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RESEARCH REPORT

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KERALA AGRICULTURAL UNIVERSITY

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DIRECTORATE OF RESEARCH
KERALA AGRICULTURAL UNIVERSITY
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CONTENTS

PART I

Faculty of Agriculture

1. Rice and rice based cropping system

HIGHLIGHTS

- A red kernelled selection from Mahsuri (RM 1) with a flowering duration of 119 days tolerant to pests diseases flooding and iron toxicity is proposed for release as PTB 53 (Mangala Mahsuri) from Pattambi

- Culture KAU M 28 1 1 (IET 13706) a hybrid derivative from the cross MO5/improved Sona with a flowering duration of 95 days with resistance to blast and moderate resistance to stem borer is proposed to be released as MO12 (Ranjini) from Moncompu

- Culture 10 1 1 a selection from the cross PTB 10/T(N) 1 with a flowering duration of 70 days and tolerance to leaf folder and moisture stress in the early growth phase developed at Mannuthy is proposed for release as Ahalya

- KAU 655 mutant line from Mahsuri with a flowering duration of 78 days and tolerance to bacterial leaf blight leaf scald stem borer and leaf folder and suited for the "Pokkali" tract developed at Vyttila is proposed for release as Vyttila 5

- KAU MO1 20 19 4 (IET 13981) a mutant derivative from the local variety MO1 (Chettivirippu) developed at Moncompu recorded the highest yield (5067 kg/ha) in the co ordinated trial (IVT IME) It also showed moderate resistance to sheath blight and sheath rot and recommended by the ZREAC Kumarakom for release

- Culture M61 6 1 1 1 (Pothara/MO5) and MO59 29 2 1 2 (Surekha / MO6) developed at Moncompu were found resistant to gall midge biotypes 1 2 and 4 During Kharif 93 Culture M59 29 2 1 2 (IET 13983) ranked 17th out of 68 national entries Apart from gall midge it was also found to be moderately resistant to blast and leaf folder

- The blast resistant donors like Zenith Ta Poo Cho Z Tetep Thadukan and Carreon continued to show resistance in all the locations

- Cultures M75 76 1 1 and M75 54 1 1 were found tolerant to sheatn blight and sheath rot during both the seasons at Moncompu

- Two accessions DV85 and BJI were found resistant to bacterial leaf blight at Moncompu

- Gall midge attack is assuming major proportion in Kuttanad Severe infestation is seen not only during the additional crop season but also during the Punja season especially in late sown crop Studies conducted at Moncompu have confirmed that the biotype present in Kuttanad is a new one Biotype 5 with R R S S pattern against the four groups of differentials

1 Reselection in Mahsuri for red kernel colour and blast tolerance

C I E of 2 8 PTB 9) F AU)

The work was started in 1988 with the objective of purification of the Mahsuri variety available locally and isolation of the red kernelled Mahsuri like plants observed in the population with tolerance to biotic stresses

In the Mahsuri variety which is popular in different parts of Kerala especially in Palghat red kernelled grains were noticed in the foundation seed lot maintained in the station and hence a reselection programme for isolation of red kernelled Mahsuri like plants and purification of the white Mahsuri was taken up The selections were scored for tolerance to biotic and abiotic stresses

Seven promising red kernelled selections were identified which did not show segregation The pest and disease resistance reaction of these lines were also studied The promising lines (RMI & RM7) were tested in farm trials in Palghat Trichur Malappuram and Ernakulam districts Based on these trials culture RM 1 was found promising (Table 1)

Culture RM 1 showed comparatively lesser score for blast and sheath blight incidence and a score for gall midge stem borer whorl maggot and blue beetle It has also shown comparable tolerance to flooding and iron toxicity Based on the results obtained RM 1 is proposed for release as PTB 53 (Vangala Mahsuri)

2 Agronomic evaluation of rice cultivars for rain fed conditions of Kerala

RIC 08 00 08 91 AGV(1 KAU/PG)

The objective of the study is to select suitable variety for rainfed crop season of southern Kerala and to find out the nutrient level required for maximum rice production under rainfed conditions and also to study the effect of seed hardening in reduced moisture stress

The results of the study revealed that during the first crop season varieties like Jaya Thulasi and Rasi could perform better than other varieties under rainfed conditions of southern Kerala The yield difference between 100 and 75 per cent of recommended nutrient levels was not significant indicating that 75 per cent of recommended level was sufficient to realise comparable grain yield under rainfed

Table 1 Yield performance of RM cultures in farm trial

Location	Grain yield (kg ha)					
	RM1		RM7		Mahsuri	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
Palghat dist	3[illegible]6	[illegible]	37[illegible]8	[illegible]910	3553	[illegible]930
Trichur dist	[illegible]4	[illegible]	[illegible]	392[illegible]	3785	3935
Malappuram dist					4700	
Mean	[illegible]7	[illegible]	[illegible]	[illegible]	4[illegible]	3433

conditions Treatment with KCl water and Triazole improved the yield net income and benefit cost ratio of rainfed rice

3 Effect of time of sowing and weed managment on the performance of dry sown rainfed rice

(RIC 08 00 89 92 ACV(1)KAU/PG)

The objective of the study is to determine the best time of sowing of rice to find out the effective weed management practice and to work out the economics of cultivation under rainfed conditions of the south west monsoon season in southern Kerala

The trial was taken up using the Onam variety of paddy under three dates of sowing and five weed management practices in a split plot design

Sowing seven days after the receipt of the first rain gave higher plant height panicle weight grain and straw yields Butachlor followed by hand weeding showed higher weed control efficiency than Butachlor followed by 2 4 D The highest profit was obtained with hand weeding twice

4 Evaluation of ammonium poly phosphate (APP) as a carrier of zinc

(RIC/89 02 07 91/MON(3)ICAR)

The objective of the experiment is to evaluate ammonium poly phosphate for its sequestering effect of metal cations in particular zinc in comparison to diammonium phosphate The experiment was taken up in a randomised block design with three levels of zinc (0 25 & 50 kg $ZnSO_4$/ha) three forms of phosphorus Po DAP and ammonium poly phosphate at 60 kg ai/ha) in nine combinations

Sequestering effect of ammonium poly phosphate for zinc was expressed in an increased grain yield but not to significant level

5 Maximisation of rice yield under transplanted conditions

(RIC/11 00 02 89/PTB(1)ICAR)

The experiment aims to study the effect of agronomic practices for realising potential yield under irrigated conditions

The treatments included recommended agronomic packages and extra management practices The results indicate that in addition to extra plant population and mineral fertilizers a matching addition of farm yard manure and micronutrients as well as effective splitting of mineral nutrient application particularly phosphorus was found to enhance grain yields

2 EXPERIMENTS IN PROGRESS

Project (01) Genetic conservation of rice germplasm collection, maintenance, cataloguing and evaluation

1 Genetic conservation of rice germ plasm

(RIC/01 00 01 72 PTB(9 KAU)

A total number of 300 entries were maintained and observations recorded for preparing the catalogue Ten elite lines from Raipur were added to the germplasm

2 Collection maintenance cataloguing and evaluation of rice germplasm

(RIC/01 00 02 82/Mon(9)KAU)

Fourteen new entries with resistance to various pests and diseases were added to the 470 entries maintained Cataloguing of 37 local varieties was completed

3 Collection maintenance and utilization of saline resistant rice varieties

(RIC 01 00 03 77/VTL(9)KAU)

Forty nine saline resistant accessions were grown and morphological and yield attributes recorded

4 Evaluation of germplasm collection for the northern region of Kerala
RIC ... 04 8 ... KAU

Nineteen local varieties were grown, morphological and yield attributes recorded

5 Evaluation and screening of rice varieties suitable for high altitudes. Maintenance of germplasm and performance evaluation of promising germplasm
RIC 01 00 05 74/AMB(9)KAU

Forty nine accessions were maintained and five new additions made

6 A multivariate approach to define the quality of rice
(RIC/01 00 06 92/ACV(9)KAU)

The different quality parameters of rice *viz* physical characteristics, nutritional composition, cooking qualities and organoleptic characteristics of five rice varieties with different processing techniques and cooking methods were studied

Project (02) Breeding for extra high yields along with multiple resistance to pests and diseases

Sub project (01) Higher yield

7 Genetic improvement of promising indica varieties through ideotype breeding
RIC 02 00 ... 9)KAU)

The ... concluded

8 mp ov ng the y e d ... ty and p ... pe ... r e ...
R ... 0 ... r ...

Two promising ... and ... coordinate ... kh ... rf 93 ... 4 ... 5th ... to ... proposed ... farm

9 District trial with selected ACRP cultures
RIC 02 ... 04 63 MON 9)KAU

The selected cultures are being evaluated in farm trials

10 Multilocational trial of Pattambi and Moncompu cultures of paddy
RIC 02 01 05 85/PTL(9)KAU

Sixteen varieties / cultures were tested. A21 gave the maximum yield (3480 kg/ha). Cultures 8756 304 311 M28 1 1 Thowar & 1727 were on par with A 21. IET 6661 culture 8756 and culture 8770 showed resistance to blast in the nursery

11 Varietal trial on rice
(RIC/02 01 06 85/PTL(9)KAU)

Seven varieties were tested in replicated trial. Thonnuran gave the highest grain yield (3250 kg/ha) which was on par with Jy thi

12 Evolving high yielding varieties of rice suitable for the northern region of Kerala
(RIC 02 01 07 84/PTL(9)KAU)

T 10 was tested with Moncompu and Pattambi cultures which gave a grain yield of 2 9 t/ha and was on par with Moncompu cultures

13 Initial yield trial irrigated medium (YT IM)
R ... 2 01 09 90/MON(9 CAR)

Sixty eight entries were tested during Khar if 93 and Rabi 93 94. The treatments did not show significant difference during the Kharif season. During Rabi season the ... M ... kg/ha ...

... Zon ... 43 ... R ...

14 Advanced variety trial irrigated mid early/AVT IME
(RIC/02 01 10 90/MON 9) ICAR)

Twenty one entries including check varieties Ratna Vikas and M06 were tested during the Kharif and Rabi seasons During Kharif season there was significant difference in grain yield IET 12867 recorded maximum grain yield of 3280 kg/ha It also showed resistance to sheath blight and sheath rot and was transferred to the germplasm During Rabi season the treatments did not show significant difference in grain yield

15 Initial variety trial irrigated mid early (IVT IME)
(RIC 02 01 [illegible] 2 90/MNY(9)ICAR)

Sixty eight entries were tested during the Kharif season The treatments showed significant difference in the grain yield and number of panicles/sq m IET 13687 gave the maximum yield of 7638 kg/ha

16 Initial variety trial irrigated medium (IVT IM)
(RIC 02 01 13 90/MNY(9 ICAR)

Fifty nine entries were tested during Kharif season There was significant difference in grain yield and IET 14003 gave the highest yield (6942 kg/ha) followed by IET 13585 ([illegible] kg ha)

17 Initial yield trial irrigated upland (IYT IU)
(RIC 02 01 [illegible] 4 90 MNY 9 ICAR

To be concluded

18 Advanced variety trial early (AVT E)
(R [illegible] 5 9[illegible] (9 ICAR

[illegible]

19 Advanced variety trial [illegible] (AVT [illegible] E)
([illegible] 9) ICAR

Twenty [illegible] entries were tested during the Kharif [illegible] The treatments differed significantly [illegible] IET 1[illegible] [illegible] kg/ha)

20 Advanced variety trial irrigated medium (AVT IM)
(RIC/02 01 17 90 MNY(9)ICAR)

Twenty five entries were tested during the Kharif season and the entries differed significantly in grain yield IET 12797 gave the highest yield (7288 kg/ha) followed by IET13271 (6800 kg/ha)

21 Initial variety trial very early (IVT VE)
(RIC/02 01 19 91/PTB(9)ICAR)

No work during the year

22 Advanced variety trial irrigated mid early (IVT IME)
(RIC/02 01 20 91/PTB(9)ICAR

No work during the year

23 Breeding short duration high yielding varieties of rice suited to Kuttanad
(RIC/02 01 21 93/MON 9 KAU)

Four promising entries were selected from the germplasm received for screening against biotic stresses and the short duration variety Hraswa was collected for hybridization

24 Genetic improvement of the popular variety Cheradi for the Mundakan season in lateritic areas
(RIC 02 01 22 93/KYM(9)KAU

The objective of the experiment is to develop high yielding types from the popular local variety Cheradi by mass selection Since this variety is photosensitive it can be grown only during the Mundakan season During 92 93 the Cheradi area was surveyed and 144 types were selected and grown along with checks during 93 94 Wide variation was observed in the plant characters and grain yield Selections 251 and 133 were found to be promising The [illegible] evaluation will be repeated

25 Evolution of high yielding rice hybrids suitable for Kerala
(RIC/02 0[illegible] 23 9[illegible] MON(9 KAU)

From the earlier work two male sterile lines of MO varieties viz Karathom A and

Asha A were developed These were crossed with a number of varieties to identify suitable restorers

26 Gametocidal properties of certain chemicals in rice (*Oryza sativa* L.)
RIC 02 01 2 94 MN (9)KAU/PG

Work not commenced

Sub project (02) Multiple resistance

27 Initial multiple resistance yield trial (IMRYT)
(RIC 02 02 01 89/PTB(9)ICAR)

No work during the year

28 Multiple resistance screening trial (MRST)
(RIC/02 02 02 84/MON(5)ICAR)

Forty entries were screened against stem borer and gall midge Among these BPT 7325 was found to be resistant to gall midge and stem borer while ORM47 showed resistance to gall midge and R 650 1817 to stem borer

29 Screening of rice varieties against major pests
(RIC 02 02 04 82/PIL(4 KAU)

No work during the year

30 Multiple resistance screening trial (MRST)
(RIC 02 02 06 90/PTB(4) CAR)

No work during the year

31 National screening nursery (NSN)
(RIC/02 02 07 90/PTB(4) CAR)

No work during the year

Sub project (03) suitability to specific situations

32 Breeding for high yielding varieties with multiple resistance to major pests and diseases of Kuttanad
(RIC/02 03 01 84 MON 9)KAU)

Seed multiplication of the promising entries for multilocation trials was taken up (Culs M38 4 1 M38 4 2 and M48 1 1 3)

33 Evolution of high yielding short duration varieties of rice suited to first crop season of Onattukara with resistance to drought and tolerance to pests and diseases
(RIC 02 03 02 86/KYM(9)KAU

Ten promising entries were yield tested with three check varieties during the Virippu season Six cultures out yielded the check varieties Cul 4003 3 1 (M 2/ 25331 3) gave the maximum grain yield (3273 kg/ha)

34 Multiple resistant variety trial (MRVT)
(RIC/02 03 03 89/PTB(9)ICAR)

No work during the year

Project (03) Breeding for resistance to specific pests / diseases / situations

Sub project (01) resistance to pests

35 Gall midge screening trial
(RIC 03 01 01 69/PTB(4)ICAR)

No work during the year

36 Gall midge screening trial
(RIC/03 01 02 84/MON(4)ICAR)

Seventy entries were screened against gall midge during the Kharif season Of these nine entries were free from gall midge attack They are WGL 3306 WGL 3971 WGL 49485 RP 1579 RI 19 RP 1579 RI 24 TTB 148 206 2 2 1 RP 2346 1323 RP 2541 1382 and RP 2939 23668 1357

37 Leaf folder and stem borer screening trial
RIC/03 0 03 83/MON 4)ICAR)

No work during the year

38 Leaf folder screening trial
(RIC/03 01 01 70/PTB(4 ICAR)

No work during the year

39 Brown plant hopper screening trial
(RIC/03 01 05 83/MON(4)ICAR)

No work during the year

40 Evolution of gall midge resistant varieties of rice suitable for Kuttanad
(RIC/03 01 06 85/MON(9)KAU)

Two promising lines M61 6 1 1 1 (Pothana/MO5) and M-59-29 2 1 2 (Sureka/MO6) were tested with gall midge screening trials and were found to be resistant to biotypes 1,2 and 3 During Kharif 93, Culture 59 29 2 1 2 (IET 13983) ranked 17th out of 68 entries Apart from gall midge it was also found to be moderately resistant to blast and leaf folder Hybridisation with donors for resistance to biotype 5 was also taken up

41 Evaluation of advanced cultures/ donors against rice stem borer (Stem borer screening trial)
(RIC/03 01 07 91/PTB(4)ICAR)

No work during the year

42 Screening of rice varieties against rice cyst nematode (*Heterodera oryzicola*)
(RIC/03 0 08 92/ACV 4 ICAR)

No work during the year

43 National screening nursery (NSN)
(RIC/03 01 09 94/MON 4)ICAR)

The objective of this co ordinated trial is to study the resistance reaction of advanced IVT entries from different parts of the country

The entries were planted along with check varieties in rows of 20 hills each at a spacing of 20 x 15 cm Fertilizer application was as per the Package of Practices Recommendation Observations on the incidence of gall midge stem borer and other pests were recorded

Four hundred and eighty three entries, were screened of which 22 showed less than 5 per cent damage to gall midge and 97 entries showed less than 5 per cent damage to stem borer

Sub project (02) Resistance to diseases

44 Screening for sheath blight resistance
(RIC/03 02 01 89/PTB(5)ICAR)

A total of 809 entries comprising of NSN 1, NSN II MRSN & KAU Cultures were screened for sheath blight resistance The disease pressure was moderate Nine entries showed resistance reaction

45 Screening for leaf blast resistance
(RIC/03 02 02 89/PTB(5)ICAR)

Seven hundred and ninety nine entries comprising of NSNI NSN II, MRST & KAU entries were tested against blast The disease pressure was moderate Among these ten entries were rated as resistant In the International Rice Blast Nursery for testing virulence monitoring the blast resistance donors Zenith Ta Poo Cho Z Tetep Thadukan and Carseon continued to show resistance in all locations

46 Screening for sheath blight and sheath rot resistance
(RIC/03 02 03 84/MON(5)ICAR)

Eleven entries out of 188 in NSN 1 46 out of 1483 in NSN 2 and two out of 96 in MRSN were found to have low score values against both sheath blight and sheath rot diseases

47 Screening rice varieties against important diseases
(RIC/03 02 04 84/MON(5)KAU)

A total number of 73 cultures were screened during the additional crop and Punja seasons out of which M75 76 1 1 and M75 54 1 1 were found tolerant to both sheath blight and sheath rot diseases during both the seasons

48 Evolution of blast resistant varieties of rice
(RIC/03 02 05 82/MON(9)NARP)

Cultures M28 1 1 (IET 13706 and M35 3 2 (IET 13708) were tested in farm trial in Alappuzha and Kottayam districts and both of them gave higher yields than the check

varieties They were also tested at 17 locations under AICRIP trial and M28 1 1 was found superior to both the check varieties in different locations M28 1 1 was recommended for release by the Zonal Research and Extension Advisory Council (special zone) held on 7th March 1994

49 Breeding high yielding rice varieties resistant / tolerant to sheath blight (RIC/03 02 06 83/PTB(9)KAU)

Two single plants from the cross Jyothy/ Culture 25331 were selected Other lines which were not promising were rejected

50 Breeding varieties resistant to virus diseases GSV / RTV complex (RIC/03 02 07 91/MON(9)KAU)

During the additional crop 93 the preliminary yield trial was repeated with 30 cultures and three check varieties The cultures did not differ significantly in yield During the Punja season the cultures were grouped into two (eleven short duration and ten medium duration) and a comparative yield trial conducted The short duration group not show significant difference The medium group showed significant difference M06 gave the highest yield (7683 kg/ha) followed by M 26 1 1 (6992 kg/ha)

51 Breeding high yielding varieties of rice with resistance to important rice diseases of Kuttanad (RIC/03 02 08 93/MON(9)KAU)

All the varieties and cultures available at Moncompu and two cultures collected from the Directorate of Rice Research were tested for BLB resistance Among these only DV85 and BJ1 were found resistant These entries are to be used as donors during the ensuing season

52 Evaluation of rice germplasm for biotic stresses (RIC/03 02 09 94/MON(5)ICAR)

The project was started during Kharif 93 The objective is to evaluate the national rice germplasm against different biotic stresses At Moncompu centre, which is a hot spot for sheath blight, these will be evaluated for resistance to sheath blight and sheath rot

A total number of 2970 accessions received from DRR were screened for sheath blight and sheath rot diseases under higher fertilizer dose and artificial inoculation Out of these 393 accessions showed moderate resistance to sheath blight and 312 to sheath rot Among these 70 acessions showed resistance to both the diseases These will be repeatedly evaluated to confirm resistance

Sub Project (03) Suitability to specific situations

53 Breeding for high yielding varieties of rice suitable for Kari lands of Kuttanad (RIC/03 03 01 85/MON(9)KAU)

The pooled analysis of four seasons results showed that M 42 46 8 1 had the highest yield (4728 kg/ha) Cul M 42 40 4 1 was nominated in the Initial Variety Trial for Kharif 93 which ranked second among the 68 entries at Rajendra Nagar Seven cultures were selected for on farm trial

54 Breeding for high yielding varieties of rice specifically suited to the additional crop season of Kuttanad (RIC/03 03 02 84/MON(9)KAU)

Three promising entries *viz* Cul M 42 6 2 M42 6 3 and M45 20 1 were multiplied for multilocational trials

55 Breeding high yielding varieties suitable for Pokkali area by hybridization between Pokkali varieties and IR 5 (RIC/03 03 03 80/VTL(9)KAU)

Seven cultures with Vyttila 3 were tested in comparative yield trial Cul 852 gave the maximum yield of 5226 kg/ha Cultures 839 905 904 and 857 were on par with culture 852

The F2 generation of Cul 857/Jaya was raised and thirty two selections made

56 Hybridization programme Improvement of Pokkali rice
(RIC/03 03 04 82/VTL(9)KAU)

Seven cultures with Vyttila 3 were tested in an yield trial in which Cul 839 gave the highest yield (5226 kg/ha) followed by Cul 859 (5100 kg/ha) and Cul 905 (4954 kg/ha) From the five new cross combinations 65 promising F4 plants were selected

57 Breeding high yielding varieties of rice for saline areas of Kerala
(RIC/03 03 07 87/PIL(9)KAU)

To be concluded

58 Breeding lodging resistant rice varieties for dry sown conditions during Virippu season
(RIC/03 03 06 83/PTB(9)KAU)

Eleven cultures were yield tested with three check varieties Cul 8755 gave the highest yield of 4890 kg followed by A4 3 1 (4771 kg/ha) None of the cultures have lodged

59 Evolution of awniess and high yielding types of "Parambuvattan for Virippu cultivation in Palliyal lands
(RIC/03 03 10 83/PTB(9)KAU)

To be concluded

60 Breeding for earliness in the variety Mahsuri by induced mutation
(RIC/03 03 12 80/VTL(9)KAU)

Three sister selections of culture 655 were yield tested along with VTL 1 and VTL 3 as check varieties The cultures did not show significant difference Farm trial of culture 655 has been completed and is being proposed for release

61 Breeding for earliness in the varieties H4 and SR 26 B by induced mutation
(RIC/03 03 13 80/VTL(9)KAU)

Three cultures were compared with VTL 1 and VTL 3 as check varieties The cultures did not show significant difference during this season

62 Evaluation of short duration rice varieties / cultures for kole lands
(RIC/03 03 14 83/MNY(9)KAU)

One hundred and eight short and medium duration selections from the crosses Mahsuri/Hraswa Mahsuri/Matta Thriveni and Mahsuri / Cul 10 2 1 were made during Kharif and evaluated in the summer crop and selections made

63 Varietal combination for first and second crop seasons for maximum productivity
(RIC/03 03 16 89/PTB(9)KAU)

No work during the year

64 Breeding tall high yielding rice variety resistant / tolerant to salinity and flood for Oorumundakan tract
(RIC/03 03 17 91/KYM(9)KAU)

Twenty three accessions received from CRRI Cuttack screened under Oorumundakan situation were not found suitable

Five selections were made from the F2 population of OM 1/H4 F3 generations of Oorumundakan were grown and selections made

65 Rice varieties for late planted Kharif situations
(RIC 03 03 18 92/PTB(9)ICAR)

No work during the year

66 Evaluation of scented and slender rice varieties suitable for Wayanad
(RIC/03 03 19 94/AMB(9)KAU)

No work during the year

Project (05) Breeding photosensitive semi-tall high yielding varieties

67 Evaluation of semi tall or dwarf type of indica rice varieties
(RIC/05 00 01 83/PTB(9)KAU)

Eleven single plants selected from the cross 20D/BR51 and 20D/BR52 were tested in progeny rows

68 Breeding high yielding tall photosensitive varieties with good straw yield specifically suited for the Mundakan season of Kerala
(RIC/05 00 02 76/PTB(9)KAU)

Seed multiplication of cultures 87117 and 87136 was taken up

69 Evaluation of high yielding photosensitive varieties of rice suited to different agroclimatic zones
(RIC/05 00 03 76/KYM(9)KAU)

Comparative yield trial with mutant lines of PTB 20 and Lekshmi was repeated One line each from PTB 20 and Lekshmi gave significantly higher yield than the parent material They are being proposed for farm trial

Project (06) Breeding for grain quality and other attributes

70 Improvement of rice varieties BR 51 and IR 36 for consumer acceptability
(RIC/06 00 01 93/PTB(9)KAU)

Ten lines from the c BR 52/Edavaka were tested in a pre ary yield trial E4 gave the highest grain yield of 4732 kg/ha Seventeen single plants were selected from the segregating lines

Project (07) Evolving cropping systems and integrated production systems

Sub Project (02) Cropping system for specific regions

71 Cropping system for double crop Kole lands
(RIC/07 02 01 83/MNY(1)NARP)

To be concluded

72 Standardisation of rice based cropping system of Wayanad
(RIC/07 02 02 87/AMB(1)KAU)

No work during the year

Sub Project (03) crop sequence

73 Multiple use of cowpea and nutrient balance in a rice based cropping system
(RIC 07 03 01/92 KAR(1)ICAR)

The summer crop of cowpea failed due to heavy rains in summer No significant difference was observed in grain yield during Kharif and Rabi seasons

74 Evaluation of component vegetable crops in a rice based cropping system
(RIC/07 03 02 92/KAR(1)ICAR)

Bhindi as a summer crop in rice fallows was found to be more profitable and to give enhanced rice yield during subsequent Kharif season

Project (08) crop management in stress situations

75 Effect of maintaining water at different levels and different growth stages of the crop
RIC 08 00 04 89/PTB(1)KAU)

work during the year

76 Evaluation of fertilizer response and production potential of promising saline tolerant cultures of rice
(RIC/08 00 05 81/VTL(1)KAU)

The effects of neither the variety nor the fertilizer level showed any significant difference during the season

77 Standardisation of fertilizer schedule for Kootumundakan system of rice cultivation
(RIC/08 00 06 88/PTB(1)KAU)

To be concluded

78 Soil fertility management of acid soils for upland rice
(RIC/08 00 07 89/PTB(3)ICAR)

No significant difference was observed between the treatments

79 Investigations on factors of excessive chaffiness in rice
(RIC/08 00 10 92/ACV(4)KAU)

The population of white jassids rice bug and leaf roller was high in both the seasons in Nilamel ela, whereas stem borer attack

was severe in Virippu season and stem borer rice bug and white jassid attack during Mundakan season in Karamana In all the areas the treated plots gave higher yields

80 Management of iron toxic soils for increasing rice productivity
(RC 08 00 11 94/KUM(3)KAU)

The experiment was taken up in a split plot design with four levels of lime (0 50% LR 100% LR & as per POP) as main plot treatments and three varieties (Phalguna Prakash & Jyothi) and two levels of fertilizer (100% NPK & 100% N + 150% PK) as sub plots during the Addit onal crop season There was no significant difference in the main plot treatments The variety Phalguna showed lesser iron toxicity symptoms at the panicle initiation stage and lesser percentage of gall midge attack The grain yields of Jyothi and Phalguna were on par

Project (09) Integrated nutrient management and cropping system

Sub Project (01) use of organic and inorganic fertilizers

81 Introduction of green manure crop in rice based cropping system
(RIC 09 01 04 89/KAR(1)ICAR

No work during the year

82 Growing leguminous crops as a source of green manure for dry sown rice
(RIC/09 0 06 89 PTB(1)KAU)

Cowpea produced double the green matter than that of sunhemp Growing green manure crops brought about two third reduction in weed dry weight when compared with rice sole crop Cowpea intercropped treatment re orded significantly higher yield than sunhemp interc opped plot and control

83 Economising nitrogen in rice production with *Sesbania rostrata*
R C 09 01 07 91/AC V)KAU PG

Work initiated

84 Yield maximisation of rice under irrigated condition
(RIC/09 01 08 91/MON(1)ICAR)

The treatments which received 33 per cent extra dose of fertilizers produced significantly higher grain and straw yields compared to those which received the normal dose

85 Nutritional requirement of pre release Moncompu cultures
(R C/09 01 09 92/MON(1)KAU

In both the seasons the effect of N was significant and higher yields were obtained with higher levels of N (120 and 150) over normal level (N90) Levels of Potash did not show any significant difference Varietal difference was not significant during both the seasons

86 Productivity of semi dry rice under simultaneous *in situ* green manuring
(RIC 09 01 10 93/VKA(1)KAU PG)

There are 16 treatment combinations consisting of two seed rates of cowpea four levels of nitrogen and two levels of phosphorus The experiment was laid out in randomised block design with three replications

87 Effect of incorporation of crop residues on productivity of succeeding rice crop
(R C/09 01 11 93/VKA(1)KAU PG)

The experiment was laid out in a split plot design with crop residues green manure and fallow as main plot treatments and levels of nitrogen as the sub plot treatment

88 Determining the frequency of P application for judicious use of P fertilizer
(RIC 09 01 12 93/KAR(3)KAU)

No work during the year

89 Maximising yield productivity of rice using FYM spacing and levels of N
(RIC/09 01 13 93/KAP(3)KAU)

The experiment was taken up in split plot design with plant population (two levels)

and combinations of fertilizer levels and FYM (three and two levels each) in cul plot

Th c a n e f d vil c d e u f at the r a c ary

Sub Project (02) Increasing efficiency of applied nutrients

c f c t of p e f a m ed c c a d coated urea on yield and N use efficiency of transplanted rice under irrigated conditions
R C 09 02 02 88 MON( ) CAR)

In both the seasons the coated modified urea gave significantly higher yield than urea full as basal dressing and absolute control

91 Effect of prilled and large granule urea on grain yield of rice under puddled condition
RI 09 02 03 8 PTB CAR

Nimin coated urea applied either as full basal or in two splits recorded significantly higher grain yield than all other treatments except split application of MRPU and LGU which were on par

92 Effect of biofertilizers on the growth yield and nitrogen economy of sesame grown in summer rice fallows
(R C 09 02 08 94 KAR1 KAU PG)

Work not commenced

93 Evaluation of partially acidulated phosphate rock (PAPR) in wet land rice
RIC 09 02 09 94 MON 3)ICAR)

The experiment has 1 treatments consisting of two levels of P_2O_5 (30 and 60 kg/ha) with single super phosphate Mussoorie rock phosphate and partially acidulated Mussoorie rock phosphate 3 levels of acidulation 10 per cent 30 per cent and 50 per cent and control No P_2O_5

The experiment was taken up with the P_2O_5 treatment in the Kharif season and with no P_2O_5 application in the Rabi season to study the residual effect No significant difference was observed in both the seasons except for plant height during the Rabi season

94 Studies on P fertilizer saving techniques for irrigated rice
(R C 09 02 4 MON 1 CAR)

The experiment was taken up in a split plot design with varieties Rasi (low P susceptible and Abhaya (low P tolerant) in the main plot and sources and methods of P application viz soil application of DAP at 40 kg P_2O_5 ha MRP + acidulant @ 40 kg P_2O_5/ha, root dipping in SSP slurry @ 16 kg P_2O_5/ha spraying 2 per cent DAP solution at mid tillering and boot leaf stages to supply 8 kg P_2O_5/ha nursery application of DAP @ 80 kg P_2O_5 ha so as to supply 8 kg P_2O_5/ha to the nursery area required to transplant 1 ha of main field with no field application of P and control (No P) as the sub plot treatments

During the Kharif season grain and straw yields and panicle weight showed significant difference Among the varieties Abhaya gave significantly higher grain yield over Rasi All the applied treatments gave significantly higher yield over control except soil application of MRP + acidulant and nursery application of DAP During the Rabi season the residual effect showed no significant difference

Sub Project (03) Effect of fertilizers on pest and disease incidence

95 Effect of different doses of NPK on incidence of rice diseases
(R C 09 03 02 89/KAR(5 CAR)

No work during the year

Sub Project (04) Fertilizer use and cropping systems

96 Effect of top dressing with complex fertilizers on the yield of rice
R C 09 04 02 87 AU/ 3 KAU PG

No work during the year

97 Zinc Management in irrigated rice based cropping system
(RIC/09 04 04 91/MON(3)ICAR)

No significant difference in yield and yield parameters was observed during both the seasons

98 Integrated nutrient management for rice based cropping systems of Onattukara tract
(RIC/09 04 05 94 ACV(1)KAU PC)

Work not commenced

Project (10) Weed management

99 Weed control trial for direct sown rice under semi dry condition
(RIC/10 00 01 88 PTB(1)ICAR)

The yield loss due to weed competition was 69 4per cent between unweeded and weed free treatments Among the herbicides tested all the test chemicals were found effective in reducing the weed problem except Pyrazosu furon Butachlor Pretilachlor and Pendimethalin when applied in conjunction with 2 4 D Na exhibited higher bio efficiency better weed control and higher grain yield

100 Weed control trial for direct sown rice under puddled conditions
(RIC/10 00 02 84 MON(1)ICAR)

In both the seasons the highest grain and straw yields were obtained for weed free check which was on par with the herbicides Anilophos + 2 4 D EE Anilophos at higher doses showed crop toxicity

101 Weed control trial for transplanted rice
(RIC/10 00 03 84/MON (1 ICAR)

In both the seasons weed free check and hand weeding twice gave the highest yields which were on par with Anilophos + 2 4 D EE (0 3 + 0 4 ai/ha) Pretilachor 50 EC (1 kg ai/ha)

102 Economics of weed control for direct sown rice under semi dry system of cultivation
(RIC/10 00 06/91 PTB(1) CAR)

No work during the year

103 Weed control trial for direct sown rice under puddled condition
(RIC/10 00 07 91/PTB(1)ICAR)

All the weedicide treatments except Anilophos + 2 4 D EE (0 4 + 0 54 kg ai/ha) Butachlor + 2 4 D EE (1 5 + 0 60 kg ai/ha) and Benthiocarb + 2 4 D EE (1 5 + 0 60 kg ai/ha) gave significantly higher yield over control and were on par with each other

104 Time of application of pre emergence herbicides on phytoxicity and weed control in semi dry rice
(RIC/10 00 08 92/VKA(1)KAU/PG)

Grain yields were higher in plots treated with Pendimethalin at 3 DAS Total returns and return for rupee invested were higher in case of Pendimethalin at 3 DAS and Oxyflurpfen at 9 DAS

105 Management of weeds in rice crop of Kuttanad
(RIC/10 00 09 93/VKA(1)KAU PC)

Survey on the incidence and intensity of weed flora in Ambalapuzha Kuttanad and Kottayam was done Experiment on crop weed competition and state level technique was done

106 Combined application of granular preparation of pre emergent herbicides and fertilizers in rice
(RIC 10 00 10/94 VKA(1)KAU/PC)

Work not commenced

Project (11) Identification of critical limiting factors in rice production in different agroclimatic situations

107 Micronutrient status of Kuttanad soils
(RIC 11 00 03 91/MON(3)KAU)

Champakulam Edathuva Vechoor and Changanacherry series were found to be strongly acidic (pH ranging between 4 5 and 5 2) and the Ramankari series

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108 Disease management trial
(RI 2 2 87 MON 5) CAR

Fungicidal application was found to be significantly superior for control in reducing the incidence of both sheath blight and sheath rot diseases during both the seasons al difference was significant only in the Rabi season

Sub Project (02) Disease management using fungicides

109 Evaluation of granular formulations for blast disease control
RIC 2 2 89 B 5 CAR

No work during the year To be concluded

110 Granular formulations in combination with seed dressers and EC/WP formulations for blast control
(RIC 12 02 03 83 PTB 5) CAR)

No work during the year To be concluded

111 Economic spray schedule for the chemical control of blast under irrigated areas in Rab
(RIC/12 02 04/80 PTB(5)ICAR

No work during the year To be concluded

112 New fungicide evaluation trial for blast disease
RIC 12 0 05 89 PTB/5 CAR

All the fungicides tested were superior in controlling neck blast incidence over control All the new formulations were on par with the standard fungicide checks in reducing the neck blast incidence However s er yields were obtained with the treatment wed by Beam 75 WP

113 Evaluation of new fungicidal formulations for sheath blight control
2 12 9 MON 5 AR

All fungicides were found effective in reducing the incidence and severity
of the disease
Item cont and stand
ed on the disease severity

114 Evaluation of new fungicide formulations for sheath blight disease control
R 12 02 08 89 PTB(5) CAR)

No work during the year

115 Effective chemical control of blast disease
(RIC 2 02 1 90 PTB(5)ICAR)

No work during the year To be concluded

116 Survival of *Xanthomonas campestris* pv *Oryzae* and its control in Kuttanadu
(RIC 2 02 12 9 AC 5)KAU FG

It was observed that protective application of chemicals was significantly superior to prophylactic application of chemicals for field control of bacterial leaf blight (BLB) Out of 70 varieties screened for resistance against BLB under field conditions 37 showed natural incidence The disease incidence was severe in the additional crop seasons of 1992 to 1993

Sub Project (03) Pest management with insecticides

117 Trial on early stage pest control
(RIC 12 03 0 /89 PTB(4) CAR)

No work undertaken

118 Insecticide evaluation trial
(RIC/12 0 02 86 MON(4 CAR)

Miral 0 75 and 0 5 kg ai/ha was found to be effective and on par with Furadan 1 kg ai/ha and Hostathion 0 25 kg ai/ha in controlling stem borer incidence

119 Efficiency of nematicides for the

control of cyst nematode *Heterodera oryzicola*
(RIC/12 03 03 89/ACV(4)ICAR)

No work during the year

120 Brown plant hopper resurgence trial
(RIC/12 03 04 90/MON(4)ICAR)

No work during the year

121 Evaluation of insecticides against major pests of rice
(RIC/12 03 05 88/MON(4)KAU)

To be concluded

122 Insecticide evaluation trial
(RIC/12 03 06 90/PTB(4)ICAR)

No work during the year

Sub Project (04) Management of virus and bacterial diseases of rice

123 Etiology and Management of virus and bacterial diseases of rice in Kuttanad
(RIC/12 04 01 91/MON(5)KAU)

Periodic survey of Padasekhara in upper and lower Kuttand areas was continued

Project (13) Integrated Pest Management

124 Integrated pest management trial
(RIC/13 00 01 83/MON(4)ICAR)

The results obtained during the Addit onal crop season was not significant During the Punja season results were significant The yield was much lower in the case of susceptible varieties in spite of pest management The incidence of gall midge and stem borer was low during the season

125 Gall midge biotype monitoring trial
(RIC/13 00 02 83/MON(4)ICAR)

The results so far obtained confirm that the gall midge biotype present at Moncompu is Biotype 5 with R R S S pattern against the four groups of differentials

126 Brown Plant Hopper biotype studies
(RIC/13 00 03 89/MON(5)ICAR)

No work during the year

127 Disease observation nursery
(RIC/13 00 04 89/MON(5)ICAR)

During the additional crop season maximum disease pressure of different diseases was observed in the third and fourth series of sowings of 13 5 93 and 26 8 93 During the punja season the incidence of different diseases was negligible up to 45 DAS Maximum disease pressure was noticed in the second series especially in Jyothi Moderate to high incidence of sheath blight and sheath rot was observed in all the series

128 Disease observation nursery for monitoring the occurrence of major rice disease in relation to weather factors during the rice crop seasons
(RIC/13 00 05 91/PTB(5)ICAR)

No work during the year

129 Economic threshold levels of major pests
(RIC/13 00 06 90/PTB(4)ICAR)

No work during the year To be concluded

130 Brown plant hopper biotype studies
(RIC/13 00 07 91/PTB(4)ICAR)

No work during the year

131 Effect of insecticides on natural enemies of rice pests
(RIC/13 00 08 93/MON(4)ICAR)

The inseticides are applied at 10 30 and 50 DAT and observations on parasites recorded Estimation of stem borer and gall midge damage recorded 60 DAT or 10 days after last insecticide application Plots which received granular treatment of Ekalux 5 G @ 1 0 kg ai/ha gave the lowest incidence of stem borer and the highest parasite emergence

132 Species composition and population fluctuation of rice leaf folder stem borer and case worm
(RIC/13 00 09 93/MON(4)KAU)

Survey was conducted during the Additional crop and Punja seasons in

different padashekarams Damaged plants together with the larval stages were collected and the larvae were reared in the laboratory Adults of yellow stem borer (*Scirpophaga incertulus*) white stem borer (*Scirpophaga innotata*) and case worm (*Nymphula depunctalis*) were obtained from these rearings Data on light trap collections showed maximum population of yellow stem borer in September and October of 1993 and February and March of 1994 White stem borer incidence was maximum in October November 1993 and March 1994 while case worm population was maximum in September 1993

133 Management of rice gall midge
(RIC/13 00 10 93/MON(4)KAU)

The incidence of gall midge was very low during the season and hence a critical evaluation could not be done

134 Role of collateral hosts in the occurrence of Udubatta diseases of rice
(RIC/13 00 11 94/AMB(5)KAU)

Work not commenced

●●●

2. Coconut and coconut based cropping system

HIGHLIGHTS

- Under laterite soil condition coconut palms respond to magnesium application producing higher yields but in alluvial soils magnesium application did not influence the yield
- Diagnosis and recommendation integrated system is applicable to coconut palms The same can be used for nutrient management in conjunction with critical level approach
- Light infiltration decreases with increase in plant height up to 6 4 metres reverse being the trend thereafter
- N P & K contents in soil did not markedly influence the yellowing of palms
- Surface mulching of the coconut basin with waste coconut leaves followed by burying coconut husks in linear trenches between rows increases moisture conservation and nut production
- Hybrids of CT x CGD and WCT x MYD are found good yielders
- Banana and cassava when grown together 75 per cent of the fertilizer dose recommended for each crop is sufficient for high yield in both the crops
- For controlling stem bleeding applying hot coal tar on cleared surface neem cake 5 kg/palm and soil drenching with 25 ml Calixin are effective
- Application of carbaryl 0 1 per cent HCH 0 2 per cent or Endosulfan 0 1 per cent controls coreid bug infestation efficiently

CONCLUDED EXPERIMENTS

1) **Standardisation of source and requirement of magnesium for root (wilt) affected and healthy palms**
(COC/03 00 06 80/VKA(3)KAU)

Yellowing is one of the important symptoms of root (wilt) disease which is attributed to the deficiency of nutrients, particularly magnesium This experiment was initiated to standardise the dose of magnesium as well as to find out the cheapest source of magnesium other than magnesium sulphate

The experiment was conducted at two locations one at RARS Kumarakom representing alluvial soil and the other at DAF, Mavelikkara representing laterite soil

Table 1 Effect of treatments on yield of nuts/palm/year

Treatment	Alluvial soil					Laterite soil				
	1987	88	89	90	91	87	88	89	90	91
T0 Control	47	13	18	13	15	46	88	99	76	24
T1 $MgSO_4$ 200 g MgO/palm	46	26	25	23	10	43	29	117	63	6
T2 -do 400 do	45	22	29	14	6	30	26	116	51	37
T3 -do 600 do	47	20	13	17	16	32	46	108	41	15
T4 -do 800 do	49	53	34	16	28	32	69	128	90	43
T5 Magnesite 200 do	43	40	28	26	11	39	59	96	66	25
T6 -do 400 do	42	20	17	18	17	30	47	106	72	14
T7 do 600 do	50	38	31	24	7	32	66	99	59	60
T6 do 800 do	42	51	49	19	26	32	55	111	56	6

Table 2. Pooled data (87-91) of nutrient status of leaf (%)

Treatment	Alluvial soi					Laterite soil				
	N	Total P	Total K	Total C	Mg	N	Total P	Total K	Total Ca	Mg
T0 Control	8 19	1 15	7 50	2 9	1 50	8 44	1 31	8 32	3 07	1 33
T1 $MgSO_4$ 200 g MgO/palm	8 65	1 10	7 11	3 05	1 24	9 82	1 32	10 00	3 47	1 15
T2 $MgSO_4$ 400 g MgO/palm	7 93	1 2[illegible]	6 66	3 25	1 44	9 17	1 37	8 09	3 36	1 41
T3 $MgSO_4$ 600 g MgO/palm	8 17	[illegible]	8 47	3 45	1 67	7 56	1 30	9 35	3 22	1 26
T4 $MgSO_4$ 800 g MgO/palm	8 05	1 15	[illegible]	[illegible]	1 42	6 21	1 19	9 05	3 23	1 02
[illegible] Magnesite 200 g MgO/palm	8 88	1 11	6 78	3 39	1 27	7 70	1 22	9 89	2 74	0 97
[illegible] Magnesite 400 g MgO palm	51	1 05	6 52	3 17	1 53	8 62	1 18	9 54	2 85	1 51
T7 Magnesite 600 g MgO/palm	8 [illegible]	1 18	7 32	2 96	1 27	8 [illegible]5	1 26	9 60	3 40	1 13
T8 Magnesite 800 g MgO/palm	8 2[illegible]	[illegible] 8	7 05	3 18	1 50	9 07	1 23	8 81	3 50	1 33

Two sources of magnesium *viz* magnesium sulphate and magnesite and four levels of magnesium *viz* 200 g 400 g 600 g and 800 g MgO/palm were tried The data on the yield of nuts and pooled data of nutrient status of leaf are presented in the Tables 1 and 2

The results indicated that there existed differences in the response of magnesium application in laterite as well as alluvial soil Significant increase in yield consequent to the application of treatments was recorded from laterite soil Application of 800 g MgO/palm as magnesium sulphate resulted in the highest increase in yield but all the other treatments, except control, were on par It was concluded that different sources and different levels of magnesium did not vary significantly in increasing the yield or in the level of nutrients in the soil or in the leaf

Results from alluvial soil showed that the different levels and sources of magnesium did not influence the yield or the nutrient status

2) **Irrigation cum fertiliser trial on T x G hybrids**
(COC/03 00 06 80/PIL(11)KAU)

The aim of the experiment was to find out the optimum irrigation and fertilizer requirement of T x G hybrids from early stages of growth nutrient supply and seedling behaviour to elucidate the interacting influence of irrigation and

Table 3 Number of nuts harvested

ANOVA

	K value	DF	SS	MS	F	Prob
1	Replication	2	869 920	434 960	2 1017	0 1461
2	Irrigation levels		1206 585	603 292	2 915	0 0753
3	Fertilizer levels	3	3028 963	1009 654	4 8786	0 0095
4	Irrigation levels x Fertilizer levels	6	1284 563	213 761	1 0324	0 4308
5	Error	22	4553 005	206 955	–	–
6	Age at full dose application	2	25 029	12 514	0 1159	–
7	Irrigation levels x Age at full dose	4	897 615	224 404	2 0780	0 0983
8	Fertilizer levels x Age at full dose	6	676 863	112 810	1 0446	0 4687
9	Irrigation level x Fertilizer level x Age at full dose	2	1089 512	90 793	0 8467	
10	Error	46	4983 557	107 991	–	
	Total	107	18813 611			

fertilizer and the effect of manuring on yield expression in coconut

This experiment was conducted for a period of 12 years from 1980 1992 using split plot design with 36 treatments and three replications The main plot treatments were 12 combinations of 3 levels of irrigation and 4 levels of fertilizers and there were 3 sub plots ie age at which full dose of fertilizer was given

There were three irrigation levels 300 litres 450 litres and 600 litres water in 4 days (I_1 I_2 & I_3) The fertilizer levels were F1 0 5 0 5 1 5 F2 0 5 0 5 2 0 F3 0 5 1 0 2 0 and F4 1 0 0 5 2 0 NPK/kg/palm year The age at which full dose of fertilizer was given was in the second year (S1) in the 3rd year (S2), and in the 4th year (S3

The results of the experiment showed that maximum number of nuts were produced in treatment receiving 600 litres water fertilizer dose of 0 5 0 5 1 5 kg of NPK per palm per year and full dose of fertiliser application in the second year

3 Investigation on the growth and productivity of coconut cv WCT as influenced by irrigation and fertilizer application
(COC 03 00 07 83/PIL(1)KAU)

The aim of the experiment was to study the effect of water saving irrigation techniques on the growth and productivity fertilizer use efficiency under irrigated condition and to compare the water requirement of the crop as influenced by irrigation and fertilizer application

The results indicated that basin irrigation at IW CPE 0 75 and drip irrigation at IW CPE 0 5 registered good moisture status in the soil Treatment having drip irrigation @ W/CPE 0 5 and NPK @ 0 5 0 32 1 2 kg/palm was superior to all other treatments with regard to plant height and girth of plant at collar region and number of functional leaves produced

3) **Applicability of Diagnosis and Recommen[illegible] Integrated System (DRIS) in co[illegible] pa[illegible] (Co[illegible]s *nucifera* L.)**
(CO[illegible] [illegible]92 KA[illegible] KA[illegible] PG

With a view to deve[illegible]p DRIS ref[illegible]ce norms for [illegible]ajor secondary and m[illegible]ro nu[illegible]ents to d[illegible] [illegible]nt[illegible]en b[illegible]lar[illegible]e nutrient de[illegible]y [illegible] excess in coconut p[illegible]m and evaluation of the accuracy of nutrient deficiency diagnosis b[illegible] DRIS method this experiment was in[illegible]iated

The study was conducted on 800 WCT pa[illegible]ms varying in the[illegible] yield from 6 to 162 in the ongoing fertilizer trials at Coconut Research Station Balaramapuram ARS Mannuthy and RARS Pilicode Leaf samples were collected from the 14th frond and were analysed for N P K Ca Mg S Cl Fe Zn & Mn DRIS norms were developed using the data generated from the chem[illegible]cal analysis of leaf samples Five nutrients namely N P Ca Mg and Cl and 33 nutrient ratios were selected on the bas[illegible]s of h[illegible]gher variance ratios as DRIS norms DRIS index worked out indicated [illegible]e[illegible]ative abundance among the nutrients considered Lower the value of the index for a nutrient greater its requ[illegible]rement The overall nutritional balance of a palm is given by the Nutritional Imbalance Index (NII) A negative significant correlation at 1 per cent level was obtained between NII and yield indicating a reduction in yield with increasing nutritional imbalance The

Table 4 Mean yield of nuts and soil moisture status as influenced by treatments

Treatment	Pre treatment yield (mean of 4 years)	Post treatment yield (mean of 6 years)	Increase or decrease	Soil moisture percentage: Upto 30 cm (Mean of March May)	30 60 cm
1) Burying coconut husk in linea trenches	51 3	59 1	7 8	7 37	7 73
2 Burying husk in circular trenches	77 5	70 8	−6 7	7 23	7 80
3) do semi circular trenches one half in one year and other half 2nd yea	65 4	60 2	−5 2	6 97	7 46
4) do in semi circular trenches	84 5	88 4	3 9	–	–
5) Mulching the basin with coconut husk	66 9	72 2	5 2	6 83	7 66
6) Mulching with waste coconut leaves	85 4	93 4	8 0	7 40	8 26
7 N[illegible] 25 kg green leaf	6[illegible] 4	[illegible]	1 7	5 23	6 23
8 Mulching with coir dust	[illegible]	[illegible]5 2	4 4	–	–
CD 0 05					

R2 value for a curvilinear equation was 0 673 indicating the strong relationship between Nil and yield

5) **Standardization of husk burial methods for cocon t**
(COC/04 00 01 86/PIL(1)KAL

This experiment was initiated at RARS Pilicode to study the influence of burying coconut rusk on growth of palm yield moisture conservation in soi nutrient enrichmert of the soil and also to find out the most effective method of burying the husk

Different methods of husk buryial such as in linear trenches circular trenches semi circular trenches and mulching the basin with husk were compared with mulching basins with waste coconut leaves and mulching with coir dust The details of nut yield and soil moisture status as influenced by treatments are given in Table 4

Surface mulching of the basin with 12 waste coconut leaves closely followed by burying coconut husks in linear trenches between rows of coconut recorded the highest increase in nut production A decrease in yield was recorded in treatment where husk was buried in circular trenches and also in semi circular trenches Soil moisture content was the highest in treatment where mulching was given with waste cocorut leaves

6) **Light infiltration studies in coconut based homestead situations**
(COC 05 00 05 92 VKA(1)KAU/PG)

The objective of this experiment was to study the light infiltration through coconut canopies of different homestead situations varying in height and spacing of palms to assess the influence of height of palms plant spacing and other measurable parameters on light infiltration and to develop a model to predict light infiltration from measurable crop parameters

A total of 113 observations were taken from different locations in Thrissur Kottayam Kasaragod and Kannur districts from July 1992 to April 1993 Each observation included measurement of light intensity from 10 a m to 4 p m using line quantum sensor in the centre of four palms and point quantum sensor in the open

The daily mean values of light infiltration in different situations ranged from 7 to 86 per cent A total of 58 per cent of the situations had light infiltration in the range from 10 to 40 It was found that light infiltration decreased with increase in plant height upto 6 4 metres there being a reverse trend above this height The approximate age corresponding to this turning point was estimated as nine years Prediction equations were developed to predict light infiltration from the measured crop parameters

7) **Studies on seasonal yellowing in coconut palms**
COC/06 00 03 87 VKS(5)KAU

Seasonal yellowing of coconut palm is a common feature in areas of level topography and areas subjected to subsidence This yellowing is different from the yellowing symptom of root (wilt) disease This experiment was taken up to find out the real cause of seasonal yellowing in coconut palms

The monthly rainfall data and yellowing index of palms for 1987 1989 at Fisheries College Panangad and DAF Mavelikkara are given in Table 5

The seasonal yellowing increases in intensity immediately after the receipt of S W monsoon But a definite relationship between the rainfall pattern and yellowing index could not be obtained during 1987 89 under both soil conditions Relatively higher values of yellowing index during dry months of the year can be related to the low available N level of the soil During the later period of the year as the available N status of soil improved yellowing index showed a decreasing trend Results indicated that the available N P & K contents in the soil did not markedly influence yellowing of palms

Table 5 Monthly variation of the mean yellowing index of palms and rainfall at Panangad and Mavelikkara

	Panangad						Mavelikkara				
	1988			1989			1987		1988		
	Rainfall (mm)	Yellowing index	Rainfall (mm)	Yellowing index	Rainfall (mm)	Yellowing index	Rainfall (mm)	No. of rainy days	Rainfall (mm)	No. of rainy days	Rainfall (mm)
January		8	0	17.87		10.4	50	3	7		4
February		22	1	5.13		4.0		0	31		
March			56	3	4	0		6.7	23.0	4	30
April		2	41	0	24	13	7	3	21		
May	3	5	64.4	7.0	3.8	1.01	6	23	53		24
June	63	5	93.5	12.68	63.6	0	44.0	24.9	496.0		
July	388	1	642	2.2	40.8	8.6	111.0		522.0	2	30
August	528.0	13.7	478.8	11.53	27.1	18.6	36.0	24.5	350.0		70
September	404.0	3	820.6	15.23	328.4	3.12	5.0	1	633.0		26
October	214.5	15.9	35.6	14.35	39.4	1.57	379.0	5	39.0	20	36.0
November	15.0	13.4	53.2	11.40	4.6	8.86	45.0	1.2	362.0	3.6	57.0
December	49.0	16.1	4	13.8	0	1.29	408.0	2	30	7	45

Table 6 Data on indexing of palms for root (wilt) disease

Treatments	Pre treatment March 90	Post treatment			Pooled mean
		March 91	March 92	March 93	
1 OTC (3 g/palm)	24 20	13 45	14 07	13 31	13 61
2 Penicillin (3 g / palm)	24 90	18 21	29 83	27 01	25 02
3 OTC (3 g/palm) + Bavistin (2 g/palm)	25 10	12 80	13 18	11 19	12 39
4 Bavistin (2 g/palm)	25 40	13 79	14 92	13 57	14 09
CD (5%)		5 77	6 90	14 40	7 44

Correlations were worked out between the different paramters such as monthly mean data for rainfall yellowing index nutrient status of the soil and leaf using pooled data for both the sites Yellowing index was positively correlated with available N P and K of soil which was again positively correlated with K percentage of leaf While significant positive correlations of total Mn of leaf was observed with yellowing index (r=0 664) total P in leaf (r=0 720) and total K in leaf (r=0 850) it was found to be negatively correlated with total Ca+Mg (r=0 497) and total Fe (r=0 431) of leaf It may be concluded that the presence of excess K and Mn increases the yellowing index and the presence of Ca Mg and Fe was found to decrease the same

Chemotherapy of root (wilt) disease of coconut

(COC/07 00 02 90 KUM(3)KAU)

This experiment was initiated to study the effect of antibiotic and systemic fungicides for remission of symptoms of root (wilt) disease of coconut

Oxytetracycline Penicillin combination of OTC and Bavistin and Bavistin alone were the chemicals tried along with control The chemicals were applied at the bole region of the palms using pressure injection technique

There was a general reduction in the root (wilt) index in different treatments which was maximum in OTC and Bavistin

EXPERIMENTS IN PROGRESS

Project (01) Germplasm conservation and evaluation

1) **Utilisation of existing germplasm and description of varieties**
(COC/01 00 01 76/PIL(9)KAU)

Morphological and yield characters were observed from the new collection planted The old palms standing in the field were removed during the year Maximum number of nut production was recorded by Kudat and Seychelles (99 nuts each)

2) **Germplasm collection of coconut**
(COC/01 00 02 76/VKA(2)KAU)

Experiment discontinued

Project (02) . Breeding for higher production and quality

3) Evaluation of Tall x Dwarfs
(COC/02 00 01 76/PIL(9)KAU)

During the year hybrid WCT x CGD produced 54 7 nuts per palm, followed by WCT x LD (54 17) and WCT x MYD (53 78) However the cumulative nut yield showed that WCT x MYD produced highest yield (311 00 nuts) followed by WCT x CBD (297 72)

4) Trial of promising seed materials
(COC/02 00 02/76/PIL(9)KAU)

The trial includes four hybrids already released and nine cultures The nut yields recorded were 147 5 Chandrasankara (COD x WCT), 140 6 Kerasankara (WCT x COD), 118 8 Keraganga (WCT x CB) and 101 8 Lekshaganga (WO x GB) The old palms were removed from the trial Comparative performance can be studied only after five years

5) Studies on inter-se cross, selfed and open pollinated progenies of Ayiramkachy
(COC/02 00 03 76/PIL(9))

To be concluded

6) Evaluation of Tall x Dwarf and their reciprocals

Under rainfed conditions the hybrid Kerasree (WCT x MYD) stands first in overall performance of leaf production and nut yield The experimental palms are getting irrigation and the production potential of the hybrids can be ascertained after five years

7) Varietal trial on coconut
(COC/02 00 06 76/VKA(9)KAU)

Trial discontinued

8) Multilocational trial on promising hybrid combinations of coconut
(COC/02 00 07 88/PIL(9)KAU)

At Nileswar, hybrid WCT x CGD stands first in height, girth and functional leaves At Kumarakom WCT x COD exhibited the maximum hybrid vigour with regard to height and number of leaves The hybrids have started bearing

9) Evaluation of promising hybrids and cultivars for planting in the alluvial soils of Malappuram district
(COC/02 00 01 76/PIL(9)KAU)

Discontinued

10) Biennial tendency and yield pattern in coconut
(COC/02 00 09 90/PIL(2)KAU)

Experiment discontinued

11) Hybrid seedling production in coconut
(COC/02 00 11 88/PIL(9)KAU)

The general growth of the seedlings planted at RARS Pilicode is good Flowering has started in Gangabondam and Lakshaganga

12) Prepotency analysis in Komadan and West Coast Tall mother palms for hybrid production
(COC/ 00 13 93/ACV(3)KAU)

Seednuts collected from 20 mother palms in four harvests were sown in nursery in Compact Family Block Design Germination was recorded three and six months after sowing Plant height number of leaves and girth of pseudostem were recorded five and nine months after sowing

Project (03) Fertilizer management

13) NPK fertilizer trial starting from young seedlings
(COC/03 00 01 64 BAL(1)KAU)

Three levels each of N P & K were tried in this trial Results indicate the following

No yield difference was observed between N treatments Palms which were not receiving P, recorded more yield Palms which received higher dose of K (K_2) recorded double the yield of KO P K interaction was found to be significant and the highest nut yield (79 nuts / palm / year) was recorded by P_2K_2 ie application of 450 g P_2O_5 and 900 g of K_2O/palm/ year

14) Spacing cum manurial trial
(COC/03 00 02 64/BAL(2)KAU)

Yield differences were not observed between 7 5 x 7 5 m spacing and 10 x 10m spacing or between M1 and M2 levels of fertilizer application But significant yield differences were recorded between no fertiliser application and M1 and M2 Interaction influence of spacing and manuring was not significant

15) Response of D x T hybrids to common salt application
(COC/03 00 05 76/PIL(3)KAU)

No work during the year

16) Developing of suitable agrotechniques for efficient nutrient management of coconut grown in the reclaimed soils of Kuttanad
(COC/03 00 08 92/KUM(1)KAU)

There was no significant difference in the yield of nuts female flower production setting percentage and disease index due to the application of treatments The experiment is just two years o f

17) Biomass production of green manure crops and mineralisation of organic nitrogen in coconut biomass
(COC/03 00 10 93/VKA(1)KAU/PG)

The experiment with the following treatments *viz* soil alone 15 N labelled *Sesbania aculeata* and soil 15 N *Crotolaria striata* and soil and 15 N *Pueraria phaseoloides* and soils are over Soil samples were analysed after incorporation of green manures for extractable NH_4 and NO_3

Project (05) Coconut based farming systems

18) Intercropping tree spices in the coconut gardens of Kuttanad
(COC/05 00 02 90/KUM(1)KAU)

Discontinued

19) Nutrient management in banana cassava cropping system
(COC/05 00 03 90/KUM(1)KAU)

Seventy five percent of fertilizers for both banana and cassava is found to be optimum and superior to lower levels for the production of high yield when banana and cassava are grown together Though 100% fertiliser application increased yield of banana it was on par with 75% fertilizers for both the crops

20) Nutrient management in Amorphophallus grown as intercrop in coconut gardens
(COC/05 00 04 90/KUM(1)KAU)

Effect of N was significant on the yield of corm Application of Nitrogen at 120 kg per ha recorded the highest yield but was on par with N application at 80 kg per ha Though treatment effect was not significant treatment combination N120K0 followed by N120K80 recorded the highest yield of corms

21) Nutrient moisture-light interaction in a coconut based cropping system
(COC/05 00 06 92/VKA(5)KAU)

No work during the year

22) Root distribution patterns of banana and colocasia in coconut gardens
(COC/05 00 07 93/VKA(1)KAU/PG)

Work initiated

23) Rhizosphere characteristics of coconut cocoa system in relation to soil fertility and root activity
(COC/05 05 08 94/VKA(1)KAU/PG)

Discontinued

Project (06) Management of pest and disease problems of coconut

24) Variation in the occurrence and intensity of different diseases on perennial crops under a coconut based multistoried cropping system
(COC/06 00 01 87/KUM(1)KAU)

On coconut the intensity of root (wilt) varied from 33 5 to 38 5 during the year The maximum incidence of root (wilt) was in November 93 and the lowest in March 94

The leaf rot index recorded was from 1 0 to 4 7 maximum during July and the lowest in October On clove and nutmeg the major disease recorded was leaf spot caused by *Colletotrichum gleosporiodes* with an intensity of 1 25 to 4 0 in clove and 1 46 to 2 78 in nutmeg Pepper was severely affected by bacterial leaf spot pollu and foot rot Sigatoka disease was present in banana

25) Investigation on stem bleeding disease
(COC/06 00 02 89/PIL(5) KAU)

The treatments tried were application of neem cake @ 5 kg/palm/year soil drenching Calixin @ 25 ml in 25 l water at 4 months interval combination of the above two and the combination of the first two + pasting 50 per cent BHC along with an untreated control

The trial was conducted in farmers field Substantial reduction in stem bleeding disease was recorded in treatments receiving neem cake and Calixin

26) Management of stem eding disea of coconut
(COC/06 00 04 92/VKA)

scontinued

27) Bionomics & control of *Paradaeynus rostratus* on coconut
(COC/06 00 05 93/ACV(4)KAU)

Multilocational trial on the efficacy of different insecticides on the control of coreid bug revealed that Carbaryl 0 2 per cent and 0 1 per cent HCH 0 2 per cent and Endosulfan 0 1 per cent are the most effective Application of insecticides eight times an year gave better control Studies revealed that the population started building up from June reaching the maximum during August October and declined from November onwards

28) Survey on the coreid bug incidence on coconut in Kerala and its control
(COC/06 00 06 93/ACV(1)KAU)

A detailed and extensive survey was conducted to study the incidence of coreid bug in Kerala as a collaborative work of the Department of Agriculture and KAU Based on the data collected and results obtained a technical bulletin on coreid bug incidence in Kerala has been published

29) Effect of management practices on the incidence of intensity of grey blight disease of coconut
(COC/06 00 07 94/BAL(5)KAU/PG)

The experiment is yet to start

Project (07) Management of root (wilt) affected coconut gardens

30) Water and fertilizer management of root (wilt) affected coconut palms
(COC/07 00 01 90/KUM(1) KAU)

Effect of irrigation and fertilizer levels on the yield of coconut and root (wilt) disease ed under farmers field condition Yie f nuts female flower production and dis se dex were not influenced by the treatments studied The experiment is in its early stage

31) Study on the population dynamics of lace bug *Stephanitis typica* vector o root (wilt) disease of coconut and its control
(COC/07 00 03 90/KUM(4)/KAU

The population build up showed a negative relation to rainfal number of rainy days and relative humidity 90per cent and above Dry spells from January to April and RH below 80per cent favoured population build up Predator population was very negligible

32) Transmission of coconut root (wilt) disease by lace bugs *Stephanitis typica*
(COC/07 00 04 90/KUM(1) KAU)

The seedlings inoculated with lace bugs fed on diseased leaves of coconut are kept under observation No symptom of root (wilt) disease has developed on the seedlings

●●●

3. Vegetables and tuber crops

HIGHLIGHTS

- The tomato line LE 79 5 a segregant of LE 79 was found resistant to bacterial wilt and has field resistance to fruit cracking This new culture has an yield potential of 43 5 t/ha This line was recommended by the 13th group meeting of the All India Co ordinated Research Project on Vegetable for releasing as a national variety

- A cluster type chilli CA 219 was found promising with regard to high colour value (139 ASTA units) pungency (0 4 per cent Capsaicin) and yield (400 g/plant) This line was also found resistant to bacterial wilt disease Seed treatment with 0 05 per cent Bavistin followed by four sprays of Fytolan (0 35 per cent) and Bavistin (0 05 per cent) in the field at an interval of three weeks commencing from 15 days after transplanting was found most effective in reducing the intensity of dieback and fruit rot diseases Studies on seasonal occurence of diseases in chilli indicated that Phytophthora leaf blight and Alternaria leaf blight were severe during monsoon months in July August and fruit rot and dieback diseases were maximum in October

- Three genotypes of pumpkin *viz* CM 349 CM 350 and CM 346 were found as high yielders 11 7 t/ha 10 12 t/ha and 13 2 t/ha respectively) with the desirable quality of orange flesh The line CM 349 was accepted for conducting adaptive trials in Kerala and CM 346 and CM 350 were recommended for national testing under AICVIP

- Two genotypes of bhindi *viz* AE 202 having creamy white long fruits and AE 198 a red type bhindi with long fruits were found promising in terms of yield (14 5 t/ha and 12 5 t/ha respectively) They are being tested for their adaptability under farm trials

- Screening of bhindi varieties against yellow vein mosaic showed that the disease was absent when the crop was raised during May 93 to September 93

- Cowpea line VS 389 was found as the top yielder with an yield of 220 g/plant The average pod weight is higher in this line (7 g/pod) This line is now under farm trial

- A winged bean genotype PT 52 was found promising with an yield of 3 6 t/ha It is being tested under farm trials

- Application of 60 kg N/ha and 160 kg K_2O/ha recorded the best growth and the highest corn yield of colocasia variety "Thamarakannan" grown as a pure crop at Vellayani As an intercrop in coconut gardens application of N @ 40 kg/ha and K_2O @ 160 kg/ha gave the best results Maximum benefit cost ratio and net returns were obtained in these treatments

CONCLUDED PROJECTS

1 **Selection efficiency and genetic and biochemical basis of resistance to bacterial wilt in tomato**
(VEG/01 02 03-85/VKA(14)KAU)

A few promising cultures resulted from an earlier study were progressed Out of these LE 79-5, a segregant of LE 79, was found resistant to bacterial wilt This line was given for testing at national level under AICVIP The 13th group meeting of the All India Co ordinated Research Project on Vegetables held at Jabalpur in December 1993 recommended for releasing it at National level This line is now under farm trials in the Central zone

2 **Identification of dessert types of muskmelon (*Cucumis melo*) suitable for the southern region of Kerala**
(VEG/02 02 03 90/ACV(18)KAU)

The major finding of the project was that the best month of sowing muskmelon in the southern zone of Kerala is December Two varieties Pusa Sharbati and PMR 6 were identified as the best for December sowing as they exhibited maximum yield per vine and maximum TSS along with good acceptability among the 10 varieties studied

3 **Artificial induction of Polyploidy in *Cucumis sativus***
(VEG/02 03 04 90/ACV(2)KAU/PG))

The study broughtout the following findings Application of colchicine 0 2 per cent for two hours by seed treatment is desirable under *in vitro* condition considering the minimum lethal effects as indicated by the survival of plants Colchicine 0 02 per cent can induce polyploidy under *in vitro* conditions with minimum deleterious effects

4 **Induction of genetic recombinations in interspecific crosses of Abelmoschus**
(VEG/04 01 05 90/ACV(9)KAU/PG))

Varietal difference in compatibility of *Abelmoschus esculentus* with wild parents *A caillei* and *A tetraphyllus* was noticed Reciprocal crosses registered higher compatibility than the direct crosses

Combining ability analysis indicated the predominance of non additive gene action for majority of the characters including yield and yellow vein mosaic resistance *A caillei* was identified as the better donor parent for transferring YVMV resistance Reciprocal crosses recorded more number of recombinants than the direct crosses

The irradiated crosses *A caillei* x Anakkompan and *A caillei* x Eanivenda were identified as the better crosses for isolating recombinants The isolated recombinants can be utilised for further breeding programmes for evolving high yielding resistant varieties in bhindi

5 Genetic **divergence in bhindi** (*Abelmoschus esculentus*)
(VEG/04 01 08 92/ACV(9)KAU/PG))

Seventy genotypes of bhindi were evaluated and based on D^2 analysis they were grouped into six clusters (Table 1) Maximum divergence was obtained between clusters II and VI and the minimum between clusters I and IV

6 **Morphological effect of gamma rays and EMS on winged bean**
(VEG/04 04 02 92/ACV(9)KAU/PG))

The germination percentage was observed to be decreased by both the mutagens Plant height was inversely related to dose of gamma rays Both gamma rays and EMS caused not much variation Days to first flowering was reduced by lower doses of gamma rays but higher doses caused delayed flowering Days taken to first flowering was not much affected by EMS treatments Number of pods per plant and fruit yield per plant were not affected by EMS treatments, though these characters were gradually decreased with increase in dose of gamma rays (Table 2)

Table 1 Average intra and inter cluster distance

Cluster	I	II	III	IV	V	VI
I	117 62	224 72	209 96	180 16	202 75	269 39
II		103 34	396 56	258 82	205 70	450 88
III			195 22	289 39	343 15	234 39
IV				89 88	263 44	230 27
V					134 98	425 14
VI						0

Table 2 Effect of mutagens on number of pods per plant fruit yield per plant and number of seeds per pod

Treatments	No of pods/ plant	Fruit yield/ plant (g)	No of seeds/ pod
Gamma rays (GR)			
Control	7 44	147 27	10 38
100 Gy	9 50	154 68	8 81
200 Gy	6 18	77 29	6 95
300 Gy	4 74	53 28	6 05
400 Gy	2 89	36 41	3 36
Mean	6 15	93 79	7 11
F_4 20	3 99**	4 92**	18 31**
C D	3 73	72 19	1 85
SEd	1 79	34 61	0 89
EMS			
Control	3 47	57 53	9 42
40 mM	4 08	75 40	11 16
80 mM	4 00	71 95	10 81
120 mM	3 41	60 59	8 98
160 mM	3 20	37 77	9 37
200 mM	3 13	48 72	8 71
Mean	3 55	58 66	9 74
F5 20	0 07NS	0 22NS	1 70NS
SEd	2 19	42 38	1 09
F_1 20 (GR Vs EMS)	9 42**	4 58*	39 14**

NS Not significant
* Significant at 5% level
** Significant at 1% level

Greater pollen sterility was induced by gamma rays, but the effect of EMS on pollen sterility was not much pronounced

7 Standardisation of spray schedule for control of dieback and fruit rot of chilli
(VEG/07 00 08 89/VKA(14)ICAR)

Seed treatment with 0 05 per cent Bavistin followed by four sprays of Fytolan (0 35 per cent) and Bavistin (0 05 per cent) at an interval of three weeks commencing from 15 days after transplanting were found most effective in curbing the intensity of diseases

8 Nutrient management for intercropped *Colocasia esculenta* var Thamarakkannan
(TUB/03 00 01 90/ACV(1)KAU/PG))

The objective of the experiment was to study the nitrogen and potassium requirements of colocasia as a pure crop in the open and as an intercrop in coconut gardens and to work out the economics of cultivation of colocasia as a intercrop in coconut gardens

The treatments consisted of three levels each of nitrogen (40 60 and 80 kg N ha ^{1}) and potassium (80 120 and 160 kg K_2O ha ^{1}) laid out in two situations *viz* as a pure crop in open and as an intercrop in coconut gardens

The results showed that the application of 60 kg N ha ^{1} and 160 kg K_2O ha ^{1} recorded maximum plant height, maximum number of leaves and maximum LAI under open condition while under intercropped situations similar results were obtained with 40 kg N ha ^{1} and 160 kg K_2O ha ^{1} The yield attributes like number of cormels per plant, mean weight of cormels cormel and corm yield per plant gave maximum values with the same N and K combinations mentioned earlier for open and intercropped situations Nitrogen had no influence on the yield of marketable tubers under intercropped situation Potassium increased the starch content of tubers under open and intercropped situations at 160 kg K_2O ha ^{1} Plant uptake of N P and K were influenced by increasing levels of K and the maximum was at the highest level of application in both open and intercropped situations Maximum benefit cost ratio and net returns were obtained by the application of N and K @ 60 kg ha ^{1} and 160 kg ha ^{1} under open (2 24 Rs 11970) and 40 kg ha ^{1} and 160 kg K_2O ha ^{1} under intercropped situation (4 92 Rs 37560) respectively

EXPERIMENTS IN PROGRESS

VEGETABLES

Project (01) Breeding for yield, quality, pest and disease resistance in solanaceous vegetables

Sub project (01) Chillies

1 Diversity, interrelationship among Capsicum spp and forms and development of paprikas
(VEG/01 01 03 89/VKA(14)KAU/PG)

Eighty three chilli genotypes belonging to four different species of capsicum were evaluated for two seasons Significant differences among genotypes for the eight characters were observed Among twenty paprika genotypes on further evaluation CA 517 was found to be resistant to bacterial wilt

2 Collection, evaluation and selection of improved chilli varieties
(VEG/01 01 04 79/VKA(14)KAU)

Among the collections, a cluster type chilli CA 219 was found best in terms of colour value (139 29 ASTA units) pungency (0 49 pi capsaicin) and yield (350 g plant ^{1})

3 Genetic and biochemical basis of resistance to bacterial wilt in chilli
(VEG/01 01 05 91/VKA(14)KAU)

Autoradiography results showed that there is no appreciable difference in the rate or extent of distribution of *Pseudomonas solanacearum* within resistant and susceptible varieties The wilting percentage of six generations (CA 219 (P_1) Jwala (P_2) F_1 F_2 B_1 & B_2) were taken and the data are being processed to make suitable ratios

4 Genetic improvement of bird pepper (*Capsicum frutescens*) by selection
(VEG/01 01 06 93/VKA(14)KAU/PG)

Eighty six lines of *Capsicum frutescens* and 24 lines of *Capsicum chinense* were raised in field and catalogued using IBPGR descriptor Few accessions viz *Capsicum frutescens* 36 3 and 103 were found to be promising with regard to fruit size and yield

5 Incorporation of bacterial wilt resistance in chilli *Capsicum annuum*
(VEG/01 01 08 94/VKA(14)KAU/PG)

Hybrid seeds of crosses CA 219 x Jwala CA 219 x Jwalamukhi Manjari x Jwala and Manjari x Jwalamukhi were developed

6 Oleoresin recovery quality characterization and storage stability in chilli (*Capsicum* spp) genotypes
(VEG/01 01 09 94/VKA(14)KAU/PG)

The work on standardisation of oleoresin recovery was initiated

Sub project (02) Tomato

7 Screening tomato lines resistant to bacterial wilt
(VEG/01 02 02 85/VKA(14)ICAR)

Highest yield and lowest incidence of bacterial wilt were noticed in Sakthi (4 6 t/ha and 23 per cent) followed by LE 79 5 (2 5 t/ha and 25 per cent)

8 Selection efficiency and genetic and biochemical basis of resistance to bacterial wilt in tomato
(VEG/01 02 03 85 VKA(14)KAU)

To be concluded The promising line LE 79 5 a segregant of LE 79 resulted from the studies was found resistant to bacterial wilt The line was recommended by the 13th group meeting of the All India Co ordinated Research Project on Vegetable for releasing in national level This line was also given for farm trial in central zone

9 Incorporation of resistance to fruit cracking in a bacterial wilt resistant genetic background in tomato
(VEG/01 02 04 91/VKA(14)KAU/PG)

Five wilt resistant tomato lines were identified They were Sakthi LE 79 5 LE 214 CAV 5 and LE 415 The F_1s were developed between wilt resistant lines and crack resistant lines They were found to be crack resistant

10 Combining ability studies in tomato
(VEG/01 02 05 93/ACV(5)KAU/PG)

Both the parents and hybrids were maintained in the field for further evaluation Work is continuing

Sub project (03) Brinjal

11 Screening brinjal varieties resistant to bacterial wilt
(VEG/01 03 01 87/VKA(14)ICAR)

The lowest disease incidence was noticed in SM 6 6 (17 6 per cent) followed by Arka Keshav BB 44 SM 141 and Arka Nidhi Highest yield was recorded in SM 6 6 (9 t ha ^{1}) followed by Arka Nidhi

12 Breeding for wilt resistant variety of brinjal
(VEG/01 03 02 86/VKA(14)KAU)

Crosses were made between the selected parents viz SM 141 SM 132 SM 197 and SM 262 The F_1 hybrids SM 262 x SM 141 and SM 262 x SM 197 were green fruited and free from bacterial wilt The yield was also good

13 Survey, collection and maintenance of brinjal, cucurbits and their wild relatives

(VEG ... 03 04 79/VKA 4 KAU)

... thirty one ... lines tested ... SM 6 ... others ...

... variability and ... brinjal

... of green fruited ... evaluated. Based on characters viz earliness, yield and disease resistance diverse parents were found superior and selected. These lines were crossed in all possible combinations ... hybrids obtained are ... evaluation.

15 Bacterial wilt resistance and yield in brinjal
(VEG ... 03 06 94 VKA 14 KAU P...)

Collected lines were planted in field for cataloguing and screening.

Sub project (05) Paprikas

16 **Screening of paprikas (Bell pepper types) for Kerala**
(VEG 01 05 01 94 VKA 14 KAU/PG)

Thirty lines of paprikas were collected from different sources. These include both indigenous and exotic types.

Project (02) Breeding for yield, quality pest and disease resistance of cucurbits

Sub project (01) Muskmelon

17 ***Identification of dessert types of muskmelon (Cucumis melo) suitable for the southern region of Kerala***
(VEG/02 01 01 90 ACV 14 KAU)

Experiment is concluded. Significant differences were observed among the varieties in the three sowing months for the percentage of germination, number of days to first female flower ... produ... harvest ... environment ... concluded that ... southern zone of Kerala. Pusa Sharbati and PMR 6 were identified as the best varieties for December sowing as they ex... maximum yield per vine ... suited.

Sub project (02) Watermelon

18 **Varietal evaluation of underexploited cucurbitaceous vegetables suited for the southern region of Kerala. Evaluation of watermelon varieties for the southern region of Kerala**
(VEG 01 02 0 90/ACV 14) KAU

Experiment on watermelon indicated that variety Sugar Baby was superior with regard to earliness in female flower production, number of fruits per plant, yield ... and TSS.

Experiment to be continued for one more year.

19 **Diallel analysis in watermelon**
(VEG 02 02 02 ... VKA(14)ICAR)

The experiment was initiated. It is to be repeated during next season.

20 **Varietal trial in watermelon**
(VEG ... VKA(14) ICAR)

Among the varieties evaluated, Sugar Baby (21 8 t ha) and RW 187 2 (21 7 t ha) recorded the highest yield with high TSS value (10 ... & 10 respectively).

21 **F_1 hybrid trial in watermelon**
(VEG/02 02 04 85/VKA(14)ICAR)

Five F_1 hybrids were compared with Sugar Baby and a local check. Results showed that the local variety out yielded (19 7 t/ha) all other hybrids in all characters ... its TSS was poor (9 5 per cent). Considering TSS and yield, MHW 6 was promising (yield 19 t/ha & TSS 12 per cent).

22 ... content of hybrid melon (Cucum...)
(VEG ... 94 ...)

... is in progress.

23 Variet[illegible] trial on water melon
(VEG 02 02 [illegible] 14 ACV[illegible] KAU PC)

Collection of germplasm and multiplication of seeds are in progress

Sub project 03 Cucumber

24 Varietal trial on cucumber
(VEG 02 03 [illegible] KAU [illegible])

A variety EC 173934 recorded the highest yield (22 4 t ha) followed by Cheethal (20 t/ha)

25 Selection of suitable cucurbit varieties cucumber / melon
(VEG/02 03 02 80/VKA(14 KAU)

The oriental preserving melon genotypes CS 26 (Mudikode Local) (8 78 kg/plant) and CS 13 (8 03 kg/plant) were found superior in yield [illegible] other tested lines Farm trials are in progress in the districts of Thrissur Palakkad and Ernakulam

26 Survey collection and maintenance of cucurbits and their wild relatives
(VEG 02 03 0[illegible] 86/VKA(14)KAU

Collection of seeds of 30 lines of bittergourd and 15 lines of snakegourd and their field evaluation are in progress

27 Selection of suitable cucurbit varieties pumpkin
(VEG/02 04 [illegible] 9/VKA/14 KA[illegible]

Among the 33 genotypes evaluated the genotypes CM 349 CM 350 and CM 346 emerged as high yielders 11 7 t ha 10 12 t/ha and 13 2 t/ha respectively with the desirable quality of orange flesh followed by CM 344 and CM 210 The culture CM 349 was accepted for conducting adaptive trials in Kerala and CM 347 and CM 350 were recommended for national testing under AICVIP

28 Varietal trial in pumpkin
(VEG 02 04 02 89 VKA 14)ICAR)

Among the varieties evaluated Ambili out yielded [illegible] t ha [illegible] other varieties

29 Breeding for resistance to mosaic virus in pumpkin
VEG 02 04 04 93 VKA 14)KAU FG)

Sixty five accessions of pumpkin and related species were collected from different parts of Kerala NBPGR and abroad and multiplied for the seed purpose Artificial screening under controlled conditions against PMV and CVMV was carried out for 15 accessions collected

30 Development of hybrid varieties of pumpkin
(VEG/02 04 05 93 VKA/14 KAU)

Collection of seeds is in progress

Sub project (05) Bittergourd

31 Varietal trial on bittergourd
(VEG 02 05 01 88/VKA(14)ICAR

New culture MC 84 recorded consistently high yields (16 6 t ha) and was recommended in the Package of Practices Recommendations 1993

32 Evaluation of bittergourd and snakegourd for the acidic alluvial soils of Kerala
(VEG 02 05 03 88 TLA 14 KAU

In snakegourd selection No 2009 Kaumudi) was recommended for cultivation in the acidic alluvial soils of Kerala by the University Variety Release Committee The bittergourd selection No 1010 was proposed for recommendation for release for the acidic alluvial soils of south Kerala

33 Development of hybrid varieties of bittergourd
(VEG 02 05 04 93 ACV/9)KAU)

Fifty three genotypes of bittergourd collected from different regions of the state were selfed and they were evaluated for their genetic divergence Based on D^2 analysis they were grouped into six clusters One type from each cluster was selected thereby selecting six parents for the estimation of combining ability by diallel analysis which is in progress

34 Evaluation of varieties of bittergourd (*Momordica charantia*) for summer rice fallows
(VEG/02 05 05 94/MNY 9)KAU)

Collection of seeds is in progress

Sub project (06) Ashgourd

35 Selection of suitable cucurbits - ashgourd
(VEG/02 06 01 86/VKA(14)KAU)

Experimental results confirmed the overall superiority of BH 21 (KAU Local) (19 35 kg/plant) with an average of 5 fruits / plant followed by BM 118 (18 98 kg/plant) having maximum number of fruits / plant (8) Farm trials of accession BH 21 is in progress in districts of Palghat Thrissur and Ernakulam

36 Breeding for mosaic resistant cultivar of ashgourd for riverbed cultivation
(VEG/02 06 02 90/PTB(14)KAU)

Among different accessions evaluated AG 53 was found comparatively free from mosaic

Sub project (07) - Others

37 Screening varieties of cucurbitaceous summer vegetables suitable for northern region of Kerala
(VEG/02 07 01 82/PIL(14)KAU)

The accession CS 1 of oriental pickling melon was found superior with regard to yield and related attributes Farm trial data from three districts showed the superiority of this line over the local check

The work will be continued with regard to other cucurbits

Sub project (08) Snakegourd

38 Evaluation of [illegible] snakegourd (*[illegible]santhes anguina*)
VEG 02 08 01 92/VKA [illegible] P[illegible]

The [illegible] hybrids were [illegible] for two seasons

39 Evaluation of varieties of snakegourd (*Trichosanthes anguina*) for summer rice fallows
VEG/02 08 02 94/MNY(9)KAU/FG)

Collection of seeds is in progress

Project (03) Breeding for yield, quality, pests and disease resistance in leafy vegetables

40 Screening for non-bolting type(s) of amaranthus
(VEG 03 00 01 81/VKA(14)KAU)

Among the twenty three lines maintained A 6 (105 days) and A 152 (109 days) were found to be late for flowering when planted in August

Project (04) Breeding for yield, quality, pest and disease resistance of legume vegetables and bhindi

Sub Project (01) - Bhindi

41 Evaluation of vegetable varieties resistant to pest and disease Evolution of bhindi varieties resistant to yellow vein mosaic
(VEG 04 01 01 90/ACV(18)KAU)

Most of the wild species of *Abelmoschus* and cultivation Accessions *viz* 94 148 and 94 271 were found as resistant/tolerant under field conditions

42 Screening bhindi varieties resistant to yellow vein mosaic virus
(VEG/04 01 03 85/VKA(14)ICAR)

No disease incidence was noticed when the crop was raised during May 93 to September 93 Highest yield was recorded in XHE 002 followed by GOH 6 and HOE 101

43 Varietal trial in bhindi
VEG 04 [illegible] 4 84/VKA 14)KAU)

The [illegible] AE 202 (14 5 t/ha) and AE [illegible] (12 [illegible]) [illegible] trial [illegible]

44 Induction of genetic recombinations in interspecific crosses of Abelmoschus
(VEG/04 01 05 90/ACV(9)KAU)

Varietal difference in compatibility of *Abelmoschus esculentus* with wild parents *Abelmoschus caillei* and *Abelmoschus tetraphyllus* was noticed Reciprocal crosses registered higher compatibility than the direct crosses *A caillei* was identified as the better donor parent for transferring yellow vein mosaic disease resistance In the irradiated crosses *A caillei* x *Anakkompan* and *A caillei* x Eani venda were identified as the better crosses for isolating recombinants

45 Evaluation of F_1 hybrids in bhindi
(VEG/04 01 06 82/VKA(14)KAU)

The F_1 hybrid (F_1 1 A) recorded highest yield (573 9 g/plant) with highest number of fruits per plant (21 3)

46 Genetic divergence in bhindi (*Abelmoschus esculentus*)
(VEG/04 01 08 92 ACV(9)KA °G)

Seventy genotypes of bh ndi were eva iated and based on D analysis the, were grouped into clusters Maximum divergence was obtained between cluster II and VI and the minimum between clusters I and IV Experiment is concluded

47 Development of hybrid varieties of bhindi
(VEG/04 01 09 93/ACV(9)KAU)

Work will be commenced on completion of another project *viz* "Combining ability studies in bhindi"

48 Induced mutations in interspecific hybrids of *Abelmoschus* spp
(VEG/04 01 10 94/ACV(9)KAU/PG)

Thirty plants each under *Abelmoschus manihot* and *A esculentus* (Kiran) were raised in field and F_1 seed production is in progress

49 Genetic improvement and cytogenetical studies in Tamara Venda (*Abelmoschus manihot*)
(VEG/04 01 11 94/VKA(14)KAU/PG)

Twenty two genotypes of Thamara Venda were collected and raised in field for evaluation

50 Combining ability in bhindi (*Abelmoschus esculentus*)
(VEG/04 01 12 94/ACV(9)KAU/PG)

Six genetically divergent clusters were identified Elite varieties from these clusters were grown in pots for making crosses

Sub project (02) - cowpea

51 Varietal trial in cowpea
(VEG/04 02 02 88/VKA(14)ICAR)

Out of the se en cowpea va ieti s evaluated VS 389 outyielded (6 9 t/ha) all other varieties Pods of this new culture possess good quality Now this variety under farm trial

52 Varietal trial in vegetable cowpea
(VEG/04 02 3 87/VKA(14)KAU)

The variety A ka Garima was found high yielding in bush type The pole types are being evaluated

53 Variability and heterosis in bush type vegetable cowpea (*Vigna ungulculata*)
(VEG/04 02 06 93/VKA(14)KAU/PG)

Ten parents selected based on the variability studies were crossed in a 10 x 10 diallel and F_1 seeds were collected Data generated are being analysed statistically

Sub project (03) - Dolichos bean

54 Survey, collection, maintenance and evaluation of germplasm of dolichos bean
(VEG/04 03 02 88/VKA(14)KAU)

Among the 30 collections evaluated the

accession DL 13 was found high yielding (15 9 kg/pit) which was followed by DL 26

Sub project (04) - Winged bean

55 Survey, collection and maintenance of germplasm in winged bean
(VEG/04 04 01 94/VKA(14)KAU)

Among different accessions tested PT 35 1 recorded the maximum yield of 5 6 t/ha followed by PT 34 and PT 62 On the basis of previous year s results one promising type PT 52 having an yield of 3 6 t/ha is being tested under farm trials

56 Morphological effect of gamma rays and EMS on winged bean
(VEG/04 04 02 92/ACV(9)KAU/PG)

The germination percentage was observed to be decreased by both the mutagens Survival percentage was reduced by both mutagens Gamma ray treated population was n reproductive phase for longer periods than EMS treated population Greater p en sterility was nduced by gamma rays t the effect of MS on pollen sterility was not much pronounced

57 Mutagenicity of gamma rays and EMS on winged bean
(VEG/04 04 03 93/ACV(2)KAU PG)

Single plant progeny rows from the surviving M_1 plants from different treatments *viz* Gamma rays at 100 200 300 and 400 Gy units and EMS at 40 60 120 160 and 200 millimoles were raised in field

Project (05) Improvement of under exploited vegetables

58 Improvement of underexploited vegetables - drumstick
(VEG/05 00 01 85/VKA(14)KAU)

MO 20 MO 85 MO 118 and MO 19 recorded higher yields On the basis of previous year's data MO 19 (5 04 kg/tree) and MO 85 (6 35 kg/tree) were found stable

59 Survey, collection, evaluation, conservation and cataloguing of germplasm of certain underexploited perennial vegetables *viz* drumstick, curry leaf, gamboge, ivygourd and star-gooseberry
(VEG/05 00 03 93/VKA(14)ICAR)

Germplasm collection of perennial vegetables include 200 accessions of drumstick 65 accessions of ivygourd 62 accessions of curry leaf 105 accessions of gamboge, and 23 accessions of stargooseberry Evaluation of these lines are in progress

Project (06) Standardisation of agrotechniques for vegetables

Sub project (01) - Solanaceous crops

60 Foliar fertilization in tomato
(VEG/06 01 02 88/VKA(14)ICAR)

The highest yield of 206 36 q ha^{-1} was obtained in the treatment where 40 kg N ha^{-1} was given as basal dose along with 40 kg N ha^{-1} as top dressing in soil This was followed by yield of 172 14 q ha^{-1} where 40 kg N ha^{-1} applied as basal dose and 20 kg N ha^{-1} each as foliar top dressing and as soil top dressing So the present year s data show that foliar fertilization is not as effective as soil fertilization

61 Economising nitrogen in brinjal using nitrification inhibitors
(VEG/06 01 03 93/ACV(1)KAU/PG)

The experiment is initiated

62 Impact of organic sources of plant nutrients on yield and quality of brinjal
(VEG/06 01 04 93/VKA(14)KAU/PG)

One season crop has been raised and observations were taken

Sub project (02) cucurbits

63 Efficacy of plant growth substances for the improvement in productivity of certain important vegetable crops of Kerala

(VEG/06 02 02 89/VKA(14)KAU)

In bittergourd CCC 100 and 300 ppm were found effective in increasing the yield per plant

64 Manipulation of frequency and quantity of irrigation using triazoles in cucumber (*Cucumis melo*)
(VEG/06 02 04 92/KYM(1)KAU)

The triazole compound triadimeron can be effectivey used for rescheduling irrigation to condition the plants to grow under drought condition

65 Effect of time of planting on mosaic incidence in pumpkin (*Cucurbitus moschatus*)
(VEG/06 02 05 92/PTB(1)KAU)

The crops raised in September October months were comparatively free from mosaic and produced better yields whereas, severe infestation of the disease occured in crops raise I in January

66 Response of cucumber (*Cucumis melo* L.) to drip irrigation under varying levels of nitrogen and potash
(VEG/06 02 06 92/ACV(1)KAU PG)

Work initiated

67 Nutritional management of bittergourd under drip irrigation
(VEG/06 02 07 93/ACV(1)KAU/PG)

Work initiated

68 Effect of fruit maturity, seed processing and storage methods on seed quality of ashgourd
(VEG/06 02 10/94/VKA(14)KAU/PG)

Fruits at five days interval were harvested from the ashgourd crop raised in field (BH 21) for examining physiological maturity of seeds Germination of seeds stored in different packing materials were recorded at monthly intervals

Sub project (03) - Bhindi

69 Enhancing nitrogen use efficiency in bhindi with nitrification inhibitors
(VEG/06 03 02 93/ACV(1)KAU/PG)

Final report due

70 Embryo rescue in the interspecific cross of *Abelmoschus*
(VEG/06 03 03 94/ACV(10)KAU/PG)

Interspecific crossing revealed that Kilichundan x *Abelmoschus manihot* was more compatible followed by Kilichundan x *A tetraphyllus*

Sub project (04) - Legumes

71 The effect of phenophased irrigation on vegetable cowpea (*Vigna sesquipedalis*) under graded doses of N and P
(VEG/06 04 01 93/ACV(1)KAU/PG)

Field experiment was completed and chemical analysis is in progress

Sub project (05) - Intercropping

72 Resource use and plant interaction in chilli intercropping system in summer rice fallows
(VEG/06 05 01 93/ACV(1)KAU/PG)

Field experiment is in completion stage Chemical analysis is in progress

73 Competitive and complementary effect of bhindi-cowpea intercropping system in summer rice fallows
(VEG/06 05 02 93/ACV(1)KAU/PG)

Field experiment was completed and chemical analysis is in progress

Project (07) Management of biotic stress in vegetables

74 Screening for resistance to root knot nematodes in vegetables
(VEG/07 00 01 89/ACV(9)ICAR)

Among 56 accessions of okra screened NBPGR lines 19 54, 64, 65, 67, 944 and

809 were found highly resistant to root knot nematode

75 Assessment of yield losses due to root knot nematode in okra / brinjal
(VEG/07 00 02 89/ACV(4)KAU)

Results showed that application of Carbofuran @ 3 kg ai/ha increased the yield by 6 7 per cent in okra

In brinjal the work is initiated

76 Evaluation of bare root dip for the control of root knot nematode in brinjal
(VEG/07 00 03 91/ACV(1)ICAR)

Nematicides at two different doses of 500 ppm and 1000 ppm were found equally effective in checking the root knot nematode infestation Experiment is in the completion stage

77 Host resistance in vegetables to their major pests - Bittergourd
(VEG/07 00 04 88/AC 4)KAU)

The experiment is vitiated d will be repeated in 1994 95

78 Control of fruit flies (*Dacus cucurbitae*) in snakegourd
(VEG/07 00 05 87/ACV(4)KAU)

The bait trap using ripe plantain fruit applied with Carbofuran granules at cut ends was effective in trapping fruit flies Two foliar sprays of Malathion and Carbaryl with soil application of BHC was found equally effective

79 Standardisation of spray schedule for control of die-back and fruit rot of chilli
(VEG/07 00 85 97/VKA(14)ICAR)

Seed treatment with 0 05 per cent Bavistin followed by four sprays of Fytolan (0 35 per cent) and Bavistin (0 05 per cent) at an interval of three weeks commencing from 15 days after transplanting were most effective in reducing the intensity of disease

80 Seasonal occurrence of chilli diseases
(VEG/07 00 09 89/VKA(14)ICAR)

Phytophthora leaf blight and alterneria leaf blight were severe during monsoon periods in July August months Fruit rot and dieback diseases were maximum in October

81 Epidemiological studies of tomato diseases
(VEG/07 00 10 87/VKA(14)ICAR)

Early blight and cercospora leaf spot were severe in July August months whereas virus diseases like mosaic and leaf curl were severe in February March

82 Investigations on mosaic disease of bittergourd
(VEC 07 00 12 92/ACV(5)KAU/PG)

Pr a quisition fasting of the vector dec ased the percentage of infection Ma imum infection of 60 per cent was obtained wh n the aphids were immediately transferred t test plants after acquisition feeding per od and no infection was obtained when the aphids were given a post acqu sition f sting beyond two hours

Project (08) Vegetable management

83 Maintenance of nutrition garden demonstration plot and specimen plot
(VEG/08 00 01 77/VKA(14)KAU)

Productivity / unit area have been recorded A new crop Giant Granedilla (*Passiflora quadrangularis*) was introduced and maintained in the specimen plot Phenological observations in this crop is being taken

84 Maintenance of vegetable arboratum
(VEG/08 00 04 79/VKA(14)KAU)

Minor vegetables *viz Spondias apinnata Pisonia alba* and Agathi (*Sesbania grandiflora*) were collected and maintained

TUBER CROPS

Project (01) . Crop Improvement for special situations

Sub project (01) - Tapioca

85 Identification of medium duration tapioca varieties suitable for wetlands
(TUB/01 01 03 84/ACV(9)KAU)

Farm trials have to be laid out at FSRC Kottarakkara as decided in the NARP (SR) Zonal workshop

86 Evaluation of cassava varieties / lines / types resistant to cassava mosaic virus
(TUB/01 01 05 93/VKA(5)KAU)

Out of 108 cassava lines scored against cassava mosaic virus disease 11 were found immune to the disease Out of 9 lines tested for artificial inoculation 2 lines Malanthari and Kuruthakattan were completely immune to the disease by grafting method and 7 lines by bombardment method Experiment is in progress

Sub project (02) - Minor tubers

87 Studies on the performance of tuber crops as intercrops in coconut gardens
(TUB/01 02 01 85/KUM(1)KAU)

Farm trials with promising types of greater yam were conducted in both Alleppey and Kottayam districts and the results showed the superiority of Dak 10/86

Farm trials with promising lesser yam entries were conducted in Mavelikkara sub division of Alleppey district Five trials were laid out during last season It was decided in the XVII ZREAC to repeat the farm trial with lesser yam including the local variety of lesser yam instead of "Sreelatha"

88 Identification of suitable types of coleus (*Coleus parviflorus*) for summer rice fallows for central zone
(TUB/01 02 01 92/PTB(1)KAU)

The experiment is not laid out

89 Biometric analysis of yield and other attributes in coleus (*Coleus parviflorus* Benth)
(TUB/01 02 02 93/VKA(2)KAU/PG)

Work initiated

Project (02) Standardisation of agrotechniques for major tuber crops

90 Nutrient-moisture interaction under phasic stress irrigation of sweet potato in summer rice fallows
(TUB/02 00 02 89/ACV(1)KAU/PG)

Thesis preparation of the student is in progress

91 Nutrient requirement of Kannikappa in southern Kerala (October-November planting)
(TUB/02 00 04 91/ACV(1)KAU)

Nitrogen and potash failed to give any significant increase in tuber yield while phosphorus increased the yield of tuber significantly in Kannikappa Application of 50 and 75 kg P_2O_5/ha significantly increased tuber yield compared to 25 kg/ha but the higher two levels were on par with each other

Project (03) Standardisation of agrotechniques for minor tubers

92 Standardisation of agrotechniques for tannia (*Xanthosoma sagittifolium*) grown as intercrop in coconut gardens
(TUB/03 00 04 91/ACV(1)KAU)

Nitrogen and potash levels or their combinations did not exert any significant effect on the tuber yield of tannia

Spacing had profound influence in modifying the tuber yield recording the maximum value for 60 x 60cm spacing

93 Effect of daughter corm size and plant density on growth and yield of elephant foot yam (*Amorphophallus companulatus* Blume) intercropped with coconut in the reclaimed alluvial soils of Kuttanad

(TUB/03 00 05 92/KUM(1)KAU)

The results of the study revealed that the daughter corms of 60g can be most economically used as planting material in the cultivation of the crop Among the daughter corm sizes of 20 g 40 g and 60 g the daughter corm of 60 g gave maximum yield of corm Planting of the corm at a wider spacing of 90 cm x 90 cm gave maximum yield of corm per plant whereas planting at a closer spacing of 45 cm x 45 cm gave maximum yield of corm per hectare The experiment for the third cropping season is in progress

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4. Fruits and floriculture

HIGHLIGHTS

- Application of 200 g nitrogen 150 g in equal splits at 30 75 120 and 165 days after planting and 50 g in equal splits at 210, 225 and 240 days after planting in banana variety Nendran gave an increased yield of 28 per cent over the recommended practice

- Application of 300 g K_2O 200 g in equal splits at 75 and 165 days after planting and 100 g in equal splits at 210 and 240 days after planting, in banana variety Nendran resulted in an increase in yield of 26 per cent over the recommended practice

- The best organic source of nitrogen for banana variety Nendran was found to be neem cake followed by FYM

- The highest yield per hectare in banana variety Nendran was realised from a planting density of 4762 plants/ha with a spacing of 1 2 m x 1 5 m x 2 0 m

- Among the various pests acking banana banana pseudostem weevil (*Odo por i longicollis*) has been identi ed as a potential pest

- Planting of gerbera in June was found to be better than in October with respect to vegetative as well as flora characters

- A combination of 15 to 20 per cent sucrose and 200 ppm 8 HQS improved the vase life of gladiolus

EXPERIMENTS CONCLUDED

1 **Leaf blight of banana and its control**
(FF/03 00 12 91/ACV(5)KAU/PG)

Colletotrichum musae, Guignardia musae Khuskia oryzae, Nodulisporium gregarium and *Phaeoseptoria* sp were found to be causing severe leaf blight in banana The field application of Dithane M 45 could control the disease satisfactorily Among the four banana varieties screened for disease resistance / tolerance, Rasakadali was found to have more resistance / tolerance compared to other varieties

2 **Effect of time of planting and growth regulators on flowering and vase life of *Gerbera jamesonii***
(FF/06 00 12 92/VKA(15)KAU/PG)

Planting of gerbera in June was found to be better than in October with respect to vegetative as well as floral characters especially for the number of flowers and flower diameter Varieties differed significantly with respect to the time taken for flowering, Presly being the earliest while Eoliet showed the longest duration from planting to flowering

Application of GA three times at monthly interval starting from one month after planting, at concentrations of 50 and 100 ppm, hastened flowering Holding solution containing 5 per cent sucrose + 20 ppm $AgNO_3$ significantly increased the vase life of cut flowers

EXPERIMENTS IN PROGRESS

Banana

1 Collection, conservation and evaluation of banana germplasm
(FF/01 00 01 73/KNR(9)ICAR)

One hundred and ninety six accessions have been maintained and evaluated During the period under report 21 accessions were added to the germplasm including three obtained from NBPGR New Delhi

Project (2) Standardisation of agrotechniques for banana and pineapple under different cropping systems

2 Standardisation of organic and inorganic fertilizer management in banana variety Nendran
(FF/02 00 06 89 KNR(1) ICAR

When different organic sources of nitrogen viz farm yard manure neem cake and FYM + neem cake were tried in banana variety Nendran, the best organic source was found to be neem cake followed by FYM The optimum ratio of organic to inorganic nitrogen was found to be 1 3 The nematode population in soil and root was minimum in neem cake treatment and maximum in the treatment with nitrogen alone

3 Effect of number of suckers retained on the performance of ratoon crop of banana grown in coconut garden under partial shade (var Palayankodan)
(FF/02 00 07 88/KNR(1)KAU)

Under partially shaded conditions only one flower per mat could be harvested within a year due to highly staggered flowering nature in the mat, which varied from 280 to 410 days The intra mat control exerted by vigorously growing follower on the other followers was established

4 Standardisation of optimum dose and time of nitrogen application in banana variety Nendran
(FF/02 00 10 89/KNR(1)ICAR)

In the banana variety Nendran four levels of nitrogen *viz* 200 g 250 g 300 g and 350 g per plant were applied in different proportions during vegetative and reproductive periods It was found that application of a total quantity of 200 g nitrogen 150 g in equal splits at 30 75 120 and 165 days after planting and 50 g at 210 225 and 240 days after planting was optimum with respect to bunch weight and economic parameters, which gave a bunch weight of 13 49 kg an increase of 28 per cent over local practice

5 Standardisation of optimum dose and time of potassium application in banana var Nendran
(FF/02 00 15 81/KNR(1)ICAR)

Application of a total quantity of 300 g K_2O as 200 g at 75 and 165 days after planting and 100 g at 210 and 240 days after planting was optimum with respect to bunch weight and economic parameters An yield increase of 26 per cent over the local practice was obtained in this treatment The application of potassium at vegetative and reproductive periods effected a marginal benefit of Rs 3 45 over the application at vegetative phase alone

6 **Studies on weed control in banana var Nendran Chemical control of weeds**
(FF/02 00 12 89/KNR(1)ICAR)

One spray with Glyphosate 2 0 kg ai/ha followed by two sprays with Grammaxone 1 81 kg ai/ha was found to be the most effective and economical weed control method in banana Sowing cowpea after planting of banana and incorporation in the soil 45 days after planting and raising a second crop thereafter was effective in controlling weeds as well as improving N content of soil

7 **Effect of nitrogen and potassium on growth yield and quality of irrigated banana var Nendran**
(FF/02 00 16 89/AMB 1)KAU)

The results obtained from the third season crop indicated that most of the vegetative characters and yield were not influenced significantly by various levels of N and K Maximum yield of 11 67 kg per plant was recorded in the treatment receiving 120 g of N and 200 g of K_2O per plant

8 **Effect of different sources and levels of P on growth and yield of irrigated Nendran**
(FF/02 00 17 89/AMB(1)KAU)

During the third season the highest bunch weight of 12 41 kg was registered by the plants receiving 115 g Mussourie phos The shortest duration (271 days) was recorded by plants receiving 195 g bone meal per plant

9 **Effect of time of planting on growth and yield of irrigated Nendran**
(FF/02 00 18 89/AMB(1)NARP)

During the previous two seasons September planting was superior with respect to yield The third crop is being evaluated

10 **Nutrient management of ratoon banana var Palayankodan Intercropped with coconut in the reclaimed alluvial soils of Kuttanad**
(FF/02 00 19 90/KUM(1)KAU)

Application of N @ 100 g and K @ 200 g along with 200 g of P_2O_5 per plant was found to be the economic optimum dose for the plant crop of Palayankodan grown in the reclaimed alluvial soil of Kuttanad For the first and second ratoon crops retaining two suckers per clump the application of N @ 150 g and K @ 800 g along with P_2O_5 @ 200 g per clump was found to be the economic optimum dose The studies on the third ratoon crop is in progress

11 **Spacing trial in banana var Nendran**
(FF/02 00 23 91/KNR(1)ICAR)

The effect of various spacing treatments accommodating plant population ranging from 2500/ha to 5555/ha on the variety Nendran was studied for three seasons Plants in the widely spaced treatements flowered earlier than under closer spacing The highest yield/ha and the highest income was realised from the treatment with 4762 plants/ha with a spacing of 1 2 m x 1 5 m x 2m

12 **Standardisation of spacing for prolonged ratooning of pineapple**
(FF/02 00 25 89/KNR(1)KAU)

The data of first ratoon crop indicated that fruit weight was maximum in the treatment of spacing 45cm x 60cm x 180cm in the variety Kew

13 **Staggering fruit production in pineapple by adjusting planting time and growth regulator application**
(FF/02 00 26 89/KNR(10)KAU)

Planting in May June is ideal for fruit yield in pineapple variety Kew

14 **Growth pattern flowering and yield potential of tissue cultured plants of banana *Musa* (AAB group) Nendran and standardisation of fertiliser schedule**
(FF/02 00 27 90/ACV(10)KAU/PG)

There was a general increase in yield in tissue culture plants over sucker derived plants

15 **Water requirement of banana var Nendran**
(FF/02 00 29 92/KNR(1)ICAR)

Among the five irrigation levels ranging from 20 to 100 CPE irrigation at 20 CPE was found to be the optimum for growth and yield of the banana variety Nendran

Project (03) Pest and disease management in banana

16 **Control of sigatoka leaf spot disease**
(FF/03 00 01 75/KNR/ICAR)

Spraying Calixin 0 06 per cent + Bavistin 0 1 per cent from May to July significantly reduced leaf spot infection in banana variety Nendran

17 **Biology and population dynamics of banana aphids**
(FF/03 00 03 86/KNR(4)ICAR)

It was found that *Pentalonia nigronervosa* completed the life cycle within a period of 8 9 days with four instars The maximum aphid population was observed during December followed by November and the minimum in April May

18 **Screening of banana germplasm against nematode pests**
(FF 03 00 04 81/KNR(4)ICAR)

Thirty four banana varieties which were inoculated with cyst nematode were found susceptible to the nematode in varying degrees

19 **Control of banana nematode using intercrops**
(FF/03 00 05 89/KNR(4)ICAR)

Among the different treatments parring + dip in 0 5 per cent Monocrotophos + raising sunnhemp in the interspace was the best in controlling nematode population and improving growth and yield of banana

20 **Survey identification and [illegible] of [illegible] and [illegible] of banana nematode**
([illegible] 83 [illegible] CAR)

Radopholus similis was [illegible] main nematode pest in Thrissur Palakkad and Malappuram districts

21 **Survey of fungal and viral diseases of banana**
(FF 03 00 07 83/KNR(5)ICAR)

Fixed plot survey conducted in Thrissur district revealed 25 to 40 per cent incidence of leaf spot 4 to 5 per cent Kokkan and less than 4 per cent incidence of bunchy top disease

22 **Survey of insect pests of banana**
(FF 03 00 09 88/KNR(4)ICAR)

Among the various pests attacking banana banana pseudostem weevil (*Odoiporus longicollis*) has been identified as a potential pest during the year under report

23 **Screening of nematode complex in banana**
(FF/03 00 12 83/ACV(4)ICAR)

In early stages minimum population was observed in treatment in which suckers were treated with hot water at 55°C for 20 minutes + parring + application of neem cake @ 1 kg/plant and Carbofuran @ 0 5 g/plant at the time of planting

24 **Virus diseases of banana**
(FF/03 00 13 89/KNR(5)ICAR)

The experiment for the detection of bunchy top infection using Benedict solution was continued during the period under report

25 **Screening of germplasm against leaf spot diseases Fusarium wilt and bunchy top of banana**
(FF 03 00 15 90/KNR(5)ICAR)

Banana varieties Pisang Lilin H_1 H_2 Chinali Kanchikela Manoranjitham Virupaksh and Krishna vazhai recorded less than 10 per cent incidence of leaf spot disease

26 **Germplasm collection assessment and maintenance of indigenous and exotic species/cultivars of orchids**
([illegible] 5 00 [illegible] 81 VKA 15 CAR)

Hybrids of Dendrobium were added to the existing germplasm collection of orchids

Project (05) Germplasm collection of orchids and anthurium

27 Testing of new cultivars of gladiolus
(FF/05 00 02 82/VKA(15)ICAR)

Two hybrid varieties of gladiolus from IIHR *viz* IIHR 82 18 16 and IIHR 82 11 90 are being evaluated during the period under report

Project (06) Standardisation of agro techniques for orchids and anthurium

28 Standardisation of nutritional requirement to promote optimum growth and flowering of orchids
(FF/06 00 04 89/VKA(15)ICAR)

Spraying one per cent solution of 17 17 17 complex fertilizer was found to increase the number of leaves and clumps number of florets/inflorescence size of florets and length of inflorescence in *Cymbidium traceanum*

29 Survey and identification of pests and diseases of ornamental plants of Kerala (orchids, anthurium and gladiolus)
(FF 06 00 07 91 ACV 4)KAU)

The survey revealed that all the plants are maintained with much care and supervision and are rarely damaged by insect pests The main pests recorded were mites slugs and mealy bugs

30 Management practices of gladiolus for the southern zone of Kerala
(FF/06 00 08 91 ACV(10)KAU)

Suitability of different varieties of gladiolus is being studied in the southern zone of Kerala

31 Evaluation of seedling variability in selected varieties of *Anthurium andreanum*
FF/06 00 10 92 ACV(15)KAU)

Morphological and floral characters of eight varieties of *Anthurium andreanum* were recorded Hybridisation was tried in 39 combinations out of which seed set was obtained in 35 combinations

32 Breeding of orchid varieties and testing for export and internal markets
(FF/06 00 11 92/VKA(5)KAU ICAR)

Pods obtained by natural set in *Spathoglottis plicata* and selfed pods of *Epidendrum radicans* and *Cymbidium traceanum* were cultured under aseptic conditions

33 Cross compatibility in *Anthurium andreanum* Linden
(FF/06 00 13 93/ACV(9)KAU/PG)

Hybridisation was attempted in 29 combinations using six different varieties Successful seed setting was recorded in 27 combinations Germination studies have been initiated

34 Variability studies in unutilised and underutilised fruit trees of Kerala
(FF 07 00 01 89/VKA(15)KAU,

Survey was conducted in selected localities of Kottayam and Alleppey districts and the variations were recorded in the minor fruits included under the study viz Kodampuli Karonda West Indian Cherry Jamun Indian gooseberry and lovi lovi

35 Evaluation of unutilisd and underutilised fruit trees of Kerala based on biochemical analysis
(FF/07 00 02 89/VKA(15)KAU)

Fruit characters of the minor fruits like tamarind Karonda rose apple lovi lovi Kodampuli and Jamun which were collected from selected households of Kottayam and Alleppey districts were recorded Biochemicl characters like acidity total sugars etc were recorded All the fruits except lovi lovi and rose apple showed an increase in acidity with the increase in maturity of fruits

Project (07) Evaluation of minor fruits in house holds and standardising agro techniques for desired ones

36 Standardisation of propagation techniques in unutilised and under utilised fruit trees of Kerala
(FF/07 00 03 79/VKA(15)KAU)

Preliminary observations on grafting in tamarind showed moderate success with soft wood gafting done on 4 5 month old rootstocks

[illegible] [illegible] with flowering fruit set and fruit development in Kodampuli (*Garcinia cambogia*)

[illegible] 93 [illegible] A[illegible] [illegible] K4 [illegible]

[illegible] observations [illegible] shoot [illegible] or [illegible] gy [illegible] in flower and fruit development were recorded

38 **Growth [illegible] flowering [illegible] fruit development in selected varieties of sapota (*Achras sapota*) in humid tropical situations**

FF 07 [illegible] 2 93 VKA(15 [illegible])

Three characters pattern of flowering fruit set and fruit development were recorded. Biochemical analysis of fruits is in progress.

Project (09) Breeding mango for high yield and quality for humid tropical conditions

39 **Management of fruit flies in mango**

FF 09 00 0[illegible] 93 KYM 4(KA[illegible])

The project was started during the period under report. The minimum percentage of fruit damage was recorded by the [illegible] [illegible] [illegible] with Ocimum leaf extract and [illegible] [illegible] granules.

Project (10) Pineapple breeding for quality and canning

40 **Clonal variation studies in pineapple [illegible] Kew**

[illegible] [illegible] [illegible] [illegible] (3) CAR

Out of the 19 clones evaluated five were found superior during the previous years and the same trend was found to continue during the year under report also. The lines are being multiplied by stem splits and by *in vitro* techniques.

41 **Breeding of new varieties of pineapple**

(FF 10 00 03 84 KNR(9)(CAR)

A multiplication plot was laid out with suckers and slips of the eight hybrids.

●●●

5. Spices

HIGHLIGHTS

- In pepper Karimunda I Karimunda II and Sulliya were promising accessions at Pannivur

- Three pepper cultures 239 331 and 54 continued their better performance during the year also under arecanut garden conditions

- Among the intervarietal hybrids culture No 5834 yielded more than 2 kg dry pepper per vine

- Among the 9 cultures tested Kalluvally Kuthiravaly and Neelamundi were promising

- Pungalyan (*Alanthus malabaricum*) continued to be the best standard for pepper followed by coral tree (*Erythrina indica*) Glyricidia and azhanthal are also good standards

- The analytical requirement for one kg increment in yield is in the tune of 6 35g N 6 33 g K 1 11 g Ca 0 47 g Mg 0 44 g P 0 29 g S 42 82 mg Fe 34 45 mg Mn and 4 2 mg Zn There is also very high correlation between the yield and the nutrient removed from the system by harvest of spikes All these indicate the need for amending the present fertilizer recommendations of black pepper based on yield potential of the vine

- For foot rot and nematode management in black pepper addition of 1 kg neem cake + 3 g ai phorate / vine + 1% BM spray + two drenching with copper oxychloride along with recommended cultural operations is ideal

- For controlling nursery diseases in pepper spraying and drenching with Validin 0 2% / Difolatan 0 1% is effective

- The cinnamon accession numbers 10 38 39 101 111 & 130 were found to be promising at AMPRS Odakkali

- At RARS Ambalavayal ginger cultivars V2E5 2 recorded highest yield of green rhizomes followed by PGS 35 and PGS 10 whereas at College of Horticulture Vellanikkara Wynad variety "Mananthody was the best followed by PGS 35 In turmeric the cultivar Sugantham was the highest yielder followed by Mundakkayam and Wynad local" at RARS Ambalavayal whereas at Vellanikkara VK 5 recorded the highest yield followed by VK 144

- Combined application of Carbofuran (1 kg ai/ha) and neem cake (2 5 t/ha) at 45 DAP recorded minimum nematode population and maximum yield of rhizomes in ginger

- Fodder cowpea was found to be best for growing as green manure crop in the interspaces of beds in ginger

- Under low shaded conditions 25 per cent of the mulch requirement for ginger can be reduced without ... the rhizome yield

- ... the management of ... disease in ginger application of 1 per cent BM ... recommended ... which also prevents further ...

- ... budding ... Se ... budding ...

EXPERIMENTS ... GRF

Project (01) Exploration and conservation of genetic resources of pepper and its exploitation

1 **Germplasm collection and screening of pepper genotypes**
(SPC/01 00 0 74 PNR(... AR)

Out of sixty five accessions flowered during 1993 94 seven cultivars yielded more than 4 kg The promising accessions were Karimunda I (PRS 20), Karimunda III (PRS 22) and Suliy (PRS 49) The cultivar TMBVi (PRS 56) consistently recorded the heaviest and largest berries as in previous years

2 **Comparative yield trial of pepper genotypes**
(SPC/01 00 02 90 PNR(9)ICAR)

Trial started only in 1990 and the vines have just started bearing

3 **Multilocational trial of promising cultures of pepper**
(SPC/01 00 03 84 PNR 9)ICAR)

Yield trends were similar as in previous years Culture 239 331 and 54 ranked first second and third respectively in terms of yield of green berries Culture 331 was released as Panniyur 3 and Culture 239 is proposed to be released as Panniyur 5 The experiment is in progress

4 **Intervarietal hybridisation in Pepper**
SPC/01 00 04 72/PNR 9)ICAR)

The top yielders for the season were culture 5834 culture 6766 and culture 6988 Only culture 5834 yielded dry pepper ... compared ... season ... culture which performed better during the previous season either did not flower or the yield was low

5 **Multilocational trial of black pepper cultivars**
(SPC 01 00 05 84/PNR 9 ICAR)

Among the nine cultivars tested Kalluvally stood first (2 58 kg green berry / vine followed by Kuthiravaly (1 96 kg) and Neelamundi (1 78 kg) The yield variation could not be attributed reliably to varietal effects due to large variation within varieties

6 **Multilocational trial on black pepper**
(SPC/01 00 07 93/PMP(9)KAU)

At Pampadumpara Kottanadan recorded maximum length of vine whereas at Panniyur Karimunda stood first followed by Kottanadan and Subhakara At Panniyur Kottanadan and Karimunda recorded 100 per cent survival followed by Panniyur 4 (93 3 per cent) and Culture 1558 (87 8 per cent)

The trial was laid out on 02 09 1992 at Ambalavayal The stand of the crop was satisfactory

Project (02) Breeding / screening for shade tolerance

7 **Screening of germplasm collection of promising cultures under shade for yield disease and pest tolerance**
(SPC 02 00 ... PNR(9 NARP)

Out of the 43 cultures yield was obtained

from 37 cultures only Culture 468 recorded maximum yield of 1 03 kg/vine followed by Culture 434 Culture 1368 Culture 818 Culture 468 also recorded least insect pollu attack Screening for Phytophthora foot rot revealed least leaf infection in Kuthiravaly (1 per cent) followed by Culture 164 and 239 There was no branch infection in Culture 239 and in Arakkulam Munda Culture 33 showed maximum branch ... 20

8 **Evaluation of black pepper genotypes in arecanut garden for yield and tolerance to pests and diseases**
(SPC 02 00 02 85 PNR(16 NARP

This year also Culture 239 gave maximum green berry yield (5 38 kg) followed by Karimunda (3 98 kg) Panniyur 1 (3 47 kg) and Culture 406 (3 3 kg) There was no insect pollu attack in Culture 406 during the season But pollu attack was recorded in Culture 239 (1 99 per cent) followed by Panniyur 3 (3 17 per cent and Kuthiravally (3 33 per cent)

9 **Trial with different tree standards for pepper**
(SPC/02 00 03 92/PNR(16 NARP)

Pongalyam (*Ailanthus malabaricum*) continued to be the best standard for pepper (variety Karimunda) The next best standard was coral tree (*Erythrina indica*) Glyricidia and azhanthal were also found to be good standards for pepper

Project (03) Improving yield potential and disease resistance using wild species

10 **Species relationship in the genus *Piper* and scope of related taxa in the improvement of *Piper nigrum***
(SPC/03 00 01 90 VKA(16)KAU)

Collection and maintenance of species continued Standardisation of electrophoretic work is in progress

11 **Izozyme variation in *Piper* spp**
(SPC/03 00 02 92/VKA(16)KAU/PG

Standardisation work completed Analysis is in progress

Project (04) Screening breeding for drought resistance

Project completed

Project (05) Nutrition and irrigation management in pepper

12 **Irrigation cum fertilizer requirement in black pepper cultivars**
(SPC 05 00 01 88 PNR 16)ICAR

There was no significant influence of irrigation and fertilizer levels Cultivar Karimunda produced significantly higher number of spikes (765 2) than variety Panniyur 1 (342 9)

13 **Nutrient removal in relation to crop production in black pepper**
(SPC/05 00 02 92/VKA 16)/KAU/PG)

Project concluded Final report submitted

14 **Nutritional requirement of bush pepper in pots**
(SPC/05 00 03 92/KTR 1 KAU)

Planting of pepper rooted cuttings was done during 1993 But there was heavy mortality and replanting was done

15 **Effect of irrigation and fertiliser application on the growth and yield of pepper**
(SPC/05 00 04 92/KTR(1)KAU

Experiment was laid out in July 92 For two years till establishment of vines uniform cultural operations were followed for all the plants

16 **Standardisation of pots and potting mixtures for bush pepper**
(SPC/05 00 05 92 KTR(1 KAU)

Size of pots showed significant influence on the number of lateral branches 6 months after planting Largest pot size recorded the highest mean value Medium with soil sand FYM @ 1 2 2 recorded the highest mean number of branches The highest pot size also recorded the highest mean number of leaves per plant 6 months after planting

17 Development of Diagnosis and Recommendation Integrated System (DRIS) in black pepper (*Piper nigrum*) in relation to yield and quality characteristics
(SPC 05 00 0[illegible] [illegible]/AC/[illegible]

Vines were selected and tagged. Leaf, berry and soil samples were collected and analysis [illegible] [illegible] [illegible] yield data were also collected

Project (06) Management of foot rot and slow wilt in black pepper

18 Screening of pepper germplasm against root knot nematode (*M incognita*) and burrowing nematode (*Radopholus similis*)
(SPC 06 00 01 89/ACV(4) ICAR

Seedlings raised from open pollinated seeds of different varieties were used for screening work. Seedlings raised from open pollinated seeds of Chengalam was found to be tolerant to *R similis*. But all the varieties were susceptible to *M incognita*

19 Phytophthora foot rot and nematode disease management in black pepper (Field trial for the control of quick wilt (foot rot) disease of pepper)
(SPC/06 00 02 87/PNR(5)ICAR)

Minimum defoliation and foliar yellowing were observed in the treatment (T7) receiving all cultural operations + 1 kg neem cake / vine + 3 g ai phorate / vine + 1 per cent BM + two drenching with copper oxychloride

20 Trial for the control of quick wilt disease of pepper
(SPC/06 00 03 87 PNR(5)/ICAR)

In general combined application of fungicides with soil amendments were found to be effective in checking the infection and in increasing the yield of pepper

21 Field trial for the control of slow wilt disease of pepper
(SPC/06 00 04 87/PNR(5)ICAR)

Combined application of neem cake with nematicide and fungicide was found to be effective in managing the disease

Project (07) Management of nursery disease in pepper

22 Studies on the control of nursery diseases of pepper
[illegible] 18[illegible]/PN[illegible] [illegible]AF

Treatment effects were significant under high shade. Spraying and drenching with [illegible] 0 2 [illegible] was found to [illegible] [illegible] [illegible] [illegible] with spraying and drenching with Difolatan 0 1 per cent. In general infection was low under low shade

Project (08) Breeding for higher yield and resistance to kattae and azhukal diseases in cardamom

23 Multilocational trial in cardamom
(SPC 08 00 0[illegible] 88/ICAR)

Different clones collected were not sufficient to lay out a full fledged 3 replication trial and hence only one replication could be laid out

(SPC/08 00 02 87 PMP(9)ICAR)
(SPC 08 00 03 87 PMP(9) ICAR)
(SPC/08 00 04 87 PMP(9)ICAR)

Discontinued by ICAR

Project (09) Nutrient, irrigation and weed management in cardamom and clove

24 Germplasm collection and description of types and varieties
(SPC/09 00 05 86/PMP(9)ICAR)

The types PS 21 PS 22 and clone 57 are notable for their bold capsules. PS2 S1 MSP PS4 PS5 PS12 PS 16 Manjirabad PS 22 and Veeraputhran were found to be promising in terms of dry yield

25 Response of clove to different levels of nitrogen and potash
(SPC/09 00 01 89/AMB/NARP)

Same trend during this year also as that of last year. Per plant yield of the experimental plants showed a wide range of 140 g to

8180 g The non significance due to different levels of N & K was mainly due to heterogenity in the population resulting in high block variation and error variance

26. Manurial experiment in cardamom
(SPC/09 00 02 93/(1)ICAR)

Biometric observations were taken There was no significant difference between various treatments

Project (10) Pest and disease management in cardamom

27 Cultural and chemical control of thrips and shoot and capsule borer of cardamom
(SPC/10 00 06 93/PMP(4)KAU)

Treatment (T_1) selective thrashing during February March recorded highest percentage of infested tillers The treatments (T_2 T_6 and T_7) were found to be on par in controlling shoot borer infestation Capsule borer infestation was not severe in T_1 & T_{10} (selective thrashing during February March and control no spraying and thrashing) more than 60 per cent of the capsules were infested by thrips

Project (11) Collection and evaluation of germplasm in nutmeg, cinnamon and clove

28 Variability in nutmeg (*Myristica fragrans*)
(SPC/11 00 01 89/VKA(16)KAU/PG)

The student discontinued and hence the programme is kept in abeyance

29 Seasonal variation in the oil content and quality of cinnamon leaf oil
(SPC/11 00 02 89/VKA(16)KAU)

No work reported during the period

30 Screening clove cinnamon and nutmeg for aromatic oil
(SPC/12 00 03 90/04(16)KAU/NP)

All the 234 cinnamon accessions were evaluated for their characters and 50 accessions were selected based on cinnamon f eid index computed on the data generated on growth and yield characters during 1992 93 for the evaluation of oil yield and quality Leaves of the 50 selected plants were harvested and distilled for oil estimation and quality analysis Chromatograms were also prepared for the leaf oil samples Out of the 50 cinnamon plants screened for oil yield and quality accession numbers 10 38 39 101 111 and 130 were found to be promising

31 Collection, maintenance and evaluation of the germplasm of *Garcinia cambogia* Desr
(SPC/11 00 04 90/KUM(9)NARP)

Studies with plant hormones for increasing the rate of success in soft wood grafting have shown that application of Kinetin @ 100 ppm or Kinetin + IAA @ 100 ppm each can give 100 per cent success in soft and grafting of *Garcinia cambogia* Out of the 17 elite types of Garcinia grafts planted for comparative study three were harvested 26 months after planting All are actively growing

Project (12) Evolving varieties of ginger and turmeric for yield and resistance to bacterial wilt and soft rot disease

32 Blossom biological and hybridization studies in turmeric
(SPC/12 00 01 90/VKA(16)KAU)

The hybrid lines found to be promising in the previous season have been planted in the field for multiplication for taking up farm trials in 1995 96 season

33 Maintenance of germplasm in ginger
(SPC/12 00 02 85/AMB(9)NARP)

As in the previous years, the cultivar V2 E5 2 recorded the highest yield of green rhizomes (67550 kg/ha) This was followed by PGS 35 (63250 kg/ha) PGS 10 (57850 kg/ha) and Thingpuri (56650 kg/ha) The driage of the cultivars ranged from 17 0 30 5 per cent Rajgarh recorded the highest driage (30 5%) followed by SO 55 (29 0%) and SG 541 (26 5%) Though V2E5 2 recorded the highest yield of green ginger its driage was very low (18 0 per cent)

In turmeric the cultivar Sugandh recorded the highest yield of 44225 kg green rhizomes/ha followed by Mundakkayam [illegible]/ha Vaj[illegible]al (38688 kg/ha) [illegible] Chayap[illegible]

34 [illegible]
[illegible]
[illegible]

[illegible]

35 Germplasm collection and evaluation of turmeric
(SPC 12 00 04 82 VKA(1) KAU)

One hundred and six collections of turmeric were maintained. Three comparative yield trials started last year were continued. Among the local collections VK 5 has recorded consistently highest dry yield (1 61 kg/2 m^2) followed by VK 144 (1 40 kg/2 m^2). Comparing with NBPGR collections it was found that maximum dry yield was obtained for VK 88 (1 3? kg/2 m^2) followed by VK 96 (1 24 kg/2 m^2). In the case of Pottangi collection VK 172 recorded maximum dry yield (1 10 kg/2 m^2) followed by VK 159 (0 98 kg/2 m^2)

36 Isoenzyme variation in Zingiberaceous spice crops
(SPC/12 00 05 90 VKA(2 KAU)

Maintenance of species and varieties continued

Project (13) Pest and disease management in spices

37 Assessment of yield loss due to nematode complex in ginger and turmeric
(SPC/13 00 01 89 ACV(4)ICAR)

Ginger An initial population of *M incognita* (166/250 g soil) and *Rotylenchulus reniformis* (6?/250 g soil) reduced the yield by 43 per cent

Turmeric [illegible] in the two trials conducted while an initial population of *M incognita* alone (108/250 g soil) resulted in 43 2 per cent decrease in yield a concomitant population of *M incognita* (241/250 g soil) and *R reniformis* (150/250 g soil) resulted in 33 37 per cent decrease in yield

[illegible] control of root knot [illegible] in ginger
[illegible]

[illegible] significant [illegible] 45 DAP [illegible] significantly at [illegible] carbofuran application. Significant increase in yield was observed in plots treated with Carbofuran (1 kg a i/ha) and neemcake (2 5 t/ha). Combined application of Carbofuran (@ 1 kg a i/ha and neem cake [illegible] 5 t/ha 45 DAP) recorded the maximum yield

39 Symptomatology and etiology of [illegible] leaf disease of pepper (*Piper nigrum*)
(SPC/13 00 03 92/VKA(5)KAU PG)

No work reported during the period

40 Management of bacterial wilt of ginger (*Zingiber officinale* Rosc) incited by *Pseudomonas solanacearum* (Smith)
(SPC 13 00 04 92/VKA 5)KAU/PG)

Final report submitted. Results presented in concluded experiments

41 Investigation on the etiology and control of wilt of clove
(SPC/13 00 05 92/ACV(5 KAU NARP)

Isolation of organisms associated with the diseased plants was carried out. No other organism other than *Botrydiplodia* sp and *Phytophthora* sp could be isolated

Project (14) Evolving management strategies for ginger and turmeric

42 Field evaluation of ginger for intercropping in coconut gardens
(SPC 14 00 01 90/KJM(1)NARP

The collection from Kuravilangad recorded the highest yield of green ginger (3 ?? kg/plot). Nedumangad Kuruppampadv and Local collection 2 were on par with the collection from Kuravilangad. Regarding drainage, Maran was found to be significantly superior to others

43 Nutritional requirement of ginger under rainfed conditions
(SPC 14 00 03 89 AMB(1)NARP)

No result was reported during this period

44 Effect of shade and mulch on the yield of ginger
(SPC 14 ... 92/A...V(10 KAU/PG

Work completed. Final report submitted

45 Effect of green manure crops in the interspaces on growth and productivity of ginger
(SPC/14 ... 07 92 VKA(16) KAU

For biomass yield fodder cowpea was found to be the best and cowpea sown in beds recorded the highest green manure yield (9 48 kg/1 5 m^2) closely followed by cowpea sown in the inter channel (9 0 kg 1 5 m^2) and *Sesbania acculeata* (7 79 kg/1 5 m^2) The rhizome yield was found to be high in *Sesbania acculeata* (6 30 kg/3 m^2) followed by cowpea sown in the interchannel (5 19 kg/3 m^2)

46 Arecanut, cardamom pepper mixed cropping in the garden lands of high ranges
SPC/14 00 08 94 AMB 16) KAU

Pepper varieties were planted for trailing on arecanut palms

CONCLUDED EXPERIMENTS

1 Nutrient removal in relation to crop production in black pepper
(SPC/05 00 02 92 VKA(16 KAU PG

Aim of the experiment was to assess the extent of nutrient removal in relation to productivity in black pepper The experiment also enabled to assess the relationship between foliar nutrient level and yield and the relationship between available nutrient in the soil and yield

One hundred and fifteen pepper vines of variety Panniyur 1 of same age group with not less than 10 years of age and stabilised yield grown under identical conditions trailed on silver oak and at different productivity level from a compact block from Regional Agricultural Research Station Ambalavayal were selected Soil samples from the basin of all the selected vines were collected for nutrient analysis Leaf samples were collected from the fruit bearing laterals just prior to flushing Spikes samples were collected at maturity The data were subjected to statistical analysis

The study revealed that soil characteristics like pH organic carbon exchangeable Mg exerted direct influence in increasing the black pepper yield At increased level of pH and organic carbon the availability of S and Fe in the soil decreased Highest yields were obtained when the organic carbon content of the soil was more than 2 per cent and pH around 6 5

Significant positive correlations were obtained between green pepper yield and soil pH carbon exchangeable Ca and Mg However the correlations between green pepper yield and available S and Fe were negative (Table 1)

Significant correlations were obtained between leaf nutrient concentrations and yield of black pepper The foliar N concentration had significant positive correlation with soil pH and organic carbon

The very high correlation between the yield and the nutrients removed from the system by way of harvest of spikes indicated a linear relationship proportionately (Table 2) The results indicated that the quantities of nutrients removed from the system through the harvest of 1 kg spike were in the order of

6 35 g N 6 35 g K g Ca 0 47 g Mg 0 44 g P 0 29 g S 42 Cu mg Fe 34 45 mg Mn and 4 28 mg Zn These quantities may be considered as the actual requirement by the vine for one kg green yield It was observed that irrespective of the yield potential the quantity of each nutrient required for production of 1 kg of green pepper is fairly constant and vines with higher production potential require relatively and proportionately higher doses of nutrients This shows the need for amending the fertiliser recommendation of black pepper based on yield potential of the vine

Table 1 Correlations and regression equations for significant relationships between soil characteristics and green yield in black pepper

Soil characteristic	r	R^2	Regression equation
pH	0 430**	0 185	y = 49 634 + 12 663 x
Organic Carbon(%)	0 545**	0 297	y = 26 694 + 31 116 x
Exchangeable Ca (ppm)	0 596**	0 355	y = 4 559 + 0 0354 x
Exchangeable Mg (ppm)	0 584**	0 341	y = 5 877 + 0 2641 x
Available S (ppm)	0 391**	0 153	y = 23 434 0 1792 x
Available Fe (ppm)	−0 318**	0 101	y = 33 118 0 5304 x

** Significant at 1 per cent level
y - Green yield (kg standard [1])

Table 2 Correlations and regression equations between quantity of various nutrients removed by way of harvest and green yield

y	x	r	R^2	Regression equation
N	Green yield	0 987**	0 974	y = 13 54 + 6 35 x
P		0 989**	0 978	y = 0 68 + 0 44 x
K		0 984**	0 968	y = 5 27 + 6 33 x
Ca	,	0 972**	0 945	y = 1 75 + 1 11 x
Mg		0 962**	0 925	y = 0 47 + 0 47 x
S		0 976**	0 953	y = 0 38 + 0 29 x
Fe		0 763**	0 582	y = 318 17 + 42 89 x
Mn		0 976**	0 953	y = 2 73 + 34 45 x
Zn		0 975**	0 951	y = 6 44 + 4 28 x

** Significant at 1 per cent level

x Green yield (kg standard [1])

y Quantity of nutrient removed through spikes by way of harvest (N P K Ca Mg and S in g and Fe Mn and Zn in mg)

2 Effect of shade and mulch on the yield of ginger (*Zingiber officinale* R)
(SPC/14 00 06 92/ACV(10)KAU/PG)

The experiment was conducted at the College of Agriculture, Vellayani during 1992 93 to study the effect of shade and mulch on the yield of ginger cv Rio de Janeiro The experiment was laid out in strip plot design with five replications the major treatments (shade levels) were open (S_0), 25 (S_1), 50 (S_2) and 75 (S_3) per cent shade levels The minor treatments (mulch levels) were 25 (M_1), 50 (M_2), 75 (M_3) and 100 (M_4) per cent of the recommended dose (30 t ha ^{1}) Green leaves were used as mulch materials Artificial shading to the required levels as per the treatments was provided by high density polyethylene shade materials LI COR LI 138 B Quantum radiometer with a photometric sensor was used for confirming the shading capacity of the shade material Except mulching all other cultural operations were carried out uniformly in all treatments as per the package of practices recommendations of the Kerala Agricultural University

The effect of shade on enhancing sprouting was found to be significant mainly during the early stages The effect of mulch was also found to be significant and increasing levels of mulch increased sprouting

The effect of shade and mulch on growth parameters leaf number, leaf area, plant height tiller number, chlorophyll content dry matter production, net assimilation rate, crop growth rate, bulking rate, utilization index, harvest index and top yield under low shade (25 per cent) exhibited significant superiority with respect to growth and yield contributing factors Most of the parameters from open were inferior to shaded conditions In general mulching retained more moisture, reduced soil temperature and produced positive changes in growth and yield contributing factors

Maximum green and dry ginger yields were resulted from low shade (25 per cent) followed by medium (50 per cent) and heavy shade (75 per cent) The trend in green and dry ginger yield obtained from open condition was significantly inferior to all shade regimes (Tables 1 and 2) The effect of mulch on green ginger yield was also found to be significant Under low shade (25 per cent) M_3 and M_4 were on par Under medium and heavy shade M_3 and M_4 were comparable

In general the quality of the produce was found to be superior under shaded conditions The uptake of N showed an increasing trend upto 50 per cent and then a decrease A general increasing trend in

Table 1 Effect of shade and mulch levels on the mean green ginger yield (kg ha ^{1})

Shade levels	Mulch levels				Mean S
	M_1	M_2	M_3	M_4	
S_0	13161	14145	17398	19517	16056
S_1	18029	21439	26030	26036	22883
S_2	15535	20492	21123	22007	19789
S_3	16292	17303	20839	21786	19055
Mean	15755	18345	21347	23337	
F test	S(S)	M(S)	SM(S)		
CD (0 05)	476 3	290 7	568 6		

Table 2 Effect of shade and mulch levels on the mean dry ginger yield (kg ha ^{1})

Shade levels	Mulch levels				Mean S
	M_1	M_2	M_3	M_4	
S_0	2736	2996	3685	4141	3389
S_1	3639	4328	5246	5256	4617
S_2	3029	4063	4117	4266	3869
S_3	3119	3375	4063	4248	3701
Mean M	3131 31	3690 31	4278 21	4278 25	
F test	S(S)	M(S)	SM(S)		
CD(0 05)	101 4	65 9	98 9		

NPK was also observed with increasing mulch levels

The study suggests that ginger is a shade loving plant giving maximum yield under low shade followed by medium and heavy Under open condition mulching gave a progressively increasing trend in yield and therefore the existing recommendation (30 t ha ^{1}) is necessary But under low shade 25 per cent of the mulch requirement can be reduced without affecting the final yield

2 **Management of bacterial wilt of ginger *Zingiber officinale* Rosc) incited by *Pseudomonas solanacearum* (Smith)**
(SPC/13 00 04 92/VKA(5)KAU/PG)

The objectives of the study were characterization and identification of the pathogen *in vitro* and *in vivo* evaluation of common antibiotic fungicides, botanicals and others against bacterial wilt pathogen study the role of weather factors on the incidence of bacterial wilt disease of ginger and study the changes in the rhizosphere microflora due to application of antibiotics fungicides and botanicals

The programme of study consisted of testing the sensitivity of common antibiotics fungicides, botamcals and others against *P solanacearum* under *in vitro* and *in vivo* conditions Ambistryn S Terramycin,Chloromycetin Streptocycline Bordeaux mixture Calixin water extract of garlic, water extract of *Ocimum* spp and fresh cowdung were used for *in vitro* study

For field experiment in wilt sick fields Ambistryn S (1000 ppm) Chloromycetin (1000 ppm), Terramycin (1000 ppm) Bordeaux mixture (1 per cent) Streptocycline (1000 ppm) water extract of *Ocimum* spp (50 g/l) water extract of garlic (50 g/l) and Calixin (0 1 per cent) were used based on the *in vitro* sensitivity study of *P solanacearum* The treatments were given when the plants exhibited symptoms of bacterial wilt 70 days after planting The treatments were repeated three more times at an interval of ten days Soil drench and plant spray were adopted

A pot culture experiment with same sets of treatments was conducted to study the incidence of bacterial wilt

The results of the *in vitro* study indicated that Ambistryn S and Chloromycetin 1000 ppm exhibited maximum inhibition of the bacterium Of the two fungicides tested Bordeaux mixture one per cent gave maximum inhibition of the bacterium Among the botanicals and others tested water extract of *Ocimum* spp and garlic at 50 g/l exhibited maximum inhibition of the bacterium

Field experiment on the management of bacterial wilt of ginger revealed that none of the treatments gave an absolute control of the disease (Table 1) However plots treated with Ambistryn S and Bordeaux mixture had minimum wilt incidence than the other treatments The results of the pot culture study on the management of bacterial wilt revealed that plants treated with Bordeaux mixture, Ambistryn S Terramycin and Chloromycetin had minimum wilt incidence (Table 2) All the chemicals found to inhibit the pathogen under *in vitro* condition were not found to control the disease as well as pathogen under field conditions The maximum reduction on the population of *P solanacearum* and minimum wilt incidence was found in Ambistryn S and Bordeaux mixture treatments

A positive correlation between maximum air and soil temperature and wilt incidence was observed The colonization of VA mycorrhiza was greater in roots of healthy plants than the roots of infected plants The plants treated with Bordeaux mixture and Ambistryn S had maximum plant height, more number of tillers and maximum yield Thus the present study revealed that application of Bordeaux mixture one per cent could be recommended as a prophylactic soil drench and spray which can reduce the incidence and prevent further spread of the disease in the field

Table 1 Field experiment on management of bacterial wilt of ginger with antibiotics, fungicides and botanicals Percentage of wilt incidence at different intervals

Treatments		Wilt incidence %)					
		Before application 70 DAP	10 days after first application 80 DAP	10 days after second application 90 DAP	10 days after third application 100 DAP	10 days after fourth application 110 DAP	Final observation 160 DAP
T_1	Ambistryn S	22 91	68 75	70 83	70 83	70 83	70 83
T_2	Chloromycetin	31 25	70 83	79 16	81 25	81 25	81 25
T_3	Terramycin	27 08	75 00	77 03	83 33	83 33	83 33
T_4	Bordeaux mixture	31 25	70 00	75 00	75 00	75 00	75 00
T_5	Streptocycline	29 16	72 91	75 00	91 66	91 66	91 66
T_6	Water extract of *Ocimum* spp	33 33	79 16	87 50	87 50	87 50	87 50
T_7	Water extract of garlic	29 16	70 83	77 03	81 25	81 25	81 25
T_8	Calixin	31 25	79 16	87 50	87 50	87 50	87 50
T_9	Control	33 33	87 50	100 00	100 00	100 00	100 00
CD (0 05)		NS	NS	NS	11 853	11 853	11 853

DAP Days after planting

NS Non significant

Table 2. Pot culture experiment on management of bacterial wilt of ginger with antibiotics, fungicides and botanicals· Percentage of bacterial wilt incidence at different intervals

Treatments	Wilt incidence (%)					
	Before application	10 days after first application	10 days after second application	10 days after third application	10 days after fourth application	Final observation
T_1 Ambistryn S	19 91	24 07	24 07	24 07	24 07	24 07
T_2 Chloromycetin	19 09	27 42	27 42	27 42	27 42	27 42
T_3 Terramycin	17 42	25 76	25 76	25 76	25 76	25 76
T_4 Bordeaux mixture	22 05	22 05	22 05	22 05	22 05	22 05
T_5 Streptocycline	19 77	36 05	50 42	72 82	100 00	100 00
T_6 Water extract of *Ocimum* spp	26 11	31 31	59 02	62 35	62 35	62 35
T_7 Water extract of garlic	20 62	27 35	30 13	30 13	30 13	30 13
T_8 Calixin	26 18	37 78	54 44	78 31	100 00	100 00
T_9 Control	24 59	34 92	72 690	100 00	100 00	100 00
CD (0 05)	NS	12 827	15 872	15 644	14 347	14 347

NS Non significant

4 **Standardisation of top working in nutmeg (*Myristica fragrans* Houtt)** (SPC/11 00 05 91/VKA(16)KAU PG)

The objective of the experiment was to assess whether top working in nutmeg will be successful and if so to standardise the conditions for the success

Budding on hard trunk using patch, forkert and modified forkert methods, beheading the trees above and below first tier and using the emerging sprouts for budding and grafting in male nutmeg trees were conducted

Budding on the hard trunk proved to be most successful Standardisation of the methods of budding on hard trunk revealed that forkert budding was the most successful when compared to patch and modified forkert methods For successful union the buds should be placed by leaving space on all four sides and the buds were selected from brown budwood with fallen leaves Stumping of plants two months after budding was the most effective in achieving a quicker bud burst (Table 1) Budding made on different age groups of trees was compared and the results showed that as age of tree increases the budding success and sprouting percentage decreases (Table 2) Budding done on three year old plants were found to be the best July was observed to be the best month for budding in hard trunk which recorded highest initial success and sprouting

The results of the present study bring out the usefulness of *in situ* budding even before sex determination as a reliable technique to assure femaleness and productivity in nutmeg *In situ* plants with the vigorous root system enable faster growth of the inserted bud This increased growth rate has an edge over the observed slow growth of grafted plants In a crop like nutmeg which exhibits dimorphic branching availability of orthotropic shoots is a limiting factor for commercial production of vegetative propagules Viewing from this angle also budding which enable production of more number of propagules from a budstick is preferred to grafting Selection of viable buds having a deep scar inner to the bark is a must for budding success

Table 1 Effect of physical treatments on sprouting of buds

Treatments	Age of tree (years)	Number of trees beheaded	Sprouting (%)	Days to sprout	Girth of sprouts (cm)	Length of sprouts (cm)	Numbe of leaves
Stumping	18	4	50	70	1 0	8 0	2
Ringing	18	4	25	173	1 0	6 5	1
Control	18	4	25	295	0 8	5 0	2

Table 2 Effect of age of plant on sprouting of buds

Sl No	Age of trees (years)	Mean height at which budding done (cm)	Mean girth of trees (cm)	Tier at which budding done	Initial success (2 MAB) (%)	Sprouting (%)
1	1	19 0	3 90	1 0	80 00	0
2	3	35 28	7 30	1 4	100 00	93 30
3	4	65 79	10 57	2 4	91 40	77 10
4	5	70 14	12 92	2 7	71 40	71 40
5	10	71 90	20 45	3 4	72 70	36 30
6	18	89 00	43 80	4 4	60 00	40 00

MAB Months After Budding

●●●

6. Commercial crops

HIGHLIGHTS

- In cashew two high yield ng varieties K 10 2 and H 3 1 7 having bette yield and nut weight were proposed for release
- Soft wood grafts of released varieties Kanaka and Dhana were distributed to cultivators
- In sugarcane Cul 527/85 a variety superior in yield and resistant to red rot disease has been proposed for release
- Sugarcane varieties from AICRP trials Co 88017 and Co 88121 out yielded all the check varieties in cane yield and commercial sugar percentage These varieties were proposed for farm trials
- A good germplasm collection of cocoa is maintained Large scale breeding programme has been attempted and 49 hybrids were promoted for progeny row trials
- Top working with snapping of stem and budd ng on chupons was found to be successful in cocoa

CONCLUDED EXPERIMENTS

1 **Flush grafting in cashew Standardisation of time of beheading in cashew**
(CC/03 00 02 88/MDA 4)ICAR)

The objective was to standardise the ideal time for inducing flushes for flush grafting Five trees were beheaded every month to induce flushes Seven days and 14 days old flusnes were grafted on 21 days old root stock Maximum success could be obtain erd when the trees were beheaded during May and June to nduce flushes for flush grafting The highest percentage of success was obtained from trees beheaded during June 1992 (27 per cent)

2 **Foliar application of urea along with insecticides**
(CC/03 00 03 89/MDA(4)ICAR

The objective was to find out the effect of foliar application of urea along with insecticides Endosulphan (0 05 per cent) was tried along with control plots The data of four years revealed that foliar application of urea at different concentrations along with endosulfan did not have any effect either on the yield of nuts or nut characters Though leaf nitrogen per cent increased considerably due to the foliar application of urea along with endosulphan there was no significant d fference among the various doses of urea applied The results indicated that soil application of N was as effective as foliar application Hence a recommendation of

foliar spray of urea along with insecticides may not hold good under our conditions Endosulphan application reduced tea mosquito to a certain extent

3 Growth and yield of cashew in relation to foliar and soil nutrient levels
(CC/03 00 07 91 VKA( )KAU PG)

In cashew the relationship between the levels of N P and K in soil and leaf in relation to growth and yield of cashew was studied in detail in a PG programme Seedling progenies of BLA 39 4 were utilized for the study Application of N P and K significantly improved growth characters and also leaf N P and K content at flushing and fruiting and yield attributing characters Cashew yield was significantly increased with N P and K application The highest net returns were obtained by 1000g N 500g P_2O_5 and 1000g K_2O/tree/year Economic optimum doses of N and P were worked out to be 748 g N 329 g P_2O_5

4 Uptake pattern of major and minor nutrients in selected cashew types
(CC/03 00 06 91 VKA(1)KAU/PG)

Variability studies of 18 cashew types in biometric characteristics of economic importance were studied in a PG programme The study revealed varietal difference in growth and nutrition of cashew Flowering time apple weight kernal weight nut weight nut yield and shelling percentage varied in the different varieties The concentration of major and minor nutrients differed between plant parts and between varieties

5 Foliar absorption of nitrogen and phosphorus by cashew
(CC 03 00 09 93/VKA(1)KAU/PG)

The main objective of the PG investigation is to find out the factors affecting foliar absorption of nutrients in cashew as compared to root absorption Variety Anakkayam 1 was used for the study A leaf washing technique was developed to quantify the foliar absorption of C^{14} and P^{32} The absorption and translocation were the highest when applied through lower surface of younger leaves Greater absorption of foliar applied urea was obtained when nutrient solution was sprayed in 0 05 per cent teepol between 1100 and 1400 hours directed to the lower surface of terminal leaves

The cashew leaves contain thicker cuticle on the upper surface with no stomata and thinner cuticle on the lower surface with large number of stomata

EXPERIMENTS IN PROGRESS

Project (01) EVALUATION OF HIGH YIELDING VARIETIES OF CASHEW

1 Collection and maintenance of cashew types
(CC/01 00 01 63/AKM(9)KAU)

Cashew varieties K 10 2 K 19 1 and K 30 1 are giving significantly higher yield In the seedling types Anakkayam 1 recorded highest yield

2 Germplasm collection and maintenance of types
(CC/01 00 02 88/MDA(9)KAU)

A total number of 115 accessions are being maintained in the clonal germplasm Five accessions identified as semi dwarf types for using as male parents were added to the germplasm The morphological and flowering characters were recorded

3 Breeding improved varieties of cashew
(CC/01 00 03 63/AKM(9)KAU)

During this year among old hybrids H 3 9 recorded the highest yield (29 80 kg) followed by H 4 7 (21 60 kg) Among new hybrids H 8 10 and H 7 6 were higher yielders Considering the data for last 24 years H 3 17 recorded an average yield of 15 kg/tree/year with a shelling percentage of 30 5 H 3 17 has been proposed for release

4 Breeding improved varieties by hybridisation
(CC/01 00 04 73/MDA (9)ICAR)

Two high yielding hybrids H 1598 and H 1608 were released as Kanaka and Dhana Soft wood grafts of these varieties are being prepared for distribution to cultivators Hybridisation programmes were started during January 1993 involving new cross combinations for evolving high yielding semi dwarf types as per the recommendation of national group discussion of cashew research workers

1 BLA 139 1 (Early types) x P 3 2 (Panama bold nuts less vigorous type)

2 BLA 39 4 (Medium) x P 3 2

3 V_5 (Vengurla cluster bearing) x H 1591 (Bold nut)

5 Comparative yield trial in cashew
(CC/01 00 06 67/AKM(9)KAU)

In a comparative yield trial with 16 promising types K 22 1 was the higher yielder followed by K 10 2

6 Study of promising clonal progenies of cashew
(CC/01 00 06 67/AKM(9)KAU)

K 10 2 recorded consistently higher yield followed by H 3 9 The variety has been recommended for release by the zonal work shop in the name Sulabha K 10 2 recorded higher yield and bigger nut size It recorded an average yield of 22 kg/tree/year with nut weight of 9 8 g and shelling percentage of 29 4 per cent The variety is tolerent to stem borer and shows slight tolerence to tea mosquito

7 Multilocational trial of 18 cashew varieties/hybrids
(CC/01 00 07 87/MDA(9)KAU)

Maximum nut weight per tree was recorded by varieties H 1608 (8 87) H 2/16 (8 50) followed by H 2/15 (8 20) and V 4 (8 07) and are significantly superior than the control Anakkayam 1 Maximum nut yield/tree was recorded by M 26 2 (8 30) followed by H 1600 (7 63) and H 1608 (7 18) Consistant superior performance was recorded by varieties M 26/2 A new multilocational trial with 13 varieties has been started to test the adaptability and yield performance of selected cashew varieties from AICRP Centres such as Baptla Vegurla Vridhachalam and NRCC Puthur

8 Comparative yield trial of promising hybrids/selections of Cashew
(CC/01 00 08 88/PIL(9)KAU)

Highest yield of cashew was obtained in variety H 16 100 followed by BLA 39 4 and K 22 1 The results are in confirmation with previous years results In growth parameters also K 22 1 and H 16 10 exhibited superiority

9 Screening of cashew root stocks at nursery stage for the use as dwarfing root
(CC 01 00 11 93/MDA(9)ICAR)

Seedlings were raised from five vigorously growing and five less vigorously growing trees Considerable variations were noticed among the different progenies in the field Less vigorous types could be identified in the seedling stage itself observing the characters like height girth internodal length bark percentage and phenolic content in leaves

Project (02) BREEDING FOR RESISTANCE TO TEA MOSQUITO AND STEM BORER

10 Screening of germplasm to locate tolerant/resistant types to tea mosquito
(CC/02 00 01 88/MDA(4)KAU)

All the accessions available in the germplasm were screened for tea mosquito and other foliage pests A heavy infestation of tea mosquito could be noticed during the months July and August 1993 The infestation on newly formed flushes ranged from 4 78 to 51 70 per cent Based on last two years observations nine cashew varieties/types were found to be comparatively tolerant to tea mosquito

infestation and they are A 22 H 3 13 H 1 H 71 H 9 H 856 H 159 A 25 2 and A 6 2

Project (03) CROP MANAGEMENT IN CASHEW

11 Nutritional studies in cashew using clonal planting materials

(CC 03 00 04 84/MDA(NAPP)

Three levels of NPK were tried to formulate a manurial schedule for cashew There was no significant difference among the different fertilizer treatments in girth spread number of nuts per panicle and nut weight The yield per tree was maximum (15 6 kg) for $N_1P_1K_2$ and minimum for $N_0P_2K_0$ (1 25 kg) Levels of N P and K were N 0 300 and 600 g/tree P 0 200 and 400 g/tree and K 0 300 and 600 g/tree/year

12 Spacing trial in cashew using clonal planting material

(CC 03 00 05 82/MDA(1)KAU)

Spacing trial in cashew is being conducted to determine the optimum spacing Maximum yield per tree was observed for 8 x 8m (5 43 kg) and minimum for 4 x 4m (1 67 kg) But the yield per hectare was maximum for 4 x 8m and lowest for 4 x 12m

Project (04) HIGH DENSITY PLANTING TO INCREASE PRODUCTIVITY IN CASHEW

13 Top working trials in cashew

(CC/04 00 01 88/MDA(16)NARP)

The possibility of rejuvenating unproductive cashew trees by top working and grafting with high yielding clones at different seasons was tried Considerable increase was noticed in the spread of all the top worked trees Height and girth were also increased considerably Tree No 1001 recorded maximum height of 4 5 m Maximum number of panicles per sq m was noticed in tree No 1001 and tree No 999 recorded the highest number of nuts/panicle

14 Pruning and training studies in cashew

(CC/04 00 02 87/MDA(16)NARP

To study whether cashew is amenable to pruning without loss of yield and to standardise the optimum level of pruning different treatments of pruning at various levels are being tried The growth and flowering characters were recorded In pruned trees with 10 per cent and 20 per cent reduction in canopy at a height of 3 m number of panicles per sq m and number of nuts/panicle were maximum But maximum girth and spread were noticed in control tree

Project (05) STEM BORER AND TEA MOSQUITO MANAGEMENT IN CASHEW

15 Chemical control of pest complex in Cashew

(CC/05 00 0 77/MDA(4)KAU)

Two sprays of endosulphan (0 05 per cent) at flowering and carbaryl (0 02 per cent) at nut set are found to be equally effective as that of three sprays A significant reduction in tea mosquito infestation could be noticed on panicle and nuts after the second spray with endosulphan But the first spray with monocrotophos was effective in reducing the infestation by leaf minor and leaf roller Considering the yield data highest yield was recorded from plots that received all three sprays monocrotophos (0 05 per cent) spray at flushing endosulphan (0 05 per cent) at flowering and carbaryl (0 02 per cent) at fruiting stage

16 Control of stem and root borer in cashew prophylactic treatment

(CC/05 00 02 89/MDA(4)KAU)

Infestation by stem and root borer was considerably reduced in all the treatments for the first two months after application Neem oil and sevidol were found to be the best and were effective for three months

17 Studies on bio-ecology of pests and survey of pest complex and their natural enemies
(CC/05 00 03 88/MDA(4)KAU)

Tea mosquito infestation on tender nuts was maximum during April 1993 and on panicle it was maximum during February 94 No infestat on could be noticed during August and September 1993 Leaf miner infestation and leaf roller infestation were comparatively low during flushing season The natural enemies and other agents noticed in the unsprayed area were ants spiders mirid bugs chrysopa honey bees and flies

18 Biology, bionomics and control of cashew stem borer
(CC/05 00 04 85/PIL/KAU)

Report not received

Project (06) EVOLVING RED ROT RESISTANT AND FLOOD TOLERANT VARIETIES OF SUGARCANE AND STANDARDISATION OF AGRO-TECHNIQUES

19 Evolution of sugarcane varieties for the different agro-climatic tracts of Kerala and fluff exchange programmes - 1985 series
(CC/08 00 84/TLA(9)KAU/NP)

Results of farm trials conducted at five locations in Pathanamthitta and Alleppey districts proved that Clone 527/85 is superior in yield and other qualities and res stant to red rot disease In the farm trials the highest yield of 93 1 t/ha was recorded by Clone 527/85 while the control variety Madhuri recorded an yield of 85 8 t/ha

The release proposal for the variety Cul 527/85 has been submitted

20 Evolution of sugarcane varieties for the different agroclimatic tracts of Kerala and fluff exchange programme 1986 series
(CC/06 00 04 85 ICAP)

Three clones 81/86 519/86 and 536/86 promoted for farm trial are being multiplied for conducting farm trial during next season

21 Evolution of sugarcane varieties for the different agroclimatic tracts of Kerala and fluff exchange programme 1987 series
(CC/06 00 05 86/TLA(9)KAU)

Three clones 1150/86 2604/87 and 2606/87 were multiplied for conducting farm trial in the next season 1993 94

22 Evolution of sugarcane varieties for the different agroclimatic tracts of Kerala and fluff exchange programme - 1988 series
(CC/06 00 06 87/TLA(9)KAU)

Cul No 1740/88 was found to be tolerant to flood situations and is having H R brix of 20 to 21 8 and recorded a cane yield of 88 47 metric tonnes Hence it was proposed for farm trial

23 Evolution of sugarcane varieties for the different agroclimatic tracts of Kerala and fluff exchange programme - 1989 series
(CC/06 00 07 88/TLA(9)KAU)

Comparative yield trial was conducted with 15 promising clones and five clones were selected for second comparative yield trial Results of comparative yield trial have shown that clone No 2217 and 1286 were on par in yield with check variety Madhuri Clone No 596 recorded the maximum millable cane

24 Evolution of sugarcane varieties for the different agroclimatic tracts of Kerala and fluff exchange programme - 1990 series
(CC/06 00 08 89/TLA(9)KAU)

(a) 1990 series

The first clonal trial with 54 genotypes were conducted during the period under report The results revealed that about 24 genotypes have shown lesser response to red rot disease and have recorded

comparatively high MCC cane yield and sucrose per cent and it was advanced to second clonal trial Among the clones evaluated in the first clonal trial genotype 264 recorded maximum cane yield followed by Accession No 104

(b) 1991 series

The result of the screening test carried out for red rot reaction studies in 64 genotypes revealed that 9 numbers were found to be moderately resistant and 9 numbers moderately susceptible Based on cane yield MCC sucrose per cent and reaction to red rot disease 15 genotypes were selected and advanced to second clonal trial The clone No 288 recorded maximum yield

(c) 1992 series

Clonal multiplication trial with 99 genotypes was conducted during the period under report The genotypes that have shown resistance to red rot disease and that have recorded maximum cane yield sucrose per cent and millable canes were selected About 52 genotypes selected were promoted for first clonal trial

(d) 1994 series

During the year under report fluff obtained from the Sugarcane Breeding Institute under sixteen cross combinations were raised Fluff was sown in the nursery and 2548 seedlings were transplanted to the main field

25 Zonal varietal trial for identifying early and mid-late maturing varieties
(CC/06 00 11 90/TLA(9)KAU)

(a) 1990 1991

The performance of the varieties tested under early group and mid late group were not found to be superior to the check varieties

(b) 1991 1992

The varieties tested in the early group were not found to be superior to the check varieties In the mid late group varieties Co 88017 and Co 88021 out yielded all the check varieties in cane yield and commercial sugar percentage These cultures were recommended for farm trial in the Zonal Workshop Farm trial is being conducted with Co 88017 a superior variety

(c) 1992 1993

Among the varieties tested under early group Co 87623 was found to be superior than the check varieties But the performance of this variety in the first ratoon crop was on par with the check varieties

None of the varieties under mid late group were found to be superior than the check varieties in the first ratoon crop while in the second plant crop Co 89026 was found to be superior than the check varieties

(d) 1993 1994 series

Among early and mid late varieties/ cultures none of them had out yielded the check variety Madhuri with respect to yield CCS/ha and MCC/ha in the first plant crop experiment

(e) 1994 1995 series

Field experiment was laid out during 1994 for evaluating the varieties under early and mid late group

26 Characterisation of sugarcane soils in Kerala
(CC/06 00 14 90/TLA(3)KAU)

A survey of different sugarcane tracts has been conducted

27 Studies on biofertilizers for sugarcane
(CC/06 00 17 93/TLA(5)KAU)

To find out the beneficial association of Azospirillum and Azotobacter in sugarcane a field experiment has been started at Sugarcane Research Centre at Menonpara

28 Studies on the effect of pressmud in combination with rock phosphate as phosphatic fertilizers in sugarcane
(CC/06 00 16 93 TLA(3 KAU)

To study the effectiveness of pressmud and rock phosphate applied alone and in combination to sugarcane crop a field experiment has been started at Menonpara

29 Studies on the integrated use of nitrogen with sulphitation pressmud in sugarcane (AICRP trial)

To reduce the reliance of nitrogeneous fertilizers through utilization of renewable organic sources the field experiment was conducted at Sugarcane Research Centre at Menonpara The results indicated that use of pressmud 4 tons/ha as a fertilizer along with nitrogen was found effective for increasing the yield of sugarcane

30 Nutritional need of sugarcane ratoon crop with and without mulch (AICRP trial)

To find out the nutritional need of sugarcane ratoon crop and to study the effect of mulch on weed control and improving soil fertility the field experiment has been started at Thiruvalla and Menonpara In mulched plots weed growth was comparatively less

31 Agronomic evaluation of promising sugarcane genotypes (AICRP trial)

To study the ideal time of planting of suitable genotypes and economic dose of fertilisers the field experiment has been started with varieties Madhuri Thirumadhuram and Co 86017

32 Project (07) Evolution of high yielding cocoa types
(CC/07 00 01 84/VKA(16)Cad India Ltd)

Germplasm collections are maintained which involve varieties from U K research stations in India superior varieties from farmers field and exotic collections Introduction of cocoa germplasm from U K was continued during the period Fifteen clones resistant to vascular streak dieback disease collected from farmers field were maintained for the proposed breeding for resistance to this disease Three clones from CPCRI station Vittal were also added

33 Cocoa breeding
(CC/07 00 02 84 VKA (16)Cad India Ltd)

The hybrids and parents of series I II and III plants of progeny trial CYT I & II inbreds (S_1 & S_2) series TV hybrids and plants of scion orchard were maintained Hand pollinations for the III stage breeding were continued Selfing was also done in some newly flowered clones of germplasm VI to assess the nature of incompatibility

A comparative yield trial with 45 high yielding clones was planted Twenty six hybrids were planted in progeny row trial Another set of 23 hybrids were selected for progeny row trial during June 94

Project (08) STANDARDISATION OF MANAGEMENT PRACTICES FOR COCOA

34 Studies to determine optimum shade requirement for Cocoa
(CC 08 00 01 84/VKA (16)Cad India Ltd)

Shade manipulation was found to have a substantial effect on yield of cocoa there being a consistent and conspicious increase with increasing levels of illumination the highest being in the open The increase was however much more in the unirrigated set than in the irrigated Comparing the high shade and no shade situations the extent of yield increase is about four times in unirrigated set while it is only about 1 5 times in irrigated set

35 Trials on training and pruning of cocoa
(CC/08 00 02 84 VKA (16)Cad India Ltd)

In the early years of the trial unpruned

control recorded higher yield Since 1988 89 the treatment differences ceased to be statistically significant, eventhough the control of no pruning recorded highest mean yield However in 1992 93 one treatment receiving pruning recorded the highest mean yield unlike the previous records of the highest yield for unpruned control

36 Standardisation of procedure for top working
(CC/08 00 04 88/VKA(16)Cad India Ltd)

Success rate of top working following snapping of stem and budding on the chupons developing below the point of snapping was found to be 100 per cent The snapped portion was removed only after at least two leaves of the scion shoot hardened Budding on hard bark gave a very low success rate A procedure for top working has been standardised Such top worked plants appeared to grow faster and give heavier yield than new budded plants Top working continued in the germplasm block All the plants top worked showed vigorous growth

Project (09) DISEASE MANAGEMENT IN COCOA

37 Survey of Cocoa diseases in Kerala
(CC/09 00 01 87/VKA(16)Cad India Ltd)

Disease survey was carried out in main cocoa growing districts of Kerala Vascular streak die back white thread blight black pod *Phytophthora* pod rot *Phytophthora* canker *Colletotrichum* pod rot leaf spot and zinc deficiency symptoms were the common diseases observed during the survey During the year under report incidence of vascular streak die back was noticed for the first time in Thrissur district This disease is spreading at an alarming rate all over Kerala Seedling blight leaf blight and *Phyllosticta* leaf spot were noticed in the farm Vascular streak die back *Colletotrichum* leaf spot and pod rot were noticed from Mannar area of Alleppey District In Idukki district along with the above diseases an unidentified thread blight disease was also noticed

38 Studies on Vascular streak die back
(CC/09 00 02 91 VKA(16)Cad India Ltd)

Fungicidal control trial was conducted

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7. Pulses & oil seeds

HIGHLIGHTS

- Two grain cowpea varieties namely V 317 and V 276 were identified as highly resistant to cowpea aphid borne mosaic virus (CAMV) by screening 59 cowpea varieties/types

- From a line x tester analysis involving 15 hybrids and eight parents the cross combinations Pusa 103 x CO2 Pusa 103 x ML 131 PDM 139 x Pusa Baisakhi and PDM 146 x PDM 134 were found the best specific combiners for yield and drought resistance

- From a germplasm evaluation of 50 horse gram genotypes the variety V 34 was found to have maximum dry matter production and have the maximum harvest index

- A study on seed dormancy in groundnut has shown that dormancy is controlled by polygenes Seed treatment with 1 1000 $HgCl_2$ for ive minutes was found most effective for breaking dormancy

- Application of 22 5 kg P_2O_5 per hectare and treatment of seeds with sodium molybdate at the rate of g per kg seeds together have recorded maximum value for branching LAI chlorophyll content pods per plant seeds per pod pod length hundred seed weight harvest index crude protein content and grain yield in cowpea

CONCLUDED EXPERIMENTS

1 **Combining ability and gene action in green gram (*Vigna radiata* (L) Wilczek)** (Pos/01 00 15 92/ACV (9) KAU/PG)

This PG project was initiated during 1992 with the objective of estimating g c a and s c a and understanding the gene action involved in combining yield with drought tolerance in green gram

Three drought tolerant lines were crossed with five high yielding testers in a line x tester analysis and fifteen hybrids and eight parents were evaluated

From the combining ability analysis both g c a and s c a were found important for root/shoot ratio harvest index root spread leaf proline content number of pods per plant seed yield and biological yield This showed that both additive and non additive gene actions are there for the expression of these characters

Based on g c a effects among the lines PDM 139 has shown the best performance on various yield and drought resistant characters Among testers ML 131 and CO 2 were good parents which had better g c a for most of the yield and drought tolerant characters

Among the different crosses tested Pusa 103 x CO 2 Pusa 103 x ML 131 PDM 139

x Pusa Baisakhi and PDM 146 x PDM 134 were found to be good specific combiners for yield and drought tolerance Since the study indicated the predominance of non additive gene action commercial use of hybrid vigour is suggested for the crop improvement even though it is practically impossible in a legume crop The mean performance of line (L) testers (T) and hybrids (LT) are given below in Table 1

Table 1 Mean performance of line testers and hybrids

Treatments	Seed yield (kg/plot)	Biological yield (kg/plot)	Ha vest index
L_1T_1	10 97	17 29	0 63
L_1T_2	16 47	35 73	0 46
L_1T_3	5 85	10 13	0 58
L_1T_4	4 14	9 03	0 46
[illegible]	10 86	23 83	0 45
[illegible]	7 38	11 52	0 64
[illegible]	10 79	12 55	0 83
[illegible]	3 11	5 48	0 55
L_2T_4	19 36	23 [illegible]	0 81
L_2T_5	17 35	22 25	0 78
L_3T	7 53	11 54	0 65
[illegible]	15 34	21 01	0 73
[illegible]	2 89	6 47	0 45
[illegible]	4 48	9 [illegible]	0 47
L_3T_5	13 98	20 [illegible]	0 69
L_1	2 40	55 6[illegible]	0 43
L_2	2 50	87 30	0 35
L_3	2 48	6 19	0 40
T_1	5 02	13 02	0 39
T_2	5 48	13 60	0 40
T_3	3 11	12 23	0 25
T_4	2 59	8 18	0 31
T_5	7 58	13 38	0 56
MSE	0 089	0 328	0 001
CD(0 05)	0 492	0 942	0 055

2 Germplasm evaluation in horse gram (*Dolichos biflorus* L)
(POS/01 00 16 92 VKA(2)KAU/PG)

The PG project was initiated in 1992 with the objective of studying genetic diversity and physiological analysis of crop growth so that promising types can be identified for further breeding programmes

Fifty genotypes of horse gram of different geographical origin were collected and grown in a 50 x 2 RBD Destructive sampling method was followed for the physiological analysis of growth

Among the characters studied length of pods and number of pods per plant have shown maximum heritability and genetic advance indicating their amenability for selection

Correlation studies indicated maximum correlation of yield with number of seeds per pod and number of pods per plant Association studies among different traits showed positive significant correlation of character pairs plant height and length of pods number of primary branches and number of pods per plant days to 50 per cent flowering and days to maturity length of pods and number of seeds per pod and 100 seed weight and days to maturity

Divergence analysis gave eleven clusters of which cluster II and VI showed maximum distance The members of these two clusters can be considered for selection as candidates for hybridization programmes

The physiological growth analysis suggested that ideal plant type will be one in which maximum dry matter production net assimilation rate and leaf area index were observed during middle growth stage with an efficient partitioning ability for dry matter towards reproductive parts

The direction that future breeding programmes in horse gram to be planned based on the above findings is suggested as future line of work

3 Screening cowpea (*Vigna unguiculata* (L) Walp) types for resistance to cowpea aphid borne mosaic disease
(POS/01 00 17 92/ACV(2)KAU/PG)

The PG project was initiated in 1992 with the objective of identifying genotypes of

cowpea with resistance to cowpea aphid borne mosaic disease (CAMV)

Fifty nine grain cowpea genotypes were screened for resistance to CAMV through sap inoculation techniques under field conditions Biological observations including scoring for CAMV and other major pests and diseases were taken on the 50 plants raised per plot at 25 x 15 cm spacing in a 59 x 2 RBD trial undertaken during the Kharif 1992 season

The disease score on CAMV on the 59 genotypes indicated that only two genotypes namely V 317 and V 276 were completely resistant to the disease The variety C 152 has recorded the highest percentage of infection followed by Varkala local There were sixteen varieties with an infection percentage below five to be mentioned as highly tolerant and seven with infection percentage above five and below ten to be mentioned as tolerant

Analysis of variance of fifteen characters as listed in Table 2 have shown significant differences among genotypes except one namely the hairiness of leaves

Genotypic and phenotypic variances were observed to be maximum for plant height at maturity and minimum for number of hairs on leaf High values of GCV and PCV were observed for the intensity of Cercospora leaf spot rust disease CAMV and number of hairs on leaf High heritability estimates were recorded for length of pod number of primary branches and hundred seed weight showing lesser influence of environment on these characters Genetic advance as percentage mean was higher for Cercospora leaf spot pea aphid infestation rust disease infection length of pod number of primary branches per plant and 100 seed weight

Correlation studies have revealed that the seed yield per plant has shown a positive significant correlation with number of seeds per pod length of pod and 100 seed weight But CAMV infection recorded a negative correlation with seed yield per plant

Based on genetic divergence studies 59 varieties were grouped into eight clusters The maximum divergence was observed between cluster V and VII indicating their better utility as parent source for recombination breeding programme

4 Seed dormancy in groundnut
(POS/02 00 11 87/VKA(2)KAU/PG)

The Ph D project was initiated in 1987 with the objective of finding the inheritance and physiological cause of dormancy and practical method to break it

Two hundred and seven genotypes of groundnut belonging to three botanical groups were evaluated for seed dormancy by recording germination at 10 days interval The part responsible for dormancy was assessed by subjecting seeds with without and pink seed testa and also excised embryonic axis to germination Various pre sowing treatments were also tried to break the dormancy Dormant types were crossed and F_1 F_2 and F_3 generation were evaluated for seed dormancy to study the inheritance pattern

Wide variability was seen among the genotypes for dormancy in all the three botanical groups (see Table 3) It was also found that the nature of breakage of dormancy was not dependant on the period of dormancy of botanical grouping The cotyledons were identified as the seat of causal agents for dormancy Leaching improved the germinability of seeds only on removal of testa $HgCl_2$ in 1 1000 dilution for five minutes was the most effective treatment for breaking dormancy Observations on the behaviour of F_1 F_2 and F_3 generations revealed that dormancy is controlled by polygenes The distributions of genotypes based on dormancy period is given in Table 3 and the effect of leaching on the germinability of groundnut types in Table 4

Table 2 Genotypic and phenotypic coefficient of variation heritability and genetic advance of 9 cowpea genotypes

Sl No	Character	Mean	GCV	PCV	H^2 (%)	GA on % mean
1	Days to first flowering	39 58	5 33	7 70	47 34	7 59
2	Days to maturity	6 13	8 04	8 04	58 06	9 62
3	Number of hairs unit area of leaf	89 72	24 80	30 34	66 84	41 78
4	Number of primary branches per plant	2 02	65 05	128 94	18 23	48 41
5	Number of secondary branches per plant	2 59	23 69	25 97	83 30	44 56
6	Number of pods per plant	11 99	18 11	29 46	37 79	22 94
7	Number of seeds per pod	11 73	9 87	14 68	45 21	13 68
8	Length of pod (cm)	14 57	27 72	28 82	95 31	54 92
9	Hundred seed weight (g)	10 50	24 12	27 27	78 23	43 94
10	Seed yield per plant (g)	14 20	23 06	33 43	47 56	32 75
11	CAMV (number of plants infected)	19 78	68 07	96 44	49 81	22 48
12	Cercospora leaf spot (score)	1 42	72 73	87 56	68 98	97 88
13	Rust disease (score)	1 29	70 03	99 78	49 26	58 06
14	Pea aphid infestation (score)	1 50	46 79	60 62	59 58	65 87
15	Epilachna infestation (score	1 29	44 98	78 79	32 58	29 84

Table 3 Distribut on of groundnut genotypes based on per ods of dormancy

Botanical group	Per od of dorm ancy (days)											
	0	10	20	30	40	50	60	70	80	90	100	110
Hypogaea	0	0	1	6	33	55	40	32	12	14	0	7
Vulgaris	0	0	2	3	1	1	0	0	0	0	0	0
Fastigiata	0	0			0	0	0	0	0	0	0	0
Total	0	0	3	9	34	56	40	32	12	14	0	7

Table 4 Effect of leaching on the germinability of groundnut types

Genotypes		Germination (%)*					
		Intact seed		Seed w thout testa		Untreated Control	Mean
		12 hours	24 hours	12 hours	24 hours		
1	ICG 198	0 29 (0 0)	0 29 (0 0)	51 95 (62 01)	71 56 (89 99)	0 29 (0 0)	61 76 (77 61)
2	ICG 1002			60 69 (76 04)	78 85 (96 26)		69 77 (88 04)
3	CG 2471			53 13 (64 00)	73 57 (92 00)		63 35 (79 88
4	ICG 2523			56 80 (70 00)	73 69 (92 11)		65 25 (82 47)
5	ICG 4326			60 69 (76 04)	81 87 (98 00)		71 28 (89 70)
6	ICG 8218			56 79 (70 00)	78 84 (96 25)		67 82 (85 75)
7	ICG 8281			55 56 (68 02)	73 57 (91 99)		64 57 (81 56)
Mean				56 51 (69 55)	75 99 (94 14)		

CD (0 05) Variety means 3 14
Treatment means 1 68
Interaction N S

*Arc sine transformation was done Figures n parenthesis ind cate values in the original scale

Table 5 Yield and yield attributes of cowpea as influenced by different levels of phosphorus and molybdenum

Treatment	Number of pods plant $^{-1}$	Length of pod /cm	Number of seeds pod $^{-1}$	Hundred seed weight	Grain yield kg ha $^{-1}$	Total dry matter production kg ha $^{-1}$	Harvest index
P_1	10 12	12 99	13 26	8 82	685 00	2637 92	26 06
P_2	13 18	14 73	15 20	10 13	1147 00	3254 25	35 14
P_3	13 26	15 09	14 93	10 39	1152 67	3264 83	35 23
P_4	11 63	14 22	14 71	9 65	965 17	2888 83	33 41
CD (0 05)	0 30	0 11	0 34	0 20	13 09	54 32	0 71
M_0	9 90	13 23	13 60	9 18	821 75	2787 83	29 42
M_1	12 62	14 54	14 59	10 03	1028 00	3011 83	33 71
M_2	12 93	14 63	14 96	9 93	1065 75	3150 25	33 45
M_3	12 75	14 63	14 95	9 84	1034 33	3095 2	33 26
CD (0 05)	0 30	0 11	0 34	0 20	13 09	54 32	0 71

5 Phosphorus and molybdenum nutrition in cowpea
(POS/03 00 05 89/ACV(1)KAU/PG)

This PG project was initiated during 1989 with the objectives of estimating optimum dose and mode of seed treatment of molybdenum and to assess the interaction effect between phosphorus and molybdenum and to work out the economics of their nutrition Nine levels of sodium molybdate and two methods of seed treatment were tried under pot culture Based on the results of this a field experiment with four P_2O_5 levels and four sodium molybdate levels was conducted The cowpea variety C 152 was used for these experiments

The results have shown that maximum significant values for grain yield and dry matter production was recorded by the treatment of 1 5 g of sodium molybdate per kg of seed The combined effect of phosphorus and molybdenum was beneficial in improving the growth and yield of cowpea Maximum dry matter production and grain yield were obtained by the treatment that received 22 5 kg P_2O_5 per hectare in conjunction with 1 5 g of sodium molybdate per kg seed Based on dose response relationship and the economics the optimum dose was found to be 28 kg P_2O_5 per hectare and 1 37 g sodium molybdate per kg of seed Further experiments with different sources of molybdenum and phosphorus were suggested as future line of work

The yield and yield attributes of cowpea as influenced by different levels of phosphorus and molybdenum are given in Table 5

Project (01) Breeding for yield quality and pest and disease resistance of pulses

1 **Identification of high yielding green gram varieties adapted to summer rice fallows of Onattukara**
POS/01 00 1 91/KYM(9)KAU/NP))

During the summer of 91 92 34 green gram varieties were screened in a 34 x 2 RBD trial and 12 varieties were promoted for CYT The first CYT was conducted during the summer of 1992 93 and Pusa 8973 was found to be the highest yielder The second CYT was grown during the summer of 1993 94 and the results are being tabulated

2 **Evolution of high yielding variety of cowpea with synchronised maturity suited for the summer rice fallows of Onattukara**
(POS/01 00 14 9 KYM(9)KAU NP)

F_2 generation of the following cross combinations were grown in garden land during the winter of 1993

Sl No	Cross combination	F_2 seeds sown	No of plants established
1	V_2 x COVU 623	75	25
2	CO 3 x COVU 623	135	38
3	COVU 358 x COVU 623	28	20
4	COVU 8456 x COVU 623	45	14
5	V 118 x COVU 623	30	1

The F_3 families were grown in garden land during the summer of 1993 94 The results from this trial are being tabulated

3 **Genetic analysis of biological nitrogen fixation and yield components in cowpea (*Vigna unguiculata* (Linn) Walp)**
(POS 01 00 13 90/ACV 9)KA PG)

The field experiments as per technical programme were over by 1992 93 itself The statistical analysis and interpretation of data are continued during the year under report The results will be presented in the final report

4 **Inter specific cross compatibility in the genus *Sesamum***
(POS/01 00 14 90/ACV(9)KAU/PG)

Since the P G student has discontinued the studies permanently this project was re allotted to a new student with new number (POS/01 00 25 94)

5 **Variability of biological nitrogen fixation traits and yield components in black gram (*Vigna mungo* (L) Hepper)**
(POS/01 00 18 93/VKA(2 KAU/PG)

Pot culture and field experiments were conducted and biometric observations on nitrogen fixation traits and yield components were collected The statistical analysis of the data is continuing

6 **Genetic analysis of productivity and quality parameters in rice bean (*Vigna unguiculata* (Thumb))**
(POS/01 00 19 93 ACV(9)KAU/PG)

Field experiments and quality factor analysis over Statistical analysis of the data is being done

7 **Breeding aphid resistant high yielding grain type cowpea varieties (*Vigna unguiculata* (L) Walp)**
(POS 01 00 20 93/ACV(9)KAU PG

Because of change in technical programme as per decisions taken in 43rd FRC the field experiments could not be laid out Works will be commenced during kharif 1994 95

8 **Genetic improvement of grain cowpea for the southern region**
(POS/01 00 21 93/ACV(9)KAU/NP))

A germplasm of 68 types / varieties was raised during summer 1993 Based on yield plant type and maturity 30 types were selected for IET which was conducted during kharif 1993 The results indicated that COVU 85020 is the highest grain yielder followed by COVU 358

The IET was repeated in rice fallows during 1994 summer in which the variety COVU 810 gave the highest grain yield followed by DPLC 210 and COVU 358

From the segregating P G materials grown eight promising cultures were isolated and maintained

9 **Increase gram advanced varietal trial**
(POS/01 00 22 93/PTB(9)ICAR)

No work during the period under report

10 **Maintenance and evaluation of cowpea germplasm**
(POS/01 00 23 93 PTB(9)KAU)

No work during the period under report

11 **Gene action and combining ability in grain cowpea (*Vigna unguiculata* (Linn) Walp)**
(POS/01 00 24/94/ACV(9)KAU/PG)

Work not yet started

12 **Interspecific cross compatibility in the genus *Sesamum***
(POS/01 00 25 94/ACV(9)KAU/PG)

Different species of *Sesamum* both wild and cultivated were collected and grown for preliminary observations

13 **Field potential and adaptability of black gram genotypes for rice fallows**
(POS/01 00 26 94/ACV(9)KAU/PG)

Work not yet started

Project (02) Breeding for yield, quality and pest and disease resistance of oil seeds

14 **Varietal evaluation for sesame**
(POS/02 00 01 87/ACV(9)ICAR)

An initial varietal trial with 30 varieties and advanced varietal trial with six varieties were conducted during summer 1994 at RRS Kayamkulam AVTS 29 and AVTS 5 have recorded the highest seed yield respectively for the two trials The oil content varied from 52 9 per cent to 53 05 per cent The work is continuing

15 **Initial evaluation trial on groundnut (Spanish bunch)**
(POS/02 00 02 87/ACV(9)ICAR)

An advanced varietal trial with seven varieties was conducted during the summer of 1994 The highest pod yield and haulm yield were recorded by AIS 9310 which also showed tolerance to tikka and rust disease The oil content of this variety was 54 per cent

16 **Varietal trial on groundnut (Spanish bunch early)**
(POS/02 00 03 90/ACV(9)ICAR)

An initial varietal trial with 11 varieties was conducted during summer 94 The highest pod yield and haulm yield were recorded by the variety INS 9313 which showed tolerance to tikka and rust disease

17 **Identification of groundnut varieties for southern region**
(POS/02 00 07 83/ACV(9)KAU/NARP)

Ten promising types/varieties selected from the IET were grown in a CYT with three replications during summer 1994 Another CYT with nine cultures derived from the hybridization done earlier was also raised Forty five elite types were maintained

18 **Germplasm maintenance in sesamum**
(POS/02 00 08 85/KYM(9)KAU/NP)

The evaluation trials during summer 1994 were lost due to heavy rain during February 1994 The lines are being maintained by sowing them in garden lands

19 **Breeding programme to develop early maturing groundnut varieties for summer rice fallows of Onattukara**
(POS/02 00 09 85/KYM(9)KAU/NP)

No work during the period

20 **Hybridization programme in sesame for developing high yielding varieties for rice fallows of Onattukara**
(POS/02 00 10 85/KYM(9)KAU/NP)

CYT trial laid out during summer 1994 was lost due to heavy rains during February 1994

21 **Pure line selection in sesame variety Pattambi Local**
(POS/02 00 12 83/Ptb(9)KAU)

No work during the period

22 **Cataloguing of groundnut germplasm**
(POS/02 00 13 83/MNY(9)NARP)

No work during the period

23 **Selection of high yielding short duration varieties of sesamum suitable for rice fallows and upland**
(POS/02 00 14 91/KYM(9)KAU)

Two CYTs one in summer rice fallows and the other in uplands were conducted during summer 1993 using 14 test materials and two checks In both trials the variety CST 785 gave the maximum seed yield The trial was repeated during summer 1994 which was lost due to heavy rains during February, 1994

24 **Genetic analysis of seed dormancy and productivity in groundnut (*Arachis hypogaea* L)**
(POS/02 00 15 92/VKA(2)KAU/PG)

No work during the period

Project (03) Standardization of agrotechniques for pulses and oil seeds

25 **P-Molybdenum interaction study in groundnut**
(POS/03 00 02 89/ACV(1)/KAU)

No work during the period

26 **Sulphur and boron nutrition of groundnut var TG-3**
(POS/03 00 03 90/ACV(1) KAU/PG)

No work during the period

27 **Agronomic management of promising genotypes of cowpea**
(POS/03 00 06 89/Ptb(1)ICAR)

No trial during the period

28 **Use of molybdenum and boron as foliar spray in cowpea**
(POS/03 00 07 89/VKA(1)KAU)

No work during the period

29 **Fertilizer management of groundnut sesamum sequential cropping system**
(POS/03 00 08 87/ACV(1)ICAR)

No work during the period

30 **Studies on component contribution in cowpea production**
(POS/03 00 09 89/PTB(1)ICAR)

The two levels of inputs namely traditional and improved varied significantly in affecting the yield The varietal factor also significantly affected the yield Improved variety and improved fertilization gave significantly higher yield over local variety and fertilization But the traditional and improved methods of weed control had no significant influence on grain yield

31 **Agronomic management of promising genotypes of mung bean**
(POS/03 00 10 89/PTB(1)ICAR)

No trial assigned during the period

32 **Response of mung bean to phosphorus and zinc application**
(POS/03 00 11 89/PTB(1)ICAR)

No trial assigned during the period

33 Productivity of groundnut (*Arachis hypogaea* L) in summer rice fallows under different frequencies of irrigation
(POS/03 00 12 93/VKA(1)KAU/PG)

No work during the period

34 Improving fertilizer use efficiency in sesamum in Onattukara tract
(POS/03 00 13 93/ACV(1)KAU/PG)

Crop failed due to unexpected rain during January 1994

35 Crop weed competition in sesame in summer rice fallows of Onattukara
(POS/03 00 14 93/KYM(3)KAU)

Experiment was vitiated by heavy rain during January and February 1994

36 Integrated weed management in sesamum in summer rice fallows of Onattukara
(POS/03 00 15 93/KYM(3)KAU)

No work during the period

37 Response of macro and micro nutrients along with organic matter and NPK on the yield of sesamum
(POS/03 00 16 93/KYM(3)KAU)

The experiment was vitiated by heavy rain during January and February 1994

38. Response of promising varieties of sesamum to nitrogen levels and plant populations
(POS/03 00 17 93/KYM(3)KAU)

The experiment was vitiated by heavy rain during January and February 1994

39 Response of cowpea to P and S levels
(POS/03 00 18 93/PTB(3)AICRP)

Grain yield was significantly improved by increased P applications Sixty kg P_2O_5 recorded the highest yield of 542 kg/ha

Increased supply of sulphur upto 40 kg/ha did not play any role in yield increase over no sulphur application

40 Weed control in cowpea
(POS/03 00 19 93/PTB(1) AICRP)

The highest grain yield and economic return were obtained from the treatment of Pendimethalin 0 75 kg ai/ha followed by one hand weeding 35 DAS Unchecked weed growth reduced yield to the tune of 75% of the weed free check

41 Weed control studies in sesamum
(POS/03 00 20 94/KYM(1)KAU)

No work during the period

Project (04) Pest and disease management in pulses and oil seeds

42 Survey identification and control of pests and diseases of pulses and oil seeds
(POS/04 00 02 91/KYM(4)KAU/NP)

A field experiment on control of pests and diseases of cowpea var Kanakamony was laid out in a 8 x 3 RBD with 2 x 2 m plot size on 22 2 1994 Minimum pest incidence was noticed in treatment of Quinalphos 0 03 per cent

●●●

9. Forage crops

HIGHLIGHTS

- In coconut garden growing subabul in the alleys along with intercropping guinea grass in the interspaces recorded the highest green and dry fodder yields
- In a comparative fodder cum seed production trial involving three legumes *viz* cowpea rice bean and soyabean conducted in the uplands highest fodder yields and seed yield were recorded by cowpea
- Cowpea variety C 152 was the most suitable legume crop for fodder production in summer rice fallows *Sesbania rostrata* was also found suitable as a fodder legume under rice fallow conditions on account of its high dry matter production and nutrient content
- The highest seed yield in guinea grass cv Riversdale was recorded from a crop planted at 60 x 60 cm spacing and fertilized with an NPK dose of 100 80 60 kg/ha which is to be left without cutting till flowering during the first season and one subsequent seed harvest in the second season
- Guinea grass variety Roxa out yielded all the other 13 varieties tried in the case of green and dry fodder production
- Bajra variety RFB 1 recorded the highest green and dry fodder yield than the 12 other varieties tried in a multicut fodder production trial

EXPERIMENTS CONCLUDED

1 **Alley cropping of fodder crops under rainfed condition in coconut garden** (FC/02 00 05 90/AN(1)NARP)

The objective of the experiment was to study the growth and bio productivity of subabul as a fodder in coconut garden and to study the fodder production potential of the grasses under alley cropping in coconut garden The treatments consisted of three cropping (coconut alone coconut + subabul coconut + subabul + guinea grass) and four levels of N (0 50, 100, 150 kg N/ ha) The results revealed that the treatments grown with coconut + subabul + guinea grass under a fertiliser dose of 200 50 50 kg NPK/ha registered the highest green fodder yield There was no significant difference among the different levels of 50 100 and 150 kg N/ha However the highest N level registered the highest green fodder yield The dry fodder yield showed the same trend as green fodder yield In both cases intercropping with zero N and K recorded the lowest value

Subabul recorded very poor fodder yield due to psyllid attack

2 **Herbage and seed production potential of annual forage legumes under different levels of phosphorus fertilization**
(FC/02 00 1(92 ACV 1) CA)

The study was aimed to evaluate the fodder and seed production potential of two annual fodder legumes *viz* rice bean and soybean in comparison with fodder cowpea under varying levels of phosphorus The experiment was laid out in split split plot design with cowpea ricebean and soybean in split plots and P levels (0 30 and 60 kg P_2O_5/ha) in split split plots The two purposes of fodder and seed constituted the main plot treatments The experiment was carried out for two years In both the years the soybean crop failed to flower and hence no seed could be realised

Among fodder crops cowpea registered the maximum green fodder yield of 9 49 t/ ha followed by soyabean and rice bean which were on par The phosphorus levels had no influence on the growth and yield of fodder crops However application of P @ 30 kg P_2O_5/ha registered the highest green and dry fodder yields In the case of seed production also cowpea was found superior The highest seed yield of 351 51 kg/ha was registered by cowpea Though P levels had no significant influence on the grain yield increasing P levels improved the yield and P @ 60 kg/ha registered the highest grain yield

3 **Herbage production of leguminous crops in summer rice fallows**
(FC/02 00 08 92/ACV(1)KAU/PG

An experiment was conducted as a P G Project at Cropping Systems Research Centre Karamana to study the comparative fodder production potential of three varieties of cowpea and *Sesbania rostrata* and to select the best legume for fodder production in summer rice fallows The study was also aimed to investigate the individual effect of lime and phosphorus and their combination on the fodder attributes of leguminous crops and to find out the residual effect on the succeeding rice crop due to the combined application of lime and phosphorus to the above crops

Table 1 Varietal effect and effect of lime and phosphorus on fodder and crude protein yields of legumes grown in summer rice fallows

Factor	Green fodder yield (t/ha)	Dry fodder yield (t/ha)	Crude protein yield (kg/ha
Lime (kg/ha)			
0	25 86	3 66	722 10
125	25 52	3 66	738 14
250	26 54	3 97	850 60
F(2 16)	0 097^{NS}	0 23^{NS}	0 54^{NS}
Phosphorus (P_2O_5kg/ha)			
0	24 38	3 77	717 13
30	25 71	3 47	736 83
60	27 84	4 06	856 89
F (2 16)	1 10	0 6[illegible]	0 62
SEd	2 35	0 53	135 38
Crops			
Co 5	30 66	3 98	693 30
C 152	31 19	3 78	778 76
Karnataka Local	15 39	2 31	386 18
Sesbania rostrata	26 67	4 99	1222 88
F(3 54)	40 37^{S}	8 37^{S}	18 96^{S}
CD	3 28	1 08	225 09
SEd	1 64	0 54	112 55

The treatments consisted of three levels of lime application (0 125 kg and 250 kg/ha) and three levels of phosphorus (0 30 kg and 60 kg P_2O_5/ha) and four crops *viz* 3 cowpea varieties Co 5 C 152 Karnataka Local and *Sesbania rostrata*

The results showed that the cowpea variety C 152 was found to be the best suited for rice fallow conditions as a leguminous fodder crop followed by cowpea variety Co 5 Dry fodder yield was highest in *Sesbania rostrata* which recorded maximum crude protein total plant phosphorus calcium and magnesium contents Combined application of 250 kg lime and 60 kg P_2O_5 produced maximum plant height number of leaves LAI and number of branches in all the crops

Application of fertilizers to the legumes did not influence the grain and straw yields of succeeding crop of rice

4 Seed production potential of guinea grass (*Panicum maximum* Jacq) var Riversdale under different management techniques
(FC/02 09 92/VKA(1)KAU/PG)

The experiment was conducted at the Dhoni farm of KLD Board in two separate field trials as a PG programme of the College of Horticulture with the objective of finding out the optimum time of cutting to obtain maximum production of seed optimum time of seed collection and to assess the optimum levels of NP and K for getting maximum seed yield The results showed that highest seed yield of 165 kg/ha was obtained from guinea grass planted at 60x60 cm spacing and fertilised with an NPK dose of 100 60 60 kg/ha and left without cutting till flowering during the first season and one subsequent seed harvest in the second season The ideal stage of harvest of seed crop to obtain maximum seed yield was found to be 10 to 15 days after panicle emergence The seed yield decreased with delayed harvest *viz* 20 25 and 30 days after emergence of panicle The seed quality was not affected due to different stages of harvest Higher levels of N tried upto 200 kg/ha was not effective in increasing the seed yield The highest cumulative seed yield was recorded from the cutting treatment with two consecutive seed cuts and no fodder cut It was further noticed that seed yield decreased rapidly with later stages of harvest P and K fertilizers did not show any significant influence on seed yield

EXPERIMENTS IN PROGRESS

Project (01) Breeding grasses and legumes for higher yield, shade tolerance, pest/disease resistance and seed production

1 Germplasm maintenance evaluation and utilisation of guinea grass
(FC/01 00 05/87/ACV(9)ICAR,

The objective of this study is to collect and maintain guinea grass varieties their description evaluation and utilisation of promising ones among them for breeding programmes A descriptor for cataloguing the varieties has been prepared Under this study altogether 45 varieties were collected and maintained

2 KBT-6 - Advanced varietal trial on guinea grass
(Final evaluation trial on guinea grass)
(FC/01 00 10 89/ACV(9)ICAR)

Fourteen varieties of guinea grass were tried and the variety P 1188 out yielded all the other varieties in green (53 t/ha) and dry fodder (22 t/ha) yields This was followed by variety PGG 9 in green fodder yield and PGG 227 in dry fodder yield

3 **Breeding trials with forage bajra (Advanced varietal trial on multicut bajra)**
(FC/01 00 12 91 ACV(9) CAR

To evaluate the fodder production potential of different bajra varieties 13 varieties were tested and variety RFB 1 recorded the maximum green fodder (63 t/ha) and dry fodder (34 t/ha) yields

4 **Maintenance and evaluation of germplasm of stylosanthes (*Stylosanthes* sp.)**
(FC/01 00 16 93/ACV(9)ICAR)

Stylosanthes varieties (22 nos.) were collected and their performance is being studied

5 **RBT 8 - Advanced varietal trial on winter maize**
(FC/01 00 17 94/ACV(9)ICAR)

Altogether nine varieties were tried wherein no significant variation was recorded with respect to growth and yield characters. Variety APFM 12 recorded the highest green and dry fodder yields

6 **Evaluation of promising fodder crop varieties for northern parts of Kerala**
FC/01 00 14 92/ACV(1)KAU

This study was conducted at Pilicode to find out the fodder production potential of five fodder grasses suitable for northern Kerala. Results revealed that Hybrid Napier variety NB 21 registered the highest fodder yield and protein content while para grass had the lowest. The experiment is being continued

Project (02) Evolving agrotechniques for forage crops under partially shaded and open conditions

7 **Biofertilizer studies in grass**
(FC/02 00 14 93/ACV(1)ICAR)

Results showed that biofertilizers have no significant influence on the fodder production of guinea and congo signal grasses tried in the experiment. But between the two grasses guinea grass was found superior in all the yield contributing characters than congo signal. Among the four levels of nitrogen (0, 75, 150 and 225 kg/ha) tried the highest level of nitrogen @ 225 kg/ha recorded the maximum green fodder yield (77.5 t/ha) but was on par with 150 kg N/ha

8 **Comparative fodder production potential of gamba grass (*Andropogon gayanus*) and guinea grass (*Panicum maximum*) under varying levels of nitrogen under coconut garden**
(FC/02 00 15 93/ACV(4)ICAR)

The objective of the trial is to make a comparative study on the growth performance and fodder production potential of two perennial fodder grasses namely gamba grass and guinea grass under three levels of nitrogen. Significant difference in their fodder production potential was noticed. Guinea grass recorded the highest green fodder yield and dry fodder yields (43.96 t/ha and 14.95 t/ha respectively). Fertilizer levels recorded no significant influence on fodder yields of the two grasses

9 **Seed production of gamba grass (*Andropogon gayanus*) under varying levels of nitrogen phosphorus and potassium**
(FC 02 00 12 89/ACV(1)KAU PG)

This experiment as a P.G. programme was started with the objective of studying the effect of three levels each of N, P and K on seed production potential of gamba grass. Field experiment has been completed chemical and statistical analysis were also done. Thesis is under preparation

10 **Agronomic evaluation of bio farming techniques for forage production in coconut garden**
FC/02 00 17/93/ACV(1)KAU/PG)

This experiment was taken up as a P.G. programme. The study aims at investigating the potential of bio farming techniques for production of forage

grasses It also aims at finding out the influence of nutrient management techniques on their uptake by crops quality of produce physico chemical condition of soil and also to work out the economics of these nutrient management techniques for forage production

Two separate experiments were laid out in coconut garden

In one trial guinea grass cv Hamil and congo signal grass were tried under 17 treatment combinations involving Azotobacter Azospirillum VAM and different NPK doses In the secord trial fodder production potential of guinea grass was tested under varying doses of vermicompost farmyard manure and NPK fertilizers separately and in combinations The experiment is in progress

11 Seed production of grasses under varying levels of NPK fertilizers
(FC/02 00 12 93/ACV(1)ICAR)

This experiment was taken up with the objective to find out the seed production potential of four grasses under varying fertiliser levels In this study it was observed that the Doob grass never flowered and set seed during the experimental period In guinea grass also seed setting was found to be less and as such the seed yield was very negligible Observations in respect of other crops are being recorded for further study

12 Influence of growth regulators on seed production of fodder grasses
(FC/02 00 15 89 ACV(1)KAU NP

Highest seed yield was in treatment with BA @ 5 ppm at 45 days after first cutting

13 Evaluation of fodder production potential of N fixing trees under different lopping managements
(FC/02 00 16 93/ACV(1)NARP)

This experiment was undertaken to compare the growth and bioproductivity of 4 N fixing trees *viz Acacia nilotica Sesbania sesban Pithecelobium dulci* and *Gliricidia spp* and to assess the fodder production potential of these trees under different lopping managements Since the initial growth of these trees was slow regular loppings were not started The experiment is in progress

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10. Medicinal and aromatic plants

HIGHLIGHTS

- Field experiments at AMPRS Odakkai showed that kacholam prefers organic manures instead of fertilizers Farm yard manure @ 30 t/ha gave 5 tonnes yield of produce and 23 litres of oil per ha Cytogenetical analysis in kacholam showed that the number of chromosomes in somatic cells is 2n = 55 Seedlessness is mainly due to incompatibility factors in the style and stigma and not due to cytological factors Protocol for the *in vitro* propagation of kacholam was developed The plants are being field tested

- Cheemathippa a geographical race of *Piper longum* was found promising for intercropping in irrigated coconut garden as it produced 300 kg spikes per ha

- Distinguishing morphological features of different species of *Rauvolfia* were discussed It was found that total crude alkaloid content in the roots and chloroform extract as well as chlorophyll content of the aexial parts were negatively correlated

- A catalogue of the available 400 accessions of lemongrass germplasm at AMPRS Odakkali was prepared and documented Three promising accessions of lemongrass *viz* OD 440 NLL 84 RRLB 1 were found suitable under rainfed conditions of Kerala

CONCLUDED EXPERIMENTS

1 **Multilocational trial of lemongrass in rainfed conditions**
/AMP/01 00 03 90/VKA (6/ ICAR)

With a view to isolate a variety of lemongrass having high oil yield and citral content a multilocational trial of selected lemongrass varieties *viz* NLG 84 NLG 85 OD 440 OD 442 RRL B1 were tested with OD 19 (local check) The experiment was laid out in Randomized Block Design with three replications The plot size adopted was 3 0 x 2 1 m^2 with a spacing of 30 x 15 cm Observations on herbage yield dry weight oil percentage total oil yield and citral content were recorded The pooled data of three years are presented in Table 1

The pooled analysis of data over three years showed that the highest herbage yield was recorded by the entry OD 440 which was on par with the entries NLG 84 OD 19 and RRLB 1 The entry OD 440 recorded 1 5 times higher herbage yield than OD 442

In the case of oil yield the entry OD 440 recorded the highest yield (348 20 kg/ha) and three entries were statistically on par The lowest oil yield was recorded by OD 19 (256 20)

The highest oil content was recorded by the entry NLG 85 and the lowest by the entry OD 19

Three years testing of entries has revealed that the entry OD 440 is giving

r g u vied c' e rtent al u he b s y yie s

he entry OD 440 can be adv s mtral a n w h OD S a a ses its performance ite ativ tors a

2 **Evaluation of selected geographical races of *Piper longum* L.**
AMP 9 89 vKA 16 CAR

To evaluate the performance of selected geographical races of *Piper longum* as intercrop in coconut gardens this experiment was conducted with four

selected races of *Piper longum* viz Pannyur, Pattambi, Cheemathippali and Kanoor.

The experiment was laid out in RBD with five replications. The spacing adopted was 60 x 60 cm with 2 plots of ... m. 20 t/ha farmyard manure was applied. No chemical fertilizers were applied.

Observations on spike yield, fresh and dry spike yield/ha (fresh and dry) were recorded for three consecutive years. The results are given in Tables 2 and 3.

Table 1 Pooled analysis of the yield data over three years (1990-93)

No	Entry	Herbage yield t/ha	Oil content %	Oil yield t/ha	Citral content %
1	NLG 84	64 96	0 428	279 50	74 30
2	NLG 85	54 39	0 5 6	345 47	48 00
3	OD 440	66 52	0 520	348 26	74 20
4	OD 442	44 54	0 595	286 29	73 93
5	RRLB 1	60 61	0 480	307 26	68 16
6	OD 19	66 20	0 405	256 20	72 55
	CD(0 05)	10 392	0 0609	64 122	2 62

Table 2 Performance of *Piper longum* races as an intercrop in coconut garden for three years (1991-94)

No	Entry	Dry spike yield (kg/ha)			Mean
		1991 92	1992 93	1993 94	
1	Pannyur	15 [illegible]	28 [illegible]	12 50	65 43
2	Pattambi	255 [illegible]	15[illegible]	73 34	228 81
3	Cheemathippali	433 3	200 9	262 59	298 93
4	Kanoor	316 7	139 5	291 11	249 10
CD	(0 05)	NS	61 5	82 13	–

Table 3 Performance of *Piper longum* races as intercrops in coconut garden (Result of pooled analysis [illegible] spike yield over three years)

No	Entry	Dry spike yield (kg/ha)
1	Panniyur	64 66
2	Pattambi	229 5
3	Cheemathippali	317 13
4	Kanjoor	23 [illegible]
	CD (0 05)	99 32

Data presented in Table 2 showed that out of three years except in 1993 94 the entry Cheemathippali recorded the highest dry spike yield and the yield was significantly superior to the other entries The entry Panniyur recorded the lowest dry spike yield in all the three years

Pooled analysis of three years data showed that Panniyur was the lowest dry spike yielder whereas all the other entries *viz* Cheemathippali Pattambi and Kanjoor were statistically on par The highest yield was recorded by the entry Cheemathippali with 317 kg/ha

The results conclusively proved that the entry Cheemathippali is a suitable variety for intercropping in coconut garden The Xth All India Workshop on Medicinal and Aromatic Plants held at Trichur recommended the entry Cheemathippali to be released as a promising long pepper variety for intercropping in irrigated coconut gardens

Further investigations on the quality evaluation of the different races should be done in order to find out the race with high medicinal value The agronomic practices to maximise the yield also should be worked out

3 Cytogenetic analysis in Kachcholam *Kaempferia galanga*

AMP 0 [illegible] 2 92 VKA 2 KAU [illegible]

To examine the chromosome number by mitotic and meiotic studies in order to verify the existing reports and to work out the karyomorphology of *Kaempferia galanga* and also to assess the problems in pollination and seed set in relation to chromosome pairing the present study was conducted with the local cultivar Vellanikkara

The salient findings of the study are summarised below

The best pre treating agent fixative and stain for mitotic studies were found to be α-bromonaphthalene Carnoy's II fluid and snows carmine respectively The best fixative and stain identified for meiotic studies were acetic alcohol and 1 per cent acetocarmine blended with a few drops of ferric acetate respectively

Root tip squash studies revealed that the number of chromosomes in somatic cells of *Kaempferia galanga* was 2n = 55 This number is being reported for the first time in this species The basic chromosome number of the genus is 11 and the species is a pentaploid Karyotype of the species is presented in Table 4

Meiotic studies revealed the presence of associations involving two or more chromosomes in addition to the univalents during diakinesis metaphase I Pentavalents quadrivalents and trivalents were observed in most of the PMCS

Mitotic and meiotic studies in *K galanga* indicated the possibility for segmental allopolyploidy in the species

Table 4 Karyotype analysis and chromosome classification in *Kaempferia galanga* L.

Chromosome No	Long arm (L) length (μm)	Short arm (S) length (μm)	Total length (μm)	Arm ratio	Chromosome type
1	0.76 ± 0.04	0.57 ± 0.07	1.33 ± 0.08	1.33	SM
2	0.65 ± 0.04	0.57 ± 0.05	1.22 ± 0.07	1.15	M
3	0.61 ± 0.05	0.55 ± 0.06	1.16 ± 0.11	1.10	M
4	0.64 ± 0.08	0.46 ± 0.04	1.10 ± 0.10	1.4	SM
5	0.59 ± 0.05	0.49 ± 0.03	1.08 ± 0.07	1.10	M
6	0.56 ± 0.05	0.50 ± 0.04	1.06 ± 0.07	1.10	M
7	0.51 ± 0.05	0.49 ± 0.04	1.00 ± 0.07	1.00	M
8	0.56 ± 0.03	0.43 ± 0.04	0.99 ± 0.06	1.30	SM
9	0.51 ± 0.01	0.43 ± 0.06	0.94 ± 0.07	1.19	SAT
10	0.47 ± 0.05	0.41 ± 0.03	0.88 ± 0.05	1.10	M
11	0.49 ± 0.08	0.39 ± 0.04	0.88 ± 0.06	1.05	SAT

SM Sub median M Median SAT Satellite

Studies on pollen fertility and viability revealed that pollen grains are having 73 per cent fertility (average) and it ranged from 46.91 per cent. The pollen grains also showed a mean viability of 69 per cent.

Studies on the factors contributing to non selfing of seeds revealed that cytological factors contributing to sterility were found to be meagre and hence the seedlessness in these crop was mainly due to incompatibility factors present in the style and stigma. The spiny stigma lengthy style and slow growth of the pollen tube were contributing towards seedlessness.

Further studies should be conducted in this crop in order to confirm the nature of ploidy as well as to unravel the phylogeny of this species. Investigations to confirm the nature of incompatibility reactions should also be taken up. The experiment using different methods of pollination should be carried out. *In vitro* pollination can also be attempted.

4 Collection, cataloguing and evaluation of *Rauvolfia* spp
(AMP/01 00 10 92/VKA(2)KAU/PG)

The objective of the experiment was to study the distribution of *Rauvolfia* sp. in different parts of Kerala and to make a descriptive study on different plant characters in order to prepare a descriptive blank and also to find out the total alkaloid content in the roots.

Rauvolfia species from different regions of Kerala *viz.* Peechi range of Thrissur and Palode range of Thiruvananthapuram, Thirunelly (Wynad), Alakkod (Kannur), Karhirappuzha, Mannarkkad (Palakkad), Edapal, Malappuram (Malappuram), Munderi, Nilambur and Vellanikkara were collected with the help of local people and brought to the College of Horticulture and planted in earthern pots of size 1 x 1 filled with potting mixture with proper labelling.

Observations on general plant habit, nature of stem, colour of young stem, colour of old stem, internodal length, number of leaves per node, types of leaves per node, appearance of lamina, colour of young leaves, number of glands on leaf axil, length of petiole, inflorescence position, orientation, branching habit, colour and shape of calyx and corolla, proportion of corolla to calyx, structure of androecium and gynoecium, colour of fruit, colour of seed coat and length, breadth and colour of root were recorded. The total alkaloid content was estimated using Cromwell (1955) and Sahu (1983) method.

The salient results of the study are summarised below

1) *Rauvolfia serpentina* is widely distributed in Kerala It prefers an open or partially shaded condition The frequency of occurrence is low *R tetraphylla* is sparse in forest lands It occurs along the roadsides waste lands and other places of human inhabitation The two species *R densiflora* and *R beddomei* are in a state of almost near extinction in Kerala while *R micrantha* appears to have completely disappeared Distinguishing features for the identification of different species of *Rauvolfia* in terms of morphology are suggested among which the mean height internodal length, shape and size of leaves number of flowers/cyme size and shape of sepals and corolla characters seem to be important (Table 5)

Table 5 Distinguishing characters of the accessions

Accession	Mean height (cm)	Internodal length (cm)	Shape & size of leaves	No of flowers/ cyme	Size & shape of sepals
A *(Rauvolfia tetraphylla)*	132	7 23	Dark green leaves with 3 types of leaves large medium & small with mean petiole length 0 72cm 0 35cm 0 2cm respectively	Few flowered (8 71)	Calyx with 0 17 cm length Sepals 0 12 cm long and saccate at the open ratio of corolla-caly x 2 88
B *(R serpentina)*	47 [illegible]	[illegible]	9 64 x 2 8 cm size medium dark and dark green upper sides of younger and older leaves	Many flowered (39 1)	Pale green calyx turning to red on ma u rity Sepals with a size of 0 25 cm w th acute apex Corolla was long and tubular with petal lobes of length 0 76 cm
C *(R densiflore)*	81 00	4 89	14 11 x 6 16cm size smooth with sharp acute leaf base wavy margin	Many flowered (51 8)	Pale green young sepals with green old sepals and having a length of 0 21cm
D *(R beddomei)*	93 13	1 34	Leaves with 12 24 x 3 75cm size with acute leaf base wavy leaf margin and acuminate leaf tip	Few flowered (11 0)	0 34 cm orig calyx pale green when young turns to green when old Apex of sepals acute Mean length of sepals 0 10 cm
E *(Rauvolfia sp)*	65 00	3 52	Leaves with 16 45 x 4 78 cm size with sharp acute leaf base wavy leaf mar gin and acu minate leaf tip	Few flowered (21 0)	Caly x 0 34cm a long pale green when young and green when old tip of the sepals curved Mean length of caly x 0 30 cm

Table 6. Variations in total crude alkaloid content (root) chloroform extract (aerial part) and total chlorophyll content (aerial parts) of *Rauvolfia spp* (on dry weight basis)

District		Localities	Total crude alkaloid content of roots (%)	Chloroform extract of aerial parts	Total chlorophyll content of aerial parts (%)
I	Accession A	(*Rauvolfia tetraphylla*)			
1	Thrissur	Peechi	1 09	4 34	0 944
2	Thrissur	Vellanikkara	1 03	6 76	0 543
3	Palakkad	Kanhirappuzha	1 35	5 52	0 616
4	Malappuram	Malappuram	1 18	6 04	0 873
		Mean	1 16	5 54	0 729
II	Accession B	(*Rauvolfia serpentina*)			
	Wynad	Thirunelli	2 65	2 09	0 333
	Kannur	Alakkod	1 33	2 74	0 517
	Malappuram	Munderi	1 58	2 19	0 346
	Malappuram	Edepal	1 63	2 16	0 268
	Palakkad	Kanhirappuzha	1 31	3 04	0 548
	Palakkad	Mannarkad	91	2 68	0 372
	Thrissur	Peechi	1 92	2 55	0 206
	Thrissur	Vellanikkara	2 09	2 87	0 382
	Thiruvananthapuram	Palode	1 53	3 48	0 599
		Mean	1 76	2 77	0 397
III	Accession C	(*Rauvolfia densiflora*)	1 49	8 20	0 482
IV	Accession D	*R beddomei*	1 77	3 91	0 352
V	Accession E	*Rauvolfia* sp	1 96	6 20	0 372

Chloroform extract and total chlorophyll content of the aerial parts varied among different species and ecotypes of *Rauvolfia* Total crude alkaloid content in the roots and chloroform extract of the aerial parts in *Rauvolfia spp* are negatively correlated with a correlation coefficient of 0 477 Total crude alkaloid content of the roots and chlorophyll content of the aerial parts are negatively correlated with a correlation co-efficient of 0 697 (Table 6) gives proof for the conclusion

5 Effect of graded levels of N, P and K on growth, yield and alkaloid content of *Catharanthus roseus*
(AMP/03 00 07 89/KAU)

In order to assess the role of major nutrients on the growth of *Catharanthus roseus* and to evaluate the response of *Catharanthus roseas* in terms of yield of plant material and alkaloid yield and also to arrive at a fertilizer schedule for this crop under Vellanikkara condition this

study was conducted The experiment was laid out in 3^3 factorial experiment with 2 replications confounding NP^2K in replication I and NP^2K^2 in replication II An absolute control was tagged in each block

Treatments N 50 100 150 kg/ha
P 30 60 90 kg/ha
K 30 60 90 kg/ha

Ammonium sulphate (20 5% N) Super phosphate (18% P_2O_5) and MOP (60% K_2O) were used for the experiment 1/2 N Full P and K were applied as basal and remaining N as top dressing in two equal splits FYM 5 t/ha was applied at the time of land preparation The experiment was conducted for two seasons 1989 90 to 1990 91 The spacing adopted was 30 x 40 cm with a plot size of 1 5 m x 2 0 m

Effect of N P and K on the yield and alkaloid content of *Catharanthus roseus* during 1989 90 and 1990 91 is given in Tables 7 and 8 respectively

The application of nitrogen had beneficial effect on yield and alkaloid content of *Catharanthus roseus* during both the years under investigation With increasing levels of N an increasing trend in root weight shoot weight total weight percentage of root and leaf alkaloids were noted in both the years Eventhough the values showed an increasing trend the differences were not significant for the vegetative characters tested for the first year of study but there was significant difference with respect to percentage of leaf and root alkaloids All the parameters tested showed significant differences during the second year of study

Table 7. Effect of N, P and K on the yield and alkaloid content *Catharanthus roseus* during 1989-90

	Root wt (g)	Shoot wt (g)	Root wt + shoot wt (g)	Leaf alkaloids (%)	Root alkaloids (%)
N_1	419 59	2408 81	2828 40	7 48	12 55
N_2	472 02	2757 40	3229 40	7 19	10 99
N_3	506 60	2702 56	3196 94	7 84	13 26
N_4	467 79	2593 36	3061 15	8 06	11 72
P_2	447 15	2573 44	3008 40	7 01	12 21
P_3	483 27	2701 96	3185 19	7 43	12 87
K_1	459 38	2520 17	2979 53	7 78	12 08
K_2	492 08	2692 70	3184 75	7 61	13 09
K_3	446 75	2655 90	3090 46	7 12	11 63
CD at 5% level	NS 81 35	NS 490 07	NS 556 26	— 0 26	— 0 38

(Transformed values are given for leaf and root alkaloids)

The root weight shoot weight and total weight estimates were found to increase with increasing levels of P showing significant differences betweeen the different levels tested Percentage of leaf and root alkaloids also showed significant differences between the levels tested The highest percentage of root alkaloids was recorded with the highest level of P in both the years Root characters like root girth root length and number of root laterals increased with higher level of P

The higher level of K applied showed a decreasing trend in estimates for percentage of leaf and root alkaloids in both the years under observation K at 60 kg/ha registered higher values for parameters like percentage of root and leaf alkaloids number of primary and secondary branches root length and number of root laterals During the first year of study K at 60 kg/ha recorded higher values for root weight shoot weight and total weight while K at 30 kg/ha recorded the highest values for the second year which were on par with the estimates for K at 60 kg/ha

Two factor interactions

The two factor interactions (N x P N x K and P x K) were found significant for the different parameters tested The highest

Table 8 Effect of N, P and K on the growth, yield and alkaloid content of *Cartharanthus roseus* during 1990-91

	Root wt (g)	Shoot wt (g)	Root + shoot wt	Leaf alkaloids (%)	Root alkaloids (%)	No of primary branches	No of secondary branches	Root length (cm)	Root girth (cm)	No of root laterals
N_1	737 82	4190	4930 04	7 97	2 03	6 42	15 78	25 97	4 26	20 37
N_2	748 22	4030	4778 44	7 54	11 70	6 06	16 08	27 02	4 44	21 56
N_3	758 08	4240	4995 30	7 58	13 24	6 36	16 82	27 64	4 43	20 30
N_4	725 83	4032	4758 05	7 16	12 32	6 46	16 16	25 93	4 40	21 00
P_2	758 07	4083	4841 40	7 52	12 36	6 23	16 30	27 69	4 32	20 02
P_3	758 22	4346	5104 33	7 80	12 29	6 15	16 22	27 00	4 41	21 21
K_1	749 82	4316	5065 38	7 25	12 54	6 16	16 13	26 43	4 41	20 27
K_2	739 76	4041	4780 88	7 77	12 58	6 43	15 50	28 08	4 34	21 24
K_3	752 54	41 05	4857 54	7 47	11 85	6 25	16 04	26 12	4 39	20 71
CD at 5% level	15 43	97 40	107 68	0 30	0 23	0 32	0 50	0 42	0 18	0 67

(Transformed values are given for leaf and root alkaloids)

level of N showed favourable effect for the different growth parameters with the highest level of P. With the highest level of applied N the lowest level of K gave significantly higher values for the different growth parameters. Similarly the lowest level of K applied showed favourable effect for the different growth parameters with the highest level of P.

Comparison of the treatment means showed that the treatment $N_3P_3K_1$ (150 90 30 NPK kg/ha) registered significantly higher values for root weight, shoot weight, total weight, root girth and percentage of leaf and root alkaloids.

EXPERIMENTS IN PROGRESS

Project (01) Exploration, collection and evaluation of germplasm of medicinal and aromatic plants

1 Morphological classification of the type collections of lemongrass available in the germplasm
(AMP/01 00 07 87/ODL/9)KAU)

Much variation was seen in colour of the leaf sheath among the types. The colour ranged between the red and white types including the exclusive red and white types. Majority of the types was affected by the smut disease. The susceptibility of the remaining types is not known. The yield characters showed much variability. The range of characters are given below.

1	Grass yield	29.2 - 363.7	g/plant
2	Oil yield	0.041 - 2.022	ml/plant
3	Oil recovery	0.12 - 1.23	% FWB
4	Citral content	37.5 - 90.7	%

The 406 oil samples were analysed for citral and other physicochemical properties of the oil. The data showed that in all the characters much variability existed between the various collections. But the general trend was that types having high oil recovery had low citral percentage and *vice versa*. A good type should have high oil content, citral content and grass yield. Detailed study is required for identifying the types having the above qualities.

2 Germplasm collection maintenance evaluation and multiplication of medicinal and aromatic plants
(AMP 01 00 09 87/VKA(16)KAU)

Two hundred and twenty five species of medicinal and aromatic plants which include rare and endangered species were maintained. New collections made during the period include Orilathamara (*Hybanthus enneaspermus*), Jeevakam (*Habenaria latislabris*) and Kaloorvanchi (*Rotula aquatica*). The collections of *Plumbago rosea*, *Holostemma annulare*, *Kaempferia galanga*, *Asparagus officinalis* and *Adhatoda beddomei* were enriched by collecting ecotypes.

3 Induction of genetic variability in Kacholam (*Kaempferia galanga* L.)
(AMP/01 00 11 92/VKA(2)KAU/PG)

From MV_1 generation studies treatments with 0.25, 0.5, 0.75 K gave more yield than the rest of treatments as well as control. The leaf size, plant spread as well as the vigour of the plants were also good.

For EMS treatment LD 50 is fixed as 1.5 per cent and duration of treatment is fixed as 10 hr based on germination data.

4 Yield and chemical characterisation of selected accessions of lemongrass germplasm
(AMP/01 00 14 93 ODL(9)/KAU)

Among the 418 accessions of lemongrass 20 top yielders recording more than 80 per cent were identified. The dry matter yield of accessions varied from 25.65 - 93.7 g/hill. The yield of oil also showed a wide variation from 0.533 to 1.03 ml/hill. Based on the analysis of variance of the data on the oil yield of the types in the three cuts 10 superior types were selected for subsequent evaluation with OD 19 as

check They are OD ... 1 ... 2? ... 307 34 68 303 ... 440

The essential oil of ... 8 ... was examined by gas chromatograph ... For seventy-seven types containing more compounds than citral in noticeable amount were identified for detailed studies

Project (02) Crop improvement in medicinal and aromatic plants

i) **Comparative evaluation of selected types of *Piper longum* in coconut plantations**
AMP/02 00 03 91 VKA (i)KAU PC

Observations were recorded for twenty three vegetative characters nine productive characters and total alkaloidal content in dried spikes of *Piper longum* for all the five types. The entry cheemathippali showed superior performance for all the important characters at all the stages and could be recommended for large scale cultivation after multilocational trials. Kanjoor also is a promising type since it differs only in a few characters with cheemathippli. The type Mala was found to be consistently inferior to all the other five types. Studies on the alkaloidal content in dried spikes are in progress

2 **Evaluation of Kacholam (*Kaempferia galanga* L.) types for morphological variability and yield**
AMP/02 ... 03 VKA ... KA...

The ... viz number of leaves leaf area, ... days to flowering plant ... number of rhizome fresh rhizome yield dry rhizome yield and oil percentage were found to be significantly different among the types studied both under open and shaded conditions. In addition height of leaves width of leaves number of suckers plant number of secondary rhizome and biological yield were found to be significantly different among the types under shade

Statistical analysis of the data is progressing

Project (03) Standardisation of agrotechniques for selected medicinal and aromatic plants

1 **Standardisation of propagation and stage of harvest in Adapathiyan (*Holostemma annulare* K. Schum)**
AMP 03 00 08 92 VKA (6)KAU PC

After the third stage of harvest the field trial was over. The chemical analysis of root sample was also completed

Table 9 Mean yield and income of different species of medicinal plants grown as intercrop in coconut garden

Sl No	Name of species	Yield/plot (kg)	Yield (t/ha)	Price/kg (Rs)	Total income ('000 Rs)
1	*Maranta arundinaceae*	4 93	5 60	4 00	22 4
2	*Kaempferia galanga*	65	80	100 00	18 00
3	*Curcuma aromatica*	1 48	1 65	25 00	42 [illegible]
4	*Piper longum*	0 16	0 [illegible]8	55 00	9 [illegible]0
5	*Coleus vetevercides*	15 50	16 89	5 00	84 45
6	*Plumbago rosea*	2 50	2 73	15 00	40 95

Ko ... ... the es mated ... ... was maximum in the ... ... Table 9

... ...

4 NPK trial on Kacholam
AV ... 03 8 ...

Application of ... FYM/ha gave the maximum rhizome yield of 7500 kg/ha ... significantly superior to application of inorganic fertilizers. Fertilizer ratios, levels, ... application of fertilizer had no effect on rhizome yield. This indicates that heavy application of organic manures is essential for realising optimum rhizome yield in Kacholam. With respect to oil yield and oil recovery application of fertilizers or FYM showed no significant effect. The quality of oil as assessed by gas chromatographic

Observ... ... ... The harvesting is proposed to be conducted during the month of May.

3 Screening of medicinal plants for intercropping in coconut garden (AMP/ ... 8 ... KAU)

Coleus vettiveroides recorded the highest yield followed by *Maranta arundinacea*

Table 10 Rhizome and oil yields and oil recovery of Kacholam as influenced by different levels and time of application of NPK

Treatment	Fresh rhizome (kg/ha)	Oil yield (l/ha)	Oil recovery (% on DWB)
Ratio of NPK			
2 1	[illegible]	25 77	[illegible]24
1 1	[illegible] 34	25 63	[illegible]28
CD(0 05)	[illegible]	NS	NS
Levels of N kg/ha			
30	550[illegible]	26 33	[illegible]30
60	576[illegible]	24 40	21
90	60[illegible]	24 63	[illegible]
100	[illegible]	27 40	1 3
CD(0 05)	[illegible]	NS	NS
Time of application			
2 splits	[illegible]67	26 00	1 24
3 splits	5633	25 40	28
CD (0 05	NS	NS	NS
Control (30+FYM/ha)	7500	27 53	1 22
Control	[illegible]	NS	NS

analysis did not show any significant variation between treatments (Table 10)

Project (04) Management of disease and pest of aromatic and medicinal plants

1) **Bioecological studies on the insects infesting medicinal and aromatic plants and their management**
(AMP 04 00 02/92 ACV (4) KAU)

Two Lepidoptera pests of *Tylophra asthmatica* (Vallippala) were got identified from IARI New Delhi

They are 1) *Dichromia orosia* (Noctuidae) 2) *Danaida aglea* (Danaidae)

The biology of the butterfly *D aglea* was studied Total life cycle is completed in 26 75 days the average egg larval and pupal period being 4 0 13 5 and 9 25 days respectively There are four larval instars larvae are voracious feeders causing severe defoliation of the crop

A new white fly (Aleurodidae) was observed on *Ocimum sanctum* Both the nymphs and adults of this showy white coloured white fly were found abundantly feeding on the under surface of the tender leaves causing fading of twigs *Solanum torvum* and *S nigrum* were also infested by this whitefly The pest was found as polyphagus species infesting several other crop plants and weeds The flies were collected and sent for identification

Project (05) Utilization and marketing of medicinal and aromatic plants

1) **Evaluation of lemongrass germplasm for oil quantity and quality**
(AMP/05 00 02 90/VKA(16)ICAR)

One hundred gram fresh sample (34 g dry matter) was taken for analysis from each varieties Two hours distillation in clevanger apparatus was sufficient to extract the oil Six collections were analysed for oil quality and quantity Citral percentage was estimated by GC

Table 11 **Estimation of oil percentage in vetiver**

Variety	Qty of root used for distillation kg	Volume obtained ml	% of oil
Hybrid 26	6 5	13 5	0 21
NC 66404	4 1	11 5	0 29
NC 66416	5 5	7 5	0 14

2) **Evaluation of vetiver germplasm for oil quantity and quality**
(AMP/05 00 03 90/VKA(16)ICAR)

Among the three varieties NC 66404 gave highest oil percentage (Table 11)

3) **Standardisation of analytical methods for the evaluation of some lesser known medicinal plants, *Aloe barbedensis, Tinospora cordifolia, Tylophora indica & Piper longum***
(AMP/05 01 89/VKA(16,ICAR)

Methods for *Piper longum* extraction is perfected The study is in progress

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11. Soils and Agronomy

HIGHLIGHTS

- Inoculation with *Pleurotus* sp and addition of urea to coir pith accelerated its decomposition in laterite soils
- In chilli cv Jwalasakhi wick irrigation at 100 per cent FC and coir pith mulching resulted in maximum WUE yield uptake of nutrients and profit
- In a study on the evaluation of different lining materials for seepage control lining with bricks pointed in cement and sand was found more suitable than lining with clay cowdung mixture and polythene
- Sub surface drainage system was found to be very effective in removing toxic salts and creating a conducive condition in the root zone of paddy in kari soils
- Field experiment at Chalakudy indicated that maintenance of 5 cm water during Kharif and 5± 2 cm during Rabi is the best water management practice for rice For the summer crop irrigation can be prolonged for three days after the disappearance of ponded water without yield reduction
- For economic yield in Nendran banana irrigation at intervals of 5 6 days with 5 cm depth of water from December May is required
- Application of oxadiazon @ 0 75 kg/ha and spade weeding at 60 and 90 DAP resulted in maximum weed control in cassava and produced highest tuber yield
- Weeds in sesamum could be effectively controlled by pre emergence application of 1 0 kg/ha metalochlor and 0 1 kg/ha oxyflourfen

CONCLUDED EXPERIMENTS

Project (01) . Management of laterite soils of Kerala

1 **Decomposition and mineralisation pattern of coir pith in latisols**
(SSA/01 00 02 91/VKA(3)KAU/PG)

A factorial experiment in CRD was carried out to determine the rate of decomposition of coir pith incorporated in a laterite soil under the influence of microbial inoculation Inoculation with *Pleurotus* sp (Cellulolytic organism) and addition of nitrogen in the form of urea accelerated the decomposition of coir pith in laterite soils Coir pith contained 1 03 per cent N, 0 09 per cent P 1 2 per cent K and 89 per cent C with a C N ratio of 90 1 After incorporation in the soil for a period of one year the C N ratio was lowered to 20 1

Project (03) Scheduling irrigation to crops and cropping system

2 **Evaluation of low cost technique in potted vegetables grown in roof gardens**
(SSA/03 00 09 92/ACV(1)KAU/PG)

A pot culture study with chilli cv Jwalasakhi was conducted at the College of Agriculture Vellayani to compare the efficiency of various techniques for economising water use The treatments included three levels of irrigation (60, 80 and 100 per cent FC) two methods of irrigation (drip and pot watering), three moisture conservation methods (coir pith mulching application of Jalasakthi and control) and their treatment combinations compared with wick irrigation as absolute control

Maximum yield was obtained for wick irrigation 100 per cent FC and coir pith mulching WUE was also maximum for coir pith mulching Drip irrigation recorded maximum WUE and 80 per cent FC resulted in higher WUE compared to other two irrigation regimes

Uptake of N P and K were maximum in wick irrigation and coir pith mulching N & K uptake were maximum at 100 per cent FC but P uptake was highest at 80 per cent FC

Maximum profit was realised by drip irrigation at 100 per cent FC along with coir pith mulching With drip irrigation and coir pith mulching 20 per cent water can be saved without much reduction in yield

Project (04) Storage, conservation and utilisation of water

3 **Studies on evaluation of different lining materials for seepage control**
(SSA/04 00 02 87/CLY(3)ICAR)

Seepage loss from the channels laid with different lining materials differed significantly Minimum seepage loss was noticed in polythene lined channel followed by brick lining pointed with cement and sand clay mixed with cowdung lined channel and unlined channel

The cost of lining with clay cowdung mixture was highest and it was damaged in a short period also Eventhough the initial cost of brick and cement lining is high it is durable and produced very little weed growth and required little maintenance Polythene lining eventhough produced only minimum seepage was damaged in a short period

Hence it is concluded that the channel lined with brick pointed in cement and sand is the most suitable

EXPERIMENTS IN PROGRESS

Project (02) Management of Kari, Kayal and Karappadom soils of Kuttanad

1 **Role of drainage in improving the physical condition and productivity of the lowland soils**
(SSA/02 00 02 90/KUM(3)NARP)

Chemical analysis of the soil after the field experiment with additional crop of paddy adopting different methods of drainage (tile drainage and drainage by gravitational flow) showed not much difference in water soluble as well as available nutrient elements except chloride The number of productive tillers and grain yield for the Punja crop was significantly higher in the tile drained plots compared to the control

2 **Effectiveness of tile drainage system on the changes of soil chemical properties with respect to time and performance of paddy crop in the kari lands**
(SSA/02 00 03 91/KDY(1)ICAR)

The effectiveness of sub surface tile drainage was compared with farmers practice of surface drainage by laying out an experiment with paddy in the field laid out with 15 m and 30 m laterally spaced tile drains Sub surface drainage system was

found to be very effective in removing toxic salts and creating conducive conditions in the root zone of paddy crop The Punja crop raised during the period performed better by yielding a higher grain weight, lower chaff percentage and more number of grains per panicle There was an incremental yield of 33 per cent in the 30 m spaced sub surface drained plots compared to farmer s practice Chemical analysis of the soils also revealed a decrease in the concentration of toxic salts in the root zone

3 **Morphological, physical and chemical characterisation of the soils of North Kuttanad**
(SSA/02 00 03 93/VKA(1)KAU/PG)

The soil samples from five selected villages of North Kuttanad collected before and after the closure of the Thanneermukkom barrage were analysed for their fertility characteristics (av N P K Ca & Mg) active and potential acidity and electrical conductivity

Project (03) Scheduling irrigation to crops and cropping systems

4 **On-farm water management studies - Pilot project**
(SSA/03 00 01/89 CLY(1)ICAR)

The results of the field experiment with Red Thriven during Kharif and "Chitteni" during Rabi indicated that for paddy during Kharif, maintenance of 5 cm water level is necessary and during Rabi stagnant submergence of 5± cm water is the best water management practice For the summer crop irrigation can be prolonged for three days after disappearance of ponded water without yield reduction The results are in agreement with the findings of 90 91 91 92 and 92 93

5 **Effect of irrigation and mulching in coconuts**
(SSA/03 00 05 91/CLY(1)KAU)

Irrigation treatments on West Coast Tall coconut palms planted in 1991 were started Application of fertilizers was done as per Package of Practices Recommendations

6 **Scheduling irrigation in ginger (Zingiber officinale) under varying nitrogen levels**
(SSA/03 00 06 91/CLY(1)ICAR)

The results so far obtained showed that nitrogen levels have no significant influence on the rhizome yield of ginger Irrigation at IW/CPE ratio of 1 5 produced maximum yield which was on par with a ratio of 1 0 These two levels of irrigation were significantly superior to irrigation at a IW/CPE ratio of 0 5 and no irrigation

7 **Response of banana cv Nendran to graded doses of N & K under different water management practices**
(SSA/03 00 07 91/CLY(09)ICAR)

Maximum bunch weight was recorded by irrigation at 20 mm CPE which was on par with irrigation at 40 mm CPE and the farmer s practice For economic yield Nendran banana has to be irrigated at an approximate interval of 5 6 days with 5 cm depth of water from December to May The present rate of recommendation of N & K is sufficient for banana grown under irrigated conditions

8 **Characterisation of soil and irrigation water of the sugarcane belt in Palghat in relation to yield nutrient uptake and quality of cane**
(SSA/03 00 08 92/VKA(3)KAU PG)

One hundred and ninety seven soil and 47 irrigation water samples collected from different locations in the sugarcane belt in Palghat were analysed for their physico chemical properties Variation in the quality of irrigation water used for irrigating the crop was also estimated at monthly intervals The yield of sugarcane nutrient content and uptake quality of cane juice etc have been estimated and are being correlated with the characters of soil and irrigation water

9 **Response of coconut to different methods of irrigation**
(SSA/03 00 10 92/CLY(1)KAU)

Irrigation treatments (drip, basin and farmer's practice) were started from January 94 taking daily evaporation data

Fertilizer application was done as per Package of Practices recommendations

10 Drip and furrow methods of irrigation in betelvine
(SSA/03 00 11/92 CLY(1)KAU)

Results from previous years study showed that the treatments have no significant influence on the total weight of betelvine leaves However, drip irrigation at 100% Eo recorded the highest weight of leaves while the lowest leaf weight was produced by drip irrigation at 75% Eo

Since the older betelvines were damaged due to the collapse of the Pandal structure a new crop has to be replanted during August / Sept 1995

Project (04) Storage, conservation and utilisation of water

11 Evaluation of long term effect of irrigation as changes in physical and chemical properties of soil
(SSA/04 00 01 85/CLY(3)ICAR)

Garden and wetland soils from selected locations in the Command Area of the Periyarvalley Irriga n Project were analysed during the hth yee for hydraulic conductivity bJi ensity pH EC organic carbon, available P & K and Ca & Mg

The study is being continued

12 Effect of various mulches on the growth and yield of banana cv Palayankodan grown under irrigated and rainfed conditions
(SSA/04 00 04 90/CLY(1)ICAR)

Irrigating banana at 30 mm CPE and mulching with dried leaves recorded the maximum yield of 10 78 kg/plant followed by mulching with polythene sheet The results of the study showed that higher yields of banana could be obtained by supplemental irrigation coupled with suitable mulching during summer season

Survey work was temporarily suspended based on the oral instruction of the Quinquennial review team (ICAR) May 92

13 Shade tolerance of different weeds
(SSA/05 00 02 89/VKA(1)ICAR)

The project is discontinued

14 Ecophysiology and management of Isachice in rice fields of Onattukara
(SSA/05 00 03 90/VKA(1)KAU/PG)

The study is in progress The results can be presented after thecompletion of statistical analysis

Project (06) . Integrated control of weed in Kerala

15 Effect of Oxyfurofen for weed control in dry sown rice
(SSA/06 00 03 91/KVA(3)KAU/PG)

No work reported

16 Control of phenerogonic practices infecting mango
(SSA/06 00 04 92/ACV(1)KAU/PG)

No work reported

1 Biology of orthogalumma terebrantis walwock on water hyacinth
(SSA 06 05 92/VKA(4)KAU/PG)

No work reported

18 Integrated weed management in Cassava
(SSA/06 00 10 92/VKA(1)ICAR)

By applying oxadiazon @ 075 kg/ha + Spade weeding at 60 and 90 DAP the highest tuber yield of 14 1 t/ha was obtained Weed population as well as weed dry matter were lowest with the application of 1 5 kg/ha pendimethalin + spade weeding at 60 and 90 DAP and produced a tuber yield of 13 7 t/ha Un weeded control plots produced the highest weed dry matter and lowest tuber yield which were significantly different compared to the above treatments

The experiment has to be continued to arrive at conclusive results

19 Integrated weed management in Sesamum
(SSA/06 00 11 92/VKA(1)ICAR)

The weeds in sesame could be effectively

19 **Integrated weed management in sesamum**
(SSA/06 00 11 92/VKA(1)ICAR)

The weeds in sesame could be effectively controlled by the application of metalochlor @ 1.0 kg/ha both as pre plant incorporation and as pre emergence application and 0.1 kg/ha oxyflourfen as pre emergence application. The highest yield of sesame was recorded in plots where Metalochlor @ 1.0 kg/ha was given as pre plant incorporation and Fluchloralin @ 1.0 kg/ha as pre emergence application

20 **Influence of herbicide combination on the growth and yield of transplanted rice**
(SSA/06 00 12 92/VKA(1)ICAR)

No work reported

21 **Biology and control of *Pennisetum polystachyon***
(SSA/06 00 13 92/VKA(1)ICAR)

Based on three years of study it is inferred that Glyphosate @ 1.2 kg/ha + 0.5% ammonium sulphate can effectively control *Pennisetum polystachyon* a serious weed in plantations

Biological studies on the weed is being undertaken

22 **Evaluation of joint formulation of Anilloguard and 2, 4-DEE for the control of weeds in dry sown rice**
(SSA/06 00 14 92/VKA(1)KAU/PG)

A field experiment in split plot design with paddy cv Jyothi was conducted The results are being statistically analysed

Project (07) Management of iron toxicity in rice fields

23 **Evaluation of the ill effects of iron in Chalakudy command area under different water management practices**
(SSA/07 00 01 91/CLY(1)ICAR)

The results of the field experiment with paddy under different levels of lime and irrigation conducted during Rabi showed superior effect of single top dressing with lime @ 900 kg/ha on yield which was on par with lime application @ 600 kg/ha During summer season lime @ 600 kg/ha as one top dressing registered the highest yield of 3632 kg/ha and was on par with the yield of 3605 kg/ha obtained by the application of 900 kg lime as one top dressing

Neither different levels of irrigation nor its interaction with lime exerted any significant influence on grain yield during both seasons

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12. Plant protection

HIGHLIGHTS

- Studies on residual toxicity of carbofuran on cucumber revealed that application of the chemical is to be avoided at the flowering stage Peeling of the outer skin of the fruit reduced the residue considerably
- Fungal pathogens like species of *Fusarium, Colletotrichum gleosporioides* etc can be utilised for biocontrol of the weed water hyacinth
- Neem oil is found to be an effective material in the management of pests infesting various crops

CONCLUDED EXPERIMENTS

1 **Chemodynamics of carbofuran in cucumber**
(PP/06 00 02 91/ACV(4)KAU/PG)

The main objective was to study the behaviour of the insecticide carbofuran when applied at various stages of the growth of the crop and the terminal residues in fruits The results of the study indicated that active absorption and metabolism of the compound was detected on the first day of application When applied one week after sowing the highest level of total carbofuran was observed in the leaves on the third day after treatment and the levels being 0 995 and 1 248 mg/kg for the doses 0 5 and 1 5 kg ai/ha The distribution of carbofuran residues in different portions of cucumber fruits, top middle and basal when treated at the flowering stage showed that the highest level of carbofuran was detected in the distal portion followed by middle and basal portion This showed that the distal portion of the fruit carried maximum residues following insecticide application The residue was also found to be more in the flesh portion than in the placenta Studies on the effect of different periods of storage on the degradation of carbofuran residues in the fruits showed that the metabolism and degradation of the compound continued even after the fruits were harvested The results also revealed that for the safe consumption a waiting period of 25 26 days should be recommended at doses of 0 5 and 1 5 kg ai/ha respectively Since cucumber fruits are harvested 20 36 days after flowering the use of carbofuran granules at the time of flowering stage of the plant should be avoided It was also observed that peeling of the outer skin could reduce the level of carbofuran residues considerably

2 **Screening of fungal pathogens for biocontrol of water hyacinth *Elchhornia crassipes* (Mart) Solms**
(PP/04 00 11 92/ACV(5)KAU/PG)

The main objective of the study was to screen different fungal pathogens of water hyacinth so as to evaluate their biological potential A survey conducted revealed seven fungi, *viz Colletotrichum gloeosporioides Curvularia lunata Fusarium equiseti Fusarium semitectum F solani, R solani* and a sterile fungus as pathogen of the plant and among them *F semitectum* caused highest intensity of infection of 5 10 per cent followed by

F equiseti and *F solani* (48 88%) Wheat bran was found to be a good medium for multiplication of these fungi For the effective destruction of the water hyacinth a spore concentration of $10x10^9$ spores/ml and $2x10^9$ spores/ml respectively for *Fusarium* spp and *C gloeosporioides* were found to be optimum

3 **Investigations on the occurrence of recombinants / hybrids in *Phytophthora* and their role in the intensity of *Phytophthora* diseases of plantation crops**
(PP/10 00 02 89/ACV(5)STEC)

The main objectives were identification of *Phytophthora* spp from the various plantation crops which are grown as multistoryed or as single cropping system

On the basis of comparibility with standard A^1 and A^2 mating types isolates made in the present study the distribution of various types in pepper and coconut plantations were made Study on the interspecific crosses of the isolates of diverse origin showed that there are chances of occurrence of recombinants in these plantations

ONGOING EXPERIMENTS

Project (01) Use of insect growth inhibitors in pest control

1 **Evaluation of Dimilin and its combinations with different insecticides against vegetable pests**
(PP/01 00 01 90/ACV(4)KAU)

In a field trial conducted with Dimilin alone and in combination with Carbaryl and Malathion against pest of snakegourd the results revealed that the population of snakegourd semi looper *Anadevida peponis* was reduced by all the treatments However, fruit flies were not controlled by any of the treatments

Project (02) · Use of microorganisms for pest control

2 **Survey and identification of natural enemies of vegetable pests**
(PP/02 00 03 89/ACV(4)KAU)

Rhizopus stolonifer isolated from red cotton bug, was found to be a potent pathogen against many important crop pests like rice bug coried bug mealy bug etc

3 **Compatibility of insect pathogens with insecticides and insect growth regulators**
(PP/02 00 07 90/ACV(4)KAU)

Compatibility studies were taken up with *Fusarium pallidoroseum* and it was found that Dimethoate, Quinalphos and Fenthion are compatible with this fungus

4 **Host specificity, pathophysiology and transmission of the Baculovirus (Kerala isolate) infecting *Oryctes rhinoceros* Linn (Scarabaeidae Coleoptera)**
(PP/02 00 09 90/VKA(4)KAU/PG)

The infection of Baculovirus in *Oryctes rhinoceros* is mainly transmitted during mating Cross infectivity studies revealed that the pathogen was not infecting red palm weevil coconut root grub coconut caterpillar etc The pathogen was safe to silkworm white mice and white rat

Project (03) Use of botanicals in pest, nematode and disease control

5 **Evaluation of plant products for pest management**
(PP/03 00 01 89/VKA(4)KAU)

Neem oil at 10 per cent was observed to have highest persistent toxicity in green

peas followed by cowpea Lowest PT value of neem [illegible] be in bengal gram in green gram [illegible] and 100 per cent mortality of pulse [illegible]

8 **Isolation of bioactive principle of *Thevetia neriifolia* Juss Apocynaceae and determination of the biological activities**
(PP 03 [illegible] ACV 4 KAU PG)

Trials with water and alcohol extracts of *T neriifolia* on amaranthus and bittergourd in comparison with the insecticide Carbaryl was studied

7 **Effect of selected medicinal plant extracts on the incidence of pumpkin mosaic**
(PP/03 00 06 91/ACV(5)KAU/PG

Initial screening of thirty medicinal plants were completed and five medicinal plants having antiviral effect against pumpkin mosaic virus selected for further studies

8 **Management of virus diseases of chilli by use of plant products**
(PP 03 00 07 91/ACV(5)KAU)

Leaf extracts of *Azadirachta indica* *Ocimum sanctum* *Polyalthia longifolia* *Vinca rosea* *Phyllanthus niruri* *Clerodendron infortunatum* *Curcuma longa* were screened to study their inhibitory effect against virus It was found that the extracts of *Polyalthia longifolia* *Phyllanthus niruri* *Clerodendron infortunatum* and *Curcuma longa* gave 100 per cent inhibition of chilli mosaic virus followed by *Azadirachta indica* and *Vinca rosea* (90 per cent)

9 **Effect of plant extracts on the fungal pathogens of rice**
(PP/03 00 08 91/ACV(5)KAU)

No work reported during this period

10 **Effect of medicinal plant extracts on fungal diseases of cowpea**
(PP/03 00 09 91/ACV(5)KAU)

Leaves of medicinal plants belonging to three different families were taken *Lansonia incenus* *Melia azadirachta* and *Vinca rosea* were selected to study the effect The fungal pathogens viz *Colletotrichum gloeosporioides* *Phytophthora vexans* and *Rhizoctonia solani* were isolated from diseased cowpea leaves and roots Maximum inhibition of growth was found in the treatments in which *Vinca rosea* was used This was followed by neem In *R solani* none of the plant extracts caused reduction in radial growth There was a slight stimulation of growth of *R solani* in liquid media indicating that a higher concentration of substances present in leaf extracts is required to inhibit growth of certain fungi

11 **Efficacy of seed oils as antimicrobial agents**
(PF 03 00 10 91/ACV(5)KAU)

In vitro effect of some of the seed oils on *Phytophthora* sp and *Xanthomonas* sp was studied Seed oil of *Azadirachta indica* (5 per cent) and *Hydrocarpus weightiana* (5 per cent) gave maximum inhibition of the growth of *Phytophthora* spp

12 **Effect of extracts of *Clerodendron infortunatum* on the epilachna beetle *Henosepilachna vigintioctopunctata* with relation to safety of its natural enemies**
(PP/03 00 14 94/ACV(4)KAU/PG)

Screening of extracts from different parts of the plant Clerodendron was initiated

13 **Screening of medicinal plants for antiheiminthic properties against different life stages of banana burrowing nematode *Radopholus similis***
(PP/03 00 15 90/ACV(4)KAU/PG)

Burrowing nematode (*Radopholus similis*) isolated from banana root is found to multiply in carrot disc placed in agar medium under sterile condition

Project (04) Biological control of weeds insects and diseases

14 Biological control of *Eichhornea crassipes*
(PP/04 00 01 83/VKA(4)KAU)

Field release of the natural enemy of the weed *Orthoga umna* was continued and field studies revealed that their establishment was poor and the impact of them on the weed was not satisfactory Preliminary studies carried out on the biology and nature of damage of this mite on the weed was carried out The number of ovipositional holes varied with the mite population and they were uniformly distributed on the leaves

15 Biological control of *Salvinia molesta*
(PP/04 00 02 83/VKA(4)ICAR)

Field release of the natural enemy *Cyrtobagous* continued and their field survival studied

16 Biological control of *Parthenium hysterophoresis*
(PP/04 00 03 87/VKA(4)ICAR)

Breeding of the beetle *Zygograma* the natural enemy of the weed has been continued

17 Biological control of *Chromolaena odorata*
(PP/04 00 04 87/VKA(4)ICAR)

Field trials carried out showed that the performance of the natural enemy of the weed, *viz Pareuchates pseudoinsulata* showed the maximum hatching percentage with a sex ratio of 1 1 for all the field combinations

18 Bionomics of *Pareuchates pseudo-insulata* Rejo Barris (Lepidoptera) Arctiidae and its interaction with the siam weed *Chromolaena odorata* Kinj and Robinson (Asteraceae)
(PP/04 00 05 91/VKA(4)KAU/PG)

Pareuchates pseudoinsulata was identified as a potential bio control agent of *C odorata*

19 The biological environment of forage grass phylloplane
(PP/04 00 07 91/ACV(5)KAU)

Samples were collected from the livestock development farm Dhoni Palghat Kannoor and Vellanikkara The forage crops included guinea grass napier grass para grass and hybrid napier *R solani* was found to be the prominent pathogen during July August period Quantitative estimation of the natural phylloplane microflora of the above crops was also studied Several like species of *Helminthosporium Alternaria Colletotrichum Rhizopus Trichoderma* were obtained None of them except *Trichoderma* sp has shown antagonistic activity against *R solani*

20 Biological control of soil-borne diseases
(PP/04 00 08/ACV(5)KAU)

Six species of *Trichoderma* were isolated and screened to test them for *in vitro* antagonism against soil borne pathogen *Rhizoctonia solani* using dual culture method

Maximum inhibition was noticed in *T viride T harzianum* and *T pituliferum* The species of *Trichoderma* were found to grow and sporulate best in rice / wheat bran for mass multiplication

21 Biological control of seed mycoflora of vegetables using *Trichoderma* spp
(PP/04 00 09 91/ACV(5)KAU)

Interaction between *Trichoderma* spp and seed borne fungi was studied Cessation of growth of mycoflora was noticed at the point of contact with test organism except in *Rhizopus oryzae* and *Aspergillus flavus*

Project (05) Monitoring pesticide residues in food commodities

22 Residues of insecticides applied for the control of pollu beetle of pepper
(PP/05 00 01 88/ACV(4)ICAR)

Field study on the dissipation of Mancozeb on pepper was carried out The chemical

was sprayed twice in two doses at 0 2 per cent and 0 4 per cent spray Analysis of the spike at 1 3 7 14 21 and 28 days after second spray revealed that in fresh pepper berries the initial residues were 6 90 and 13 48 mg/kg when applied at 0 2 and 0 4 per cent respectively This dissipated to 97 84 and 99 8 per cent by 28 days after treatment In dry pepper the residue was 23 54 and 38 30 mg/kg respectively for lower and higher doses No residue was detected in dry pepper on 28 days after treatment Waiting period of Mancozeb on fresh pepper berries when treated at the recommended dose (0 2 per cent) was 14 62 days and at double the recommended dose was 19 43 days and corresponding values in dry pepper were 19 43 and 21 56 days respectively

23 Studies on waiting periods of insecticides recommended for paddy pest control
(PP/05 00 04 87/ACV(4)KAU)

No work during the year

24 Studies on waiting periods of insecticides recommended for the control of pests of spices
(PP/05 00 05 87/ACV(4)KAU)

No work during the year

25 Monitoring insecticide residues in vegetables collected from markets
(PP/05 00 06 89/ACV(4)ICAR)

Residue analysis of vegetables from farmers' field revealed that Monocrotophos and Phosphamidon were the two insecticides preferred by farmers and the dosage used was higher than recommended dose Residue of the insecticides in cowpea pods ranged from 0 79 to 1 54 ppm which is 4 7 times of MRL fixed for these chemicals In bhindi the residue of Phosphamidon (0 44 to 0 94 ppm) which was two to five times of MRL

However, none of the samples of brinjal and snakegourd showed insecticide contamination

Project (06) Persistence and dissipation of insecticide residues in crops

26 Insecticide residues of treated crops
(PP/06 00 07 92 ACV (4) CSP)

(i) Fate of Carbofuran applied to soil basin of black pepper

Sorption experiment and field experiment to assess the mobility of pesticide during the monsoon periods are in progress

(ii) Carbofuran residues in amaranthus

As a result of detailed field trial and residue analysis the waiting periods were fixed for Carbofuran in amaranthus as 28 and 30 days for 0 5 kg ai/ha and 1 kg ai/ha respectively

(iii) Monocrotophos residues in coconut

Coconut pulp and water were fortified with different concentration of Monocrotophos and the insecticide re extracted as per the protocol supplied by TNAU But recovery was poor and the procedure is being standardised

(iv) Carbofuran residues in cowpea

The study revealed that the active absorption initiated from the first day of application and the highest level of residues was detected on the 7th day after application and a slow decline thereafter when applied at the flowering stage @ 0 5 and 1 0 kg ai/ha The residues took 27 and 29 days to reach below MRL of 0 1 ppm in the lower and higher doses respectively

(v) Residues of Mancozeb in cardamom capsules

Studies with Mancozeb showed that a waiting period of 3 weeks may be recommended for safe use of Mancozeb in cardamom Data on the effect of processing on the removal of residues indicated that there is tremendous scope for studying this effect for the recommended contact insecticides Rigorous washing of capsules immediately after harvest may help to remove considerable portion of surface residues

(vi) Supervised trial for Lindane and Endosulfan in cowpea

The dissipation pattern of Lindane in cowpea showed that when applied @ 0 05 per cent and 0 1 per cent the residues dissipated from an initial deposit of 1 37 mg/kg and 2 43 mg/kg to ND and 0 08 respectively on 15 days after application At harvest the residue was below detectable level in pod cover and grains The decontamination of washing and cooking of the Lindane residues ranged from 25 5 to 46 9 per cent by washing alone and washing followed by cooking removed 30 66 to 59 38 per cent of Lindane residues

(vii Pesticide residues in paddy

Determination of the residue of Quinalphos and Butachlor applied at 1 0 kg ai/ha and 2 0 kg ai/ha at transplanting stage and Triazophos at 0 25 kg ai/ha and 0 5 kg ai/ha one month before panicle emergence showed that the residues were below detectable level in grain, husk and straw In Triazophos also the residues were below the detectable levels excepting in straw A residue level of 0 01 and 0 14 ppm were detected at lower and higher doses of Triazophos respectively

(viii) Quinalphos residues in brinjal fruits

Dissipation of Quinalphos was studied on brinjal plants adopting gas chromatographic analysis Upto 95 per cent of initial spray deposit on fruits dissipated with in a week However the statistical computation arrived at a safe waiting period of 11 days for Quinalphos even at double the recommended dose Hence the application of Quinalphos for the control of shoot and fruit borer in brinjal may be restricted only in the vegetative phase of the crop and any insecticide with short waiting period (3 4 days) may be preferred for pest control

27 Monitoring pesticide residues in animal food
(PP/06 00 08 93/ACV(4)AICRP)

The study revealed that the main source of contamination in milk and milk products by insecticide is through feed concentrate which are fed to animals

Project (08) Pest surveillance and forecasting

28 Epidemiological studies on important rice diseases in Kuttanad
(PP/08 00 02 76/MON(4)KAU)

Correlation of disease incidence with weather parameters was carried out

Project (09) Solarization for the control of soil pests, plant diseases and weeds

29 Effectiveness of soil solarization for the control of soft rot disease of ginger
(PP/09 00 01 91/VKA(5)KAU/PG)

Observations on the total population of microbe, nematode, earthworm and weed were recorded at regular intervals The soft rot incidence has been recorded at fortnightly intervals

Project (10) Strain variation in pathogenic nematodes & fungi

30 Morphology and taxonomy of *Colletotrichum gloeosporioides* infecting important plantation crops
(PP/10 00 01 91/ACV(5)KAU)

Cultural and morphological characters of different isolates of *Colletotrichum gloeosporioides* obtained from rubber cashew and cocoa from different locations were studied and variations recorded

31 Distribution of species of Phytophthora affecting coconut and pepper in Kerala
(PP/10 00 03 91/ACV(5)KAU/PG)

Fourteen isolates of Phytophthora (6 pepper 4 coconut 2 cocoa, 2 orchids) were isolated and the morphological characters studied The isolates from coconut were *P palmivora* and those from pepper *P capsici* Inoculation studies with pepper and coconut isolates on coconut were successful Coconut isolate could also produce symptoms of foot rot on pepper, while pepper isolate failed to infest coconut

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7. Biotechnology

HIGHLIGHTS

- Viable protocols were developed for rapid *in vitro* cloning of elite plants of black pepper and for the successful establishment of plantlets
- Protocols were developed for the *ex vitro* establishment of pineapple plantlets
- Ginger plantlets could be propagated *in vitro* and planted out
- Protocols were developed for the mass *in vitro* clonal propagation of *Kaempferia galanga* and for the field establishment of the plantlets
- Protocols were developed for the micropropagation of the medicinal plants *Adathoda bedomeii* and *Holostemma annulare*
- Protocols for the *in vitro* propagation and *ex vitro* establishment of *Anthurium andreanum* could be evolved
- Somatic embryoids could be produced from the nucellus tissues of mango varieties
- Somatic embryoids could be produced from the cotyledons and embryonic axes of cocoa
- Mature seeds of ginger were produced *via in vitro* placental pollination

CONCLUDED EXPERIMENTS

1 **Standardisation of *in vitro* propagation techniques in *Gymnema sylvestre*** (BT/01 01 11 89/VKA(16)KAU/PG)

Profuse callusing could be induced from leaf and stem segments of *Gymnema sylvestre* on MS medium supplemented with BA 0 5 mg/l NAA 1 0 mg/l and sucrose 30 0 g/l Efforts for inducing re differentiation were not successful Somatic embryoids formed in a few instances failed to develop beyond the torpedo stage Multiple shoots could not be induced using the sprouts from nodal segments cultured on half strength MS medium supplemented with kinetin 0 4 mg/l and IAA 2 0 to 5 0 mg/l Microbial interference hindered culture establishment of explants collected during May to December

The results indicate the necessity of further studies for evolving techniques for the *in vitro* propagation of the crop

2 **Enhancing *in vitro* response of explants from mature jack (*Artocarpus heterophyllus* Lam) trees**
ST/0 C 1 3 ACV(10 KA PG)

Attempts to improve the *in vitro* propagation effic ency of mati re phase jack trees were made Among the stock plant treatments tried grafting on to juvenile rootstock was found to be effective in improving the *in vitro* response o explants Cold shock at 20°C f r five m nutes as well as near treatmen at 42 C for two m nutes were the beneficial stress treatments for improving the *in vitro* response Using explants from grafts was also benef cial Season was found to play a significant role on the response of mature explants the highest response being observed during March to April

3 **Standardisation of medium supplements for shoot proliferation in Dendrobium**
(BT 01 01 21 92/VKA(5)KAU/PG)

A successful method for the *in vitro* propagation of *Dendrobium nobile* was standardised Axillary buds were established on half strength MS medium or Vasin and Went medium supplemented with NAA 1 0 mg/l and BA 3 0 mg/l Shoot proliferation was ach eved on Vacin and Went medium supplemented with NAA 2 0 mg/l + BA 5 0 mg l + peptone 40 mg/l - glucose 30 0 g/l (16 7 shoots per culture) as well as on half strength MS medium containing NAA 2 0 mg/l + BA 5 0 mg/l + casein hydrolysate 50 mg/l + sucrose 30 0 g/l (9 3 shoots per culture) Knudson C medium containing 30 0 g/l glucose was the best for *in vitro* rooting The plantlets could be established well in the open in a potting medium containing coconut husk

4 **Induction of genetic variability in *Musa* sp var nendran by *in vitro* methods**
BT/01 01 23 92/VKA(5)KAU/PG)

Callus could be induced from explants of banana excised from growing shoot tips leaf bits and basal leaf sheath Maximum callus index (281) was observed when 2 4 D 7 0 mg/l + BA 1 0 mg/l were included in the medium Embryo like bipolar structures were formed from scalp callus when transferred to medium devoid of plant growth substances

A multiplication rate of 8 7 shoots per culture resulted when shoot apices were cultured on MS medium supplemented with NAA 2 0 mg/l + BA 10 0 mg/l Rate of multiplication varied with the number of subcultures and did not follow any specific pattern For *in vitro* rooting MS medium containing NAA 10 0 mg l and activated charcoal 0 05 per cent was ideal

Plants derived from various subculture cycles differed in the rate of growth with respect to height and leaf area However no difference in chromosome number (2n = 33) was observed

5 ***In vitro* propagation of bijasal (*Pterocarpus marsupium* Roxb) through tissue culture**
(BT 01 01 24 92 VKA(F)KAU PG)

Woody Plant Medium supplemented with 2 0 mg/l kinetin and 0 1 mg/l IAA was useful for inducing multiple shoots from primary explants Lack of further leaf production and growth in the multiple shoots formed and the problem of leaf abscission were major hurdles in evolving a protocol for the *in vitro* propagation of bijasal Cycocel 0 75 mg/l incorporated in the culture medium helped the retention of leaves though the number of multiple shoots was reduced

6 **Standardisation of media and containers for *ex vitro* establishment of *Anthurium* plantlets produced by leaf culture**
(BT 01 02 02 92/ACV(10)KAU/PG)

Potting media and containers were standardised for the successful *ex vitro* establishment of anthurium plantlets Plantlets with 2 5 to 3 0 cm size (with 3 4 leaves and two or more roots) recorded upto cent per cent *ex vitro* establishment Soilrite was the best rooting media Plastic pot polythene cover and mudpot were the suitable containers

7 ***In vitro* multiplication and standardisation of hardening techniques in pineapple (*Ananas comosus* L Merr)**
BT 01 03 0 - V A(15)KAU PG)

Crown and suckers were found to establish well in MS medium supplemented with BA and NAA Proliferation of the nodular structures formed on subculture of the primary cultures was the best in MS medium supplemented with BA with or without 1 0 mg l NAA Profuse rooting of shoots was observed in MS medium containing IBA 1 0 to 2 0 mg/l Methods were standardised for the successful establishment of the plantlets in the field immersing the roots of plantlets in water for 18 hours prior to planting out increased the survival Potting mixtures like cocoapeat soilrite and biofibe were found to be good Treating the plantlets with nutrient starter solutions (NPK fertilizer solution or 1/4 strength MS salt solution) once in a week resulted in vigorous growth Artificial seeds using calcium alginate could be produced The plantlets after three months of hardening in the greenhouse and having 10 cm height and 12 leaves could be planted in the open field

8 **Anther culture in cocoa (*Theobroma cacao* L)**
(BT/02 01 03 91/VKA(2/KAU/PG)

Callus pro embryoids and embryoids could be produced from the anthers of cocoa varieties The embryoids could be germinated into plantlets However, the plantlets subsequently dried up and the regeneration process was not repeatable

9 **Induced mutation in rose adopting *in vivo* and *in vitro* cultures**
(BT/02 02 01 88/ACV(10)KAU/PG)

Techniques were standardised for the *in vitro* propagation of rose cultivar Folklore Budwoods were collected at five different growth stages and exposed to gamma rays at 20 to 50 Gy, before culturing Multiple shoots were also subjected to gamma irradiation Gamma irradiation caused reduction in bud sprout and survival

One reddish yellow mutant was isolated from 30 Gy treated explants Another mutant for increased number of petals was isolated from 40 Gy treated explants Gamma irradiation induced variation in size and shape of leaves at 30 and 40 Gy

Successful hardening and *ex vitro* establishment (66 7%) of plantlets were achieved by surface inoculation of germinated spores of VAM *Glomus etunicatum*

Exposure of multiple shoots to gamma rays induced several morphological abnormalities and reduced the shoot production and rooting efficiency

ONGOING EXPERIMENTS

Project (01) *In vitro* propagation of plants of economic importance

Sub-project (01) Standardisation of *in vitro* propagation techniques

1 **Tissue culture on cocoa**
(BT/01 01 04 88/VKA(16)Cad)

Multiple shoots could be induced from the shoot apices of field grown trees using Woody Plant Medium supplemented with 2 iP 4 0 mg/l phloroglucinol 200 mg/l silver nitrate 5 0 mg/l and cycocel 0 75 mg/l The concentration of 2 iP had to be reduced to 2 0 mg/l for supporting sustained growth of shoots Use of streptomycin sulphate 100 mg/l in the culture medium helped reduce the cessation of growth and drying of leaves in the cultures Efficiency of rooting of the microshoots could not be improved The plants derived from seedling explants started yielding after two years in the field The pods and bean characters were comparable to those of the *in vivo* grown plants

2 **Mass multiplication through *in vitro* culture and callus mutagenesis in clove**
(BT 01 01 07/90 VKA 16 KAU)

Treating the stock plants with aureofunginsol prevented the contamination problem of the cultures Sealing the cut ends of the explants with molten wax could overcome polyphenol interference Multiple shoots could be induced on WPM supplemented with BA and kinetin Subculturing to medium containing lower concentration of BA and activated charcoal supported shoot elongation and leaf production *In vitro* rooting of shoots resulted on medium having NAA and IBA Attempts to induce somatic organogenesis are in progress

3 ***In vitro* propagation techniques in cinnamon (*Cinnamomum verum*)**
(BT 01 01 08/90 VKA 16 KAU)

Standardisation of techniques for *in vitro* propagation of cinnamon is aimed at Multiple shoots that could be induced remained dormant and dried up after two months

4 **Improvement of black pepper through *In vitro* techniques**
(BT 01 01 09/89 KAU NP)

The protocol developed for the *in vitro* multiplication of black pepper was found ideal for all the high yielding varieties with slight varietal difference in the *in vitro* response The variety Anchana exhibited the best response The *in vitro* plantlets were evaluated for their later performance Good vegetative growth and excellent root system were observed by the time the plantlets were made ready for field planting The *in vitro* plants showed cent per cent field establishment and normal growth habit Normal flowering and fruit set was observed by the second year of field planting

Plantlets of five different cultures *viz* Karimunda Kalluvally Balankotta Cheriya Kaniakadan and Panniyur 1 raised by callus mediated organogenesis were hardened and planted out Partial purification of the culture filtrate of *Phytophthora capsici* was initiated using ion exchanger columns Various *in vitro* screening methods were in progress Regenerants from the variety Kalluvally responded better

5 **Standardisation of *In vitro* techniques for rapid multiplication of difficult to root and endangered species of medicinal plants**
(BT/01 01 10 89 VKA(16)KAU/NP)

The cultures of *Kaempferia rotunda Adathoda bedomei* and *Holostemma annulare* were maintained using the protocols developed in the previous year Efforts were continued for the *in vitro* propagation of *Gymnema sylvestre* and *Coccinium fennestratum* Attempts were made to standardise a medium supporting slow growth of *Kaempferia rotunda* cultures helpful in conservation of germplasm Use of mannitol 4 0 per cent in the media could extend the subculture frequency upto four months

6 **Standardisation of *In vitro* propagation techniques in ginger**
(BT/01 01 12 90/VKA(16)KAU/NP)

Ginger plantlets were successfully established *ex vitro* Evaluation of their field performance in comparison with plants raised from seed bits of 5 15 and 25 g is in progress

7 **Standardisation of *In vitro* propagation techniques in banana**
(BT/01 01 13 88/VKA(15)KAU/PG)

Work completed final report due

8 **Standardisation of rapid clonal propagation through *In vitro* culture in pineapple**
(BT/01 01 14 89/VKA(15)KAU/PG)

Work completed final report due

9 ***In vitro*** **propagation of orchids**
(BT/01 01 15 89/VKA(15)ICAR)

Plantlets of *Sarathoglottis plicata* were produced through in vitro culture using Vasin and Went basal media supplemented with sucrose 15 0 g/l coconut water 10 0 to 15 0 per cent and banana pulp 40 0 g/l Multiple shoots of *Epidendrum radicans* could be produced However the rate of multiplication was low Embryo culture of the species was also successful

10 **Standardisation of explant for *In vitro* propagation of *Dendrobium* spp**
(BT/01 01 16 89/VKA(15)KAU/PG)

Work completed Final report due

11 **Response of black pepper (*Piper nigrum* L) to cloning through *in vitro* technique**
(BT/01 01 18 91/KAU/PG)

No results reported for the period

12 **Standardisation of *In vitro* techniques in gurmar (*Gymnema sylvestre*)**
(BT/01 01 20 92/VKA(16)KAU/PG)

No results reported for the period

13 **Somaclonal variation in black pepper (*Piper nigrum* L)**
(BT/01 01 22 92/VKA(16)KAU/PG)

In vitro screening of the calli derived from the five cultivars (Panniyur 1 Karimunda, Cheriyakaniyakadan Balankotta and Kalluvally) was completed using various screening techniques like incorporation of concentrated culture filtrate (CCF) to the culture media shaking in CCF incorporated basal media and double layer technique Survival of calli depended on the concentration of the CCF Plants were regenerated from the surviving calli Screening of the regenerants for tolerance to *Phytophthora capsici* is in progress

14 **Standardisation of *in vitro* propagation technique in clove *Syzygium aromaticum***
(BT/01 01 25 92/VKA(16)KAU PG

Pure contamination could be reduced to 44 per cent by surface sprays of the mother plant Scaling the cut ends with wax prevented polyphenol interference Multiple shoots could be induced on WPM basal media containing cytokinins Activated charcoal incorporated in the culture medium helped in shoot elongation Rooting of shoots was observed on WPM basal medium containing auxins Callus could be induced from leaf segments using 2 4 D

15 **Standardisation of *In vitro* techniques for the rapid clonal propagation of mango (*Mangifera indica* L)**
(BT/01 01 26 92/ACV(10)KAU/PG)

Induction and initiation media were standardised for somatic embryogenesis from the nucellus of monoembryonic (Mulgoa and Neelum) and polyembryonic (Vellari Manga) mango varieties using MS basal medium containing supplements Standardisation of media and conditions for normal maturation and germination of the somatic embryoids is in progress

16 **Response of gladiolus to rapid cloning through *In vitro* techniques**
(BT/01-01 27 93/VKA(15)KAU/PG)

Culture establishment of the explants was the best on MS medium supplemented with BA 3 0 mg/l Shoot proliferation could be achieved on MS medium + BA 1 0 mg/l + NAA 0 5 mg/l Shoot elongation occurred in the absence of plant growth substances

17 **Plantlet regeneration through somatic embryogenesis in *Theobroma cacao* L**
(BT/01 01 28 93/VKA(2)KAU/PG)

Work on optimisation of somatic embryogenesis from immature cotyledons of cocoa as well as on enhancing germination of the embryoids was in progress Medium containing NAA coconut water and thiamine was found to be ideal Only weak plantlets could be obtained from

the embryoids on germination The plantlets failed to survive *ex vitro*

18 Effect of physiological preconditioning of explants and explant sources of *Myristica fragrans* Houtt to *in vitro* culture establishment and growth
(BT 01-01 29 92/ACV(10)KAU/PG)

Dipping the explants in casein hydrolysate 5 0 to 15 0 mg/l for 10 to 15 minutes was found to help culture establishment Pruning the stock plants and spraying with BA, kinetin and GA were also helpful The work is in progress

19 Optimising *in vitro* somatic embryogenesis in polyembryonic mango (*Mangifera indica* L) varieties
(BT/01 01 30 93/ACV(10)KAU PG)

Culture media and conditions were standardised for the induction and initiation of somatic embryoids from the nucellus as well as embryos of polyembryonic mango varieties The embryoids however were malformed on germination Attempts for standardising media and conditions supporting normal maturation and germination of embryoids were in progress

20 Standardisation of *in vitro* techniques for mass multiplication of Aranthera and Dendroblum
(BT/01 01 32 93/ACV(10)KAU/PG)

The work was initiated

21 Micropropagation of tree spices of Kerala
(BT/01 01 33 93/ACV(10)KAU/DBT)

Multiple shoots could be induced in nutmeg shoot tip cultures *In vitro* rooting of shoots could be obtained Physiological preconditioning of the stock plants could generate juvenile shoots useful for culturing In clove single axillary shoots could be induced from nodal explants

22 *In vitro* techniques for the rapid multiplication of *Kaempferia galanga L*
(BT/01 01 34 94/VKA(16)KAU)

The plantlets produced *via in vitro* techniques were hardened and planted out at monthly intervals from September 1993 onwards In spite of good vegetative growth the rhizome production was limited

Delayed planting and summer irrigation might have been the reasons A new field trial along with conventional planting material (rhizome bits) was laid out The trial is in progress

23 Standardization of *in vitro* techniques for rapid multiplication of *Holostemma annulare* K Schum
(BT/01 01 35 94/VKA(16)KAU/PG)

The work was initiated

24 Clonal propagation of selected plus trees of Indian rosewood (*Dalbergia latifolia* Roxb) through tissue culture
(BT/01 01 36 94/VKA(F)KAU/PG)

The work was initiated

Sub-project (03): *In vitro* and *ex vitro* propagation techniques

25 Standardisation of *In vitro* and *ex vitro* propagation in *Anthurium andreanum*
(BT/01 03 02 92/ACV(10)KAU/NP)

Callus could be induced in Red varieties of *Anthurium andreanum* using Murashige and Skoog basal medium containing supplements The work is in progress

26 Rapid asexual multiplication of hybrid seedlings of pineapple
(BT/01 03 03 92/KNR(10)KAU/NP)

No results reported for the period

27 *In vivo* and *In vitro* screening of *Sida spp* for ephedrine content
(BT/01 03 04 93/VKA(16)KAU/PG)

Callus could be induced from various explants of *Sida spp* Callus proliferation and root regeneration were obtained

28 Refinement of *In vitro* propagation techniques in pineapple var Mauritius and mass multiplication of elite clones
(BT/01 03 05 94/VKA(15)KAU/PG)

The work was initiated

29 Micropropagation in selected varieties of *Anthurium andreanum* (Lind)
(BT/01 03 06 94/ACV(10)KAU/PG)

The work was initiated

30 Micropropagation of *Phalanopsis*
(BT/01 03 07 94/VKA(15)KAU/PG)

The work was initiated

31 Cost effective methods and devices for home scale adoption of plant tissue culture
(BT/01 03 08 94/ACV(10)KAU/PG)

The work was initiated

32 Low cost technology for propagation of Musa (AAB) 'Nendran
(BT/01 03 09 94/VKA(15)KAU/PG)

The work was initiated

Project (02) improvement of crop plants through genetic engineering

Sub project (01). Somatic cell culture studies

33 Tissue culture and somaclonal variation in ginger (*Zingiber officinale Rox*)
(BT/02 01 01 89/VKA(16)KAU)

The calli induced in media supplemented with 2,4-D and BAP regenerated in the same basal medium with higher levels of BAP (5 0 to 8 0 mg/l) Silver nitrate (0 25 to 2 0 mg/l) was found to have a highly favourable influence on callus regeneration The callus derived shoots were of normal morphology and responded well to *in vitro* rooting The *in vitro* plantlets were successfully hardened and planted out for further evaluation

34 Callus induction and plantlet regeneration in *Cucumis sativus* L. by anther culture
(BT/02 01 02 90/ACV(10)KAU/PG)

No results reported during the period

Sub project (02) *In vitro* mutagenesis, utilisation of somaclonal variability

35 *In vitro* production of hybrids in ginger / *Zingiber officinale* Rox
(BT 02 02 03/91 VKA 16 KAU PG)

Ovules developed in placental pollination modified placental pollination and ovular or test tube fertilization Pollen grains suspended in ME3 medium were used for pollination About 75 0 to 83 3 per cent of cultures showed ovule development Histological examination of the ovules four days after pollination showed eight celled pro embryo and 40 days after pollination showed well developed embryo and endosperm rich in starch and oil grains Eighty days old seeds when incubated in medium containing BA and 2 4 D germinated

36 *In vitro* mutagenesis in ginger (*Zingiber officinale* Rox)
(BT/12 02 03 89/VKA(16)KAU)

In vitro sprouts of ginger were subjected to gamma irradiation at 0 2 to 0 8 Kr levels The irradiated cultures were maintained in the media identified for *in vitro* multiplication of ginger The rate of multiplication was considerably reduced on increasing the number of sub culture cycles The cultures recorded healthy growth upto the 3rd sub-culture Increasing the level of cytokinin at later sub cultures favoured the growth of cultures Further work on irradiation is in progress

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14. Post Harvest Technology

HIGHLIGHTS

- Cashew fruits can be successfully stored for 21 days when soaked in 0 1 per cent KMS along with 7 0 per cent brine Pre cooling vegetables, *viz* amaranthus, brinjal chilli cowpea, okra and tomato reduced their physiological loss in weight (PLW)
- Cassava and sweet potato based macroni and noodles were developed
- Karonda based products *viz* wine candy jelly and canned fruits were processed
- Products developed from passion fruit were Ready to Serve (RTS) beverage wine and jelly
- In bread making maida was replaced partially by soya flour tapioca flour and milk powder

CONCLUDED EXPERIMENTS - Nil

EXPERIMENTS IN PROGRESS

Project (01) Post harvest handling and marketing

Sub project (03) Pineapple

1 **Effect of pre harvest treatment on the post harvest quality of pineapple variety "Kew"**
[PHT/01 03 01 89/VKA(17)KAU]

The trial was not carried out

Sub project (04) Winged bean

2 **Chemical composition and nutritive value of winged bean varieties**
[PHT/01 04 01 89/VKA(17)KAU]

The trial was not carried out

Sub project (05) Mango

3 **Harvest and post harvest losses in Mango (Mangifera Indica L) and its management**
[PHT/01 05 01 93/VKA(17)KAU]

Since the student has discontinued the course no work has been carried out

Sub project (06) Solar drier

4 **Utility value of foldable solar dryer at household/farm level Standardisation studies**
[PHT/01 06 01 94/ACV(11)SDST]

Standardisation of drying procedures for roots tubers (tapioca and sweet potato) vegetables (bittergourd and spring beans) and fruits (pineapple and plantain) were completed in comparison with sundrying

Project (02) : Post harvest storage and preservation

Sub project (01) Cashew

5 **Handling storage and utilization of cashew apple**
[PHT/02 01 01 90/VKA(17)KAU]

Successful storage of harvested cashew apple for 21 days was found possible if the

fruits were soaked in 0 1 per cent KMS and [illegible] per cent KMS along with 7 0 per cent brine The stored fruits did not show any type of spoilage but there was considerable reduction in weight and TSS storage period increased Removal of astringency from the brining salt solution starch solution gelatin alcohol or their combinations were found successful without affecting the overall acceptability of the fruits Preservatives added to cashew apple juice were found to reduce the tannin level

Sub Project (05) Others

6 Consumer packaging of selected vegetables
[PHT/02 05 02 92/VKA(10)KAU/PG]

The experiment on the standardisation of precooling treatments to improve the post harvest life of vegetables revealed that the precooling treatments significantly reduced the physiological loss in weight (PLW) and enhanced the marketability of the vegetables *viz* amaranth brinjal chilli cowpea okra and tomato both under ambient and low temperature situations Unventilated poly bags were beneficial in certain vegetables like amaranth cowpea and okra while for vegetables like brinjal chilli and tomato ventilated bags were more beneficial Portion packaging of vegetables were observed to help in delaying the incidence of unmarketability

Sub Project (06) Toddy

7 Preservation of toddy using chemical preservative
[PHT 02 06 01 91/VKA(17)KAU]

Kept in abeyance

8 Effect of heat treatment on shelf life quality of toddy
[PHT/02 06 02 91/VKA(17)KAU]

Kept in abeyance

9 Carbonation blending of fermented toddy for flavour and consumer acceptability
[PHT 02 06 03 91/VKA(17)KAU]

Kept in abeyance

10 Merits and demerits of containers for storage of preserved toddy
[PHT 02 06 04 9 VKA(7 KAU]

Kept in abeyance

Sub Project (07) Sweet potato

11 Changes in the cooking qualities nutritional composition and shelf life of sweet potato stored under different methods
[PHT/02 07 01 92/VKA(11)KAU/PG]

Sweet potato kept as control in ordinary basket and mud coated tubers were spoiled completely after 30th day of storage Shelf life of polythene covered tubers was extended upto 45 days without spoilage eventhough weevil attack was observed while similar situation was noted only after 60 days in tubers stored in paddy husk coir pith and carbon paper

During storage there was an increase in cooking time and decrease in water absorption Among the nutritional qualities decrease in starch and moisture and an increase in reducing sugar were observed The acceptability rate decreased as the storage period advanced

Sub project (08) Pulses

12 Influence of storage on the quality of selected pulses
[PHT/02 08 01 92/ACV(11)KAU/PG]

Black gram cowpea green gram and horse gram were the pulses commonly cultivated by farm families surveyed in the order of preference Average area under pulse cultivation was in the range of 20 to 40 cents After harvest crop loss was mainly due to insects rodents and birds Pulses were sundried and treated with insecticides before storage in mud pots and gunny bags Loss observed in stored pulses were weight loss changes in colour taste texture and in organoleptic qualities

Sub Project (09) Flowers

13 Standardising the post harvest technology for gladiolus
[PHT/02 09 01 92/VKA(15)KAU]

No work during the year

Sub Project (10) Rice

14 Qualitative and quantitative changes in stored rice
[PHT/02 10 01 93/ACV(11)KAU/PG]

High yielding variety Matta Thriveni and local variety Kochuvithu (PTB 10) were stored for six months in wooden storage structure (Pathayam) gunny bags and storage bins advocated by the Department of Agriculture Variations in grain constituents (moisture nutrients and non nutrients) cooking characteristics (water uptake cooking time and volume expansion) and organoleptic qualities were observed between varieties and among storage structures

Project (03) Processing product development and utilisation

Sub project (01) Jack

15 Standardisation of Jack RTS beverage
[PHT/03 01 01 88 VKA(17)KAU]

Trial not laid out

16 Suitability of osmotic drying techniques for product development in jack fruit
[PHT/03 01 06 93/ACV(11)KAU/PG]

Two popularly known fully mature and half ripened varieties viz soft flesh type and firm flesh type were selected for the study The fruits were split longitudinally dewatered with osmotic solution and dried in open sun to obtain desired moisture level as indicated in FPO standards Shelf life studies of the products kept in poly propelent covers were conducted to ascertain acceptability organoleptic and nutritional composition

Sub Project (02) Banana

17 Application of osmotic dehydration technique for product development in banana Musa (AAB group) Palayankodan
[PHT/03 02 02 92/ACV(11)KAU/PG]

Ripe fruits were peeled and cut into round slices and subjected to initial dewatering with sucrose solution Further drying was carried out in the open air Dehydrated samples which were immersed in different concentrations of sucrose solution at different periods and at different temperatures were assessed for FPO standards with reference to organoleptic qualities acceptability and dehydration characteristics

Sub Project (03) · Others

18 Physico-chemical, nutritional and toxicological evaluation of thermally oxidised edible oils
[PHT/03 03 03 92/ACV(11)KAU/PG]

Frying banana chips in coconut oil and groundnut oil was found to affect the physico chemical properties like smoke point boiling point iodine number saponification number and acid value of the oils Changes in fatty acid composition were analysed using Gas Chromatographic method to assess the percentage of each fatty acid in oil samples Toxicological evaluation of reheated oil heated upto 12 hrs conducted both in bacterial system and through animal experiments gave negative results

19 Standardisation of dehydration techniques in Anachunda (*Solanum torvum* Swartz), Black night shade (Solanum nigrumhinn) and lotus (*Nelumbo nucifera Gaertn*)
[PHT/03 03 04 93/VKA(17)KAU/PG]

Lotus stolons collected from Palakkad and Mudicode and seedlings of black night shade raised in the Kerala Agricultural University nursery were planted during the period under report

Sub Project (04) Pulses

20 Consumption of pulse proteins on the nutritional status and incidence of atherosclerosis
[PHT/03 04 01 91/ACV(11)ICAR]

A survey was conducted among 500 farm

households to find out the frequency of consumption of different types of pulses Ninety seven per cent of the families had income from farm produce Cowpea black gram and green gram red gram and bengal gram were cultivated Prior to storage pulses were sundried, ash, sand rice bran and neem leaves were used to improve the shelf life of stored pulses Airtight tins gunny bags mud pots, plastic / steel / aluminium tins were used as containers Different processing methods applied by the farm families on pulses were decortication, soaking, roasting and germination

A survey was conducted among 100 atherosclerotic patients in the age group of 41 to 60 years Normal blood sugar level was noted only among 35 per cent of the patients Diabetis mellitus obesity and hypertension were also found to be associated with atherosclerosis Smoking and alcoholism were also prevalent among 28 to 35 per cent of the patients A direct relationship between these habits and blood cholesterol level were also observed Pulses were the major items in the dietaries of 30 per cent patients

21 Nutritional evaluation of the newly evolved pulse varieties in Kerala Agricultural University
[PHT/03 04 02 91/ACV(11)KAU/PG]

Different pulse varieties from research stations were collected and analysed for their physical characteristics cooking characteristics and nutritional composition

22 Effect of processing on the mineral status of selected pulses
[PHT/03 04 03 92/ACV(11)KAU/PG]

Green gram and black gram were processed by drying germinating dehusking and powdering The processed pulses after soaking and without soaking were cooked by boiling steaming roasting and frying methods The nutritional constituents and anti nutritional constituents in the cooked pulses were determined

23 Assessment of quality of selected varieties of green gram and grain cowpea
[PHT/03 04 04 93/ACV(11)KAU/PG]

Five varieties of greengram and four main grain cowpea varieties *viz* Pusa baisaki M3 Mg 161 Pusa 8973 C 152 Pournami V 118 and Kanakamony were collected from RARS Pattambi RRS Kayamkulam and National Seed Corporation Physical characteristics such as 100 grain weight and volume were determined in the above varieties

Sub project (05) Toddy

24 Reconstitution of concentrated toddy with auxiliary substances
[PHT/03 05 01 91/ACV(17)KAU]

Kept in abeyance

Sub Project (06) Pineapple

25 Developing partially dehydrated pineapple products using solar drier
[PHT/03 06 01 92/ACV(11)KAU/PG]

Partially dehydrated pineapple products developed by solar drying and sundrying were sealed in polypropylene covers Shelf life qualities of the products were determined by assessing weight loss, bulk density and nutrient loss Organoleptic qualities and microbial content of the products were determined periodically

26 Keeping quality of pineapple as well as canned slices in syrup with reference to maturity at harvest
[PHT/03 06 02 92/VKA(17)KAU]

No work during the year

Sub Project (07) Papaya

27 Impact of pretreatments and processing on the shelf life quality of papaya products
[PHT/03 07 01 92/ACV(11)KAU/PG]

Products such as squash, jam and candy were processed from papaya pretreated through blanching sulphiting exposing to sulphur fumes and immersing in citric acid solution using standardised techniques The products were kept at ambient condition and in refrigerator for shelf life studies TSS acidity reducing sugar total sugar organoleptic quality and mold content of the stored products were determined periodically for one year

Sub Project (08) · Mushroom

28 Nutritional studies on dehydrated oyster mushroom and their utilisation in product development
[PHT/03 08 01 92/ACV(11)KAU/PC]

Using dehydrated mushroom powder mushroom wafers were standardised Blackgram flour and dehydrated mushroom flour were cooked in the ratio of 25 75 35 65 50 50 60 40 and 75 25 The last combination was selected based on organoleptic tests The wafers packed in polypropylene covers, were stored for one year The wafers were nutritionally rich with proteins and maintained its quality for five months

Sub project (09) Cassava

29 Developing complementary food products based on cassava and sweet potato
[PHT/03 09 01 92/ACV(11)KAU/PG]

Cassava and sweet potato based macroni and noodles were developed The combination was cassava / sweet potato 50 per cent, maida 35 per cent and soyaflour 15 per cent A total of 15 kg each of cassava and sweet potato noodles were developed Six kg of noodles were kept for storage and nine kg for consumer preference studies Acceptability trials of the eight products were conducted at three different levels at institutional level among high society ladies and preference test among farm women

Sub Project (11) : Karonda

30 Development of Karonda (*Carissa carandus* L) based products
[PHT/03 11 01 93/ACV(11)KAU/PG]

Karonda based products like wine, candy jelly and canned fruits were processed using standard methods The shelf life qualities of the products were assessed by ascertaining the organoleptic qualities

Sub Project (12) Supplementary food

31 Evaluating the nutritional quality of soya based supplementary foods
[PHT/03 12 01 93/ACV(11)KAU/PG]

Several formulations of the supplementary food was worked out with the basic ingredients *viz* parboiled rice defatted soya flour and groundnut Amino acid scores were computed to select the suitable formulae Five formulae were selected Nutritional composition organoleptic qualities shelf life qualities and cost analysis of the selected formulations were ascertained and suitable formulation with rice (85 per cent) soya (10 per cent) and groundnut (5 per cent) was selected The nutritional quality of the supplementary food selected was tested by conducting animal experiments and through six months feeding trial for four pre school children

Sub Project (13) Passion fruit

32 Development, diversification and shelf life studies of passion fruit products
[PHT/03 13 01 93/ACV(11)KAU/PG]

Products developed using passion fruit were Ready to Serve (RTS) beverage wine and jelly Six variations of wine were prepared and kept for shelf life studies Standardisation of RTS beverage using passion fruit with blends of other fruits were done and based on sensory evaluation three different proportions of RTS were selected for bulk production Shelf life

studies of the products are in progress

Sub Project (14) Quality improvement of food

33 Improvement of nutritional quality of bread

[PHT/93 4 01 93 ACv(1)KAU/R a]

In bread making maida was replaced partially by soya flour tapioca flour and milk powder in different proportions with variations in the fermenting time From eight combinations worked out 13 3 g protein was available while in standard bread made of maida only 9 1 g protein was available Maida and soya flour mixture with fermenting time 1 ½ hours was selected as the best combination based on baking characteristics nutritional composition organoleptic qualities and shelf life studies

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15. Technology Transfer and Rural Development

HIGHLIGHTS

- A vast majority of male labourers were found to have considerably higher role perception in decision making with the farmers in agricultural practices such as variety to be selected type of manures and fertilizers to be used in basal application type of fertilizers required for top dressing and irrigation of crop in the main field

- Most important constraint experienced by agricultural labourers under Kerala Agricultural Workers Pension Scheme was non availability of pension regularly while those under Kerala Agricultural Workers Welfare Fund Scheme was non availability of benefits in time

- Significant association between the NARP zones and fertilizer use behaviour of farmers were observed with respect to composite fertilizer use behaviour index (CFUBI) use of nitrogenous phosphatic and potassic fertilizers and organic manures and also with respect to the components of each nutrient and organic manures

- Lack of knowledge about fertilizer use lack of assured irrigation facilities high cost of fertilizer high rate of labour wages increased incidence of pests and diseases non availability of organic manures and improper drainage facilities were the major constraints in the composite fertilizer use behaviour of rice farmers in Kerala

- There was linkage between officials in the soil conservation unit and the Department of Agriculture in the implementation of soil and water conservation programmes but their linkage was only medium

- The major constraints felt by Agricultural officers in implementing coconut development programmes were lack of proper co ordination and linkage between various agencies involved in the implementation of coconut development programmes procedural complexities in sanctioning the assistance under the programme inadequacy of infrastructure placed at Krishi Bhavan level, lack of good rapport between the implementing and sanctioning agencies and non availability of good quality seedlings during planting seasons

- The political system does not permit group approach possible only when there is continuous leadership

- There was a significant change on the favourable side in the use of information sources by the respondents exposed to group management appraoch

- There was a positive significant relationship developed between the yield obtained by respondents and group management efforts

- The analysis of the overall job efficiency of Agricultural Officers indicated that little more than half of the Agricultural Officers (51.31 per cent) had high job efficiency

- More than half of the respondent rural youths had medium to high level of participation in agriculture and allied fields

- Clinical examination of the tribal women revealed that 95 per cent of women showed at least one or other of the nutritional deficiency diseases. The diet consumed by the tribal women was not balanced. The intake of pulses, green leafy vegetables, other vegetables, roots and tubers, fruits, fats and oils were very poor and the consumption rate was below 20 per cent of the RDA

- Female adults and adolescents were better than male adults and adolescents in nutritional status index

- Nutritional status of the adolescent girls were found to be better than adolescent boys

- Two meal a day pattern was followed by the tribes which included cereals, fats and oil and spices and condiments

- Participation index of the beneficiaries was found to be high and nutritional status index increased significantly with participation index

- As regards vertical mobility status of VHSEA certificate holders it was observed that half of them were studying in degree classes and more than one fourth of the respondents were not continuing their studies after VHSEA and four respondents were studying in Agricultural College. Majority of VHSEA certificate holders were unemployed, over six per cent of them working as lab assistant and only two respondents were engaged in self employment avenues

- Job opportunities to pass out should be increased, permanent teachers should be appointed and public should be made aware of the relevance of the vocational agricultural courses were the important suggestions for improvement of VHSEA

- Result tests conducted in nine locations of the central region with three packages of farm implements and machinery namely "Low mechanization package (LMP), medium mechanisation package (MMP) and "high mechanisation package (HMP) revealed that the HMP required the lowest quantity of human labour input followed by MMP. It was the highest for the LMP. The differences among the packages were highly significant. Cultivation with the MMP achieved the highest per hectare yield. But the three packages did not suffer significantly with respect to per hectare yield of paddy. Rice cultivation with the HMP required the lowest per hectare cost followed by the MMP. Cost of cultivation of the plots where the LMP was used was the highest. The differences in per hectare cost of cultivation existing among the three packages were highly significant.

- The destruction of the traditional life support system reduced the tribals to the status of casual wage labour and have been constrained to buy most of their requirements from the market. Thus the traditional self reliant non monetised tribal economy got gradually transformed into a "dependant" and monetised economy making them highly vulnerable to the external economic and social environment

1 **Role of agricultural labourers in decision making in paddy production by farmers in Thiruvananthapuram district**

(TOT 01 00 04 92/ACV(c)KAU/PG)

Thirty one areas of decision making in paddy production were identified in which agricultural labourers had their role with the employer farmers The study indicated that the role perception and role performance of agricultural labourers though not excellent was generally good in activities they involve most frequently A vast majority of male labourers were found to have considerably higher role perception in decision making with the farmers in agricultural practices such as variety to be selected type of manures and fertilizers to be used in basal application type of fertilizers required for top dressing and irrigation of crop in the main field Remarkably higher fractions of female labourers were observed to have significant role perception in decision making areas namely spacing to be adopted for transplanting time of weeding and harvesting number of labourers required for transplanting weeding harvesting threshing winnowing and processing of straw

Significantly higher fractions of the male respondents were reported to have high role performance in deciding the variety to be selected interval of irrigation required type of fertilizers required in the nursery and mainfield number of ploughing required for top dressing time of weeding time of application of plant protection chemicals and number of labourers required for weeding

Role performance of majority of female agricultural labourers was higher in deciding various aspects of transplanting weeding and harvesting Role perception and role performance of agricultural labourers were found to be significantly correlated to each other Significant difference was observed among male and female agricultural labourers with regard to overall role perception and role performance

Majority of farmers perceived the role of male agricultural labourers as important in deciding the number of labourers required for transplanting type of manures and fertilizers to be used in basal application irrigation of crop in the mainfield time of weeding number of labourers required for weeding operations time of application of plant protection chemicals and quantity of plant protection chemicals Role of female agricultural labourers in deciding various aspects of transplanting weeding and harvesting was ascribed significant importance by the employer farmers

Significant positive correlation was observed for eight characteristics of male agricultural labourers namely farming experience period of employment under the farmer attitude towards job attitude towards employer farmer knowlege of scientific agricultural practices feeling of responsibility in increasing the agricultural production and achievement motivation with their role perception as well as role performance in decision making with the farmer

Significant positive correlation was observed for four characteristics of female agricultural labourers, namely farming experience, period of employment under the farmer attitude towards job attitude towards scientific agricultural practices knowledge of scientific agricultural practices and contact with extension agency with their role perception and role performance in decision making with the farmer Three characteristics namely period of employment under the farmer, attitude towards employer farmer and achievement motivation were found to have significant positive correlation with role performance alone

"Period of employment under the farmer" contributed as much as 53 84 per cent variation in the role perception of male agricultural labourers "knowledge of scientific agricultural practices" accounted for 36 76 per cent variation in the role perception of female labourers With regard to role performance knowledge of scientific agricultural practices accounted for 46 06 per cent variation in the case of male agricultural labourers and period of employment under the farmer accounted for 58 20 per cent variation in the case of female agricultural labourers "Period of employment under the farmer had maximum direct effect on the role perception of male agricultural labourers whereas it was "knowledge of scientific agricultural practices" which had maximum direct effect on the role performance

2 **Welfare schemes for agricultural labourers- a multi-dimensional analysis** (TOT/01 00 07 92/ACV(6)KAU/PG)

Majority of agricultural labourers under Kerala Agricultural Workers Pension Scheme (KAWPS) were found to have low education low family education status small family size low socio economic status low cosmopoliteness low mass media participation low social participation low contact with extension agency high economic motivation high innovativeness and low level of aspiration (both future and present)

Majority of agricultural labourers under Kerala Agricultural Workers Welfare Fund Scheme (KAWWFS) had high education high family education status large family size, high socio economic status high cosmopoliteness low mass media participation high social participation, low contact with extension agency high economic motivation high innovativeness and high level of aspiration (both future and present)

Majority of agricultural labourers under KAWPS and KAWWFS had high awareness about modus operandi of KAWPS and KAWWFS respectively

Majority of agricultural labourers under KAWPS under KAWWFS had favourable attitude towards KAWPS and KAWWFS respectively

Majority of agricultural labourers under KAWPS had high utility perception about KAWPS and majority under KAWWFS had low utility perception about KAWWFS

There was significant difference between agricultural labourers under KAWPS and KAWWFS with respect to all their selected profile characteristics

Positive and significant correlation was obtained between awareness of agricultural labourers under KAWPS modus operandi of KAWPS and their characteristics like education socio economic status cosmopoliteness mass media participation social participation contact with extension agency innovativeness and level of aspiration (future)

Characteristics of agricultural labourers under KAWWFS like education family size socio economic status cosmopoliteness mass media participation social participation contact with extension agency economic motivation innovativeness and level of aspiration (future) were found to have a positive and significant correlation with their awareness about modus operandi of KAWWFS

Level of aspiration (both future and present) of agricultural labourers under KAWPS had negative and significant correlation with their attitude towards KAWPS

Education, cosmopoliteness, mass media participation contact with extension agency economic motivation innovativeness and level of aspiration (future) of agricultural labourers under KAWWFS had positive and significant relationship with their attitude towards KAWWFS

Family size of agricultural labourers under KAWPS had positive and significant

correlation with their utility perception about KAWPS

Socio economic status cosmopiliteness mass media participation social participation economic motivation innovativeness and level of aspiration (both future and present) of agricultural labourers under KAWWFS had positive and significant correlation with their utility perception about KAWWFS while education had negative and significant correlation

Majority of the implementing officials had a favourable attitude towards KAWPS and KAWWFS

Most important constraint experienced by agricultural labourers under KAWPS was non availability of pension regularly" while those under KAWWFS was "non availability of benefits in time" Identification of agricultural labourer as per the rules and regulations of the scheme" and "the staff pattern allowed is insuff cient" were the most important constraints experienced by officials in the implementation of KAWPS and KAWWFS respectively

3 **Adoption of improved agricultural practices by pepper growers of Idukki district**
(TOT/02 01 91 ACV(6)KAU/PG)

Majority of pepper growers in the study area had medium level of awareness of improved agricultural practices in pepper The independent variables namely education, scientific orientation economic motivation, risk orientation cosmo politeness information sources used social participation innovativeness contact with extension agency and market orientation were positively and significantly related with awareness But age was found negatively and significantly correlated with awareness of improved agricultural practices in pepper Step wise regression analysis revealed education as the most important variable in prediction of the extent of awareness followed by scientific orientation economic motivation risk orientation cosmopoliteness information source used innovativeness contact with extension agency and market orientation

Majority of the pepper growers had medium level of knowledge about improved agricultural practices in pepper The independent variables namely, education scientific orientation economic motivation risk orientation cosmopoliteness information source used social participation innovativeness contact with extension agency and market orientation were positively and significantly related with knowledge of improved agricultural practices in pepper whereas age was found negatively and significantly correlated with knowledge Education was found as the most important variable in prediction which alone contributed 50 per cent of variation in the extent of knowledge The other important variables in prediction were education contact with extension agency innovativeness social participation scientific orientation risk orientation information source used and market orientation

In the case of attitude of pepper growers majority of pepper growers had medium level of attitude towards improved agricultural practices in pepper Education scientific orientation economic motivation risk orientation cosmopoliteness information source used social participation innovativeness contact with extension agency and market orientation were positively and significantly related with attitude of pepper growers towards improved agricultural practices in pepper Age was found negatively and significantly correlated with attitude Sc entific orientation was found as the most important variable in prediction of attitude of pepper growers towards improved agricultural practices in pepper followed by market orientation education risk orientation innovativeness social participation and age Scientific orientation alone contributed 41 per cent of variation in prediction

Majority of pepper growers in the study area had medium level in adoption of improved agricultural practices in pepper The independent variables namely education scientific orientation economic motivation risk orientation, cosmo politeness information source used social participation, innovativeness contact with extension agency and market orientation were positively and significantly related with adoption of improved agricultural practices in pepper Age was found negatively and significantly related with adoption Step wise regression analysis revealed that education was the most important variable in the prediction of adoption of improved agricultural practices in pepper The other important variables were contact with extension agency social participation information source used innovativeness scientific orientation and market orientation

The following are the major constraints in the adoption of improved agricultural practices as perceived by pepper growers

1 Extensive prevalence of pests and diseases

2 High cost of production inputs

3 Lack of awareness of improved agricultural practices in pepper

4 Traditional systems of cultivation

5 Inadequate extension support

6 Lack of sufficient good quality planting materials

7 Inadequate research support

8 Long duration of rainless period

9 Fluctuating prices of black pepper

10 Non availability of literature on improved agricultural practices

11 Non availability of input materials

12 Small and marginal size of holdings

Solutions suggested to overcome the important constraints in adoption of improved agricultural practices

1 Develop low cost technology for the control of pests and diseases

2 Develop disease tolerant varieties

3 Production and distribution of good quality planting materials

4 Provide adequate training to farmers about improved agricultural practices

5 Implement soil and water conservation programmes with adequate financial assistance

6 Develop drought tolerant varieties

7 Ensure proper marketing net work coupled with remunerative price for black pepper

8 Supply of newer high yielding varieties

4 Production, marketing and supply response of sugarcane in Chittur block (TOT/02 03 01/VKA(8)KAU/PG)

The area index showed fluctuations while production and productivity indices remained steady during initial period with a steep fall during 1982 83 The compound growth rates were 6 87 per cent 6 61 per cent and 0 24 per cent for area, production and productivity respectively Decomposition analysis revealed that the increase in production of sugarcane was mainly due to area increase Yield effect fluctuated while only area price effect showed significance among the interaction effects The cost of cultivation for the planted and ratoon crops was determined For the planted crop the total cost of cultivation for the three classes were Rs 19 237 16, Rs,21 056 83 and Rs 21 434 86 for class I II and III respectively For the sample as a whole the cost comes to Rs 20 677 78 at cost C_2

Rental value of land was the highest expensive item followed by costs on harvesting and post harvest handling for planted crop It ranged from 24 15 per cent in class I to 29 34 per cent in class III

Harvesting and post harvest handling expense was 17 80 per cent of the total cost for the sample as a whole The cost of cultivation for the ratoon crop also behaved similarly Harvesting and transporting operations recorded the second highest expenditure having values Rs 3 689 44 Rs 3 605 39 Rs 3 421 26 for class III II and I respectively As in the case of planted crop manures and manuring was the third highest expensive operation Considering the input wise cost of cultivtion hired human labour was the most expensive input for both planted and ratoon crops Family labour was the highest in class I followed by class II and class III Among the materials used the highest material cost was incurred by manures and fertilizers for both the crops A comparison of yield and value of output showed that planted crop produced higher yield than that of ratoon crop The yield had a direct relationship with farm s ze

For all the crops all the costs showed a direct relationship with farm size For the planted crop at cost C_2 the cost of cultivation was Rs 19 237 16 Rs 21 056 83 Rs 21 454 88 and Rs 20 677 78 for classes I II III and sample as a whole respectively For the ratoon crop the corresponding values were Rs 15 958 73 Rs 17 243 42 Rs 17 827 29 and Rs 17 159 63 For the combined crop the cost of cultivation at cost C_2 ranged from Rs 17597 94 in class I to Rs 19,641 89 in class III The benefit cost ratio based on various cost concepts were greater than one for all the three crops It was the highest in class III showing values 1 37 1 36 and 1 36 for planted ratoon and combined crops respectively at cost C_2

To study the relationship between the output and the various inputs used production function analysis was carried out using Cobb-Douglas production function For the planted crop expenditure on manures and fertilizers plant protection chemicals showed a negative influence indicating that this input was used in excess Expenditure on manures and fertilizers indicated a significant positive value showing that there was a positive response in total returns The analysis showed excess use of labour though not significant Irrigation expense was found to be inadequate Similar results were obtained for the ratoon crop

The important marketing channels of sugarcane were

1 Producer Factory
2 Producer Gur producer wholesaler (as gur) retailer consumer
3 Producer Commission agents gur producer wholesaler retailer consumer
4 Producer Gur producer commission agents wholesaler retailer consumer
5 Producer Wholesaler (as gur) retailer consumer

Of the total farmers 69 17 per cent sold their produce to the factory while 15 83 per cent produced gur by themselves Some of the producers sold their produce to gur producers

In order to study the price spread marketing aspects of gur was considered The study revealed that the wholesaler s margin was the highest in all the channels followed by retailers and gur producers The producers could obtain more profit when they produced gur by themselves rather than selling sugarcane to gur producers or to the factory

5 Fertilizer use behaviour of rice farmers of Kerala
(TOT/02 04 01 90/VKA(6)KAU/PG)

It was found that more than 30 per cent of the farmers each were grouped under "good" and "satisfactory" categories respectively, while 24 33 and 10 67 per cent of the farmers were grouped under "poor" and "very poor" categories respectively The Central NARP zone had higher percentage of farmers under "good' category of CFUBI with the highest mean value (70 263) for composite fertilizer use

behaviour Index (CFUBI) With respect to the use of nitrogenous fertilizers 30 33 and 37 00 per cent of the farmers respectively were found in "good and satisfactory levels while 21 67 and 11 00 per cent of the farmers respectively were in poor" and "very poor" categories Problem zone had the highest percentage of farmers with good" and satisfactory" categories (81 67% with mean use value of 76 57) followed by the Central Zone (25% with mean use value of 69 11, in the case of nitrogenous fertilizer use behaviour while southern zone was found to be very poor Majority of the farmers (63 00%) were classified as either good or "satisfactory with respect to the use of phosphatic fertilizers while 22 67 and 14 33 per cent respectively came under poor" and very poor" categories The problem zone had the highest percentage of farmers with good" use behaviour (55 00% with mean use value of 80 71) followed by the Central zone (33 33%) with mean use value of 75 38) in the case of use of phosphatic fertilizers With respect to the use of potassic fertilizers it was found that farmers were almost similarly distributed in the four categories good satisfactory poor and very poor The problem zone had higher percentage of farmers under good" category with regard to potassic fertilizer use while there were no farmers in the northern zone under "good" level of use whereas 66 67 per cent of farmers were under "very poor" category Twenty three per cent of the farmers were classified under good" and 33 33 per cent under satisfactory" categories with respect to the use of organic manures while 18 00 and 25 62 per cent of farmers respectively were under poor and "very poor" categories High Range Zone had the highest percentage of farmers with "good" level of use of organic manures (55 00%) followed by Central zone (26 67%) A large majority (93 33%) of the farmers in the problem zone were with "very poor" organic manure use behaviour

Significant association between the NARP zones and fertilizer use behaviour of farmers were observed with respect to CFUBI use of nitrogenous phosphatic and potassic fertilizers and organic manures and also with respect to the components of each nutrient and organic manures There was significant difference observed among the five NARP zones in respect of the different components of nitrogenous phosphatic and potassic fertilizers and organic manure use The result of PCA indicated that use behaviour of potassic fertilizers had the highest factor loading (0 895) in explaining 53 79 per cent variation in the CFUBI of farmers followed by the use of nitrogenous fertilizers With respect to nitrogenous fertilizer use behaviour split application of nitrogenous fertilizer obtained the highest factor loading (0 924) followed by quantity of fertilizer and time of application in explaining 67 76 per cent of variation

Time of application emerged as important in explaining the variation in relation to the use of phosphatic fertilizer with the highest factor loading of 0 854 followed by related management practices (0 808) All the five dimensions were found almost equally contributing to the variability in potassic fertilizer use which in total explained 85 33 per cent of variability All the three factors were found to be significantly contributing to the variability in explaining about 72 27 per cent of variability in the use of organic manures Split application of nitrogenous fertilizers quantity and time of application of phosphatic fertilizers quantity and split application of potassic fertilizers and quantity of organic manures were found significant in predicting the yield index

The important situational and technological factors contributing to the fertilizer use behaviour of rice farmers as perceived by farmers agricultural scientists agricultural extension personnel and input dealers were irrigation facilities perceived appearance of the crop stand, drainage facilities price of produce availability or rain and availability of labour Main occupation level of aspiration rational decision making ability attitude towards

fertilizer use, information source utilisation and economic performance index were found to be significant in predicting the fertiliser use behaviour of farmers Lack of knowledge about fertiliser use, lack of assured irrigation facilities, high cost of fertiliser, high rate of labour wages, increased incidence of pests and diseases non-availability of organic manures and improper drainage facilities were the major constraints in the composite fertilizer use behaviour of rice farmers in Kerala

6 Linkage between the Department of Agriculture and Soil Conservation Programmes in Kerala
(TOT/02 05 01 89/ACV(6)KAU/PG)

Majority of the Agricultural Officers and 50 per cent of the Principal Agricultural Officers had low level of perception about their roles with respect to soil and water conservation programmes Majority of officials in the Soil Conservation Unit viz District Soil Conservation Officers and Junior Soil Conservation Officers had high level of perception about their roles with respect to soil and water conservation programmes More than half of the Agricultural Officers and 5 per cent of the Principal Agricultural Officers had high level of perception about their roles with respect to soil and water conservation programmes About two third of the District Soil Conservation Officers and Junior Soil Conservation Officers had high level of performance in fulfilling their roles prescribed for soil and water conservation activities Majority of the Principal Agricultural Officers and District Soil Conservation Officers had high level of job involvement

In the cadre of Agricultural Officers and Junior Soil Conservation Officers, job environment was less satisfactory whereas in Principal Agricultural Officers and District Soil Conservation Officers cadre job environment was highly satisfactory Majority of the Officials in the Department of Agriculture and Soil Conservation unit had high level of job satisfaction

The characteristics viz , trainings undergone, job involvement, job environment and job satisfaction were having a significant and positive relationship with role perception of the Agricultural Officers The most important characteristic which contributed much to role perception of the Agricultural Officers both directly and indirectly was job involvement Age, experience, rural urban background, trainings undergone achievement motivation job involvement and job environment had no significant relationship with role performance of Agricultural Officers in the Department of Agriculture

There was linkage between officials in the Soil Conservation Unit and the Department of Agriculture in the implementation of Soil and Water Conservation programmes but their linkage was only medium There was no difference in the performance of linking roles by the officials in the Department of Agriculture and Soil Conservation Unit

The factors affecting linkage as perceived by the officials in Soil Conservation Unit were absence of separate department for soil and water conservation inadequate contact between the officials in the Department of Agriculture and Soil Conservation Unit, lack of team work between officers in the Department of Agriculture and Soil Conservation Unit negative attitude towards functional integration of Soil Conservation Unit with the Department of Agriculture, and lack of formal and informal communication between the officials in the Department of Agriculture and Soil Conservation Unit, overlapping of soil conservation works by the Soil Conservation Officials and Agricultural Officials and possible areas of joint activity left undefined

7 An analysis of selected development programmes for promoting coconut production in Kerala
(TOT/02 11 01 91/ACV(6)KAU/PG)

The study revealed that majority of

beneficiary farmers of the selected coconut development programmes belonged to high level category with respect to their level of awareness about coconut development programmes and knowledge about recommended coconut farming practices Regarding the attitude of beneficiary farmers towards selected coconut development programmes, majority of them had favourable attitude There was significant difference between the beneficiaries and non beneficiaries with respect to their level of awareness, attitude, knowledge and adoption

Regarding adoption of recommended coconut farming practices majority of beneficiary and non beneficiary farmers belonged to low level of adoption category Practice wise adoption of recommended practices showed that adoption of high yielding hybrid varieties for new planting was the least adopted practice while spacing and filling the pits with top soil at the time of planting were shown high levels of adoption among beneficiary farmers None of the farmers adopted application of fertilizers according to the recommended doses Most of the beneficiary farmers adopted 50 to 60 per cent of the recommended dose of fertilizers The extent of adoption of recommended practices was higher in the case of beneficiaries of Area Expansion Programme when compared to other two programmes

The study revealed that there was positive and significant relationship between selected characteristics such as mass media exposure, social participation and extension contact and level of awareness, knowledge and extent of adoption recommended practices by the beneficiary and non beneficiary farmers There was positive and significant relationship of farming experience scientific orientation and economic motivation with level of attitude of beneficiary farmers towards coconut development programmes

The major constraints as experienced by the beneficiary and non beneficiary farmers in adopting the recommended practices and coconut development programmes in the order of importance were high labour charges non availability of labourers in time inadequate and untimely supply of coconut seedlings, non availability of climbers for carrying out plant protection opertions and harvesting and lack of adequate financial assistance and subsidies which are also not given in right time

The major constraints felt by Agricultural Officers in implementing coconut development programmes were lack of proper co ordination and linkage between various agencies involved in the implementation of coconut development programmes procedural complexities in sanctioning the assistance under the programme inadequacy of infrastructure placed at Krishi Bhavan level lack of good rapport between the implementing and sanctioning agencies and non availability of good quality seedlings during planting seasons

The solutions suggested to overcome the important constraints were

i Timely supply of coconut seedlings should be ensured by starting decentralised nurseries in the farmers field and opening sales outlets at areas of heavy demand

ii Labour saving group management programme may be strengthened and adopted in all coconut growing areas

iii The beneficiary farmers may be provided with inputs like fertilizers pesticides, etc along with financial assistance

iv Training programme of coconut development board for unemployed youths in coconut plant protection and palm climbing using the new climbing device may be strengthened and implemented in all districts on priority basis

v Technical officers of various organisations implementing coconut development programmes may also be included as members of the Advisory Committees of departmental organisations such as Krishi Bhavans

vi Procedure in availing the assistance under coconut development programmes shall be simplified and assistance disbursed to the farmers in time

vii Field level offices may be started by the Coconut Development Board, in the model of Rubber Board to implement the programmes directly

8 Group management in rice production - An action research
(TOT/03 01 02 87/ACV(6)KAU/PG)

The study was undertaken in Punjakari ela of Kalliyoor panchayat Trivandrum district The research design followed in this action research study was that of before and after the experiment type in which the experiment had the respondents participation in planning implementing and evaluation and with an action research component of utilising the results of the study for further refinement of the group management approach through continuous monitoring and evaluation of the entire programme A suitable technology package was identified to overcome the selected constraints and introduced in the study area The impact of the action programme on the selected socio psychological and economic variables was closely monitored and evaluated

The most important reasons for the failure of earlier group approaches were found to be

The policital system does not permit group approach possible only when there is continuous leadership group approach dies out when external leadership is withdrawn, no knowledge about group management, farmers are not co-operative, heterogenous group members are more in villages no proper machinery to popularise group management less scope for unanimous decision, no proper extension guidance, no proper guidance from government side, inadequate member of voluntary organisations public involvement is less

The nature of content reflected in the results on the constraints in increasing rice production were "non availability of inputs" "incidence of pests and diseases "labour related problems", "marketing" "drainage" and "lack of technical advice

There was a significant change on the favourable side in the use of information sources by the respondents exposed to group management approach The changes brought in the adoption of package of practices through group management approach were significant Group management approach had brought in favourable changes in the character of social participation of respondents Group management approach had played a vital role in enhancing the knowledge level about high yielding varieties of rice cultivation There occured a gradual but favourable improvement in the cosmopoliteness extension orientation management orientation and group cohesiveness among the respondents over group management approach period

There was a positive significant relationship developed between the yield obtained by the respondents and group management efforts The net income from rice cultivation also increased considerably There was marked significant reduction in the cost of cultivation of rice noticed for all the operations selected for the study except harvesting over the four crop seasons as a result of group management However a slight increase in the cost of cultivation of different operations was noticed, other than transplanting and manures and manuring during the follow up crop season when the researchers' supervision was withdrawn

The extension method field visit was preferred much for all the package of

practices of high yielding varieties of rice cultivated in the study area Farmer's training group discussion and individual contact were found to be preferred next best in their sequence during the post exposure periods of group management approaches

9 Job efficiency of panchayat level agricultural officers of department of agriculture in Kerala
(TOT/03 02 02 89/ACV(6)KAU/PG)

The analysis of the overall job efficiency of Agricultural Officers indicated that little more than half of the Agricultural Officers (51 31 per cent) had high job efficiency The dimension wise analysis with respect to the Agricultural Officers on the whole revealed that majority of them fall under the category of high group except "office management" dimension There was no significant difference between overall job efficiency of the Agricultural Officers among the three zones There was significant difference among the Agricultural Officers of the zones in the job dimension namely "coordination", "office management" and professional competency" The job dimension "farmer development" "planning" and "coordination" differed significantly with all other dimensions at State level The job dimension "farmer development" and "planning" differed significantly with all other dimensions in all the three zones

The mean percentage score of the independent variables indicated that the Agricultural Officers possessed relatively high favourable "attitude towards profession" and "facilities and resources" was perceived to be poor at state level The Agricultural Officers of the central and northern zone possessed highly favourable attitude towards profession and the officers of the southern zone possessed high self confidence' They also differed significantly only in the independent variables of job satisfaction and facilities and resources

The multiple regression analysis revealed that the ten independent variables put together contributed significantly to the job efficiency of the Agricultural Officers and explained 77 per cent of the variation in job efficiency The variables namely, "technical competency", self confidence and communication behaviour were found to have significant contribution and direct effect on job efficiency The best sub set of variables for predicting the variation in job efficiency were communication behaviour' technical competency' and self confidence' which explained 76 per cent of variation in the job efficiency of Agricultural Officers

The result of path analysis indicated that the variable technical competency had highest direct effect on job efficiency and the variable 'job satisfaction exerted the highest indirect effect on job efficiency of Agricultural Officers From the analysis done to find out the relationship of individual and organization related variable on job efficiency as well as job dimensions the variable 'communication behaviour' technical competency' 'self confidence job satisfaction job involvement and intrinsic motivation were identified as most important variables Similarly these variables were found to be influencing job dimension either directly or indirectly

10 Aspiration of educated unemployed youth for self-employment in agriculture and allied fields
(TOT/04 00 10 91/ACV(6)KAU/PG)

More than half of the respondents had medium to high level of participation in agriculture and allied fields Farm size, farming experience, extension agency contact, mass media exposure and attitude towards self employment in agriculture and allied fields and positive and significant relationship with extent of participation in agriculture and allied fields

Majority of the respondents had aspired for getting higher income in their profession followed by getting a government job and developing farm Majority of the

respondents had preferred vegetable production and plant nursery management as their self employment avenues

Extent of participation in agriculture and allied fields had association with preference for self employment in agriculture and allied fields and aspiration of youths Extent of participation in agriculture and allied fields had no significant association with training need Preference for self employment in agriculture and allied fields had significant association with training needs for the selected self employment avenue in agriculture and allied fields There was significant difference between males and females in their extent of participation in agriculture and allied fields and preference for self employment in agriculture and allied fields

In the case of vegetable production selection and production of good quality seeds was perceived as the area having maximum training need The order of preference of training needs were preparation of insecticides and fungicide solution, fertilizer application processing of vegetables field preparation harvesting and storing and marketing of vegetables In the case of plant nursery management control of pests and diseases was perceived as the area having maximum training need Selection of good quality planting material nutrient application budding grafting marketing of produce layering artificial pollination construction and maintenance of green house irrigation preparation of potting mixture field preparation and tissue culture were the other sub items in which training was needed

The topmost preference was given to peripatetic training of long duration during summer in Krishi Bhavans They also indicated 'Demonstration as the most preferred training method

10 Nutritional status of women engaged in fish vending in Thiruvananthapuram district
(TOT/05 00 01 89/ACV(11)KAU/PG)

The study revealed that cereals nuts and oil seeds (coconut) sugar and jaggery fish and beverages were found to be the daily used food items while foods like green leafy vegetables fruits milk products fat and oils and egg were least frequently used food items Women engaged in fishvending were responsible for dual work as housewife and as wage earner of the family Compared to the work outside the women were found to spend less time for household work An assessment of the total time spent for these two activities revealed that majority of the women were working more than 10 hours in a day There was no significant relationship observed between the selected variables and time spent for household activities Time spent for fishvending activities is associated with the family income age of the fisherwomen and fisherwomen s income Energy expenditure by an individual was influenced by the type of activity and time spent for each activity Majority of the women (87 34 per cent) were found to spend more energy than the Recommended Daily Allowance (RDA) specified by ICAR (1989) for moderate working women Energy expenditure for different activities revealed that the energy expended for household activities was found to be less than the energy spent for fishvending activities which was found to be four times greater The energy spent for leisure activities was comparatively negligible

Mean height and weight of the fisherwomen were found to be below the ideal height (155 cm) and weight (50 kg) suggested for a reference women (ICMR 1989) Bodymass Index (BMI) of the women revealed that 33 33 per cent of them had chronic energy deficiency Correlation analysis of the data shows a highly significant association between BMI and body weight ($r = 0\ 6211^{**}$) and height ($0\ 3171^{**}$) Nutritional status index developed ranged from 14 04 to 18 58 with a mean of 16 25 Lowest nutritional status was observed only in 9 33 per cent of the women Correlation studies of the data showed that there was a highly significant

association between nutritional status and height (r = 0 48211**) weight (r = 0 9370**) BMI (r - 9195**) quality of life index (r = 0 3284**) and energy expenditure (r = 0 8964**)

Clinical examinations of the fisherwomen revealed that 95 33 per cent of women showed any one or other of the nutritional deficiency diseases The diet consumed by the fisherwomen was not balanced The intake of pulses green leafy vegetables other vegetables roots and tubers fruits fat and oils were very poor and the consumption rate was below 20 00 per cent of the RDA Mean nutrient intake of the women revealed that availability of energy fat calcium iron retinol thiamine niacin riboflavin and vitamin C were inadequate in their daily diet but the intake of protein was higher than the RDA It was observed that the fisherwomen surveyed were in negative energy balance when compared to RDA Deficiency of calories ranged from 6 60 to 14 65 per cent All the women utilised more energy than they consumed and it ranged from 9 43 to 35 77 per cent

Biochemical analysis of the blood constituents revealed that 66 67 per cent each had low haemoglobin and total protein About 46 67 per cent of the women studied had low albumin content Serum vitamin A was below the normal level of 25 kg in 86 67 per cent of the women

11 Communication behaviour of women heading farm families in Neyyattinkara taluk

(TOT/05 00 02 91/ACV(6)KAU/PG)

Majority of the respondents had low level of communication behaviour with regard to both paddy (42%) and coconut cultivation (40%) closely followed by 40% and 36% respectively with high level of communication behaviour There was no significant difference between farm women cultivating paddy and those cultivating coconut with regard to inward exposure outward exposure communication behaviour and the various independent variables selected for the study

All the ten independent variables selected for this study showed significant correlation with the dependent variable communication behaviour The variable age" had a negative correlation whereas all other variables like education farm size social participation cosmopoliteness management orientation scientific orientation level of aspiration adoption of improved agricultural practices and knowledge about improved agricultural practices showed positive correlation with communication behaviour Path analysis between the independent variables and communication behaviour indicated that in the case of farm women cultivating paddy the maximum positive direct effect on communication behaviour was exerted by knowledge about improved agricultural practices (in paddy) followed by scientific orientation and level of aspiration The maximum indirect effect was due to adoption of improved agricultural practices (in paddy) followed by management orientation

The maximum positive direct effect on the communication behaviour of farm women cultivating coconut was exerted by social participation followed by farm size and management orientation The maximum positive indirect effect was exerted by knowledge about improved agricultural practices (in coconut) followed by scientific orientation and level of aspiration

12 Food consumption pattern of selected farm families in Thiruvananthapuram district

(TOT/06 01 01 89/ACV(11)KAU PG)

Majority of the families were Hindus and were of nuclear type Majority of the families had children belonging to pre adolescent and adolescent age Members of the smaller land holding were employed as casual labourers whereas in bigger holdings government and private

employees were found With increase in land holding there were increase in income and decrease in the per cent of income spent in food Families irrespective of land holdings had savings for future use Families of larger holdings cultivate paddy and was utilised for home use Coconut was grown in all the families with a surplus production among larger land holdings which was used as a source of income

Families of higher land holdings produce fruits and vegetables and was utilised for domestic consumption Major share of food budget was spent on staple food items in smaller holdings and fish was a common food item in all the groups Three meal pattern was observed in majority of the families and better food combination was followed among the families of larger holdings Frequently used food items were cereals vegetables fish milk and sugar Use of egg meat and bakery items was very rare in the families studied

Weight for age profile indicated that adults and adolescents were below the prescribed standards On assessing the grades of malnutrition adult members of the families belonged to normal group whereas majority of the adolescents were in grade I malnutrition Compared to male members female members were found healthier Energy intake of adult male members were below RDA whereas it was sufficiently met among females in general Protein intake was below RDA in adults and male adolescents of smaller land holdings Intake of nutrients such as iron and B complex were satisfactory in adult males than in adult females and adolescents Both adult and adolescent females were free from clinical manifestation of diseases except the incidence of anaemia Nutritional status index worked out for the family members did not vary significantly with landholdings But female adults and adolescents were better than male adults and adolescents in nutritional status index

13 Food preference and dietary habits of adolescents among agricultural labourers
(TOT/06 01 03 89 ACV(1)KAU PG)

Of the families surveyed majority belonged to under prev leged commu nities with nuclear type families The per cap ta income of majority of them ranged between Rs 200/ to 500/ The families surveyed were habitually non vegetarians Cereals tubers and roots vegetables milk fish fats oils sugar and jaggery and spices were found to be most frequently used food among the adolescents Factors such as total income of the family type and size of family educational status of adolescents and their parents and peer group were not found to influence the food preferences of the studied adolescents

Consumption of cereals and fish was above the recommended dietary allowances (RDA) and nutrients such as protein energy thiamine and niacin was met above 90 per of RDA in adolescent boys and girls apart from Vitamin C in adolescent girls Normal haemoglobin level was observed only in negligible adolescents Nutritional status of the adolescent girls were found to be better than adolescent boys in the present study

14 Nutritional status and dietary habits of Irulas of Attappady
(TOT/06 01 04 90/ACV(11)KAU/PG)

The study indicated that majority of the families were of nuclear type with an average family size of 4 73 Majority of the adult members were illiterate and agricultural labour was their main occupation Major expenditure of the family income was incurred for food especially cereals Two meals a day pattern was followed by the tribes which included cereals fats and oils and spices and condiments The nutritional status of children was deficient and it was revealed in the anthropometric measurements like height, weight mid upper arm circumference and skinfold thickness Food weighment survey revealed a deficient

intake of all foods except cereals The intake of most of the nutrients was low

Anaemia was the most important clinical symptom observed among children which was reflected in the bio chemical examination of blood for haemoglobin RBC count and packed cell volume Sickle cell anaemia and worm infestations were observed among the children

The respondents had a favourable attitude towards the developmental programmes implemented by various agencies to improve their health status However awareness about health and nutrition was found to be poor

15 Nutritional status of ICDS beneficiaries with respect to participation
(TOT/06 01 05 88/ACV(11)KAU/PG)

The study indicated that joint family system with 'small family norm' was a characteristic feature of the families surveyed Their major expenditure was for food Evaluation of ICDS programme indicated that supplementary nutrition component was the most preferred component while referral service the least Sharing of the food supplement incomplete utilization of immunization irregular supply of vitamins and under utilization of referral services were some of the lacunae identified in the ICDS programme

Assessment of anthropometric measure ments of the beneficiaries revealed that beneficiaries were better than their counterparts in the control group Food and nutrient consumption of the beneficiaries were much better than the control group Clinical evidence of various deficiency diseases were lower in the experimental group compared to the control group So also the bio chemical parameters

Participation of the beneficiaries in the programme and their levels of participation were independent of various socio economic variables analysed Nutritional status index developed for respondents was significantly better in the experimental group Participation index of the beneficiaries was found to be high and nutritional status index increased significantly with participation index

16 The factors influencing the intrafamily distribution of food among agricultural labour families of Thiruvananthapuram with special reference to the nutritional status of girl children
(TOT/06 01 07 91/ACV(11)KAU/PG)

More than 50 per cent of the total income in all families were spent for food The expenditure on health and educational requirement was negligible Expenditure was higher for the purchase of foods like cereals flesh foods (fish) milk tapioca and coconut More quantities of vegetables and fruits were purchased Cereals flesh foods and milk were important food stuffs, in the family diet of most families

Often male members employed members head of the family or children were given priority while serving foods Inferior quality of foods usually went to adolescent and adult females of the households Cereals sugar and fats and oils were included in the family diets of all age groups Comparatively less number of families were including foods like pulses roots and tubers leafy vegetables and fruits in their diets Expensive foods such as fish fruits vegetables and pulses even if included were preferentially given to adult males and children Calcium carotene fat and riboflavin were the most deficient nutrients in the diets of children since the requirements were met only around 50 per cent of their requirement However males of all age groups met 50 to 74 per cent of their protein requirement The diets of adult females were more deficient in all the nutrients except vitamin C compared to other male counterparts However, nutrient intake of adolescent females about 16 years were better than adolescent males of the same age group Females of 6 to 15 years have more prominent deficiency of

all the nutrients except energy, iron, thiamine and niacin compared to the males of the same group In pre-school children and toddlers also, all the nutrients except energy was more deficient among girls compared to boys except in fat and calcium intake in 4 to 6 years Analysis of actual food consumption of adolescent boys and girls revealed that foods like pulses, leafy vegetables, other vegetables, roots and tubers fats and oils and milk were more deficient among girls than boys

Mean food intake of adolescent boys were higher than adolescent girls with regard to all foods except milk Highest deficiency was observed in the case of pulses leafy vegetables fats and oils and milk which were above 70 per cent deficient in both the sexes Percentage of male children consuming all foods to meet upto 75 per cent of the RDA except milk was very high Compared to girls, in general preference was given to adolescent males in the provision of food money and education

17 Factors influencing the working efficiency of women engaged in stone breaking with special reference to nutritional status
(TOT/06 01 08 91/ACV(11)KAU/PG)

The surveyed families belonged to under previleged communities with nuclear families The main bread winner of these families were found to be females The per capita income of majority of the families ranged between Rs 100/ to Rs 200/ The major share of the family income was spend for the purchase of food articles Rice and fish are the major ingredients in their dietaries

Longer hours of work inadequate rest meagre wages, hazardous and risking conditions affect the health and well being of the respondents Negative energy balance was observed in the respondents

Intake of major nutrients viz energy Vitamin A Vitamin B2 and Vitamin C was found to be inadequate in their dietaries

Anaemia was the major nutritional disorder found in the respondent Negative iron status, reflected in their low cardiac abilities and poor physical endurance Working efficiency of the respondents showed no association with their nutritional status index (NSI) developed Among the various factors influencing working efficiency, it was found that only monthly income and resting hours in between their work showed a significant correlation

18 Vocational higher secondary education in agriculture in Kerala - A multi dimensional analysis
(TOT/08 01 01 91/ACV(6)KAU/PG)

Majority of the student respondents hailed from rural areas with agricultural background, they had secured low marks in SSLC/VHSEA and their family educational status and economic status were poor Majority of the student respondents had only medium level of knowledge about the subject matter of VHSEA courses and favourable attitude towards VHSEA programme and scientific agriculture With regard to overall evaluative percept on of VHSE courses in agriculture it was found that majority of the respondents had noted the course only as moderate

Commercial flower production was the most preferred vocational interest area of the respondents undergoing PP NM & OG courses and VHSEA certificate holders while general agriculture was the most preferred vocational interest area of the student undergoing F & V courses

As regards vertical mobility status of VHSEA certificate holders, it was observed that half of them were studying in degree classes and more than one fourth of the respondents were not continuing their studies after VHSEA and four respondents were studying in Agricultural College Majority of the VHSEA certificate holders were unemployed, over six per cent of them working as Lab Assistant and only two respondents were engaged in self employment avenues

interest in higher education, job opportunities due to higher qualification and attitude towards higher education were the most important factors influencing vertical mobility of VHSEA students Awareness about the avenues for self employent, skill training for doing self employment, and interest in taking up self employment were the most important factors influencing the employability of VHSEA students The teachers and experts, in general, evaluated the VHSEA as moderate

Lack of library facilities, lack of building facilities and lack of facilities for doing practicals were the most important constraints faced by the student respondents while low standard of pupil lack of practical facilities in the school and non-availability of materials and equipments were the most important constraints expressed by the teachers of VHSEA

Permanent teachers should be employed proper scholarships and [illegible] should be provided and provision for higher education were the important suggestions put forward by student respondents for improving VHSEA while job opportunities to pass outs should be increased, permanent teachers should be appointed and public should be made aware of the relevance of the vocational agricultural courses were the important suggestions put forward by teachers for improvement of VHSEA

19 Resource use management in urban co-operative banks in Thrissur district
(TOT/04 00 12 91/MNY(CB)KAU/PG)

The study revealed that deposits constituted the lion's share of total sources of funds of banks The borrowings of the banks were negligible The strong capital base of the banks helped to retain the credibility of the depositors Reserves which contribute the major chunk of the owned funds, increased the total source of funds The high proportion of fixed deposits in the funds mobilised caused to rise the interest liability of the banks Since there are limits to control the interest cost, banks have to bring down their manpower and other expenses, improve revenue by the profitable deployment of funds, besides enhancing the mobilisation of deposits for short periods

Among the three types of loans and advances, short term loans and advances occupied highest place However banks may further improve the share of short term loans in the funds deployment which can ensure frequent recycling of funds maximise profit and keep the liquidity needs met The major part of investment in short term loans and advances were financed through fixed deposit mobilisation Funds were not rationally allocated from the view point of periodicity Yielding lesser income to the banks, the investments increased enormously The disproportionate growth of equity and debts of the banks intensified the risk exposure of funds portfolio There was no direct relationship between risk and return of the banks and a proper risk return trade off is lacking in majority of the banks Banks had kept excess liquid assets and liquid cash over and above the statutory requirements This necessitates scientific evaluation of the liquidity needs to identify the funds blocked as idle and utilise the excess fund kept for profitable deployment Credit-deposit ratio of the banks was below the desirable level and this affected the profitability adversely The lending efficiency of the banks was also affected by the poor recycling of funds Therefore, steps may be taken to improve the credit deposit ratio, reduce mounting overdues and ensure efficient management of risk and return which in turn calls for the scientific management of funds

20 Adoption of farm implements and machinery by the rice farmers of Kerala
(TOT/02 06 01 86/ACV(6)KAU/PG)

The regionalwise Rice Farm Mechanization Quotients (RFMQ) obtained were as follows

Sl No	NARP Region	RFMQ	Rank
1	Northern Region	21 40	4
2	Central Region	42 86	1
3	Southern Region	25 81	3
4	Highrange Region	16 73	5
5	Problem Region	36 70	2

There was significant difference amongst the five NARP regions with respect to extent of adoption Bose plough by virtue of its highest work capacity and quality of work and the lowest operational cost was found to be an efficient animal drawn plough followed by the improved country plough The use of animal drawn puddlers was confined to the central region The helical blade puddler due to its high work capacity quality of puddling and suitability to all types of soils was found to be an efficient puddling for all regions As to the power tiller and various implements operated by it the problem region had distinctly higher percentage of owner users and custom hirers Tractor ploughing has gained popularity in all the regions except the high range region The central region had the highest percentage of users of tractor and the implements like cultivator cage wheel paddy puddler rotavator and wet land leveller

The problem region had the highest percentage of owner users of all the three conventional water lifting devices namely counterpoise lift water wheel and swing basket Axial flow pumps which are used to operate the petti and para were found confined to the problem region alone The central region had the highest percentage of owner users and custom hirers of kerosene pumpsets, diesel engine pumpsets and the highest percentage of owner users of electric motor pumpsets

Among the three plant protection equipments, hand compression sprayers followed by knapsack sprayers were common in all the regions Power sprayers were only selectively owned and used and custom hired The problem region had the highest percentage of owner-users and custom hirers of knapsack sprayers where as the central region had the highest percentage of owner users and custom hirers of hand compression sprayer and power sprayer

Preponderant majority of farmers of all regions used the indegenous country sickle for harvesting paddy There were only neglible and isolated use of improved sickles The mechanically operated paddy harvester (self propelled vertical conveyor reaper) had also negligible number of users In general, mechanical threshing of rice has not gained momentum in Kerala The central region had the highest number of owner users and custom-hirers of mechanical threshers The mechanical winnowers viz the motorised simple winnowing fan and high type motorised paddy winnowers were found to be selectively used that too, by a very low percentage of farmers of the central region and problem region Results tests were conducted in nine locations of the central region with three packages of farm implements and machinery namely low mechanization package' 'medium mechanization package' (MMP) and high mechanization package' (HM) It was found that the HMP required the lowest quantity of human labour input followed by MMP It was the highest for the LMP The differences among the packages were highly significant Cultivation with the MMP achieved the highest per hectare yield But the three packages did not differ significantly with respect to per hectare yield of paddy Rice cultivation with the HMP required the lowest per hectare cost followed by the MMP Cost of cultivation of the plots where the LMP was used, was the highest The differences in per hectare cost of cultivation existing among the three packages were highly significant

21 Impact of new settlers in western ghat region in the socio-economic conditions of the tribal population in Wynad district, in Kerala
(TOT/04 00 03 89/MNY/CB/DOE

The study revealed that two-third (67 54 per cent) of the households covered by the

study had lost part of their land holdings especially to the settlers Two third of the households covered by the study reported that approximately half of the area held by them prior to the immigration of the settler had been alienated in different ways It was found that more than nine tenth of the area of land transferred had gone to the settlers alone They not only grabbed the tribal lands, but had also encroached to forest lands in which tribals exercised considerable user rights

The mean per capita income (PCI) of the sample is estimated to have risen by 55 53 per cent from Rs 2017 at present prices just before the commencement of in migration to Rs 3137 at present The income shares however did not show significant variation While farm income remained stable around one fourth level there was marginal appreciation in the share of wage income from 63 62 to 65 21 per cent The only notable change is the fall in the share of self employment income from 8 67 to 4 11 per ce and emergence of salary income

The transformation matrix ved that approximately two third of the samples 64 91 per cent) moved upto higher income classes of which approximately half of them had crossed over the next higher class

As many as 80 per cent of the social and political leaders and officials interviewed felt that traditional employments have declined considerably in the post migration period At the same time 50 per cent of them believed that establishment of farms and estates by the settlers increased new employment opportunities to the tribals But the loss of traditional employment in forestry sector, crafts and collection of MFP was not adequately compensated by these new employment opportunities as tribals are not skilled enough to take up the emerging opportunities

There has been notable changes in the cropping pattern of significantly larger proportion of households The proportion of samples reporting rise in area was highest in respect of pepper (73 25 per cent) followed by coffee (37 72 per cent) and banana (17 98 per cent) The corresponding percentage for paddy, ginger and other crops were 7 46 5 26 and 4 82 respectively At the same time, 30 26 and 25 88 per cent reported reduction in area under paddy and coffee respectively The corresponding decline was to the tune of 12 72 per cent for other crops and well below 10 per cent for ginger, banana and pepper

The extremely poor quality of housing is revealed by the fact that the values of the houses of two third of the samples were below Rs 5000 only A notable observation is that 51 75 per cent of the samples believed that the settlers induced the tribals to consume more liquor Altogether 76 95 per cent of the households obtained liquor from the settlers A noteworthy observation is that 48 68 per cent of the samples strongly felt that they could learn new cultivation practices from the settlers Approximately half the number of samples strongly felt that the transport and road facilities in the area improved after the influx of settlers About half (48 25 per cent) of the samples strongly felt that opening up of new schools and nurseries in the area consequent on the settlement of the migrants really improved the accessibility to educational institutions Approximately half of the samples (48 66 per cent) strongly felt that establishment of hospitals and dispensaries in the area both by the settlers and the public health department improved the accessibility to medical care institutions and doctors

The destruction of the traditional life support system reduced the tribals to the status of casual wage labour and have been constrained to buy most of their requirements from the market Thus the traditional self reliant non monetised tribal economy got gradually trnsformed into a "dependent" and monetised economy making them highly vulnerable to the external economic and social environment

Majority (54.39 per cent) of the samples felt that there was perceptible decline in the influence of Moopan in the social religious and political life of the tribal groups

As many as 86 per cent of the social and political leaders and officials interviewed pointed out that tribal women have been harassed abused and exploited by outside elements including some of the settlers They have also been subjected to sexual exploitation

Eventhough 59.65 per cent of the samples claimed that the traditional system of faith and worship is continued without significant change a notable erosion in the religious faith is reflected in religious ceremonies method of workship etc

EXPERIMENTS IN PROGRESS

Project (01) Socio-economic conditions of agricultural labourers

1 **A study on the labour involved families in rice farming in Kuttanad**
(TOT/01 00 01 88 MON(8)KAU

No work reported during the period

2 **Agricultural labour in Kerala - A multidimensional analysis**
(TOT/01 00 02 92/ACV(8)KAU

Schedule being prepared

3 **Profile analysis of coconut climbers in Thiruvananthapuram district**
(TOT/01 00 03 92/ACV(6)KAU/PG)

Final report being prepared

4 **Differential preference of work by agricultural labourers and their employment and wage pattern in Thiruvananthapuram district**
(TOT 01 00 05 92/ACV(6)KAU/PG)

Final report being finalised

5 **Training needs of agricultural labourers in Thiruvananthapuram district**
(TOT 01 00 06 92 ACV 6)KAU PG)

No work done

6 **Farmer - Labourer relationship in rice production systems - A case study**
(TOT 01 00 08 92 ACV(6)KAU PG

Analysis of data in progress

7 **Comparative analysis of characteristics of women agricultural labourers in social systems of Kollam and Kanyakumari districts**
(TOT/01 00 09 92/ACV(6)KAU/PG)

No work done

8 **Cause and effect analysis of immigration of agricultural labourers**
(TOT/01 00 10 93/ACV(6)KAU/PG)

Interview schedule being prepared

9 **Economic status of agricultural labourers in Thiruvananthapuram district**
(TOT/01 00 11 93/ACV(8)KAU/PG)

Final report under preparation

10 **Impact of increase in wage rate and cost of fertilizers on rice production in Thiruvananthapuram district**
(TOT/01 00 12 93/ACV(8)KAU PG)

Analysis in progress

11 **Feasibility and utilisation of improved vegetable production technologies in family farming by agricultural labourers in Thrissur district**
(TOT/01 00 12 93/VKA(6 KAU/PG)

Data collection completed

Project (02) Socio-economic consequences of technology adoption

Sub project (01) Rice

12 **Optimisation of enterprise combinations in the rice based farming**

system of the high range
(TOT/02 01 01 81/AMB(8)KAU)

No work reported during the period

13 Economic analysis of rice production in the Kuttanad and kole areas of Kerala
(TOT/02 01 04 92/VKA(8)KAU/PG)

Final report being prepared

14 Indigenous practices in rice cultivation in Thrissur district
(TOT/02 01 05 94/VKA(6)KAU/PG)

Interview schedule being finalised

Sub project (02) Vegetables

15 Indigenous practices of vegetable cultivation in Thrissur district
(TOT/01 02 03 94/VKA(6)KAU/PG)

Interview schedule being finalised

Sub project (08) Ginger

16 Economics of production and marketing of ginger in Kerala with special reference to Idukki district
(TOT/02 08 02 92/VKA(8)KAU/PC)

Final report being prepared

Sub project (09) General

17 Transfer of technology evolved by KAU - A cross sectional study
(TOT/02 09 02 50/MNY DE ICSSR)

Final report being prepared

18 Socio-economic impact of changes in the ecology of Kuttanad consequent on the commissioning of the Thannermukkam regulator
(TOT/02 09 03 89/KUM(8)KAU)

Final report being prepared

19 Analysis of the management for sustainable agriculture by the farmers in Kerala
(TOT/02 09 04 94/VKA(6)KAU/PG)

Final report being prepared

20 Differential adoption of plant protection technology by farmers in Kerala - A critical analysis
(TOT/02 09 05 91/ACV(6)KAU/PG)

Final report being prepared

Sub project (11) Coconut

21 Transfer of agricultural technology among marginal farmers in coconut based farming systems under rainfed conditions
(TOT/02 11 02 91/ACV(6)KAU/PG)

No work reported

22 Resource use management among coconut growers in Kerala
(TOT/02 11 03 92/VKA(6)KAU/PG)

Final report being prepared

23 Indigenous practices in coconut farming in Thrissur district
(TOT/02 11 04 94/VKA(6)KAU/PG)

Interview schedule being prepared

Sub project (12) Arecanut

24 Economics of arecanut cultivation in Kasaragod district

(TOT/02 12 01 91/VKA(8)KAU/PG)

Final report being prepared

Sub project (13) Banana

25 Risk management behaviour of banana growers'
(TOT/02 13 01 91/VKA(6)KAU/PG)

Final report being prepared

26 Production and marketing of banana (Nendran) in Malappuram district
(TOT/02 13 02 92/VKA(6)KAU/PG)

Final report being prepared

27 Indigenous practices of banana cultivation in Thrissur district
(TOT/02 13 03 94/VKA(6)KAU/PG)

Interview schedule prepared

Sub project (14) Dairy products

28 **Economics of milk production in Kerala with special reference to Thrissur district**
(TOT/02 14 01 92 VKA(8)KAU/PG)

Final report being prepared

Sub project (15) Sericulture

29 **Adoption behaviour of sericulturists - A multivariate analysis**
(TOT/02 15 01 92/VKA(6)KAU/PG)

Final report being prepared

Sub project (16) Rubber

30 **Consequences of conversion of marginal homesteads for planting rubber in Kottayam district**
(TOT/02 16 01 93/VKA(6)KAU/PG)

Collection of materials for preparation of interview schedule in progress

Sub project (17) Fisheries

31 **Economics of paddy-cum-prawn culture in Pokkali lands of Ernakulam district**
(TOT/02 17 01 94/VKA(8)KAU/PG)

Review of literature in progress

Sub Project (18) Floriculture

32 **Prospects and constraints of commercial cutflower production in Thiruvananthapuram district**
(TOT/02 18 01 94/ACV(6)KAU/PG)

Review of literature in progress

Project (03) Group farming, Krishi Bhavan and other approaches

Sub Project (01) Group farming

33 **A study on the role perception and the role performance of the convenors of group farming committees of rice cultivation**
(TOT/03 01 04 91/VKA(6)KAU PG)

Final report being prepared

34 **Profile analysis of farmers and farming situations under group management in rice**
(TOT/03 01 89/MNY(8) KAU

Final report being prepared

35 **Interpersonal communication behaviour of members of group farming committee in the adoption of rice production technology**
(TOT/03 01 05 92/VKA(6)KAU/PG)

Final report being prepared

Sub project (03) Farming System

36 **Evaluative perception of homestead farmers in relation to appropriateness of farming systems and cropping patterns**
(TOT/03 03 01 92/VKA(6)KAU/PG)

Final report being prepared

Project (04) Rural Development

37 **Input management in Dairy Co-operative banks in Thrissur district**
(TOT/04 00 12 91/MNY(CB)KAU/PG)

Final report under preparation

38 **People's participation in cooperatives A study in Kerala**
(TOT/03 04 01 93/MNY(C&B)KAU)

To be initiated

39 **Economic viability of PAC in Kerala**
(TOT/04 00 09 90/MNY(C&B)GOK)

Final report under preparation

40 **Supply utilisation and repayment of crop loans of commercial banks in Alappuzha district**
(TOT/04 00 14 92/VKA(8)KAU/PG)

Final report under preparation

41 **Financing of farmers in Manjeswar block of Kasargod district**
(TOT/04 00 15 92/VKA(8)KAU/PG)

Project not yet initiated

42 **Economic impact of minor irrigation in Palakkad district**
(TOT/04 00 16 94/VKA(8)KAU/PG)

Interview schedule being prepared

43 **Rural unemployment in Palghat district**
(TOT/04 00 17 94/VKA(8)KAU PG)

Review of literature in progress

44 **Input management in Dairy Co-operatives of Ollukkara Block**
(TOT/04 00 13 94/MNY(C&B)KAU/PG)

Final report under preparation

45 **Income, savings and capital formation in farm households of Kodakara development block**
(TOT/04 00 18 94/VKA(8)KAU/PG)

Review of literature in progress

46 **An analysis of the characteristics of women s groups and their role in rural development**
(TOT/04 00 19 94/ACV(6)KAU/PG)

Review of literature in progress

Project (05) Problems and issues of women

47 **Communication behaviour of women heading farm families in Neyyattinkara taluk**
(TOT/05 00 02 91 ACV(6)KAU PG)

Final report submitted The same is included in Concluded Experiments

48 **Participation of farm family women in sericulture in Palakkad district**
(TOT/05 00 04 93 VKA(6)KAU/PG)

Data collection completed

49 **Role of farm women in generating additional income through subsidiary occupation A case study in Thiruvananthapuram district**
(TOT/05 00 05 94/ACV(6)KAU)

Review of literature in progress

50 **Socio economic and cultural determinants influencing the nutritional status of women workers of informal sectors in Thiruvananthapuram district**
(TOT/05 00 06 94/ACV(11)ICSSR)

Final report under preparation

51 **Enterpreneurial behaviour of rural women in Thiruvananthapuram district**
(TOT/05 00 08 94/ACV(6)KAU/PG)

Review of literature in progress

52 **Nutritional status of women engaged in the coir industry**
(TOT/05 00 09 94/ACV(11)KAU/PG)

Review of literature in progress

Project (06) Socio-economic and nutritional problems

Sub Project (01) Rural Families

53 **Food consumption pattern of rural households below poverty line as influenced by food subsidies distributed through fair price shops**
(TOT 06 01 06 91/ACV(11)KAU/PG)

No work done

54 **Food consumption pattern and nutritional status of farm women in Thrissur district**
(TOT 06 01 09 94/VKA(11)KAU/PG)

Review of literature in progress

55 **Agricultural information source utilization pattern of neo-literate farmers in rural areas**
(TOT 06 01 10 94/ACV(6)KAU PG)

Preparation of interview schedule in progress

56 **Problems and prospects of self employment of trained rural youth in agriculture**
(TOT/06 00 11 94/ACV(6)KAU/PG)

Review of literature in progress

Project (01) Biological nitrogen fixation

1 **Effect of selected plant protection chemicals on the beneficial microorganisms in cowpea rhizosphere**
(BMI/01 00 09 93/VKA(5)KAU/PG)

An *in vitro* study on the inhibitory effect of fungicides on the native strains of *Azospirillum* and *Bradyrhizobium* spp isolated from cowpea was completed

2 **Effect of *Asospirillum* inoculation on establishment and growth of bush pepper**
(BMI/01 00 10 93/ACV(5)KAU/PG)

Azospirillum was isolated from different varieties of pepper These cultures were tested for their IAA producing ability under *in vitro* condition The isolate which produced maximum IAA was further selected for root induction study in bush pepper using Karimunda and Panniyur 1

3 **Nitrogen fixing bacteria associated with plantation and orchard crops of Kerala**
(BMI/01 00 11 93/ACV(5)ICAP)

Eighteen out of the thirty one isolates of *Asospirillum* were found capable to produce IAA under *in vitro* conditions Among them an isolate from pepper and mango produced maximum IAA @ 50 to 65 µg/ml of the culture medium These were selected for further studies particularly with reference to the growth and establishment of seedlings of various plantation and orchard crops like pepper nutmeg clove mango and jack

Project (02) Mycorrhizal association in crop plants and their effect on crop growth and yield

4 **Investigations on VA mycorrhiza of cassava in enhancing the nutrient availability**
(BMI/02 00 04 84/ACV(5)KAU)

Inoculation with *Glomus etunicatum* along with the full dose of N&K and half the dose of P recorded the highest plant biomass production under field conditions The final tuber yield is to be recorded

5 **Growth and establishment of tissue culture plantlets as influenced by VA mycorrhiza**
(BMI/02 00 06 91/ACV(5)KAU)

VA mycorrhiza inoculation increased the survival of tissue culture plantlets of anthurium and rose

6 **Growth, phosphorus uptake and resistance to root knot nematode infection in ginger and turmeric as influenced by VA mycorrhizal colonisation**
(BMI/02 00 07 91/ACV(5)KAU)

Inoculation of ginger and turmeric with the VA mycorrhiza *Glomus etunicatum* along with the full dose of NPK resulted in higher yield In ginger and turmeric these were 55 71, 62 55 and 80 51 g/plot and 69 63 84 98 and 116 26 g/plot respectively after inoculation with VAM alone NPK alone and in combination with VAM and NPK treatments

7 **Evaluation of VA mycorrhiza as bio control agent against wilt diseases of pepper**
(BMI/02 00 08 92/ACV(5)ICAR)

Different VAM species like *Glomus Acaulospora* and *Sclerocystis* spp were found associated with pepper The slow wilt symptoms due to the combined inoculation in *M incognita* and *R similis* varied with the species of VAM It was observed that while inoculation with *G mosseae* increased the symptom development inoculation with *G fasciculatum*, *G monospora* and *G etunicatum* reduced the nematode multiplication and symptom development

Sub Project (02) : Children

57 Iron deficiency and behaviour pattern of pre-school children
(TOT/06 02 93/ACV(11)KAU/PG)

Review of literature in progress

58 Impact of training on nutrition and health education in the integrated child development service (ICDS) set up
(TOT/06 02 03 94/ACV(11)KAU)

Interview schedule prepared

59 Nutritional profile and mental functions of pre school children belonging to agricultural labourer families in Thrissur district
(TOT/06 02 04 94/VKA(11)KAU/PG)

Review of literature in progress

Sub project (03) Adults

60 Glycemic response to selected bohydrate rich foods in diabetics
(T T/06 03 0 93/AC /(11,K/ PG)

St n progress

6 **Dietary hab is, fat cor sumption pattern and blood liquid profile of adults engaged in moderate activity**
(TOT/06 03 02 94/ACV(11)KAU/PG)

Review of literature in progress

Sub Project (04) Special Groups

62 Socio-economic status of traditional fisherfolk in Kerala - a study in Thiruvananthapuram ditrict
(TOT/06 04 01 94/ACV(8)KAU/PG)

Review of literature in progress

Sub P oject (05) General

63 Taxonomical analysis of agricultural modernity of farmers
(TOT/06 05 01 94/ACV(6)KAU/PG)

Review of literature in progress

Project (07) : Statistical Research techniques in crop sciences

64 A comparison of transformations used in the analysis of data from agricultural experiments
(TOT/07 00 08 92/VKA(7)KAU/PG)

Required data and literature have been collected The project was completed because the student has temporarily discontinued

65 A comparison of alternate methods for the control of experimental error in perennial crops
(TOT/07 00 06 91/VKA(7)KAU/PG)

The feasibility of using certain techniques for the improvement of precision in the estimation of treatment effects was examined emperically and the results showed that the use of appropriate functional terms of the covariance adjustment model with pre experimenta yields as the concomittant variate resulted in a significant reduction of error The nearest neighbourhood analysis (NNA) and mov ng block me od were also fou d to be better than t e conventional method f stratification

66 Determination of realistic premium rates for crop insurance - A pilot study
(TOT/07 00 07 91/VKA(7)KAU)

The beneficiaries of crop insurance were only 4 in number in Thrissur district as such the data collected from them was quite insufficient to carryout the analysis A sampling frame for the same consisting of 50 respondents is available in Palghat district As no travelling allowance was admissible no further work has been done

67 Analysis of auto correlated data in groups of experiments
(TOT/07 00 09 92/VKA(7)KAU/PG)

Collection of literature is completed Development of methodology including the development of software is in progress

68. Optimality of block deaigna uaed in one way elimination of heterogenity
(TOT/07 00 14-93/VKA(7)KAU/PG)

The relevant literature for the research work has already been collected A new approach to optimality of block designs is being worked out

69 Yield prediction of pepper based on biometrical characters
(TOT/07 00 11 92/VKA(7)KAU/PG)

Regression models for the prediction of pepper through stepwise regression analysis are being developed Analysis is in progress

70 Construction of composite sow index and study of its effects due to size, parity and season in pigs
(TOT/07 00 12 93/VKA(7)KAU/PG)

Collection of literature and the analysis of data are over Results are being analysed

71 Optimum plot size for intercropping experiments
(TOT/07 00 13 93/VKA(7)KAU/PG)

Uniformity trial in bhindi intercropped with cowpea has been carried out Results are being analysed

72 Estimation of plot size for field experiments in pineapple
(TOT/07 00 15 93/VKA(7)KAU/PG)

The student discontinued

73 Estimation of extent of border effect in varietal trial on vegetables
(TOT/07 00 16 93/VKA(7)KAU)

Data have been collected from a trial on bhindi conducted by All India Co ordinated Vegetable Improvement Project Data on several other vegetables are yet to be collected

74. Multivariate approach for the comparison of growth in broiler chicken
(TOT/07 00 17 94/VKA(7)KAU/PG)

Literature and data collection are in progress

75 Optimum stratification
(TOT/07 00 18 94/VKA(7)KAU/PG)

Collection of literature is in progress

76 Time series modelling and forecasting of the yield of cashew in Kerala
(TOT/07 00 19 94/VKA(6)KAU/PG)

Relevant literature is being collected

Project (08) Agricultural education and training

Sub-project (01) · Formal education

77 Work motivation - A multivariate analysis among teachers of the Kerala Agricultural University
(TOT/08 01 02 93/VKA(6)KAU/PG)

Preparation of questionnaire in progress

78 Interaction of psychological, economic, sociological and technological determinants of the enterpreneurial behaviour of agricultural students
(TOT/08 01 03 94/ACV(6)KAU/PG)

Review of literature in progress

Project (09) · Marketing

79 Impact of promotional strategies for consumer non durables in rural markets
(TOT/09 00 01 93/MNY(C&B)KAU/PG)

Study in progress

80 Marketing of hospital service by non-governmental organisations
(TOT/09 00 02 93/MNY(C&B)KAU/PG)

Study in progress

81 Marketing practices on co-operative banks - A case study of Thrissur District Co-operative Bank
(TOT/09 00 03 93/MNY(C&B)KAU/PG)

Temporary discontinuance for two semesters

82 Economics of production and marketing of selected medicinal plants in Thrissur district
(TOT/09 00 04 93/VKA(8)KAU/PG)

Analysis of data in progress

83. Economics of production and marketing of tuber crops in Palakkad district
(TOT/09 00-05 93/VKA(8)KAU/PG)

Interview schedule prepared

84 Marketing practices of fruits and vegetable processing industries - A case study of Thrissur district
(TOT/09 00 06 92/VKA(C&B KAU/PG)

Study in progress

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16. Beneficial Microorganisms and Productive Insects

HIGHLIGHTS

- Twenty five per cent fertilizer nitrogen could be saved in rice due to *Azospirillum* inoculation under field conditions
- Inoculation with VA mycorrhiza, *Glomus fasciculatum* was found to supress the collar rot pathogen *Rhizoctonia solani* and the root knot nematode *Meloidogyne incognita* in cowpea
- Under rainfed conditions, the mulberry varieties MR_2 and S 54 recorded the maximum leaf yield while under irrigated condition the MR_2 variety performed the best in terms of leaf yield

INCLUDED EXPERIMENTS

1 **Economising nitrogen in rice production with *Azospirillum***
(BM /01 00 07 92/ACV(1)KAU/PG

A field experiment was conducted at the College of Agriculture, Vellayani using the rice variety Matta Thriveni to find out the efficacy of different methods of *Azospirillum* inoculation in economising nitrogen in rice production There were four *Azospirillum* treatments such as seed inoculation, seedling dip, seed treatment along with seedlings and all the three methods together along with the use of 50, 75 and 100 per cent of the recommended dose of fertilizer nitrogen and with and without the use of lime at the rate of 600 kg/ha It was observed that the combined application of *Azospirillum*, 100 per cent N and lime resulted in the highest values of growth characters However, economic analysis of the data revealed that the combined application of *Azospirillum* 75 per cent N and lime produced a net income comparable to the above treatment with 100 per cent N Thus it was observed that it is possible to save about 25 per cent fertilizer nitrogen by using *Azospirillum*

2 **Control of collar rot and root knot of cowpea with VA mycorrhiza**
(BMI/01 00 07 92/ACV(1)KAU/PG)

Among the different VA mycorrhiza tested, *Glomus fasciculatum G mosseae* and *Acaulospora morroweae*, *G fasciculatum* was found more effective in supressing the collar rot pathogen, *R solani* and the root knot nematode *M incognita* in cowpea Plants inoculated with VAM had a higher phenol content when compared with the uninoculated control treatment

Project (01) Biological nitrogen fixation

1 **Effect of selected plant protection chemicals on the beneficial microorganisms in cowpea rhizosphere**
(BMI/01 00 09 93/VKA(5)KAU/PG)

An *in vitro* study on the inhibitory effect of fungicides on the native strains of *Azospirillum* and *Bradyrhizobium* spp isolated from cowpea was completed

2 **Effect of *Asospirillum* inoculation on establishment and growth of bush pepper**
(BMI/01 00 10 93/ACV(5)KAU/PG)

Azospirillum was isolated from different varieties of pepper These cultures were tested for their IAA producing ability under *in vitro* condition The isolate which produced maximum IAA was further selected for root induction study in bush pepper using Karimunda and Panniyur 1

3 **Nitrogen fixing bacteria associated with plantation and orchard crops of Kerala**
(BMI/01 00 11 93/ACV(5)ICAP)

Eighteen out of the thirty one isolates of *Asospirillum* were found capable to produce IAA under *in vitro* conditions Among them an isolate from pepper and mango produced maximum IAA @ 50 to 65 µg/ml of the culture medium These were selected for further studies particularly with reference to the growth and establishment of seedlings of various plantation and orchard crops like pepper nutmeg clove mango and jack

Project (02) Mycorrhizal association in crop plants and their effect on crop growth and yield

4 **Investigations on VA mycorrhiza of cassava in enhancing the nutrient availability**
(BMI/02 00 04 84/ACV(5)KAU)

Inoculation with *Glomus etunicatum* along with the full dose of N&K and half the dose of P recorded the highest plant biomass production under field conditions The final tuber yield is to be recorded

5 **Growth and establishment of tissue culture plantlets as influenced by VA mycorrhiza**
(BMI/02 00 06 91/ACV(5)KAU)

VA mycorrhiza inoculation increased the survival of tissue culture plantlets of anthurium and rose

6 **Growth, phosphorus uptake and resistance to root knot nematode infection in ginger and turmeric as influenced by VA mycorrhizal colonisation**
(BMI/02 00 07 91/ACV(5)KAU)

Inoculation of ginger and turmeric with the VA mycorrhiza *Glomus etunicatum* along with the full dose of NPK resulted in higher yield In ginger and turmeric these were 55 71 62 55 and 80 51 g/plot and 69 63 84 98 and 116 26 g/plot respectively after inoculation with VAM alone NPK alone and in combination with VAM and NPK treatments

7 **Evaluation of VA mycorrhiza as bio-control agent against wilt diseases of pepper**
(BMI/02 00 08 92/ACV(5)ICAR)

Different VAM species like *Glomus Acaulospora* and *Sclerocystis* spp were found associated with pepper The slow wilt symptoms due to the combined inoculation in *M incognita* and *R similis* varied with the species of VAM It was observed that while inoculation with *G mosseae* increased the symptom development inoculation with *G fasciculatum G monospora* and *G etunicatum* reduced the nematode multiplication and symptom development

Project (03) Utilisation of mushrooms

8 Improvement on the techniques for the cultivation and preservation of tropical species of mushrooms
(BMI/03 00 01 89/ACV(5)KAU/PG

Project is completed The final report is to be submitted

Project (C4) Standardization of sericulture techniques

Sub project (01) Standardization of agrotechniques for mulberry for maximising yield and quality of cocoon

9 Spacing cum manurial trial on mulberry as an intercrop in coconut garden under rainfed condition
(BMI/04 01 01 91/ACV(4)CSB)

Density of planting significantly influenced leaf production of mulberry in coconut garden A closer spacing of 75x75 cm was found significantly superior to other treatments Application of NPK at higher dose of 130 65 65 kg/ha from second year onwards recorded the highest foliage production during the third year However the effect of mulberry leaves grown under different spacing and manurial combinations in rainfed conditions was not significant on silk worms

10 Spacing cum manurial trial on mulberry as an intercrop in coconut garden under irrigated condition
(BMI/04 01 02 91/ACV(4)CSB)

Closer spacing of 60x60 cm recorded the highest leaf yield Application of NPK at the rate of 300 120 120 kg/ha/year recorded the highest foliage production during the third year The variation between the leaf quality produced in different treatments under spacing cum manurial trial was significant Eventhough leaves under low fertility level was consumed more better cocoons with more shell weight and shell ratio were produced under higher fertility level

11 Standardising pruning and harvesting techniques of mulberry grown as intercrop in coconut garden under rainfed condition
(BMI/04 01 03 91/ACV(4)CSB)

Pruning techniques had no significant influence on plant height plant spread number of leaves number of branches and leaf yield But harvest intervals significantly increased the plant height plant spread number of leaves and leaf yield Irrespective of the pruning techniques harvesting at 60 D interval was on par with 45 D interval for leaf harvest However the leaves harvested 45 D after pruning produced better cocoons of 1 713 g mean weight shell weight of 0 317 and shell ratio of 17 96

12 Standardising pruning and harvesting techniques of mulberry grown as intercrop in coconut garden under irrigated condition
(BMI/04 01 04 91/ACV(4)CSB)

The pruning schedule of two bottom prunings in May and September and two middle prunings subsequently were found to increase leaf yield significantly Leaf yield was more when the harvest interval was extended from 1 to 2 months However the leaves harvested at 45 D interval was best for maximising cocoon yield shell weight and shell ratio despite more leaf consumption

13 Production potential of mulberry under different management practices
(BMI/04 01 06 92/ACV(1)KAU/PG)

Different experiments of growing mulberry as a single crop and as an intercrop in coconut garden are in progress

14 Establishment and growth of rainfed mulberry as influenced by planting methods and *Azospirillum* treatments
(BMI/04 01 08 93/ACV(1)KAU PG)

A pot culture experiment is completed

15 **Influence of weather and rearing techniques on mulberry silk worm in Kerala**
(BMI/04 01 09 93 ACV 4 KAU PG)

The rearing of silk worms during June July in different rearing houses by manipulating the spacing of worms in the rearing bed and also the feeding schedule was in progress

16 **Irrigation requirement of mulberry grown as an intercrop in coconut garden during summer**
(BMI/04 01 10 93/ACV(1)CSB)

There was no significant difference in leaf yield during the third year between the levels of irrigation But the treatment with CPE 12 mm recorded maximum leaf yield during the third year

17 **Selecting mulberry varieties for shade tolerance in coconut garden under rainfed condition**
(BMI/04 01 11 93/ACV(4)CSB)

Six varieties of mulberry such as S 13 S 34 S 36 S 54 MR_2 and K_2 along with a local variety were tested for shade tolerance in coconut garden under rainfed condition Out of these the variety MR_2 recorded the highest leaf yield along with the local variety

18 **Selecting mulberry varieties for shade tolerance in coconut garden under irrigated condition**
(BMI 04 01 12 93/ACV(4)CSB)

Among the six varieties of mulberry tried along with the local variety the variety MR_2 recorded the highest leaf yield

Sub project (02) Rearing techniques for silk worms

19 **Standardising rearing techniques under stress conditions of high rainfall humidity and temperature**
(BMI/04 02 01 91 ACV(4)CSB)

Bivoltine NB 18 NB 4 D 2 CA 2 CC 1 and KA along with multivoltine My 1 P2S1 RD1 and SM were reared during the rainy season The disease incidence was heavy on bivoltines when compared to multivoltines

Sub project (03) Pest and disease incidence in silk worms and mulberry

20 **Pest and disease incidence in silk worms and mulberry**
(BMI/04 03 01 93/ACV(4)CSB)

A survey for disease incidence of mulberry silk worms was conducted in Palakkad and Idukki districts with the help of NSB in farmers rearings

21 **Pest and disease incidence in mulberry crop**
(BMI/04 03 02 93/ACV(4)CSB)

A new pest of the group of white flies was recorded It was found to be polyphagous in feeding and caused serious damage to the crop The insects were collected for identification

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17. Integrated farming system

HIGHLIGHTS

- Testing of coconut based homestead models developed at Sadanandapuram indicated that irrigation had a positive influence on growth of tree crops and also the growth as well as yield of annual crops grown as intercrops

- Family details of sample households in Vettikkavala Village Kollam district indicated more average annual non farm income in the category growing crops alone than in the category with a combination of crops and livestock However the cropping intensity of farms with crop and livestock was higher than the category with crops alone indicating that farmers of the former group are more industrious and hard working than the latter group

- Studies on homestead farming under different soil fertility status in Pathanamthitta district revealed that the homestead farms surveyed for pretesting of the questionnaire were under exploited production units with considerable scope for improvement in space utilization, species diversity and productivity

- Integration of crops and livestock in the bund system of cultivation in Kuttanad along with growing fishes in the channels gave more returns per unit area of land

Concluded experiments - Nil

EXPERIMENTS IN PROGRESS

1 **Studies on homestead farming under different soil fertility status in Pathanamthitta district**
(IFS/01 00 01 90/KTR(18)KAU)

The questionnaire has been pretested based on a survey of five homesteads in Pathanamthitta district and necessary modifications were further made to gather all necessary information

2 **Comparative economics of homestead farming with and without livestock component**
(IFS/01 00 02 90/KTR(18)KAU)

The study based on data collected from 60 homesteads of Vettikkavala Panchayat 30 with a combination of crops and livestock and 30 with crops alone indicated the following

The first group (crops alone) had an average annual non farm income of Rs 16 750/ and the second group (crops livestock) had Rs 9452/

The cropping intensity of farms with crops and livestock was higher than the category with crops alone indicating that farmers of the former group are more industrious and hardworking than the latter group

3 **Establishment of homestead models developed in the station**
(IFS/01 00 04-91/KTR(18)KAU)

The yield of homestead models developed at the station was tested under rainfed as well as irrigated conditions The intercrops such as tapioca, yams, banana, pineapple planted during 1992 were harvested during June to November, 1993 The yield and biomass production of intercrops such as banana and pineapple showed superiority in the irrigated condition than the rainfed plot However, the yield of intercrops like tapioca, yams and amorphophallus did not reveal any significant difference under rainfed or irrigated situations

4 **On-farm research on existing homesteads for optimising farm business income**
(IFS/01 00 06 91/KTR(18/KAU)

Idakkayyalas in the selected plots were strengthened and guinea grass slips were planted Channels were also dug along the Idakkayyalas so as to divert the water along the slope to a pond farm in the north eastern corner of the plot which formed the natural outlet of the catchment area A grassed water way was erected which acted as a natural sieve for water and prevented silting in the pond

Project (02) · Improvement of components in the integrated farming system

5 **Testing integrated farming system models involving coconut, fish and livestock for Kuttanad**
(IFS/02 00 04 91/KUM(18)KAU)

Yield of banana and fodder grown as intercrops in coconut garden was satisfactory Yield of fodder obtained (8 6 tonnes/2500 sqm) grown on the fringes of bunds was sufficient to feed a cow at a feeding rate of 20 to 25 kg green fodder per day Cowdung obtained from a single cow was sufficient to manure coconut intercrops and grasses Integration of crops and livestock in the bund system of cultivation in Kuttanad along with growing fishes in the channels gave more returns per unit area of land

Project (09) Sustainable farming systems

6 **Impact of sustainable farming practices on soil proprties and crop productivity**
(IFS/09 00 01 94/ACV(9)STED)

The experiment was started during August 1993 with the financial assistance of STED of Kerala The first crop in upland trials was raised during late rabi and before commencing the experiment physico chemical properties of the soil were analysed The taxonomic status of the soil from the experimental field was Loamy Kaolinitic Isohyper Thermiophodic Haplic Lustox The soil belonged to the textural class "Sandy clay loam" Chemical analysis of the soil revealed a clay content (27 50 per cent), organic carbon (0 54 per cent), organic matter (0 93 per cent) total nitrogen (0 12 per cent), total P_2O_5 (0 07 per cent), total K_2O (0 04 per cent) Biological properties of the soil did not reveal any count for nitrogen fixers and the count of phosphorus solubilizers was found to be 106/g soil

●●●

18. Agrometeorology and remote sensing

HIGHLIGHTS

- In the Onattukara region, probability of occurrence of a dry spell is high during the last week of August
- Daily rainfall analysis indicated 75 per cent probability of success for dry sowing of rice in the 1st week of May in Onattukara
- The CERES Rice model can be used for simulating grain yield of Kharif while it needs revalidation for Rabi

EXPERIMENTS IN PROGRESS

Project (01) Influence of weather components on growth and yield of crops

1 **Climate and rice in Onattukara**
(MET/01 00 01 86/ A(21)KAU)

The rainfall data collected from Mavelikkara, Kayamkulam Harippad and Karunagappally (all these stations come under Onattukara region) indicated that during the dry season (December March) Karunagappally had the highest coefficient of variation followed by Mavelikkara and Harippad The probability analysis indicated that the 75 per cent probability rainfall at Karunagappally was 848 mm whereas at Mavelikkara it was 1330 mm

2 **Influence of period of sowing and levels of irrigation on the growth and yield of watermelon grown in rice fallows**
(MET/01 00-03 90/VKA(21)KAU)

The results indicated that watermelon can be successfully raised in rice fallows, if it is irrigated daily (10 litres/pit/day) and sown in the middle of November The plants irrigated daily (10 litres/pit/day) were superior to others with regard to vine length date of picking maturity, number of male and female flowers production, number of fruits, fruit girth, fruit weight, total fruit yield and total dry matter production, but was on par with IW/CPE ratio of 1 0 Irrigation at IW/CPE ratio of 1 0 was superior with regard to number of female flower production and number of seeds per fruit Irrigation treatment IW/CPE ratio of 0 5 recorded the highet sex ratio hundred seed weight and T S S content The crop sown on November 16th was superior to others with regard to most of the crop characters

3 **Prediction of water availability periods for crop planning in Kerala**
(MET/02 00 01 84/VKA(21)KAU)

Daily rainfall data of 97 rainguage stations were collected from IMD in the form of floppy disks, for further analysis

4 **Agrometeorology of coconut and coconut based farming systems**
(MET/01 00 02 89/PIL(21)DST)

Effect of moisture stress on productivity of coconut

The nut yield in coconut was high in all the treatments over the pre treatment yield There was an increase of 33 per cent in nut yield when irrigation was provided @ 450 litres/palm/week, while the increase was 20 per cent when irrigation was provided as per climatic water balance approach It also indicated that providing irrigation till water is available during summer is not detrimental to coconut palms

19. Agroforestry

HIGHLIGHTS

- *Macaranga* and *Trema* were ideal as green leaf manure species as they had moderately high foliar nutrient levels
- Members of the family leguminosae in general recorded high foliar nitrogen levels
- The rainy season is ideal for lopping the trees for green manure purpose as the foliar nutrient concentrations are high during this time
- Alternate wetting and drying produced the highest seedling emergence in *Ailanthus* at 20 days after sowing
- Height and diameter growth increased as a result of pruning lateral branches in teak
- High site quality thinning regimes and three fertilizer applications promoted teak growth
- A density management diagram which helps the silviculturist in taking stand density management decisions was constructed
- Litter fall in silvi pastoral systems followed a monomodal distribution pattern with a distinctive peak during December February and chemical composition of the composite litter samples showed considerable variations due to both species and sampling time
- Irrespective of the tree components recovery of foliar ^{32}P in the tree components of silvi pastoral systems decreased as the depth of application increased The foliar concentration of ^{32}P declined with increasing lateral distance of ^{32}P application also but only in the case of *Acacia auriculiformis* and *Casuarina equisetifolia*
- A survey on the mangrove flora of Ashtamudi Puduvyppu and Kumarakom was conducted
- Foliar deficiency symptoms of N, P K Mg and S were demonstrated on *Ailanthus* seedlings

CONCLUDED EXPERIMENTS

1 Studies on intercropping of forest trees with fast growing nitrogen fixing tree species
(AF/04 033 01 91/VKA(19)ICFRE ADHOC)

As part of the project the following five trials were carried out

Trial 1 Assessing the changes in foliar nutrient composition of important indigenous tree species

Foliar samples of the following ten species (from the upper, middle, and lower portions of the functional crowns) were collected at four monthly intervals and analysed for

nitrogen, phosphorus and potassium besides moisture content *Tectona grandis* Linn f (Verbenaceae), *Dalbergia latifolia* Roxb (Leguminosae), *Ailanthus triphysa* (Denn) Alston (Simaroubaceae), *Acacia auriculiformis* Cunn ex Benth (Legummosae), *Acacia mangium* Wild (Leguminosae), *Macaranga peltata* Muell (Euphorbiacae), *Trema orientalis* Blume (Ulmaceae) and *Bambusa arundinaceae* Willd (Poaceae)

Mean foliar nitrogen phosphorus and potassium contents of the ten tree species presented in Table 1 depict very pronounced interspecific variations Members of the family leguminosae in general recorded high nitrogen levels with *Acacia mangium* having recorded the highest value during the peak monsoon season (2 76 per cent) Important multi purpose tree species such as *Ailanthus* bamboo *Macaranga* and *Trema* recorded intermediate nitrogen levels The high nitrogen levels in the gumes can be attributed to biological nitrogen fixation

Regarding foliar P levels, the variations were not very pronouncced Teak had relatively high foliar P contents at all stages of observations, except February *Cullenia* registered the highest K content in leaves and *Ailanthus,* the least

Seasonal changes also contribute to the variations in foliar nutrient contents The pattern of variations in mean foliar nutrient content implies that elemental concentrations in leaves increased during the monsoon season (June August) In almost all cases, the N and foliar moisture contents were high during this season except in the case of Cullenia The low nutrient content during the dry season might be due to the retranslocation of nutrients from the older leaves particularly for deciduous species

The results show that *Macaranga* and *Trema* would be ideal as green leaf manure species Although nutrient status of the two acacias is high as their residence times are high they may not be appropriate green leaf manure The rainy season is also ideal lopping the trees for green manure purpose

Table 1. Seasonal variations in the mean foliar N P and K contents (%) of important tropical tree species

Species	Months											
	February			April			June			August		
	N	P	K	N	P	K	N	P	K	N	P	K
Tectona grandis	1 34	0 08	0 79	1 98	0 08	0 82	2 30	0 11	0 72	2 34	0 10	0 87
Dalbergia latifolia	2 57	0 07	0 94	2 89	0 05	0 88	2 88	0 06	0 82	2 88	0 05	0 78
Pterocarpus marsupium	2 37	0 05	0 75	2 56	0 06	0 88	2 79	0 11	1 22	2 68	0 07	1 20
Acacia auriculiformis	2 06	0 05	0 87	2 53	0 08	1 02	2 67	0 07	0 90	2 29	0 06	0 95
Acacia mangium	2 81	0 05	1 31	2 82	0 06	1 08	2 76	0 07	1 20	3 04	0 08	1 10
Ailanthus triphysa	1 98	0 08	0 47	1 72	0 03	0 51	1 71	0 08	0 71	2 14	0 07	0 71
Cullenia excelsa	1 85	0 04	1 59	1 91	0 02	1 60	1 73	0 03	0 79	1 64	0 09	0 65
Bambusa arundinaceae	1 93	0 08	1 00	1 99	0 09	1 30	2 13	0 07	0 99	2 77	0 05	1 23
Macaranga peltata	1 99	0 07	1 08	1 90	0 06	1 01	2 87	0 07	0 89	2 29	0 10	1 01
Trema orientalis	1 88	0 10	0 92	2 21	0 08	1 30	2 40	0 08	1 03	21 9	0 08	1 06

Trial 2 Nursery experiments to standardize the pre treatment of tree seeds

Two separate randomized block design experiments with three replications each to compare the effect of the following pre sowing treatments on field emergence of *Grevillea robusta* and *Ailanthus triphysa* were conducted T1 control (No pretreatment) T2 overnight soaking in water T3 alternate wetting and drying of seeds (four cycles seeds were soaked over night and dried under shade during day time for four consecutive days) T4 mechanical scarification T5 soaking seeds in 250 ppm GA_3 solution for 24 h and T6 soaking seeds in 0 2 per cent KNO_3 solution for 24 h

The results of the *Grevillea* experiment suggest that this species does not require any pre treatment at all as evidenced by the high germinability values in control (Table 2) Mechanical scarification resulted in extremely low field emergence probably due to the physical damage suffered by the seeds while imparting the treatment

The data presented in Table 2 show that alternate wetting and drying produced the highest seedling emergence in *Ailanthus* at 20 days after sowing However at the time of the second observation there was a substantial reduction in the seedling count in this treatment that was due to damping off incidence The treatment differences were nevertheless statistically not significant in the *Ailanthus* experiment at both stages of observations

Trial 3 Pruning - cum - intercropping experiment in teak with gliricidia

With the objectives of standardizing the teak pruning practices to facilitate intercropping in teak plantations and quantify the complementary effects of fast growing N_2 fixing tree intercrops on teak growth and productivity a factorial in R C B experiment with three replications was laid out in a seven year old teak plantation at Vellanikkara Based on tree height the plots were grouped into high medium and low categories and the treatments superimposed The treatments included combinations of pruning treatments and planting geometry of gliricidia as detailed below

Table 2 Effect of various seed treatments on seedling number per m^2 in Grevillea robusta and Ailanthus malabarica (transformed values, X' = X+0 5)

Treatments		Seedlings per m^2		
		Grevillea	*Ailanthus*	
		45DAS	20DAS	45DAS
1	Control	6 35(40)	11 37(129)	5 09(25)
2	Overnight soaking	5 37(28)	11 57(133)	4 97(24)
3	Alternate wetting and drying	5 23(27)	20 54(421)	4 78(22)
4	Mechanical scarification	1 82(3)	9 26(85)	2 34(5)
5	GA_3 treatment	5 87(34)	11 04(121)	4 53(20)
6	KNO_3 treatment	4 90(24)	10 77(116)	3 30(10)
	SEm (+)	0 81	2 35	1 16
	CD (0 05)	2 08	—	—

DAS Days after sowing Figures in parenthesis indicate original values

Table 3 Effect of different teak pruning treatments and geometry of interplanting *Gliricidia sepium* on sapling height and radial growth of teak and gliricidia

Treatments	Teak					Gliricidia					
	Height (m)			DBH (cm)		Height (cm)			Collar girth (cm)		
	Sep92	Apr93	Nove93	Sep92	Mar93	Nov93	Sep92	Mar93	Nov93	Sep92	Mar93	Nov93
I Pruning treatments												
1 No pruning (control)	4 95	5 78	6 68	5 23	6 16	6 98	96 89	111 37	187	1 27	4 40	5 95
2 Pruning all laterals of teak upto 2 m height	5 32	5 98	7 21	5 75	6 46	7 06	90 18	105 61	183	1 27	4 36	5 86
3 Pruning all laterals of teak upto 3 m height	5 40	6 09	7 50	5 62	6 31	7 38	104 12	124 76	224	1 33	4 85	6 76
4 Pruning all laterals of teak upto 4 m height	5 71	6 39	7 26	5 62	6 54	7 05	90 75	114 51	203	1 31	4 73	5 52
II Planting geometry of gliricidia as an intercrop in teak plantations												
1 Teak monoculture	5 44	6 95	5 53	7 27	6 26	6 26	6 95					
2 Gliricidia (one row) after every row of teak	5 28	5 60	5 63	7 17	6 23	7 15	97 63	114 50	207	1 28	4 62	6 3
3 Gliricidia (one row) between alternate rows of teak	5 32	5 61	5 50	7 06	6 60	7 25	93 34	113 62	192	1 30	4 5[illegible]	6 11
4 Gliricidia monoculture							112 00	125 00	290	1 40	5 00	11 9

Pruning treatments Pruning all the branches of teak up to 2 3 and 4m above the ground level along with a no pruning control treatment

Geometry of gliricidia planting One row of gliricidia between every two rows of teak one row of gliricidia (at 2 0m spacing) between alternate pairs of teak rows and control (monoculture of teak and gliricidia) Containerized one year old gliricidia seedlings were planted during June 1992 in 30 cm^3 pits dug in the interspaces according to the treatment protocol

Although there was a clear trend of rapid height and diameter growth in the pruned plots (Table 3) the differences were not statistically significant This may be due to the relatively low proportion of the teak crown removal (10 15 per cent) If crown removal was substantial (>30 per cent) perhaps the trend might have been clearer A very low crown ratio (residual below 50 per cent) however may reduce diameter growth of trees As the objective of pruning in the present study was to identify its effect on diameter for a butt log of 4m pruned length the maximum pruning height of 4m was set accordingly Thus by fixing 4m as the maximum pruning height the maximum crown removal turned out to be only 10 15 per cent which did not give any significant effect in terms of tree growth parameters during the first two years of experimentation Gliricidia growth vis a vis teak pruning also did not exhibit any statistically significant variations although gliricidia growth was better in control

Trial 4 Leucaena teak Intercropping trial

In order to standardize the population density of N_2 fixing trees such as *Leucaena* in teak plantations and to evaluate the complementary effects of a leguminous intercrops in teak plantations a field experiment was laid out at Vellanikkara during June 1992 The experimental protocol included various replacement series of teak and leucaena such as 100 0 70 30 50 50 30 70 0 100 per cent of the population (respectively of teak and leucaena) with four replications in a randomized block design The plot size was 20 x 20m (total number of plots = 20) and the spacing adopted was uniformly 2 x 2m for teak and leucaena (100 plants per plot) One year old teak stumps from the local Forest department nursery was planted in crowbar holes during the last week of May 1992 One year old containerized leucaena seedlings (seed inoculated with Rhizobium) were also planted in 30cm^3 pits during June 1992 after the onset of monsoons according to the experimental protocol

The results are presented in Figures 1 and 2 Seedling heights and basal stem diameters of both teak and leucaena did not exhibit any significant variations during the first and second years of experimentation However there was rapid height and radial growth of teak and leucaena during this period as evident from Figures 1 and 2 Moreover mean height of leucaena seedlings was consistently higher

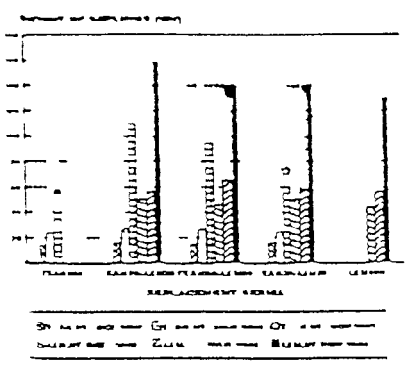

Fig 1 Height of seedlings as affected by different replacement series of teak and leucaena

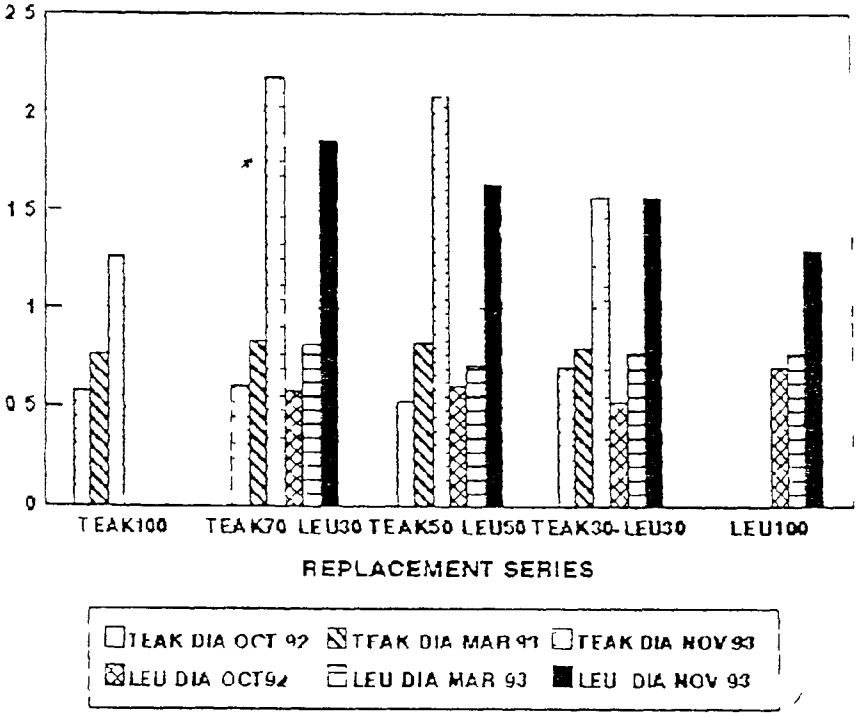

Fig 2 Radial growth of saplings as affected by different replacement series of teak and leucaena

than teak (Fig 1) Radial growth rates of the two component crops also did not exhibit any profound variability (Fig 2) Results of the trial are inconclusive and therefore insufficient to draw any valid generalizations regarding growth and productivity of teak intercropped with fast growing nitrogen fixing tree species

2 Stand density manipulation and fertilization studies on teak
(AF/02 00 01 90/VKA(20)KAU/PG)

A field experiment with factorial combinations involving three site quality levels (high medium and low) three thinning intensities (no thinning removal of alternate diagonal rows and removal every third diagonal row of trees) and three fertilizer levels (control 50 25 25 kg N P_2O_5 and K_2O per hectare per year) and having three replications was conducted at Vellanikkara Thinning operations were carried out during July 1990 and fertilizer applications during July 1990 June 1991 and June 1992 (plot size 144 m^2)

High site quality consistently resulted n faster diameter growth of teak trees and the differences were statistically significant at all stages of observation (Table 4) However thinning regimes and fertilizer doses did not exert any marked influence on this parameter although moderate levels of thinning (removal of 30 per cent of trees) registered relatively high values at all stages of observations The effect of fertilizer application on diameter growth of teak also was not statistically significant

High sites consistently recorded higher values for mean tree height and were statistically superior to other site classes (Table 5) There were no perceptible differences with respect to either thinning or fertilizer application

Nitrogen content of the foliage was consistently higher in the low site quality followed by medium and high sites possibly on account of the high biomass production observed in the latter sites as evident from the better growth rates As regards to P and K also in general high site quality recorded higher values Thinning intensities did not have a pronounced influence on foliage N status while it favoured P and K accumulation

Regarding fertilizer levels 100 50 50 kg ha^{-1} of N P_2O_5 K_2O recorded the highest N content Medium and high doses of fertilizers also recorded high P levels in teak leaves

Allometric relationships were not evolved for teak trees in the past and hence linear biomass equations were developed linking oven dry tree biomas to tree diameter and height for predicting tree biomass of young teak trees (see equations below)

Y 0 2670+0 00024[DBH^2*H] (r^2 0 91 n 149)

Y 5 3908(DBH)+2 507(H) (r^2 0 52 n 197)

Y 0 5372+0 000139[DCL^2*H] (r^2 0 9e n 130)

Y 1 8 31(DCL) 0 0055*F(n) (r^2 0 83 n 130)

where Y biomass DBH - diameter at breast height and DCL diameter at collar level

Sapwood cross sectional area is often used to predict leaf area and leaf weight as direct determinations of these parameters is extremely difficult To facilitate this four linear regression models were developed relating foliage area and foliage dry weight with sapwood cross sectional area at breast height and collar level

L 16 277+2 0988(SWCA) (r^2-0 89 n 239)

D 0 1511+0 1115(SWCA) (r^2-0 78 n 239)

L 1 0670+0 52237(SWCA BH) (r^2 0 77 n 239)

D 0 08304 + 0 0000307 (SWCA BH) (r^2 0 82 n 239)

where L leaf area (m^2) D foliage dry weight (kg/tree) and SWCA - sap wood cross sectional area in cm^2 at collar and SWCA BH sap wood cross sectional area in cm^2 at breast height

Table 4 Radial growth of teak as affected by site quality, thinning regimes and fertilizers

Treatments		Mean tree diameter at breast height (cm)						
		NOV90	FEB91	MAY91	JAN92	AUG92	MAR93	SEP93
1	Site quality							
	High	5 39	5 90	6 02	6 39	7 53	8 68	9 69
	Medium	4 56	5 18	5 30	5 16	5 65	6 58	7 22
	Low	3 16	3 46	3 57	4 04	4 11	4 82	5 36
	F test	**	**	**	**	**	**	**
	S_y	0 09	0 09	0 11	0 29	0 30	0 32	0 39
2	Thinning regimes							
	Control (unthinned)	4 06	4 47	4 55	5 03	5 51	6 50	7 20
	Medium	4 28	4 87	5 03	5 54	6 16	7 06	7 55
	Heavy	4 76	5 20	5 31	5 02	5 62	6 54	7 50
	F test	NS	NS	NS	NS	NS	NS	NS
3	Fertilizer levels							
	Control (no fert)	4 21	4 68	4 78	5 00	5 43	6 51	7 30
	Medium	4 30	4 79	4 89	5 42	6 09	6 96	77 61
	Heavy	4 59	5 07	5 23	5 17	5 78	6 63	7 35
	F test	NS	NS	NS	NS	NS	NS	NS

Table 5 Height growth of teak as affected by site quality thinning regimes and fertilizers

Treatments		Mean tree diameter at breast height (cm)						
		NOV90	FEB9	MAY91	JAN92	AUG92	MAR93	SEP93
1	Site quality							
	High	4 18	4 58	4 70	6 11	6 79	7 69	9 34
	Medium	2 94	3 43	3 54	4 10	4 67	5 74	7 03
	Low	1 88	2 11	2 22	2 81	3 03	4 03	4 91
	F test	**	**	**	**	**	**	**
	$S_{\bar{x}}$	0 12	0 16	0 17	0 40	0 36	0 32	0 41
2	Thinning regimes							
	Control (unthinned)	2 86	3 17	3 25	4 52	5 00	6 03	7 21
	Medium	3 05	3 49	3 65	4 73	5 12	5 93	7 18
	Heavy	3 09	3 46	3 57	3 77	4 37	5 50	6 90
	F test	NS	NS	NS	NS	NS	NS	NS
3	Fertilizer levels							
	Control (no fert)	2 84	3 21	3 30	4 00	4 60	5 69	7 02
	Medium	3 01	3 36	3 47	5 03	5 30	5 98	7 27
	Heavy	3 14	3 55	3 70	3 99	4 59	5 80	7 00
	F test	NS	NS	NS	NS	NS	NS	NS

Since most of the teak trees sampled in the present study did not have heart wood formation diameter at breast height can possibly act as a surrogate for sapwood cross sectional area Furthermore it is easier to measure diameter than sapwood cross sectional area The relevant equations are furnished below

L 1 0675*Exp 0 3407*DBH) + 0 5580 (r^2 0 86 n 196)

D 0 0834 Exp 2997*DBH) 0 0227 r^2 0 85 n 191

L 7511*Exp 0 0727 G ... 685 r^2 ... n 208

D 0 06 0 Exp 0 0860*G) 0 00064 (r^2 0 9 n 96

where L = leaf area (m^2) D = foliage dry weight (kg tree DBH = diameter at breast height (cm) G = girth at ... (cm)

DENSITY MANAGEMENT DIAGRAM

A stand density management diagram for teak also was constructed using the stand inventory data collected from teak plantations throughout Kerala state One hundred and ninety three plots of size 63 25 x 63 25 m (one acre) plots were established in randomly selected teak stands from October 1989 to November 1992 and the total height and girth at breast height over bark (1 3 m from the base) of all trees were measured The age of the plantation was calculated as on 1990 from the year of plantation establishment

For the construction of the density management diagram the following models developed using the SAS procedure was used These models explain the relationships between Vol Den and Dq on the one hand and D_q density and site height on the other The first equation relating Vol and Den to Dq has a coefficient ...

of determination (r^2) of 97 per cent In both cases the plots of residuals reflect only a modest amount of bias and are well within reasonable limits to cause any practical concern

$$Vol = 10.579 + (0.0/0.0E817 * den * D_q^{2.746} \quad \text{(Eq 1}$$

The second equation relating Ht and Den to Vol has a coefficient of determination (r^2) of 89 per cent

$$Dq = 8.07074 + (0.41111\ 0.06084 * Den^{0.2214} Ht_s^{1.5468} \quad \text{(Eq 2)}$$

The elements of the density management diagram include variables namely Dq Mvol Ht and SDI (Fig 1) The regression equations for Dq and Mvol were used to generate two families of curves representing height and volume Density on x axis (from 50 to 2000 trees per hectare) and Dq on the y axis (from 1 to 70 cm) was chosen for the density management diagram because they are the most widely used and easiest to estimate in the field and are represented in the range of the data The solid diagonal lines represent site heights (height of the dominants) and the broken lines represent volume (Fig 1)

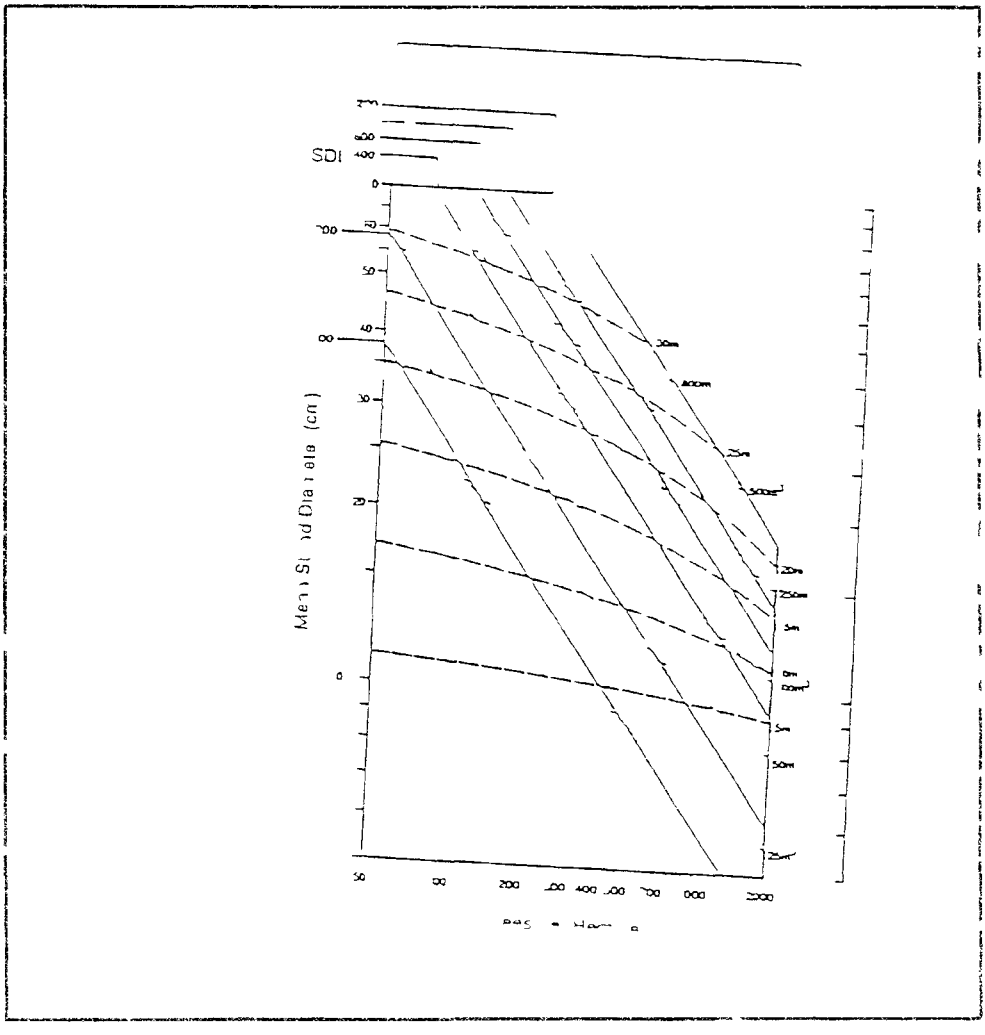

Fig 1 Density management diagram for teak plantations of Kerala

3 **Biomass production and resource partitioning in silvi-pastoral systems** (AF/05 00 06 92/VKA(20)KAU/PG)

Litter dynamics the associated nutrient turnover and their long term influence on soil physico chemical properties were evaluated in silvi pastoral systems involving four fast growing tree species Litter fall followed a monomodal distribution pattern with a distinctive peak during December Feburary The annual rate of litter production was highest for *Acacia* (6 25 Mg ha $^{-1}$ yr $^{-1}$) followed by *Causarina* (231 Mg ha $^{-1}$ yr $^{-1}$) *Leucaena* (2 30 Mg ha $^{-1}$ yr $^{-1}$) and *Ailanthus* (1 92 Mg ha $^{-1}$ yr $^{-1}$) Foliage biomass accounted for most of the litterfall in all four stands (71 100 per cent of the total litter mass)

Chemical composition of the composite litter samples showed considerable variations due to both species and sampling time Leucaena litter was rich in macro elements (2 67 per cent 0 1 per cent and 0 25 per cent N P and K respectively) The corresponding figures were 1 40 per cent 0 07 per cent and 0 20 per cent for *Casuarina* 1 09 per cent 0 04 per cent and 0 13 per cent for *Acacia* and 0 50 per cent 0 09 per cent and 0 13 per cent for *Ailanthus* The high nutrient levels of leaf litter especially that of the *Leucaena* and *Casuarina* suggest that these species help in conserving nutrient elements on site and may also ensure their rapid recycling Furthermore N and P content of litter increased during the rainy season But the dry season was characterized by a general decline Potassium however showed a reverse trend

Leaf litter decay rates were highly variable The residual litter mass declined exponentially with time Of the four tree species studied only *Casuarina* and *Leucaena* litter decomposed completely during the experimental period (within a period of six and seven months respectively) At the end of the one year period *Acacia* retained about 0 38 per cent of the original mass while *Ailanthus* retained as much as 9 4 per cent

Mean nitrogen content of the litter increased during decomposition Phosphorous however exhibited an initial increase followed by a decline Potassium possibly due to leaching declined during the decay process for all four species The change in absolute contents of N P and K was best described by a cubic function Nutrient release from the decomposing litter generally followed a triphasic pattern characterized by a rapid initial release followed by a brief period of accumulation and a final release phase or a biphasic pattern depending on the length of the decay period Potassium however did not exhibit any accumulation phase

The annual addition of major nutrients through litter fall ranged from 16 63 kg N 1 7 2 7 kg P and 2 4 8 3 kg K ha $^{-1}$ yr $^{-1}$ Moreover the long occupancy of woody perennials also caused significant and favourable changes in the physico chemical properties of the soil Interspecific variation also was quite pronounced in this respect Organic C N P and K in the top 15 cm soil layer were highest in *Acacia Leucaena Casuarina* and *Acacia* plot respectively

Root level interactions during P uptake in polyculture systems involving factorial combinations of four tree species namely *Leucaena leucocephala Casuarina equisetifolia, Acacia auriculiformis* and *Ailanthus triphysa* and four fodder species namely *Pennisetum purpureum* (hybrid napier) *Brachiaria ruziziensis* (congo signal) *Panicum maximum* (guinea grass) and *Zea mexicana* (teosinte) were evaluated based on their relative absorption of applied ^{32}P in mixed and sole crop situations Absorption of ^{32}P applied at two lateral distances (25 and 50 cm) and two depths (15 and 50 cm) was monitored through radioassay of leaves Irrespective of the species the recovery of ^{32}P in the leaf decreased as the depth of application increased The foliar concentration of ^{32}P declined with increasing lateral distance of ^{32}P application in *A auriculiformis* and *C equisetifolia* In sole crop situations fodder species registered an order of

magnitude higher ^{32}P activity in their leaves None of the fodder species when grown along with the tree species was found to adversely effect the absorption of ^{32}P by the trees All the fodder species exerted a complementary effect on ^{32}P absorption by casuarina *Leucaena* was also benefited in the same way when grown in association with congo signal or teosinte The results clearly suggest that tree species were the dominating component in the silvi pastoral systems studied from the point of view of root competition Among the tree species *A auriculiformis* and *L leucocephala* were found to compete severely with the forage crops for ^{32}P with the result ^{32}P absorption by the fodder species was considerably reduced

4 Nutritional deficiency symptoms of Ailanthus (*Ailanthus triphysa* (Dennst) Alston seedlings
(AF/05 00 07 92/VKA(20)KAU/PG)

The characteristic nutrient deficiency symptoms on ailanthus seedlings included leaf discolouration necrosis scorching defoliation stunted growth and reduced biomass accumulation Acute shortage of N caused severe chlorosis of the entire seedlings followed by premature defoliation P deficiency appeared as purple brown patches on the older leaves and Mg deficiency caused severe interveinal chlorosis Sulphur resulted in discoloration of leaves followed by necrosis Seedlings that received complete nutrient solution were however healthy with dark green foliage Chlorophyll a Chlorophyll b and total chlorophyll declined under nutrient deficiency situations Visual deficiency symptoms were also accompanied by reduced foliar nutrient concentrations Nonetheless the foliar deficiency symptoms disappeared gradually in the recovery studies

5 Survey, collection and evaluation of mangrove species
(AF/07 01 93/KMK(2)KAU)

A survey of the mangrove flora of Puduvyppu Kumarakom and Ashtamudi areas was carried out A total of eight true mangrove species and sixteen associated species were recorded Important species included *Acanthus ilicifolius Avicennia officinalis Bruguiera gymnorhiza Excoecaria agallocaha Rhizophora apiculata R mucronata Kandelia kandel* and *Sonneratia caseolaris* Differences between the tracts were not quite pronounced

ONGOING EXPERIMENTS

Project (03) Diagnosis and management of farming systems in agroforestry

1 Diagnostic survey and appraisal of farming systems and agroforestry systems
(AF 03 00 01 84/TZK(20 CAR)

A survey was conducted in 17 blocks of Kerala state to elucidate the floristic structure composition and the extent of similarities and diversities in the composition of homegardens of Kerala with particular reference to small (below 0 4 ha) medium (0 4 to 2 ha) and large (> 2 0 ha) holding size categories Besides attempts were also made to characterize the potential of homegardens to supply commercial timber and fuelwood Two hundred and fifty two farmers were selected through a stratified random process Besides gathering general information on crop and livestock production enterprises all scattered trees and shrubs (≥ 15 cm girth at breast height) on the homestead and border trees except palms and rubber were enumerated

There was tremendous variability both in the number of trees and shrubs present and species diversity of the selected homesteads in different provinces The small medium and large sized holdings

also exhibited profound variability in the number of woody taxa and individuals present In total 128 woody species (Girth at Breast Height (GBH) ≥ 15 cm were encountered The mean number of woody taxa found in the homega dens ranged from 11 for Pathanapuram to 39 in Perinthalmanna Floristic diversity was higher in the smaller homesteads it decreased with increasing size of holdings Mean Simpson's diversity index for the homesteads ranged from 0 251 (Kochi) to 0 739 (Kottarakkara) suggesting that florish diversity of homegardens was moderate to low compound to a value over 0 90 for the species rich ever green forests of the Western Ghats The Sorensens similarity indices suggested a moderately high degree of similarity for the different tree species encountered in the homesteads of Kerala

No clear cut planting pattern was discernible in the homegarders of Kerala The homegarden trees and shrubs were either scattered throughout the homestead or on farm boundaries Farmers tend to prefer timber trees such as ailantnus (highest frequency) and teak besides fruit trees such as mango jack cashew and the like Major homegarden species were represented in all diameter classes The diameter structure however exhibited a slightly skewed (+) distribution pattern having the highest frequency in the 20 30 cm classes ensuring adequate regeneration status and in that process making homegardens a sustainable as well as dynamic land use system

Average commercial standing stock of homesteads ranged from 6 6 to 50 8 m^3 ha^{-1} and fuel wood volume was of the order of 25 3 85 m^3 ha^{-1} Implicit in the high commercial timber volume and fuel wood volume is that a substantial proportion of the society's wood demands are met from the homesteads Teak however constituted the dominant component of standing commercial timber and fuel wood volumes accounting for 63 per cent and 72 per cent respectively of the total wood from these categories

Project (04) Multipurpose tree production systems

Sub project (01) Compatibility in different cropping systems

2 Exploitation of indigenous multipurpose tree species in selected agro socio forestry systems
AF 04 01 90/VK(20)ICAR)

The experimental stands were maintained and observations on tree growth characteristics continued The results were similar to that of the previous year

3 Collection and evaluation of promising species/cultures of fuel, fodder and small timber tree species
AF 04 01 02 84/TZK(20)ICAR)

Acacia auriculiformis consistently recorded the highest tree height However the highest radial growth was recorded by *Paraserianthes falcataria*

Project (05) Management of agroforestry systems

4 Compatibility of different components in silvo-pastoral systems
(AF/05 00 01 88 TZK(20)ICAR)

Observations on tree growth characteristics were continued Forage crops were not raised during the period under report Tree growth data showed that *Acacia* consistently recorded the highest height and radial growth The differences were statistically significant in this respect

5 Utility of some fast growing trees as pepper standards Part I stem cuttings
(AF 05 00 02 88 TZK 20)ICAR)

Differences in black pepper yield was not statistically significant *Gliricidia sepium* registered the highest yield Regarding vine growth also *Gliricidia* recorded the highest length of vine and the differences were significant in this respect

Tree growth characteristics such as height of support tree radial growth and the amount of biomass harvested through lopping of lateral branches were markedly different among the species In general

Girudi se ec t highes eigh growth rate and biomass ? ollowed by Sesuga u et al. The species a popul ea s te y ecorded the lowest he ght grow h. Regard ng radial growth of support trees however Erythr na ind ca regis e ed the highest growth ate

6 Utility of some fast grow ng trees as pepper standards Part I seedling grown trees
(AF/05 00 0C 88/TZK/2) ICAR

The trial was designed to identify l ve supports of seed origin which possess quick growth characteristics for training black pepper vines The results so far showed that *Casuarina equisetifolia* and *Acacia auriculiformis* possessed fast height growth although peppe vines did not exhibit any statistically sign ficant growth variations *Acacia* recorded the highest vine length Regarding radial growth of trees *Macaranga peltata* consistently recorded the highest girth at breast height (GBH) followed by *Ceiba pentandra* and *Acacia auriculiformis* *A auriculiformis*, *Artocarpus heterophyllus* and *Macaranga peltata* also yielded substantial quant ties of foliage and branchwood during the periodical lopp ng operations The trial is in progress

7 Spatial arrangement and harvesting schedules in agri silviculture
(AF/05 00 03 86 TZK 2?) CAR

Due to regenerat on problems of leucaena the research data was not gathered

8 Nutrient deficiency d agnosis in *Tectona grandis* L f
AF 05 00 08 9 /VKA(2(KAU PC

Sampl ng pro edure for can py was standardized The study is n progress

9 Nutrient content and decompos tion of leaf biomass of selected woody species
AF 05 00 09 ?? VKA 20 KAU/PG

Trial in progress

10 Biomass production and root distribution pattern of selected fast growing multi purpose tree species
(AF 05 00 10 93/VKA 20 KA PC)

Root distribution pattern of *Artocarpus hirsutus* was characterized using radioactive phosphorus 32 besides evaluating the biomass production potential of nine tree species Data are being analysed and the trial is in progress

11 Pheno-morphological studies of selected tree species in a tropical forest ecosystem selected woody species
(AF/05 00 1 93/VKA(20)KAU PC)

The trial is in progress Data are being processed

Project (06) Wild life management

12 Food and feeding habits of Asian elephants (*Elephas maximus* L)
(AF/06 00 01 93/VKA(20)KAU PC)

Sixty one food plants of elephants were identif ed Feed ng accounted for 65 per cent of the activity of the animal during the dry season and 81 per cent in the wet season Grazing is predom nant both in the wet and dry seasons Elephant dung samples analyzed contained seeds of four spec es In general the v ab lity and germ nability we e bet er than fresh samples

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22. Basic research

HIGHLIGHTS

- Mathew s triacid extractant was found to be the best for extracting available P in laterite and coastal alluvial soils In the alluvial soils of Kuttanad Mathew s Olsens and Bray No 1 extractants gave similar results All these extractants gave the highest relationship with P uptake Al P of Kuttanad alluvium showed the highest correlation with P uptake and available P extracted by the different extractants

- Rice plants absorb molecular forms of urea even in the presence of other readily available forms of nitrogen Plantation crops do not prefer molecular form of urea

- Uptake of nitrogen was more when rice plants were supplied with a combination of forms Among the different forms ammonium and nitrate in equal proportion was the best

- Combined application of P through green manure and inorganic fertilizer met the phosphorus requirement of the rice crop throughout the growth period

- Wetlands of the state in general has immature soil morphology Characteristics of the wetland soils of the state are mainly derived from parent material The wetland soils belong to the soil orders Entisols inceptisols and Ultisols

- Fertilizer application in the tall varieties of coconut was not found to influence the content and quality of oil

CONCLUDED EXPERIMENTS

1 **Evaluation of methods to improve nitrogen use efficiency of urea in rice**
(BR/01 00 20 9 /VKA(3 Godrej/PG)

Incubation study indicated that N micin coated urea was more efficient than untreated prilled urea in maintaining higher NH_4 N content in soil for longer period Field experiment also revealed a similar trend Lower concentration of NO_3 N was observed during the initial stages both in the incubation study and field experiment

2 **Behaviour of phosphorus in selected soil types of Kerala**
(BR/0 00 22 9 /VKA(3)States PC)

Soils from laterite black brown hydromorphic coastal alluvium and Kuttanad alluvium were used for the study

The study revealed that the same extractant cannot be used for P for all the soil types of Kerala Mathew s triacid Olsen s or Bray I can be used for laterite soils For coastal alluvium Mathew triacid

and for Kuttanad alluvium Olsen Bray I and Mathews triacid gave significant correlations with P uptake

In Kuttanad alluvium Al P was the most available form and correlated well with P uptake and P extracted by extractants In coastal alluvium, Saloid P, Al P and Fe P correlated to P uptake In the case of black soils none of the above methods were useful for predicting P availability to plants

3 **Behaviour of potassium in selected soils series of Trivandrum district**
(BR/01 00 25 91/ACV(3)KAU/PG)

Available potassium was found to be positively influenced by water soluble, exchangeable and nitric acid extractable forms of potassium Organic carbon had a positive influence where the content was low CEC had a positive influence on available potassium Percentage base saturation had positive influence except in forest soils

The potassium fractions had positive and negative relations with other soil components Potassium fertilisation must be based on, not only the available potassium, but also with other potassium fractions as well as with physico chemical properties

4 **Molecular absorption of urea by flooded rice**
(BR/01 00 26 91/VKA(1)KAU/PG)

Urease activity was maximum for black cotton soils and least for kari soils Under non submergence, steady decline in urease activity was noticed following submergence Kari soils recorded little effect on submergence for urease activity Flooded rice recorded higher molecular absorption of urea than non flooded rice Top dressing of urea showed greater molecular absorption than urea applied as basal dose The molecular absorption was greater with the higher level of urea applied Urease activity measured by isotope method recorded much lower values than by the conventional methods

5 **Release of nitrogen and potassium from root contact packets of urea and muriate of potash and their crop response**
(BR/01 00 27 91/VKA(3)KAU/PG)

Study revealed that there can be substantial regulation and slow release of urea and muriate of potash when packed in perforated polythene bags Polythene bags with 0 5 needle holes per cm^2 appear to be suitable for urea and those with two holes per cm^2 for muriate of potash as they ensure extended periods of retention even 90 days after application

6 **Potassium dynamics in Neyyattinkara soil series under coconut cultivation**
(BR/01 00 35 92/CVA(3)KAU/PG)

The study revealed acidifying effects of NH_4^+ ions in the plots with continuous addition of $(NH_4)_2\ SO_4$ as the source of nitrogen Exchangeable calcium increased with increasing rates of superphosphate addition Significant correlations were obtained between the difficultly extractable forms of potassium with CEC and pH The levels of potassium significantly influenced the coconut yield More than 200 per cent increase in nut yield was observed with potash addition Yield of coconut was significantly and positively correlated with available K exchangeable K and water soluble K

7 **Assessment of nitrification rates of soils and screening of plant materials for nitrification inhibition properties**
(BR/01 00 38 92/VKA(1)KAU/PG)

The present study was taken up to assess the nitrification rates of laterite, alluvial and forest soils, to relate nitrification rates to cropping history and to assess the nitrification inhibition properties of a few plant materials

Nitrification rate was low for all the three soils studied Laterite and forest soils were found to maintain higher ammoniacal nitrogen content throughout the period of the incubation study, as compared to alluvial soil A distinct crop association pattern of ammonium conversion was not

apparent The early exception was the alluvial soil from banana association The change in NO_3-N content in all the soils was erratic A general increase in its content over initial value was noticed

The nitrate content of the sample receiving N serve treatment was low Cashew shell was found to be the most effective plant material for nitrification inhibition Among the plant materials used, in addition to cashew shell, tobacco waste calotropis leaf, neem leaf and castor waste were found to show consistent nitrification inhibition properties

The growth parameters, plant nitrogen content and total N uptake was found to be maximum in the treatment receiving urea + cashew shell All the materials tested in the pot experiment were found to be better than neem cake

8 Classification of wetland soils for placement in Taxonomy
(BR/02 04 90/ACV(3)KAU/NP/PG)

The wetland soils of the state were heterogenous due to variable soil forming factors Soils were young without any horizon differentiation Three soil orders namely entisols (Vellayani Karamana, Kari Kayal and Kaipad pedons), inceptisols (Karappadom, Pokkali and Kole pedons) and ultisols (Pattambi) dominated the wetland soils Isohyperthermic temperature regimes were common for all the pedons The *Kari* and *Pokkali* pedons exhibited accumulation of sulfide materials in some parts of the horizons

9 Classification of upland soils of Kerala
(BR/02 00 06 90/ACV(3)KAU/PG)

Studies on soil profiles collected from the Research Stations of the Kerala Agricultural University and CWRDM Calicut were carried out Based on silt/clay ratio the soil profiles were placed in the decreasing order of weathering viz Calicut Kottarakkara Balaramapuram Vellayani, Pampadumpara, Ambalavayal, Thiruvalla Pilicode, Vellayani Tavanur, Odakkali, Vellanikkara, Kannara CEC and percentage base saturation were very low for all the profiles All the profiles were developed from same parent material granite gneiss The soils had low available water capacity

Based on the available information the profiles from Balaramapuram Pampadum para Kannara and Ambalavayal are classified under Alfisol Vellayani Thiruvalla, Odakkali Kottarakkara Vellanikkara Pilicode and Calicut are classified under ultisol The Tavanur soils come under inceptisol

10 Soil temperature and moisture characteristics as influenced by inter-cropping of fodder crops in coconut garden
(BR/03 00 02 89/ACV(3))

Growing of fodder as an inter crop showed decline in moisture content on the surface Not much variation was observed in the subsurface depth Fodder cultivated plots showed increase in the surface hydraulic conductivity Higher infiltration rates were observed in plots cultivated with hybrid napier Intercultivation of fodder grass in coconut garden improves hydraulic characteristics and thermal properties of the soil

11 Effect of long term fertilizer application on the soil physical properties in coconut garden
(BR/03 00 05 92/ACV(3)KAU/PG)

The structural index and mean weight diameter had been influenced by long term application of chemical fertilizers Application of 680 g N/palm/year 900 g K_2O/palm/year and skipping phosphorus application recorded the highest yield and maintained optimum physical property

12 Quality and fatty acid composition of coconut oil in relation to varietal variation and mineral nutrition
(BR/15 00 01 91/ACV(2)KAU/PG)

The study revealed significant effect for varietal variation in oil content and quality parameters The tall varieties were better oil yielders followed by hybrids and dwarfs There was little effect of mineral nutrition viz NPK fertilizers of palms on the oil content and quality parameters

Project (01) : Fertility investigations in relation to movements of nutrients losses, transformation and efficiency under different agroclimatic regions

1 **Permanent Manurial Trial**
(BR/01 00 04 87/MON(1)KAU)

Grain yield obtained for treatments receiving 90 kg N ha ^{1} were statistically superior to other treatments in Kharif season Package recommendation for medium duration variety has given the highest grain yield

In Rabi season also Package recommendation has given the highest yield and was on par with all those treatments having 90 kg N along with 45 kg each of P and K or either one of them Soil test based recommendation was found statistically inferior

2 **Permanent Manurial Trial**
(BR/01 00 05 64/KYM(3)KAU)

Statistical analysis of the grain and straw yield data of both Kharif and Rabi seasons indicated that in both the seasons grain and straw yield were higher for the treatments 80 kg as cattle manure (16 t ha ^{1}) and 20 kg N an cattle manure (4 t ha ^{1}) along with 60 kg N as ammonium sulphate and 40 kg each of P_2O_5 and K_2O

3 **Long range effect of continuous cropping and manuring on soil fertility and productivity**
(BR/01 00 10 77/KAR(1)ICAR)

The results indicated that application of 80 kg/ha P_2O_5 and 40 kg/ha K_2O were good for economic yield

4 **Permanent manurial experiment (dwarf indica)**
(BR/01 00 11 73/PTB(3)KAU NP)

The results of the previous years and current year clearly indicated that the productivity level of dwarf indica genotype could be maintained at substantial level only through application of higher levels of organic manures to the tune of 50 per cent of total N schedule The results also showed that manurial practices affected seed quality

5 **Permanent manurial experiment on integrated nutrient supply in rice based cropping system**
(BR/01 00 12 85/KAR(3)ICAR)

Continued application of organic and inorganic sources was always found beneficial for higher grain yield Fertilizer application with 50 per cent NPK substituted through FYM in Kharif season gave higher yields and had carry over effect for the succeeding Rabi crop

6 **Permanent manurial experiment (tall indica)**
(BR/01 00 13 61/PTB(3)KAU)

The results of the last and current years clearly indicated that the response of tall indica varieties to produce higher yields are shifting towards conditions of combined application of organic and inorganic manures, for sustained productivity Detrimental effects on yield have been noted for continuous application of glyricidia alone or chemical fertilizers alone

7 **Nutrient fixation in Kuttanad soils**
(BR/01 00 14 91/MON/3)KAU)

Five soil samples collected from Pallippad Thottappally and Karuvatta series were analysed for available phosphorus and potassium and for nutrient fixing capacities Among the three series studied Pallipad series recorded the highest potassium fixing capacity (93 5 per cent) and lowest potassium availability The same soil recorded the lowest phosphorus fixing capacity (82 7 per cent) Highest P fixation was reported for Thottappally series

Soil samples were collected from another six series and preliminary investigations completed

8 **Soil fertility of coconut root zone as influenced by long term inorganic fertilizers**
(BR 01 00 15 90/VKA(3)KAU NP)

The studies indicated that application of ammonium sulphate increased exchange acidity and exchangeable Al in different soil layers Application of muriate of potash decreased the exchangeable acidity and exchangeable Al in the lower layers Comparison of the chemical characteristics of the uncropped unfertilised area with cropped but unfertilised area revealed similarities in the root zone to a depth of 100 cm

9 **Monitoring soil fertility and crop productivity under different cropping systems at moderate levels of fertilizer application**
(BR/01 00 18 87/MON(1)ICAR)

Pooled analysis of grain and straw yield data of three Kharif seasons showed that nitrogen levels only significantly increased both grain and straw yield Application of 60 kg N produced 16 per cent grain yield and 21 per cent straw yield during Kharif season During Rabi season also significant increase in grain and straw yield could be obtained for nitrogen levels only Eighty kg N ha^{-1} increased grain (20 per cent) and straw yield (30 per cent)

10 **Permanent Manurial Trial of rice in acid saline soils under flooded condition (Pokkali tract)**
(BR/01 00 19 77/VTL(3)/KAU)

The experiment aims at finding out the long term effect of inorganic fertilizers on the productivity of Pokkali soils The experiment is in progress Conclusions can be drawn only after processing the data already collected But experiment conducted in the Kharif season of 1993 94 indicated that application of NPK and Ca (20 40 20 and lime 1000 kg ha^{-1}) did not increase grain yield over "no manure" control

11 **Standardisation of plant part as an index of potassium status in banana Musa (AAB group) Nendran**
(BR/01 00 23 91/ACV(3)KAU/PG)

The field experiment has been completed and all observations have been recorded Chemical analysis of soil and plant samples have been completed The statistical analysis is in progress

12 **Influence of soil nutrient status under different agro-climatic situations on the quality of mulberry (*Morus alba*) leaf**
(BR 01 00 29 91/ACV(3)KAU/PG)

Not started

13 **Transformations and losses of N under different periods of N application to rice in submerged lowland acid laterite soils**
(BR/01 00 30 91/PTB(3)NARP)

The volatalization loss of ammonia was in the range of 1 17 to 2 48 per cent during Virippu season, and 2 22 to 9 08 per cent during Mundakan season The lowest loss occurred with reduced application of N as basal dressing

14 **Fertilizer requirement for different yield targets of paddy based on soil test values in lowland acid laterite soils**
(BR/01 00 31 91/PTB(3)KAU/NP)

The amount of N P_2O_5 and K_2O required to produce one quintal of rice grain were 2 3 0 49 and 1 88 kg/ha respectivelv Fertilizer prescription equations have been calculated Ready reckoners for fertilizer recommendation for specific yield targets based on initial soil nutrient status availability of organic manures and financial resources of the farmer can be prepared

15 **Dynamics of the absorption of forms of N by crop plants**
(BR/01 00 36 92/VKA(1)KAU/PG)

The nutrient solution containing different labelled forms of N was standardised for growing rice The absorption of 14C labelled urea by coconut pepper, ginger turmeric cocoa, cashew and banana was studied by treating roots of seedlings of the above crops The chemical analysis is in progress

16 **Seasonal variations in nutrient transformations of lowland rice soils**
(BR/01-00 37 92/VKA(3)KAU/NP/PG)

The experiment was designed to find out variations in the content of organic carbon

major and secondary nutrients in rice soils in different seasons and the influence of manures and fertilizers on the transformations The chemical analysis has been completed and preparation of thesis is in progress

17 Assessment of nitrification rates of soils and screening plant materials for nitrification inhibition properties
(BR/01 38 92/VKA(1)KAUP/PG)

Nitrification rates of the soils were assessed in laterite forest and alluvial soils of Trichur district by incubating 100 ppm N as urea at 65 per cent moisture Among the different soils results of the study indicated that alluvial soil had maximum nitrification efficiency of 64 per cent

18 Availability of potassium under different levels and methods of application of lime
(BR 01 00 39 91/VKA(3)KAU/NP/PG)

The incubation study in *kole* soils and field experiments in the kole lands have been carried out The chemical analysis of soil and plant samples have been completed Tabulation of data and statistical analysis are in progress

19 Partial substitution of muriate of potash by common salt for cassava (*Manihot esculenta Crantz*) in oxisols of Kerala
(BR 01 00 40 92/ACV(3)KAU/PG)

Field experiments were conducted in two years at Instructional Farm College of Agriculture Vellayani to explore the possibility of partial substitution of muriate of potash with common salt Chemical analysis of soil and plant samples were completed Statistical analysis is in progress

20 Utilization of phosphorus from green manure by rice
(BR 01 00 41 92/VKA(3)KAU/PG)

Utilisation by rice from P labelled green manure was studied The available P of the green manure amended soil was high in the initial day of incubation Application of 0 25 per cent green manure along with amophos considerably increased the dry matter production and P uptake by rice Grain and straw yield were also high

21 Dynamics of nutrient release and transformations from slow release fertilizers in acid rice soils
(BR/01 00 42 93/VKA(3)KAU/PG)

The incubation and pot culture experiment has been completed The chemical analysis is in progress

22 Dynamics of potassium in soils of *kole* lands
(BR/01 00 43 93/VKA(3)KAU/PG)

Collection of soil samples from 15 locations in the kole area has been completed Basic chemical analysis and the incubation study with the surface samples are in progress

23 Suitability of North Carolina reactive rock phosphate for direct application in upland soils of Kerala
(BR/01 00 44 93/VKA(3)KAU/PG)

The experiment has not been undertaken during the year under report

24 Soil nutrient dynamics in cocoa (*Theobroma cacao*)
(BR/01 00 45 93/VKA(3)KAU/PG)

The sampling of the soil at different depths from the basin of cocoa plants coming under a fertilizer trial has been completed The leaf samples have also been collected The chemical analysis is in progress

25 Suitability of North Carolina reactive rock phosphate for direct application in acid rice soils of Kerala
(BR/0 00 46 93/VKA(3)KAU/PG)

The experiment has not been undertaken during the year under report

26 Differential response of rice cultivars to potash application in the rice soils of Onattukara
(BR/01 00 47 93/ACV(3)KAU/PG)

Seeds were procured from various research stations of KAU and classified as 1) Tall long duration 2) Tall short duration 3) Dwarf medium duration 4) Dwarf short duration Initial soil analysis was

completed All the varieties were grown at four levels of potassium with package recommendation as the maximum dose Initial soil analysis and field observations on crop growth were completed during the period

27 Vertical movement of nitrogen in major rice soils of Kerala
(BR/01 00 48 93/ACV(3)KAU/PG)

Soil samples were collected from rice growing areas of *Onattukara, Karappadom, Kayal Kole* and lateritic alluvial soils Soil samples collected from 15, 30 and 45 cm depth were analysed for soil physical and chemical properties

28 Characterisation of soils under reed in Western Ghats
(BR/01 00 50 93/VKA(1)KAU PG)

Collection of soil samples from profile and sampling for fertility parameters have been completed Litter decomposition studies have been initiated

Project (02) Pedological and mineralogical studies of Kerala soil

29 Pedological investigations on the ecosystem of Vellayani lake
(BR/02 00 09 92/ACV(3)KAU/PG)

The experiment has not been undertaken during the year under report

30 Taxonomy and fertility capability classification of soils in the kole areas of Trichur
(BR/02 00 10 93/VKA(3)KAU/PG)

The soil profile morphology in the identified soil series in the kole area has been completed The soil samples from the profiles and also surface samples representing the soil series have been collected Chemical analysis is in progress

31 Micromorphology and minerology of the soils of the major land resource areas of Kerala
(BR/02 00 11/93 ACV (3) KAU/PG)

Soil samples were collected from eleven sites Granulometric analysis of soil samples was completed Sample preparation for micromorphological studies is in progress

32 Morphology and physical characteristics of soils of major land resource areas (MLRAs) of Kerala
(BR/02 00 12 93/ACV(3)KAU/PG)

Profile description of eleven sites viz Kottarakkara Palode Vellayani Kayamkulam, Moncompu Vellanikkara Eruthempathy, Vyttila, Nedumangad Mannanthala and Kazhakkuttam were completed Granulometric composition of the soils was determined Soil physical properties like volume expansion and waterholding capacity were determined These properties were found to be higher in soils containing higher amount of clay

Project (03) Soil physical properties in relation to crop production

33 Investigations on changes in the physico-chemical properties of coconut garden soils due to continuous interculture of fodder crops
(BR 3 00 02 92/ACV(3)others)

Growing of fodder crop in the coconut garden will improve many of the physical parameters especially structure and hydraulic characteristics of the soil The yield of coconut showed increase in the plots where fodder is grown

34 Effect of long term fertilizer application on the soil physical properties in coconut garden
(BR/03 00 05 92 ACV(3)KAU/PG

Organic matter content of the soil was found to increase with increasing nitrogen rates at both the depths of 0 30 cm and 30 60 cm Physical properties of soil like volume expansion porosity and waterholding capacity were not much affected by the long term fertilizer application except in the surface soil where it was found to increase with increasing levels of nitrogen application

35 Effect of coir pith on physico chemical and moisture retention properties of selected soil groups of Kerala
(BR/03 00 06 92/VKA(3)KAU/PG)

The study was carried out to find out the effects of coir pith on the physico chemical

and moisture retention properties of red laterite and sandy soils and to evaluate the soil plant interaction

The samples representing the three soil types have been collected Pot culture and incubation experiments have been completed

Project (05) · Distribution of pests and pathogens in Kerala

36 Survey of plant parasitic nematodes in paddy, banana, ginger, turmeric, medicinal and aromatic plants
(BR/05 00 01 87/ACV(4)ICAR)

Root soil of rhizosphere and grain samples of paddy collected from Malappuram, Thrissur and Palakkad districts showed *H oryzicola* in all the samples

Out of ten banana samples collected from Thrissur district only *H oryzicola* was detected in five samples

Medicinal and aromatic plants collected from TBGRI Palode and Kariyavattom showed that most of them are hosts of *M incognita* Ectoparasitic nematodes were also obtained from the soil samples collected

37 Distribution and bioecology of phytophagous mites of vegetables, medicinal plants and ornamental in Thiruvananthapuram district
(BR/05 00 02 90/ACV(4)KAU PG)

Survey of phytophagus and predatory mites was continued Permanent slides of mites were prepared Slides of gall making insects belonging to family Tropbvcidae infesting medicinal plants were also prepared To study seasonal abundance of mites field experiments were conducted using chilli pumpkin bhindi snakegourd and cowpea Pot culture experiments were conducted using bhindi and chilli to assess the damage caused by *Tetranychus* and *Polyphagus arsonemus*

38 Strain variations in *Colletotrichum gloeosporioides* Penz
(BR/05 00 03 91/ACV(5)KAU/PG)

Pathogenicity studies of sixty isolates of the pathogens obtained from 57 ornamental plants and three vegetables were conducted Positive results were obtained on 27 ornamental plants and three vegetables Symptoms produced by artificial inoculation varied from small specks to several centimeters in diameter Cultural characters of the highly virulent thirty isolates were studied by growing them on potato dextrose agar medium Toxin production by isolates obtained from ten ornamental plants was conducted Prominent symptoms were produced on four ornamental plants by inoculation with toxins produced by the respective isolates

Project (11) : Vermicompost and organic manures in relation to nutrients, soil, plant and crop response

39 Vermicomposting of vegetable garbage
(BR/10 00 01 93/ACV(3)KAU/PG)

Efficiency of composting of biowastes by the exotic species *Eudrilus eugineae* was compared with that by local worms The exotic worm was more efficient than local worms both in the period required for composting as well as in the quality of compost

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PART II

Faculty of Veterinary and Animal Sciences

1. Animal Diseases

HIGHLIGHTS

- By elegant experimental studies in goats calves, dogs and quails suitable anaesthetics were identified and dose regimes were prescribed
- Taking appropriate animal model systems the toxicity of citrinin was evaluated and its significance was brought to light The efficacy of various indigenous plant leaves in inhibiting fungal growth was assessed
- The basic mechanisms involved in the immunological response to duck plague infection was identified and the efficacy of passive haemagglutination test in the diagnosis of the disease was clarified
- The serological profile of cattle bearing ethmoid carcinoma was charted and the usefulness of certain biomarkers in the diagnosis of the tumour was delineated
- Employing various animal models and immunomodulators experimental transplantation studies on ethmoid carcinoma was carried out and an ideal transplantation model system was developed
- Tests for the diagnosis of paratuberculosis in goats were evaluated and a suitable diagnostic test was recommended
- The plasmids of *E coli* isolated from cases of mastitis and *C jejuni* isolated from pigs and man were characterised and their significance was highlighted and the scope for therapy was pointed out
- Immunosuppression was identified as an important factor in precipitating outbreak of diseases among ducks in Kerala
- Hypocalcaemia was identified to be the most important factor in inducing Downer Cow syndrome
- A method of choice was developed for diagnosing subclinical nematode infection in cattle
- A formalinised vaccine prepared from the local pasteurella isolate was found to be of value in immunoprophylaxis against pasteurelloisis

CONCLUDED EXPERIMENTS

1 **Xylazine-azepromazine anaesthesia in goats**
(AD/06 00 03 92/VC(12)KAU/PG)

The study was conducted in eighteen Malabari kids Xylazine hydrochloride was administered in different doses to one group and with azepromazine in another group Time of induction clinical signs duration of anaesthesia and period of recovery were studied It was concluded that xylazine hydrochloride @ 0 10 mg/kg and 0 15 mg/kg weight were suitable for surgical procedure of short duration in goats Addition of azepromazine had no special advantage

2 Tiletamine zolazepam anaesthesia with xylazine premedication and reversal with aminophylline in dogs
(AD/06 00 04 92/VC(12)KAU/PG)

The objective of the study was to find out the synergestic effect of xylazine on Tiletamine zolazepam anaesthesia and to evolve a suitable combination in dogs and also to study the efficacy of aminophylline as a reversing agent

The combination of xylazine (1 mg/kg) I/m and tilatamine zolazepam (1 25 mg/kg) I/V could be used to produce satisfactory short term anaesthesia in dogs Ammophylline at a dose of 20 mg/kg I/V could be used to reverse anaesthesia produced by tilatamine zolazepam xylazine combination

3 Xylazine anesthesia in calves with diazepam premedication
(AD/06 00 05 92/VC(16)KAU/PG)

The objective of the project was to recommend a satisfactory dose of xylazine as an anaesthetic for cattle with or without diazepam as a premedication

The study was conducted in 24 calves of 6 to 12 months of age divided into two major groups Each group was further divided into two sub groups Xylazine hydrochloride at the rate of 0 2 mg/kg body weight was given intramuscular to one group and 0 3 mg kg body weight for second group diazepam at the rate of 1 0 mg/kg body weight and after 15 minutes xylazine hydrochloride at the rate of 0 2 mg/kg body weight for the third group and diazepam at the rate of 1 0 mg/kg body weight and after 15 minutes xylazine hydrochloride at the rate of 0 3 mg/kg body weight for the fourth group The study revealed that administration of xylazine alone did not result in good analgesia of short link and premedication with diazepam deepened the effect of sedation

4 Anaesthesia of pigeons and quails using ketamine and xylazine
(AD/06 01 02 92/VC(16)KAU/PG)

The objective of the study was to try the efficacy of ketamine xylazine and a combination of these two in pigeons and quails and to evaluate the consequent effect of these drugs on the birds

The study was conducted in 30 pigeons and in 30 quails The loss of balance ruffled feathers sitting posture and sluggishness were observed during onset of anaesthesia A significant reduction in temperature was observed in all the birds Intraperitoneal administration of xylazine ketamine hydrochloride and xylazine followed by ketamine hydrochloride produced satisfactory anaestnesia in both pigeons and quails It was concluded that combination of xylazine and ketamine hydrochloride is advantageous because of the short time for induction long duration and quick recovery

5 Mycotoxicosis in domestic animals
(AD/09 00 03 89/VC(16)KAU PG)

The pathology of a citrinin toxicosis was studied and the residual toxins were detected in edible tissues like liver kidney skeletal muscles and gizzard after oral administration of citrinin in birds The public health importance of the evidence of residual toxins in ed ble tissues of chicken is emphasized

Aqueous extracts of tender leaves of *Thespesia populenia Allium cepa Allium sativum Allium ascalonium* and Gugul inhibited fungal growth n rice

6 Viral gastro enteritis in animals
(AD/12 00 02 87/VC 8)KAU)

Prevalance of parvovirus infection in dogs and rota and coronavirus infection in calves were established both by serological and virus isolation techniques In gereral gastro enteritis was noticed during the early rainy season and better management could reduce the incidence of viral gastro enteritis

7 **Assessment of immunity to duck plague (Duck viral enteritis virus) on vaccination**
(AD/13 00 02 91/VC(16)KAU/PG)

Studies on the immune response of ducklings to duck plague vaccine have shown that the effect of single vaccine was negligible The commercial vaccines tested had low virus titers while the laboratory adapted vaccine stimulated the immune system satisfactorily as indicated by good virus neutralization titers and passive haemagglutination titers (humoral immunity) and leukocyte migration inhibition percentages (cell mediated immunity) The duration of immunity following the use of this vaccine was over six months However the antibody titers were low even in the double vaccination group which rose to a greater extent after challenge infection

It was concluded that both humoral and cell mediated immunity were involved in inducing resistance to duck plague either by vaccination or by natural infection The passive haemagglutination test was standardised so that it can be used as one of the serological tests for diagnosis of duck plague

8 **Clinico-therapeutic studies on Downer Cow syndrome**
(AD/18 00 01 89/VC(4)KAU)

Analysis of data from 14 Downer cows indicated higher incidence among cross bred jersey cows during summer season Clinical signs included recumbency and hindquarter weakness Clinical data were within normal range with no indication of systemic disturbances Metabolic profile test revealed hypocalcaemia hypophosphataemia hypoproteinaemia and hypoalbuminaemia were associated with Downer Cow syndrome

9 **Metabolic profile of Downer Cow syndrome**
(AD/18 01 02 92/VC(4)KAU/PG)

Analysis of data from 14 diseased cows indicated a highly significant increase in PCV and significant increase in haemoglobin content Lymphopenia Nutrophilia and eosinopenia were observed Hypocalcaemia hypophasphalaemia hypoproteinaemia and hypoalbuminaiema were obtained with no significant variation in blood glucose urea nitrogen sodium potassium magnesium and albumin / globulin ratio

10 **Screening for fluorine in blood, urine milk and mineral mixture in University farms**
(AD/20 00 01 89/VC(12)KAU)

Work completed

11 **Evaluation of blood constituents as diagnostic markers for ethmoid carcinoma in cattle**
(AD/21 00 04/VC(11)KAU/PG)

The investigation was carried to evaluate the usefulness of blood constituents as tumour markers for carcinoma of ethmoid There was increase in the serum calcium level and reduction in serum phosphorus level in tumour bearing animals Serum magnesium level did not reveal any statistical significance Serum total sialic acid and serum lipid bound sialic acid were high in tumour bearing animals when compared to control

Using agar gel precipitation test for detecting tumour antibodies serum of tumour bearing animals tested against prepared tumour antigen revealed two distinct precipitin bands one band close to the serum wall and another sharp band closer to the antigen wall Majority of the serum samples of control animals also showed both precipitin band None of the tumour samples processed and inoculated into embryonated eggs revealed the presence of any haemagglutinating agents

12 **Characterisation of *Campylobacter jejuni* isolated from pigs and man**
(AD/28 00 02 92/VC(8)KAU/PG)

Campylobacter jejuni was isolated (42 3 per cent) from piglets below two months of

age with diarrhoea/enteritis The organism was also isolated from 20 per cent of children below two years of age with diarrhoea / enteritis

Sonicated *C jejuni* antigen prepared from selected strains from porcine and human origin were found suitable for sensitization of gluteraldehyde stablized sheep RBC for serum antibody monitoring The sonicated antigen retained its affinity to sheep RBC even after 6 months of storage at 60°C and for about three months at 4°C The optimum concentration of antigen for coating of stabilized SRBC was standardized and found to be 2 mg/ml The optimum level of SAPA cells required in the sero monitoring of *C jejuni* specific antibodies by SAPA AMHA test was found to be 0 1 per cent

Comparative studies on the sensitizing SAPA AMHA and PHA tests in screening *C jejuni* specific antibodies showed that SAPA AMHA could advantageously replace the conventional PHA for serological diagnosis of animal and human campylobacteriosis

Antibiogram studies of *C jejuni* showed that the isolates were sensitive to chloramphenicol gentamicin and nalidixic acid irrespective of their source or origin

13 Characterisation of *Pasteurella multocida* isolates from rabbits
(AD/29 00 01 91/VC KAU/PG)

The prevalence of *P multocida* as one of the causative agents of respiratory tract infection of rabbits was established by the isolation of six strains of *P multocida* from ailing rabbits These isolates were shown to be pathogenic to mice but they were unable to establish clinical infection in rabbits by experimental intranasal inoculation The antibiogram of the isolates were also studied and all the isolates were uniformly sensitive to most of the antibiotics except erythromycin All the isolates obtained from rabbits were serologically distinct from bovine *P multocida* vaccine strain P 52

14 Characterisation of plasmids of *E coli* isolated from mastitis
(AD/29 00 02/VC KAU/PG)

All the *E Coli* strains isolated from bovine mastitis were sensitive to kenamycin and Norfloxacin Among the multiple drug resistance Oxytetracycline rifamicin resistance was noticed in 76 2 per cent cases Twenty six different patterns of antibiotic resistance was noticed among 43 E coli isolates giving a reliability of 60 46 per cent in differentiating the isolates indicating that antibiogram could only be used as an adjunct to plasmid profiling in epidemiological studies Resistogram studies revealed 100 per cent resistance to lead followed by antimony copper silver and cetrimide All the isolates were sensitive to cadmium and mercury

A correlation between the antibiotic resistance and heavy metal resistance such as lead, antimony and copper was observed in the descending order Transfer of the hemolytic character by conjugation studies revealed that this character of *E coli* was plasmid mediated and not the enterotoxin producing property Studies on the plasmid profile showed that the number of plasmids present in various isolates differed from 1 to 5 Isolates with similar plasmid profile revealed similar antibiogram resistogram and Ent character The study concluded that indiscriminate use of antibiotics should be dispensed with

15 Etiology and pathology of carcinoma of mucosa of ethmoid in domestic animals
(AD/32 00 01 92/VC(3)USDA)

Homologous and heterologous transplant ation of bovine ethmoid carcinoma cells were attempted to assess the xerograftic efficiency of the neoplasm Tumour tissue cell culture was successfully carried out using trypsnim single cell suspension and tumour tissue fragments Transplantation was carried out subcutaneously or intraperitoneally The results of the study indicated that mice could be used as an experimental model for the studies on bovine ethmoid carcinoma

16 **Assessment of the role of aflatoxin in the etiology of carcinoma of the mucosa of ethmoid**
(AD/33 00 02 92/VC(11)USDA/PG)

Work completed Final report is under preparation

17 **Modified Intradermal test for the diagnosis of paratuberculosis in goats**
(AD 34 00 01 92/VC(15)KAU/PG)

Examination of faecal sample and rectal pinch are not authentic to reveal the presence of myco paratuberculos s Serum magnesium level also did not show significant variation in positive and negative animals Modified intradermal test was conducted in one group of animals Postmortem studies revealed that this study gave better results than the other two It was concluded that MID 1 test could be used as a better diagnostic test for detection of paratuberculosis among goats

ONGOING EXPERIMENTS

1 **Prevalence and pathology of dermatosis in domestic animals**
(AD/03 00 01 85/VC(15)KAU)

The cutaneous response to various sensitizers were evaluated in calves The data are being analysed

2 **Prevalence and pathology of dermotological disorders in cattle**
(AD/03 00 02 92/VC(11)KAU/PG

The histopathological study and the dermatological conditions observed are in progress

3 **Hypoglycaemic effect of selected indigenous drugs in rabbit**
(AD/04 00 01 87/VC(12)KAU)

Temporarily discontinued

4 **Preliminary study on the anticonvulsant effect of selected indigenous drugs**
(AD/04 00 02 89/VC(12)KAU)

Temporarily discontinued

5 **Evaluation of selected drugs for sedation and anaesthesia in birds**
(AD/06 00 01 85/VC(16)KAU)

The combination of xylazine and metamine hydrochloride is advantageous for anaesthesia in pigeons and quails because of the short time for induction long duration of anaesthesia and quick recovery

6 **Paravertebral anaesthesia in goats using *Bupivaccine hydrochloride***
(AD/06 00 02 91/VC KAU/PG)

Study revealed that 13 thorasic first and second lumbar spinal nerves have to be blocked at the proximal site for anaestnesia of the flank in goats Both 0 5 per cent and 0 25 per cent of Bupivaccine hydrochloride produced anaesthesia for sufficient duration It was also observed that 0 25 per cent is sufficient for paravertebral anaesthesia in goats producing analgesia for more than 3 hrs There were no significant variation in the rectal temperature, heart rate respiration rate and rumen motility of the experimental animals Slight inordination on the hind limb on the side of nerve block was observed

7 **Comparative study of reversal of xylazine ketamine anaesthesia with yohimbine and phentolamine in small animals**
(AD/08 00 01 89/VC(12)KAU)

Xylazine ketamine combination gave satisfactory anaesthesia at 1 2 ratio intraperitoneally Yohimbine @ 2 mg/kg produced reversal anaesthesia within four minutes and can be used with satisfactory results for recovery after surgical procedures performed under xylazine ketamine anaesthesia

Phentolamine 50 mg/kg also produced reversal of xylazine ketamine anaesthesia but low doses were found to be ineffective

8 Effect of intramuscular anaesthetic in rabbits and its reversal
AD/08 00 02 93/VC(12)KAU)

It was observed that combination of xylazine and ketamine provided effective anaesthesia in rabbits after 7 minutes Prior administration of ketamine (35 mg/kg) and 10 minutes later xylazine intramuscular (5 mg/kg) also provided effective anaesthesia after 15 minutes lasting for about 50 minutes

The effect of reversal using alpha blockers is under investigation

9 Prevalence and pathology of hypothyroidism in pigs
(AD/10 00 01 85/VC(11)KAU)

All the experimental animals gained weight upto one month and subsequently showed a gradual and progressive reduction in the body weight The thyroid adrenal and pituitary glands showed an increase in weight when compared to controls The level of plasma proteins and serum cholesterol showed an increase in the experimental animals while the serum thyroxin level showed a decrease Enlargement of the thyroid gland and moderate dilatation of the right ventricle were present in the experimental animals at postmortem

10 Pathology of hypothyroidism in pigs
(AD/10 00 02 93/VC(11)KAU/PG)

Slight increase in the relative weight of adrenal and pituitary glands were observed in affected animals when compared to controls A gradual decline in the serum thyroxin level was also observed in this group The serum cholesterol level was markedly increased The level of plasma protein in the experimental group increased gradually from the 30th day onwards Further work is in progress

11 Investigations on diseases of ducks in Kerala
AD/14 00 02 85/VC 11)KAU)

Failure of the immunological system was attributed to be the cause for the outbreak of duck plagues in different parts of Kerala

12 Comparative study on the immunopathological response in Ochratoxin A, Cadmium and Mercury toxicities in ducks (*Anas platyrrhynchos domesticus*)
(AD/14 00 02 93 VC(11)KAU/PG)

No significant result has been reported during the period Work is in progress

13 Immunopathological response of the duck (*Anas platyrrhynchos domesticus*) to suolethal dose of selected agrochemicals
(AD/14 00 03 93/VC(11)KAU/PG)

Sub lethal doses of Carbofuran (pesticide) and 2 4 D (herbicide) treated ducks showed slight leukocytosis with neutrophilia and reduction in haemoglobin when compared to the control birds Total serum protein albumin and globulin also showed reduction in the affected birds Humoral immune response of the treated and control birds was assessed with R_2B virus The H I titre was very low in the affected animals which is suggestive of immunosuppression The cell mediated immune response was also reduced in the affected birds

14 Comparative pathology of Aflatoxicosis in the duck and fish with special reference to the immune system
(AD/14 00 04 93/VC(11)KAU/PG)

It was demonstrated that aflatoxin has significant suppressive effect on the bone marrow characterised by leukopaem a and anaemia in ducks

15 Secretory immunoglobulins of the duck (*Anas platyrrhynchos domesilcus*)
(AD/14 00 05 93/VC(8)KAU/PG)

The immunoglobulins were separated by

ammonium sulphate precipitation from sera tracheal washings intestinal washings and bile from ducks These were then concentrated by poly vinyl pyrolidone and the concentration was estimated by direct method The presence of immunoglobulins in the above samples was ascertained by agar gel precipitation test using anti duck whole serum Work is in progress

16 Autografts using ribs for the treatment of fracture of metacarpus in calves
(AD/19 00 02 91/VC(16)KAU/PG)

The objective of the study was to treat fracture of metacarpus using autogenous rib graft in calves Fracture created on the metacarpus was immobilised with bamboo splints and plaster of paris after suturing the wound It was found that after two weeks of immobilization animals could get up and lie down without assistance In the other group the fracture on the metacarpus was treated with autogenous rib graft prepared from the same animal by fixing its position at the site of fracture and immobilization with plaster of paris

It was found based on radiographical and histological examination that autogenous rib graft was satisfactory for fracture of metacarpus in calves The rib grafts used were gradually replaced with trabeculae new bone formation

17 Studies on metabolic diseases among cross-bred cattle in Kerala
(AD/23 00 01 85/VC(8)KAU)

The incidence pathogenesis therapy and control measures of various metabolic disease effecting cattle was studied High yielding dairy cows during late pregnancy or few weeks after pasturation were found to suffer from this Analysis of data collected from the field revealed 61 per cent Hypocalcaemia 13 per cent Ketosis 11 per cent Downer cows 8 per cent Hypomagnesemia and others 7 per cent Majority of the cases responded to treatment within one to three days but poor response was reported in Downer cows

18 An investigation of R-plasmids and transposons in staphylococci
(AD/24 00 01 89/VC(8)KAU)

Temporarily discontinued

19 Certain plasmid-mediated characters of staphylococci isolated from the bovine mastitis
(AD/24 00 02 93/VC/8)KAU/PG)

Staphylococci isolated from 26 cases of bovine mastitis were biotyped utilizing haemolysin production on sheep and rabbits blood agar Resistograms have been obtained against inorganic compounds These isolates are being phage typed and their plasmid profile is being studied

20 Necrosis of extremities in cattle and buffaloes
(AD/25 00 01 85/VC(4)KAU)

Temporarily discontinued

21 Effect of antihelmintic treatment of milk production in subclinical nematode infections of cows
(AD/26 00 02 93/VC(4)KAU/PG)

Dung cultures were set up from 15 dairy cows belong to University Livestock Farms at Thumburmuzhi Thiruvazhamkunnu Though microscopic examination of faeces did not reveal any helminth eggs culture revealed the presence of larvae of nematodes proving that faecal culture is the method of choice for detecting sub clinical nematode infection Work on these aspects is in progress

22 Antigens of *Pasteurella multocida* isolated from rabbit and their immunogenicity
(AD/29 00 04 93/VC/KAU/PG)

Four strains of *Pasteurella multocida* isolates from rabbits were subjected to detailed study with respect to their antigenic components Antigens were prepared from these isolates by heat inactivation sonication and treatment with potassium thiocyanate The protein and carbohydrate

contents in these antigens were also estimated A formalin killed vaccine prepared from *Pasteurella artipestifer* solated from ducks was found to give satisfactory protection as evidenced by their ability to withstand challenge

23 Dry cow therapy for control of mastitis
(AD/30 00 01 91/VC(07)KAU/PG)

Milk samples collected at late stage of pregnancy were subjected to detailed cultural examination and antibiotic sensitivity test Based on the above intramammery infusion with long acting antibiotics were tried The infusion was repeated after three weeks It was observed that quarter infection in cows subjected to dry cow therapy was much less compared to animals which did not receive the therapy but further this treatment did not prevent infection during subsequent lactation

24 Homologous and heterologous transplantation of bovine ethmoid carcinoma cells
(AD/33 00 02 93/USDA/PG)

Ethmoid tumour obtained from clinically affected cows were identified histopathologically as adenocarcinoma papillary adenocarcinoma, undifferentiated carcinoma and squamous cell carcinoma Tumour cell/tissue culture employing trypsinated single cell suspension/tumour tissue fragments were carried out After the monolayer formation the cells were harvested and subcultured in rats and mice There was no evidence of tumour growth either grossly or microscopically at the end of the experiment

25 Studies on the incidence pathology and preventive measures of common diseases of goats
(AD/35 00 01 89/VC KAU)

The common conditions encountered during the period are coccidiosis pneumonia gastro enteritis hepatosis and nephrosis due to aflatoxicosis tape worm infection enterotoxaemia and Johnes disease The incidence of aflatoxicosis was more during the period Histopathological studies are in progress

26 Pathology of the endocrine glands in goats and pigs
(AD/36 00 01 89/VC KAU)

Hypothyroidism was induced in pigs using thiourea and the clinical profile was evaluated Work is in progress

27 Investigations on kid mortality
(AD/37 00 00 89/VC/KAU)

The causes for the mortality in kids were studied and was mainly due to coccidiosis gastroenteritis and pneumonia

28 Prevalence and pathology of the Myocardial lesions in bovines
(AD/38 00 01 93/VC(11)KAU)

A total of 92 heart samples were examined The following conditions were observed (1) Sarcocysts (2) Myocarditis (3) Congestion (4) Myocardial degeneration (5) Oedema (6) Pericarditis (7) Haemorrhage, and (8) Haemopericardium Further study is in progress

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2. Cattle and Buffaloe

HIGHLIGHTS

- Prawn waste can be ensiled satisfactorily with paddy straw and tapioca flour as additive
- Growth and survival rate of calves increased with higher dairy awareness among farmers
- Cattle and buffalo bullocks developed equal traction power during dry and wet ploughing
- Subabul venga and banana leaves are suitable as fodder for goats along with jack leaves

CONCLUDED EXPERIMENTS

1 **Determination of the availability of animal feed resources and their utilisation with special emphasis on crop residues, forest, aquatic and slaughter house origin and animal and organic wastes for evolving economic rations for livestock and poultry**
(CB/01 00 01 87/VC(9) CAR)

Work completed and report already submitted

2 **Effect of tannins in commonly fed fodders**
(CB/01 00 02 91 VC(9)KAU)

The investigation was carried out to asses the nature and level of tannins in tree leaves on nutrient availability in goats Fourteen different locally available tree leaves commonly fed to goats were analysed for their chemical composition total tannins condensed and hydrolysable tannins Based on the tannin contents as well as palatability and local availability of the fodders four tree leaves *viz* subabul jack venga and banana were slected for experiment The different tree leaves studied were found to be higher in dry matter crude protein and calcium but lower in crude fibre and phosphorus as compared to the common grass fodders Total tannin content in the different tree leaves studied ranged from 2 6 to 7 8 per cent with condensed tannins predominating in majority of the fodders The average dry matter consumption of goats when fed jack and subabul leaves with 4 per cent and 5 5 per cent of total tannins respectively on dry matter basis were higher than when fed venga and banana leaves with 4 7 and 3 7 per cent respectively The animals fed of the four fodders maintained positive balances for calcium the negative balance for phosphorous was recorded in animals fed subabul and venga leaves while those fed on jack and banana leaves showed positive balance for the same The haematological constituents *viz* haemoglobin plasma protein calcium and phosphorus in goats fed the four fodders were well within the normal ranges for the species

From the overall evaluation of the results obtained it was inferred that a level upto 5 5 per cent of total tannins and 3 4 per cent of condensed tannins in tree leaves do not exert any significant influence on feed intake and nutrient utilisation in goats

No significant difference was observed on dry matter consumption digestibility coefficient of drymatter crude protein ether extract and crude fibre and balance of nitrogen in animals fed of the four different fodders It was concluded that jack subabul venga and banana are suitable for popularisation as fodder sources for goats on the basis of the present investigation

3 **Nutritive evaluation of prawn waste to straw silage in cattle**
(CB/01 00 03 92/VC(9)ICAR/PG)

The objective was to assess the feeding value of prawn waste paddy straw silage in cattle Prawn waste was ensiled with paddy straw (1 1 wet basis) with 10 per cent tapioca flour as additive and allowed to ferment for a period of six weeks Nutritive evaluation of prawn waste paddy straw silage was carried out using six adult non producing cows of uniform breed age and body weight Three experimental diets *viz* basal ration of hay alone basal ration plus paddy straw 50 50 and basal ration plus prawn waste paddy straw silage 50 50 were used for the study Digestion trials were carried out involving a collection period of seven days under each treatment The chemical composition of hay paddy straw and prawn waste silage and the average digestibility coefficients of nutrients were estimated

Overall assessment of the results of the study revealed that prawn waste can be ensiled satisfactorily with paddy straw and tapioca flour as additive on a large scale and that the material is well relished and digested by cattle as evidenced by feed intake and digestibility coefficients of nutrients

4 **Effect of dried spleen as a growth stimulator in mixed rations**
(CB/ 00 04 92 VC(9)ICAR)

Incorporation of dried spleen in the ration of weaned the growth performance of animals Animals maintained on spleen incorporated ration showed better digestibility of crude protein and ether extract than control groups Incorporation of dried spleen could not exert any influence on fibre fractions Experimental animals showed better retention of calcium phosphorus magnesium and nitrogen

Overall assessment of the results indicated that incorporation of dried buffalo spleen in the ration of goats at the rate of 0 1 per cent certainly augmented the nutrient utilisation by increasing the digestibility and retention and can be recommended as a natural growth promotant with economic benefit

5 **Progeny testing of crossbred bulls in rural areas**
(CB/02 00 01 86/VC(3)ICAR)

Discontinued

6 **Characterisation and evaluation of dwarf cattle of Kerala**
(CB/06 00 01 90/VC(3)KAU/PG)

No report received

7 **Comparative draught capacity of cattle and buffaloes**
(CB/07 00 02 92/VC(7)KAU/PG)

The physiological responses of buffalo bullocks increased to a level indicative of extreme heat stress due to dryland ploughing Respiratory rate pulse rate and rectal temperature increased when compared to cattle There were also behavioural changes indicative of distress due to heat stress During wet land ploughing the responses were not so marked in buffaloes and did not show behavioural signs of distress The haemoglobin per cent PCV and plasma bicarbonate decreased significantly due to dry and wet ploughings The ESR and blood lactic acid showed significant increase due to work Buffaloes consumed more dry matter on metabolic body size basis and also consumed more water

Kannayam bullocks completed more area per unit time than Surti buffaloes The differences observed in this respect under wet ploughing Cattle was

with greater speed than buffaloes and had longer stride length than them under dry ploughing Under wet ploughing the differences were negligible

There was no difference between cattle and buffalo bullocks in the traction power developed during dry and wet ploughings Both the species developed higher horse power during wet ploughing

8 Factors influencing calf growth and mortality in field and organized farms
(CB/09 00 02 92/VC(7)KAU/PG)

The performance of contemporary crossbred calves in the field and organised farms are given below

	Farms	Field (Mavelikkara)
Daily weight gain (g)	590	170
Mortality rate (%)	8 1	14 0

In comparison to the milk feeding schedule followed in the University Farm the milk available to female calves in the field was deficient by about one litre in the second and third months Milk feeding of the male calves in the field was quite inadequate compared to farms This resulted in poor growth and high mortality among male calves in the field Concentrate feeding of calves was also at a lower rate n the field compared to the farms

Some farmers did not feed colustrum which resulted in mortality of two out of three such calves Higher growth rate and no mortality were observed among calves fed colostrum within 15 minutes after birth

Better hygiene and daily grooming resulted in higher weight gain and reduced mortality rate The growth and survival rate of calves increased with higher dairy awareness of the farmers

ONGOING EXPERIMENTS

Project (09) Cytogenetics, karyology and blood groups in cattle

1 Performance of calves under different feeding and housing systems
(CB 09 00 01 89/VC(7)KAU)

The effect of shelter *vis a vis* open conditions and replacing part of concentrate rations with green legumes on the physiological responses and growth of crossbred calves between 6 12 months of age under hot humid climate was investigated

Physiological reactions like respiratory rate pulse skin temperature and rectal temperature were significantly higher in calves kept in the open Even though these may indicate a higher thermal load on the animals kept in the open the calves seemed to have successfully coped up with the situation physiologically as there was no reduction of growth in the exposed group Replacing part of the concentrate with green legumes did not affect physiological reactions or growth rate

Project (10) Integrated farming

2 Mineral content of feeds and fodder in selected village and mineral status of the cattle in that locality
(CB/10 00 00 87/VC(9)KAU)

Blood samples collected from cattle of the University livestock farm Mannuthy as well as private owners were analysed for mineral contents such as calcium phosphorus manganese iron and magnesium copper and zinc Simultaneously the concentration of the minerals in feeds and fodders used in these places were also analysed

From the data obtained it was observed that the mineral contents of feeds and fodders collected from Mannuthy and surrounding areas had satisfactory levels

of different minerals The concentration of minerals in the blood of various categories of cattle was also found to be within the normal limits reported for the species indicating a satisfactory mineral status in cattle maintained in and around Mannuthy

3 **Lucaena leaf meal as an ingredient in cattle ration**
(CB/11 00 01 87/VC(9)KAU)

No report received during the year

4 **Evaluation of the suitability of the type of fodder grass in terms of nutrient yield and animal performance**
(CB 13 00 01 87 VC/KAU)

A trial was undertaken to find out the type of grass most suitable to the conditions of Kerala with regard to yield and performance of animals

Guinea grass hybrid napier and congo signal were grown and samples collected for analysis Feeding trials for utilisation of grass will have to be carried out Work is in progress

5 **Blood groups and biochemical polymorphism in cattle**
(CB/19 00 00 89/VC/ICAR)

A total of 45 sets of isoimmunisations were carried out and the polyvalent sera are stored Fifty eight bovine blood typing reagents have been produced in the laboratory Available polyvalent sera have undergone further fractionation Eight hundred and nine animals were blood typed with the available reagents Blood factor "F was found to be the predominent one in Jersey crossbreds and Holstein freisien crossbreds whereas E 3 was found to be predominant in Brown swiss crossbreds and Bos taurus animals Seven hundred and forty five animals were typed for haemoglobin variants in which Hb AA was found to be more frequent Parentage control programme was initiated in the University farm was found to be 40 per cent and in Livestock Development Board it was nil Eight hundred and nine animals belonging to Kerala Agricultural University and Kerala Livestock Development Board were screened for albumin postalbumin transferrin and post transferrin Work is in progress

6 **Milk protein genetic variants in cross bred dairy cattle**
(CB/18 00 01 92/VC(3)KAU/PG)

No report received during the year

7 **Chromosome banding pattern and its association with reproductive disorders in cross bred cattle**
(CB 20 00 01 92/VC(3)KAU/PG)

Temporarily discontinued

8 **Chromosome profile of crossbred bulls in Kerala**
(CB/20 00 02 93/VC(3)KAU/PG)

Fifty three bulls used for A I of three genetic group (H F cross Jersey cross and Brown Swiss cross) were karyotyped for chromosome status The karyotypes revealed 29 pairs of autosomes and one submetacentric X chromosome The Y chromosome was submetacentric in CB HF while it was nearly metacentric in J and CBBS In G banding a total of 405 G bands were identified in crossbred bulls The semen picture of three bulls revealed abnormal semen morphology One bull exhibited oligospermic semen second bull produced semen with high percentage of knobbed acrosome defect and the third produced semen unsuitable for freezing Further detailed analysis and other reproductive performances are being investigated

9 **Comparison of immune response of indigenous and crossbred cattle of Kerala**
(CB/21 01 01 92/VC(3)ICAR/PG)

No report received during the year

10 Effect of bypass protein on yield and composition of milk in crossbred cows (CB/22 00 01 92/VC(9)KAU/PG)

The main object of the project was to find out the rumen protein degradability estimates with respect to different feeds and fodders used in the ration of dairy cattle and to assess the effect of varying levels of rumen degradable protein and undegradable protein on quantity and quality of milk and thereby to formulate economic and efficient concentrate mixtures based on bypass protein availability for optimum milk production in dairy cows

Rumen protein degradability of common feed and fodders were estimated using rumen fistulated animals with nylon bag technique Rumen liquor was collected for determination of pH ammoniacal nitrogen and total volatile fatty acid Three isonitrogenous and isocaloric rations with varying levels of RDP and UDP were used for lactation studies Records of feed intake body weight milk yield and milk composition were maintained during the period of study The data collected are being analysed Work is in progress

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3. Animal Reproduction

HIGHLIGHTS

- Synchronisation super ovulation and embryo collection can be successfully done in goats using prostaglandin (PGF2) progesterone and ECG without affecting their future reproductive performance
- Thermal stress had a significant effect on fertility and placental development of cows

CONCLUDED EXPERIMENTS

1 **Certain haematological parameters and blood biochemical constituents in cows with normal and impaired fertility**
(AR/OF 00 03 91/VC KAU/PG)

The object of the study was to assess the influence of certain haematological parameters like haemoglobin (Hb) packed cell volume (pcv) and biochemical constituents like total serum protein serum phosphorus total blood cholesterol and blood glucose in CB cows and the efficacy of replacement therapy of glucose and phosphorus on fertility in deficient animals

It was observed that levels of haemoglobin packed cell volume serum phosphorus blood glucose total serum protein and total blood cholesterol were low in animals with impaired fertility than in normal fertile animals The conception rate in animals with normal blood values was 81 80 per cent while the same in animals with low blood values was only 11 11 per cent It was concluded that levels of certain haematological and biochemical parameters have definite influence on the fertility levels The conception rate in repeat breeders could be improved by suitable therapy

2 **Prostaglandin therapy for postpartum clinical endometritis**
(AR 06 00 04 92/VC/2)KAU/PG)

The object of the project was to evaluate the therapeutic value of PGF_2 alpha for evolving a non antibiotic alternative for the treatment of post partum clinical endometritis

The trial was conducted using 42 cross bred cows having post partum clinical endometritis and divided them into four groups The group (1) of ten animals was inseminated twice in their natural oestrus at 24 hours intervals and group II was given post insemination intrauterine treatment based on antibiotic sensitivity test in their natural oestrus Group III was subjected to induction of oestrus by administration of PGF_2 alpha between 8 to 12 days of their cycle and inseminated twice at 24 hours interval Group IV was subjected to induction of oestrus as above and inseminated at 24 hours interval and given intra uterine antibiotic therapy 24 hours later Based on clinical recovery and conception rate of the experimental animals it was concluded that administration of PGF_2 alpha alone is beneficial in the treament of post partum clinical endometritis and can be recommended as the drug of choice

1 **Reproductive performance of cows under homeothermal disturbances**
(AR/01 00 01 90/VC(2)KAU/PG)

The study was undertaken to know the effect of thermal stress on fertility and placental development of cows During this period the data from 2298 animals were analysed to study the influence of age parity and colour on rectal temperature Mean rectal temperature on arrival at AI centre was 39 08°C Appreciable variability in rectal temperature was observed in farmers animals depending upon the colour of the animal distance walked speed taken and also the time of arrival for insemination

The overall mean rectal temperature of farmers animals was 37 74°C The influence of factors like pre partum weight of dam post partum weight of dam sex of calf on placental development are being investigated The work is in progress

2 **Synchronisation of oestrous superovulation and embryo collection in goats**
(AR/01 00 02 91/VC KAU/PG)

The object of the project is to standardise techniques for synchronization of oestrus superovulation and collection of embryos in goats Synchronization of oestrus was effective both by the administration of PGF_2 alpha and progesterone Superovulation was carried out with equine chorionic gonadotrophin (eCG) injection and embryos were collected by laparatomy operation Parity and age of the animals were found to have no influence on ovulation points and the number of embryos collected Further work is in progress

3 **Superovulatory response embryo collection and transfer in crossbred cows**
(AR/01 00 03 92/VC/KAU/PG)

No report received during the period

4 **Investigation on the incidence, nature and magnitude of prevalence of infertility conditions among crossbred cattle of Kerala**
(AR/06 00 01 85/VC/KAU)

During the period 1195 cases were reported in the centre for diagnostic and treatment purpose The various forms of infertility conditions noticed were Anoestrum Endometritis Delayed ovulation Repeat breeding Silent oestrum and other miscellaneous gynaecological problems Detailed haemogram of anoestrus animals were carried out for estimation of calcium phosphorus blood glucose and protein and their influence on the condition was studied Addition of mineral supplements improved fertility rate Nonspecific uterine infection constituted one of the major causes for repeat breeding in cows

5 **Phosphorus and trace element status of anoestrus and repeat breeder crossbred cattle**
(AR/06 00 05 92/VC(2)KAU/PG)

No work conducted during the year

6 **Effect of administration of prostaglandin in repeat breeding cows**
(AR/06 00 06 92/VC(2)KAU/PG)

Discontinued

7 **Pathological conditions of ovary and bursa in crossbred cattle**
(AR/06 00 07 92/VC(2)KAU/PG)

The object of the study was to investigate the common pathological conditions affecting the ovaries and bursa of cross bred cattle based on slaughter house specimens Out of 252 non gravid genitalia 139 (55 16 per cent) showed one or more lesions in the ovary and bursa Out of these 36 genitalia had two or more lesions affecting the ovary bursa and ligaments The conditions encountered were inactive ovaries (23 41 per cent) cystic ovaries (2 78 per cent) cystic copra

lutea (2 78 per cent) haemorrhage in the ovaries (5 56 per cent) abscess in the ovary (0 40 per cent) senile atrophy (5 56 per cent) persistent corpus luteum associated with hydrometra (0 79 per cent) retention cysts in the tunica albuginea (0 79 per cent) retention cysts in the tunica albuginea (0 79 per cent) par ovarian cysts (3 17 per cent) and par ovarian abscess (0 40 per cent) Further work is in progress

8 **Structural and functional changes in the testis and epididymis of cross bred bulls with impaired fertility**
(AR/06 00 08 93/VC(2)KAU/PG)

The objective of the study is to investigate the structural and functional changes in the testis and epididymis of cross bred bulls with impaired fertility with the object of suggesting suitable measures for better breeding programme

Clinico andrological examination of six CB bulls are being carried out Semen samples collected periodically are also being evaluated Reproductive organs of bulls with abnormal semen picture were collected after slaughter for histological examination Work is in progress

9 **Management of Oestrous cycle in crossbred cattle using Prostaglandin**
(AR 06 00 09 93/VC(2)KAU/PG)

The object of investigation is to evaluate the efficiency of administration of prostaglandin F2 alpha by single or double injection regimes in the management of oestrous cycle in crossbred cattle and the fertility of fixed time AI at induced oestrus

Material used were 96 heifers and cows which were cycling from the Kerala Agricultural University farms Sixteen he fers and 16 cows in group I were given 25 PGF2 alpha (Lutalyse) I/M when they had functional corpora lutea while in group II 16 heifers and 16 cows were administered two injection of PGF2 alpha 25 mgm each 13 days apart Sixteen heifers and 16 cows were treated as control

Twelve heifers (75 per cent) and 16 cows (100 per cent) in group I and all animals in group II responded to treatment Mean time taken for induction of oestrus was 56 64 and 65 44 h respectively in heifers and cows This difference was significant

Age of cows significantly influenced the time taken for induction of oestrus Duration of oestrus was significantly different between heifers and cows of the experimental group All experimental animals which responded to PGF2 alpha showed marginal increase in physical characteristics of reproductive tract The conception rate of experimental an mals is being studied

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4. Poultry and Ducks

HIGHLIGHTS

- Cage rearing of layer quails was found superior to deep litter system
- Irrespective of housing system employed layer quail requires 200 sq cm floor space per bird
- IWP x IWN strain cross also showed promise for commercial exploitation for egg production

CONCLUDED EXPERIMENT

1 **Effect of floor density on production performance of Japanese quails reared in cages and deep litter**
(PD/12 00 02 91/VC(14)KAU/PG)

An experiment of 45 weeks duration using layer Japanese quails was conducted to evaluate the effect of system of housing on egg production parameters and the effect of different floor densities in these two systems of housing namely, deep litter and cage on egg production and related traits The floor densities studied in cages were 100 150 200 and 250 sq cm per bird and that in deep litter were 150, 200 250 sq cm per bird The performance of laver quails under the two housing systems and the different floor densities under each system is presented in Tables 1 and 2 and the results suggest the following

i) Cage rearing of layer quails was found to be superior to rearing them in deep litter system when performance indicators alone were considered

ii) Among the floor levels tested under the two systems the floor space allowance of 200 and 250 sq cm per bird elicited better response in terms of most of the production traits when compared to other levels studied However the difference between them was not significantly different Therefore it was concluded that irrespective of the housing system layer quails require 200 sq cm per bird for better production

iii) The attempt to work out correlation between part year egg production and annual egg production revealed that egg production from 15th week of age has very high correlation with annual egg production

ONGOING EXPERIMENTS

1 **Project on poultry for eggs**
(PD/01 00 01 76/VC(14)ICAR)

The two strains of white leghorns namely IWN and IWP are under continued selection for improving egg production and egg weight During the period under report S14 generation of both strains were raised and tested for their part year production

S13 generation birds of IWN and IWP strains kept for testing production upto 500 days completed the programme

The random birds of IWN IWP and control birds of S14 generation were housed for annual testing

The results indicated positive increment both in egg production and egg weight eventhough the magnitude of improvement in the former was comparatively lower

The strain cross IWN and IWP (Athulya) and its reciprocal also showed improvement in performance The IWP x IWN crosses tended to show that their performance is comparable to IWN x IWP cross As recommended in the workshop of the project attempts are being made to make use of larger population size during selection and extension of testing period

2 Evolving synthetic breed of chicken incorporating desi germplasm - a pilot study
(PD 05 00 01 90/VC(14)KAU)

No work was taken up during the year except maintenance of germplasm already procured and refined

3 Studies on glycogen storage in Japanese quail s
(PD/12 00 01 92/VC/13)KAU/PG)

The work was not taken up since the PG scholar discontinued his studies

4 Nutrient requirements of layer quails
(PD/12 00 02 91/VC(14)/KAU/PG)

The biological studies of establishing dietary energy and protein requirements of layer quails have been completed The data need statistical processing Biological studies on dietary calcium and phosphorus requirements have to be completed The scholar is on leave on medical grounds and hence the work is to be taken up

5 The structure and function of shell gland in Japanese quail under different levels of dietary calcium
(PD/12 00 03 90/VC 14)KAU/PG)

The biological experiment was taken up The length and weight of oviduct of quails fed with different levels of calcium were recorded at 6th, 16th and 24th weeks of age Structural histological and histopathological studies of shell glands at the above ages had been completed Likewise the plasma and shell gland concentration of calcium phosphorous alkaline phosphatase and acid phosphatase were also estimated at the aforesaid ages Egg production and egg shell quality studies were also carried out The data collected are being subjected to statistical analysis for drawing appropriate conclusion Work is in progress

6 Quality evaluation of quail meat patties under storage
(PD/12 00-05 93/VC(14)KAU/PC)

Using deboned minced meat from spent layer quail meat patties were prepared The receipe for the meat patties was developed considering and an palate The patties were stored at freezing temperature (-15°C) and at refrigeration temperature (5°C) the patties stored under freezing temperature were withdrawn at 0 15 30 45 and 60 days of storage while those stored under refrigeration temperature was withdrawn at 0 4 and 6 days of storage The samples withdrawn were chemically analysed for proximate principles rancidity and total bacterial count and were also subjected to organoleptic evaluation to study the shelf life of the product The data collected are being subjected to appropriate statistical analysis

7 Evaluation of Australorp with respect to economic traits
PD 12 00 05 93/VC(14)KAU PG)

The experiment was taken up to collect certain unexpected problems in the

Table I Summary of performance of birds reared under different floor densities in cages

	Parame er	Floor Densities				
		100 sq cm bird	150 sq cm bird	200 sq cm/ bird	250 sq cm/ bird	Overall mean
1	Body weight (g)	166 75±8 62	166 08±8 99	171 05±9 46	171 32±9 3	168 80±4 38
2	Age at first egg (days)	57 00±2 09	55 50±1 71	56 75±1 80	60 50±2 66	57 44±1 05
3	Age at 10 per cent production (days)	60 25±2 56	69 50±7 73	56 75±1 80	60 50±1 80	61 75±2 30
4	Age at 50 per cent production (days)	99 00±8 38	89 75±14 59	82 75±6 61	83 50±5 55	88 75±4 55
5	Per cent egg product on	44 27±7 10	41 64±7 16	51 03±6 78	48 56±7 18	46 71±3 37
6	Mean daily feed consumption bird (g)	22 81±0 56	22 93±0 65	23 42±0 68	23 87±0 58	23 24±0 32
7	Feed eff c ency (kg feed per dozen eggs)	1 25±0 63	1 23±0 53	0 96±0 44	1 84±1 25	1 32±0 38
8	Livab lity (%)	96 22±1 70	97 01±0 91	97 78±0 97	97 91±0 74	97 23±0 56
9	Mean egg weight (g)	10 40±0 22	10 90±0 18	10 58±0 21	10 58±0 16	10 61±0 09
10	Shape I ndex	78 79±0 40	78 96±0 28	78 94±0 34	78 85±0 25	78 89±0 15
11	Albumen Index	0 098±0 005	0 099±0 003	0 101±0 004	0 098±0 004	0 100±0 002
12	Yolk ndex	0 474±0 005	0 474±0 005	0 471±0 007	0 486±0 007	0 477±0 0005
13	Shell thickness (mm)	0 227±0 004	0 224±0 004	0 218±0 001	0 226±0 006	0 224±0 002
14	Haugh unit	53 18±2 18	51 42±1 33	53 12±1 58	52 67±1 71	52 64±0 82
15	Return over feed cost bird n 315 days (Rs)	9 11	4 94	16 32	11 66	
16	Return over feed cost b rd unit floor space (sq cm) in 315 days (Rs)	0 09	0 05	0 16	0 12	

Table 2 Summary of performance of birds reared under different floor densities in deep litter

	Parameter	Floor Densities			
		150 sq cm/ bird	200 sq cm/ bird	250 sq cm/ bird	Overall±SE mean
1	Body weight (g)	165 10±8 83	167 48±9 05	170 67±9 93	167 79±5 18
2	Age at first egg (days)	64 25±3 82	61 25±4 03	85 50±5 25	70 33±3 84
3	Age at 10 per cent production (days)	73 50±4 57	61 25±4 03	85 00±5 25	73 42±3 85
4	Age at 50 per cent production (days)	103 50±9 91	107 00±5 99	100 75±0 85	103 75±3 59
5	Per cent egg production	35 87±6 56	39 64±7 10	41 19±8 06	38 90±4 25
6	Mean daily feed consumption/bird (g)	23 05±0 67	23 39±0 75	23 71±0 71	23 38±0 40
7	Feed efficiency (kg feed per dozen eggs)	1 80±1 02	1 35±0 59	1 44±0 65	1 34±0 41
8	Livability (%)	96 37±1 30	97 05±1 18	97 92±1 17	97 26±0 69
9	Mean egg weight (g)	10 15±0 21	10 18±0 15	10 22±0 17	10 19±0 11
10	Shape Index	79 19±0 60	79 12±0 46	78 25±0 34	78 85±0 28
11	Albumen Index	0 107±0 005	0 103±0 002	0 099±0 003	0 103±0 002
12	Yolk Index	0 487±0 009	0 479±0 012	0 486±0 006	0 449±0 0005
13	Shell thickness (mm)	0 220±0 004	0 222±0 004	0 220±0 004	0 221±0 008
14	Haugh unit	55 01 ±1 79	55 01 ±0 87	53 19 ±1 13	54 19 ±0 77
15	Return over feed cost/ bird in 315 days (Rs)	2 01	2 05	3 33	
16	Return over feed cost/ bird/unit floor space (sq cm) in 315 days (Rs)	-0 02	0 02	0 03	

Table 3 IWN strain Layer production parameters of different weight classes

	Weight group (g)	20 wk Bw (g)	40 wk Bw (g)	ASM (days)	Egg No 40 wk (HDN)	Egg wt 32 wk (g)	Egg wt 40 wk (g)
1	900 1000						
2	1001 1100	1070 9±3	1392 2±20	163 6±1	82 4±1 5	51 6±0 3	52 3±0 3
3	1101 1200	1162 0±4	1467 7±8	161 2±0 6	84 6±1 2	51 9±0 2	52 8±0 2
4	1201 1300	1256 2±2	1502 7±10	154 6±0 5	90 3±0 9	51 9±0 2	52 9±0 2
5	1301 1400	1350 8±2	1540 3±9	150 2±0 5	96 4±0 9	51 8±0 2	53 4±0 2
6	1401 1500	1450 2±2	1617 8±10	147 8±0 6	99 1±1 2	51 9±0 2	53 3±0 2
7	> 1500	1555 1±4	1731 8±32	146 5±1	101 4±2 2	52 2±0 4	54 1±0 4
Overall mean		1302 2±3	1531 3±2	153 5±0 3	92 6±0 5	51 9±0 1	53 1±0 2

Table 4 IWP strain Layer production parameters of different weight classes

	Weight group (g)	20 wk Bw (g)	40 wk Bw (g)	ASM (days)	Egg No 40 wk (HDN)	Egg wt 32 wk (g)	Egg wt 40 wk (g)
1	900 1000					5	
2	1001 1100	1078 4±4	1425 3±9	164±0 3	74 7±5	49 3±0 5	50 7±0 6
3	1101 1200	1150 0±4	1461 3±11	157 2±1	88 8±1 8	50 1±0 2	51 5±0 2
4	1201 1300	1256 2±2	1517 6±8	153 3±0 7	93 4±1 1	50 6±0 2	51 6±0 2
5	1301 1400	1350 8±2	1564 2±8	146 3±0 6	98 1±1 1	50 4±0 2	52 1±0 2
6	1401 1500	1450 2±2	1620 9±10	143 9±0 5	100 1±1 2	51 0±0 2	52 6±0 2
7	> 1500	1581 2±4	1740 2±15	141 4±0 7	98 8±1 9	51 5±0 3	53 1±0 3
Overall mean		1335 8±4	1562 7±5	148 7±0 4	95 5±0 6	50 6±0 1	52 1±0 9

experimental flock Therefore the project was dropped

8 Influence of pullet body weight on production traits in white leghorn
(PD 01 00 01 93 VC(14) KAU/PG)

The objective of this work was to study the magnitude of variation in pullet body weight in white leghorns and to evaluate the influence of pullet body weight on layer production trait in order to suggest the optimum pullet body weight for efficient production performance

The study was carried out in two strains of white leghorn viz IWN and IWP strains maintained at All India Co ordinated Research Project on Poultry Breeding Mannuthy Individual body weight of 1227 birds of IWN strain and 1316 birds of IWP strains were recorded at 20 weeks of age to the nearest 10 g and the birds were housed in single bird cages Based on 20 week body weight the pullets were classified into seven groups group 1 ranging from 900 to 1000 g and group 7 consisted of birds weighing more than 1500 g each group differing by 100 g in body weight

The main items of observations recorded during the course of study (from 21 to 40 weeks of age) were

1 Body weight at 20 weeks of age
2 Age at first egg
3 Hen housed number and per cent
4 Egg weight at 32 and 40 weeks of age
5 Egg quality traits at 40 weeks of age
6 Livability
7 Meteorological observation inside the experimental house
8 Body weight at 40 weeks of age

The preliminary results obtained are set out in Tables 1 and 2 for IWN and IWP strains respectively It shows that as the pullet body weight (body weight at 20 weeks) increases the egg number also increases in both IWN and IWP strains The egg weight also shows a marginal increase The age at sexual maturity decreases in the higher pullet weight classes Forty weeks body weight also shows an increasing trend but the quantum was lesser when compared to increase in pullet body weight classes

Though pullet body weight is a character with high genetic control the managemental conditions during the growth phase also influences the trait considerably Therefore in addition to the genetic aspects the managemental conditions such as floor space feeder and water space optimal feeding and timely health care measures should be meticulously followed during the grower phase so as to exploit the full layer production potential in these two strains The work is in progress

9 Post-natal development of the oviduct in the Japanese quail (*Coturnix coturnix japonica*)
(PD/12 00 06 93/VC(14)KAU/PG)

Collection of material has been completed In all 72 birds were used for the investigation Gross observations including biometry and topography of the oviduct have been recorded The growth pattern showed a positive correlation to body weight and age of the birds The tissue processing for the microscopic study is in progress

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5. Animal Products Technology

HIGHLIGHTS

- The bacterial load on the meat surface was significantly lowered by treatment with lactic acids the effect of which was directly proportional to the concentration and inversely proportional to the duration of storage
- Electrical stimulation of carcasses immediately after slaughter enhances beef quality
- *Yersinia pseudo tuberculosis* was isolated from buccal cavity and tonsils of pigs

CONCLUDED EXPERIMENTS

1 Identification of bacterial critical points and antibacterial effect of actic acid on beef carcass

(PT/07 00 02 92/VC(18)/KAU/PG)

The aim of the investigation was to identify the bacterial critical points on beef carcass surfaces and also to assess and compare the sanitizing effect of lactic acid solutions at room temperature and at 70°C Carcasses from University and Municipal slaughter houses were utilised for identification of bacterial critical points Evaluation of total viable count (TVC) was made on six different sites on each carcasses The TVC observed on carcasses from University slaughter house was lower than Municipal slaughter house which could probably be due to the availability of improved infrastructural facilities and practices at University Similarly the highest count of TVC was observed at the neck lateral region than at the other five regions This could be attributed to the frequent handling of the exposed area of the neck at the time of slaughter and later The results of the study indicate that for identification of bacterial critical points to evaluate the sanitary standard of beef carcasses neck flate at fore limb lateral hind limb lateral and forerriblateral are suitable as they are found to be highly contaminated sites

Use of lactic acid solution at 1 per cent level as a sanitizer for beef was found to produce highly significant effect in bacterial reduction When the temperature of the lactic acid solution was elevated to 70°C added sanitizing effect was observed It was concluded that washing beef carcasses with one per cent lactic acid solution preferably at 70°C will help in reducing initial bacterial load and thus extend the period of storage in retail market meat

2 Occurrence and survivability of yersinia in pork

(PT/07 00 03 92/VC(18)KAU/PG)

The occurrence of Yersinia species in pigs and also its survivability in pork during chilled and frozen storage was studied Biomaterials collected from University slaughter house and Municipal slaughter house Trichur were utilised for isolation of yersinia

Yersinia pseudo tuberculosis could be isolated from three out of 171 samples screened from 39 animals Two isolates were obtained from the buccal cavity and tonsil of the same animal and the third from the tonsil of another animal Cold enrichment was found to be effective in isolating the organism when direct plating was not possible from the same sample The study indicated that healthy pigs

harboured *Y pseudo tuberculosis* In a survivability study of the organism it was observed that the organism survived upto 7 days in pork at 4°C At 15°C organism could be recovered upto 30 days after inoculation by direct plating It was recovered on the 60th day after resuscitation Study highlighted the importance of resuscitation for isolation of yersinia from frozen meat to assess consumer risk during quality control

3 Effect of acetic acid and propionic acid on bacteriological quality of beef
(PT/07 00 04 92/VC(18)KAU/PG)

The results of the study indicate that treatment of beef immediately after slaughter with acetic acid and propionic acid at 1 per cent and 2 per cent levels have significant sanitizing effect by their bactericidal and bacteriostatic effect for storage of meat for about 9 hrs at ambient temperature The effect was found directly proportional to the strength of the acid and inversely proportional to the duration of storage The bacterial load could generally be maintained upto 5 hrs with 1 per cent acetic acid and upto 9 hrs with 2 per cent acetic acid within the initial bacterial count Propionic acid was found to be superior to propionic acid for sanitation of carcasses

4 Effect of electrical stimulation on beef quality
(PT/07 00 05 92/VC KAU/PG)

The study indicates that electrical stimultion of carcasses immediately after slaughter enhances meat quality with respect to pH changes NPN value TVC and organoleptic characters and therefore can be adopted as one of the methods to improve the tenderness and keeping qualities at ambient temperature atleast for eight hours

ONGOING EXPERIMENTS

1 Differentiation of meat by serological methods
(PT/03 00 01 90/VC KAU)

The procedure for producing antibeef sera in rabbits has been standardised The specificity of antisera is being improved and the work is in progress

2 Physico-chemical quality of buffalo meat under refrigeration
(PT/07 00 06 93/VC KAU/PG)

No report has been received during the period

3 Technological evaluation of Keraice cream
(PT/09 00 03 92/VC(5)KAU/PG)

Studies were conducted with Kera cream with different levels of fat substitution Different flavours and stabilizers were also tried for consumer acceptance Experimental rats were fed with Kera cream and the levels of serum cholesterol and triglyceride were estimated Protein efficiency ratio feed efficiency and estimation of energy value are also being carried out Work is in progress

4 Preparation of Mozzarela cheese using skim milk filled with coconut milk
(PT/09 00 04 92/VC(5)KAU/PG)

Trials are being conducted in the preparation of Mozzarella cheese with cow milk in which fat is replaced with coconut milk fat The quality of the by product whey for the preparation of drinks is being tried The work is in progress

5 Effect of incorporation of condensed cheese whey and *Bifidobacterium bifidum* in Yogurt
(PT/10 00 03 92/VC(5)KAU/PG)

Work has been completed and the data are being subjected to statistical analysis

6 *Lactobacillus acidophilus* as a dietary adjunct in *dahi* and yogurt
(PT/10 00 04 93/VC(5)KAU/PG)

The effect of feeding yogurt and dahi in rats is being studied Serum cholesterol and triglyceride levels are being estimated Work is in progress

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6. Swine, Elephant & other species

HIGHLIGHTS

- Weight at weaning had significant effect on puberty
- Heavy weaners on high plane of diet are most efficient in feed conversion economy and early age at puberty
- Addition of chitin in the ration of pigs helped in growth promoting and had hypolipidimic and hypocholesterolemic effect
- Oxyclozanide was found effective against amphistomiasis in elephants

CONCLUDED EXPERIMENTS

1 **Effect of season of birth and energy levels of feed on production performance of pigs**
(SE/01 00 01 88 VC(7)KAU)

Thirty two weaner pigs of large white yorkshire breed born in two seasons were distributed under two dietary treatments All the animals were slaughtered on attaining the target weight of 90 kg Animals born in season II were superior to animals born in season I in all parameters like growth rate feed efficiency average daily gain and carcass characteristics

The energy level in the ration had a moderate influence on the performance of growe pigs Animals on NRC level of feed were found to be better than animals on 15 per cent less than NRC levels in all the characteristics except for fat The overall results obtained indicated that unit cost of production is less for animals maintained in NRC level of ration Animals born in season I were better than in season II in production performance

2 **Effect of weight at weaning and plane of feeding on the onset of puberty of pigs**
(SE/02 00 04 92/VC(7)KAU)

Thirty six large white yorkshire weaning females of 8 kg were randomly maintained on three different planes of feeding with respect to crude protein and digestible energy viz (i) NRC recommended level as control (ii) high plane of 10 per cent increase of CP and DE than NRC and (iii) a low plane of 10 per cent decrease of CP and DE with respect to NRC from weaning to puberty The heavy weaners were having better growth rate daily gain higher feed intake and attained puberty earlier but the feed conversion efficiency was lower Heavy weaners on high plane attained puberty earlier than animals in NRC or low plane diet In both heavy and light weaners LP group attained puberty later than the other groups Plane of feeding had no significant effect on puberty attainment oestrous cycle length and duration of pubertal oestrus but weight at weaning had a significant effect on onset of puberty The overall results suggested that heavy weaners on high plane diet are most efficient in feed conversion efficiency economy and attainment of puberty at younger age

3 **Influence of chitin on growth and fatty acid composition in growing pigs**
(SE/06 00 01 91/VC(7)KAU)

The influence of chitin in feed on growth carcass characteristics blood cell count haemoglobin serum cholesterol

triglyceride and fatty acid profile of muscle were carried out in pigs Chitin was fed along with standard ration at levels of 0 5 per cent and 1 per cent for experimental animals

Digestibility of chitin did not differ between the two groups The percentage of digestibility increased from three months to five months of age and thereafter remained constant Chitin fed groups had significantly higher body weight than controls Experimental animals had higher average daily weight than the controls Higher body length heights and girths and higher daily gains also were observed Animals in the chitin fed groups had higher feed efficiency and had higher slaughter weight than nine months of age The dressing percentage was higher in the experimental groups

The haemoglobin concentration total erythrocyte count total leukocyte count and differential leukocyte count did not differ significantly between the groups of pigs The level of serum cholesterol and triglyceride were low in animals fed with 1 per cent chitin

The fatty acid composition of muscle and backfat did not differ between groups

The results revealed that chitin had growth promoting hypolipidimic and hypocholesterolic effect in pigs It also improved the degree of unsaturation in pig meat

4 **Effect of administration of iron in the growth of early weaned pigs**
(SE/07 00 01 91/VC(7)KAU)

No report received

5 **Utilization of elephant energy with enhanced system of efficiency**
(SE/08 00 00 91/VC(13)ICAR)

Project just commenced Report awaited

6 **Enzyme kinetic studies in Indian elephants**
(SE/09 00 01 91/VC/KAU CAR)

Discontinued

ONGOING EXPERIMENTS

1 **Parasitic infestation in Indian elephants**
(SE/05 00 01 85/VC/KAU)

To identify the parasites in captive and wild elephants 61 elephants were screened for various parasitic infestation It was observed that 41 were positive for strongyles 10 for amphistomiasis 2 for tape worms 12 for Bivitellobilharia species and 35 for louse infestation

Oxyclozanide at a dose rate of 3 mg/kg body weight was found to be very effective against cases of amphistomiasis

2 **Influence of age and weight of gilt on breeding performance and feed intake during gestation and suckling period**
(SE/10 01 93/VC/ICAR/PG)

Work has just started Experiment is in progress and the data are being collected

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7. Goat and Rabbit

HIGHLIGHTS

- Synchronisation of oestrum helps in reduction of man power requirements in goats
- Genetic group exerted significant influence on birth weight and litter weight in rabbits
- Local inheritance increased preweaning survivability in crossbred rabbits

CONCLUDED EXPERIMENTS

1 **Management effects of synchronisation of oestrus in goats**
(GR/01 00 03 91/VC/ICAR/PG)

Synchronization of oestrus by two injections of PGF_2 alpha at 11 days interval was carried out in Malabari and their crosses with Alpine and Saanen After the first injection 75 per cent of the does and after the second injection 100 per cent of the does came to heat The interval between the injection and onset of oestrus was 45 93 ± 2 19 hours in the case of first and 48 38 ± 2 06 hours in the case of second injection The conception rate in the control group following matings in first second and third consecutive heats were 75 90 and 95 per cent respectively The conception rate in the synchronised group was 85 per cent Gestation period was significantly longer in the treated group

There was significant reduction in man hour requirement for looking after the does and kids due to oestrus synchronisation

2 ***Genetic body dimensions of Malabari goats and its crosses in Kerala***
(GR/01 00 04 91/VC/ICAR/PG)

Project completed Final report awaited

3 **Comparative performance of pure bred, two bred and three bred crosses of broiler rabbits in humid tropics**
(CR/02 00 01 89/VC/KAU)

The data collected over a period of three years was subjected to detailed analysis Higher birth weight was recorded in Soviet Chinchilla with a mean of 63 2 ± 6 4 gms At four weeks and 12 weeks Newzealand white had the highest body weight The lowest body weight was in Soviet Chinchilla x local type At 24 weeks and 28 weeks highest body weight was observed in Soviet Chinchilla x Newzealand white Genetic groups exerted significant effect on body weight at all ages

Gestation length was shortest in Newzealand white x local with 31 83 ± 0 63 days The longest was recorded in Soviet Chinchilla x local group with a mean of 33 13 ± 0 12 days The genetic group exerted no influence on the gestation length

Litter size at birth was highest in Soviet Chinchilla x local group with 7 1 ± 1 03 and lowest in local x Newzealand white with 4 9 ± 2 63 Litter size was not influenced by genetic group

Litter weight at birth was heaviest in New Zealand white x Soviet Chinchilla and lowest in Soviet Chinchilla x local Genetic group had a highly significant effect on litter weight at birth

At weaning litter size of local x Soviet Chinchilla was highest followed by pure local and pure New zealand white respectively The lowest litter size was

seen in Soviet Chinchilla x New Zealand white Genetic groups had no significant effect on the litter size at weaning

At weaning Soviet Chinchilla x New zealand white had heaviest litter weight followed by New Zealand white x local Lowest litter weight at weaning was recorded for local type The effect of genetic groups on the litter weight at weaning was not significant

Highest pre weaning survivability was recorded for local rabbits (82 25 per cent) The lowest survivability was seen in Soviet Chinchilla x New Zealand white with 43 5 per cent The local inheritance increased the pre weaning survivability rates

Highest dressing percentage without pluck was seen in local group with 49 68 per cent followed by local x Soviet Chinchilla type with 46 92 per cent The lowest dressing percentage was seen in Soviet Chinchilla group with 41 69 per cent

Biochemical polymorphism of transferrin post transferrin and haemoglobin were studied in local New Zealand white and Soviet Chinchilla Two alleles namely Tf A and Tf C contributing to two phenotypes namely Tf AA and Tf AC were observed The post transferrin alleles Ptf "F and Ptf S" contributing to three phenotypes Ptf FF Ptf FS and Ptd SS were observed Haemoglobin polymorphism was not observed in rabbits

4 **Genetic analysis of body weight and litter traits of pure bred rabbits**
GR/02 00 02 91/VC/KAU PG

An experiment was conducted to study the body weights till slaughter and certain litter traits and inheritance of these traits in three breeds of rabbits viz grey Giant Soviet Chinchilla and New Zealand white

The mean body weight was highest in Soviet Chincnilla than the other two The effect of sex on the body weight of rabbit was not significant in all the three breeds The sire and dam also affected the body weight at each stage in all the three breeds

The phenotypic correlation between the body weight at different ages was positive generally high and tend to decrease as differences between ages increased

Effect of the breed was not significant on gestation length Litter size at birth and at weaning were significantly affected by the breed Soviet Chinchilla had the lowest litter size at birth and at weaning Maximum pre weaning mortality was seen in Soviet Chinchilla Mean litter weight at weaning was highest in Soviet Chinchilla

ONGOING EXPERIMENTS

1 **Genetic studies on the immune response of broiler rabbits**
(GR/02 00 03 ?? VC(3)KAU PG)

Humoral immune status by way of serum immunoglobulin ... and antibody ... to bovine red blood ... has been assessed in 1 0 breeding ... rabbits The cell mediated immune response by way of contact sensitivity to Dinitrochlorobenzene (DNCB) and Phyto h... (PHAM) has been ... 5 broiler rabbits in ... genetic groups ... and ... of the ... being ... litter size ... and their association with these traits have been compiled The data are being analysed

2 **A survey on chromosomal abnormalities in goats**
(... 6 00 01 91 VC KAU)

The karyotyping and chromosome analysis of goats were undertaken in Saanen Alpine and their crosses with Malabari The karyotypes of all ... groups revealed ... of autosomes to med... with ... sex ... in female ...

male X chromosome revealed acrocentric morphology in metaphase. Y chromosome contributed more than 5 per cent of the total complement length in all the breeds studied and Y chromosome was the shortest in all males with repeat breeding. Karyotype could not reveal any chromosome abnormality.

3 **Socio economic aspects of goat production in different farm holdings**
(GR/07 00 01 92 PIL(3)KAU)

The object was to identify constraints as perceived by goat farmers and thereby to help technologies for efficient management of Malabari goats. The work will be initiated during the next year.

4 **Conservation and evaluation of *Malabari* breed of goats**
(GR/08 00 01 92/PIL(3)KAU)

Malabari goats were found to be highly prolific with 42 per cent single birth, 34 per cent twins and 24 per cent triplets. The percentage of kid mortality was 6 per cent against 30 per cent observed during the previous year. The reason for the reduced mortality rate could be attributed to the wooden platform in the houses provided to kids.

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8. Economics and Extension

EXPERIMENTS IN PROGRESS

Extent of adoption of improved dairy management practices by farmers of Thiruvananthapuram village
(EE/07 00 01 92 vC(6)KAU)

Temporarily discontinued

PART III

Faculty of Fisheries

Faculty of Fisheries

HIGHLIGHTS

- The protein level in the diet of *Macrobrachium rosenbergii* could be reduced from 35 to 30 per cent without affecting the growth survival and feed efficiency by increasing the carbohydrate level from 20 to 30 per cent

- Lowering the temperature from 30 ± 1°C to 23 ± 1°C and maintiaining a salinity of 25 pot were found effecting in increasing the duration and survival rate of *Penaeus indicus* seed during transport in oxygen packing and in this condition 100 per cent survival could be obtained for a duration of 4 00 to 4 75 hrs at a packing density of 500 post larvae/litre of water

- *Spirulina fusiformis* has been found as an effective substitute for fishmeal in the diet of *Etroplus suratensis*

- De oiled silkworm pupae has been found a nutritionally better substitute for fish meal as an animal protein source in the diet of *Chanos chanos* seed

- A production rate of 808 kg/ha/5 months was achieved from the monoculture of *Macrobrachium rosenbergii* in pokkali field ponds

- From the biculture of *Chanos chanos* and *Mugil cephalus* in ponds at Puduveypu production rates ranging from 1 493 to 1819 kg/ha/year were achieved

- The hormone progesterone injected at 0 2 mg/g body weight of the prawn has proved to be capable of giving an impetus for ovarian development in *Penaeus indicus*

- Infestation of the isopod *Alitropus* sp has been found as one of the serious pest problem in culture fishes in Kuttanad Application of DDVP (100 per cent EC) at different concentrations was partially effective in controlling the parasite

- Application of Povidone Iodine (0 5 per cent w/w available iodine) has been found effective in containing EUS infections in fishes which were moderately ulcerated

- *Macrobrachium equidens* (Dana 1852) and *M equidens* Pillai (Jayachandran, 1989) the two closely related populations of palaemonid prawns in Cochin backwaters were found to possess constant characters of their own and hence they have been separated into two distinct species A thorough taxonomic revision has been made and names for the two species has been proposed as *M equidens* (Dana 1852) and *M sulcatus* (Henderson and Mathai 1910)

- The major determinants of head drooping in prawns were found to be the biochemical composition of the arthroid membrane and the easiness with which the hydrolytic enzyme of the hepatopancreas are released on post mortem handling and processing

1 **Mixed culture of *Lates calcarifer* and *Crassostrea madrasensis* in brackish water ponds**
(F1 Aqua 1 21/87 PGD/KAU)

The objective of the project was to assess the production rate of *L. calcarifer* in brackish water ponds where Tilapia is cultured as a forage fish and to determine the qualitative and quantitative production rate of Tilapia

Repeated experiments showed that Tilapia is an ideal forage fish for *L. calcarifer*. Among the different ratios tried 1:10 and 1:13 respectively of *L. calcarifer* and *O. mossambicus* were found good for attaining better growth and production of both the species at a stocking density of 5 000 nos./ha

2 **Effect of eyestalk ablation on growth and reproduction of *Macrobrachium equidens* (Dana)**
(F1 Aqua 1 21/91 PGD KAU PG)

The project was carried out to study whether eyestalk ablation has any effect on the growth of the prawn and to assess its influence on the ovarian development spawning brood development and spawning

In the experiment conducted in females for a period of 60 days eyestalk ablation was found to enhance ovarian development in terms of the number of spawns per female Fecundity absolute fecundity and incubation period were not significantly affected although a marginal increase in absolute fecundity could be observed

In males it was found that growth rate and cheliped development were significantly better in ablated ones Further contrary to that observed in females there is a significant effect for destalking on growth in males

3 **Culture of *Spirulina fusiformis* and its evaluation as a protein source in the diet of *Etroplus suratensis***
(F1 Aqua 2/89 PGD KAU/PG)

The objective of the experiment was mass culture of *S. fusiformis* and to evaluate its utility as a dietary protein source for *Etroplus suratensis*

From the culture done in five different media Zarrouk medium CFTRI medium with procaine improved CFTRI medium and rural waste medium it was found that Zarrouk medium is the best followed by CFTRI medium

In the two mass culture media tested the rural waste and sewage better growth was observed in the former

The FCR of *E. suratensis* was found to be significantly influenced by *Spirulina* protein and the best conversion ratio was obtained at 35 per cent protein level *Spirulina* protein also increased the protein digestibility rate the protein efficiency ratio and the productive protein value Experiments showed that fish meal protein in the diet of *E. suratensis* can be replaced upto 50 per cent with *Spirulina* protein

4 **Infestation of crustacean parasites in carps**
(F1 Aqua 1 23/91 PGD KAU PG)

Since the student left the course no work was carried out and subsequently the project has been terminated

5 **Effect of various growth promoters in the diets of *Macrobrachium rosenbergii* post larvae**
(F1 Aqua 1 24/92 PGD KAU/PG)

The objective of the study was to evaluate the growth performance and conversion efficiency of *M. rosenbergii* with selected hormones vitamins and chemicals as growth promoting substances in the diet

and to determine the optimum level of selected substance which show positive response to better growth

Among the various growth promoters tried (thyroxine prazam and oxytetracycline) oxytetracycline showed the best result with a specific growth rate of 2 62 protein efficiency ratio of 0 077 and productive protein value of 13 47 Incorporation of growth promoters in the feed has markedly reduced the feed conversion ratio of the test prawn Lowest FCR was obtained for the post larvae fed with oxytetracycline incorporated diet while the highest was for the control diet the range being 2 94 4 36

The average survival rate during the experiment was 69 5 per cent The prawn fed on oxytetracycline incorporated diet gave the maximum survival of 72 0 per cent

From the experiment conducted in order to find out the optimum rate of oxytetracycline for getting the best result it was found that 10 mg/100 g of feed is the optimum level

6 **Conditions for oxygen - packed transportation of *Penaeus indicus* seed**
(F1 Aqua 1 25/92 PGD KAU/PG)

The purpose of the study was to enhance the survival rate and duration of oxygen packed Penaeus indicus seed in transportation In the experiment conducted in closed type respirometers (136 ml capacity) to study the oxygen consumption rate at varying packing densities (200 300 400 and 500 PL) salinities (20 25 and 30 ppt) and temperatures (30 ± 1°C and 23 ± 2°C) it was found that the least oxygen consumption rate was at 25 ppt Lowering of the temperture from 30 ± 1°C and 23 ± 2°C resulted in reduced oxygen consumption rate With the increase in packing density the oxygen consumption rate decreased probably due to the increased falling rate of ambient oxygen with increase in the number of shrimps per unit volume

In another experiment to study the effect of packing densities salinities and temperatures on the duration and survival of oxygen packed seed during transportation in specially designed hard plastic containers under uniform pressure of oxygen showed that at packing densities of 200 300 400 and 500 PL/l the PL could be transported with 100 per cent survival upto 6 5 8 5 3 2 5 0 2 0 2 5 and 1 25 and 1 5 hr at ambient temperature of 30 ± 1°C respectively With the lowering of temperature from the ambient level of 30 ± 1°C and 23 ± 2°C the safe duration could be increased to 22 0 42 5 8 25 9 0 6 25 6 75 and 4 0 4 75 hr respectively at the above packing densities The major cause of mortality with increase in packing density was observed to be cannibalism

A salinity range of 20 25 ppt gave better survival rates as compared with that of 30 ppt

Experiments were also conducted to study the effect of introducing inert habitat materials in the packing medium on the duration and survival of oxygen packed seed with hollow transluscent plastic straw (10 15 mm bits) in the ratio 1 2 (bit PL) in specially designed containers of 600 ml capacity under uniform oxygen pressure at ambient temperature of 30 ± 1°C and salinity of 25 ppt Observations showed that incorporation of habitat did not significantly alter the safe duration of transport in the various packing densities However this resulted in longer duration at the later period of transportation in higher density packings of 400 and 500 PL/l

7 **Evaluation of different protein sources in the formulated feed for *Macrobrachium rosenbergii***
(F1 Aqua 1 26 92 PGD KAU/PG)

The aim of the project was to find out the best protein source in the feed for the juveniles of *M rosenbergii* taking into consideration the availability acceptability

and economics and to work out the optimum protein starch ratio in the feed using the selected source of protein

Among the five protein sources tried clam meat prawn head waste squid waste squilla meat and silk worm pupae clam meat was found to be the ideal one From the experiment conducted to evaluate the best protein carbohydrate ratio in the diet of *M rosenbergii* juveniles using protein levels of 35 30 and 25 per cent and carbohydrate levels of 20, 25 and 30 per cent it was found that lowering the protein level from 35 to 30 per cent could be achieved by increasing the carbohydrate level from 20 to 30 per cent without affecting the growth survival and feed efficiency

8 **Adaptive trials on culture of *Clarius batrachus* in brick field ponds of Thrissur district**
(F1 Aqua 1 42/92 MNY KAU)

No work could be carried out under the project due to lack of manpower and infrastructure facilities and hence it was terminated

9 **Comparative study on certain aspects of the biology of *Macrobrachium equidens* (Dana, 1852) and *M equidens* Pillai (Jayachandra, 1989)**
(F2 FB 1 05/91 PGD KAU/PG)

The study was aimed at establishing the taxonomic status of two closely related populations of palaemonid prawns in the Cochin backwaters and also to study their general biology Detailed investigations on the morphological morphometric meristic length weight relationship electrophoresis and oogenesis were carried out The study established that each population possesses constant characters of its own and hence they are separated into two distinct species The oogenetic pattern in the two species are entirely different In the light of the observations a thorough taxonomic revision has been made and proposed names for the two species as *M equidens* (Dana, 1852) and *M sulcatus* (Henderson and Mathai 1910)

10 **Effect of certain pesticides on the developmental biology of a Cichlid *E suratensis* (Bloch)**
(F2 FB 1 07/93 PGD KAU/PG)

As the student has left the course no work was carried out and subsequently the project has been terminated

11 **Studies on depuration of edible oyster *Crassostrea madrasensis***
(F4 PT 1 05/90 PGD KAU/PG)

Since the student has left the course no work was carried out and the project has since been dropped

12 **Investigations on head drooping in head-on processed prawns**
(F4 PT 1 07/92 PGD KAU PG)

Studies on *Penaeus indicus* and *P monodon* showed that the major determinants of head drooping in prawns are the biochemical composition of the arthrodial membrane and the easiness with which the hydrolytic enzymes of the hepatopancreas are released on post mortem handling and processing

13 **Investigations on the effect of purging the freshwater prawn *Macrobrachium rosenbergii* in extending its ice storage life**
(F4 PT 1 98/92 PGD KAU/PG)

M rosenbergii collected from culture ponds and maintained in large FRP tanks with mud at the bottom and with constant aeration were used for the study For purging 50 per cent of the prawns were kept in large cylindroconical FRP tanks for 15 hrs with constant aeration and continuous flow of freshwater 50 per cent of the purged animals were dipped in 1 ppm chlorinated water for 1 hr and then stored in 1 1 ice Analysis of stored samples taken at 0 3 5 8 and 9th day intervals for AAN TVB NPN acid soluble ash TPC and sensory evaluation showed that the prawns purged in running water were better than the chlorine dipped and unpurged samples

EXPERIMENTS IN PROGRESS

1 Development of brood stock and hatchery production of *Lates calcarifer*
(F1 Aqua 1 14/89 PVP KAU)

Specimens maintained as brood stock although reached a weight range of 4 5 6 5 kg did not show any indications of advanced gonadal maturity Further the annual growth rate has come down to 145 g at the end of the 4th year against 338 g during the 3rd year

2 Optimisation of factors to maximise prawn production
(F1 Aqua 1 15/89 VYT KAU)

The salinity during the year decreased drastically in the farm ponds making it unsuitable for prawn culture The salinity during the year in the prawn culture season ranged from 2 9 to 7 9 ppt only as against 9 90 to 14 73 ppt in 1992 93 Hence no progress was made under the project

3 Intensive culture of giant freshwater prawn *Macrobrachium rosenbergii* in pokkali field ponds
(F1 Aqua 1 20/90 PGD KAU)

During the year two culture trials were carried out one on monoculture and the other on polyculture with fishes Under monoculture the prawn was stocked @ 30,000/ha In polyculture the prawn was stocked @ 9 500/ha along with fishes @ 3 000/ha in the ratio 1 3 1 1 6 respectively for Catla, Rohu Silver carp Grass carp and Grey mullet Tne size of the prawn at stocking was 16 mm/230 mg in both the cases In monoculture the prawns were fed with pelleted commercial prawn feed daily at an approximate rate of 5 10 per cent of the body weight Dense bloom of the blue green algae *Microcystis* developed in the pond was effectively controlled biologically by introducing *Eichhornia* so as to cover about 10 40 per cent of the surface area

In polyculture small quantities of groundnut oil cake and wheat bran were provided as supplementary feed for the fishes daily during the first three months No separate feed was given for the prawns Following the heavy rains in September October the water pH dropped from 7 0 to 5 0 due to the leaching of the acids from the desilted mud kept on the bunds into the pond Since there was doubt about the survival of the prawn and fishes due to the sharp drop in pH no further supplementary feeding was given

In monoculture harvesting was done after 5 months and a production rate of 808 kg/ha/153 days was achieved as per details shown in Table 1 Eighty per cent of the harvested prawns attained a marketable size with a mean weight of 42 0 g and they contributed to 92 per cent of the total production A conversion rate of 3 6 6 0 was obtained for the supplementary feed given The cost of production was Rs 88 20/kg of prawn Supplementary feed accounted for 69 71 per cent of the production cost while cost of seed accounted for 21 04 per cent

In polyculture harvesting was done after 158 days and the prawn production rate was 125 5 kg/ha/158 days with a retrieval rate of 53 58 per cent and a final average weight of 24 66 g per piece Of the harvested prawns 46 per cent showed an average weight of 34 6 g forming 64 5 per cent of the catch by weight Among the fishes the carps were almost completely lost most probably due to the drastic drop in pH *Mugil cephalus* on the other hand showed a retrieval rate of 45 43 per cent although the growth was poor (average weight 150 g) The total fish production amounted to only 132 kg/ha/158 days A noteworthy observation from this was that while the carps could not withstand the acidic conditions the prawn apparently did not show much difficulty in withstanding the same

Table 1 Production details of *M rosenbergi* in monoculture

Pond area	1700 m²
Rearing period	150 days
	6.8.93 to 5.1.94
Stocking rate	5100 nos (3000/ha)
Initial size	16 to 2 g
Size at harvest	0 g (av. 36.69 g
Survival	3745 nos to 73.43%
Production	137.40 kg
Production rate	808.24 kg/ha/153 days

4 **Selective breeding of gold fish *Carassius auratus* and breeding and rearing of a few selected ornamental fishes**
(F1 Aqua 1.27/92 PGD KAU)

Selective breeding trial conducted with single tail brass coloured male and fan tail red colored female gold fish showed the following characteristics in the progeny 3 months after hatching 23.5 per cent showed both the male parent characteristics (single tail and brass color) and 19.43 per cent showed both the female parent characteristic (fan tail and red color) while 57.05 per cent showed mixed characters of the parents

As for color brass color with 67.69 per cent showed its dominance over red color and among the tail characteristics fan tail with 63.60 per cent was dominant Furtner studies are in progress

5 **Grow out of giant freshwater prawn *Macrobrachium rosenbergii* alone and along with fishes**
(F1 Aqua 1.30.92 PGD KAU)

An experiment on polyculture of *Macrobrachium* and carps (grass carp silver carp rohu and mrigal) was started in October 1993 at a stocking density of 25 000/ha at 4:1 ratio Assessment of growth conducted after 3 months showed that while the growth of carps was satisfactory the growth of prawn was very low each prawn 12 g

6 **Culture of the pearl spot *Etroplus suratensis* in homestead ponds**
(F1 Aqua 1.3.92 PGD KAU)

Pearlspot was cultivated in two ponds of 80 m² and 105 m² at a density of 5000/ha Since the water level went down in the ponds the fish was harvested after about 7 months In pond the fish grew to only 8.8 g while in pond it reached 73.5 g

7 **Standardization of oxygen packing and transporting procedure of *Macrobrachium rosenbergii* seed**
(F1 Aqua 1.32.92 PGD KAU)

While part of the technical programme was carried out the rest could not be undertaken for want of the required number of the seed of the required size and of a single broodstock

8 **Induced maturation and spawning of penaeid prawns for commercial larval production**
(F1 Aqua 1.33/92 PGD DFK)

Since the project leader was away on deputation not much work was carried out under the project However some preliminary testing of the effect of inducing agents was done and it was found that progesterone was capable of giving an impetus for ovarian development in *Penaeus indicus*

9 **Intensive culture of fish in brackishwater ponds**
(F1 Aqua 1.34/92 VYT KAU)

Three culture trials one on polyculture of milk fish stripped mullet and carp in the ratio 3:6:1 second on biculture of milk fish and carp in 1:4 ratio and the third on monoculture of pearl spot are in progress In all the three stocking was done @ 5000/ha

Wide fluctuations in salinity showed adverse effect on the development of phytoplankton either specific to low saline or high saline requirement Combined with this the shallow nature of ponds (0 4 0 6 m) affected growth rate of fishes The experiment is in progress

10 **Production techniques for seed of pearlspot *Etroplus suratensis***
(F1 Aqua 1 35 92 PVP KAU)

For increasing the production of seed selected number of brood fishes are being reared in separate ponds Based on the quantum of production from the different stocking densities the optimum density can be identified based on which the production from unit area can be increased

11 **Studies on the effect of turbidity on growth and production of brackishwater fishes**
(F1 Aqua 1 36/92 PVP KAU)

In order to study the effect of turbidity on growth and production of fishes an experiment was carried out on the biculture of *Chanos chanos* and *Mugil cephalus* in three ponds at Puduveypu In pond 1 no tidal water exchange was allowed and manuring and feeding were alone In pond 2 frequent tidal water exchange was allowed in additional to manuring and feeding In pond 3 frequent tidal water exchange was allowed out without feeding and manuring The production rates obtained from ponds 1 2 and 3 were respectively 1819 1781 and 1493 kg/ha/year

Results showed that there was some correlation between fish production and sediment load since the maximum turbidity was found in pond 3 with lowest production and the minimum in pond 1 with highest production Growth pattern of *C chanos* was also similar However the excessive turbidity in pond 3 did not adversely affect the growth of *M cephalus*

A second experiment under this is in progress with the two species *C chanos* and *M cephalus*

12 **Studies on the reproductive physiology and induced breeding of grey mullet**
(F1 Aqua 1 37/92 PVP KAU)

External examination of brood fish stock maintained in ponds did not show any appreciable advancement in gonadal maturity and hence breeding trials have not yet been taken up

13 **Fish diseases and their possible relation to aquatic pollution with special reference to Kuttanad Kerala**
(F1 Aqua 1 38 KUM KAU)

The EUS incidence recurrence was noticed for the 3rd consecutive year during June July months in 1993 Although the outbreak was less serious almost 80 per cent of *Channa striatus* was found affected during this season also It was also noticed in other species like *Puntius Heteropneustes Gobius and Mastacembelus* although less acute For the first time during June July large scale mortality of water snakes was noticed in the area No external symptoms such as ulcerations on the body were visible

Detailed studies on the haematology and histopathology of diseased fishes showed that an absolute decline in erythrocyte counts and an abnormal increase in leucocytes were characteristics as observed in the previous years This also indicated large scale proliferation / infiltration of macrophage in the sinusoid spaces and parenchym cells of the liver obviously indicating inflammatory reactions

Screening of a few chemotherapeutic agents against EUS Nacl dip Iodine solution (10 minute dip) Povidone Iodine (0 5 per cent w/w available iodine) application and application of CIFAX an agent reported to be effective by Central Institute of Freshwater Aquaculture carried out revealed that application of povidone iodine was equally effective like CIFAX in containing infections in fishes which were moderately ulcerated For severely ulcerated fishes none of the treatments were effective

Survey conducted indicated that infestation of isopod *Alitropus* sp is one of the serious pest problems in culture fishes in Kuttanad Electron microscopic studies on the isolated parasite and also on the ill lamellae attacked showed that the parasite causes extensive damage to the host gill epithelium and opercular tissues resulting in extensive haemorrhage The affected fish becomes emaciated due to anaemia and eventually succumbs to death No remedy is till known for this

Treatment with 2 5 per cent Nacl solution dip bath in $KMNO_4$ solution at 10 ppm for 2 hrs dip in formalin at 15 25 ppm and application of DDVP (100 per cent EC) at different concentrations showed that only the last treatment was at least partially effective

14 Aquaculture in Karl lands of Kuttanad, selection of species and standardization of culture techniques
(F1 Aqua 1 39/92 KUM KAU)

Studies on fish culture were undertaken at RARS Kumarakom in areas where acid sulphate field conditions existed Liming followed by heavy organic manuring (@ 10 ton/ha of cowdung slurry) and application of urea @ 200 kg/ha and mussoriphos @ 500 kg/ha helped to bring pH to near neutral conditions from the usual range of 4 5 Carps (Catla Rohu Mrigal and Cyprinus) indigenous species *Heteropneustes* and *Anabas scandens* and tilapia were stocked in different combinations in the experimental ponds

By the management practices adopted pond productivity could be enhanced and pH kept at a near neutral regime In summer when water level went down to abnormally low levels resulting in drop of pH to 5 5 mortality of bottom dwelling fish Mrigal occurred But other fishes were not affected

The preliminary results indicate that no single practice is effective in combating acidity in Karl lands and only a combination of practices can be effective The following practices are found useful

1 Application of high dose of farm yard manure combined with liming

2 Maintaining higher water level in the pond than the feeder channels so that seepage water always flow towards outside (Acid ity contributed by the dike soil is more than that from subsurface bottom soil)

3 Maintaining high plankton product vity in the pond by resorting to periodic inorganic fertilizer appl cation

4 Maintaining high dissolved oxygen levels in the pond water either by pumping in water or resorting to artificial aeration

Studies on performance of different species of fishes as to their tolerance of karl land conditions are continued

15 Fish crop-livestock integrated farming system in coconut gardens of the Kuttanad tract
(F1 Aqua 1 40/92 KUM KAU)

No work has been reported under the project during the year

16 Rearing of giant fresh water prawn *Macrobrachium rosenbergii* in freshwater bodies of Kuttanad Kerala
(F1 Aqua 1 41/92 KUM KAU)

No work has been reported under the project during the year

17 Induced maturation of *Penaeus indicus* with exogenous hormones
(F1 Aqua 1 43/93 PGO KAU/PG)

Experiment was conducted to evaluate the effect of progesterone and progesterone combined with Tocopherol on ovarian development of *P indicus* and to arrive at the optimum level of the same to induce full ovarian development The hormones were injected into female prawns above 13 cm length in three different doses (0 05 mg/g 0 1 mg/g and 0 2 mg/g body weight) The results showed that there was not much difference in ovarian development between the different treatments

Analysis of the Gonado Somatic Index of the ovaries showed that the G S I values of Progesterone treated shrimps as 0 2 ug/g body weight and it differed significantly from that of the others

The overall survival rate of the treated prawns were high (87 26 per cent) and there was not much difference between the t eatments From the study it was concluded that progesteron injected at 0 2 mg/g body weight of the shrimp is capable of giving an impetus for ovarian development in *P indicus*

18 Utilisation of silkworm pupae as feed for selected species of brackishwater and freshwater fishes
(F1 Aqua 1 44 93 PGD KAU)

Laboratory experiment conducted with *Chanos chanos* seed with de oiled silkwork pupae based diet with 0 per cent 20 per cent 40 per cent 60 per cent 80 per cent and 100 per cent replacement of fish meal showed that the FCR of the various diets ranged from 9 3 per cent in 0 per cent to 30 18 in 100 per cent replacement of fish meal The survival rate ranged between 83 100 per cent The PER was 0 26 in 0 per cent and 0 76 per cent in 100 per cent replacement of fish meal The percentage of wet weight gain was 150 20 in silk pupae based diet whereas it was only 27 76 per cent in fish meal based diet

The results showed that nutritionally silk worm pupae is a better subst tute for fish meal as an animal protein source in the diet of fishes

19 Intensive culture of fish in running waters
(F1 Aqua 1 45/93 MNY KAU)

The work has not yet been initiated due to the lack of facilities and a proposal has been submitted to ICAR for funding

20 Intensive farming and seed production of monosex tilapia (*Oreochromis mossambicus*)
(F1 Aqua 1 46/93 PVP KAU)

The seed required for conducting the experiment has been collected locally and it is being reared with supplementary feed for attaining the required size for stocking the culture ponds

21 Agricultural cropping pattern suitable for a coconut fish farming system in an accreted wetland
(F1 Aqua 1 47/93 PVP KAU)

The site required for conducting the experiment has been selected and initial land preparation for the experiment started

22 Chromosonal and electrophoretic studies of certain palaemonid prawns of Kerala
(F2 FB 1 06/92 PGD KAU)

Because of the non availability of specimens the work could not yet be carried out

23 Studies on wave refraction along the shore line near Kochi
(F3 FH 1 01/90 PGD KAU)

Computer programme for wave refraction is being finalised Subroutines depth refrac curve and writer have been finalised separately and the subroutines have been combined with the main programme This is to be checked and finalised before running a trial data Then the actual data which is being obtained will be run for obtaining the results

24 Preparation of reagent kits for on the spot assessment of water quality in fish farms
(F3 FH 1 02/93 PGD KAU)

Formulation of reagents and qualitative studies have been carried out Further work is in progress

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PART IV

Faculty of Agricultural Engineering and Technology

Faculty of Agricultural Engineering and Technology

HIGHLIGHTS

- Modifications were carried out on the tractor operated paddy harvester and was successfully demonstrated to farmers with an average field capacity of 0 5 ha/hr
- With improved concave the flow through paddy thresher was found to give maximum threshing and winnowing efficiencies with 1000 1200 kg of cleaned paddy per hour
- A power operated arecanut dehusker was designed and fabricated and found satisfactory
- The best season for paddy cultivation in "Kari" soils of Kuttanad is August to November
- A spacing of 30 m is recommended for laying out sub surface drainage in Kari lands of Kerala to obtain an average grain yield of 4 6 tonnes/ha

CONCLUDED EXPERIMENTS

1 **Hydrological studies on Kuttanad river basin with special reference to Thottappally Spillway and Thanneermukkam Regulator**
(AE/01/00/11/90/TNR'KAU/PG)

The student has discontinued the work of the above project

2 **Studies on the effects of various parameters on the performance of petti and para**
(AE/01/00/05/91/TNR/KAU/PG)

Studies for optimizing the speed of operation and evaluation for the efficiency for the various design of impellers were carried out An optimum pump speed for high level of efficiency at relatively higher head has been found to be 330 340 rpm for a 15 hp petti and para The detailed analysis of the performance curves obtained from the tests with four bladed five bladed and six bladed impellers clearly established that the optimum number of blades in the impeller is five for a 15 hp petti and para

3 **Studies on tractor mounted paddy reaper**
(AE/01/00/08/91/TNR/KAU/PG)

Detailed studies and modifications on the hitching and power transmission system of the newly fabricated 2 2 m wide paddy reaper were carried out Weight transfer studies indicated that the wheels were not affecting the stability The power requirement for various components were also carried out After successful modifications the reaper has the average field capacity of 0 5 ha per hour The crop is neatly harvested without loss of straw and is conveyed and winnowed without any shattering loss of paddy It is established that the tractor operated reaper

is suitable to Kerala which saves an amount of Rs 800 per ...

4 **Design development and testing of a cashewnut decorticator**
(AE 01/00/08 91/TNR/KAU P3)

A manually operated cashewnut decorticator ... designed developed and evaluated The major parts ... top blade assembly 2 ... bottom ... linkage ... fixed on a work table

The steamed cashewnut is placed manually between the top and bottom blades Upon pressing the pedal the top and bottom blades slit the two long sides of the nut The two bottom blades are then opened wide with a cam splitting the shell into two halves The kernel is released from the shell The efficiency in decorticating is 88 per cent while the percentage of the number of kernels damaged is 12 The capacity of the machine is 900 nuts/h The important physical properties of nuts were also studied It is kidney shaped Its mean size is 32 40 mm long 24 60 mm wide and 17 60 mm thick The average kernel size is 26 00 mm long 17 20 mm wide and 12 00 mm thick The average thickness of the shell is 3 20 mm The average weight of the nut is 7 0 g while that of the kernel is 2 1 g Considering its performance the mechanism is sound It is recommended for further studies and modifications

5 **Design, fabrication and testing of an arecanut dehusker**
(AE/01/00/91/TNR/KAU/PG)

A power operated arecanut dehusker was designed developed and its performance evaluated

The major parts are the hopper feeder lead plate cutting blade shearing blade ... plate and ... The ... receives the graded fruit from the hopper and ... The ... is compressed ... the ... lead plate The teeth ... the ... and the kernels are ... out through the slot on the ... plate and the husk is removed A single phase 0 5 hp motor operates the machine

From the studies the optimum set up of the machine for deriving maximum dehusking efficiency and lower percentage of the number of kernels damaged is at a speed of 35 rpm blade angle of 60 degree and slot angle of 140 degree At this set up the machine gives an output of 9 0 kg dried fruit/h with 84 5 per cent dehusking efficiency

6 **Evaluation of drip and conventional method of irrigation in cool season vegetables and to evaluate the water requirement of cool season vegetables**
(AE/01 00/093/AMB/KAU)

Drip irrigation was significantly superior to basin irrigation With half the quantity of water applied in basin method drip method gave superior yield About 41 per cent increase in yield and 180 per cent increase in water use efficiency were noted in drip method IW/CPE ratio of 0 5 was found to be the optimum irrigation schedule for cabbage Water requirement for cabbage was found to be 618 mm

EXPERIMENTS IN PROGRESS

1 **Studies on wick irrigation system for cropping on flat roof terrace**
(AE/01 0 0 91 TNR KAU)

To evaluate the performance of wick irrigation in comparison with drip and conventional irrigation methods on a roof terrace a study was conducted The results obtained from the study are to be analysed Physical observations showed that the crops under wick irrigation system were healthy and water application efficiency was more in this method

2 **Socio-economic feasibility of selected farm implements for rice cultivation**
(AE 01 00/03/02 93 /PTB/KAU)

All the trials were completed during September 1994 The tabulation and analysis of the data are in progress

3 **Evaluation and modifications of power tiller operated paddy reaper**
(AE 0 00 11 93 TNR KAU/PG)

A vertical conveyor reaper winnower with 1 6 m width was mounted on a 10 HP Mitsubishi Power tiller The successful field tests carried at KCAET farm gave a field capacity of 0 4 ha/hr An auxillary gear box was designed and fabricated to transmit power from the rotovator gear Further field trials are in progress

4 **Development of a power tiller operated paddy transplanter for conventional seedlings**
(AE/01 00 01 93/TNR/KAU/PG

The 10 HP air cooled diesel engine mounted power tiller (Mitsubishi Make) was used for research purpose The fabrication of the new unit eight row power tiller operated paddy transplanter was successfully completed The fabricated transplanter was attached to the power tiller at rear side by three point hitch system The transplanter was tested in the laboratory for 10 hours to find out any defects It was observed that the power transmission system was satisfactory So the machine was operated for five hours in the puddled land without any seedlings to find out its feasibility

The paddy transplanter is to be tested with seedlings

5 **Design and fabrication of a rotary type black pepper cleaner**
(AE 01/00/02 94/TNR KAU/PG

According to the objectives of the study an inclined rotating disc is used to study the separating effectiveness in black pepper A disc 90 cm in diameter is made using six cm plywood Top of the disc is covered with mica to reduce the friction The disc is connected to a 35 mm diameter hollow pipe through a flange A suitable bearing is also fixed to the pipe The unit is fixed to an angle iron frame Provisions are made to set the disc at various angles An involute shape scraper is made to scrape out non spherical particles A cylindrical drum having 6 mm diameter hole is fixed over the disc so that particles may fall in a uniform line over the disc A hopper is to be connected to this drum to feed the grain Collecting trays are made for collecting clean pepper and other contaminants A variable speed motor is used to give the drive The testing of the machine at various speed and angle of inclinations have to be undertaken From this data optimum speed and inclination of disc is to be found out for maximum separating effectiveness

6 **Development and evaluation of a low cost power operated paddy thresher cum winnower**
(AE 01/00/03/93 TNR/KAU PG

According to the objectives of the study various components of the machine were designed and fabricated

A loop type threshing drum is fabricated following the I S specifications The length of the drum is fixed as 75 cm and has a diameter of 45 cm at the tip of the wire loop The drum is centered on 25 mm M S shaft A concave is also provided below the threshing drum

The sieve has longitudinal slots of 20 x 4 mm size The length and width of the sieve is 90 cm and 84 cm The sieve is fixed on an angle frame and is hinged below the concave

A blower has been designed and fabricated for winnowing the threshed grains There are two sets of four blades each fixed radially on a single shaft The blades are 11 5 cm wide and 30 cm long The blower casing is made of G I sheet of 22 guage The diameter of the casing is 40 cm The different components fabricated are to be assembled on a frame and the testing of the machine at different speeds and

various crop moisture levels have to be undertaken The test data have to be studied and an equation for power consumption has to be found out

7 **Design and fabrication of a large diameter pit digger for laterite terrain** (AE/01/00/04 93/TNR/KAU/PG)

Field studies on available equipments such as post hole digger laterite stone cutters etc have been done Based on these a design for a large diameter pit digger for laterite terrain has been prepared Fabrication work is in progress

8 **Simulation studies on different design parameters of spurs (groynes)** (AE/01/00/05/93/TNR/PG)

The study is going on as per the technical programme The model has been prepared The readings on the rigid bed condition is over Now the readings of the mobile bed condition is being taken and the analysis of the rigid bed condition is going on

9 **Design fabrication and testing of a low cost green house** (AE/01/00/06 93/TNR/KAU/PG)

A floor area of 36 m^2 with 12 m length and 3 m width was selected The greenhouse was East/West oriented and gable shaped with hoops placed at 1 m interval A ridgeline mechanism was provided to give lateral stability to the structure Ultraviolet stabilised polythene film was spread without wrinkles and held on to the structure

A fan and pad cooling system was designed to suit the cooling requirement Fan and pad were placed opposite to each other on shorter sides The pad was placed on a masonary wall provided with a water return gutter Water was supplied to the pads through two perforated PVC pipes and excess water from the pads was drained

The environmental conditions created in the greenhouse were to be studied The parameters monitored included dry bulb temperature wet bulb temperature and intensity of solar radiation A horizontal temperature variation of 5°C and a vertical temperture difference of 0 5°C was obtained To evaluate the performance of the costing system the system was switched on and off for various time intervals The temperature and humidity variations were noted The temperature inside the greenhouse was lower than the outside temperature while the relative humidity was higher than the outside

10 **Performance evaluation of the sub surface dyke at AMPRS Odakkali** (AE/01/00 07 93/TNR/KAU)

Data on water table fluctuations are being collected from the existing piezometers A still well and a rectangular flume was constructed and water level recorder was installed to measure the surface runoff from the watershed Rainfall is being measured with an automatic rainguage Analysis of surface run off and rainfall is progressing Evapotranspiration has been calculated using Blaney Criddle method

The analysis has shown that the infiltration rates most of the time are higher than the rainfall intensities The average hydraulic conductivity of the laterite formation in this area is about 2 x 10 cm/sec It was also found that the infiltration rates vary with elevation

11 **Energy inflow - outflow in paddy cultivation, as affected by different levels of mechanization** (AE/01/00/10/93/PTB/KAU)

Since the Principal Investigator is relieved from RARS Pattambi no report has been received on this project

12 **Modifications of existing 'petti and para to improve its efficiency and economy (CAPART Scheme)** (AE/01/00/11/91/VKA/CAPART)

The work on hydraulic performance of petti and para was continued at the specially designed and constructed test bed at the KAU Headquarters Vellanikkara During the period under report extensive further studies for optimising the speed of operation were carried out Evaluation was also done for the efficiency for the various designs of the impeller

Characteristic curves were fitted for the three impellers (4 5 and 6 bladed) at selected speeds using the data obtained from the pumping tests The plotted curves of discharge efficiency relationship for the three impellers were second degree in nature and therefore second degree curves were plotted which are of the form

$E = K + K_1Q + K_3Q^2$

The fitted curves of input power discharge and head discharge relationship were of semi logarithmic nature as

$HP = K_1 + K_2L \wedge Q$ and

$L \wedge H = K_1 + K_2Q$

The detailed analysis of the performance curves obtained with four bladed five bladed and six bladed impellers clearly established that the optimum number of blades in the impeller is five for a 15 hp petti and para and the maximum speed of operation is 330 rpm

In all the cases the efficiency of five bladed impeller was maximum and that of the six bladed impeller was minimum

13 AICRP on farm implements and machinery (ICAR)

1 Evaluation of APAU transplanter (FIM/KAU/93 1)

The defects in all the individual components of the transplanter were rectified and the unit with improved auxiliary gear box with oil seal housing and improved tray and picker arm movement mechanisms was field tested successfully with an average field capacity of 0 08 ha/hr

2 Evaluation of self-propelled paddy reaper winnower
(FIM/KAU/93 2)

i) Several improvements were incorporated in the 5 hp self propelled paddy harvester The unit harvested the crop efficiently leaving only 3 to 5 cm stubble conveyed and winnowed neatly when the field was submerged or dry Several field demonstrations were arranged at different places

An improved version of this reaper with modified chasis design efficient balancing adaptability of the chasis and prime mover for other farm operations efficient steering clutches and improved knife guard was fabricated

ii) A power tiller operated 1 8 m width paddy harvester was developed Development of an auxiliary gear box and modification on the cutter bar are in progress

iii) The tractor operated 2 2 m width paddy harvester was field tested Substitution and modification were carried out on crop dividers cutter bar knife guard fixtures conveying hitching lifting and power transmission assemblies

Method of field operation was standardised Power consumption by cutter bar conveyor belt intermediate shaft and gear box with unijoints were studied for optimization

The change in the weight distribution in all the four wheels of the tractor with the front mounted harvester was studied A saving of Rs 800/ha was achieved when compared with conventional harvesting

3 Evaluation of Rasp bar paddy thresher cum-winnower
(FIM/KAU/93 3)

The new concave developed for increasing the threshing efficiency with high moist paddy crop was field tested satisfactorily Several field demonstrations were conducted The average clean grain output was fixed to be 1000 1200 kg/hr with a saving of Rs 900/ha and 150 man hrs/ha

4 Other activities

i) Participated in several exhibitions including the Pooram Exhibition Thrissur Agrifair 93 Tavanur and Sarvodaya Mela Tavanur

ii) Talks on mechanisation of rice farming in Kerala at AIR Calicut and Trichur by Dr M Sivaswami

iii) Attended the Annual Workshop held at HAU Hisar during October 27th and 29th 1993 by Dr M S [illegible]

iv) Participated in [illegible] Congress during [illegible] at Th[illegible] by Dr M Siv[illegible]

v) Seminar on [illegible] paddy [illegible] and [illegible] post hole digger were organised at RARS Pattambi on 16th February 1994 in which more than 300 farmers from all over Kerala attended

14 AICRP on Agricultural Drainage Karumady

1 Title Field studies on sub surface drainage

a) Assessment of hydraulic properties

[illegible]om the data collected since 198[illegible] till date it was informed that the average hydraulic conductivity is 0 231 m/day and the transmissivity is 0 33 m^2/day These values can be used for future large scale adoption of sub surface drainage in this area

b) Assessment of effect on crop production in tile drainage system

There was a significant difference in crop parameters between the sub surface drained area and control where farmers adopted only surface drainage

c) Assessment [illegible] chemical changes in soil and leachate in [illegible] drainage system

[illegible] data obtained during the previous [illegible] gene[illegible] made

[illegible]

[illegible]

i [illegible] Fe C Mg [illegible] K [illegible] lower values during the season under report but [illegible] concentration shows more or less the same value

2 Title Evaluation of drain tube filters

Due to the water fallow which is a normal practice in the region the observations could not be taken during the period under report

3 Title Investigations on the feasibility of wider than so far adopted drain spacings and its economic advantages (AE 01 00 08 93 KDY KAU)

The site comprising an area of 8 ha for the lay out of the experiment has been selected at the farmer s field of Vaiyatnuruthu Padasekharam at Karumadi The survey work has already been made The required materials have been procured for the experiment The tile drains could not be laid as the fields were under water fallow just after the harvest of the crop

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