of cows and buffaloes in relation to farm size. Preparation of questionnaire and the selection of sample for conducting survey work was completed.

Intercropping of coconut–Maximization of returns– Ag. 15.18. Ag. Econ. 1.01 [Vellayani]

Work on this project was not taken up during the year.

Marketing of vegetables in Trivandrum city– Ag. 15–18–Ag. Econ 3.01 [Vellayani]

Dependable data were not available and hence the project was discontinued.

Medium term loans advanced by Co-operative institutions in Cannanore District– Ag. 15–18–Ag. Econ 6.01 [Vellayani]

Due to technical reasons this project was not taken up.

Area planning – Kerala Agricultural University village, Muttakkad– Ag. 15. 18. Ag. Econ. 7.01 [Vellayani]

To understand the existing utilisation of resources of the Muttakkad village and to evolve alternate plans for the development of the resources potential, this study was taken up. Basic data on 100 agricultural holdings were collected.

Study of the cost of cultivation of sugarcane– [Vellayani]

Data collection and statistical analysis were completed.

Resource efficiency in paddy cultivation in Kuttanad area– Ag. 15. 19 Ag. Econ. 15.01- [Vellayani]

In order to estimate the extent of use of resources in paddy cultivation in the Kuttanad area and to estimate the efficiency of resources, the study was undertaken. Work was in progress.

Techno-economic evaluation of utilisation of pumpsets in Trchur District– Ag. 15. 19. Ag. Econ. 16.01– [Vellayani]

The objectives were to study the factors influencing selection of pumpsets by farmers and to estimate the divergence between actual performance of various types of pumpsets in field conditions and their rated capacities. Data collection was in progress during the period.

Production and marketing of milk in Trichur District– Ag. 15. 19. Ag. Econ. 16.01 [Vellanikkara]

Data collection on this project was in progress to study the sources of finance for purchase of milk animals, and to analyse the impact of dairy enterprise on resource use at farm level.

AGRICULTURAL STATISTICS

Research on statistical methodology [Vellayani]

Procedure were developed for regression analysis which enable the inclusion of more variables in the analysis.

New computation formulae was evolved for D^2 analysis. This is more convenient for programmable calculations.

New techniques were evolved for the computation of co-variance and calculations with as many as 17 variables and any number of observations for the Micro 2200.

Futurology studies– Ag. 25. 18. Stat. 5.01 [Vellayani]

With the aim of building up a data bank and to utilise the information for prediction of population, requirement of agricultural inputs, production of crops and other allied aspects, this project was taken. Work was in progress.

13. Soil Conservation and Farm Mechanisation

HIGHLIGHTS

The results of preliminary studies on the mechanical control of the floating type aquatic weed *Salvinia molesta* using a 5 HP harvesting machine were quite encouraging. A strong possibility for developing economically viable prototype systems for harvesting this weed has thus emerged. Both laboratory and pilot plant level studies indicated that bio-gas production from the *Salvinia* weed mass was comparable to that from cowdung. In studies on the small scale equipments for wet processing of coconut, the round type grater was found to be more promising when worked at 360 rpm. In sandy-loam soils, the method of puddling and soil compaction were found to have very little influence on the water loss and yield of grain. This suggested that in sandy-loam soils, only minimum tillage need be given. Amaranthus and bhendi responded well to drip irrigation.

SUMMARY

The basic chasis design for the garden tractor was altered to suite 5 HP light weight engine which was to be used as the prime mover. Work on a tractor and trailer combination was in progress at Vellanikkara.

Work on the design and fabrication of a wind powered water pump was not taken up for want of workshop facilities at Vellayani.

The projects on the development of granular fertilizer applicator and Manual weeder were discontinued.

As part of the studies on the mechanical control of the floating type of aquatic weeds, the 5 HP pumpset which was to be used as the prime mover was calibrated. The jet devise was field tested with this pumpset as the prime mover. It was found that 5-10% by weight of weed materials can be pumped by the system for a given rate of pumping. This in turn indicated the strong possibility for developing economically viable prototype systems.

Laboratory and pilot plant level studies had shown that bio-gas production from *Salvinia* was comparable to that from cowdung.

Preliminary experiments were conducted on a small seed drying unit which utilised carbon filament bulbs which had higher heat output than conventional bulbs. The temperature distribution across the section was found to be satisfactory. It was considered that the unit as such would have potential as a small scale vegetable seed drier.

A variable speed motor drive was set up and preliminary studies on the performance of different types of grating tools at three different speeds were made. The study indicated that a round type grater at 360 rpm performed better and offered greater ease of operation.

An experimental set up to operate the pedal thresher at various speeds utilising a variable speed drive unit was completed.

Neither grain yield nor water loss was influenced by puddling and soil compaction in sandy-loam soil.

The project on the utilisation of sub-surface water for irrigation through sub-surface drains was continued during the year.

Studies on the drip irrigation technique were continued. Amaranthus and bhendi responded very well to drip irrigation.

PROJECTS IMPLEMENTED

		Locations
Energy Sources Development		
1	Development of low cost garden tractor (Ag. 19.19. Engg. 8)	Vellanikkara
2	Design and fabrication of a wind powered water pump (Ag. 19.18. Engg. 9)	Vellayani
Machinery development for crop production		
3	Development of a granular fertilizer applicator (Ag. 19.18. Engg. 3)	Vellayani
4	Development of a seed drill for upland paddy (Ag. 19.18. Engg. 4)	Vellayani
5	Development of a Manual weeder (Ag. 19.18. Engg. 5)	Vellayani
6	Devising mechanical barrier to protect cocoa pods from the attack of squirrels (Ag. 19.19. Engg. 12)	Vellanikkara
7	Survey of agricultural implements and machinery used in Kerala (Ag. 19.19. Engg. 15)	,,
8	Application of electrical energy for control of field rats in Kuttanad (Ag. 19.19. Engg. 16)	,,
Control and utilisation of aquatic weeds		
9	Preliminary studies on mechanical control of floating aquatic weeds (Ag. 19.19. Engg. 2)	,,
10	Utilization of aquatic weeds for bio-gas production (Ag. 19.19. Engg. 13)	,,
Post-harvest technology & processing systems		
11	Development of a low cost paddy drier (Ag. 19.19. Engg. 6)	,,
12	Small scale equipment for wet processing of coconut (Ag. 19.19. Engg. 14)	,,
13	Development of small scale threshing equipment for paddy (Ag. 19.19. Eng. 18)	,,
Soil conservation and land reclamation		
14	Preliminary studies on equipment and systems for reclamation of kayal lands (Ag. 19.19. Engg. 7)	,,
On-farm irrigation equipments & systems		
15	Trials to find out alternate structures for bunds which do not harbour weeds (Ag. 19 5. Engg. 1)	Moncompu
16	Application of Jet pumps for low lift irrigation (Ag. 19.19. Engg. 10)	Vellanikkara
17	Utilization of filter point wells for high volume pumping (Ag. 19.19. Engg. 11)	,,
18	Design and fabrication of an improved manually operated water pump (Ag. 19.19. Engg. 17)	,,

19	Study on the effect of impervious layers to prevent percolation losses for increasing irrigation efficiency (Ag. 1.3.1.11)	Chalakkudy
20	Utilization of subsurface water for irrigation through sub-surface drains (Ag. 1.3.1.14)	"
21	To develop a drip irrigation technique and to assess its advantages over the furrow method of irrigation for vegetables (Ag. 1.3.1.14)	"

Development of low cost Garden Tractor-Ag.19.19. Engg. 8 [Vellanikkara]

The newly acquired 5 HP light weight engine was utilised as the prime mover and the basic chasis design was altered to accommodate this engine.

The fabrication of a new chasis and trailer combination to form a motorised cart was in progress.

Design and fabrication of a wind powered water pump-Ag.19.18. Engg.9 [Vellayani]

The work could not be undertaken due to lack of workshop facilities. Fabrication work through the Agro-Industries Corporation also did not materialise.

Development of a granular fertilizer applicator-Ag. 19.18. Engg.3 [Vellayani]

Discontinued in the year.

Development of a seed drill for upland paddy-Ag.19.18 Engg.4 [Vellayani]

Discontinued during the year.

Development of a manual weeder-Ag. 19 18. Engg. 5 [Vellayani]

Discontinued during the year.

Devising mechanical barriers to protect developing cocoa pods from the attack of squirrels-Ag.19.19 Engg. 12 [Vellanikkara]

The project was concluded.

Survey of agricultural implements and machinery used in Kerala-Ag. 19.19. Engg. 15 [Vellanikkara]

The project could not be implemented due to lack of staff assistance.

Application of electrical energy for control of field rats in Kuttanad-Ag. 19.19. Engg 16 [Vellanikkara]

The project was planned to utilise consultancy from KELTRON, Trivandrum

Preliminary studies on mechanical control of floating type aquatic weeds-Ag.19.19. Engg. 2 [Vellanikkara]

The light weight 5 HP pumpset purchased specially for the project was calibrated at the Government College of Engineering, Trichur. The jet device was field tested with this pumpset as the prime mover. Approximate measurements indicated that 5-10% by weight of weed materials could be pumped by the system for a given rate of discharge. This result, indicated the strong possibility of making economically viable prototype systems for harvesting *Salvinia* weeds.

Action was taken to acquire high capacity pumpsets and to design jet systems to match such prime movers.

Utilisation of aquatic weeds for bio-gas production-Ag. 19.19 Engg. 13 [Vellanikkara]

Both laboratory level and pilot plant level studies had indicated that bio-gas production from the *Salvinia* weed was comparable to that from cowdung.

The pilot plant design was modified for increasing the holding capacity and improving the gas production rate.

Development of a low cost paddy drier-Ag. 19.19.Engg.6 [Vellanikkara]

Preliminary experiments were made on a small drying unit which utilized carbon filament bulbs, which have higher heat output than conventional bulbs. The temperature distribution across the section, measured by mercury thermometers, was found to be satisfactory. It was considered that the unit as such would have potential application more as a small scale vegetable seed drier than as paddy drying unit.

Small Scale equipment for wet processing of coconut- Ag. 19.19. Engg. 14 [Vellanikkara]

A variable speed motor drive was set up and preliminary studies on the performance of different types of grating tools at three different speeds were made. The study indicated that the performance of round type grater at 360 rpm offered greater convenience of operation and comparable output in relation to other tools and speeds tried.

Development of a small scale threshing equipment for paddy-Ag-.19.19. Engg. 18 [Vellanikkara]

An experimental set up to operate the pedal thresher at various speeds, utilising a variable speed drive unit was completed.

Preliminary studies on equipment and systems for reclamation of Kayal lands Ag. 19.19. Engg. 7 [Vellanikkara]

The studies were discontinued due to lack of supporting staff.

Trials to find out alternate structures for bunds which do not harbour weeds Ag.19.5. Engg.1 [Moncompu]

This project was discontinued.

Application of jet pump for low lift irrigation-Ag. 19.19. Engg. 10 [Vellanikkara]

A light weight pumpset was purchased. Owing to lack of staff assistance, the work on field trials for the jet pump device already developed, could not be taken up.

Utilization of filter point wells for high volume pumping - Ag. 19.19. Engg. 11 [Vellanikkara]

This project could not be taken up during the year.

Design and fabrication of an improved manually operated water pump-Ag. 19.19. Engg [Vellanikkara]

The fabrication work of the unit was completed. Extensive tests at laboratory and field levels are planned for the next year.

Study on the effect of impervious layers to prevent percolation losses for increasing irrigation efficiency-Ag. 1. 3. 1. 11 [Chalakkudy]

The experiment started during 1974–75 was concluded during this year. The grain yield and water losses were not significant.

This indicated that the method of puddling and soil compaction, had no infruence on grain yield.

Utilization of sub-surface water for irrigation through sub-surface drains- Ag.1.3.13 (Chalakudy)

The experiment was continued during 1979–80. In addition to the 10 cm tile laid during 1976–78 an aditional 15 cm tile line was laid during 1979-80. The slops given to the old tile line was 0.2%. The slope given to the new tile line was 0.1%. The yield from the new tile line was more than double that of the old line. The flow along the old tile line had stopped by the end of January while that in the new line continued till March

Development of drip irrigation technique and to asses its advantages over the furrow method of irrigation for vegetables Ag. 1.3.1.14 (Chalakkudy)

The low pressure drip irrigation system developed at the Station during 1977–78 continued to work satisfactorily without any substantial replacement of parts and accessories. Practically there was no problem of clogging and in rare cases of blocking, tapping on the tubes removed such obstructions. The total cost for the system worked out to Rs. 3500–4500 per hectare and the system could be fabricated with materials available locally. Amaranthus and bhendi responded well to drip irrigation. The yield increase in the case of bhendi was significant while that of amaranthus was not. The treatment were

1	IW/CPE ratio 1.0	with N & K dissolved in irrigation water and P as soil application	(Drip	irrigation)
2	IW/CPE ratio 0.7	(quautity as per current Package		
3	IW/CPE ratio 0.4	of Practices)	(,,	)
4	IW/CPE ratio 1.0	Soil application of NPK as per	(,,	)
5	IW/CPE ratio 0.7	Package of Practices.	(,	)
6	IW/CPE ratio 0.4		(,,	)
7	IW/CPE ratio 1.0		(Furrow irrigation)	
8	IW/CPE ratio 0.7	,,	(,,	)
9	IW/CXE ratio 0.4		(,,	)

The treatments 7, 2 and 1 were on par in the case of bhendi.

The results indicated the possibility of effectively and profitably utilising the small quantities of water avilable in the tanks and wells surrounding the ricee fields, to raise vegetable crops.

PART II

FACULTY OF VETERINARY & ANIMAL SCIENCES

I. Cattle

HIGHLIGHTS

A corrective factor was found to be essential in the calculation of total solids of milk when different formulae were employed for the purpose. Coffee husk can be incorporated in the concentrate ration of dairy cows up to 20% for economic milk production. By using this cheap concentrate mixture, the cost of production per kg of milk could be reduced to Rs. 1.33 as against Rs. 1.42 in the conventional feed. Coconut pith possesses a value of zero DCP and 62.7 TDN and this can be used up to 20% in the concentrate ration of growing calves. Spent anatto seed possesses a DCP value of 7.9 and TDN value of 67.2. Calves reared in open were clinically as healthy as those maintained in the barn shed.

SUMMARY

Coffee husk, coir waste and spent anatto seeds were subjected to feeding trials and it was indicated that coffee husk fed at 20% level in the concentrate mixture of dairy cattle helped to reduce substantially the cost of production of milk. Similarly, it was found that coconut pith and spent anatto seeds could be used in the ration of growing calves up to 20% level without any deleterious effects.

In the estimation of total solids of milk by employing the available formulae such as Richmond, I. S. I., modified Richmond and Ling, it was found that a correction factor was essential to get the values in close agreement with those obtained by the gravimetric method.

Experiments were conducted to ascertain the relationship of blood constituents in heifers to their future milk producing ability. Studies were also undertaken to elucidate the role of lactoferrin in milk production and diseases associated with milk production. In the area of selection and the genetic improvement of the dairy herd, studies on the milk production efficiency and fertility score in cross bred dairy cattle were initiated. The animals culled from the University Livestock Farm for reasons other than diseases were used to ascertain the carcass yield and meat characteristics. The physiological responses of crossbred cattle to the environmental stress have been studied and it was observed that cross bred calves reared in open were clinically as healthy as those maintained in the barn shed.

PROJECTS IMPLEMENTED

DAIRY SCIENCE

1	Relationship of blood constituents in hefiers to their future milk producing ability (VA-1-1-6-7)	Mannuthy
2	Studies on some aspects of physiology of lactation (VA-1-1-6-8)	"
3	Determination of solids content of milk by specific gravity Lactometer (VA-1-1-6-10)	"
4	Composition of milk of cross-bred cattle (VA-1-1-6-11)	"

NUTRITION

5	Utilisation of paddy straw treated with urea and molasses as cattle feed (VA-1-1-9-1)	"
6	Poultry litter as cattle feed (VA-1-19-2)	"
7	Nutritive value of cheap (all concentrate) ration for cattle (1) Based on coir waste (coconut pith) (VA-1-1-9-10 (b) (25)	"
8	Evaluation of coffee husk for milk production in cows (VA-1-1-9-12)	"
9	Evaluation of the nutritive value of coconut pith (coir waste) for cattle (VA-1-1-9-10)	"
10	Evaluation of the nutritive value of spent anatto seeds (*Bixa orellana*) for cattle (VA-1-1-9-19)	"
11	Feeding value of coconut pith (coir waste) for growth in cross-bred calves (VA-1-1-9-24)	"
12	Effect of spent anatto seed (*Bixa orellana*) feeding on growth rate in cross-bred calves- (VA-1-1-9-26)	"

PHYSIOLOGY

13	Studies on the environmental physiological responses of cross-bred animals at the Cattle Breeding Farm, Thumburmuzhi (VA-1-1-13-2)	Thumburmuzhi

BREEDING & GENETICS

14	Genetic study on milk production efficiency and fertility score in cross-bred dairy cattle (VA-1-1-4-1)	Mannuthy

MEAT QUALITIES

15	Carcass yield and certain meat characteristics of cattle (VA-1-1-17-1)	"

DAIRY SCIENCE

Relationship of blood constituents in heifers to their future milk producing ability- VA-1-1-6-7 [Mannuthy]

Recognising the limitations of phenotypic selection for improving dairy production, attempts were made to establish a correlation between blood constituents and the future milk producing capacity of heifers for purposes of selection. Twenty seven female calves from the University Livestock Farm Mannuthy have

been used for the experiment. The blood samples from these female calves were collected from the age of 3 months up to 12 months and the RBC count, haemoglobin content and haematocrit value, were estimated. The values of haemoglobin/RBC count, haemoglobin/haematocrit value and haematocrit value/RBC count were studied in relation to the future milk yield of the experimental animals. All the 27 animals in the experiment had calved and had completed their first lactation. The milk yield of these animals was converted to a 305 day lactation equivalent basis. The data collected on blood values and milk yield are being analysed statistically. The work was in progress.

Studies on some aspects of physiology of lactation- VA-1-1-6-8 [Mannuthy]

Lactoferrin is an iron binding protein found in milk. It has been found in milk of many species including cattle and man. Its function in milk is not known. The role of lactoferrin in the prevention of Mastitis is not known.

The present investigation was undertaken to study the distribution pattern of immunoglobulins and nature of lactoferrin in milk and to study the metabolism of natural and synthetic hormones during induction of lactation.

Work on the standardisation of methods for estimation of immunoglobulins was in progress.

Determination of solids content of milk by specific gravity lactometer- VA-1-1-6-10 (Mannuthy)

The objective of the present study was to derive a suitably modified formulae for determination of solids in milk especially those having a high fat content using the specific gravity lactometers from the existing formulae available for such determination.

A total of 207 samples of milk from the University Livestock Farm, Mannuthy were collected for the study. The samples were analaysed for fat by Gerber's method. The total solids in milk were determined by the gravimetric method and also estimated by using the different formulae such as Richmond, ISI, Modified Richmond and Ling. Two types of lactometers viz., Zeal and Quevenne were used for getting the lactometer reading. In the samples analysed, the fat percentage varied from 3.0 to 9.0. The total solids as determined by the gravimetric method was found to vary from 10.95 $\pm$ 0.31 to 17.83 $\pm$ 0.35. The total solids percentage as calculated by the different formulae was found to be 10.38 $\pm$ 0.25 to 17.25 $\pm$ 0.21. The calculated values were not found to agree with the values obtained by the gravimetric method and hence a correction factor was found essential. The analysis of more number of samples was continued to arrive at the extact correction factor. The work was in progress.

Composition of milk of cross bred cattle- VA-1-1-6-11 (Mannuthy)

The present study was taken up to collect authentic data on the composition of milk of crossbred cattle reared in the State and to study the factors that modify the composition.

A total of seven animals (Jersey cross bred) have been included in the study for the period. The milk samples were collected from the beginning of the lactation at weekly intervals and 124 samples were analysed so far for fat, protein, lactose and ash. The values for fat, protein, lactose and ash ranged from 2.2 to 9 5, 2.8 to 5.21, 2.50 to 5.73 and 0.23 to 0.90 respectively. The work was in progress.

NUTRITION

Utilisation of paddy straw treated with urea and molasses as cattle feed– VA–1–19–1 (Mannuthy)

Based on the fact that the non–protein nitrogen can be utilised by the ruminant for the synthesis of their body protein, attempts were made to fortify paddy straw, a nutritionally poor quality roughage, with a non–protein nitrogen source such as urea along with readily available cheap source of energy such as molasses

Paddy straw treated with 2% urea and 10% molasses was found to be palatable for lactating cows and preliminary observation indicated no adverse effects on milk production or on any physiological functions. Further work on the above aspects was in progress.

Poultry litter as cattle feed– VA–1-1.9–2 (Mannuthy)

The feasibility of incorporating poultry litter in the ration of ruminants to reduce the feed cost has been explored. Poultry litter was found to contain 16% protein and 2.15% calcium. Work on the processing of poultry litter for feeding purposes was in progress.

Nutritive value of cheap (all concentrate) ration for cattle (1) *Based on coir waste* (*coconut pith*) –VA-1-1-9–10 (b) (25) (Mannuthy)

Over one lakh tons of coconut pith (coir waste) is estimated to be available from the mechanised defibring units in the State. Preliminary studies conducted to evaluate the feeding value of coconut pith for cattle revealed that the material has a high TDN of 62.7. The feasibility of incorporating this material in 'all concentrate' ration for cattle particularly in the wake of rising cost of such poor quality roughages as paddy straw was explored with a view to evolve cheap and balanced ration for cattle.

All concentrate rations with different levels of coir waste were tried on bullocks. A ration containing 30% coir waste as indicated below was found to be fairly palatable.

Ingredient	*Percentage incorporation*
Coconut pith (coir waste)	30
Tapioca starch waste	26
Groundnut oil cake	22
Mineral mixture	1
Salt	1
paddy straw	20
Total	100
Calculated DCP	9.0
,, TDN	52.0
Cost/quintal	Rs. 63.70

A digestion-cum-metabolism trial on bullocks fed on the above ration was conducted and work on the analysis of the biological materials collected during the trial was in progress.

Evaluation of coffee husk for milk production in cows VA-1-1-9-12 *(*Mannuthy*)*

The availability of coffee husk, a byproduct of the coffee processing industry, has been estimated as 44,450 tons in the country and the bulk of it is contributed by Kerala. Preliminary studies have indicated that coffee husk is palatable for bullocks and can profitably be incorporated up to 10% in the rations of growing calves. The DCP and TDN of the material has been estimated to be 3.1 and 50 respectively. The present investigation was undertaken to assess the feeding value of coffee husk for milk production in cows so as to incorporate the same in the concentrate mixture for bringing down the cost of feeding and also to find out the effect of coffee husk feeding on the characteristics of butter fat.

Lactation studies involving 9 cows divided into 3 groups of 3 animals each in a three month switch over trial and fed respectively with 0, 10 and 20 percent coffee husk replacing rice bran in the dairy concentrate rations were completed.

The coffee husk used for the study contained 6.75% moisture, 7.58% crude protein, 30.5% crude fibre, 2.04% ether extract, 54.34% nitrogen free extract and 5.99% total ash. Coffee husk was incorporated in the experimenta ration to get a DCP of about 17% and a TDN of 68% as follows:

Ingredients	Ration		
	0% coffee husk (control)	10% coffee husk	20% coffee husk
Groundnut cake	30	30	32
Maize	32	32	32
Rice bran	35	25	11
Coffee husk	...	10	20
Common salt	2	2	2
Mineral mixure (calciphos)	1	1	1
Vitamins (*)			
Cost per quintal (Rs)	103.50	99.50	98.0

(*) Vitablend (Vitamin AD_3) Livestock was added at the rate of 100g/500 kg of mixed feed (1000 IU/kg concentrate of Vitamin A and 1000 IU of vitamin D_3/kg concentrate.

The total milk production (4% fat corrected milk) for 90 days of the animals on 0, 10 and 20% coffee husk in the ration was 1393 13, 1293.29 and 1410.55 kg respectively. All the cows gave milk containing the normal percentage of total solids The analysis of blood samples for blood values like haemoglobin content, packed cell volume and total erythrocyte count indicated that all the animals had

normal physiological status. The data relating to some of the physical and chemical constants of butter fat indicated that the values were normal and within the range. The feeding of coffee husk at 10 or 20% level in the concentrate mixure did not influence the body weight of the animals to any significant level. Though no significant differences were observed in respect of the quality and quantity of milk produced by cows in the different treatments, animals receiving 20% coffee husk in their ration produced slightly more quantity of 4% fat corrected milk than those of other groups. The total cost of feed for producing one kg of milk in animals getting 0, 10 and 20% level in the concentrate mixure. It was concluded that coffee husk can profitably be incorporated in the ration of diary cows up to 20% level for economic milk production.

Evaluation of the nutritive value of coconut pith (coir waste) for cattle – VA-1-1-9-10 [Mannuthy]

Preliminary studies on the chemical composition of coconut pith (coir waste) revealed that it was a rich source of soluble carbohydrate and could form a potential sorce of energy for livestock. Palatability and digestibility trials with the material in bullocks revealed that coconut pith is fairly palatable and possesses DCP and TDN values of zero and 62.7 respectively.

Evaluation of the nutritive value of spent anatto seeds (Bixa orellana) for cattle – VA-1-1-9-19 [Mannuthy]

Spent anatto seeds obtained as a by-product after extraction of dye and oil was found to contain 11.8% crude protein and 62.4% nitrogen free extract. Palatability and digestibility trials with the material in bullocks revealed that it was fairly palatable and possessed DCP and TDN values of 7.9 and 67.2 respectively.

Feeding value of coconut pith (coir waste) for growth in crossbred calves – VA-1-1-9-24 [Mannuthy)

Ingredients	Concentrate mixtures		
	0% coconut pith (control)	10% coconut pith	20% coconut pith
Groundnut cake	33	34	35
Tapioca chips (dried)	30	29	28
Rice bran	34	24	14
Coconut pith (coir waste)	...	10	20
Mineral mixture (*)	1.5	1.5	1.5
Salt	1.5	1.5	1.5
Vitamin supplement	**	**	**
DCP (Calculated)	15.8	15.8	15.8
TDN (Calculated)	66.3	66.7	65.3
Cost per quintal	111.12	109.19	107.27

(*) Calciphos

(**) Vitamin A supplement was added at the rate of 8000 IU/Kg concentrate feed

Growth studies involving 18 Jersey cross-bred calves of 6 ot 9 months of age, divided into three equal groups and fed on concentrate rations containing 0, 10 and 20% coconut pith respectively as indicated below with paddy straw as the sole roughage were carried out for a period of 184 days.

Data obtained on DCP and TDN intakes, nitrogen balance and digestibility coefficient of various nutrients in the ration obtained from metabolism trials were almost similar. No significant differences were observed in respect of the rate of body weight gain per day for the calves in 0, 10 and 20% coir waste ration which were 346.92 ± 8.91 g, 369.53 ± 15.31 g and 313.4 ± 13.06 g respectively and were found to be satisfactory and comparable to values reported for cattle. The feed efficiency in terms of concentrate alone were 6.66, 6.23 and 7.37 respectively for the control, 10% coconut pith and 20% coconut pith ration and cost of feeding concentrates per unit grain in body weight worked out as Rs. 7.39, Rs. 6.80 and 7.90 respectively. All the animals showed positive nitrogen balance. The results indicated that coconut pith can be used as a feed ingredient up to 20% level in concentrate rations for growing calves.

Effect of feeding spent anatto seeds (Bixa orellana) on growth rate in crossbred calves-VA-1-1-9-26 [Mannuthy]

Growth studies involving 12 Jersey crossbred calves of 6 to 9 months of age divided into two equal groups and fed on concentrate ration containing 0 and 20% spent anatto seed respectively as indicated below with paddy straw as the sole roughage were carried out for a period of 153 days.

Ingredients	Concentrate mixtures	
	0% spent anatto seed (control)	20% spent anatto seed
Groundnut cake	33	31
Tapioca chips (dried)	30	26
Rice bran	34	20
Spent anatto seeds	—	20
Mineral mixture (*)	1.5	1.5
Salt	1.5	1.5
Vitamin supplement	**	**
DCP (calculatd)	15.8	15.8
TDN (calculated)	66 3	66.5

(*) Calciphos

(**) Vitamin A supplement was added at the rate of 8000 IU/kg concentrate feed

Data obtained on DCP and TDN intakes, nitrogen balance and digestibility coefficient of various nutrients in the ration obtained from metabolism trials were almost similar. Significant differences were not observed in respect of the rate of body weight gain per day for the calves in 0 and 20% spent anatto rations which were 390.0 ± 11.5 g and 330.00 ± 21.70 g respectively and were found to be satisfactory and comparable to values reported for cattle. The feed efficiency in

terms of concentrates alone were 5.71 and 6.84 respectively for the control and 20% anatto groups and the cost of feeding concentrates per unit gain in body weight worked out as Rs. 6.35 and 6. 90 respectively. All the animals maintained positive nitrogen balance. The results of the study indicated that though spent anatto seeds can be placed in the list of usable unconventional feeds for cattle, its inclusion at 20% level in the concentrate mixture failed to show any monetary advantage.

PHYSIOLOGY

Studies on the environmental, physiological responses of crossbred animals at the Cattle Breeding Farm, Thumburmuzhi–VA-1–1–13–9 [Thumburmuzhi]

Though the milk production in the, State has been increased considerably with the introduction of the cross breeding programme with exotic breeds of cattle data on the environmental, physiological responses of these crossbred animals under different agro-climatic conditions as it exists in the State is scanty. The project was designed to obtain basic information on the physiological response of cross bred cattle with special reference to rearing them under confinement *vis a vis* semi intensive system.

Twelve crossbred calves were divided tnto two equal groups. While the calves in the control group were housed in barn sheds, those in the experimental group were let loose in an enclosed area with a thatched central shed. All ihe animals were mainted under identical nutritional regime. Data on body weight gain, body measurements, daily feed and water intake were collected. Rectal temperature, pulse and respiration rate were recorded simultaneously with the ambient temperature and relative humidity. The data obtained so far have indicated that the experimental group of calves reared the open were clinically as healthy as those mainted in the barn shed. The experimental group appeared to spend more time in the shed during march than in the months of January and February The experiment was continuing.

BREEDING & GENETICS

Genetic study of milk production efficiency and fertility score in cross-bred dairy cattle– VA–1–1–4–1 [Mannuthy]

In order to find out whether milk production efficiency in the first lactation can be used as an indicator for life time milk production efficiency which will help serve as criteria for selection in cross bred cattle, it was proposed to analyse the data available in the University farms. Data on peak yield and persistency of lactation among cross–bred dairy cows were being gathered. The work was in progress.

MEAT QUALITIES

Carcass yield and certain meat characteristics of cattle– VA-1-1–17-1 [Mannuthy]

As a preliminary step to the introduction of the beef farming and meat trade in the State, data on the carcass yield and other characteristics of cattle of different breeds. age and sex were collected. The unproductive animals of the University Livestock Farm were utilized for this study. The main items of observations were live weight, breed, age, sex, carcass yield, meat yield and the proportion of edible and inedible offals.

So far, a total of 166 cattle were subjected to the study. The study was in progress.

2. Buffalo

HIGHLIGHTS

Buffaloes exhibited superior growth rate than crossbred cattle when maintained on a higher plane of nutrition. Buffaloes showed lesser variation in respiration rate than crossbred cattle under the prevailing agroclimatic conditions in the central zone of Kerala. During the first six months of age, the growth rate in terms of shank circumference in buffaloes was negligible.

SUMMARY

Studies on the meat potentialities and meat qualities of buffaloes in Kerala were in progress. The variation in the respiration rate in crossbred cattle were much more than in the case of buffaloes. The mean monthly weight gain in buffaloes fed at 140% of Morrison Feeding Standard (experimental) and at 100% of Morrison Feeding Standard (control) were 11.5 kg and 8.05 kg respectively as compared to the respective figures of 9.86 kg and 8.85 kg for crossbred cattle, indicating thereby that buffaloes have a faster growth rate than crossbred cattle at higher planes of nutrition. The rectal temperature of buffaloes varied from 37.4° to 38.6° C and that for cross bred cattle, it varied from 38.4° to 38.8°C. The highest respiratory rate was 24/minute in buffaloes while crossbred cattle showed a higher rate of 49/minute. The growth rate of buffaloes measured in terms of shank circumference showed very negligible increase during the first 6 months of age.

Simple techniques to detect oestrum in buffaloes were being evolved.

Metabolism-cum-digestion trials in buffalo calves fed with 20% rubber seed cake for a period of 4 months were carried out.

PROJECTS IMPLEMENTED

		Locations
PHYSIOLOGY		
1	Studies on the meat potentialities and meat qualities of buffaloes (VA–2–1–13–1)	Mannuthy
ANIMAL MANAGEMENT		
2	Studies on sexual behaviour of buffaloes (VA-2–1–2-1)	Mannuthy
NUTRITION		
3	Effect of rubber seed cake on growth rate in buffalo calves (VA–2–1–9-3)	Mannuthy

PHYSIOLOGY

Studies on rhe meat potentialities and meat qualities of buffaloes– (VA–2-1–13–1) Mannuthy

In order to assess the potentialities of buffaloes as meat animal in Kerala' studies were undertaken utilising buffalo calves, to study the meat potentialities of buffaloes under agro–climatic conditions of Kerala and the meat qualities of buffaloes.

Buffalo and cross–bred calves were grouped into two. Control group was fed on a ration of 100% Morrison's standard while the experimental group was fed on a 140% of Morrison's standard. During the year under report, 56 buffaloes and 32 cattle were under experimentation.

GROWTH RATE

During the year under report the mean monthly weight gain in buffaloes and crossbreds were:

	Control	*Experimental*
Buffaloes	8.05 kg	11.5 kg
Crossbreds	8.85 kg	9.86 kg

It was revealed that buffaloes exhibited a higher rate of weight gain than crossbreds under the experimental feeding regime.

PHYSIOLOGICAL RESPONSES

Alteration in the rectal temperature and respiration rate were measured under different ambient temperatures and relative humidity levels. The ambient temperature was highest during the month of March and lowest during July. The rectal temperature in buffaloes varied from 37.4° to 38.6°C. In cross breds, the rectal temperature was found to be invariably higher than that observed in buffaloes, the range being from 38.4° to 38.8°C. Similarly, the respirarory rate in cross–breds were appreciably higher than those in buffaloes. While the highest respiratory rate was 24/minute in buffaloes, it was 49 in the case of crossbreds. The lowest respi–ratory rate was 13/min. in buffaloes and in the case of crossbreds this was 31. The results indicated that buffaloes exhibit lesser variations in the respiration rate than cross breds.

HAEMATOLOGICAL STUDIES

Chemical constituents in the blood samples were analysed by standard methods. The results obtained are as follows:

Constituent	Buffaio	Cross–bred
Total glucose mg%	45.0	45.0
Blood urea nitrogen mg%	16.5	17 5
Total plasma protein g%	11.0	10.8

The haemoglobin content in buffaloes was 12.5 g% while in cross breds it was 12.3 g%. There was no appreciable difference in the values for PCV in buffaloes (35.5%) and cross breds (34.0%). The erythrocytes sedimented at a much faster rate in buffaloes (57.5mm/hr) than in cross-breds (2.5mm/hr).

BODY MEASUREMENTS

Linear body measurements of buffalo calves were recorded during the year at monthly intervals. Data obtained are presented in Table II. 2.1.

Table II. 2.1: Linear body measurements of buffalo calves

Parameter	At birth	Month					
		1	2	3	4	5	6
Body weight (kg)	28.3	42.5	51.5	64.4	68.0	83.0	93.0
Height cm	68.8	75.3	80.8	83.5	84.0	89.0	91.0
Length cm	61.0	65.5	73.0	77.5	82.5	87.0	95.0
Girth cm	72.5	82.0	90.0	93·7	96.5	102.0	105.0
Shank (circumferance cm)	12.8	13.0	13.0	13 0	13.3	13.5	14 0

During the period of observation, the growth rate in terms of shank circumference was neglible but in terms of height, length and girth, it showed steady increase.

HISTOLOGICAL AND BIOCHEMICAL ANALYSIS OF MUSCLE

Methods have been standardised for the analysis and collection of data on this aspect.

ANIMAL MANAGEMENT

Studies on sexual behaviour of buffaloes – VA-2-1-1 [Mannuthy]

Buffaloes have a different behavioural pattern as opposed to cattle during oestrus and often the heat deriod is missed for purposes of breeding. The object of the study was to detect oestrus and ovulation period in buffaloes by simple means.

Ten female buffalo calves and ten cross bred female calves were maintained under identical oonditions. Data on their monthly body weight gain, rectal temperature pulse rate and respiration rate were recorded thrice daily. The thermal shift if any were recorded. Data on blood values as haemoglobin, PCV and ESR were collected weekly. The work was in progress.

NUTRITION

Effect of rubber seed cake on growth rate in buffalo calves– VA-2-1-9-8 [Mannuthy]

Feeding trials with the object of establishing the value of rubber seed cake as an ingredient in the ration of growing buffaloes were carried out in 8 buffalo calves for a period of 4 months. The cake in the concentrate mixture was 440 g as against 318 g for those fed the control ration. A metabolism-cum-digestion trial was carried out at the end of the experiment. Records of feed consumption, dung and urinary output were maintained during the collection period. The overall results indicated that rubber seed cake can be incorporated up to 20% level in the ration of growing buffalo calves without any deleterious effects.

3. Goat

HIGHLIGHTS

The research projects on goats were directed towards finding out the production, reproduction and growth potential of Saanen x Malabari and Alpine x Malabari crossbred goats in comparison to local Malabari goats. Studies on the nutritional requirements of goats to evolve feeding standards were in progress. Studies on the patterns of inheritance of qualitative traits and immunoglobulin level in different genetic groups of goats were also in progress. Studies conducted so far have shown that crossbred goats have better potentialities for growth, production and reproduction in comparison to local Malabari goats.

SUMMARY

Growth studies showed that the body weight in Saanen half-bred kids were higher than Malabari kids in all monthly observations. Birth weight appeared to be influenced by maternal environment. Male kids were heavier than female kids. Litter size affected only birth weight and its effect soon disappeared perhaps as a result of rearing triplets and twins as singles. Saanen half-breds matured and kidded earlier than Malabari goats. Weight at kidding was influenced by genetic group.

A spurt of growth was observed in males between 5 and 6 months.

Separation of penis from perpuce commenced at 2½ to 3 months and was completed by 3½ months. Kids showed sex libido by mounting females at 4 to 6 month of age. Vulval slit at 7 month of age measured an average 2 cm. Average duration of oestrus cycle was 21 days 23 hours.

The average duration of oestrum was 51.5 hours.

Lactation yield, lactation length, milk yield per day of lactation length and milk yield per day of kidding interval, were significantly higher in Saanen half-breds and the goats having higher body weights at kidding. Season of kidding influenced lactation yield and peak yield while type of kidding did not exert any influence on production traits

The requirements of energy in terms of total digestible nutrients and starch equivalent for maintenance was found to be 8.78 g and 7 66 g respectively per kg body weight for females and 14.69 g and 12.77 g respectively per kg body weight for males. The requirements for nutrients per kg gain ranged from 0.86–0.90 kg for different groups in the case of digestible crude protein, 4.84–5.31 kg in the case of total digestible nutrients and 4.21–4.60 kg in the case of starch equivalent. The requirements per day of these nutrients ranged from 54.8-60.1 g of digestible crude protein, 308.3-358.7 g of total digestible nutrients and 268.2–310.8 g of starch equivalent, for growing kids.

A trend of higher immunoglobulin level in Saanen x Malabari and Alpine x Malabari compared to the Malabari was noted.

PROJECTS IMPLEMENTED

		Locations
ANATOMY		
1	Post-natal development of ruminant stomach of goat (Capra hicrus) (VA-3-1-1-1)	Mannuthy
2	Anatomy and histology of ruminant stomach of goat (Capara hircus) (VA-3-1-1-1 (1)	"
BREEDING & GENETICS		
3	Reproductive performance of Malabari goats (VA-3-1-4-1)	"
4	Productive performance of Malabari goats and standardisation of phenotpyic and factors influencing them (VA-3-1-4-2)	"
5	Adaptability of Malabari and crossbred' goats to the Agro-climatic condition of Kerala- A comparative study (VA-3-1-4-3)	"
6	Birth weight and growth rate of Malabari and crossbred kids (VA-3-1-4-4)	"
7	Immunoglobulin level in goats and its association with survivability (V-3-1-4-5)	"
8	Inheritance of certain qualitative traits in goats (VA-3-1-4-10)	"
9	Inheritance of threshold characters in goats (VA-3-1-4-1)	"
NUTRITION		
10	Establishment of feeding standards for goats (VA-3-1-9-3)	"
PHYSIOLOGY		
11	Comparative haematological studies on Malabari, exotic, and crossbred goats of different age groups (VA-3-1-13-1)	"
12	Certain aspects of reproduction in crossbred goats- A study to gather information on the reproductive traits of crossbred goats- (VA-3-1-13-3)	"

ANATOMY

Post-natal development of ruminant stomach of goat (Capra hircus)-VA-3-1-1-1-[Mannuthy]

Anatomical and histological aspects of the developing stomach of goat from day old to five months of age were being investigated. Gross aspects of 12 groups have been completed. Histological work was also in progress.

Anatomy and histology of ruminant stomach of goat (Capra hircus)-VA-3-1-1 (1) [Mannuthy]

Materials were collected from goats above 6 months of age, from the abbattoir. The exact external and internal anotomical features were studied. The detailed linear, weight and capacity measurements of different compartments

of stomach were recorded. The same material was used for the histological work. Tissue pieces were collected from different parts of rumen, reticulam omasum & abomasum. These were being processed for histological work. Gross studies on the blood and nerve supply to the organs are in progress.

BREEDING & GENETICS

Reproductive performance of Malabari goats – VA–3–1–4–1 [Mannuthy]

The goats were reared under stall fed condition. Least square means for Malabari and Saanen half-breds were 436.5 ± 20.89 and 412.9 ± 19.20 days for age at first oestrus 615.7 ± 51.63 and 498.1 ± 59.52 days for age at kidding, 20.6 ± 1.32 and 25.9 ± 1.52 kg for weight at kidding 147.0 ± 0.95 and 147.7 ± 1.91 days for gestation period and 299.1 ± 40.07 and 377.4 ± 55.88 days for kidding interval respectively. Weight and age at first kidding were found to be influenced by genetic group indicating that Saanen half bred are superior to Malabari goats in these traits. Season of birth did not influence any of the reproductive traits while year of birth influenced only age at kidding.

Productive performance of Malabari goats and standardisation of phenotypic factors influencing them – VA-3–1–4–2 [Mannuthy]

The goats were reared under stall fed condition. Analysis of data showed that lactation yield, lactation length, milk yield per day, lactation length and kidding interval were significantly affected by the genetic group and weight at kidding. Season of kidding influenced lactation yield and peak yield significantly while year of kidding and type of kidding did not exert any influence on production traits. Dry period was not significantly affected by any of the factors under study.

Adaptability of Malabari and cross-bred goats to the agro–climatic conditions of Kerala - A comparative study – VA–3–1–4–3 [Mannuthy]

The project was undertaken to rate the different breeds on the basis of their adaptability to survive local conditions and susceptibility to common diseases and to study the various factors involved. Incidence of mortality, Mastitis, abortion and specific diseases throughout the life span of goats were recorded. The influence of season of birth, year of birth, age of the animal. birth weight and genetic group were studied in this project. Statistical analysis was in progress.

Birth weight and growth rate of Malabari and cross-bred kids – VA–3–4–4 [Mannuthy]

Adjusted means for birth weight of Malabari and Saanen half–breds was 1.76 ± 0.024 kg and 2.01 ± 0.27 kg respsctively. The adjusted averages for body weights for Malabari and Saanen half breds were 2.8 ± 0.5 kg and 3·9 ± 0.05 kg (1 month) 4.0 ± 0.07 and 5.2 ± 0.07 kg (2 months) and 5.0 ± 0.12 and 6.5 ± 0.11 (3 months) respectively. The adjusted averages for body weights increased from 6.6 ± 0.17 at 4 month, 15.0 ± 0.37 kg at 12 month in Malabari, while the same increased from 8.6 ± 0.15 to 19.32 ± 3.0 kg in Saanen half–breds. The factors influencing these traits have been studied in detail.

Immunoglobulin level in goats and its association with survivability–VA–3–1–4–5 [Mannuthy]

The project was undertaken to study the changes in immunoglobulin level in successive kiddings and the effect of sex on immunoglobulin.

level and the heritability of immunoglobulin level. Based on 200 samples analysed, optical density values obtained were 0.433 for Malabari, 0.388 for Alpine x Malabari and 0.410 for for Saanen x Malabari. With limited data, the trend was that 75% Saanen had a level of 0.404 while 75% Alpine had a level of 0.290. It is thus indicated that Saanen inheritance is better than Alpine inheritance as revealed by optical density values. However, the work was in progress to draw valid conclusions.

Inheritance of certain qualitative traits in goats – VA–3–1–4–10 [Mannuthy]

The project was undertaken to study the pattern of inheritance of qualitative traits like tassels, horns, colour etc. Data collected was subjected to statistical analysis.

Inheritance of threshold characters in goats – VA–3–1–4–11 [Mannuthy]

The objective was to study the pattern of inheritance of threshold characters like mortality and resistance to diseases. Information on the incidence of mortality among parental and offspring generations were being collected.

NUTRITION

Establishment of feeding standards for goats – VA–3–1–9–3 [Mannuthy]

The requirement of energy in terms of total digestible nutrients and starch equivalent for maintence was found to be 8.78 g and 7.66 g respectively per kg body weight for females and 14.69 g and 12.77 g respectively, per kg body weight for males. The requirements for nutrients per kg gain ranged from 0.86 - 0.90 kg for different groups in the case of DCP, 4.84-5.31 kg in the case of TDN and 4.21–4.60 kg in the case of starch equivalent. The requirements per day of these nutrients ranged from 54.8 – 60.1 g of digestible crude protein, 308.3-358.7 g of total digestible nutrients and 268.2–310.8 g of starch equivalent for growing kids.

PHYSIOLOGY

Comparative haematological studies on Malabari, exotic and cross–bred goats of different age groups – VA–3–1–13–1 (Mannuthy)

Blood samples collected from 6 months old Alpine-Malabari cross-bred kids were analysed for the various haemotological constituents. Erythrocyte sedimentation was 0.5 to 1 mm in males having slightly lower values. Total red blood cell count was 17.08 million per cm of blood and Haemoglobin level was 10–11 g percent for males and 8 to 9 g for females. The work was in progress.

Certain aspects of reproduction in cross–bred goats – Study to gather Information on the reproductive traits of cross-bred goats – VA–3–1–13–3 [Mannuthy]

A spurt in the growth of the gonads was observed in males between 5 and 6 months. Seperation of penis from perpuce commenced at $2\frac{1}{2}$–3 months and was completed by $3\frac{1}{2}$ month. Kids showed sex libido by mounting females at 4 month of age. Vulval slit at 7 months of age measured on average 2 cm. Age of first heat was found to be 192 days when the body weight was 16.9 kg. Average duration of oestrus cycle was 21 days and 20 hours. The erythrocyte sedimentation rate was found to be high (3.5 to 5 mm/hr) during heat period. Standardisation of technique for enzymatic assay are being carried out at present.

4. Poultry

HIGHLIGHTS

The research in chicken were primarily directed towards improving the production potentialities of White Leghorns, Rhode Island Reds and Australops for commercial exploitation. The identification of a cross-bred bird for back yard system is progressing. Assessing the magnitude of variation in the composition of poultry feed ingredients, especially micro-nutrients was receiving attention. Basic studies on the physiochemical differences between chicken and duck eggs were in progress. White Leghorn male chicks could be economically raised for meat purpose. White Plymouth Rock could be exploited for broiler production.

SUMMARY

The White Leghorn, Rhode Island Reds and Australop breeds of chicken were subjected to intra-population index selection to improve the productive efficiency.

The observations that pure bred, high producing White Leghorn hens were unable to withstand the strain of backyard environment led to testing of exotic crossbred chicken. Different crosses were being tested to their suitability to the backyard condition.

Studies were being carried out to collect information on some of the economic traits of desi duck.

The influence of season on egg quality traits were studied to device suitable methods of storage.

Basic studies on the differences between chicken and duck eggs were in progress.

PROJECTS IMPLEMENTED

		Locations
PHYSIOLOGY		
1	A comparative study on the fractionation of lipids and proteins of eggs from ducks and hens (VA–4–1–13–3)	Mannuthy
BREEDING		
2	Inheritance of chick weight and egg production in three strains of White Leghorns and their relationships (VA-4–1-4–1)	"
POULTRY SCIENCE		
3	Package of practice for Poultry improvements to back-yard units (VA–4–1-14-23)	"
4	Establishment of nutrient requirements of ducks (VA-4–1–14-7)	"
5	Seasonal quality of chicken eggs (VA-4–1–14-21)	"
6	Evaluation of pure bred white Leghorn Rhode Island Reds and Australop breeds and their crosses (VA–4–1–14–23)	"
7	Studies on certain economic traits in desi ducks (VA-4–14-24)	"
8	Trace mineral content in poultry feed ingredients (VA–4-1–14-25)	"
9	Evaluation of pure bred & cross bred chicks for broiler performance (VA–4–1–14–26)	
10	Economics of raising White Leghorn male chicks (VA-4–1-14–27)	"

PHYSIOLGY

A comparative study on the fractionation of lipids and proteins of eggs from ducks and hens VA-4-1–13–3 [Mannuthy]

Using agar-gel electrophoresis techinque, the fractionation of albumen of chicken and duck eggs were carried out. The results indicated that the chicken egg albumen contained five fractions while that of duck egg albumen had only four fractions. The relative concentration of the fractions in the hen egg albumen were 28.01, 20.22, 8.71 16.08 and 27.66%. The concentration of the four fractions in the duck egg albumen were 40.21, 23.70, 12.22 and 21.99%.

BREEDING

Inheritance of chick weight and egg production in 3 strains of White Leghorn and their relationship VA–4–1–4–1 [Mannuthy]

Studies were made using 2500 individuals of P and N strains of White Leghorn. The data on the body weights of these birds at different ages as well as their egg production were collected. The work with F strain could not be taken up due to aflatoxicosis. Therefore, studies are to be repeated for one more generation before valid conclusions are drawn.

POULTRY SCIENCE

Package of practices for poultry – Improvements to backyard units VA–4-14-7 [Mannuthy]

The egg production efficiency under backyard conditions of four crossbred

combinations were studied. The results indicated that WL x RIR and ALP x WL combinations were superior in egg production and livability than WL x ALP and RIR x WL combinations. The other crosses are also being subjected to test.

Establishment of nutrient requirements of ducks VA-4-1-14-7 [Mannuthy]

The biological test for determination of metabolisable energy value of ducks relating to 12 feed ingredients were completed. Chemical analysis was in progress.

Seasonal quality of chicken eggs VA-4-1-14-21 [Mannuthy]

A total of 678 eggs were subjected to quality rating during the seasons of cold, rainy I and II. The studies during hot season was in progress. The trend of the results indicated that egg quality was influenced by the season.

Evaluation of purebred White Leghorn, Rhode Island Red and Australop breeds and their crosses VA-4-1-14-23 [Mannuthy]

The results achieved with White Leghorn was encouraging. The overall production percentage in this strain has been increased from 54.5 to 68.7. The work with RIR and ALP was in progress.

Studies on certain economic traits in desi ducks VA-4-1-14-25 [Mannuthy]

Studies carried out with one hundred desi ducks revealed that the age of sexual maturity is 182 days and that the production potential is around 80 eggs/bird/annum.

Trace mineral content in poultry feed ingredients (a) Manganese VA-4-1-14-25 [Mannuthy]

The manganese content of five poultry feed ingredients were worked out. The contents of manganese per kg of rice bran was 76.18 mg, wheat bran 32.92 mg, groundnut cake 10.38 mg, gingelly oil cake 13.88 mg and yellow maize 0.912 mg.

Evaluation of pure bred chicks for broiler performance VA-4-1-14-26 [Mannuthy]

Among three breeds and their crosses evaluated for broiler traits, pure bred White plymouth rock was found to be best while Australop, Rhode Island Red as well as the cross breds employed in the study were unsuitable as broilers. The White plymoth rocks average 1056.1 $\pm$ 45.1 g at 10 weeks while the others had significantly lower body weights at the same age. Similarly WPR pure bred birds had a feed efficiency of 3.19. The GCA effect for 10 week body weight was significant for WPR. Based on these results, it was concluded that WPR breed could be exploited for broiler production and that further improvement in body weight of this breed could be achieved by adopting pure bred selection schemes.

Economics of raising White Leghorn male chicks for meat VA-4-1-14-27 [Mannuthy]

The results of the study directed to explore the possibility of using White Leghorn male chicks as meat bird revealed that White Leghorn males could be economically raised for meat. The economic weight of slaughter was found to be around 1 kg. It was also observed that White Leghorn males on broiler ration attained the economic slaughter weight of 1 kg at 12 weeks of age, while on starter and grower ration, the same weight was obtained only at 14 weeks of age However, both the feeding systems were found to be economical.

5. Pig & Other Animals

HIGHLIGHTS

Medium sized litters having 8-9 numbers were found to be desirable for obtaining better litter weight and weaning weight in pigs. Cross breeding between large White York Shire and Landrace pigs was found to be better for improving the pre-weaning performance in pigs. Tapioca starch waste can effectively and profitably be incorporated in swine rations, replacing either tapioca chips or maize. Dried land snail meal can replace fish meal up to 5% in swine rations. The cost of production per kg of pork was found to be the least at 55 kg body weight when the protein content of the ration ranged from 14-18% and 85 kg body weight when the protein content of the ration was fixed at 16%. Indigenous pigs of Kerala under improved care and management are having good meat potentialities and are comparable to exotic pigs.

SUMMARY

The Research projects on pigs were mainly directed to study the various aspects of their growth, feed efficiency and the utilization of locally available food stuffs. Since the majority of the service population in the country belongs to the non-descript indigenous variety, investigations were carried out to assess the potentialities of the indigenous pigs of Kerala.

PROJECTS IMPLEMENTED

		Location
1	Potentialities of indigenous pigs of Kerala (VA-3A-1-2-2)	Mannuthy
2	'Earn While you Learn Pork Project (VA-3A-1 2-2)	,,
3	Pig rearing on frog leg trimmings under farmers' field conditions	,,
4	Effect of energy supplementation of creep feed on the pre-weaning performance	,,
5	A comparative study of open stye housing and farrowing house	,,

Potentialities of indigenous pigs of Kerala – VA-3A-1-2-2 [Mannuthy]

The economic traits of indigenous pigs were studied. Eventhough the the indigenous animals were inferior to the exotic animals with respect to body weight, their efficiency and rate of growth were comparable with exotic animals.

'Earn While you Learn' pork project [Mannuthy]

Pigs were economically reared on waste food. Each participant student got a return of Rs. 345/20.

Pig rearing based on the utilization of frog leg trimmings in the farmers' field [Mannuthy]

In this study, it was found that pigs can be raised on frog leg trimmings.

Effect of energy supplementation of creep feed on the pre-weaning performance [Mannuthy]

The birth weight of control animals were 1.31 kg and that of experimental animals 1.5 kg. Weight at 21 days were 3.86 kg and 4.52 kg respectively for the control and experimental group. The weaning weight was 9 5 kg for control and 10 kg for experimental animals. The study was in progress.

A comparative study of open stye housing and farrowing house [Mannuthy]

The weaning weight of animals in the open stye housing was 6.68 kg and for the farrowing house this was 7 kg. The work was in progress.

6. Animal Reproduction & Artificial Insemination

HIGHLIGHTS

A wide calcium-phosphorus ratio due to deficiency of phosphorus was observed to be a major cause of anoestrus in cows. Treatment with Clomiphene citrate in anoestrous animals, due to non-nutritional cause proved to be of value. Administration of progesterone in doses of 5 to 10 mg immediately after insemination proved to be of value in improving conception rate in cows. A new apparatus has been fabricated for uterotubal insufflation test for diagnosis of tubal impotency in cow.

SUMMARY

Buck semen could be stored up to 60 hours in TRIS, Skim-milk-citrate-fructose-glycine and in Milk-citrate-fructose-glycine, with good motility at 5°C.

A wide calcium-phosphorus ratio was observed to be a major cause for anoestrum in cows. Treatment of anoestrum due to non-nutritional causes, by administration of Clomiphene citrate was found to be of value.

To study the post-natal development of testis and physico-chemical characteristics of semen of cross-bred bulls and its freezability, the samples were collected from 24 bull calves in the age group of 0 day to 12 months.

Progesterone administration in small doses of 5 to 10 mg immediately after artificial insemination was found to be of value in improving the conception rate.

A suitable equipment has been fabricated for utero-tubal insufflation test for diagnosis of tubal patency in cows.

Studies on inferitility due to trichomoniasis and vibriosis are in progress by collection and examination of the samples for the presence of the organism.

PROJECTS IMPLEMENTED

		Location
1	Age ofsemen and conception rate in goats [VA-6-1-3-5]	Mannuthy
2	Effect of early post-partum breeding on reproductive performance of crossbred cows [VA-6-1-3]	,,
3	Investigation on the incidence, nature and magnitude of prevalence of infertility condition among cross bred cows of Kerala [VA-6-1-3-12]	,,
4	Certain aspects of reproduction in cross-bred bulls [VA-6-1-3-20]	,,
5	Post-partem anoestrum in cattle [VA-6-1-3-15]	,,
6	Synchronisation of oestrum and artificial insemination in breeding swine [VA-6-1-3-14]	,,
7	Detailed studies on the reproductive performance of Malabari goat [VA-6-1-3]	,,
8	Progesterone administration for improving the conception percentage in dairy cattle [VA-6-1-3-4]	,,
9	Utero-tubal insufflation test as an aid in the diagnosis and treatment of tubal impatency in repeat breeding cows [VA-6-1-3-13]	,,
10	Infertility due to Trichomoniasis [VA-6-1-3]	,,
11	Infertility due to Vibriosis [VA-6-1-3]	,,

Age of semen and conception rate in goats VA-6-1-3-5 [Mannuthy]

Conception rate by using semen diluted in different extenders and stored for different periods of time was observed. Buck semen could bestored up to 60 hours in TRIS, Skim-milk-citrate, fructose glycine, milk citrate fructose glycine with good motility at 5°C. In CME, semen could be stored only up to 24 hours in 1:200 dilution. Egg yolk containing diluents proved to be least susceptible for preservation for Buck semen at 5°C. Percentage of conception was 44, 52, 53 with Tris, SMCSG and MCFG diluents respectively.

Effect of early post-partem breeding on reproductive performance of cross bred cows VA-6-1-3 [Mannuthy]

To evaluate how early cows can be bred post-partem to improve the reproductive efficiency, fifteen cows were to be bred earlier than 60 days and another 15 were to be bred after 15 days and conception rate, gestational accidents milk yield of the two groups were to be compared. Ten cows were inseminated earlier than 60 days and other ten was kept as control. The results of the experiments are awaited.

Investigation on the incidence, nature and magnitude of prevalence of infertility condition among cross bred cows of Kerala VA-6-1-3-12 [Mannuthy]

The major problem observed in the Brown Swiss cross breds was delayed maturity of heifers. Among cows, anoestrum was also found to be a major problem.

Blood analysis revealed a low haemoglobin level in delayed maturity cases. A wide calcium-phosphorus ratio was observed to be a major cause of anoestrum in cows. Treatment by administration of clomiphene citrate in anoestrous cows due to non-nutritional causes and mineral supplementation in nutritional anoestrum was found to be of value.

Certain aspects of reproductive biology in cross bred bulls VA – 6 – 1 – 3 – 20 [Mannuthy]

To study the post-natal development of testicular tissue and physico-chemical characteristics of semen of cross bred bulls and freezability of semen, macroscopic and microscopic studies on the testis and epididymis collected from 24 bull calves in the age group of 0 day to 12 months were conducted. The data were being processed. Studies on physical characteristics and freezability of 450 samples collected from 8 bulls in different age groups were carried out. The work was in progress.

Post-partem anoestrum in cattle VA–6–1–3–15 [Mannuthy]

The object of the study was to assess the causes of anoestrum among cross bred cattle and to evolve suitable corrective measures. A wide calcium–phosphorus ratio (2.69 or or 2.46) and sub–normal copper level 88.32 g/dl and 91.07 g/dl) were detected in cows of true anoesfrum. Treatment with Fertimin, a brand of mineral mixture could induce ovulatory oestrum in 91.67% cows and 78.26% of heifers in true anoestrum due to nutritional causes. Conception rate in the treated group was also higher Fertivet (Clomiphene citrate) was capable of inducing oestrum in 100% cows and 89.47% heifers in true anoestrum due to non–nutritional causss. Conce–ption rate was also good in treated ones as compared to nontreated ones.

Synchronisation of oestrum and artificial insemination in breeding swine VA-6-1–3-14 [Mannuthy]

The testing of suitable extender for boar semen was completed. Kiew–1, Kiew–2, Glucose, Glycine EDTA and Soda bicarb citrate diluent were found to be superior in diluting boar semen. It was also observed that preservation was more effective at 15°C than at 5°C.

Detailed studies on the reproductive performance of Malabari goat VA–6–1-3 [Mannuthy]

The various pathological conditions affecting the genitalia of goats were studied. A total of 950 genitalia inclusive of 42 gravid ones were examined and sixty one showed various pathological conditions. Forty genitalia showed various lesions of ovaries. The various pathological conditions were macerated foetus, cystic ovary and parovarian cyst. Uterine pathology in female goat was found to be a common occurrence.

Progesterone administration for improving the conception percentage in dairy cattle VA–6–1–3-4 [Mannuthy]

The object of the scheme was to study the effect of progesterone administration after insemination on the percentage of conception as compared to the

results of untreated animals. Seventy five cows were treated with progesterone immediately after artificial insemination and 75 were kept as control. The results of the treatment were being processed.

Utero tubal insufflation test as an aid in the diagnosis and treatment of tubal impatency in repeat breeding cows- VA–6–1–3–13 (Maunuthy)

The object of the project was to assess the incidence of various pathological conditions in the bursa and salpinx of cells using both utero-tubal insufflation techniques. A suitable equipment was fabricated for utero–tubal insufflation test for the diagnosis of tubal impatency in cows. Slaughter-house genitalia were used for test trials. So far twelve repeat breeder cows belonging to the University Livestock Farm were also used for the application of the technique.

Infertility due to Trichomoniasis- VA-6-1-3 (Mannuthy)

The object of the study was to assess the incidence of Trichomoniasis in Kerala, to standardize the diagnostic techniques and to formulate adequate control measures. Collection and examination of the samples for the presence of the organism was in progress.

Infertility due to Vibriosis- VA–6–1–3 (Mannuthy)

The object of the scheme was to find out the incidence of Vibriosis in cross-bred cattle of Kerala. Technical programme included collection of vaginal mucous and mucous agglutination test of all animals having history of natural service, survey of animals slaughtered in the muncipal slaughter house and screening of breeding bulls. The work was started.

7. Animal Diseases

HIGHLIGHTS

Exfoliative cytological technique for early diagnosis of ethmoid tumour was perfected. Employing various immunological markers, the immuno-competency of tumour bearing animals was assessed, the cancer growth was staged and immunotheraphy was instituted. Studies on goat pneumonia indicated a viral etiology. Gastro-enteritis was identified to be the important killer disease of kids and the aetiological agents were identified and characterised. The pre-natal and post-natal sequential development of the lymphoid system in the goat was studied and the nature of development was described. The clinico-pathologicial features of ochratoxicosis in goats were investigated and pathological features were established. The pulmonary lesions in animals due to exposure to polluted environment were studied and the pathogenesis was clarified. The sequential development of inflammatory response in ducks was studied and the nature of reaction was described. The microbial factors associated with infectious abortion were identified. The etiological factors associated with enteric infection in pigs were identified and therapeutic measures prescribed. The role of free flying birds in the epidemiology of New Caste disease was brought to light. The effect of RD vaccine was studied and the factors influencing the development of immunity were identified. Investigations on helminthic infections in ducks, chicken and calves were carried out and the patho-biological features were described and treatment schedules formulated. Studies on mastitis have revealed that teat dipping is effective in controlling incidence of mastitis. Pathogenic organisms associated with mastitis were isolated, sensitivity was tested and prophylactic and therapeutic measures were advocated. An effective line of treatment was prescribed for the bovine necrotic syndrome in its early stages.

SUMMARY

Tumours of the mucosa of the ethmoid were recorded in pigs during this year also, indicating that there was no species barrier for this tumour. The malignant character of the tumour cell was delineated by exfoliative cytological studies. Employing several immunological markers, the immuno-competency of tumour bearing animals was assessed and the stage of effective immunotherapy was identified. In early stages of growth the

tumour bearing animals were found to be immunocompetent. Mucosal block techique for cytological diagnosis of the tumour was perfected and criteria for diagnosis were described. The DNCB test to assess CMI response in tumour bearing cattle was developed and standardised. By electron microscopic studies the nature of the tumour cell was characterised. Viral agents were isolated from tumour tissue.

The endocrine involvement in Johne's disease in goats was investigated and it was observed that the pathological change in the endocrines were of secondary nature and there was no primary involvement of the the endocrines in this disease.

Caseous lymphadentis was found to be one of the common affections in goats and the cause was identified to be *C. pyogenes*.

Winter pneumonia was found to be very common in goats. The primary causative agent was found to be a virus. Deaths were due to secondary bacterial complications and these cases were effectively treated with Chloramphenicol.

E. coli was identified to be the important aetiological agent associated with enteritis in goats. Cordinol was found to be very effective in treating coccidial enteritis.

Long feeding trials with aflatoxin was found to induce hepatic disorders leading to icterus and anemia, in goats.

Of the various chemicals employed to effect amelioration of aflatoxin toxicity, propionic acid and acetic acid when incorporated at 0.5% level in the feed was found to inhibit aflatoxin production. Fifty three samples of animal feeds were analysed for aflatoxin content and 35 were found to contain toxic levels of aflatoxin. Toxigenic fungi isolated were *A. flavus* and *A. parasiticus*.

Toxic effects of ochratoxin were studied in goats. Nephrotoxicity was associated with elevation of BUN and reduction in creatinine level. Sequential development of lesions in ducks was studied using various chemical agents. The cellular response and vascular response were studied and nature of development of lesions were clarified.

With the objective of understanding the pathogenic effects of environmental pollution in industrial areas, the pumonary lesions in animals resident in industrial localities of Alwaye and experimental animals stationed in the locality were studied. Varied types of pathological changes were encountered in the pulmonary tissue which could be directly associated with the polluted environment.

A comparative study of STT and RPT indicated that SPT was the reliable test to detect infectious agents associated with abortion in cattle. Cases were identified and preventive measures were advocated.

Pathogenic strains of *E. coli* and *Salmonella* were identified to be associated with enteritis in pigs. Choloramphenicol and Gentamycin were found effective for therapy.

Free flying birds like crows were found to be responsible for transmission of Ranikhet disease in chicken.

By different trials, the intermediate host for the nematode parasite *Tetrameres* in chicken was identified to be a grasshopper.

The indirect haemaggiutination test was found to be useful test for the diagnosis of hydatid infection in cattle.

Acquaria spiralis was established to be a pathogenic species of chicken parasite and biological effects on the host was worked out.

Parasitic enteritis was found to be common during June to be September in calves. Several drugs were tried for therapy and nemafax, Morantrel tartarate and Levamisole were found to be most useful.

Teat dipping with 0.5% iodophore was found to be effective in reducing sub-clinical mastitis in goats. Chloramphenicol was found to be the drug of choice for treating mastitis. Necrosis of the tail in cattle was found to be associated with feeding fungus infected straw. This condition could be prevented by avoiding feeding such fungus infected straw.

PROJECTS IMPLEMENTED

		Locations
1	Incidence, aetiology and pathology of tumours of the ethmoid in domestic animals (VA–7–1–11–2)	Mannuthy
2	An assessment of the macrophage–Lymphoid system in animals bearing tumours of the Ethmoturbinate region (VA–7–1–11)	"
3	Cytological studies on exfoliated cells of tumours of the Ethmoturbinate region (VA–7–1–11)	"
4	Enzymology of tumour in cattle arising from the Ethmoid region (VA–7–1–11)	"
5	Pathobiology of the neoplasma involving the paranasal sinuses in bovines (VA–7–1–11)	"
6	Pathology of endocrine glands in cattle and pigs (VA–7–1–11–3)	"
7	Investigations on caseous lymphodenitis in goats (VA–7–1–11–5)	"
8	Investigation on posterior paralysis in goats (VA–7–1–11–6)	"
9	Studies on the incidence, pathology and preventive mesaures of common diseases in goats (VA–7–1–11–7)	"
10	Studies on the correlation of post–natal development of stomach comparments and the incidence of Gastro-intestinal disorders in goats (VA–7–1–11–8)	"
11	Haematological studies on Malabari exotic, and cross-bred goats under different physiological and pathological conditions (VA–7–1–11–9)	"
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13	Incidence and nature of diseases of young stock in Kerala (VA–7–1–11–16)	"
14	Embryomortality in hatcheries (VA–7–1–11–14)	"
15	Post-natal mortality in kids - A pathoanatomical investigation (VA–7–1–11)	"
16	The lymphoid system and the immuno response in the goat (VA–7–1–11)	"
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18	The cellular response in inflammatory reactions in the duck (VA–7–1–11)	
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30	The role of free flying birds in the epizootology of New castle disease (VA-7-1-8–9)	"
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33	Pathogenecity and treatment of helminth parasites of ducks (VA–7-1–10-2)	"
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37	Cutaneous myiasis and its control in domestic animals (VA–7–1–10)	,,
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47	Haematology of viral infections in cattle (VA–7–1–15)	,,
48	Practical utility of rumeno-rectal fistula as a relief measure for chronic tympany of the rumen in cattle (VA–7–1–17–1)	,,
49	Studies on necrosis of extremities in cattle and buffaloes (VA-7–1–5–1)	,,
50	Studies on experimental therapeutics of hydrocyanic acid poisoning in goats (VA–7–1–5)	,,
51	Studies on leukaemia in cattle (VA–7–1–5)	,,
52	Incidence of leukaemia and leukaemoid reaction in cattle In Kerala (VA–7–1–5)	,,
53	Clinical observations on seasonally occurring respiratory diseases in goats (VA–7–1-5–5)	,,
64	Studies on wobbles in goats in Kerala (VA-7–1–5)	,,

Incidence, aetiology and pathology of tumours of the Ethmoid in domestic animals– VA–7–1-11–2 (Mannuthy)

The incidence of the tumour was recorded in cattle, goats and pigs indicating that there is no species barrier. The symptomatology was established and diagnostic criteria were defined. The malignant character of the cell was delineated by exfoliative cytological studies. The tumour growth was associated with significant biochemical changes in the blood stream. Employing several immunological tests, the immunocompetency of the tumour bearing animals was assessed and it was clarified that in early stages of growth, the tumour bearing animals were immunocompetent. Immunotheraphy induced immunological enhancement in the tumour–bearing host. By electron microscopic studies, the nature of the tumour cell was characterised. Viral agents were isolated from tumour tissue and their pathogenic potential was being assessed. The tumours were all carcinomas with varying degrees of maligancy potential.

An assessment of the macrophage - lymphoid system in animals bearing tumours of the Ethmoturbinate region– VA–7–1–11 [Mannuthy]

The cytochemical studies on macrophages indicated that activated population of cells were more in animals in the early stages of cancer development. Lymph node biopsy studies after specific and non–specific immunostimulation indicated that the macrophage response was dependent of the stage and type of growth. The DNCB skin sensitisation test in cattle was developed and perfected. Immunological profile of the tumour bearing animals was characterised by using different immunological markers and the stage of effective immunotherapy was identified.

Cytological studies on exfoliated cells of tumours of the Ethmoturbinate region- VA-7-1-11 [Mannuthy]

Various characteristics of the neoplastic cells exfoliated through the nasal passage were studied employing several cytochemical techniques and the nature of the tumour cell was characterised and its malignant potential was assessed. Mucosal block technique was adopted and perfected and the results were correlated with exfoliative cytological studies. The studies so far made have shown that it would be possible to diagnose the cancer by this technique even before clinical symptoms are seen.

Enzymology of tumour in cattle arising from the Ethmoid region- VA-7-1-11 [Mannuthy]

Various enzymes in the serum of tumour bearing animals were quantified. The distribution of hydrolytic enzymes and cytochemical localisation studies indicated a variation in different stages of tumour development. Enzyme profile was weak in advanced cancer growth.

Pathobiology of the neoplasams involving the paranasal sinuses in bovines– VA–7–1–11 [Mannuthy]

The symptomatology was established. The earliest symptom was intermittent nasal discharge. Unilateral exopthalmos was a consistent finding. Biochemical studies indicated reduction in plasma protein, inbalance in calcium–phosphorus ratio, varied globulin pattern, anaemia and leucocytosis. Electron

microscopic studies indicated the involvement of viral agents in the causation of tumour. The tumours were classified as Adenocarcinoma, Squamous cell Carcinoma and undifferentiated Carcinoma. Employing LMI test, the immune status of the tumour bearing animals was staged.

Pathology of endocrine glands in cattle and pigs– VA–7–1–11–3 [Mannuthy]

The data collected on 75 goats were analysed. The endocrine changes associated with Johne's disease were one of hyperplastic reaction in the adrenal. Thyroid revealed colloid changes. Pituitary revealed basophil hyperplasia. There was no evidence of primary infection in the endocrines.

Investigations on Caseous lymphodenitis in goats– VA–7–1–11–5 [Mannuthy]

The incidence was recorded in adult goats and it was characterised by caseating lesions in the lymph nodes. Mastitis was also encountered in some cases. *Corynebacterium pyogenes* was identified to be the causative agent.

Investigations, on posterior paralysis in goats– VA–7–1–11–6 [Mannuthy]

The posterior paralysis syndrome was found associated with atrophy of cerebellar hemispheres. Histologically cerebrum revealed oedema, cytoplasmic vacuoles and neuronophagia.

Studies on the incidence, pathology and preventive measures of common diseases in goats–VA–7–1–11–7 [Mannuthy]

Common disease conditions encountered were Caseous lymphadenities pneumonia, Gastro-enteritis and Coccidiosis. Pneumonia was common during winter season and the histo-pathological lesions were indicative of viral aetiology. *E. coli* was found to be the agent associated with enteritis. Cordinol was found to be effective in the treatment of coccidial enteritis.

Studies on the correlation of post-natal development of stomach compartments and the incidence of Gastro-intestinal disorders in goats–VA–7–1–11–8 [Mannuthy]

The incidence of Gastro-enteritis was seen more during the developmental phase of stomach compartments, particulary during the first month of post-natal life.

Haematological studies on Malabari exotic and cross-bred goats under different physiological and pathological conditions–VA–7–1–11–9 [Mannuthy]

Reduction in total erythrocyte count and haemoglobin level was recorded in kids affected with Pneumonia. Leukocytosis was associated with lymphocytosis.

Aflatoxicosis in goats-VA-7–1–11–13 [Mannuthy]

Long term feeding trials were conducted with feed contaminated with aflatoxin in goats. The animals had anaemia and icterus. Alkaline phosphatase and SGOT levels in the serum were elevated.

Incidence and nature of diseases of young stock in Kerala - VA–7–1–11–16 [Mannuthy]

Diseases encountered were gastro-enteritis, Pneumonia, toxic hepatitis, renal cortical hypoplasia and pox. *E.coli* and *E. aerogenes* were isolated from cases

of enteritis in kids Coccidial enteritis was caused by *E. arlongi* and *E. intricata*. Multifactorial aetiology was considered responsible for Pneumonia. The delayed hypersensitivity reaction was monitored employing both allogenic and xeonogenic systems.

Embryomortality in hatcheries-VA-7-1-11-14 [Mannuthy]

One thousand three hundred ane twenty five eggs which failed to hatch were examined. Most of the embryos (45%) were dead during early periods of incubation. Infection of the embryo was indicated by omphalitis and inflammation of yolk sac. In 7 per cent of cases different types of malformations were observed.

Posr-natal mortality in kids—A patho-anatomical investigation— VA-7-1-11. [Mannuthy]

Incidence of mortality in kids was highest in the age group of 0 to 3 months. Most important disease was gastro-enteritis (88.6%) of a catarrhal type Catarrhal, necrotic and haemorrhagic enteritis were recorded. Coli organisms were responsible for enteritis. Pneumonia was encountered in 17.1% of cases and the aetiological agents identified were *S.pneumoniae* ahd *K. pneumoniae*. Aflatoxin was found to be the cause of toxic hepatitis.

The lymphoid system and the immune response in the goat-VA-7-1-11 [Mannuthy]

Ontogeny of the lymphoid system was studied. The thymus was microscopically visible by 30 days and subsequently there was progressive growth and the growth decreased during the last 18 days of gestation. Antigen and colostrum was found to influence the post-natal development of the thymus. The maximum growth was reached (100 g) by 45 days and by about 100 days it weighed only 20 g. The spleen was visible by 50th day post-conception. The prescapular lymph-node was seen grossly by 45 days. By 140 days, the cortex and medulla were clearly demarcated. The growth of lymph node was much smaller than thymus and spleen.

Aflatoxicosis in ducks and chicken-VA-7-1-11-17 [Mannuthy]

Various chemicals were employed for the amelioration of aflatoxin toxicity. Ammonium carbonate and sodium carbonate did not have any positive effect. Propionic acid and acetic acid when incorporated at 0.5% level in the feed, inhibited aflatoxin production.

The cellular response in inflammatory reactions in duck-VA-7-1-11 [Mannuthy]

Fundamental studies were taken up to elucidate the mechanism of inflammatory response in the duck. Sequential development of the lesion was studied by inoculating different chemical agents. The heterophilic and mononuclear reaction and vascular response in each of the situations were studied and delineated. The development of giant cells was a late manifestation. Granuloma developed by 96 hours as response to homologus erethrocyte infiltration. Comparative response to different agents was assessed. Irrespective of the agents employed, the primary response was heterophiiic.

Mycotoxicosis in domestic animals-VA-7-1-11-19 [Mannuthy]

On analysis of 53 samples of animal feed, 36 samples were found to contain varying quantities of aflatoxin ranging from 50 ppb to 25 ppm. Toxigenic fungi isolated from the feed samples were *Aspergillus flavus* and *A. parasitious* and *Penicillium* sp. Methods of quantitative estimation of ochratoxin were standardised.

Ochratoxicosis in the goat-VA-7-1-11 (Mannuthy)

On feeding the toxin to goats, anaemia and leucopaenia were manifested after two weeks. There was elevation of blood urea nitrogen and reduction in creatinine level.

Pulmonary pathology of animals in industrial areas-

One hundred and fifty two dogs which were resident in the Udyogamandal area were examined. The pulmonary lesions encountered were anthracosis, peri and endobronchiolitis, squamous metaplasia of bronchial epithelium and bronchiolitis obliterans. Rabbits maintained in the same environment for varying periods also developed similar lesions. The studies indicated that that there was pulmonary damage as a result of exposure to polluted environment.

Diseases of ducks in Kerala- VA-7-1-11 [Mannuthy]

The inflammatory reaction in the duck was studied using a variety of chemical irritants and homologus erythrocytes. When high molecular substances were used the initial reaction was heterophilic but eventually histiocytic reaction followed leading to granuloma. The sequence of development of the lesion induced by different agents was qualitatively assessed and the cellular response was evaluated. Irrespective of the agents employed, the primary reaction was heterophilic.

Investigations on microbial aetiology of infectious abortion in livestock-VA-7-1-8-1 [Mannuthy]

One hundred and fifty five bio-samples were screened. Brucellosis, leptospirosis and vibriosis were established to de prevalent in the State causing abortion. A comparative study of STT and RPT indicated that STT was uniformily consistent, authenic and reliable. On identification of the disease condition in the herds, suitable preventive measures were advocated.

Bacterial species associated with Pneumonia in goats- VA-7-1-8-2A [Mannuthy]

Thirteen species of *Klebsiella*, four species of *Corynebacterium* and five strains of *Streptococcus pneumoniae* were isolated from cases of pneumonia. Chloramphenicol and Ampicillin were found to be effective for therapy.

Bacterial species associated with enteritis in goats- VA-7-1-8-2B [Mannuthy]

E. coli and *Salmonella* sp. were isolated from cases of Enteritis. However, coli infection was more frequent (43.5%). The pathogencity of the isolates was established by biological tests.

Enterobacterial infections in pigs in Kerala- VA-7-1-8-3 [Mannuthy]

Pathogenic strains of *E.coli* and *Salmonella* were isolated, They were found to be sensitive to Chloramphenicol and Gentamycin.

Porcine enterovirus in Kerala State- VA-7-1-8-4 [Mannuthy]

Viral agent was isolated from 19% of apparently healthy pigs and 12.3% of diseased pigs. The isolate was found to be RNA virus. This was found to grow only in porcine systems.

Reproductive failures in bovines due to infectious bovine rhinotracheitis (IBR)/ Infectious pustular vulvo-vaginitis- (IPV) virus- VA-7-1-8-9 [Mannuthy]

Six cytopathic agents were isolated from 72 specimens examined. The isolates were characterised and grouped under Herpetoviridae.

Incidence, pathogenesis and control of Corynebacterium group of bacterial infection in livestock of Kerala- VA-7-1-8-8 [Mannuthy]

C. pyogenes and *C. pseudotuberculosis* were isolated from cases of lymph node abscesses and mastitis. They were sensitive to Chloramphenicol, Eryrhromycin and Tetracycline.

The role of free flying birds in the epizootology of New castle disease VA-7-1-8-9 (Mannuthy)

Four pathogenic strains of NDV were isolated from ducks. There was serological evidence of NDV infection in crows, but there was no clinical evidence of diseases in crows. Isolation of NDV was also made from minah and pigeon.

Comparison of serological tests for the detection of leptospira antibodies in immunised animals. VA-7-1-8 (Mannuthy)

The passive haemagglutination test was found equally useful as that of microscopic agglutination test. The passive haemagglutinating antigen was also found to be stable.

Susceptibility of ducks to New castle disease and their role in the transmission of the disease in chicks-VA-7-1-8 (Mannuthy)

Four strains of NDV were isolated from ducks. One of them was found to be pathogenic.

Pathogenecity and treatment of helminth parasites of ducks-VA-7-1-10-2 [Mannuthy]

Different probable intermediate hosts were screened for the presence of larval stages of parasites. Certain species of grasshoppers were found to harbour the infective larvae of *Tetrameres analis*.

Taeniasis of zoonotic importance-VA-7-1-10-4 [Mannuthy]

The indirect haemagglutination test was found useful for the diagnosis of hydatidosis in cattle. Higher titres were found to have relation with the fertility of the hydatid cyst and the protein content of the cystic fluid.

Spirurids of poultry-VA-7-1-10-9 [Mannuthy]

The pathological changes caused by *Acquria haemulosa* were studied after experimental infection. Anaemia, leucocytosis and severe tissue reactions were seen.

Incidence, pathogenecity and control of parasitic diseases in crossbred calves in Kerala VA–7–1–10–12 [Mannuthy]

Most of the cross–bred calves (66%) were found to harbour one or more parasites. The incidence was high during the period June to September. *Strongyloides papillosus* was the commonest parasite. Several anthelmintics were tried for treatment and their efficacy was assessed and suitable ones (Nemafax; Morantel tartarate and Levamisole) were identified.

Cutaneous myiasis and its control in domestic animals

Maggots were obtained from cases of myiasis. The flies reared out of them failed to infect the artificially inflicted wound in animals.

Biology, pathogenecity and control of helminthic parasites of carnivora in Kerala VA–7–1–10 (Mannuthy)

The incidence of helminthic infection in dogs, cats and toddy cats in Mannuthy area was determined. Experimental studies indicated that *A. caninum* of dog–origin was infective to mice, rat and cat.

Haemetophagous arthropods of domestic animals in Kerala– VA–7–1–10 [Mannuthy]

Different species of haematophagous arthropods were identified. Blood smears collected from buffaloes housed in *Stomoxys* infested shed revealed *Trypanasoma evansi* infection.

Role of fishes and other edible aquatic fauna as transmitters of parasitic diseases of animals and birds. VA-7-1–10 [Mannuthy]

Different species of aquatic fauna were screened for developing forms of parasites of domestic animals and birds with negative results.

Further studies on corticosteroids as supportive therapeutic measures in snake venom–VA–7–1–12–2 [Mannuthy]

The LD 50 of the cobra venom was determined to be 1 mg/kg in dogs. Betamethasone was found to be useful in overcoming the delay in administration of antivenin.

Economic assessment of different drugs used for euthanasia-VA–7-1–12 [Mannuthy]

Twenty four dogs were euthanised at different dosage levels of the drug.

To investigate the galectagogue action of Satavari, Vidarikad and Peplimol VA–7–1–12 [Mannuthy]

Data were collected. Analyses were to be done.

Programme for rodent control using indigenous plants VA-7-1-12 [Mannuthy]

Plumbagin was extracted in pure form from the plant *Plumbago zyleinica.*

Mastitis and its control in cattle and goats VA–7–1–15-3 [Mannuthy]

Teat dipping with 0.5% Iodophore was found to be effective in reducing the incidence of sub–clinical mastitis. Chloramphenicol and nitrofurazon were vary effective in treating clinical mastitis.

Control of common avian diseases with special reference to breakdown of immunity VA–7-1–15–4 [Mannuthy]

Adequate immunity was found to persist for nearly two years following RD vaccination. Coccidiostats had an inhibitory effect on the development of immunity against RD.

Haematology of viral infections in cattle VA-7-1-15 [Mannuthy]

Reduction in leucocyte count was observed in cattle affected with viral infections.

Practical utility of rumeno-rectal fistula as a relief measure for chronic tympany of the rumen in cattle VA-7-1-16-1 [Mannuthy]

The study was conducted in six calves. The fistulation did not bring about any pathgnomonic symptoms.

Studies on necrosis of extremities in cattle and buffaloes VA-7-1-5-1 [Mannuthy]

The line of treatment formulated was found to be effective in curing the disease in its early stages. The fungus infected srraw was found to be the cause and when this was avoided, there was no incidence of the disease.

Studies on experimental therapeutics of hydrocyanic acid poisoning in goats VA-7-1-5 [Mannuthy]

Fortyfive common forage plants were screened for the presence of hydrocyanic acid. Tapioca leaves, rubber leaves and *Cleome viscosa* were found to have toxic levels of hydrocyanic acid.

Studies on leukaemia in cattle VA-7-1-5 [Mannuthy]

The survey carried out did not reveal any incidence of leukaemia

Incidence of leukaemia and leukaemoid reaction in cattle of Kerala VA-7-1-4

Five hundred and fifty animals in different age groups were screened. One hundred and fifty animals had enlarged lymph nodes but none of the animals had leukaemia or leukaemoid reactions.

Clinical observations on seasonally occurring respiratory disease in goats VA-7-1-5-5 [Mannuthy]

The incidence of the disease was found to be high during November to February. The symptomatology of the disease was defined and chemotherapy was attempted with different drugs. Chloramphenicol was found to be the drug of choice for treatment. Clinical parameters were studied and diagnostic criteria were defined. Stress was found to precipitate the disease.

Studies on wobbles in goats in Kerala VA-7-1-5 [Mannuthy]

The clinical features of the disease were described and symptomatic treatment was chalked out. This was found to be effective in ameliorating the symptoms.

8. Miscellaneous

HIGHLIGHTS

The tree leaves commonly fed to goats were found to be low in crude fibre content and fairly rich in crude protein. Tannic acid in leaves was found to be one of the factors responsible for the low digestibility of nutrients in tree leaves. The relatively wide calcium-phosphorus ratio in tree leaves was another important factor influencing their nutritional status. The ultimate pH of refrigerated meat was obtained 96 hours after slaughter under refrigerated conditions, whereas it varied from 12 to 16 hours at room temperature. The spoilage of beef under room temperature occurred 21 hours after slaughter in market samples whereas in case of beef from farm animals, spoilage occurred 37 hours after slaughter. Addition of 2% salt in meat enhanced the keeping quality by five hours and addition of 5 percent sugar had reduced the keeping quality. Differentiation of goat meat (chevon) and beef was possible by serological method of testing with cent per cent accuracy. Adulteration of beef and chevon could be detected at levels of 20%.

PROJECTS IMPLEMENTED

		Location
1	Factors influencing adoption of selected animal husbandry practices by milk producers (VA–M–1–7–3) (1)	Mannuthy
2	A study on the relative effectiveness of extension tools and techniques employed in the adoption of improved animal husbandry practices under Dairy development programme in Trichur District (VA–M–7–4)	Mannuthy
3	Tannic acid content and digestibility of nutrients in tree leaves (VA–M–1–9–2)	Mannuthy
4	Differentiation of beef from chevon by serological methods (VA–M–1–17–1 (B)	Mannuthy
5	Preliminary studies to assess the mass loss shrinkage in cattle and buffaloes subjected to transport on hoof (VA-M-1-17-2)	Mannuthy
6	Preliminary studies to evolve a suitable formula for predicting the live weight of slaughter cattle and buffaloes (VA–M–1–17–3)	Mannuthy
7	Certain post–slaughter physico–chemical changes in beef (VA–M–1–17–5)	Mannuthy

Factors Influencing adoption of selected animal husbandry practices by milk producers–VA–M–1–7–3 (1) [Mannuthy]

This study was taken up to ascertain the extent of adoption of improved cattle rearing practices. The respondents were selected from among the milk producers of Ollukkara Block area, preferably members of the Co-operative Societies. The information were collected on the basis of pre–tested interview schedule.

A study on the relative effectiveness of extension tools and techniques employed in the adoption of improved animal husbandry practices under Dairy development programme in Trichur district. VA-M–7–4 [Mannuthy]

To evaluate the comparative efficiency of extension techniques singly and in combinations and thereby to understand the training needs of the extension personnel, this project was taken up. The farmers in Trichur district and extension personnel ofithe area were to be covered. About 1000 personnel consisting of 5 percent of the population in the study area were to be interviewed with a pre–tested schedule to collect the relevant information.

Tannic acid content and digestibility of nutrients in tree leaves–VA-M-1–9-2 [Mannuthy]

In order to assay the tannic acid content of common tree leaves and to ascertain the digestibility of leaves to goats, the studies were carried out.

Chemical analysis of nutrients and estimation of tannic acid were done. Palatibiiity of different leaves for goats was studied. To assess the nutritive value of different tree leaves, digestion and metabolism trials were conducted in goats. The relation between tannic acid content and digestibility of nutrients was also made. The results indicated that the tree leaves in general were low in crude fibre and fairly rich in crude protein. It was indicated that tannic acid was present in most of the tree leaves. The calcium-phosphorus ratio was wider in tree leaves.

Differentiation of beef from chevon by serological methods – VA–M–1–17–1 (b) [Mannuthy].

With a view to devise methods for differentiating goat meat (chevon) and beef and thereby to detect cases of adulteration, studies were taken up.

Anti-sera were raised in rabbits against chevon and beef. The sera containing cross-reacting antibodies were absorbed using freez-dried meat of the species against which the cross–reacting anti-body is present in order to remove them. This sera, was made use of in tube precipitation test as well as gel diffusion test against antigens prepared from meats to be tested. The result of the test indicated that the differentiation of chevon and beef could be made with cent per cent accuracy, thereby helping to detect misrepresentation of meat. In a mixture of beef and chevon, either of the ingredients could be detected at a level as low as 20 per cent. This will be useful in detection of adulteration of chevon with beef.

Preliminary studies to assess the mass loss shrinkage in cattle and buffaloes subjected to transport on hoof– VA–M–1–17–2 [Mannuthy]

During transport of animals for slaughter, they are often forced to walk long distances without proper feeding and rest. This leads to considerable weight loss and shrinkage. The extent of this loss is not yet estimated. This study was to observe the loss of body weight and shrinkage and to estimate the economic loss incurred on account of transporting slaughter animals on hoof for long distances.

One hundred and ninety eight heads of cattle transported from Coimbatore/ Pollachi to Trichur on foot were subjected to the study. The data were colleeted.

Preliminary studies to evolve a suitable formula for predicting the live weight of slaughter cattle and buffaloes– VA–M–1–17–3 [Mannuthy]

Though the accurate live weight of animals can be known only by weighing them over a balance, the approximate weight could be estimated by a formula, incorporating certain body measurements under FPS system. The estimation of weight, is essential for purpose of administration of medicine to the animal, or to estimate the value of animal for slaughter. When we switched over to metric system the old formula under FPS system is not useful,

The accurate weight and certain body measurements of 239 heads of cattle were recorded with the aid of weigh bridge and tape. The data were to be collected for more number of animals.

Certain post–slaughter physico-chemical changes in beef– VA–M–1–17–5 [Mannuthy]

Meat will undergo physico-chemical changes during post–slaughter period. Increase in pH is one of the early changes in meat. The spoilage of meat takes place when kept under room temperature. The spoilage of meat is influenced by factors like atmospheric temperature, bacterial load and the amount of pre–slaughter care and rest to the animal.

The study indicated that the ultimate pH is reached 96 hours after slaughter in refrigerated meat and 12–16 hrs. under room temperature. Occurrence of spoilage of meat of two different sources under room temperature widely varied. The meat collected from public slaughter houses got spoiled after 21 hours of slaughter whereas in similar samples collected from farm animals slaughtered in the College slaughter house, spoilage occurred only after 37 hours. Addition of 2 per cent salt in meat enhanced its keeping quality, whereas addition of 5 percent sugar decreased the keeping quality.

PART III

FACULTY OF FISHERIES

Fisheries

HIGHLIGHTS

Puthuveypu, near the Cochin harbour mouth was found to be a good collection centre for the seed of cultivable species of brackishwater prawns and fishes. The availablity of tiger prawn post-larvae in appreciable numbers was recorded from Puthuveypu during April-May. *Mugil cephalus* fingerlings were collected from this area in appreciable numbers during July and August. A production of 1353/kg/ha in $7\frac{1}{2}$ months was obtained when *Etroplus. Chanos* and *Mugil cephalus* were cultured together. Liming was found helpful in correcting the pH of water during the heavy rains. The exotic fish Goramy was found to thrive well in Pokkali rice fields.

SUMMARY

The survey conducted for assessing the availabilty of the seed of cultivable brackish water fishes and prawns had shown that the seed of prawns was available abundantly during the pre-monsoon season especially during March–May. Mullet fry and fingerlings were available during April–August.

Monoculture experiments with prawns *Penaeus indicus* and *Penaeus monodon* were conducted. Although the growth obtained in these experiments was appreciable, the rate of survival was found to be low. In the case of the experiment with *Penaeus monodon*, it was found that most of them died when the salinity dropped to 0.42‰. An experiment on mixed culture of of prawns *Penaeus indicus*, *Metapenaeus monoceros* and *M. dobsoni* conducted at Vyttila had shown that the growth rate of the latter two species was less than 2g per month, whereas this was 4.71 g for *P. indicus*. In a mixed culture of *Etroplus* with *Chanos* and *Mugil cephalus*, a production of 1353 kg/ha was obtained in $7\frac{1}{2}$ months.

The pH of the pond water was found to drop considerably during the first few heavy monsoon rains. Studies conducted have indicated that the leaching of acidic salts from the pond bunds might contribute to the lowering of pH of pond water. Liming was found helpful in correcting the pH of water.

Of the 5 species of fishes cultured along with rice in the Pokkali fields, only *Osphronemus goramy* survived in spite of heavy overgrowth of the weed *Salvinia* in the fields.

Experiments conducted in the Kuttanad and Kole lands showed that the Indian major carps, Catla, Rohu and Mrigal and the common carp grew well under the paddy field conditions.

The rate of growth of *Etroplus suratensis, Cirrhinus origola* and *Cyprinus carpio* was faster in a pond fertilized with pig dung at 5 kg per day as compared to the growth rate under fertilization with coconut oil cake and rice-bran mixed at 1:1.

In the case of induced breeding of grey mullets, it was found desirable to have the breeders lightly sedated. Tertiary butyl alcohol, Quinaldine, sodium barbital and Pentobarbital and Pentobarbital sodium were used as anaesthetics. Considering the quickness of the anaesthetic effect, the comparatively brief recovery period and the healthy condition of the fish after recovery, Tertiary butyl alcohol in 0.7% solution was found to be most suitable.

PROJECTS IMPLEMENTED

		Locations
1	The survey of seed resources of cultivable species of prawns and fishes in Cochin back waters (VA-F-6-18-2)	Vyttila
2	Nursey rearing of prawns and fishes (VA-F-6-18-18)	,,
3	Studies on mono and polyculture of finfish and shell-fish, with and without artficial feed (VA-F-6-18-IC)	,,
4	Studies on the ecology of brackish water ponds in relation to productivity (VA-F-6-18-ID)	,,
5	Studies for the identification of suitable varieties of fishes which can be cultured along with rice in pokkali fields (VA-F-6-18-3A)	,,
6	Adaptive trials for introducing fish culture in Pokkali fields (VA-F-6-18-38)	,,
7	Farming of fish as follow-up crop in paddy fields (VA-F-8-18-4A)	Kole lands, Trichur
8	Adaptive trials for simultaneous farming of fish and prawns along with paddy (VA-F8-18-4C)	Kuttanad
9	Prawn culture in Pokkali rice fields after the harvest of paddy (VA-F6-18-5A)	Vyttila
10	Pig cum fish culture (VA-F-9-18-6A)	Kumarakom
11	Composite culture of Indian major carps and exotic carps (VA-F-9-18--78)	,,
12	Propagation and farming of frogs	,,
13	Induced breeding of the Grey Mullets	Vyttila
14	Seed resource survey of cultivable species of prawns and fishes in the Cochin backwaters (VA-F-6-18-2)	,,

The survey of seed resources of cultivable species of prawns and fishes in Cochin back waters VA-F-6-18-2 [Vyttila]

The survey was intended to make a qualitative and quantitative assessment of the availability of seed of cultivable species of prawns and fishes during the different seasons so that the seed resources could be exploited for commercial fish and prawn farming.

The survey for forecasting and assessing the availability of the seed of cultivable species of prawns and fishes was contiuned at the Puthuveypu collection site. Different gears such as midnapore type shooting net, haps net made of velon net meterial and a drag net of 15 mm mesh size (7x2 m) were used for the survey. With the shooting net operated during high tide at a channel running at right angles to the main canal, up to 7655 post-larvae of prawns could be collected per hour the maximum being in April, 1979 (Table III-1). By the start of the monsoon, there was a decrease in the availability of seed and it picked up again in March 1980. Haps net was found more convenient and efficient for collection of juveniles. With the haps net up to 1156 juveniles of prawns could be collected per hour in February 1980. As in the case with shooting net, collection made during the

Table III. 1. Data of seed resource survey for cultivable prawns and fishes conducted at Puthuvypeen during 1979–80

Species	Catch per net per hour											
	1979									1980		
	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Prawns												
(*Penaeus indicus: Metapenaeus dobsoni: M. monoceros and Penaeus monodon*)												
a) Prawn juveniles												
i) Hapa net	780	128	426	44	108	564	165	90	54	216	1156	366
ii) Drag net	480	808	2826	288	300	1092	477	174	60	126	624	240
b) Prawn post-larvae i) Midnapore shooting net	7655	5566	5573	8702	1983	230	2760	156	420	280	276	1038
Mullets												
Lize macrolepis and Mugil dussumieri	368	2616	72	688	3600	94	18	36	12	Nil	42	12

monsoon months with haps net showed that the availability was relatively less. With drag net also the same pattern of availability was recorded. *Penaeus indicus* contributed more than 50% during the post and pre-monsoon period starting from November. The maximum of 72.7% was obtained in January, 1980 and the minimum (9.5%) was in July, 1978 synchronising with the peak monsoon season. *Penaeus monodon* post larvae were available in appreciable numbers during April and May 1978, when up to 10% of the total catch comprised of *P. mondon* post-larvae. The availability of the juveniles of *P. monodon* was very poor during the report period.

Mullet fry and fingerlings were available abundantly during May, 1979, when the catch per net per hour was of the order of 2616. In July and August also, the availability was very high. In August 1979, the catch per net per hour with drag net was as high as 3600. *Mugii cephalus* fingerlings were available during July and August, when they contributed 6.0 and 13.1% respectively. Among the other mullets *Mugil dussumieri* was more during May, August and October (73.3, 66.6 and 80.0% respectively) whereas *Lize macrolepis* was more during other months. *Chanos* fry and fingerlings were available in limited numbers from March to June 1979.

Nursery rearing of prawns and fishes VA-F-6-18-18 [Vyttila]

The objective of the project was to find out the best nursery rearing practices suitable to the locally available species of prawns and fishes in order to obtain maximum survival rate during nursery rearing.

Penaeus monodon post-larvae and the fry of *Chanos chanos* were kept for a month in plastic pools and fed with pelletised feed made of rice bran and groundnut oil cake provided at 1:1 ratio (with a little wheat flour in paste form to act as binder) in the former case and with rice bran alone in the latter case. The survival rate obtained in the case of *P. monodon* worked out to less than 40%, whereas this was more than 90% for *Chanos*.

Studies on mono and polyculture of finfish and shellfish with and without artificial feed VA-F-6-18-IC [Vyttila]

The project was carried out to find out the best species combination to achieve maximum production from brackishwater ponds and also to find out a cheap nutritive supplementay feed for fishes and prawns.

Two monoculture experiments of *Penaeus indicus* were conducted, one during 1979 and the other in 1980. In the former experiment, *P. indicus* having a size of 27.0 mm and 0.048 g was stocked at a density of 50,000/ha during March, 1979. When harvested after a period of 3 months, they reached a size of 126.1 mm and 9.5 g. The average monthly growth obtained was 32.6 mm and 3.15 g. The rate of survival obtained (7.66%) was very low. In the latter experiment, juveniles of *P. indicus* having a size of 47.8 mm and 0.66 g were stocked in January, 1980 at a stocking density of 70,000/ha.

An experiment of monoculture of the tiger prawn *Penaeus monodon* was done during the report period. The post larvae of this prawn collected from Puthuvypeen were stocked at a concentration of 25,000/ha during June, 1979. Up to 29-10-79 they reached a size of 156.2 mm weighing 36.080 g. On the commencement of another spell of North-east monsoon, they started dying from the first week of November and these were harvested on 8-11-79 when large scale mortality was observed. Only 140 numbers out of 4250 could be harvested alive. The salinity which was 1.42% on 21-6-79 dropped to 0.42% by 3-11-79.

Two experiments on mixed culture of prawns such as *Penaeus indicus Metapenaeus monoceros*, and *M. dobsoni* were conducted. In the first experiment conducted during 1979, they were stocked at a concentration of 45,000 at 1:1:1 ratio and in the second experiment the concentration was doubled while keeping the same ratio. In the first experiment which was over in the report period, the average monthly growth obtained for *P. indicus* was 33.5 mm and 4.71 g while it was 10.3 mm and 1.7 g for *M. monoceros* and 8.9 mm and 1.1 g for *M. dobsoni*. The rates of survival obtained were 24.50% for *P. indicus* 56.28% for *M. monoceros* and 65.25% for *M. dobsoni*. The production obtained for a period of 3 months worked out to 154.76 kg/ha.

Both monoculture as well as mixed culture operations were carried out involving the fish *Etroplus suratensis*. Monoculture of *Etroplus* with single stocking and repeated harvesting was tried with a lower rate of initial stocking and also at a higher rate of initial stocking. From the pond (0.4 ha area) in which the former experiment was in progress from October, 1978, where the initial stocking density was only 1500 nos/ha, 880 Nos. of *Etroplus* fingerlings and 198 adults were removed during the report period bringing the total fry and fingerlings collection to 5095 and that of the table fish to 26.29 kg. In the latter experiment started during August, 1979 the fish *Etroplus* was stocked at a density of 15,000/ha.

In a mixed culture experiment conducted during the report period, a production of 1353 kg/ha for 7½ months (2165 kg/ha per year) was obtained with manuring only. The details are given in the Table III. 2.

Table III. 2: Performance of fishes under poly culture with manuring

Species stocked	Stock-ing density and ratio	Date of stocking	Size at the time of stocking	Date of harvest ing and period of rearing	Average size at the time of har-vesting	Average monthly incre-ment of growth	Per-centage survival
Etroplus suratensis		2-8-79	120.3mm 40.0 g	22-3-80 7½ months	190.0 mm 151.5 g	9.69 mm 14.86 g	87.75%
Chanos chanos	5500/ha 5:5:1	9-8-79	82.0mm 4.0 g	,,	452.0mm 682.0 g	49.33 mm 90.40 g	27.25%
Mugil cephalus		9-8-79	53.0mm 2.5 g	,,	297.5mm 328.0 g	32.60 mm 43.40 g	40.00%

The growth obtained for *Etroplus* and *Chanos* was quite appreciable.

The experiment of polyculture with the fish *Mugil dussumieri* and the prawn *Penaeus indicus* was initiated during the report period. They were stocked at a ratio of 3:5 and at a density of 16,000/ha.

Studies on the ecology of the brackishwater ponds related to productivity VA-F-6-18-10 (Vyttila)

This study was aimed to find out the optimum dosage of lime, manure, supplementary feed etc. required in each pond with a view to obtain maximum production.

The physico-chemical conditions of the water in the ponds showed wide seasonal variation. Maximum salinity of 18.3% was recorded in April '79 and as the monsoon started, the salinity dropped steeply to only traces in June, 1979. From June to December, the salinity was very low with occasional improvement up to 2%. Maximum temperature (35°C) was recorded during April–July of 1979 and February and March of 1980. Highest values of dissolved oxygen was recorded (up to 14.7 mg/1) in ponds having dense phytoplankton. In certain ponds, the water pH showed a steep drop up to 4.4 in June '79 during the first heavy rains. Studies conducted to elucidate this phenomenon had shown that the leaching of acidic salts from the pond bunds may contribute to the lowering of pH of pond water.

The analysis of the bottom mud to study the constitution and the production of the benthic fauna had revealed that the fauna was mainly constituted by polychaete worms, amphipod crustaceans and gastropod and bivalve molluscs. The quantity varied from 10.1 g per sq meter (up to a depth of 10 cm) to 214 g per sq meter.

Quantitative and qualitative analyses of the zooplankton in different ponds were done during the period. The quantity of zooplankton available in 50 litre of water ranged between 0.01 ml in pond VI and 0.5 ml in pond I. The volume of zooplankton used to be always high in this pond were supplementary feed comprising of rice bran and groundnut oil cake was used before. The zooplankton represented were calanoid and cyclopoid copepods, cledocerans decapod larvae and insect larvae.

The ponds were used to be treated with lime or calcium carbonate at a dose of 500 kg/ha at the time of preparation for stocking. Liming or use of calcium carbonate in such low quantities did not help in increasing the pH substantially, but helped to keep the pH level from dropping too low. So also, it was found that manuring with RCD, urea and Rock phosphate did not bring about significant change in the soil nutrient level, but there was increased production of phytoplankton as could be seen from the primary production values.

Studies for the identification of suitable varieties of fishes which can be cultured along with rice in pokkali fields–VA-F-6-18-3A (Vytilla)

The study was aimed to find out suitable species of fishes which could be grown along with rice in Pokkali fields adjoining the backwaters. During the report

period, 5 species of fishes, viz., *Etroplus suratenis, Mugil* sp., *Tilapia mossambica, Cyprinus carpio and Osphronemus goramy* were introduced in separate plots after the paddy seedlings were spread out from mounds. Before release, the field was prepared by raising the cross bunds, by deepening the side channels and by separating the plots by putting bamboo screen in the connecting feeder channels. The weed *Salvinia* was removed periodically. When harvested, it was found that the exotic fish Goramy alone had survived, the rate of survival being 50%. The failure on the part of the other fishes to survive, could be attributed to the thick growth of *Salvinia* which could not be controlled in spite of repeated removal from the field.

Adaptive trials for introducing fish culture in Pokkali fields– VA–F-6–18–38 (Vytilla)

The scheme was initiated with a view to take up fish culture along with paddy in the pokkali fields so as to increase the revenue from such fields and to utilise such pokkali fields which are not currently used for prawn filtration practice.

During the year 1979, the experiment was conducted at 3 fields, one at Pattanakkad, one at Edacochin and the third at Eroor. All the three were low saline fields. After preliminary preparation such as raising bunds and putting up sluices, the fish *Etroplus suratensis* was stocked in those fields at a concentration of 2000/ha. The dates of stocking and harvesting, size at the time of stocking and harvesting and the rates of survival are given in Table III.3.

Table III. 3: Performance of *Etroplus suratensis* in Pokkali field.

Location	Date of stocking	No. stocked	Average size at the time of stocking	Date of harvesting	Average size at the time of harvesting	Percentage survival
Pattanakad	30.8.79	200	71mm 10.0 g	17.12.79	150 g	61%
Edacochin	30.8.79	256	71mm 10.0 g	22.11.79	45 g	8.4%
Eroor	11.9.79	80	82mm 16.0 g	5.2.80	135mm	53.75%

Of the three plots, two had given encouraging results. The field at Pattanakkad was having an average depth of about 80 cm always and there was flourishing growth of *Hydrilla*. These factors where quite favourable to achieve appreciable growth for the fishes. The field at Edacochin was very shallow and hence there was very little growth as well as very low survival rate.

Farming of fish as a follow-up crop in paddy fields-
VA-F–8–18–4A (Kole lands, Trichur)

The objective of the project was to ascertain the feasibility of raising a crop of fish after the harvest of paddy. In a plot at Karanchira having an area of 1.2 ha the fishes *Catla catla* and *Cirrihina mrigala* were stocked at a concentration of 4166/ha at 1:1 ratio during September, 1979. At the time of stocking, Catla had an average size of 47.5 mm and 12.5 g and Mrigal 46.7 mm and 11.5 g. The fish culture trial was in progess.

Adaptive trials for simultaneous farming of fish and prawns along with paddy- VA–F–18–4C (Kuttanad, Alleppey)

In order to study the feasibility of raising a crop of fish along with flood tolerant variety of paddy, a field at Ramankari in Kuttanad was selected. In the 2.4 ha field, 2000 nos. of Catla and 5000 nos. of *Mrigal* were stocked on 17–10–79 and 3000 nos. of common carp on 12.2.80. When an assessment of growth was made on 26.1.80, it was found that *Catla* had grown to an average size of 330mm and 425 g and *Mrigal* to 190 mm and 110 g.

Prawn culture in Pokkali rice fields after harvest of paddy- VA–F–6–18–5A (Vytilla)

The objective of the scheme was to study the ways and means to improve the prawn filtration practices in Keraia by inducting scientific methods. During 1979–80, the eastern fields of the Rice Research Station, having 1.716 ha (i) and the southern portion of the western field having 1.936 ha (ii) were used as control fields, as in the previous year. The preliminary preparation of the fields such as installation of sluice and repair of sluices, deepening of channels and removal of weeds were done in November–December period. The stocking of prawn in the control fields by conventional methods was started by the middle of January, 1980, when the salinity of the water had gone up and prawn juveniles appeared in appreciable numbers. In the eastern field, where the harvesting of the prawns was conducted in the traditional way, the harvesting was continuous whereas in the control field II, the prawns that were trapped were allowed to grow for more than two months. From the eastern field, 66 kg of prawn was obtained whereas from the western field 115 kg of prawns were obtained, showing that the latter method is more profitable and advantageous in the interior Pokkali fields, where there is not much scope for the entry of large quantity of adult prawns.

During the report period, a plot of 0.16 ha on the northern side of the west field was used for controlled cultivation of prawns. This was prepared during January, 1980, by raising the bunds and killing the weed and predatory fishes by applying mahua oil cake at a dose of 250 kg/ha. 12.00 Nos. of *Penaeus indicus* juveniles (75,000/ha) having an average size of 47 mm and 0.66 g were stocked in this plot during the first week of February. When harvested in April after 68 days of rearing they have achieved an average size of 115 mm and 10.4 g. The rate of survival obtained was 23%. A better rate of survival could have been obtained, if the level of water had not gone down so low, causing rise in temerature and mortality.

Pig-cum-fish culture- VA–F–9–18–6A (1) (Kumarakom)

This study was taken up to find out the extent to which fish production could be increased by utilizing pig dung and urine as manure in ponds.

The ponds (0.1 ha) which were prepared after clearing Salvinia, were stocked with fingerlings of *Etroplus suratensis Cirrhina mrigala* and *Cyprinus carpio* at 5:4:4 ratio at a concentration of 3250/ha. Pig dung was dumped at the rate of 5 kg in one pond (experimental) and in the other pond (control), feed mixture consisting of coconut oil cake and rice bran at 1:1 ratio was given at a daily dose of 2% of the total body weight of the fishes. Monthly growth measurements recorded are given in the Table III. 4.

Table III. 4: Growth measurement of fishes in ponds fertilized with pig dung

Months	Average growth measurements					
	Under fertilization with pig dung				Under fertitization with oil cake and rice bran	
	E. suratensis		*C. mrigala*		*C. carpio*	
	Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)
Experimental pod						
December '79	80	10.00	90	6.50	40	1.80
January '80	92	15.60	103	10.75	85	7.50
February '80	106	22.60	135	22.50	99	9 75
March '80	114	22.50	175	54.50	113	14.50
Control pond						
December ,79	80	10.00	90	6.50	40	1.80
January '80	90	13.80	100	10.00	83	6.75
February '80	103	20.50	132	21.00	96	9.00
March '80	111	25.25	170	51.75	110	12.10

Composite culture of Indian major carps and exotic carps–VA–F–9–18 (Kumarakom)

The objective of the study was to find out the best system of culture of the fresh water fishes at Kumarakom.

The project was started in December 1979. In one pond (0.1 ha) prepared after weeding and manuring, the fingerlings of Catla, *Cirrhina mrigala* and *Cyprinus carpio* were stocked at the rate of 120, 160 and 260 numbers respectively. The fishes were fed regularly with mixture of oil cake and rice bran at 1:1 ratio.

The growth measurements were recorded regularly (Table III.5)

Table III.5: Growth measurements of carps under composite culture

Month	Catla		*Cirrhina mrigala*		*Cyprinus carpio*	
	Length (mm)	Weight (mm)	Length (mm)	Weight (mm)	Length (mm)	Weight (mm)
December 79	85	7.500	90	6.500	40	1.800
January 80	124	28.500	100	10.000	90	8.200
February ,,	165	77.500	130	20.750	105	10.500
March ,,	196	105.100	173	53.750	115	16.400

Propagation and farming of frogs [Kumarakom]

The project was aimed to artifically propagate the commercially important species of frogs so as to produce a large number of juvenile frogs for release in the paddy fields and natural waters in order to sustain large field populations for culturing the frogs up to the adult stage

The project was started in February 1980. To begin with, a preliminary survey of the different speceis of frogs available locally was conducted. Studies on the population of adult frogs based on fortnightly samples drawn from 10 centres had shown that the species *Rana hexadactyla* outnumbered *R. tigrina*.

A pond was prepared for stocking the adult frogs with the sides fenced closely with plaited coconut leaves and the top was covered over with nylon netting. A mercury vapour lamp was installed in the centre of the circular pond. Adult frogs were stocked in the pond,

Induced breeding of the grey mullets [Vyttila]

The project was aimed to induce the breeding of the grey mullets, especially *Mugil cephalus* through hypophysation and the administration of various hormonal preparations. It was also envisaged to develop a technology for the large scale rearing of mullet larvae.

Mugil spp. were found to be severely affected by the injuries sustained during netting and handling the fish for administration of pituitary injections. It was, therefore, decided to anaesthetise the fish as soon as they are caught with a suitable anaesthetics. The following four anaesthetics were tried at different dilutions in order to achieve "light sedation" in fhe adult fish : (1) Teritary butyl alcohol (2) Quinaline (3) Sodium barbital (4) Pentatarbital sodium. *M. macrolesis* of early maturity stages (females of average length of 23.45 cm and weight 141 g and males of average length 23.48 cm 136.5 g) were used for the experiments. Salinity of the water used for experiments was 11.4% and the pH was 7.5. In the case of Tertiary butyl alcohol, 0.7ml/100ml solution gave "light sedation" to the fish in about 35 minutes. The recovery time was 10–15 minutes. A higher concentration of 0.9 ml/100ml solution gave light sedation in 25 minutes, but the fish showed signs of distress. In 0.009% solution of Quinaline, the mullets exhibited light sedation in 30 minutes. In 0.1 g/100 ml solution of Sodium barbital, the fish appeared lightly sedated in about 30 minutes and in 0.15 g/100 ml solution, the fish became lightly sedated in 20 minutes. In 0.002 g/100 ml solution of Pentobarbital sodium, the fish were lightly sedated in about 30 minutes and deeply sedated in about an hour. In general, considering the quickness of the anaesthetic effect produced, the comparatively brief recovery period and the healthy condition of the fish after recovery, Tertiary butyl alcohol in 0.7% solution is remommended for anaesthetising the breeders of *Mugil* spp.

APPENDICES

APPENDIX—I

RESEARCH COUNCIL

	The Vice Chancellor, Kerala Agricultural University, Vellanikkara.	Chairman
	The Director of Research, Kerala Agricultural University, Vellanikkara.	Secretary
1	Dr. VSS Potti, Director of Extension Education, Kerala Agricultural University, Vellanikkara.	Member
2	Dr. N Sadanandan, Dean, College of Agriculture, Vellayani.	"
3	Dr. PG Nair, Dean, College of Veterinary & Animal Sciences, Mannuthy.	"
4	Sri. VS Ouseph, Professor, Mar Ivanios College, Trivandrum.	"
5	Prof. TP Mohammed Kunhi, Manna, Taliparamba.	"
6	Dr. MG Krishna Pillai, Professor, University of Cochin.	"
7	Sri. M Janardhanan Nair, Rtd. Director of Agriculture, Lakshmi, Sasthamangalam, Trivandrum.	
8	Sri. Jacob P John, Retd. Additional Director of Agriculture & Private Secretary to the Governor of Andhra Pradesh.	"
9	The Director of Research, Tamil Nadu Agricultural University, Coimbatore.	"
10	Dr. SN Rao, Senior Scientist and Head of Department of Horticulture, Andhra Pradesh Agrl. University, Tirupathy.	"
11	Dr. K Krishnamoorthy, Director of Research, University of Agrl. Sciences, Bangalore.	"
12	The Agrl. Production Commissioner, Trivandrum.	"
13	Dr. MV George, Chief, Evaluation, State Planning Board, Trivandrum.	"

APPENDIX—II

RESEARCH ADVISORY COMMITTEE

1	The Vice-Chancellor, Kerala Agricultural University, Vellanikkara.	Chairman
2	The Director of Research, Kerala Agricultural University, Vellanikkara.	Convener
3	All non-official members in the Executive Committee	Member/Members
4	All Deans in the Kerala Agricultural University	"
5	All the members of the Research Council of the Kerala Agricultural University	"
6	The Directors or representatives of the ICAR Research Institutes in the State	"
7	The Director, Forest Research Institute, Peechi, Kerala	"
8	The Director of Agriculture, Kerala	"
9	The Director of Animal Husbandry, Kerala	"
10	The Director of Fisheries, Kerala	"
11	The Chief Conservator of Forests, Kerala	"
12	The Director of Dairy Development, Kerala	"
13	All the members of the General Council nominated by the Chancellor under Section 19 (9) KAU Act, 1971	"
14	All the MLA s in the General Council of the Kerala Agricultural University	"
15	The Deputy Director of Agriculture, State Planning Board	"
16	The Farmer's Representatives nominated by the Vice-Chancellor	"
	1 Sri. Vasudevan Nair, Punnappuram House, Pirappancode P. O., Trivandrum Dist.	Member
	2 Sri. EP Madhavan Nair, EPM Industrial & Agrl. Estate, Palappuram, Ottappalam, Palghat Dist.	"
	3 Sri. TN Rishikesan Bhattathirippad, Kudamaloor, Kottayam District	"
	4 Sri. TV Varghese Vaidyan, Kalpakavady, Thottappally, Alleppey District	"

	5 Sri. Joseph Alappattu Thoppil, Karanchira, Trichur Dist.	Member
	6 Sri. Vasudevan Namboodiripad, Karuvakundu, Palghat Dist.	,,
17	The Farm Radio Officers, All India Radio, Trichur & Calicut	,,
18	All the members of the Faculty Research Committees of the Kerala Agricultural University	,,
19	All the Project-Co-ordinators in the Kerala Agricultural University	,,

APPENDIX—III

FACULTY RESEARCH COMMITTEES

(a) **Agriculture**

1	The Dean, College of Agriculture, Vellayani	Chairman
2	The Associate Dean, College of Horticulture, Vellanikkara	Member ,,
3	Heads of Departments	,,
4	Dr. M Aravindakshan, Professor, College of Horticulture, Vellanikkara	,,
5	Sri. N Gopalan, Assoc. Professor, Rice Research Station, Pattambi	,,
6	Sri. N Rajappan Nair, Assoc. Professor, Rice Research Station, Moncompu	,,
7	Dr. UP Bhaskaran, Director of Research, Kerala Agrl. University, Vellanikkara	,,
8	Dr. MM Koshy, Professor of Agrl. Chemistry, College of Agriculture, Vellayani	Part time Secretary & Convenor

(b) **Veterinary & Animal Sciences**

1	The Dean, College of Veterinary & Animal Sciences, Mannuthy	Chairman
2	Heads of Departments	Member
3	Superintendent, University Livestock Farm, Thiruvazhamkunnu	,,
4	Research Officer, Cattle Breeding Farm, Thumburmuzhi	,,

5	Dr. M Sthanumalayan Nair, Fodder Research Officer, Mannuthy	Member
6	Dr. KT Punnoose, Assoc. Professor, Scheme for studies on Porcine Enterovirus	,,
7	Dr. M Krishnan Nair, Professor of Pathology, College of Veterinary & Animal Sciences, Mannuthy.	,,
8.	Dr. A Venugopalan Nambiar Professor (Research Co-ordination	Part-time Secretary & Convenor

APPENDIX –IV

VARIETY EVALUATION COMMITTEE

1	Director of Research Kerala Agrl. University, Vellanikkara	Chairman
2	The Director, CTCRI, Trivandrum or his nominee	Member
3	Director, CPCRI, Kasargod or his nominee	,,
4	The Director of Agriculture, Trivandrum or his nominee	,,
5	Director of Extension Education, Kerala Agricultural University, Vellanikkara	,,
6	Professor of Agronomy, College of Agriculture, Vellayani	,,
7	Professor of Plant Pathology, College of Agriculture, Vellayani	,,
8	Professor of Agrl. Botany, College of Agriculture, Vellayani	,,
9	Professor of Horticulture, College of Agriculture, Vellayani	
10	Professor of Entomology, College of Agriculture, Vellayani	,,
11	Associate Professor i/c, Rice Research Station, Pattambi	
12	Associate Professor i/c., Coconut Research Station, Pilicode	,,
13	Associate Professor, Directorate of Research, Kerala Agricultural University, Vellanikkara	Convenor

APPENDIX—V

PROJECT CO-ORDINATION GROUPS

A. AGRICULTURE

1 **Rice:**

Project Co-ordinator– Sri. PN Pisharody
Membsrs–Dr. V Gopinathan Nair, Sri. N Rajappan Nair,
Dr. K Karunakaran, Sri. KI James, Sri. TF Kuriakose,
Sri. PJ Tomy, Dr. VK Sasidhar, Sri. PK Gangadhara Menon,
Dr. RS Aiyer, Sri. NN Ramankutty, Dr. CC Abraham,
Dr. MJ Thomas, Dr. MC Nair.

2 **Coconut, Arecanut & Oilpalm:**

Project Co–ordinator–Sri. K Kannan
Members–Sri. B Thomas, Sri. EP Koshy, Dr. PK Narayanan Nambiar,
Dr. C Sreedharan, Dr. R Vikraman Nair,
Dr. TV Viswanathan, Dr. Al Jose, Dr. TS Venkitesan,
Dr. MC Nair, Dr. SK Nair.

3 **Spices, Cocoa and Other beverage crops:**

Project Co–ordinator–Dr. N Mohanakumaran
Members–Dr. L Rema Devi, Sri. V Sukumara Pillai,
Dr. N Krishnan Nair, Dr. K Kumaran, Dr. R Vikraman Nair,
Dr. CC Abraham, Dr. TS Venkitesan, Sri. S Balakrishnan,
Dr Abi Cheeran.

4 **Cashew and Fruits:**

Project Co–ordinator–Sri. VK Damodaran
Members–Dr. N Krishnan Nair, Dr. K Kumaran, Sri. K Kannan,
Sri. S Balakrishnan, Dr. N Mohanakumaran, Sri. MK Mammen,
Sri. P Sethumadhavan, Dr. MNC Nair, Sri. G. Sreekantan Nair,
Sri. G. Madhavan Nair, Sri. PC Jose, Associate Professor
Cashew Research Station, Anakkayam, Associate Professor
Cashew Research Scheme, Madakkathara.

5 **Vegetable and Tuber crops:**

Project Co–ordinator–Dr. PK Gopalakrishnan
Members–Dr. Mary K George, Sri. PK Asokan,
Dr. KV Peter, Sri. P Sethumadhavan, Sri. S Balakrishnan,
Dr. N Mohanakumaran, Dr. TS Venkitesan,
Dr. CK Peethambaran.

6 **Pulses and Oil seeds:**

Members–Dr. Mary K George, Dr. TV Viswanathan,
Smt. Santhakumari,
Dr. VK Sasidhar, Sri. TF Kuriakose,
Sri. Al Thomas, Sri. MRC Pillai, Dr. RS Aiyer,
Dr. PJ Joy Dr. Abi Cheeran.

7 **Essential Oils and Medicinal Plants:**
Project Co-ordinator–Dr. Mary K George
Members–Sri. EVG Nair, Dr. Al Jose, Sri. T Prabhakaran,
Dr. TV Viswanathan, Sri. MK Mammen, Professor of Pharmacology, College of Vety. & Animal Sciences, Sri. VP Sukumara Dev, Sri. G Indrasenan.

8 **Post-harvest Technology & Nutrition:**
Project Co-ordinator-Sri. KK Vidyadharan
Members–Sri. Luckins C Babu, Dr. KV Mammen,
Dr. Jose Samuel, Dr. KV Peter, Sri. P Sethumadhavan,
Sri. VP Sukumara Dev, Dr. Susamma Philip, Dr. SK Nair,
Dr. L Prema, Associate Professor–Agrl. By Products Scheme,
College of Veterinary & Animal Sciences, Mannuthy.

9 **Sugarcane & Other miscellaneous crops:**
Project Co-ordinator-Dr. KMN Namboodiri
Members–Sri. Al Thomas, Dr. R Vikraman Nair,
Sri. S Sukumaran Nair, Sri. R Ravindran Nair,
Sri. PK Chellappan Nair, Sri. K Chandrasekharan Nair,
Dr. MC Nair.

10 **Fodder Crops:**
Project Co-ordinator–Dr. C Sreedharan
Members–Dr. V Gopinathan Nair, Sri. G Raghavan Pillai,
Sri. KP Madhavan Nair, Sri. TF Kuriakose, Dr. MC Nair,
Fodder Research Officer–Fodder Research Scheme, Mannuthy,
Associate Professor–Livestock Research Station, Thiruvazhamkunnu.

11 **Plant Protection:**
Project Co-ordinator-Dr. N Mohandas
Members–Sri. KP Madhavan Nair, Dr. KP Rajaram,
Dr. CC Abraham, Dr. Abraham Jacob, Dr. TS Venkitesan,
Dr. MC Nair, Dr. Abi Cheeran, Dr. KM Rajan.
Dr. James Mathew, Dr. SK Nair.

12 **Soils and Agronomy:**
Project Co-ordinator–Dr. KP Rajaram
Members-Dr. C Sreedharan, Dr. R Vikraman Nair,
Dr. VK Sasidhar, Sri. PJ Tomy, Dr. RS Aiyer,
Dr. (Mrs.) P Padmaja, Dr. Al Jose, Sri. PK Gangadhara Menon,
Sri. NN Ramankutty.

13 **Farm Economics and Extension:**
Project Co-ordinator-Sri. AG Menon
Members–Sri. EJ Thomas, Sri. KS Karayalar,
Sri. ER Narayanan Nair, Dr. V Radhakrishnan,
Dr. K Mukundan, Dr. T Prabhakaran, Sri. P Ramachandran Nair,
Dr. AM Tampy.

14 **Soil Conservation and Farm Mechanisation;**
Project Co-ordinator-Dr. Jose Samuel
Members–Sri. TP George, Sri. P Jacob John,
Sri. AK George, Dr. P Balakrishna Pillai,
Sri. John Thomas, Sri KP Madhavan Nair.

15 **Cropping Patterns and Farming Systems;**
Project Co-ordinator–Dr. VK Sasidhar
Members-Sri. PN Pisharody, Dr. KP Rajaram,
Sri. N Rajappan Nair, Sri. KI James, Sri. K Kannan,
Dr. N Mohankumaran, Dr. CC Abraham, Dr. Abi Cheeran,
Dr. Anantha Subramanyam, Dr. K Karunakaran,
Dr. R Vikraman Nair, Sri. PJ Tomy.

B. VETERINARY & ANIMAL SCIENCES

1 **Cattle and Buffaloes:**
Project Co-ordinator- Dr. TR Bharathan Namboothiripad (upto 13.2.1980)
Members–Dr. M Subramaniyam, Dr. CP Neelakanta Iyer,
Dr. R Kalyana Sundaram, Dr G Mukundan, Dr. E Sivaraman,
Dr. M Krishnan Nair, Dr. G Nirmalan, Dr. CK Thomas,
Dr. TG Rajagopalan, Dr. K Pavithran, Dr. A Rajan,
Dr. CR Anantha Subramanyam, Dr. CS James.

2 **Goat Improvement:**
Project Co-ordinator- Dr. G Mukundan
Members-Dr. BR Krishnan Nair, Dr. KM Ramachandran,
Dr. EN Kunjukutty, Dr. B Nandakumar, Dr. Joseph Mathew.

3 **Poultry and Ducks:**
Project Co–ordinator-Dr. A Ramakrishnan
Members-Dr. CK Venugopalan, Dr. R Kalyanasundaram.
Dr. Maggie D Menachery, Dr. A Rajan, Dr. G Nirmalan,
Dr. Sosamma Iype.

4 **Pig and other Animals:**
Project Co-ordinator-Dr, TG Rajagopalan
Members-Dr. PK Abdulla, Dr. CT Thomas, Dr. M Krishnan Nair,
Dr. CR Ananthasubramanyam, Dr. G Nirmalan.

5 **Artificial Insemination and Animal Reproduction:**
Project Co-ordinator-Dr. CP Neelakanta Iyer
Members–Dr. TR Bharathan Namboothiripad, Dr. V Sudersan,
Dr. PK Abdulla, Dr. A Rajan, Dr. CT Thomas, Dr. MS Nair,
Dr. E Madhavan.

6 **Animal Diseases:**
Project Co-ordinator– Dr. A Rajan
Members–Dr. M Krishnan Nair, EP Paily, Dr. PK Abdulla,
Dr. R Kalyanasundaram, Dr. Jacob V Cheeran, Dr. NM Aliyas,
Dr. CP Neelakanta Iyer, Dr. PO George.

7 **Miscellaneous:**
Project Co-ordinator–Dr. R Padmanabha Iyer,
Members–Dr. PU Surendran, Dr. GR Nair, Dr. T Prabhakaran,
Dr. PS Pushkaran, Dr, E Nanu.

APPENDIX–VI

PERSONNEL

RESEARCH ADMINISTRATION

Director of Research	Dr. UP Bhaskaran (up to 26–12–1979)
	Mr PN Pisharody, Professor (Project Co-ordinator) Rice, held charge from 26-12-1979)
	Mr. PG Veeraraghavan Assoc. Professor, Directorate of Research

LIST OF SCIENTIFIC STAFF IN THE VARIOUS CAMPUSES

A) COLLEGE OF AGRICULTURE, VELLAYANI

Dean	Dr. N Sadanandan
Professor (Research co-ordination)	Dr. MM Koshy
1 *Department of Agronomy*	
Professor–1	Dr. C Sreedharan
Associate Professor-4	Mr. KP Madhavan Nair
	Mr. P Chandrasekharan
	Mr. U Mohamed Kunju
	Mr. EP Koshy (up to 26-7–79)
	Mr. G. Raghavan Pillai (from 31–7–79)
Assistant Professor–4	Mr. G Raghavan Pillai (up to 12-5–79)
	Mr. M Oomen
	Mr. M Abdul Salam (from 16–5–79 to 13–2–80)
Jr. Assistant Professor–3	Mr. Abraham Varghese (up to 30-6-79)
	Mr. N Purushothaman Nair (from 30–7–79)
	Smt. Kamalam Joseph (from 17-4-79)
	Smt. Annamma George (from 23-8-79)
2 *Department of Agricultural Botany*	
Professor-1	Dr. (Mrs.) Mary K George
Associate Professor–3	Mr. AT Abraham
	Mr. N Gopinathan Nair
	Dr. (Mrs.) ST Mercy
Assistant Professor-3	Smt. N Kamalam
	Smt. D Chandramoni
Junior Assistant Professor–3	Smt. J Sreekumari Amma
	Mr. SG Sreakumar
	Mr. N Ramachandran Nair
3 *Department of Agricultural Chemistry*	
Professor–1	Dr. RS Aiyer
Assoc. Professor-4	Dr. V Gopalaswamy
	Mr. P Ramasubramoniam
	Dr. (Mrs.) P. Padmaja
	Mr. Thomas Varghese

	Assistant Professor–5	Smt. Alice Abraham
		Mr. PA Korah
		Mr. Abdul Hameed
	Jr. Assistant Professor–3	Mr. M Subramania Aiyer
		Dr. VO Kuruvila
4	*Department of Entomology*	
	Professor–1	Dr. N Mohandas
	Associate Professor–7	Mr. J Johnson
		Mr. SP Christudas
		Dr. John Kurian
		Dr. Abraham Jacob
		Dr. (Mrs.) A Visalakshy
		Mr. NJ Narayanan
		Dr. D Dale
	Assistant Professor–7	Mr. PA Rajan Asari
		Mr. George Koshy
		Mr. KP Vasudevan Nair
		Mr. K Sasidharan Pillai
		Mr. K Saradamma
		Dr. PB Gopinath
		Mr. KK Raveendran Nair
	Junior Assistant Professor–6	Mr. Babu M Philip
		Smt. S Naseema Beevi
		Smt. S Pathummal Beevi
		Smt. MS Sheela
		Mr. Job Satyakumar
		Smt. Suma Kuruvila
5	*Department of Agricultural Extension*	
	Professor–1	Prof. AGG Menon
	Associate Professor-4	Dr. AM Thampi
		Dr. GT Nair
		Dr. (Mrs.) L Prema
	Assistant Professor–5	Mr. Mohammed Hussain
		Smt. NK Vimalakumari
		Mr. O Abdul Rahiman Kunju (up to 4-7-79)
	Junior Assistant Professor–5	Dr. C Bhaskaran
		Mr. R Prakash
		Mr. Muraleedhara Prasad
		Smt. Mary Ukkru
		Smt. V Usha
6	*Department of Agricultural Economics*	
	Associate Professor–1	Mr. KS Karayalar
	Assistant Professor–1	Mr. S Venugopalan
		Mr. ER Narayanan Nair
	Junior Assistant Professor-2	Mr. Thomas
		Smt. NP Kumari Sushama

7	*Department of Agricultural Statistics*	
	Professor–1	Mr. EJ Thomas
	Associate Professor-2	Mr. PV Prabhakaran (up to 9–8–79)
	Associate Professor–5	Mr. MP Abdurazak Smt. Indira Devi (up ro 30–4–79)
	Junior Asst. Professor-1	—
8	*Department of Agricultural Engineering*	
	Professor–1	Dr. Jose Samuel (up to 8-10–79)
	Associate Professor–2	Mr. Jacob John —
	Assistant Professor–2	Mr. MS Thomas Mr. Jippu Jacob
	Junior Assistant Professor-1	—
9	*Department of Plant Breeding*	
	Professor–1	Dr. V Gopinathan Nair
	Associate Professor–2	Mr. H Padmanabhan Thampy Mr. R Gopimony
	Assistant Professor–2	Mr. P Manikantan Nair
	Junior Assistant Professor–1	—
10	*Department of Horticulture*	
	Professor–1	Prof. K Srinivasan
	Associate Professor–1	Mr. G Srikantan Nair
	Assistant Professor–2	Mr. BK Jayachandran —
	Junior Assistant Professor–2	Mr. C Babu Joseph Mr. M Abdul Wahab
11	*Department of Animal Husbandry*	
	Associate Professor–1	Mr. JB Rose
	Assistant Professor–2	Dr. Skariah Oommen Dr. ET Jacob
12	*Department of Plant Pathology*	
	Professor–1	—
	Associate Professor–4	Dr. MC Nair Dr. S Balakrishnan Dr. James Mathew (from 4–6–79) Dr. SK Nair (from 20–7–79)
	Assistant Professor–5	Dr. James Mathew (up to 3–6–79) Dr. (Mrs.) L Rema Devi (up to 3–6–79) Smt. S Bhavani Devi (from 3-5-79) Dr. (Mrs.) Susamma Philip (up to 9-10-79) Mr. SN Shanmugham (from 26–10–79 to 21–3–80)

Junior Assistant Professor–7	Smt. P Santhakumari
	Smt. KK Sulochana
	Smt. S Bhavani Devi (upto 2–5–79)
	Smt. Suharban (from 2–6–79)
	Mr. Rajendran Pillai (from 1–1–80)
	Mr. M Vijayan (upto 30–5–79)
	Mr. Koshy Abraham (from 17–4–79)

Instructional Farm, Vellayani

Associate Professor–1	Mr. K Pushpangadan
Assistant Professor–1	Smt. KJ Alice

B) COLLEGE OF HORTICULTURE, VELLANIKKARA

Associate Dean	Dr. PC Sivaraman Nair

1 *Department of Pomology & Floriculture*

Professor–1	Dr. M Aravindakshan (up to 5–10–79)
	Mr. VK Damodaran (from 6–10–79)
Associate Professor–1	Dr. K Kumaran (ICAR Jack scheme)
Assistant Professor–1	Mr. PK Rajeevan
Junior Assistant Professor	Smt. T Radha
	Sri. NK Parameswaran
	Smt. Valsamma Mathew
	Smt. S Prasannakumari (ICAR Jack scheme)
	Mr. R Gopinathan (ICAR Jack scheme)

2 *Department of Plantation Crops & Spices*

Professor–1	Dr. N Mohanakumaran
Associate Professor (NRP)	Dr. TV Viswanathan
Assistant Professor-1	Vacant
Junior Assistant Professor-3	Smt. PA Nazeem
	Mr. R Kesavachandran
	Smt. Rema Menon
Junior Assistant Professor-1 (NRP)	Mr. Joseph Philip

Kerala Agricultural Development Project

Professor–4	Mr. K Kannan (coconut)
	Dr. N Mohanakumaran (Cocoa)
	Mr. VK Damodaran (Cashew)
	Mr. KK Vidyadharan (Cashew)
	Mr. S Balakrishnan (Pepper)
Associate Professors–3	Mr. K Madhavan Nair (Instrumentation)
	Dr. PA Wahid (Radio Tracer)
	Smt. NV Kamalam (Safety Officer)
Assistant Professor–6	Mr. KK Ravindran Nair
	Dr. PJ Joy (Nematology)
	Dr. VK Venugopal (Soil Science)
	Smt. KC Marykkutty (,,)
	Mr. A Augustine (Biochemistry)
	Mr. PK Rajeevan (Horticulture)
	Mr. MS Rajeevan (,,)

	Junior Asst. Professors	Smt. Sally Mathew (Plant Pathology) Mr. S Ravi (Virology)
3	*Department of Olericulture*	
	Professor–2	Dr. PK Gopalakrishnan Dr. KV Peter
	Junior Assistant Professor–2	SM Akbar KV Subramanian
4	*Department of Processing Technology*	
	Professor–1	Prof. P Sethumadhavan
	Assistant Professor (Nutrition)–1	Smt. KA Girija
	Junior Assistant Professor–1	Mr. Jacob John
	Junior Assistant Professor (Nutrition)–1	Smt. V Indira
5	*Department of Agronomy*	
	Associate Professor–1	Dr. R Vikraman Nair
	Assistant Professor–1	Mr. M Abdul Salam
6	*Department of Agricultural Botany*	
	Professor	Dr. KMN Namboodiri (Sugarcane scheme)
	Assistant Professors–3	Smt. VK Mallika
	Assistant Professor (Basic Sciences)–1	Mr. Luckins C Babu
	Junior Assistant Professor–2	Smt. Achamma Ommen (Sugarcane scheme) Mr. Mathew K Jacob "
7	*Department of Soil Science & Agricultural Chemistry*	
	Associate Professor–1	Dr. Al Jose
	Assistant Professor–3	Smt. G Droupathi Devi Smt. KC Marykutty Smt. KA Mariam
	Assistant Professor (Bio-chemistry)–1	Mr. T. Prabhakaran
8	*Department of Agricultural Entomology*	
	Professor–1	Dr. CC Abraham (AICRP–BCCP)
	Assoc. Professor–1	Dr. KV Mammen
	Assoc. Professor–1 (Nematology)	Dr. TS Venkitesan
	Asst. Professor–3	Dr. PJ Joy Mr. G Madhavan Nair Smt. T Nalinakumari Smt. MK Sheila (AICRP–BCCP)
	Jr. Asst. Professor–1	Mr. CM George (")
9	*Department of Plant Pathology*	
	Associate Professor–1	Dr. Abi Cheeran
	Assistant Professor–2	Dr. CK Peethambaram Mr. A Sukumara Varma

PEPPER RESEARCH SCHEME

Junior Assistant Professor–1	Mr. B Mohankumar (up to 29–11–79)
	Mr. KM Thomas (From 12-12–79)

10 *Department of Agricultural Economics*

Professor–1	Dr. V Radhakrishnan
Assistant Professor–2	Dr. M Mukundan
	Mr. DV Rajendran

11 *Department of Agricultural Extension*

Assistant Professor–1	Mr. KP Ramachandran Nair

12 *Department of Agricultural Statistics*

Associate Professor–2	Dr. KC George
	Mr. PV Prabhakaram
Assistant Professor–1	Mr. VK Gopinathan Unnithan

13 *Department of Agricultural Engineering*

Professor–1	Dr. Jose Samuel
Special Officer–1	Mr. TP George
Assistant Professor-1	Mr. K John Thomas
Assistant Exe. Engineer (on working arrangement)	Mr. CP Mohammed
Junior Assistant Professor–1	Mr. Vijayan Raja

14 *Department of Agricultural Meteorology*

Professor-1	—
Associate Professor–1	Dr. P Balakrishna Pillai

RESEARCH STATION & INSTRUCTIONAL FARM, MANNUTHY

Assoc. Professor (Agronomy)	Dr. VK Sasidhar
Assoc. Professor (Botany)	Mr. PD Vijayagopal
Junior Asst. Professor (Agrl. Chem.)	Mr. MA Hassan
	Mr. TN Jagdish Kumar
	Mr. Lathif

C. COLLEGE OF VETERINARY AND ANIMAL SCIENCES, MANNUTHY

Dean	Dr. PG Nair till 4–2–80
	Dr. A Venugopalan Nambiar, Professor, held charge for the remaining period.
Professor (Research Co-ordination)	Dr. A Venugopalan Nambiar

1 *Department of Anatomy*

Professor	Dr. K. Radhakrishnan
Assoc. Professor	Dr. PA Oommer
Asst. Professor	Dr. (Mrs.) Lucy Paily
Junior Asst. Professor 3	Dr. KR Harshan
	Dr. CK Sreedharan Unni
	Dr. Jose John Chungath

2 *Department of Animal Management*

Professor–2	Dr. TG Rajagopalan
	Dr. CK Thomas
Assoc. Professor–1	Dr. Kurian Thomas
Asst. Professor–1	Dr. KS Sebastian
Junior Asst. Professor	Dr. Francis Xavier
	Dr. PC Saseendran

3 *Department of Animal Reproduction*

Professor–2	Dr. CKSV Raja (On deputation)
	Dr. CP Neelakanta Iyer
Assoc. Professor–5	Dr. K Prabhakaran Nair
	Dr. E Mathai
	Dr. Dr. V. Sudarsanan
	Dr. MS Nair
	Dr. E Madhavan
Asst. Professor	Dr. T. Sreekumaran
Junior Asst. Professor–3	Dr. KV Athman
	Dr. V. Vijayakumaran
	Dr. KN Aravinda Ghosh

4 *Department of Animal Breeding & Genetics*

Professor	Dr. G. Mukundan
Assoc. Professor–2	Dr. CA Rajagopala Raja
	Dr. Sosamma Iype
Asst. Professor	Dr. P. Nandakumaran

5 *Department of Clinical Medicine*

Professor	Dr. KM Alikutty (on deputation)
Assoc. Professor	Dr. NM Aleyas
Asst. Professor	Dr. VS Balakrishnan
Junior Asst. Professor–2	Dr. KM. Jayakumar

6 *Department of Dairy Science*

Professor	Dr. M Subrahmonyam
Assoc. Professor	Dr. K Pavithran
Asst. Professor–2	Dr. MV Sukumaran
	Dr. UT Francis
Junior Asst. Professor	Dr. M Mukundan
	Dr. V Prasad
	Dr. PI Geevarghese

7 *Department of Extension*

Professor	Dr. GR Nair
Assoc. Professor	Dr. Prabhakaran
Asst. Professor	Dr. V Raju (Supdt.)
Junior Asst. Professor	Dr. CV Andrews
	Dr. MR Subhadra (on leave)

8	*Department of Microbiology*	
	Professor	Dr. PK Abdulla
	Assoc. Professor–2	1. Dr. S Sulochana (Virologist, ICAR Scheme)
		2. Dr. KT Punnose (on deputation)
	Asst. Professor–3	Dr. PC James
		Dr. V Jayaprakasan
		Dr. R Madhusoodanan Pillai
	Junior Asst. Professor–2	Dr. MC George
		Dr. G. Krishnan Nair
9	*Department of Nutrition*	
	Professor	Dr. E Sivaraman
	Assoc. Professor 4	Morely Mohan Lal (on leave)
		Dr. CT Thomas
		Dr. Maggie D Menacherry
		Dr. PA Devassia
	Chemist	Mr. N. Nandakumaran
10	*Department of Parasitology*	
	Professor	Dr. R Kalyanasundaram
	Assoc. Professor 3	Dr. K Rajamohan
		Dr. K Chandrasekharan
		Dr. V Sathianesan
	Asst. Professor 3	Dr. K Madhavan Pillai
		Dr. G George Varghese
		Dr. C Pythal
	Junior Asst. Professor	Dr. H Subramaniam
11	*Department of Pathology*	
	Professor 2	Dr. M Krishnan Nair
		Dr. A Rajan (Project Officer, ICAR Scheme
	Assoc. Professor 2	Dr. KM Ramachandran
		Dr. (Mrs) KI Maryamme
	Asst. Professor	Dr. KV Valsala
	Junior Asst. Professor 3	Dr. CR Lalithakunjamma
		Dr. CB Manomohan
		Dr. N Vijayan
12	*Department of Pharmacology*	
	Professor 2	Dr. MK Rajagopalan (on deputation)
		Dr. Jacob V Cheeran
	Assoc. Professor 2	Dr. Zacharias Cherian
		Dr. P Marykutty
	Asst. Professor 2	Dr. N Gopakumar
		Dr. AM Chandrasekharan Nair
	Junior Asst. Professor 2	Dr. Santha E George
		Dr. K Venugopalan

13 Department of Physiology

Professor 1	Dr. G Nirmalan
Assoc. Professor 3	Dr. G Venugopal
	Dr. MG Ramakrishna Pillai
	Dr. KP Sadanandan
Asst. Professor 3	Dr. KP Surendranathan
	Dr. (Mrs.) PT Philomina
Chemist 1	Mr. PK Ismail

14 Department of Poultry Science

Professor 2	Dr. A Ramakrishnan
	Dr. AKK Unni (On deputation)
Assoc. Professor	Dr. R Sabarinathan Nair
Asst. Professor	Dr. G Raghunathan Nair
Junior Asst. Professor 6	Dr. PA Peethambaran
	Dr. Amrithavally
	Dr. VK Elizabeth
	Dr. Sabu Kuruvilla
	Dr. K Narayanankutty
	Dr. Leo Joseph

15 Department of Preventive Medicine

Professor	Dr. EP Pally
Assoc. Professor	Dr. PT Georgekutty
Asst. Professor 2	Dr. (Mrs.) K Baby
	Dr. K Venugopal

16 Department of Surgery

Professor	Dr. PO George
Assoc. Professor 2	Dr. KN Muraleedharan Nair
	Dr. AM Jalaluddin
Asst. Professor 2	Dr. S Raveendran Nair
	Dr. C Abraham Varkey
Junior Asst. Professor 2	Dr. T Sarada Amma
	Dr. K Rajankutty

17 Department of Veterinary Public Health

Professor	Dr. R Padmanabha Iyer
Assoc. Professor 2	Dr. M Soman
	Dr. P Prabhakaran
Asst. Professor 2	Dr. J Abraham
	Dr. E Nanu
Junior Asst. Professor 2	Dr. MT Jose
	Dr. P Kuttinarayanan

18 *Department of Statistics*

Professor	Dr. PU Surendran
Asst. Professor	Mr. R Balakrishnan Asan
Junior Asst. Professor	Mr; KL Sunny

All India Co ordinated Research Project on Goats for Milk Production

Geneticist	Dr. BR Krishnan Nair
Assoc. Professor	Dr. N Kunjikutty
Junior Pathologist	Dr. T Sreekumaran (from 11–5–1979)
Asst. Professor (F.M.)	Dr. B Nandakumaran (from 9–5–1979)
Junior Physiologist	Dr, Joseph Mathew (from 9/79)
Asst. Professor of Statistics	—
Junior Asst. Professors	Dr. Annamma Kurian
	Dr. KC Raghavan (from 2–6–1979)
	Dr. VL Somanathan (from 15–10–1979)

All India Co ordinated Research Project for Agri. By-products

Scientist (Professor)	Dr. CR Ananthasubramaniam
Asst. Professor	Dr. CS James (up to 23-5–79)
Research Asst./Jr. Asst. Prof.	Dr. M Mukundan
Junior Asst. Professor	Dr. TV Viswanathan (23–5–79 to 13–1–79)
	Dr. George Mathen (from 18–7–79)
	Dr. AD Mercy (from 6–10–79)

All India Coordinated Research Project on Poultry for egg production

Professor	Dr. CK Venugopalan
Assoc. Professor	Dr. (Mrs.) Maggie D Menacherry
Asst. Professor	Dr. (Mrs.) Sosamma Iype (up to 31–7–79)
	Dr. Obul Reddy (20–8–79 to 31-10–79)
	Dr. Renchi P George
	Dr. G Mony (from 30–7-79)
Junior Asst. Professors	Dr. Sabu Kuruvilla
	Dr. PA Peethambaran
	Dr. OJ George (upto 23-10-79)
	Dr. Jose John Chungath (from 20-12-79)

University Livestock Farm, Mannuthy

Assoc. Professor	Dr. MS Nair (Up to 14–5–79) Dr. P Ramachandran (From 14-5–79)
Junior Asst. Professor	Dr. UT Francis (Up to 25–7–79) Dr. CM Aravindakshan Dr. KP Achuthankutty (From 1–8–79)

Poultry & Duck Farm, Mannuthy

Junior Asst. Professor	Dr. A Radhamma Pillai

Fodder Research & Development Scheme, Mannuthy

Asst. Professor	Dr. MS Nair (Up to 22–5–79) Dr. E Nanoo (From 22–5–79)
Junior Asst. Professor	Smt. P Sreedevi (From 6–4–79)

Pig Breeding Farm, Mannuthy

Asst. Professor	Dr. PC Saseendran

D. COLLEGE OF FISHERIES, MANNUTHY

Dean	Dr. MJ Sebastian
Jr. Asst. Professors–3	Mr. CG Rajendran Dr. Ritakumari Mr. Sankara Narayanan

E INSTITUTE OF AGRICULTURAL TECHNOLOGY, TAVANUR

Director	Mr. PN Pisharody (upto 19–5–79) Mr. NN Ramankutty
Asst. Professor (Hort)	Mr. S Rajan
Asst. Professor (A. H.)	Dr. PC James Dr. TV Viswanathan
Asst. Professor (Agron)	Mr. Philipose Joshua
Jr. Asst. Professor (Engg.)	Mr. Job V Paul
Jr. Asst. Professor (Farm)	Mr. T Arthur Jacob
Jr. Asst. Professor (Pl. Path)	Mr. Mr. K Anil Kumar
Jr. Asst. Professor (Agron)	Mr. CK Prabhakaran Thampi
Jr. Asst. Professor	Mr. Syam S Kurup

F RESEARCH PERSONNEL IN THE RESEARCH STATIONS/PROJECTS/SCHEME

Coconut Research Station, Kattachalkkuzhi P. O , Balaramapuram

Assoc. Professor (Agronomy)	Mr. EP Koshy
Asst. Professor (Entomology)	Smt. KS Remamoni
Asst. Professor (Plant Pathology)	Mr. S Sasikumaran

Model Agronomic Research Station, Karamana

Assoc. Professor	Sri. V Ramachandran Nair (1-4-79 to 18-5-79)
	Sri. K Sivasankara Pillai (18-5-79 to 31-3-80)
Junior Asst. Professor	Sri. KP Jagan Mohan

Sugarcane Research Centre, Kalanjoor

Asst. Professor	Mr. K Ravindran Nair
Junior Asst. Professor (Ag. Botany)	Smt. R Devika

Rice Research Station, Kayamkulam 690 502

Assoc. Professor (Ag. Bot.)	Mr. AE Sreedhara Kurup
Asst. Professor (Ag. Bot.)	Smt. S Santha Kumari (till 27-12-79)
Junior Asst. Professor (Entomology)	Mr. M Vijayan (6-6-79 to 9-10-79)
	Smt. Maya Devi (20-12-79 to 31-3-80)
Junior Asst. Professor (Plant Pathology)	Mr. NK Sasidharan (Up to 15-10-79)
	Sri. KC Iype (28-12-79 to 31-3-80)

Sugarcane Research Station, Thiruvaila-689 101

Assoc. Professor (Agronomy)	Mr. PK Chellappan Nair
Asst. Professor (Ag. Botany)	Mr. S Sukumaran Nair
Junior Asst. Professor	Smt. Alice Antony

Rice Research Station, Moncompu Thekkekkara 688 503

Assoc. Professor (Ag. Botany)	Mr. N Rajappan Nair
Assoc. Professor (Agronomy)	Mr. PJ Ittyaverah
Asst. Professor (Entomology)	Mr. K Balakrishna Pillai
Asst. Professoor (Chemistry)	M. K Harikrishnan Nair

Operational Research Project on Integrated Control of Rice Pests in Kuttanad, Moncompu 688 503

Assoc. Professor (Entomology)	Dr. MJ Thomas
Asst. Professor (Plant Pathology)	Mr. MG Vasavan
Junior Asst. Professors	Mr. Jim Thomas
	Mr. Babu George
	Mr. R Harikumar
Junior Statistician	Smt. PR Krishnakumari Amma

Project for the Development of Rice Varieties Resistant to the BPH & GSV, Moncompu

Asst. Professors	Sri. Madhusudanan Nair
	Smt. Chandramani
	Smt. Susamma Mathai
Junior Asst. Professors	Smt. M Rema Bai
	Mr. PS John

Fisheries Research Scheme, Moncompu

Junior Asst. Professor (Fisheries)	Mr. M Girija Sankaranarayanan

Special Disease and pest Research Sub-centre, Moncompu

Assoc. Professor (Plant Pathology)	Dr. KM Rajan

All India Co-ordinated Agronomic Research Project-Experiments in Cultivator's Fields-Alleppey Dt. Changanacherry

Asst. Professor (Agronomy)	Mr. K Sankara Panicker

Coconut Research Station, Kumarakom

Assoc. Professor (Entomology)	Mr. B Thomas (From 10-5-79)
Asst. Professor (Plant Pathology)	Mr. G Mathai
Asst. Professor (Entomology)	Mr. B Thomas (Up to 9-5-79)
Junior Asst. Professor (Agronomy)	Mr. Abraham Varghess (From 9-7-79)
Junior Asst. Professor (Vety. Sc.)	Mr. S Balakrishnan Nair (From 31-7-79)
Junior Asst. Professor (Fisheries)	Mr. MM Jose (Up to 7-5-79) Mr. V Jayaprakash (From 7-5-79 to 18-2-79- from 18-2-79 continued under the Frog Farming Scheme.)

Cardamom Research Station, Pampadumpara 685 553

Assoc. Professor	Dr. S Balakrishnan (Up to 7-5-79) Dr. L Rema Devi (From 8-5-79)
Asst. Professor (Entomology)	Mr. D Joseph

Rice Research Station, Vytilla, Cochin 682 019

Assoc. Professor (Agronomy)	Mr. PJ Tomy
Assoc. Professor (Ag. Bot.)	Mr. TU George

All India Co-ordinated Researc Project on Brackishwater Fish Farming

Assoc. Professor (Fisheries)	Dr. DM Thampi
Assoc. Professor (Fisheries)	Dr. Suseela E Abraham
Junior Asst. Professor (Fisheries)	Dr. Jayasree
-do- (Chemistry)	Sri. PS Mrithunjayan
-do- (Fisheries)	Sri. MM Jose

Lemongrass Research Station Odakkaii 683 549

Assoc. Professor (Agronomy)	Mr. EVG Nair
Asst. Professor (Chemistry)	Smt. NP Chinnama

Junior Asst. Professors	Smt. R Pushpa Kumari (Up to October '79)
	Smt. Alice Kurian (From December '79
	Mr. KC Rajan (From December '79)

Agronomic Research Station, Chalakudy 680 304

Assoc. Professor (Chemistry)	Mr. NN Ramankutty (Up to 21–5–79)
	Smt. K. Leela (18-7–79 to 31–3–80)
Assoc. Professor (Agronomy)	Mr. R Ravindran Nair (16–5–79 to 13–9–79)
	Mr. T F Kuriakose (14–9-79 to 31-3-80)
Assoc. Professor (Agrl. Engg.)	Mr. TP George
Junior Asst. Professor (Agrl. Chem.)	Smt. PK Sushama (Up to 15–11–79)
	Mr. Jose Mathew (28–12–79 to 31-3–80)
	Mr. NK Parameswaran (23-6-79 to 5-10–79)
	Mr. V Jayakumaran (5–10–79 to 31-10-80)
Junior Asst. Professor (Agronomy)	Joseph S Painadath (Up to 28–12–79)
	Mr. KN Balakumaran (28–12-79 to 31–3–80)
Junior Scientific Asst,, Statistics	Mr. J Shahul Hameed

Cattle Breeding Farm, Thumburmuzhi.

Assoc. Professor	Dr. K Parameswaran Nair

Command Area Research Centre, KAU Headquarters

Professor of Agronomy i/c,	Mr. TF Kuriakose
Junior Asst. Professors	Sri. N Ramachandran Nair
	Mr. Kuruvilla Varghese (Up to 11–12–80)
	Mr. FMH Kaleel
	Mr. P Lakshmanan (Up to 29–11–80)
	Smt. PA Valsala (29–12-79 to 1–12–80)

Junior Asst. Professors	Smt. Maicykutty P Mathew (29–5–80 to 21–11–80)
	Smt. S Nazeema Beevi (11–6–80 to 19–9–80)
	Smt. S Pathummal Beevi (12–6–80 to 25–11–80)
	Smt. Kamalam Joseph (22–7–80 onwards)
	Smt. K Sudharma (1–10–80 to 1–12–80)
	Smt. P Prabha Kumari (3–10–80 to 1-12-80)
	Smt. Sumam George (16-10-80 to 1–12–80)

All India Coordinated Tuber Improvement Project - Vellanikkara

Asst. Professor (Agronomy)	Sri. PK Asokan
Junior Asst. Proressor (Agronomy)	Sri. M Kurian

All India Co-ordinated Floriculture Improvement Project, Vellanikkara

Assoc. Professor (Horticulture)	Mr. S Ramachandran Nair (till 28-8-79 and Mr. KM George thereafter)
Junior Asst. Professors	Smt. KK Santha
	Salikutty Joseph

Cashew Research Centre, Madakkathara

Assoc. Proressor (Ag. Botany)	Mr. KK Vidyadharan (1-4-79 to 11-5-81)
	Dr. PK Vijayan (12-6-79 to 31–3-80)
Jnior Asst. Professors	Sri. VK Raju
	Joseph S Pynadath (5-1–80 to 31-3-80)

Banana Research Station, Kannara–680 653

Assoc. Professor (Plant Pathology)	Mr. PC Jose
Assoc. Professor (Plant Physiology)	Dr. MNC Nayar
Assoc. Professor (Agrl. Botany)	Mr. PA Varkey
Asst. Professor (Agronomy)	Mr. V Muraleedharan Nair
Asst. Professor (Entomology)	Smt. K Santhakumari
Asst. Professor (Botany)	—
Junior Asst. Professors	Mr. TE George
	Mr. V Radhakrishnan
	Smt. Lyla Mathew
	Smt. KT Prasannakumari
	Smt. KR Lyla

Rice Research Station, Pattambi 679306

Assoc. Professor (Botany)	Mr. KI James
Assoc. Professor (Plant Pathology)	Mr. PK Sathiyarajan
Assoc. Professor (Entomology)	Mr. K Karunakaran
Assoc. Professor (Agronomy)	Mr. IPS Nambiar
	Mr. PK Gangadhara Menon
Assoc. Professor (Botany)	Dr. K Karunakaran
Assoc. Professor (Extension)	Mr. Abdul Rahiman Kunju
Asst. Professor (Plant Pathology)	Mr. VP Sukumara Dev
Asst. Professor (Plant Pathology)	Smt. Susamma Philip
Asst. Professor (Agronomy)	Mr. Janardhanan Pillai
	Mr. D Alexander
Asst. Professor (Statistics)	Mr. P Gangadharan
Junior Assistant Professors	Dr. VO Kuruvilla
	Mr. S Mothilal Nehru
	Mr. I Johnkutty
	Mr. KJ Joy
	Smt. VL Geetha Kumari
	Smt. P Chandrika
	Mr. TC Mohandasan
	Mr. Baby P Skaria

AICARP Headquarters Unit, Pattambi

Assoc. Professor (Agronomy)	Mr. TF Kuriakose (1-4-79 to 17-5-79)
	Mr. V Ramachandran Nair (18-5-79 to 31-3-80)
Asst. Professor (Agrl. Statistics)	Mr. P Gengadharan
Asst. Professor (Agrl. Chem.)	Smt. S Pushkala
Junior Asst. Professor	Smt. Sumam Susan Varghese

Sugarcane Research Centre, Menonpara

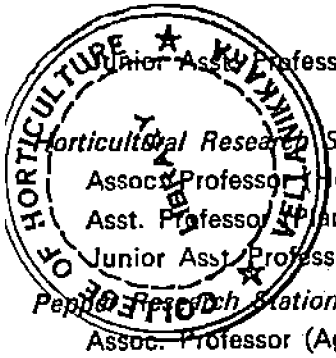
Asst. Professor (Ag. Chem.)	Mr. K Chandrasekharan Nair

Livestock Research Station, Thiruvazhamkunnu - 678606

Assoc. Professor (Nutrition)	Dr. CS James
Asst. Professor (Genetics)	Dr. MR Rajan
Junior Asst. Professor (Animal Reprodn.)	Dr. PP Balakrishnan

Cashew Research Station, Anakkayam 676516

Assoc. Professor (Agronomy)	Dr. KM Sukumaran (28-5-79 to 13-7-79 and 31-8-79 to 1-9-79)
Asst. Professor	Mr. VP Sukumara Dev (26-12-79 to 6-1-80)
	Mr. MG Vasavan (1-4-79 to 27-5-79, 14-7-79 to 30-8-79 and 2-9-79 to 7-12-79)



Junior Asst. Professor	Mr. VK Raju (from 7-1-80)

Horticultural Research Station, Ambalavayal 673 593

Assoc. Professor (Hort.)	Mr. MK Mammen
Asst. Professor (Plant Patholgy)	Mr. G Indrasenan
Junior Asst. Professor (Hort.)	Mr. K Vasantha Kumar

Pepper Research Station, Panniyur, Taliparamba 670 141

Assoc. Professor (Ag. Chem)	Mr. V Sukumara Pillai
Asst. Professor (Ag. Bot)	Mr. KC Chandy
Junior Asst. Professor (Ag. Ent.)	Mr. Mohamad Ali

All India Coordinated Cashew & Spices Improvement Project

Assoc. Professor (Plant Breeding)	Mr. K Sivan Pillai
Junior Asst. Professor (Plant Path.)	Mr. KP Mammooty

All India Coordinated Agronomic Research Project – Experiments in cultivat fields, Kozhikode Dt., Karaparamba.

Asst. Professor (Agronomy)	Mr. Madhusoodanan Nair (Up to 9-5-79)
	Mr. J Thomas (10-5-79 to 22-5-79)
	Mr. CT Abraham (23-5-79 to 13-9-79)
	Mr. S Janardhanan Pillai (24-9-79 onwards)
	Mr. P Gangadharan (14-9-79 to 23-9-79)

Coconut Research Station, Pilicode 670 353

Assoc. Professor (Ag. Chem.)	Dr. PK Narayanan Nambiar
Assoc. Professor (Agronomy)	Mr. N Neelakandan Potty
Assoc. Professor (Botany)	Mr. PD Vijapagopal (22-5-78 to 29-8-79)
	Mr. CA Joseph (From 26-11-79)
Research Officer (Agronomy)	Mr. K Bhaskaran Nambiar
Research Officer (Botany)	Mr. PK Ramachandran Nambiar
Asst. Professor (Plant Pathology)	Mr. TC Radhakrishnan
Asst. Professor (Entomology)	Mr. PA Rajan Asari
Junior Asst. Professor (Ag. Chem.)	Mr. MA Hassan (Up to 24-10-79)
Junior Asst. Professor (Botany)	Mr. G Jayaprakesh Naik (6-12-79 to 31-3-80)