SEASONAL SUMMARY OF RESEARCH RESULTS

OF

N.A.R.P. PROJECTS

Rabi - 1987-'88

P A R T - I

1. Introduction

The National Agricultural Research Project (NA.R.P.) for the Special Zone covers the problem regions of the state, viz., Onattukara, Kuttanad, Kole and Pokkali areas of Quilon, Alleppey, Kottayam, Ernakulam, Trichur and Malappuram districts. The sub project was sanctioned by I.C.A.R. in the year 1981. It started functioning with effect from 30-11-1981 with Kumarakom as the Regional Research Station and Rice Research Station, Moncompu, Kayamkulam, Vyttila and Kole land Research unit at Mannuthy as the sub centres. The main objective of the project is to find out solutions to the location specific problems in the different agroclimatic regions of the service areas of this region.

Staff pattern - N.A.R.P.

1. R.A.R.S., Kumarakom

Category	Sanctioned strength	Staff in position
A. Scientific staff		
1. Associate Director	Nil	The post of Professor of Agronomy upgraded to the status of Assoc.Director wef 20-7-87.

Category	Sanctioned strength	Staff in position
2.Professor	Nil	-
3.Associate Professors		
a)Agrl.Extension	1	Vacant
b)Agrl.Economics	1	Asst.Prof.officiating
c)Fisheries	1	-do-
d)Agrl.Chemistry	1	Shifted from Moncompu
4.Assistant Professors		
a)Plant Breeding	1	JAP officiating
b)Entomology	1	Vacant
c)Microbiology	1	1
d)Bio-chemistry	1	1
e)Fisheries	1	1
f)Agrl.Engineering	2	1.Vacant-1.
g)Horticulture	2	2
h)Plant Physiology	1	Vacant
i)Weed science	1	1
5.Junior Asst.Professors	Nil	-
B.Administrative and supporting staff		
Administrative Officer	1	1
I Grade Assistants	2	2
I Grade Typist	3	3
Lab.Asst.Gr.III	6	4 - Vacant-2.
Peon (Hr.Gr.)	2	2
Duplicator Operator	1	1
Driver	1	1
Boat Driver	1	Vacant
Sarang	1	Vacant

Category	Sanctioned strength	Staff in position	
Tractor Driver	1	1	
Photographer	1	Vacant	
Artist	1	1	
ii)Rice Research Station, Moncompu			
A.Scientific staff			
Associate Professors			
a)Entomology	1	1	
b)Soil Science & Ag.Chem.	1	1	Upgraded to the cadre of Professor and post shifted to Kumarakom.
Assistant Professors			
a)Extension	1	-	JAP officiating
b)Soil Science	1	1	
c)Plant Pathology	2	1	Vacant-1.
d)Plant Breeding	1	1	JAP officiating
B.Administrative and supporting staff			
Lab.Assistant Gr.III	4	2	Vacant-2.
Boat Driver	1	-	Vacant
Sarang	1	-	Vacant
iii)Rice Research Station, Kayamkulam			
A.Scientific staff			
Assistant Professor			
a)Agrl.Engineering	1	1	
b)Jr.Asst.Professor (Ag.Bot.)	1	1	
B.Administrative and supporting staff : NIL			

Category	Sanctioned strength	Staff in position
iv)Rice Research Station, Vyttila		
A.Scientific staff		
Asst.Professor (S.S.)	1	1
B.Administrative & supporting staff : NIL		
v)Kole lands(Research Station, Mannuthy)		
A.Scientific staff		
Assistant Professor (Agro)	1	1
b.Administrative & supporting staff : NIL		

2.Objective of the Station

The broad objective of the station revolved around the problem oriented and location specific research on major crops after identifying the research gaps in the respective areas with a view to enhance the production potential of the tract. The specific functions of the different research centres are given below:-

Research centre	Lead function	Testing and verification function
(1)	(2)	(3)
R.A.R.S., Kumarakom.	Coconut, Coconut based cropping systems, crop-Livestock-Fishery integrated system.	Rice, Pulses, Oil Seeds, vegetables, tubers and banana.
R.R.S., Moncompu.	Rice	.....

(1)	(2)	(3)
R.R.S., Kayamkulam	Pulses and Oil Seeds	Rice
R.R.S., Vyttila	Rice-Fisheries	Rice
Kole station	Rice	Rice-Fisheries

3.Research requirement of the region

The problems identified for research for the entire region in the last eight NARP Regional workshops conducted since the commencement of the project are listed below.

3.1. Problems identified for the entire region

3.1.1. The coconut Root (wilt) disease.

3.1.2. Management practices on the yield of Root (wilt) affected palms.

3.1.3. Salvinia infestation.

3.1.4. Identification and control of weeds.

3.2. Onattukara region

3.2.1. Evaluation of Tall Photosensitive High Yielding varieties of Rice for 2nd crop season.

3.2.2. Varietal improvement to suit cropping pattern.

3.2.3. Varietal screening of groundnut, castor and vegetables for rice fallows.

3.2.4. Lack of improved varieties of minor tuber crops suitable for the region.

3.2.5. (a)Absence of high yielding, saline resistant variety suited to the orumundakan areas of the region.

(b)Identification of rice varieties having dormancy.

Crop Management

3.2.6. Standardisation of economic weed control for dry sown paddy and for garden lands.

3.2.7. Standardisation of the different water management technique.

3.2.8. Water table fluctuations and its effect on crops.

3.2.9. Possibilities of conservation irrigation.

3.2.10. Intensification of Research on the manurial aspects (method, time and form of fertilizers) in relation to moisture conditions for the dry sown 1st crop of paddy.

3.2.11. Drainage in relation to crop production.

3.2.12. Reasons for the non-adoption of HYV of rice by the farmers during the second crop season.

3.2.13. Method of application of azolla and its utilisation for the succeeding crops for improving the organic matter status of the region.

3.2.14. Comparison of complex fertilizers and straight fertilizers on sandy soil.

3.2.15. Organic recycling.

3.2.16. Split application of fertilizers for paddy.

3.2.17. Effect of age of seedling on the nutrient uptake from soil.

3.2.18. Iron toxicity in soils.

3.2.19. Changes in cropping pattern and scope for mixed and relay cropping in garden and wet lands.

3.2.20. Standardisation of fertilizer schedule on the basis of new categorisation of nutrient status of soils.

3.2.21. Effect of sea water irrigation for coconut gardens in sandy soils.

3.2.22. Abnormalities noticed in paddy crop due to the application of 2,4-D.

3.2.23. Fertilizer recommendation for cheradi variety of rice.

3.2.24. Water management on sesamum.

3.2.25. Recommendation for fertilizers and pesticide application to vegetables.

3.2.26. Application of sodium chloride to coconut.

3.2.27. Suitable post harvest technology to avoid the germination loss of paddy during harvest time.

3.2.28. Low cost technology for sowing paddy seeds in Onattukara region.

Crop Protection

3.2.29. Standardisation of preventive and curative measures.

3.2.30. (a) Control of stackburn disease of rice.
(b) Control of the weed striga using herbicides.

Social Science

3.2.31. To work out the economics of different crops grown in rice fallows.

3.3. Kuttanad region

3.3.1. Varietal improvement of vegetables for summer fallows.

3.3.2. Varietal improvement for B.P.H. resistance.

3.3.3. Varietal improvement for short duration tapioca varieties and their fertilizer recommendations for Kuttanad conditions.

3.3.4. Evolution of sheath blight tolerent variety of rice for Kuttanad.

3.3.5. Breeding rice varieties with dwarf nature and tolerance to salinity and alkalinity for the kari soils of Kuttanad.

3.3.6. Lack of varieties suited for Kootumundakan areas of Kuttanad.

3.3.7. Absence of H.Y.V. of rice suited for mundakan season.

3.3.8. An improvement to Jyothi with resistance to slow blight.

3.3.9. Evolving rice varieties tolerant to chemical stresses like acidity, salinity etc. for kari lands of Thakazhi area extending about 4000 ha.

Crop Management

3.3.10. Weedicidal trial for the wet direct sown rice.

3.3.11. Standardisation of tillage practices.

3.3.12. Time and method of application of weedicides.

.13. Investigation on the changes in Eco system of Kuttanad due to Thanneermukkom barrier.

3.3.14. Nutrient removal due to frequent washings.

3.3.15. Testing the possibility of zero tillage.

3.3.16. Lime requirement and type of liming material for different padasekharams.

3.3.17. Insecticidal pollution of river water.

3.3.18. Designing of machinery for salvinia control.

3.3.19. Fodder cultivation as intercrop in coconut garden.

3.3.20. Suitable intercrop for coconut garden of low lying Kuttanad region.

3.3.21. Scope for integrated coconut-cattle, coconut-fish, coconut-prawn, coconut-pig farming and their economics.

3.3.22. Standardisation of agronomic techniques for vegetables.

3.3.23. Identification of suitable varieties and standardisation of agro-techniques for rainfed banana.

3.3.42. Bark splitting in tapioca.

3.3.43. Scope for the multiplication of azolla.

3.3.44. Lack of standardisation of lime requirement.

3.3.45. Skipping over of P_2O_5 for rice in Kuttanad.

3.3.46. Yellowing of middle whorl of leaves of coconut palms.

3.3.47. Standardisation of fertilizers for the newly released rice variety 'Pavizhom'.

3.3.48. P_2O_5 application along with N & K as top dressing in flooded rice soils.

3.3.49. Time and dose of fertilizer application for banana.

3.3.50. Fertilizer recommendation for paddy in kari lands.

3.3.51. Problem of Ischaemum sp. of weed infestation

. . 52. Feasibility of applying calcium carbonate as top dressing instead of lime.

3.3.53. Drying of emerging inflorescence in coconut palms of 10-15 years old in certain parts of Kuttanad (Haripad).

3.3.54. Possibility of fertilizer application during summer months in irrigated areas when irrigation is done with saline water.

3.3.55. Application of common salt at different doses of 50-150 kg/ha as basal and top dressings upto panicle initiation stage.

3.3.56. Management practices of all vegetables.

3.3.57. Suitable fertilizer recommendation for kari land paddy cultivated in Thuravoor area of Alleppey district to an extent of 3000 ha.

3.3.58. Application of Magnesium sulphate to control yellowing of paddy.

3.3.77. Efficacy of copper fungicides like bordeaux mixture in controlling the disease of paddy.

3.3.78. Pouring bordeaux mixture, Hinosan, Dithane M-45 and and Copper oxychloride at the crown for controlling leaf rot, instead of spraying to reduce the cost of application.

3.3.79. Control measures for controlling cock chaffer beetle in the soils without adversely affecting the tapioca and other intercrops.

3.3.80. Suitable control measures against the pest noticed in sugarcane similar to rice bug.

3.3.81. Lack of a suitable substitute to propanil to control Echinocloa (sp)

3.3.82. Standardisation of the quantity of water recommended for spraying one hectare of paddy crop in different stages.

3.3.83. Fabrication of an effective spraying device against sheath blight and BPH.

3.3.84. Cause for the sudden wilting of coconut palms in Kuttanad area.

3.3.85. Cause for the mid whorl yellowing and suggest suitable control measures.

3.3.86. Find out effective remedial measures for the control of quick wilt disease of pepper.

3.3.87. Methods to control Eleocharis other than the present mechanical way of removal.

3.3.88. Integrated paddy-cum-fish/prawn culture.

3.3.89. Aquaculture investigations.

3.3.90. Cage culturing of fishes/prawn.

3.3.91. Socio-economic problem of aquaculturists.

3.3.92. Duck-cum-fish culture trials.

3.4. Pokkali Region

Crop Improvement

3.4.1. Varietal improvement and screening of saline tolerant variety evolved elsewhere.

3.4.2. Lack of salt resistant variety of rice of pokkali rice.

3.4.3. Lack of a bacterial leaf blight tolerant variety for pokkali area.

Crop Management

3.4.4. Utilisation of nutrients by pokkali crops time and method of application of fertilizer.

3.4.5. Lack of response to potash application.

3.4.6. Investigations of fertilizer application.

7. Tidal effects on soil properties.

3.4.8. Standardisation of cultural methods.

3.4.9. Soil and water characteristics at different stages of crop growth.

3.4.10. Fertilizer recommendation for coconut garden, irrigated with salt water in the sandy tract.

3.4.11. Lack of sufficient seed multiplication programme.

3.4.12. Weed control in pokkali lands.

Crop Protection

3.4.13. Stem borer, leaf roller, case worm and their control in pokkali region.

3.4.14. Chemical control of paddy pests on pisiculture.

3.4.15. a) Insecticidal control of pests and diseases in pokkali area.

b) Plant protection in pokkali rice using chemicals without causing harm to fish fauna.

Fishery Science

3.4.16. Pesticidal application on the survival and growth of prawns.

3.4.17. Standardisation of suitable prawn/fish culture for pokkali area and working out their economics.

3.5. Kole Region

Crop Management

3.5.1. Lack of saline resistant short and medium duration varieties suited to kole region.

3.5.2. Standardisation of water and fertilizer management practices.

3.5.3. Lack of suitable short duration varieties of blackgram, greengram and rice crop.

3.5.4. Severe acidity and iron toxicity resulting in stunted growth, reduced tillering decaying of roots, discolouration of leaves and unfilled grains.

Crop Protection

3.5.5. To determine the optimum dose of granular insecticides like carbofuran in kole lands.

3.5.6. Stem bleeding in coconut gardens.

3.5.7. Standardisation of fertilizer recommendations for rice.

3.5.8. Lack of saline acid resistant short and medium duration varieties of rice.

3.5.9. Severe acidity and iron toxicity and consequent low productivity of rice in kole region.

4.RESEARCH

(a)Salient research results achieved under the Project.
(highlighting inter disciplinary research efforts)

4.a.1. R.A.R.S., Kumarakom

Crop Improvement

1. Evaluation of vegetable type cowpea for intercropping in the coconut gardens of Kuttanad.

Three cowpea varieties Manjeri Red Plain, Manjeri mottled and Kurutholapayar were selected for multi-locational trial based on studies conducted during the period 1984-'87. Variety Manjeri Red Plain recorded an yield of 10900 kg/ha of green pods. This variety is proposed to be released as a variety suitable for the zone.

2. Evaluation of short duration tapioca cultures for reclaimed soils as intercrop in coconut gardens.

Tapioca cultivar Ramanthala recorded an yield of 27.46 tons/ha outyielding all the rest of the varieties put under this trial. Ramanthala seems to be a promising variety of tapioca for intercropping in coconut gardens.

Crop Management

1. Standardisation of agro techniques for vegetables and tubercrops in the reclaimed soils of Kuttanad.

Results of trial conducted on the NPK requirement of vegetable type cowpea identified 10:20:10 kg/ha as the best NPK combination for the crop in the reclaimed alluvial soils of Kuttanad. This results have since been incorporated in t he Package of Practice Recommendations of Kerala Agricultural University for 1988.

The existing fertilizer recommendation for bhindi is 50:10:35 NPK kg/ha. This has been modified to 75:5:15 kg/ha based on experiments conducted at the typical reclaimed alluvium as prevalent in Kuttanad.

Crop Protection

The results of special staining of thin sections of of herbaceous plants showing suspected MLO disease symptoms indicated negative reactions in respect of all the samples tested. Seven species of plants which are found predominent in the root (wilt) affected tracts were subjected to the study. In so far as none of the plants tested could be suspected as carriers of MLO, it would be unlikely for these species of plants to be collateral hosts of root (wilt) pathogen.

Results of survey on the diseases of oil palm in Kerala revealed presence of two new diseases in oil palm. The leaf rot and fruit rot. The associated organisms are isolated and sent for identification.

Investigations conducted on the diseases of bamboo and reeds (STEC Project) in Kerala resulted in the identification of six diseases, most of them being first report from India.

Fisheries Science

Studies on culture of fishes and prawns as follow-up crop in paddy fields show that marketable and table sized fishes could be harvested when grown in the interphase period (5-6 month) between two paddy crops under Kuttanad condition.

Preliminary studies indicate that fish cum duck farming is a viable system under Kuttanad conditions.

R.R.S., Moncompu

Work on evolving high yielding blast resistant rice varieties resulted in the selection of following cultures which registered yield above 4 tons/ha.

Designation	Parentage
28-10-1	Mo5 x Sona
28-17-2	-do-
29-2-3	Rasi x Mo5
36-4-1	Mo6 x Rasi

Comparative yield trials are being conducted to arrive at the final selection.

, ice culture 153-1, a medium tall, short duration variety evolved at Moncompu was tested against pest and disease tolerance and found to be promising.

Studies conducted on the economics of weed control in direct sown rice under Kuttanad condition revealed that the use of herbicide benthiocarb and butachlor were the best substitutes to hand weeding. The cost benefit ratio favours the use of herbicides in rice fields for weed control.

Screening trials against tolerance to acidity, salinity, iron aluminium and manganese conducted with hundred and twenty four rice varieties indicated that varieties IR-8, Rohini, Cul.25315, Jaya and Supriya tolerated the salinity and iron toxicity prevalent in the kari soils of Karumady-Thakazhy areas of Kuttanad.

Growth studies with four rice cultivars revealed that culture 153-1 and Mo6 registered higher grain yield at 90:45:45 fertilizer level and they were found more responsive to fertilizers than the rest.

Trials conducted to identify the vulnerable stage of crop growth and to asses loss due to concurrent pest infestation resulted in concluding that incidence of major pests was high at late tillering and early reproductive stages and plant protection during these periods helped in reducing damage.

Qualitative and quantitative studies in Nitrogen fixing microorganisms in Kuttanad soils revealed that the population of bacteria and fungi was higher in kayal soil, whereas the population of actinomycetes, Nitrogen fixing bacteria & Blue green algae was higher in karapadam soils.

R.R.S., Kayamkulam

Combined application of organic (cowdung at 20 kg N/ha) and inorganic (60 kg N as Ammonium sulphate) manures was found to be more benefitial for rice yield, than the application of inorganic manures alone, in the sandy loam soils of Onattukara.

4(b) Details of programme of research not taken up, if any.

NIL

4(c) Likely changes new experiments proposed in view of experience gained. : NIL

5.EDUCATION

1.Details of participation of NARP staff in teaching

Assistant Professor (Microbiology) continued to be the member of Advisory Committee of one P.G.student.

2.Training of scientists for acquiring knowledge.

Sri.Jose Abraham, Jr.Asst.Professor (Agrl.Engineering) was deputed for undergoing training on mangrove management.

6.EXTENSION

a)Seminars/workshops

T & V workshops were regularly conducted in all the 4 centres of the project under the chairmanship of the concerned head of station. Senior scientists also attended these workshops as resource personnel. The X NARP zonal workshop was conducted during 6-7 September, 1988 at this station.

b)New problems received from extension staff and action taken

NIL

c)Training (Training programmes arranged)

A training programme was conducted on Mushroom Cultivation to 35 unemployed youths during this period.

d)Adoption of village, farmers camps at stations, number of farmers visiting the station.

The following villages were adopted under Village Adoption Programme.

1.Kumarakom (R.A.R.S., Kumarakom)
2.Pathiyoor (R.R.S., Kayamkulam)
3.Keerikkad (R.R.S., Kayamkulam)
4.Poonithura (R.R.S., Vyttila)
5.Moncompu (R.R.S., Moncompu)

Demonstrations on duck cum fish culture were taken up at the R.A.R.S., Kumarakom in addition to School Adoption programmes in Moncompu.

e) Contact of research scientists with extension officers

Scientists numbering 3-5 from each centre of the region acted as resource personnel of the district T & V workshops and maintained contact with extension officers. The scientists also attended to problems in the field (diagnostic teams) in association with extension staff. The scientists also actively participated in the different training programmes organised by extension staff. A very effective linkage between scientists and extension staff exists in this region.

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

The results of research carried out and package of practice recommendations were made available to the extension agencies then and there.

g) Major constraints in the adoption of research recommendations if any:

NIL

R I C E

1. Varietal Improvement

Rice Research Station, Moncompu

1.1. Evolution of blast resistant varieties

With the objective of evolving high yielding varieties with blast resistance, Mo 5, Mo 6 and Mo 7 were crossed with the blast resistant varieties Rasi, Vani and Sona (improved). The breeding programme is in the comparative yield trial stage.

During the punja season of 1987-'88, the following cultures exhibited yield potentials above 4 t/ha : 28-10-1, 28-17-2 (Mo 5 x Sona), 29-2-3 (Rasi x Mo 5), 36-4-1 (Mo 6 x Rasi). However, the best yielder was the check variety Mo 4 (5.2 t/ha). All the cultures mentioned above are tolerant to blast with the score ranging between 1 and 3. Mo 4 recorded a score of 2.

1.2. Improving the yield and quality of rice varieties by induced mutation.

The aim of the experiment was to evolve high yielding varieties suited to the conditions existing in Kuttanad. The traditional as well as modern varieties were subjected to gamma radiation at varying doses and selection made from the progenies for desirable agronomic traits including grain yield. Now, the breeding programme is in the CYT stage.

During the punja season of 1987-'88, 22 cultures were identified as promising based on yield and pest and disease reaction. They will be put to test during the next season.

1.3. Breeding for high yield and multiple resistance

This experiment has the specific objective of breeding varieties with potential yields of 8 t and above and multiple resistance to pests and diseases. The donors for multiple resistance used in the breeding programme included Chennellu, Ptb.18, Ptb.33, IR 5, IR.42, Culture 954 and Culture 25331. Mo 4, Jyothi, Mo 5, Mo 6 and IR 8 were used as donors for high yield.

None of the cultures showed yield potentials above 8 t/ha during the current season's trial. However, several of them did exhibit multiple resistance to pests and diseases. The trial will be continued.

1.4. Breeding for high yielding varieties specifically suited for the additional crop season of Kuttanad

Pokkali 372, Mo 1, Kuruka and Culture 12814 were crossed with the popular high yielding varieties Mo 4, Mo 5, Mo 6, Mo 7 and Jyothi and selections made for high yield, better grain quality and seed dormancy.

During the punja season of 1987-'88, a preliminary yield trial with 26 cultures was conducted. Based on yield and reaction to pests and diseases, 20 cultures were selected for further testing.

1.5. Evolution of gall midge resistant varieties

Mo 4, Mo 5, Mo 6, Mo 7, Jyothi, Culture 93 and Culture 153-1 were crossed with the gall midge tolerant varieties Surekha, Kakatya, Pothana, Mahaveera, WGL 26889, Phoolum, Moirangphu, and Ritiang and single plant

selections made with the objective of identifying a high yielding, gall midge resistant variety for the Kuttanad tract.

Sl.No.	Cross No.	Designation	No.of plants selected
1	M 59	Surekha x Mo 5	11
2	M 60	Kakatya x Mo 5	1
3	M 61	Pothana x Mo 5	9
4	M 63	Mo 6 x Pothana	2
5	M 64	Pothana x Mo 4	4
6	M 65	Pothana x Mo 7	4
7	M 66	Kakatya x Mo 6	3
			34

In addition, the following fresh crosses were also made.

1	M 70	Mahaveera x Mo 5
2	M 71	,, x Mo 6
3	M 72	,, x Jyothi
4	M 73	,, x Culture 93
5	M 74	,, x Culture 153-1.

1.6. Breeding high yielding varieties suitable for the karilands of Kuttanad

The parents involved in the cross breeding programme included Kuruka, Chettivirippu, Vyttila 1, Vyttila 3, Culture 2533, Mo 4, Mo 5, Mo 6, Mo 7, Jyothi and, IR 5. The first two cultivars are widely grown in the Thuravoor kari of Shertallai taluk.

During the puncha season of 1987-'88, 39 cultures belonging to the F 5 generation were raised at Moncompu and at 5 locations in the Karumadi area. These cultures were screened for their reaction to high acidity. Several of them showed a fair degree of tolerance to acidity. The yield data ranged from 3 t/ha to 5 t/ha.

The selected cultures will be put to test during the next year.

1.7. Developing male sterile lines

The project was taken up with the objective of developing male sterile lines for use in hybrid seed production.

Three cytoplasmic male sterile lines viz., Pankhari 203 A, V 20 A and Ms 577 A and their maintainers received from IRRI were maintained. Male sterile lines of the popular high yielding varieties like Mo 4, Mo 5, Mo 7, Jyothi and Jaya have been developed. The following crosses were made during the puncha 1987-'88 to identify restorer lines:

Mo 5 A x IR 54; Jyothi A x Cul.129, Jyothi A x Cul.170.

The work will be continued.

1.8. Evolving a short duration variety of rice

This project was taken up to study the yield performance of the medium tall short duration variety Culture 153-1 (IR 1561 x Ptb 33) evolved at Moncompu.

The culture 153-1 was found to be promising with respect to yield and tolerance to pests and diseases in the current seasons trial.

1.9. District trial with selected AICRIP cultures

This was a trial sponsored by the AICRIP, with 3 cultures (OR 131-3-1, OR130-2-5, OR 131-3-3) and 3 check varieties (Mo 5, Mo 6 and Jaya) with the ultimate objective of selecting promising cultures suited for the tract.

The culture OR 131-3-1 derived from the cross Kumar x CR 57 recorded the highest yield of 4.9 t/ha at Moncompu. In the multilocation trial (6 trials) also it topped the list with a mean grain yield of 3.5 t/ha (Table 1).

Table-1. Yield performance of rice cultures in the M.L.T. (kg/ha)

Culture	Moncompu	Pattambi	Kayamkulam	Kumarakom	Mannuthy	Karamana	Mean
OR 131-3-1	4900	2797	3307	2755	2985	4393	3523
OR 130-2-5	4450	2652	4062	2785	2685	4264	3483
OR 131-3-3	4450	2689	3622	2625	3070	3189	3274
Mo 5	3650	2856	3194	1805	2745	2316	2761
Mo 6	4760	2477	3594	2135	2955	2537	3066
Jaya	4700	2802	2695	1650	3255	3727	3148
C D (0.05)	719	115	798	411	565	698	

1.10. Uniform variety trial-3 (AICRIP)

The comparative performance of 16 medium duration varieties was studied in this experiment, using Mo 5 as the local check. IET 9361 (PPW 6-13 topped the list of varieties in grain yield (8 t/ha). IET 9363 (RPW 6-13) ranked second (7.5 t/ha).

1.11. Preliminary variety trial (AICRIP)

Fortynine entries of early maturing rice selections were yield tested in a simple lattice design using Mo 7 as local check during the puncha season of 1987-'88. IET 8092 (Rasi x WGL 22245) ranked first in yield (6.0 t/ha). The incidence of sheath blight and sheath rot was, however, high in most of the entries. No selection was made, therefore, for future screening.

1.12. Sheath blight resistant variety trial (AICRIP)

The yield performance of 22 sheath blight resistant varieties were studied in this experiment using Mo.6 as local check during the puncha season. Out of these, 11 entries did not flower. Out of the entries which flowered, IET 10663 (Pankaj x Swaradhan) recorded the highest yield of 5.8 t/ha).

Rice Research Station, Vyttila.

1.13. Hybridisation programme - Improvement of Pokkali Rice

The object of the project was to evolve high yielding varieties suitable for Pokkali tract by taking up crosses between present Pokkali varieties and modern yielding varieties.

A comparative yield trial of 3 cultures with Vyttila 1 and Vyttila 3 as control was conducted. Inspite of the adverse conditions the cultures gave higher yield than the control varieties. The yield difference was statistically significant and the culture 906 gave the highest yield of 3217 kg/ha (Table 2).

Table-2. Grain yield and other important characters of pre-release cultures.

Culture No.	Flowering duration (days)	No.of grains/ panicle	Weight 1000 grains (g)	Grain yield (kg/ha)
904	93	117.0	31.6	3132
905	90	132.5	30.8	3133
906	89	119.0	31.2	3217
Vyttila 1	88	102.0	31.3	2533
Vyttila 3	87	115.0	32.1	2750

All the three cultures gave higher yield than the control varieties. Moreover, the cultures have very good desirable plant characters such as duration, plant height and grain size.

1.14. Breeding for earliness in the variety Mashuri by induced mutation

The object of the project was to reduce the duration of the variety Mashuri by using physical mutagens.

Six early mutant cultures of the variety Mashuri have been evolved under this project. These cultures were in a comparative yield trial with Vyttila 1 and Vyttila 3. The crop was harvested in October and due to the adverse condition of salinity during the productive phase the grain yield was considerably reduced.

All the six mutant cultures have desirable duration (Table 3). Though the crop was very badly affected by salinity, the cultures gave fairly good yields comparable to the yields of control varieties. The trial has to be repeated.

Table-3. Grain yield and other important plant characters of Mashoori mutants.

Culture No.	Flowering duration (days)	No. of grains/ panicle	Weight of 1000 grains (g)	Grain yield (kg/ha)
88-12-59	75	162	17.2	1760
88-2-49	77	103	20.2	2530
87-5-48	79	112	19.8	2140
88-3-50	82	113	19.0	2210
88-8-55	81	146	19.2	2180
88-10-56	80	132	18.0	2510
Vyttila 1	84	101	30.6	2570
Vyttila 3	85	126	29.4	2430

1.15. Breeding high yielding rice varieties suitable for Pokkali area by hybridization

The object was to evolve high yielding rice varieties suitable for Pokkali area by hybridization between Pokkali varieties and IR 5.

Seven hybrid cultures selected from the F7 generation (Vyttila 2 x IR-5) during '86-'87 were in a replicated preliminary yield trial during the year 1987-'88. Another set of fifteen cultures selected from F7 generation (Vyttila 1 x IR 5 and Ponkuruka x IR 5) were also in an unreplicated preliminary yield trial and Vyttila 1 and Vyttila 3 were used as control in both these trials. Out of the seven cultures in the replicated trial six cultures gave significantly higher yield ranging from 3555 kg/ha to 3900 kg/ha

while the control varieties Vyttila 1 and Vyttila 3 gave 2222 kg/ha and 2866 kg/ha, respectively (Table 4).

Table-4. Grain yield and flowering duration of cultures under CYT

Culture/Details No.	Flowering duration (days)	Grain yield (kg/ha)
Culture 852	90	3555.5
854	92	3722.2
857	91	3784.4
858	92	3755.5
868	93	3777.7
869	95	3900.0
871	89	3144.4
Vyttila 1	87	2222.2
Vyttila 3	88	2866.2

1.16. Breeding for earliness in the variety H4 and SR 26 B by induced mutations

The objective of the project was to reduce the duration of the varieties H4 and SR 26 B by using physical and chemical mutagens.

A comparative yield trial of five mutant cultures of the variety H4 was conducted with Vyttila 1, Vyttila 3 and Cul. 53 as checks. It was a drought year and the rainfall was very little especially during the month of August and September when the crop was in the productive phase. The salinity in the field rose upto 9 ppt during the last week of August, '87 resulting in the reduction of grain yield. The trial will be repeated.

1.17. Collection, maintenance and utilisation of saline resistant rice varieties:

The objective of the project was to have a collection of saline resistant rice varieties suitable for Pokkali areas and also to use fresh varieties to evolve new saline resistant rice varieties suitable for the saline areas in the state.

Forty three saline resistant rice varieties and types were collected and maintained under this project. The establishment of seedling after transplanting was normal and the growth of plants was good in the initial stages. But the lack of rains in the month of August and the consequent increase of salinity affected most of the varieties. Harvesting was done in October. The plant characters such as height, duration, number of productive tillers, number of grains per panicle, 1000 grain weight and reaction to pests and diseases were collected and recorded in all the varieties. One variety - Ponkuruka - from this collection has already been used in one of the hybridization programme in this station.

2. CROP MANAGEMENT

Regional Agricultural Research Station, Kumarakom

2.1. Optimisation of dose and timing of 2,4-D application to reduce phytotoxic effects in rice

This experiment was taken up to find out the optimum dose and time of application of 2,4-D sodium salt for weed control in rice, without causing any phytotoxic effect on the crop.

The treatments consisted of factorial combinations of four doses and four stages of application of 2,4-D sodium salt, which will be compared with one weed free control and one unweeded control. The test variety was Jyothi.

Work done

The field experiment was laid out during August 1987 and harvested during January 1988. Observations on toxicity to rice seedlings, weed count, fresh and dry weight of weeds, weed spp, as on 10 DAA and 60 DAS and grain and straw yield were recorded.

The doses and stages of application had a very significant effect on the toxicity to crop. Application of 2,4-D at 10 DAS produced more number of deformed seedlings. The 25 DAS application had the least deleterious effect on the crop. As the dose of weedicide increased from 0.25 to 1.00 kg the seedling mortality increased from 2.352 to 4.394. Regarding the weed control efficiency of 2,4-D, all the doses except 0.25 kg/ha of 2,4-D had significantly reduced the number of weeds. Among the stages of application 20 and 25 DAS were found to be the most effective (Table 5).

Table-5. Effect of doses and stages of application of 2,4-D sodium salt on No. of weeds/sq.m

Doses of 2,4-D (kg/ha)	Stages of application				Mean (doses)
	10 DAS	15 DAS	20 DAS	25 DAS	
0.25	3.9969	5.7503	4.2294	4.5680	4.636
0.50	1.6667	3.3744	1.6667	3.2019	2.477
0.75	1.0000	3.5028	1.6667	3.3744	2.386
1.00	3.5028	3.7353	1.4120	1.8685	2.630
	2.542	4.091	2.244	3.253	

C D for comparing stage and dose means : 1.274

The effect of the treatments on rice grain yield was not significant both in the case of stage and dose of application. However, 1.0 kg/ha of 2,4-D sodium salt gave almost similar yields. Among the stages of application though the effect was not significant 20 DAS application gave the maximum grain yield.

Considering all the above it can be concluded that the dose 0.5 and 0.75 kg/ha of 2,4-D sodium salt is as effective as the present recommendation of 1.00 kg/ha for rice weed control. Among the stages of application 20-25 DAS application is optimum.

2.2. Performance of Azospirillum in the acid soils of Kuttanad

The effect of Azospirillum on the yield and nitrogen use economy in rice was investigated in this trial (observational).

Design : A C.R.D. under pot culture in green house, using the peat based Azospirillum supplied by the Agricultural University, Madurai. The treatments were:

i) Sowing treated seeds + Half the doze of Nitrogen, Full P and K in splits.

ii) Sowing untreated seeds + Full doze of nitrogen, Full P and K.

iii) Soil application and sowing + Half doze of nitrogen, full P and K.

iv) No application and sowing + Full doze of nitrogen, full P and K.

v) Soil application and planting + Half doze of nitrogen, full P and K.

vi) No application and planting + Full doze of nitrogen, full P and K.

vii) Seedling dip and planting + Half doze of nitrogen, full P and K.

viii) Seedling dip and planting + Full doze of nitrogen, full P and K.

ix) Control, No treatment and no fertilizers.

Fertilizer doze 90:45:45, Variety - Jyothy, Replication - 3.

The grain and straw yields were recorded. The grain and straw samples were analysed for estimating the total nitrogen. The soil in the pot was also analysed for estimating the pH, EC, Organic carbon, Available P and K (Table 6).

Table-6. Performance of Azospirillum sp. in the reclaimed soils of Kuttanad (Mean values)

Treatment	Yield			Nitrogen content		
	Grain (gms/pot)	Straw (gms/pot	Percentage	Straw m.gms/pot	Percentage	Grain m.gms/pot
1	3.044	130.00	1.019	1325	0.767	23.34
2	1.577	125.12	1.018	1274	0.972	15.33
3	2.424	163.40	0.957	1564	1.155	27.99
4	2.427	117.38	0.805	945	1.094	26.67
5	2.414	115.93	1.140	1404	1.20	28.99
6	2.723	196.08	0.851	1669	1.277	34.77
7	4.098	174.26	0.943	1643	1.064	43.60
8	1.775	198.82	0.857	1784	1.094	19.42
Control	0.211	78.46	1.018	704	0.728	15.36
Inference	N S	Sig.	-	Sig.	-	Sig.

The maximum grain yield with higher content of nitrogen was obtained when rice seedlings were dipped in Azospirillum slurry and planted with half the doze of nitrogen.

R.R.S., Moncompu

2.3. Studies on the nutritional requirement of pre-release cultures (Cul.153-1, Cul.200, and Cul.204)

Objective

To find out the optimum dose of fertilizers for selected paddy cultures and to find out their comparative performance under different fertilizer levels.

The treatments comprised of the combinations of 3 varieties (culture 153-1, culture 200 and culture 204) and 4 NPK doses (N_1 - 50:25:25 (kg N, P_2O_5 and K_2O per ha), N_2 - 70:35:35, N_3 - 90:45:45, N_4 - 110:55:55)

During punja season of 1987-88 all the three varieties responded well in grain yield and straw yield upto 90:45:45 kg N, P_2O_5 and K_2O/ha. The highest grain yield of 3.7 t/ha was obtained at 90:45:45 kg N, P_2O_5 and K_2O/ha followed by 70:35:35 kg N, P_2O_5 and K_2O (3.38 t/ha). N_1 and N_4 levels significantly were inferior to N_3 with the grain yields of 2.98 t/ha and 3.36 t/ha, respectively (Table 7). The decrease in yield at N_4 may be attributed to a higher rate of disease infestation as is seen in the score on sheath blight.

Table-7. Yield performance of pre-release cultures at different fertilizer levels.

Fertilizer level	Cul.153-1	Cul.200	Cul. 204	Mean
N_1	3333	2750	2850	2978
N_2	3517	3383	3250	3383
N_3	4183	3583	3417	3728
N_4	3567	3333	3167	3356
Mean	3650	3263	3171	

Among the three varieties studied Cul.153-1 recorded the higher yield of grain and straw. Cul.153-1 was found superior with low rate of sheath blight incidence (Table 8).

Table-8. Reaction of pre-release cultures to sheath blight as influenced by fertility levels (scoring done at maturity).

Fertilizer level	Cul.153-1	Cul.200	Cul.204	Mean
N_1	2.9	3.1	3.1	3.02
N_2	2.8	3.4	4.1	3.42
N_3	3.2	3.8	3.8	3.61
N_4	3.7	4.1	4.2	3.98
Mean	3.15	3.58	3.79	

2.4. Permanent Manurial trial

The effect of continuous application of nitrogen, phosphorus, potassium and lime on the soil fertility and yield of rice under Kuttanad condition where straw is incorporated is being studied in this experiment. The treatments are listed in Table 9.

The treatments did not show any significant effect on the height of plants, panicle density and grain yield during the season. The highest straw yield of 6042 kg per ha was recorded under the treatment 3 where 90 kg N/ha alone was applied. The results also showed that P_2O_5 in the absence of N had a negative influence in the yield of straw (Table 9).

Table-9. Permanent Manurial trial : Yield, panicles/m^2 and disease score of rice as influenced by treatments Punja 1987-'88.

Sl. No.	Treatment	Panicles per m^2	Grain yield (kg/ ha)	Straw yield (kg/ha)	Sheath blight score	Sheath rot score
1.	Absolute control	236.00	3267.5	4875	2.40	1.27
2.	Control (no manures and with straw incorporation)	238.68	3457	4592	4.20	3.20
3.	90 kg N/ha as urea	297.32	3817	6042	2.07	1.53
4.	90 kg N + 45 kg P_2O_5/ha as urea and mussoriphos respectively.	285.32	3875	5457	2.00	2.27
5.	90 kg N + 45 kg K_2O per ha as urea and MOP respectively.	270.68	3600	2782	4.07	3.13
6.	45 kg P_2O_5 + 45 kg K_2O/ha as mussooriphos and MOP, respectively.	253.32	2917	4042	3.93	2.27
7.	90kg N + 45 kg P_2O_5 + 45 kg K_2O/ha.	314.68	3832	5675	2.93	1.60
8.	90 kg N + 45 kg P_2O_5 + 45 kg K_2O + 600 kg lime/ha.	265.32	3600	4992	1.87	2.23
9.	NPK and lime as per soil test data.	286.68	3575	5432	2.40	1.73
C D (0.05)		N S	N S	1152	1.51	N S

2.5. Integrated nuttrient management in irrigated rice (AICRIP)

The integrated effect of organo-inorganic sources of nitrogen on the growth and yield of rice was studied in this experiment. The treatments are detailed in Table 10.

The effect of treatments was significant for both grain and straw yields.

Table-10. Panicle density, yield and reaction to sheath blight as influenced by integrated fertilizer treatment, punja 1987-88.

Sl. No.	Treatments	No. of panicles /m^2	Grain yield (kg/ha)	Straw yield (kg/ha)	Sheath blight score
1.	Control (no NPK)	257	3127	8548	0.53
2.	20 kg P_2O_5 + 20 kg K_2O/ha	248	3294	8965	1.00
3.	40 kg N + 20 kg P_2O_5 + 20 kg K_2O/ha.	260	3682	10354	1.37
4.	Azolla + Treatment No.2	249	3544	9382	1.40
5.	Azolla + Treatment No.3	255	3699	11563	1.07
6.	Daincha + Treatment No.2	252	3640	9103	1.70
7.	Daincha + Treatment No.3	259	3907	10729	0.77
8.	Daincha + Azolla + Treatment No.2	292	4099	10425	1.43
9.	80 kg N + 40kg P_2O_5 + 40 kg K_2O/ha	285	3907	10521	0.90
	C D (0.05)	N S	288	1825	N S

The maximum grain yield (4.1 t/ha) was produced by the treatment receiving (Tr.8) daincha + Azolla + 20 kg P_2O_5 +

20 kg K_2O per ha. The treatment receiving 80 kg N + 40 kg P_2O_5 + 40 kg K_2O/ha (Tr.9) was on par with treatment 9, however, the treatments 7, 8 and 9 were superior and on par indicating that daincha and azolla have high potential in reducing the dependance on chemical fertilizers.

2.6. Weed control trial in transplanted rice (AICRIP)

Objective: To identify suitable herbicide for easy and economic method of weed control in transplanted rice. The treatments are detailed in Table 11.

The results revealed that the weed infestation was significantly reduced by the methods of weed control adopted. However, the yields of T_5 and T_6 were significantly lower to that of T_{10}. A higher toxicity of Dowco 356 herbicide compared to others might have attributed to the low yield of grains (Table 11). Among the herbicides tried Penoxalin 1.5 kg ai/ha and Scarle 1.0 kg ai/ha were the least toxic.

2.7. Weed control trial in direct sown rice under puddled condition

The objective of the experiment was to identify suitable herbicide for easy and economic weed control in direct sown rice under puddled condition. The treatments are detailed in Table 12.

The results revealed that Arozin and Dowco 356 were highly toxic to direct sown rice under the doses tried. These two chemicals were significantly inferior to the others in grain yield (Table 12) probably due to loss in plant stand. The highest yield was recorded by the weed free check (4.95 t/ha) and it was significantly superior to the other treatments. The next best treatment was

Table 11.

Toxicity rating, weed weight and grain yield as affected by weed control practices, punja 87-88.

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Treat No.	Treatments	Toxicity rating.	Control rating	Dry wt. of weeds (g/m^2)	Grain yield (kg/ ha)
T1	Penoxalin 1.5 kg ai/ha.	2.00	6.33	27.7	4665
T_2	Penoxalin 2.25 kg ai/ha.	2.16	7.33	22.3	4400
T_3	Arozin 0.5 kg ai/ha.	2.14	8.33	18.8	4335
T_4	Arozin 0.6 kg ai/ha.	2.33	8.00	17.0	4515
T_5	Dowco 356 0.5 kg ai/ha.	2.33	6.33	29.6	4250
T_6	Dowco 356 0.75 kg ai/ha.	2.50	8.00	18.6	4250
T7	Scarle 1.0 kg ai/ha	2.00	7.00	27.2	4365
T8	Scarle 1.5 kg ai/ha.	2.17	8.33	19.7	4550
T9	Benthiocarb 1.5 kg ai/ha.	2.17	8.00	17.6	4500
T10	Weed Free	1.0	8.66	10.5	4815
T11	Hand weeding twice (20 and 40 DAT)	1.0	8.00	19.4	4585
T12	Control (no weeding)	1.0	1.00	102.6	1665
	C.D.(0.05)	0.34	1.04	8.6	430

Table 12. Rating on toxicity, weed control, dry matter of weeds and grain yield as affected by weed control practices, punja, 1987-88.

Treat No.	Treatments	Toxicity Rating	Control Rating	Dry weight of weeds (g/m^2)	Grain yield (kg/ha)
T1	Penoxalin 1.5 kg ai/ha	2.66	6.6	7.2	4100
T2	Penoxalin 2.25 kg ai/ha.	4.33	7.3	7.1	3950
T3	Arozin 0.5 kg ai/ha	4.66	7.6	5.0	3166
T4	Arozin 0.6 kg ai/ha	6.00	8.0	7.9	3083
T5	Dowco 356 0.5 kg ai/ha	8.00	8.0	4.9	2400
T6	Dowco 356 0.75 kg ai/ha.	8.30	8.6	6.4	2166
T7	Scarle 1.0 kg ai/ha.	2.30	8.0	8.0	3916
T8	Scarle 1.5 kg ai/ha	2.60	8.3	5.8	4066
T9	Benthiocarb 1.5 kg ai/ha.	1.60	7.3	7.0	4150
T10	Weed Free check	1.00	8.6	3.2	4950
T11	Hand weeding twice	1.00	8.0	5.9	4483
T12	Non weeded control	1.00	1.0	23.0	2750
	C.D.(0.05)	1.41	1.08	3.7	440

hand weeding twice (4.48 t/ha). It was, however on par with Penoxalin @ 1.5 kg ai/ha (4.1 t/ha), Scarle @ 1.5 kg ai/ha (4.07 t/ha) and Benthiocarb @ 1.5 kg ai/ha (4.15 t/ha) (Table 12).

2.8. Economics of weed control in the direct sown rice under puddled condition (AICRIP)

To conduct an economic analysis of the efficacy of herbicide use for weed control in specific rice eco system.

This was laid out as an unreplicated trial with 6 treatments (Table 13) in large area plots.

The results revealed that yield of grain was maximum in T_4 (Weed free check). Hand weeding twice resulted in more profit. The herbicides benthiocarb and butachlor were the best substitutes to hand weeding twice. The cost : benefit ratio showed that the above two herbicides were better than the other methods.(Table 13).

2.9.Tolerance (screening) studies on high yielding varieties of rice for acidity, salinity, iron, aluminium and manganese under Kuttanad conditions

Kuttanad soils are sulphate soils and are characterised by high acidity and seasonal salinity and also have toxic concentration of iron, aluminium and manganese. The high yielding varieties and those which are at the stage of releasing have to be subjected to a screening study to decide their relative tolerance to higher concentrations of these anionic elements. Hence, this study is carried out.

Table 13. Economics of weed control in direct sown rice under Puddled condition (AICRIP)

Treatment No.	Treatment	Yield of straw (kg/ha)	Dry wt. of weeds (g/m^2)	Yield of grain (kg/ha)	Value of produce *	Cost of weeding + herbicide cost **	Net profit	Cost Benefit ratio
T_1	Benthiocarb (1.0 kg ai/ha)	5375	6.5	3650	9662	910	8752	1 :4.3
T_2	Butachlor (1.0 ai/ha)	5450	6.5	3675	9732	900	883.2	1 :4.6
T_3	2,4-DEE. (0.8 kg ai/ha)	4875	4.9	3175	8425	860	7565	1 :3.2
T_4	Weed-Free check	7400	2.0	3975	10677	1800	8877	1 :2.3
T_5	Hand weeding (Twice)	6300	7.5	3900	10380	1440	8940	1 :2.9
T_6	Non-weeded check	3825	23.8	1775	4820	-	4820	

* Value of produce @ 2.50 per kg of paddy grain and Rs.0.10 per kg of straw.

** Value (approx) of herbicide + weeding cost @ Rs.15/- per woman worker.

Hundred and twenty four varieties of rice were screened. The varieties/cultures tolerant to 0.5% salt concentration and 400 ppm iron concentration were selected (IR 8, Rohini, Culture 25315, Jaya, Supriya, Pavizhom, Culture 93, Culture 153-1) and replicated field trials were carried out in farmers' fields in five different locations in the kari soils of Karumady-Thakazhy area.

The pH andEC of the soils of the different locations were monitered at the different growth stages of the crop.

For the different observations taken, the varieties performed differently in the five locations. The data of the five locations were pooled and statistically significant differences were obtained between the varieties/cultures for all the observations except number of productive tillers per 0.1 m^2 and the incidence of sheath blight (Table 14).

Table-14. Yield performance and disease tolerance of rice varieties under stress conditions(pooled data of 5 locations)

Tr.No.	No.of prod. tillers/ 0.1 m^2	Grain yield (kg/ ha)	Straw yield (kg/ ha)	Disease score (0 - 9)		
				Sheath blight	Sheath rot	Blast
IR 8	30.5	3023	3547	1.23	4.33	2.53
Rohini	32.9	2387	2923	1.07	4.47	2.53
Cul.25315	32.9	3230	3698	1.47	5.53	1.40
Jaya	31.9	3583	4093	1.52	4.53	4.07
Supriya	34.1	2770	3313	1.25	3.93	2.53
Pavizhom	37.4	3612	4017	1.21	2.53	3.40
Culture 93	33.1	3442	3927	1.93	5.80	2.20
Cul.153-1	30.3	3308	3918	1.07	3.40	1.60
C D (0.05)	N S	200	270	N S	1.25	1.47

The pH of the soil of these locations varied from 5-6 at the time of sowing to 2.90 at the time of harvest and EC varied from 0.42 mmhos/cm at the time of sowing to 3.30 mmhos/cm at the time of harvest. The soluble iron content ranged from 0.17 ppm to 14.77 ppm.

The saline and iron tolerant varieties IR 8, Rohini, Cul.25315, Jaya and Supriya tolerated the salinity and iron toxicity conditions prevalent in the kari soils of Karumady-Thakazhy area with variation in their yielding capacity. The check varieties Cul.93 and Cul.153-1 exhibited leaf symptoms of iron toxicity.

2.10.Growth studies in rice varieties

Objective: 1)To determine relative growth rate, net assimilation rate, crop growth rate of different varieties of rice.

2)To compare the reason for yield difference from varieties to varieties and season to season.

The performance of Mo.5, Mo.6, Culture-93 and Culture 153-1 was studied under 3 fertility levels namely, L_1 - 70:35:35 (NPK kg/ha), L_2 - 90:45:45 and L_3 - 110:55:55.

The experiment was started during Punja 1987-'88. Meteorological data during Punja season were recorded. Biometric observations like plant height, number of tillers, dry matter production, leaf area, leaf number etc. were noted at maximum tillering, panicle initiation and at maturity stages. Panicle characters like length of panicle, number of panicles/hill, number of grains/panicle, number of filled grains and chaff/panicle and chaff percentage, weight of panicle, grain yield, straw yield etc. were also recorded.

An analysis of the data showed that at maximum tillering stage there was no significant difference in plant height among the varieties and fertilizer rates. The highest dry weight of plants was recorded by the variety Culture-93 at the fertilizer level 70:35:35. At panicle initiation stage and at maturity stage Culture 153-1 and Mo 5 were on par in plant height and significantly superior to that of Cul.93. All the varieties were on par with respect to dry weight of plants at panicle initiation stage and at maturity stage. Culture 153-1 (5.17 t/ha) and Mo 6 (5.2 t/ha) produced higher grain yields at the fertilizer level 90:45:45 and they were found to be more responsive to fertilizers than the other two.

2.11. Potential grain filling in pre-release cultures

To study the potential of grain filling in promising pre-release cultures and to estimate the yield and yield components of rice, this project was taken up.

The treatments included two fertilizer levels, T_1 - 60:30:30, T_2 - 120:30:30 kg NPK/ha and 6 pre-release varieties 1)Culture 93, (2) Culture 126, (3) Culture 129, (4)Culture 153-1, (5) Culture 168, (6) Culture 170, (7) Culture 200, (8) Culture 204, (9) Mo 6, (10) Mo 7, (11) Jyothi and (12) Mahaveera.

The experiment was laid out in split plot design during punja 1987-'88. Observations like days to 50% flowering, plant height, number of total tillers, number of productive tillers, grain yield, panicle length, number of filled grains/panicle in 1.0, 1.06 and 1.2 specific gravity solutions and their corresponding 1000 grain weight were recorded.

During the punja season the highest plant height was recorded by the variety Culture 153-1. Culture 168 recorded the highest grain yield (5762 kg/ha). Almost all the varieties performed better at the fertilizer level 120:30:30 kg NPK/ha.

Rice Research Station, Vyttila

2.12. Permanent manurial trial of rice in acid saline soils under flooded condition (Pokkali tract)

The objective of this trial was to evolve a manurial schedule for soils under ill drained and flooded conditions. The treatments included (1) 0 - Control (2) N @ 20 kg/ha, (3) P_2O_5 @ 40 kg/ha (4) N & P (treatments 2 & 3) (5) NPK Treatments 4 + 20 kg K_2O/ha (6) NPK & Ca (Treatment 5 & Ca Co_3 1000 kg/ha) (7) NP Ca. (Treatment 4 & Ca Co_3 1000 kg/ha) (8) P & Ca (Treatment 3 & Ca C_3O 1000 kg/ha) (9) NPK (Treatments 5 nitrogen by urea applied in mud balls) (10) NPK (N given as slow release by mixing urea with neem cake).

The experiment was laid out in a RBD with four replication. The test variety used was Vyttila 1.

The crop was harvested by October and statistical analysis of grain yield indicated that there was no significant difference between treatments. However, highest yield was recorded by (T_1) control (2987 kg/ha) followed by T_4)N:P:20:40) (2925 kg/ha) and T_2 (N @ 20 kg/ha) (2775 kg/ha).

2.13. Evaluation of fertilizer response and production potential of promising saline tolerant cultures of rice

The objective of the experiment was to study the fertilizer response and production potential of four saline tolerant cultures selected from the screening trials conducted during 1978-1980 along with the varieties and cultures developed at Rice Research Station, Vyttila. The treatment consisted of 8 varieties (V_1 - Vyttila-1, V_2 - Vyttila-2, V_3 - Vyttila 3, V_4 - Culture 53, V_5 - Anakodan, V_6 - C.23-2-1, V_7 - Culture 11, V_8 - CSR-4) and two levels of fertilizers (L_0 - control and L_1 - N:P:K - 20:40:0 kg/ha).

The crop was harvested in October and statistical analysis of grain yield data showed that there was no significant difference between the levels of fertilizers and that of interactions. But the varieties were found to differ significantly. The variety V_3 (Vyttila-3) was superior to all the varieties except V_4 (Culture-53), V_2 (Vyttila-2), V_8 - (CSR-4) and V_6 (C-23-2-1).

2.14. Effect of granular pesticides for control of rice pests on fish in Pokkali crop

The objective of the trial was to evolve a simple technology and safe chemical for control of major pests in Pokkali rice, namely, stem borer, leaf roller and rice bug without harm to fish and prawn.

The treatments consisted of (1) Control - no insecticide (2) Basudin - 10 G @ 10 kg/ha (3) Carobofuran 3 G @ 18 kg/ha. The experiment was laid out in a RBD with 8 replications. The variety used was Vyttila 1. Granular

insecticides were applied after releasing Tilapia (gill breathing) and prawn at the rate of 10 each in each plot before dismantling the mounds.

The crop was harvested in October and statistical analysis of the data showed that there was no significant difference in yield between treatments. This indicate that granular pesticides applied on mounds has no residual effect in controlling the pests like stem borer, leaf roller. There was no significant difference between treatments on fish and prawn mortality.

2.15. Tidal effect on the properties of Pokkali soils

The objective of the trial was to find out the effect of salinity (tidal effect in correlation with weather elements) on physico-chemical properties of Pokkali soils.

The technical programme consisted of collection of water and soil samples at periodical intervals for analysis.

The maximum tidal amplitude (from May to November) of 43 cm was recorded during the month of July on 12-7-87 and the next highest of 40 cm on 13-7-87.

During 1987, the month of June received the highest amount of rainfall of 822.8 mm followed by August (618.2 mm) November (283.2 mm) July (197.8 mm) September (163.7 mm), October (134.9 mm).

Water samples were collected on all full moon, new moon and Astami days from May to November and results revealed that the pH of water samples ranged from 3.69 to 8.20. The lowest value was recorded during the month of May and the highest during September. The salinity of

water samples also started decreasing from June onwards and maintained normal values throughout the cropping period, except 3.231 ppt experienced during 31-7-'87.

Soil samples collected a day after full moon and new moon days from May to November revealed that the pH values (1:2 Soil : Water) ranged from 3.10 to 4.99. Available nitrogen percentage ranged from 0.0078 to 0.0147. The highest values were recorded during June-July months. In each month samples collected during the new moon days showed a higher value as compared to those of full moon days.

Available phosphorus percentage ranged from 0.0036 to 0.0095, the highest value being 0.0095% recorded on 27-6-'87 (NM). The exchangeable potassium percentage ranged from 0.0105 to 0.061. The exchangeable sodium percentage ranged from 0.079 to 0.130. Higher values were observed during May and November. The exchangeable calcium percentage ranged from 0.032 to 0.074 with the higher values during the month of May.(For all soil analysis dry soil samples were used).

3. CROP PROTECTION

Rice Research Station, Moncompu

3.1. Avoidable losses to the rice crop at various growth stages due to infestation by rice pests

Objective: 1) To identify the most vulnarable stage in the crop growth of a medium duration high yielding variety in Kuttanad.

2) To assess the extent of crop loss due to concurrent infestation by major pests.

The experiment was laid out in RBD with 8 treatments as detailed in Table 15. The experiment was conducted in the Punja crop of 1987-'88 on a direct sown crop of variety Karthika.

The results are summarised hereunder:

In the case of incidence of silver shoot and dead heart in the vegetative phase, the treatments receiving plant protection with Furadan 3 G @ 1.0 kg ai/ha (P_1 and P_2) were significantly superior to the other treatments.

With regard to incidence of white earhead, the treatment ($P_1 + P_2 + P_3$) receiving plant protection throughout significantly reduced the white ear head but was on par with the treatment '$P_2 + P_3$'. Protection up to 30 DAS (P_1) only was on par with no protection (P_0).

There was significant difference among treatments in the control of leaf roller and the treatment $P_1 + P_2 + P_3$ was the best followed by $P_2 + P_3$ and $P_1 + P_3$.

In the case of Rice bug also the plots receiving plant protection after 60 DAS with Nuvacron at 0.5 kg ai/ha and methylparathion 0.25 kg ai/ha at dough stage significantly reduced rice bug incidence.

Incidence of Brownplanthopper was noticed in the vegetative phase only and observations recorded at 45 DAS showed significant difference among treatments and the treatments P_1 and P_2 and $P_1 + P_3$ showed no infestation.

There was significant difference among treatments in grain yield. The highest yield was recorded in treatment $P_2 + P_3$ (plant protection after 30 DAS) followed by the treatments $P_1 + P_2 + P_3$ and $P_1 + P_3$.

The results indicate the necessity of plant protection from 30 DAS till harvest. The incidence of all the major pests was observed at the late tillering stage and early reproductive stages and plant protection during these stages helped in reducing the damage to the crop. Application of Furadan 3 G @ 1 kg ai/ha after 30 days followed by application of Nuvacron 0.5 kg ai/ha at 60 DAT and methylparathion 0.25 kg ai/ha at dough stage significantly reduced the incidence of deadheart and silver shoot at the tillering stages and white earhead, rice bug and leaf roller at the reproductive stage which is reflected in the yield. The highest cost benefit ratio of 1.26 was obtained in the treatment $P_2 + P_3$ ie. Protection from 30 DAS till harvest while the treatment $P_1 + P_2 + P_3$ receiving protection throughout gave a C/B ratio of 1.16 only.

3.2. Replicated trial with dimilin

In order to evaluate the bio efficiency of dimilin against rice leaf folder this study was taken up. The experiment consisted of 3 levels of dimilin 25 WP (Table 16) Carbaryl 50 WP and Quinalphos 25 EC at the recommended doses. The test variety was Jaya, susceptible to leaf roller.

Table-15. Estimation of avoidable loss due to insect pests, punja, 1987-'88

Treatment	Silver shoot(%) 30 DAT	Silver shoot(%) 45 DAT	Dead heart (%) 30 DAT	Dead heart (%) 60 DAT	White ear head (%)	Leaf roller damaged leaves (%)	Brown plant hopper (Mean No.)	Rice bug (Mean No.)	Grain yield kg/ha	C/B ratio
1.No plant protection (Po)	6.3	7.45	7.22	10.89	12.76	3.84	80.23	11.66	3300	1.04
2.Protection upto 30 DAS with Furadan 3 G 1 kg ai/ha (P_1).	1.3	4.03	0.74	5.98	11.01	2.80	11.66	10.33	3535	1.03
3.Protection from 30 DAS to 60 DAS with Furadan 3 G 1 kg ai/ha (P_2)	6.0	3.17	5.87	2.16	8.88	2.41	5.66	10.00	3850	1.12
4.Protection from 60 DAS till harvest with monocrotophos 0.5 kg ai/ha + Methyl parathion 0.25 kg ai/ha at dough stage (P_3)	3.9	6.43	5.34	7.24	7.07	1.53	83.00	3.33	3980	1.19
5.P_1 + P_2	1.5	0.00	1.25	0.97	8.22	2.34	0.00	10.66	3920	1.05
6.P_1 + P_3	0.1	3.30	0.30	4.09	5.83	1.91	7.66	3.00	4430	1.22
7.P_1 + P_2 + P_3	0.00	0.00	0.00	0.73	2.58	0.65	0.00	2.33	4445	1.14
8.P_2 + P_3	5.2	3.70	6.06	1.82	4.35	0.79	3.00	2.33	4460	1.23
C D (0.05)	3.703	1.429	4.916	3.625	3.54	1.182	1.930	0.93	695	-

Table-16. Incidence of leaf roller and grain yield of Jaya rice, punja, 1987-'88.

Treatment	% of leaf roller damaged leaves		Yield (kg/ha)
	After 1st application	After 2nd application	
1.Dimilin 25 WP 200 g/ha	2.56 (9.23)	3.02 (9.96)	4400
2. ,, 300 ,,	2.49 (9.13)	3.01 (9.90)	4540
3. ,, 400 ,,	2.49 (9.11	3.13 (10.10)	4430
4.Carbaryl 50 WP 2.5 kg/ha	2.40 (8.87)	3.29 (10.31)	4250
5.Quinalphos 25 EC 1 lit./ha.	2.63 (9.37)	3.12 (10.06)	4430
6.Untreated control	2.78 (9.39)	4.65 (12.31)	4285
C D (0.05)	N S	N S	N S

The results showed no significant difference among treatments with regard to control of leaf roller and grain yield. However, Quinalphos @ 1 l/ha was found to be superior to other treatments. The same trend was observed during the previous season also.

It can be concluded that Quinalphos 25 EC @ 1 l/ha is a better treatment for the control of leaf roller than dimilin at the doses tested.

3.3.Evaluation of Dadaci against major pests of rice

To evaluate the efficiency of Dadaci against major pests of rice.

Three doses of Dadaci were compared with the commonly recommended insecticide Quinalphos 25 EC @ 750 ml/ha. The experiment was laid out in RBD with 4 replications, using the variety Jaya.

Table-17. Pest incidence and grain yield of Jaya rice, Punja, 1987-88

Treatments	Deadheart (%)	Silver shoot (%)	Leaf roller damage(%)	B P H (No.)	White ear head (%)	Grain yield (kg/ ha)
1.Dadaci 5.9 EC 750 ml/ha	3.78 (11.18)	3.56 (10.75)	2.94 (9.83)	16.75 (4.05)	15.06 (15.06)	3615
2.Dadaci 5.9 EC 1000 ml/ha.	4.21 (11.86)	4.03 (11.57)	2.66 (9.21)	11.75 (3.38)	15.07 (22.80)	3685
3.Dadaci 5.9 EC 1500 ml/ha	3.61 (10.97)	3.36 (10.58)	3.65 (11.02)	11.75 (3.40)	12.57 (20.65)	3730
4.Quinalphos 25 EC 750 ml/ha	3.22 (10.32)	2.97 (9.85)	2.41 (8.83)	6.50 (2.52)	9.13 (17.47)	4135
5.Untreated control	5.15 (13.13)	4.15 (11.61)	2.87 (9.75)	37.00 (6.07)	16.93 (24.31)	3620
C D (0.05)	N S	N S	N S	0.72	3.78	N S

A statistical analysis of the data showed no significant difference among treatments in the control of dead heart, silver shoot and leaf roller (Table 17). But Quinalphos 25 EC @ 750 ml/ha recorded the lowest incidence of these pests. Application of quinalphos was found to be significantly superior to all other treatments for the control of BPH but it was on par with Dadaci at 1500 ml/ha for controlling white ear head. There was no significant difference in grain yield but plots treated with quinalphos recorded the higher yields.

It is concluded that Dadaci, which is a combination of Buprofezin - a chitin synthesis inhibitor - and Deltamethrin - a synthetic pyrethroid - has no superiority over the commonly used insecticide quinalphos for the control of rice pests.

3.4. Evaluation of plant products for pest management

Objective: To evaluate the effect of plant products in controlling rice pests.

Five plant products were compared with the recommended dose of Nuvacron and an untreated control. The experiment was laid out in RBD with 3 replications. The treatments were applied on need basis twice.

The incidence of gall fly and stem borer was very low in the experimental plots during vegetative phase. There was significant reduction in BPH population in plots treated with Nuvacron, Acorus and Garlic. In the case of white earhead there was no significant difference among treatments. However, garlic treated plots recorded the lowest incidence of white earhead followed by Nuvacron

and Acorus. Grain yield also showed no significant difference. But the plots treated with garlic recorded the highest yield (Table 18).

Table-18. Pest incidence and grain yield as influenced by plant production, punja, 1987-'88.

Treatment	BPH (Mean No.)	Stem borer WE (%)	Grain yield (kg/ha)
1.Acorus calamias Water extract 4%	53.30 (7.19)	2.56 (8.90)	3765
2.Kacholam water extract 5%	86.60 (9.26)	3.13 (9.96)	3465
3.Onion crude extract 5%	117.60 (10.84)	3.20 (10.26)	3235
4.Garlic crude extract 5%	60.30 (7.61)	1.86 (6.42)	3915
5.Neem leaf crude extract 5%	85.30 (9.20)	3.23 (10.31)	3700
6.Nuvacron 600 ml/ ha	40.60 (6.27)	1.93 (6.46)	3750
7.Untreated control	125.60 (11.20)	4.50 (12.23)	3615
C D (5%)	2.34	N S	N S

3.5. Multidisciplinary project on pests and diseases

The population dynamics of crop pests and occurrence of disease in relation to weather factors were studied in this experiment.

An observational plot of rice was fixed up without any plant protection measurers. Observations on pests and diseases were recorded on fixed days in every standard week from three fixed sample plots of 1 m^2. The variety used was Pavizhom.

The observations on pests and diseases recorded during the punja season of 1987-'88.indicated the following.

At the seedling stage there was heavy incidence of thrips. There was a heavy incidence of BPH at the active tillering stage in the observational plots, but the population declined afterwards. Leaf roller incidence started at the active tillering stage and persisted till maturity of the crop, the attack being moderate. There was moderate infestation of rice bug. Stem borer incidence appeared late in the season and there was only low incidence of white earhead.

3.6. Pest management trial

Objective: To test the efficiency and economics of pest management in relation to resistant and susceptible varieties.

Two resistant varieties IET 8116 and IET 8111 were were compared with the susceptible variety Jaya, for their performance under protected and unprotected conditions.

The results (Table 19) show that the three varieties reacted similarly to the incidence of gall midge, stem borer (dead heart and white earhead) and leaf roller, under pest management. There was no significant difference between resistant and susceptible varieties in the incidence of these pests when there was no pest management. IET 8116 recorded the highest yield under pest management followed by Jaya and IET 8111. In the resistant cultures IET 8116 and 8111, there was no significant difference in yield of plots under protected (pest management) and unprotected conditions (no pest management).

Table-19. Pest Management Trial: Pest incidence and grain yield.

Treatments	Silver shoot (%)		Dead heart (%)		White ear head (%)	LR damaged leaves (%)	Grain yield (kg/ha)
	40 DAT	60 DAT	40 DAT	60 DAT			
IET 8116 protected	3.37 (10.57)	4.19 (11.69)	4.78 (12.58)	3.35 (10.51)	3.82 (11.19)	5.67 (13.52)	4030
IET 8116 Unprotected	5.75 (13.78)	8.22 (16.62)	8.50 (16.89)	11.43 (19.70)	7.85 (16.23)	10.85 (19.14)	3775
IET 8111 protected	3.44 (10.63)	4.42 (12.12)	4.88 (12.55)	3.77 (11.20)	4.01 (11.43	4.60 (12.30)	3775
IET 8111 Unprotected	6.60 (14.87)	8.20 (16.61)	8.70 (17.12)	11.55 (19.84)	7.95 (16.34)	11.02 (19.32)	3335
Jaya protected	4.35 (12.06)	4.09 (12.01)	6.17 (14.27)	3.94 (11.41)	4.10 (11.56)	5.07 (12.78)	3955
Jaya Unprotected	6.90 (15.25)	8.20 (16.62)	10.32 (18.63)	12.63 (20.93)	9.96 (18.32)	11.51 (19.84)	3065
C D (0.05)	1.58	1.56	3.19	1.95	2.80	3.69	445

But the susceptible variety Jaya recorded significantly higher yield under protected conditions.

3.7. Insecticide evaluation trial (AICRIP)

The relative efficiency of selected insecticide on the control of major pests of rice was studied in this experiment.

Ten insecticides (Table 20) were compared using Mo 6 as test variety. The insecticides were applied twice, the first being prophylatic and the second need based. There was significant difference in the incidence of stem borer, gall midge and leaf roller among treatments. All the granular insecticides were found significantly superior to EC formulations in controlling dead heart. Among the granules, Furadan, Basudin and Coroban recorded the lowest incidence of dead heart. Among EC formulations Coroban 40 EC was the best. Padan 4 G recorded the lowest incidence of white ear head followed by Furadan 3 G and Coroban 40 EC.

At 30 DAT Furadan and Coroban recorded the lowest incidence of Gall midge, while at 50 DAT Padan and Furadan granules recorded the lowest incidence. Among the EC formulations Coroban 40 EC was the best in controlling gall midge.

EC formulations were found superior to granules in controlling leaf roller and Coroban 40 EC and Zolone 35 EC recorded the lowest leaf roller damage.

Padan 4 G was significantly superior to all the other treatments in yield. Mocap and Basudin granules were the next best. Among the EC formulations Coroban 40 EC showed superiority in yield also.

Table-2C. Insecticide Evaluation Trial : Data on pest incidence and grain yield.

	Treatments	Dead heart incidence		Silver shoot		Grain yield (kg/ha)
		30 DAT	50 DAT	30 DAT	50 DAT	
T_1	Padan 4 G 1.5 kg ai/ha	1.08 (4.87)	4.42 (12.10)	1.88 (7.79)	2.07 (8.16)	5145
T_2	Furadan 3 G 1.0 kg ai/ha	0.00 (0.00)	3.21 (10.29)	0.00 (0.00)	2.33 (8.70)	4255
T_3	Coroban 40 EC 0.5 kg ai/ha	0.94 (5.52)	4.44 (12.13)	0.27 (1.71)	5.15 (13.12)	4270
T_4	Dadaci 5.9 EC 0.09 kg kg/ha	2.83 (9.69)	7.38 (15.73)	2.71 (9.51)	7.28 (15.60)	3855
T_5	Zolone 35 EC, 0.5 kg ai/ha.	2.88 (9.78)	7.06 (15.39)	2.20 (8.52)	6.15 (14.38)	3950
T_6	Mocap 10 G 1 kg ai/ha	0.86 (4.28)	4.01 (11.53)	1.13 (5.99)	2.57 (9.14)	4610
T_7	Coroban 10 G 1 kg ai/ha	0.00 (0.00)	3.99 (11.50)	0.00 (0.00)	3.29 (10.44)	4070
T_8	Asataf 75 DP 0.5 kg ai/ha.	2.30 (8.70)	7.95 (16.22)	2.57 (9.21)	6.02 (14.21)	3940
T_9	Basudin 10 G 1.5 kg ai/ha.	0.41 (2.10)	3.69 (11.09)	0.28 (1.81)	3.11 (10.08)	4455
T_{10}	Untreated control	3.85 (11.34)	10.84 (19.24)	4.96 (12.82)	8.74 (17.13)	3940
	C D (0.05)	3.92	2.19	2.47	2.18	340

The following conclusions are drawn from the results:

The granular insecticides are more effective against stem borer and gall midge. Padan, Mocap and Basudin granules will lead to higher yields. Among the sprays Coroban 40 EC is the best.

3.8. Epidemiological studies on important rice diseases in Kuttanad.

The objective of the experiment was to study the influence of weather factors on the incidence and severity of different diseases of rice.

Fortnightly planting of four varieties viz., T(N_1), Jyothi, Mo 6 and Mo 7 were (Jaya and Bhadra were replaced by Mo 6 and Mo 7 during this season) done and the incidence and intensity of disease incidence recorded.

The incidence of all diseases was comparatively low during this season on all the varieties. Jyothi was found to be more susceptible to sheath blight and sheath rot diseases as in the previous season. In yield, Mo 6 and Mo 7 were superior to the other 2 varieties.

3.9. Screening rice varieties against important diseases

The relative tolerance of 171 rice varieties available at the Rice Research Station, Moncompu was studied in this experiment.

Out of the 171 cultures, 87 recorded a low sheath blight incidence score of below 3 on the 0-9 scale whereas, 82 cultures recorded a score of less than 3 in the case of sheath rot. None of the varieties was free from sheath blight or sheath rot attack. Forty nine entries recorded a score of less than 2.0 in the case of brown spot leaf

infection and 5 entries less than 1.0 in the case of grain infection. With regard to stackburn incidence, 15 cultures recorded a score below 1.0 in leaf infection and 21 cultures a score less than 2.0 in grain infection.

The experiment will be continued.

3.10. Evaluation of common fungicides for the control of stackburn disease of rice

To screen out an efficient fungicide for the control of the disease and to find out the proper time of application of the fungicide.

The treatments included 7 fungicides, 3 times of application and a control. Fungicides : 1)Bavistin - 1 g/l, (2)Hinosan - 1 ml/l, (3) Fytolan - 3 g/l, (4)Vitavax--1 g/l), (5) Difolatan - 3 g/l, (6) Dithane M-45 - 4 g/l, (7)Bordeaux mixture - 10 g/l (stabilized Bordeaux mixture) and (8) Control.

Time of application - (1) 40 DAS, (2) 60 DAS, (3) 80 DAS.

The test variety was Jyothi.

During punja season of 1987-'88, no significant difference was obtained among the treatments in the case of leaf infection as well as grain infection. However, the minimum leaf infection was obtained in the case of Fytolan sprayed at 40 DAS followed by Hinosan at 40 DAS and 60 DAS and Dithane M-45 at 40 DAS. The minimum grain infection was recorded in the case of Fytolan sprayed at 60 DAS.

There was significant difference in grain yield, the maximum being recorded in the plot sprayed with stabilized

Bordeaux mixture applied at 80 DAS. With regard to straw yield, there was no significant difference among the treatments. Similar results were obtained during the last season also.

3.11. Chemical control of sheath blight (AICRIP)

The efficacy of fungicidal formulations on the control of sheath blight disease of rice was investigated in this trial using Jyothi as the test variety. The treatments are listed in Table 21.

There was significant difference among treatments in sheath blight incidence and spread. The minimum disease incidence was noticed in the case of plots sprayed with Bavistin (1 g/l) and Validacin (2 ml/l). The minimum spread was obtained in plots treated with Moncut (1 g/l) followed by Validacin (2 ml/l). There was no significant difference among treatments with regard to grain and straw yields.

3.12. Sheath rot management trial

Objective : To study the disease incidence on 7 breeding lines (IET 7592, 7895, 8616, 8613, 8611, 7804 and 7302) both under protected and unprotected conditions.

There was significant difference in disease incidence and spread. As was expected, the minimum incidence and spread were noted in the protected crop. IET 7592 recorded the minimum disease incidence (score 1.47) as well as spread (11.88% of hills affected). Under unprotected conditions, this variety recorded 3.85 and IET 7895, 3.80. The others recorded a score above 5. The interaction effect was not significant in either case (protected and

Table-21. Sheath blight incidence and spread and grain yield of Jyothi rice, punja, 1987-'88.

Tr. No.	Treatment	Mean disease incidence (score 0-9 scale)	Mean disease spread (% of tillers affected)	Grain yield (kg/ha)
1.	Bavistin (1 g/l)	1.13	14.56	2700
2.	Rizolex (1 g/l)	1.48	19.46	2800
3.	Topsin (1 g/l)	2.27	30.92	3070
4.	Validacin (2 ml/l)	1.13	13.78	2830
5.	Dithane M-45 (2.5 g/l)	2.17	26.35	2800
6.	Satum (2 ml/l)	1.57	16.41	3170
7.	Dithane M-45 (2.5 g/l) + Satum (2 ml/l)	2.50	22.78	2700
8.	Mancut (1 ml/l)	2.47	23.40	2900
9.	Mancut (1 g/l)	1.73	13.67	2630
10.	Control	3.27	32.75	2830
11.	Ziride (2 g/l)	2.03	24.10	2270
12.	Aureofunginsol (0.1 g/l)	1.93	33.39	2500
13.	Hinosan (1 ml/l)	1.57	16.91	2530
14.	Difolatan (1.25 g/l)	1.80	26.17	2870
15.	Stabilized Bordeaux mixture (1%)	1.97	31.70	2300
16.	Kitazin (1 ml/l)	2.10	27.65	2500
17.	Calixin (1 ml/l)	3.11	27.57	2300
	C D	1.24	10.36	N S
	C D (for missing plot)	1.44	12.04	

unprotected). No significant difference was obtained in the case of grain yield whereas that of straw yield was significant wherein IET 7592 ranked first (9.4 t/ha).

3.13. Disease management trial (AICRIP)

Objective: To test the efficiency of disease management in relation to resistant and susceptible varieties.

There were 6 treatments with 3 varieties (Mo 6, Mo 7, Jyothi) and 2 seed treatments (treated and untreated).

During the season there was significant difference between varieties and treatments in the case of sheath blight incidence. The lowest score was recorded by Mo 6 (1.58 under no seed treatment) followed by Mo 7. Sheath blight incidence was significantly lower in treated crop when compared to the untreated one for all the three varieties.

3.14. Studies on N_2 fixing micro organisms in Kuttanad soils

Objectives : (1) Qualitative and quantitative study of microorganisms present in Kuttanad soils. (2) Isolation and screening of N_2 fixing micro organisms with special reference to blue green algae (BGA) for use in rice culture.

The three different types of Kuttanad soils viz., kayal, kari and karapadam were analysed for different groups of microorganisms like bacteria, fungi, actinomycetes, N_2 fixing bacteria and blue-green algae by serial dilution plating technique using appropriate media and their reaction to acidity studied.

The data on qualitative and quantitative enumeration are given in Table 22.

Table-22. Microbial population (g dry soil)

Type of soil	Bacteria x 10^5	Fungi x 10^2	Actinomyc- x 10^3	N_2 fixing bacteria x 10	BGA x 10
Kayal	122.6	72.5	80.0	8.0	9.0
Karappadam	116.5	41.5	97.0	60.0	13.0

Penicillium, Aspergillus and Rhizopus dominated the fungal population. N_2-fixing bacteria, when transferred to fresh medium, did not come up. Among the 5 strains of blue-green algae obtained, one was identified as **Anabaena,** 2 strains as Nostoc and 2 were unidentified.

The BGA isolates obtained were made into pure cultures. All BGA isolates except Nostoc showed very low growth rate. However, their ability to tolerate acidity will be studied **further.**

The population of bacteria and fungi was higher in kayal soil whereas the population of actinomycetes, N_2 - fixing bacteria and BGA was higher in karappadam soil. Further studies are being undertaken with the isolated micro-organisms.

Rice Research Station, Kayamkulam

Crop Improvement

1. Evolution of high yielding photosensitive varieties of rice suited to different Agro-climatic zones

With the objective of evolving high yielding semi-tall photosensitive varieties of rice suited to the second crop season of Onattukara, hybridization work involving different combinations was initiated at the Rice Research Station, Moncompu and the hybrid seedlings were planted at

the Rice Research Station, Kayamkulam and selection practised. The photosensitive cultures evolved at other research stations were also tested for their adaptability in Onattukara. During 1987-88 sixty hybrid cultures involving five parential combinations received from Pattambi were tested in an initial evaluation trial:

Sl.No.	Culture Nos.	Parentage
1	Nos. 8779 - 8791	Ptb-20 x Mashoori
2	Nos. 8792 - 87100	Ptb-20 x Jaganath
3	Nos. 87101 - 87113	Ptb-20 x H4
4	Nos.87114 - 87115	Co-25 x Jaganath
5	Nos.87116 - 87118	Co-25 x H4

The cultures yielding more than 4000 kg/ha grain are proposed to be advanced in a comparative yield trial during the second crop season of 1988-'89 to locate the best among them. The following are the cultures selected.

1) Cul-8780 (2) Cul-8781 (3) Cul-8793 (4) Cul-87100
5) Cul-87101 (6) Cul-87103 (7) Cul-87106 (8) Cul-87122
9) Cul-87137.

2. Mutation studies on variety Ptb-20 by gamma irradiation

Objective : To evolve beneficial mutants of Ptb-20 with high yield.

Technical programme : Irradiation of Ptb-20 seeds at three doses by irradiation at 11 kr, 22 kr, 33 kr.

Seeds of the variety Ptb-20 were irradiated at the Radio Tracer Laboratory, Vellanikkara on 29-7-1987 at three different doses viz., 11 kr, 22 kr and 33 kr and planted on 12-9-1987. The M_1 generation of seeds was harvested on

15.1.1988 and M_2 seeds collected and preserved for raising M_2 generation.

3. Genetic refinement of Ocrumundakan

Objective: This project is proposed to identify a superior variety by mass selection and bulk progeny testing in the local variety "Oorumundakan" and to develop a high yielding tall indica variety suited to the illdrained, saline Oorumundakan area of Karunagappally and Karthikappally taluks during second crop season.

The seeds collected during 1986-'87 were raised in the typical Oorumundakan area at Govindakuttom during August, 1987. Two hundred promising earheads of each type (single earhead from one hill) were selected for conducting replicated progeny row trial during 1988-'89.

Crop Management

Permanent Manurial Trial

Objective: To study the effect of continuous application of nitrogen both as organic and inorganic as well as phosphoric acid and potash on the soil fertility and yield of rice.

Technical programme

Treatments

1. 80 kg N/ha as Cattle Manure.
2. 80 kg N/ha as Ammonium Sulphate.
3. 80 kg N/ha as Ammonium Sulphate + 40 kg P_2O_5/ha as Super Phosphate.
4. 80 kg N/ha as Ammonium Sulphate + 40 kg K_2O/ha as Muriate of Potash.

5. 40 kg P_2O_5/ha as Super Phosphate + 40 kg K_2O/ha as Muriate of Potash.
6. 80 kg N/ha as Ammonium Sulphate + 40 kg P_2O_5/ha as Super Phosphate + 40 kg K_2O/ha as Muriate of Potash.
7. 80 kg N (60 kg N/ha as Ammonium Sulphate + 20 kg N/ha as Cattle Manure) + 40 kg/ha each of P_2O_5 and K_2O as Potash respectively.

Test variety : Jaya

There was significant difference in the grain and straw yields due to the effect of treatments. The treatments receiving cattle manure along with straight fertilizers (T_7) and those that receive cattle manure along (T_1) recorded the maximum yields and was statistically superior to all other treatments.

C O C O N U T

4. Varietal Improvement

Rice Research Station, Vyttila.

4.1 Studies on growth, performance and disease resistance of coconut cultivars and hybrids under disease stress conditions.

The objective of this trial was to study the growth, performance and disease resistance of important coconut cultivars and hybrids under disease stress conditions at Vyttila.

According to the technical programme 9 treatments consisting of the following 5 hybrids and 4 cultivars were planted with 10 replications.

Hybrids

1. Tall (T) x Dwarf (D)
2. Dwarf(D) x Tall (T)
3. Laccadive Ordinary (LO) x Ganga Bondam (GB)
4. Tall (T) x Yellow Dwarf (YD)
5. Tall (T) x D (NCD)

Cultivars

6. WCT (West Coast Tall)
7. LO (Laccadive Ordinary)
8. AO (Andaman Ordinary)
9. Cochin China (CC) for 7 replications and Andaman Giant (AG) for 3 replications.

The highest number of nuts was produced by Andaman Giant (56.3 nuts) followed by D x T (55.3). The highest intensity root (wilt) was observed in LO followed by T x D (NCD) and AO. Cochin China was completely free from the disease followed by D x T.

The highest number of leaves was affected by leaf rot in AO, T x D (NCD), LO and AG, DxT, T x YD and Cochin China was completely free of leaf rot (Table 23).

Table 23. Nut of yield, total number of leaves on the crown root (wilt) disease intensity and number of leaves affected by leaf rot.

Treatments	Total No. of leaves	No.of nuts/ palm	No.of leaves affected by leaf rot	Root (Wilt) disease intensity
T x D	24.6	40.0	0.8	6.2
D x T	23.6	55.3	0	0.4
LO x GB	22.1	43.1	1.0	2.6
T x YD	23.3	49.6	0	4.3
T x D (NCD)	23.3	38.2	3.1	13.6
WCT	22.2	47.3	1.7	9.4
LO	22.4	46.9	3.0	15.0
AO	23.0	42.7	3.2	11.4
Cochin China	23.6	42.4	0	0
AG	22.7	56.3	3.0	7.9

5. Crop Management

R.A.R.S., Kumarakom

5.1 TIDAL effect on the physico-chemical properties of Chira (bund) and its influence on the yield and disease incidence in Coconut palms.

The experiment aimed to study the influence of tidal water on the properties of soil, yield of Coconut and the intensity of root (wilt) disease.

The bund and channel system existing at Kumarakom was used for the experiment. The channel was desilted and the silt used for strengthening the bund. Provision was made for the free flow of water in the channel from the nearby Vembanad lake during the tides. The Physico-Chemical properties of the soil and Channel Water were studied at quarterly intervals under different systems of Cropping like Coconut alone, Coconut + Banana and Coconut + Cocoa. The properties of soil from a control bund were also studied during the period.

Work done

The Physical properties of soil like apparent density absolute sepecific gravity, Maximum water holding capacity percent of pore space, volume expansion etc. were studied along the period and data recorded. Chemical properties of soil like pH, EC, Organic Carbon, available P_2O_5 and K_{20} etc. were estimated and data recorded. Water soluble constituents like Carbonate, Bicarbonate, Calcium, Magnesium, Chloride, Sulphate, Iron, pH, EC etc. were also estimated from the soil samples collected from the trial bunds.

The data so far gathered revealed no spectacular change in the soil properties. The yield of nuts increased under the intercropping system. The root (wilt) disease intensity was low in the bunds benefitted by the tidal flow of water.

5.2 Effect of growing and incorporation of different green manure crops and its influence on diseased and apparently healthy coconut palms.

Objectives

1) To study the effect of growing and incorporation of different green manure crops on the disease intensity of diseased palms and on the occurance of disease in apparently healthy palms (WCT).

2) To investigate the effect of the above practices on the yield of apparently healthy and diseased palms.

The treatments included 4 green manure crops

(T1 - Cowpea, T2 - Sesbania, T3 - Daincha, T4 - Sunhemp) and a control (T5).

The XIIth post treatment indexing for root (wilt) disease intensity was done during the season and the yield of nuts recorded. The mean data as compared to the pretreatment values are presented in the Table 24.

Table 24. Disease index, Green matter yield and nut yield of coconut CV.WCT

A. Apparently healthy palms.

Sl. No.	Treatment	Disease index Pre-treatment values	XIIth post treat. index	Difference	Pre-treat. nut yield	Nut yield	Yield of green manure Kg/palm
1.	Cowpea	15.66	13.30	-2.36	32.54	37.88	12.00
2.	Sesbania	16.04	17.00	+0.96	42.63	51.68	10.50
3.	Daincha	20.42	15.90	-4.52	42.84	46.00	7.60
4.	Sunhemp	20.53	13.00	-7.53	34.42	35.88	5.13
5.	Control	16.37	16.60	+0.23	33.21	34.63	--

B. Diseased palms

1.	Cowpea	35.18	18.5	-16.68	26.17	46.88	10.00
2.	Sesbania	36.09	22.3	-13.79	36.38	55.75	9.00
3.	Daincha	44.64	23.0	-21.64	23.71	34.63	6.00
4.	Sunhemp	33.88	21.4	-12.40	28.84	35.00	6.50
5.	Control	36.79	17.8	-18.99	26.79	31.63	--

A general reduction in the disease index was noticed in both the apparently healthy and diseased palms, compared to the pre-treatment values, though the treatment effects were not significant. The reduction in disease intensity index was comparitively higher in palms having higher pre-treatment index values, both in apparently healthy and diseased palms.

5.3 Response of diseased and apparently healthy palms to fertilizer levels and organic manuring.

Objectives

1. To study the response of apparently healthy and diseased palms to fertilizer levels and organic manuring.

2. To find out the effect of organic manuring in combination with chemical fertilizers on the yield of diseased and apparently healthy palms.

Treatments

L.1. Control
L.2 NPK @ 0.34Kg : 0.17Kg : 0.68 Kg/palm as fertilizer
L.3 50% of L2 as fertilizer and 50% as FYM
L.4 75% of L2 as fertilizer and 25% as FYM
L.5 NPK @ 0.5 : 0.3 : 1.2 Kg/palm as fertilizer
L.6 50% L5 as fertilizer and 50% as FYM
L.7 75% of L5 as fertilizer and 25% as FYM.

The experiment is being conducted in the farmers' fields in 4 locations each in Laterite and alluvial soil types. The Xth post treatment indexing for disease intensity was done during the period (Table 25)

Table 25. Yield of nuts and disease indices of coconut palms in different soil types.

A. LATERITE SOIL

(i) Apparently healthy palms.

Treatment	Pre-treatment disease index	Post treat: index	Pre-treat: Yield/palm per annum	Post treat: yield
L.1	13.1	12.2	75	42
L.2	14.4	10.7	58	29
L.3	12.3	11.2	54	41
L.4	10.5	9.9	60	47
L.5	10.7	11.0	81	44
L.6	12.0	11.6	61	39
L.7	11.7	12.3	78	42
(ii) Diseased palms				
L.1	17.8	14.1	57	25
L.2	17.0	17.5	53	28
L.3	17.8	18.1	48	32
L.4	19.7	14.5	45	29
L.5	22.1	16.0	51	26
L.6	23.6	15.7	58	27
L.7	21.4	15.8	55	26
B. ALLUVIAL SOILS				
(i) Apparantly healthy palms				
L.1	15.9	10.3	66	41
L.2	18.0	9.4	84	69
L.3	17.1	9.7	81	65
L.4	16.1	9.6	79	56
L.5	14.0	9.9	75	51
L.6	14.0	9.0	59	61
L.7	18.7	9.6	69	59

(ii) Diseased palms

Treatment	Pre-treatment disease index	Post treatment index	Pre-treat: yield nuts/ palm per annum	Post treat: yield nuts/ per annum
L.1	33	13.9	59.8	35.1
L.2	33	13.6	52.9	46.3
L.3	30	14.7	48.8	32.7
L.4	29	13.7	50.7	35.2
L.5	30	14.3	71.5	54.5
L.6	32	15.2	64.8	43.9
L.7	25	14.0	53.6	37.2

There was a general decrease in the intensity of the disease in apparently healthy and diseased palms in both the soil types, the decrease being more pronounced in palms with high pretreatment disease index. However, the treatments did not influence the yield of nuts, female flower production and post treatment disease indices, both in alluvial and laterite soil types.

5.4 Standardization of doses and sources of magnesium for root (wilt) affected palms.

This experiment was started in 1987 to find out the optimum dose of magnesium and its cheapest source for root (wilt) disease affected palms.

The treatments comprised of combinations of 2 sources (Mg SO4, Magnesite) and 4 doses (200, 400, 600, 800 g per palm).

The study is in progress.

Rice Research Station, Vyttila

5.5 Response of diseased and apparently healthy palms to fertiliser levels and organic manuring (in reclaimed soil type)

The objective of the experiment was to study the response of diseased and apparently healthy palms to different fertilizer levels and organic manuring and to estimate the occurrence and spread of the disease in healthy palms under different fertiliser levels and organic manuring.

The technical programme consist of 7 treatments with 4 replications.

Treatments:	N	P_2O_3	K_2O
L1	0	0	0
L2	0.34	0.17	0.68
L3	50% of fertilizer in L2 + Organic manure to substitute 50% of fertiliser		
L4	75% of fertiliser in L2 + organic manure to substitute rest 25%		
L5	0.5	0.32	1.2
L6	50% of fertiliser in L5 + organic manure to substitute 50% of fertilizer.		
L7	75% of fertiliser in L5 + organic manure to substitute 25% fertiliser dose.		

Results:

A. Apparently healthy palms

A reduction in disease intensity was noted in all the treatments (Table 26). In all the treatments except L7 an increase was noted in total number of leaves. The highest increase was in L5. With regard to yield of nuts, the treatments except L3 showed a decrease. The highest decrease was noted in L7 followed by L6 and L5 (Table 27).

B. Diseased Palms

There was a decrease in disease intensity in all the treatments (Table 28). The maximum decrease in disease intensity was noted in L5. In all the treatments except L3 there was an increase in the number of leaves. There was a decrease in the yield of nuts in all the treatments. The maximum decrease was noted in L7 followed by L2. (Table 29)

Apparently healthy palms

Table 26. Disease intensity at the 10th indexing (difference between 1st and 10th indexing)

Treatment	Ponnu-runni	Vyttila	South Chittoor	Edaya-kunnam	Mean
L1	- 6.89	- 0.97	- 4.60	- 3.93	- 4.10
L2	- 0.33	- 4.55	- 2.45	- 7.45	- 3.70
L3	- 2.75	- 8.93	- 4.11	- 2.72	- 4.63
L4	- 5.05	- 2.48	- 6.15	- 1.99	- 3.92
L5	- 7.29	- 6.32	- 4.72	- 8.82	- 6.79
L6	- 2.41	+ 1.43	- 6.81	- 1.56	- 2.34
L7	- 1.14	+ 1.39	- 5.68	- 0.27	- 1.43

Apparently healthy palms

Table 27 Total No. of nuts/palm at 10th indexing (Difference between 1st and 10th indexing)

Treatment	Ponnu-runni	Vyttila	South Chittoor	Edaya-kunnam	Mean
L1	- 3.25	+ 0.50	- 18.00	+ 13.00	- 1.94
L2	- 18.50	+ 24.00	- 23.50	+ 4.25	- 3.44
L3	- 16.00	+ 45.25	- 17.00	+ 5.75	+ 4.50
L4	- 13.75	+ 31.50	- 23.75	- 10.50	4.13
L5	- 13.25	- 3.75	- 40.25	+ 10.55	-11.68
L6	- 28.25	- 5.25	- 32.50	- 5.75	-17.94
L7	- 18.50	- 60.75	- 7.00	- 10.25	-24.13

DISEASED PALMS

Table 28. Mean values of disease intensity at 10th indexing (Difference between 1st and 10th indexing)

Treatment	Ponnuru-nni	Vyttila	South Chittoor	Edaya-kunnam	Mean
L1	- 20.18	- 12.78	- 4.64	- 8.22	- 11.46
L2	- 11.38	- 16.65	- 9.90	+ 8.22	- 7.43
L3	- 12.22	- 9.36	- 9.91	-11.08	- 10.64
L4	- 15.46	- 12.84	- 3.67	- 6.62	- 9.65
L5	- 30.09	- 20.42	- 5.37	- 9.62	- 16.38
L6	- 18.46	- 7.55	- 5.94	- 8.03	- 10.00
L7	- 35.44	- 10.42	- 6.07	- 7.24	- 14.79

Diseased palms

Table 29. Total No. of nuts/palm at 10th indexing (Difference between 1st and 10th indexing)

Treatment	Ponnuru-nni	Vyttila	South Chittoor	Edaya-kunnam	Mean
L1	- 4.25	+ 20.50	- 26.00	- 23.50	- 8.31
L2	-16.25	- 17.67	- 22.25	- 0.50	-13.92
L3	+ 1.75	- 20.50	- 47.75	- 13.75	- 9.79
L4	-23.50	+ 13.75	- 39.75	- 6.00	-13.88
L5	- 1.75	+ 11.00	- 21.75	- 34.00	-11.65
L6	- 2.75	- 14.25	- 7.50	- 5.25	- 7.44
L7	-11.50	- 15.50	- 24.00	- 20.50	-17.88

5.6 Quality analysis of coconut endosperm obtained from palms of varying intensities of root (wilt) disease.

The quality of the endosperm obtained from palm of varying intensities of root (wilt) disease was investigated in this experiment. The treatments were:

1. Apparently healthy palm
2. Palms with disease index 15 - 25
3. Palms with disease index 26 - 35
4. Palms with disease index above 35

The results indicated no significant variation between the apparently healthy and diseased palms in the following aspects: Copra recovery, moisture content of Kernal, total sugar, protein amino acids, oil, Na, Ca, K and Mg contents of endorsperm.

5.7 Nutrient status of coconut water at different stages of development in palms of varying intensities of root (wilt) disease.

Objective: To study the nutrient status of coconut water at different stages of development in diseased palms.

The major treatments were the same as described in the experiment"quality analysis of coconut endosperm". In addition there were 4 minor treatments representing the different stages of development of nut, viz. 6 month, 8 month, 10 month and mature stages. The inflorescences were tagged at the time of opening and one nut from each bunch was taken for analysis.

Coconut water drawn from mature nuts was analysed for total sugar, reducing sugar, amino acid, protein, ash & minerals (Na, K, Ca, Mg & P). The amount of protein was trace in all the samples.

Statistical analysis showed that reducing sugar, amino acid and phosphorus contents were significant for the different treatments. Reducing sugar and phosphorus contents were high in the nuts of palms in the advanced stage of root (wilt) disease. However, the Amino acid content was low in these nuts. The other parameters were not significant.

5.8. RNA - DNA contents in coconut palms as influenced by root (wilt) disease

The RNA & DNA contents in healthy and diseased palms (root wilt) of varying intensity were estimated in this study.

Five groups of coconut palms CV. WCT of the same age were selected for the study, as detailed below:

T1 - Healthy

T2 - Apparently healthy

T3 - Palms having initial stage of root(wilt) disease

T4 - Palms having medium stage of root (wilt) disease

T5 - Palms having advanced stage of root(wilt) disease.

There were five palms in each group. Samples of root and leaf were analysed for nucleic acid, RNA and DNA.

Table 30. Nucleic acid content of leaf tissues in coconut palms as influenced by root (wilt) disease intensity.

Treatment	Total nucleic acid mg/g tissue	Ribonucleic acid mg/g tissue	Deoxyribo nucleic acid mg/g tissue
T1	20.36	17.80	37.17
T2	20.64	17.43	26.89
T3	21.07	17.42	28.26
T4	19.97	17.99	24.14
T5	21.75	18.51	27.99

The data did not show much variation between the treatment. However the DNA content of healthy palms was found to be higher than in the other groups (Table 30)

5.9 Nature of protein fractions in coconut palms as influenced by root (wilt) disease.

Objective: To study the possibility of differentiating healthy seedlings from the diseased ones in the early stages.

Coconut seednuts collected from healthy and diseased mother palms, were planted in a compact area. The protein pattern of leaf and root samples of mother palms were studied and the study is continued on the seedlings at intervals of 6 months for 5 years. The disease symptoms will be monitored during the period.

It is seen that the electrophoretic pattern of leaf protein of healthy mother palms is different from that of the diseased palms. The experiment is continued.

6. Crop Protection

RARS, Kumarakom

6.1 Mycoplasma as possible causal agent of the root(wilt) of coconut.

This project was initiated during December, 1986 to study the influence of oxytetracyclin and pencillin on the symptomatology of root (wilt) disease in order to confirm the etiology of the disease. Field trials were laid out at the RARS, Kumarakom and RRS, Kayamkulam in Randomised Block Design with 3 treatments and 7 replications. The treatments included quarterly application of oxytetracycline and penicillin through stem injection using pressure injector. The palms in different treatments were indexed for root (wilt) intensity at six monthly intervals. The

results so far obtained showed no significant difference between treatments. The slight differences observed were only seasonal in nature.

Table 31. Chemotherapy against root (wilt) disease
disease indices

Treatment	RARS, Kumarakom		RRS, Kayamkulam		
	Pretreatment 6/87	Disease index 12/87	Pretreatment 3/87	D.I 9/87	D.I 3/88
T1 Oxytetracycline	35.08	40.19	22.90	19.99	22.3
T2 Penicillin	33.60	38.42	22.54	21.07	24.9
T3 Control	34.59	41.92	22.92	21.88	25.7

6.2 Symptomatology, Etiology and Control of Quick (Yellow) Decline of Coconut

The Project was initiated during September, 1985 to study the symptomatology, etiology and control of quick (yellow) decline in Coconut, a disease of recent origin. Accordingly, an observational trial was laid out in Kayamkulam Kayal Farm. Soil application of micronutrients as well as stem injection of oxytetracycline and penicilline were given to the affected palms. There was slight reduction in the disease score of leaf and inflorescence in palms consequent on the combined application of micronutrients and oxytetracycline (Table 32)

Table 32. Chemotherapy against Quick (Yellow) Decline
Mean score of Quick (Yellow) Decline of Coconut

Treatment		Leaf score				Inflorescence score			
		3/86	2/87	8/87	2/88	3/86	2/87	8/87	2/88
T1	Soil application of Cu and Mu	1.5	1.5	1.5	2.0	2.5	2.0	1.5	1.0
T2	Stem injection of oxytetracycline	1.5	1.8	2.0	1.8	2.5	3.5	3.0	2.4
T3	Stem injection of penicillin	1.5	1.8	1.8	1.8	2.5	1.8	2.3	1.8
T4	T1 + T2	1.5	1.3	1.3	1.0	2.5	2.0	1.5	1.0
T5	Untreated control	1.5	2.0	2.8	2.0	2.5	2.8	3.0	2.3

6.3 Light/Fluorescent microscopy of root (wilt) infected Coconut palm and suspected collateral hosts.

This programme was initiated during December 1986 in continuation to a survey undertaken in the root (wilt) affected tracts of Quilon, Alleppey, Kottayam and Ernakulam districts with the objective of cataloguing all herbaceous plants and indigenous weed flora commonly seen in such areas. A meticulous scrutiny of the possible role of such herbaceous plants as reservoirs of the root (wilt) pathogen was the objective of the present study.

Under this programme the herbaceous plants showing disease symptoms of MLO and which were found predominent in

the root (wilt) affected area were subjected to special staining technique and light microscopy. The staining was conducted on the following predominent herbs showing suspected MLO disease symptoms.

Name of species	Family
1. Emilia sonchifolia	Compositae
2. Synedrella nodiflora	"
3. Ageratum Conyzoides	"
4. Croton sparsiflorus	Euphorbiaceae
5. Sida cordifolia	Malvaceae
6. Stachytarpheta indica	Verbenaceae
7. Catharanthus roseus	Apocynaceae

The results of special staining of thin sections of plants showing suspected MLO disease symptoms were negative in respect of all the samples tested. Next to electronmicroscopy the method of special staining was reported to be reliable to demonstrate the presence of MLO in diseased plants. In the present study the phloem of stem sections of all the diseased and healthy plants tested remained unstained indicating the absence of MLO in the suspected collateral hosts of root (wilt) Pathogen. In so far as none of the plants screened could be suspected as carriers of MLO, it would be unlikely for these species of plants to be the collateral hosts of root (wilt) pathogen. The project is proposed to be concluded.

6.4 CONTROL OF LEAF ROT DISEASE OF COCONUT USING SYSTEMIC AND NON SYSTEMIC FUNGICIDES.

Objective: To study the comparative effectiveness of systemic and non systemic fungicides in combination/sequential application on the control of leafrot disease of coconut caused by Pipolaris holoides.

The third and fourth fungicidal applications were done during October 1987 (monsoon break) and June 1988 (pre monsoon). The second post treatment leafrot indexing was also carried out in June 1988 (table 33).

Table 33. Control of leaf rot of coconut: disease index as influenced by chemical treatments.

	Treatments	Leaf rot disease index (Mean of 4 Repln.)	
		Pretreatment score	Post treatment score
T1	1% Bordeaux mixture (3 times)	25.82	24.17
T2	1% BM+0.3% Dithane + 0.5 Fypolan	25.96	38.99
T3	0.1% Calyxin - 3 times	25.94	26.62
T4	0.1% Vitavax 3 times	23.37	29.41
T5	0.1% Calyxin + 1% BM+ 0.5% Dithane M45	21.83	28.42
T6	0.1% Vitavax + 1% BM + 0.5% Dithane M45	27.66	28.85
T7	Control	25.34	28.46

An increase in disease index was observed in all the treatments except Bordeaux mixture. This is indicative of its superiority over the other fungicides.

6.5 VARIATIONS IN THE OCCURRENCE AND INTENSITY OF DIFFERENT DISEASES ON PERENNIAL CROPS UNDER A COCONUT BASED MULTISTORIED CROPPING SYSTEM EXISTING IN THE BACKWATER REGION OF KERALA.

Objective: To investigate the periodicity of occurrence and intensity of different diseases on perennial crops like Coconut, Cocoa, banana, pepper, nutmeg cinnamon cloves and fodder grasses in a coconut based multi storyed cropping system existing in the backwater region of Kerala.

The occurrence and intensity of the different diseases in randomly marked out plants (Coconut 10, Cloves 5, Cocoa 10, pepper 6, Cinnammon 10) were recorded regularly at monthly intervals. A crop war review is furnished below:

Coconut: The main diseases were Root(wilt) and leafrot. The Root(wilt) disease score was 36.01 (Mean value) leaf rot was seen only during November 1987 on a high palm (score 3.5).

Cloves: The major disease on these crop was the leafspots caused by Alternaria spp and Colletotrichum spp. The mean disease score for the period were 1.7 and 0.92 respectively. Sooty mold was recorded as are of the plants in November 1987.

Cocoa: This crop also was seen less infected by diseases. wilt was the major disease seen.

Pepper: Bacterial leafspot caused by *Xanthomonas Campertris* P.V. *betlicola* and fungal leafspot by *Colletotrichum* sp. was the important diseases observed.

Cinnamon: None

Banana: Sigatoka leafspot, Bunchy top, Kokkan (Kalluvazha) were the major diseases seen.

This study will be continued.

6.6 Effect of Boron on the leaf rot disease of coconut.

The effect of boron on the control of leafrot disease of coconut CV. WCT was studied in this experiment.

The treatments included:

T0	Control
T1	Application of 1% borax solution by root injection 10ml/palm at quarterly intervals.
T2	Application of borax as 1% solution in the crown 1 l /palm at quarterly intervals.
T3	Application of borax as 1% falior spray 2 l/palm at quarterly intervals.
T4	Application of borax 250 g/palm/year through soil drenching in two splits.

All the treatments (T1 to T4) were applied during this season. The yield of nuts at monthly intervals were recorded and the data recorded.

6.7 Studies on the arthropod fauna in the rhizosphere of coconut palms.

The study was initiated to identify soil arthropods, if any, responsible for the incitation of the root (wilt) disease. For this soil samples were collected at monthly intervals from diseased and apparently healthy palms. During the period 84 samples were collected and extracted for both macro and micro arthropods.

The macroarthropods consisted mainly of root grubs and the microarthropods included collembolans and mites. The population of none of those arthropods were high enough to inflict any serious injury to coconut palms and the difference in population of arthropods between healthy and diseased palms was negligible. These findings show no major deviation from the previous year's results.

6.8 Nature and intensity of damage caused by mealybug (Pseudococcus) and their control

Heavy incidence of mealybugs is often reported on coconut palms affected by root (wilt) and leaf rot disease. The objective of the trial is to study the nature and intensity of damage caused by the mealybug and formulate effective control measures.

The trial was carried out on a large group about 100 coconut seedlings closely planted for restricting the growth of the seedlings and for stimulating the mealybug

population build up. Mealybug crawlers were released on those seedlings at periodical intervals from October 1986 onwards.

Build up of the mealybug population was noticed from January, 1988 onwards and by late February a number of the seedlings had moderate to heavy attack of the bugs. The population of the mealy bug on these seedlings ranged from 0 to 380 on a seedling. The bugs often confined themselves on the central unopened spindle. But inspite of the severe attack of the mealybug, the seedlings suffered negligible loss of vitality and vigour. There was apparently no visible damage except for minor yellowing, necrosis and lesions.

The mealy bug population drastically reduced after the opening of the spindle leaves or after the receipt of continuous showers. The bugs showed a clear preference for settling along concealed areas of the tender tree parts such as inner leaf axils, unopened leaflet axils, partly opened inflorescence etc. The bugs in the exposed surface are probably unable to withstand heavy showers or bright sun.

6.9 Control of rodents infesting coconut gardens

This project was started with the objective of devising suitable rodent control methods in coconut gardens. The first part of the experiment was to evaluate the different type of rat traps and it was found that the Kumarakom trap was superior to the bow trap, Moncombu trap and the common box trap.

The second part of the experiment was to evaluate the different type of rat baits. As part of this trial an observational trial was laid out using bromadiolone, a single dose anticoagulant.

Readymade bromadiolone cakes were purchased from local market (trade name moosh moosh) and placed at the leaf axils of rat affected coconut trees at three different positions. One packet of the cake costing about Rs.5/50 was necessary for baiting a single tree. Before baiting the number of rodent damaged nuts on each tree was recorded. After about two weeks the trees were reexamined and rebaited wherever there was fresh attack.

Out of twelve trees baited with the cake, only two trees showed fresh attack after two weeks and the rodent attack on those trees were also brought under control by rebaiting.

Rice Research Station, Kayamkulam.

6.10 Symptomatology, etiology and control of quick yellow decline in coconut.

An attempt has been made in this experiment to study the symptomatology, etiology and control of quick yellow decline in coconut which is relatively of recent origin.

This observational trial was laid out in the Kayamkulam Kayal farms with the following 5 treatments during the year 1987.

1. Soil application of Cu + Mn @ 250 gm/year
2. Stem injection of oxytetracycline @ 3 gm/year.
3. Stem injection Pencillin.
4. Treatment 1+ 2
5. Untreated control

As per the decision taken in the combined meeting of scientists of C.P.C.R.I. and K.A.U. held at C.P.C.R.I. during August 1986, the frequency of application of penicillin and oxytetracycline was fixed at once in 3 months.

During the current year, an increase in the leaf disease index was noticed in all the treatments except Trs. No.4 ie. stem injection of oxytetracycline + soil application of Cu and Mn (Table - 34)

Table 34. Leaf disease index as influenced by treatments.

Tr.No.	Pre-treatment index	Post treatment index as on February 1988
1	1.25	2.0
2	1.25	1.75
3	1.25	1.75
4	1.25	1.00
5	1.25	2.00

In all the treatments there was reduction in inflorescence disease index over pre-treatment index. The maximum reduction in inflorescence index was in treatment 1

and 4 ie. stem injection of oxytetracycline and stem injection of oxytetracycline + soil application of Cu + Mn, respectively (Table 35).

Table 35. Inflorescence disease index as influenced by treatments, 1987-88

Tr. No.	Pre-treatment index	Post-treatment index as on February 1988
1	2.5	1.0
2	2.5	2.39
3	2.5	1.75
4	2.5	1.00
5	2.5	2.25

6.11 Control of leaf rot disease of coconut using systemic and non-systemic fungicides.

Objectives: To study the effectiveness of systemic fungicides in combination/sequential with non-systemics against leaf rot of coconut.

Treatments:

1. 1% Bordeaux mixture (three applications/year)
2. 1% BM - Dithane M-45 0.3% - Fytolan 0.5%
3. Calyxin 0.1% three times a year.
4. Vitavax 0.1% three time a year.
5. 0.1% Calyxin - 1% Bordeaux mixture - Dithane M-45 0.3%
6. 0.1% Vitavax - 1% B.M. - Dithane M-45 0.3%
7. Untreated control.

Treatments were given as per schedule. Disease indexing was done before each application. The treatment effects were not statistically significant. Though not significant, there was a reduction in disease intensity in the fungicide spraved plots. The maximum reduction (5.15)in disease index was in the Bordeaux mixture spread tress closely followed by Tr.2 ie. sequential treatment of Burdeaux mixture, Dithane & Fytolan. In the control plot there was an increase in disease index (+2.10).

6.12 Mycoplasma as possible causal agent of the coconut Root (wilt) disease.

The influence of oxytetracycline and pencillin on symptamatology of root 'wilt) in order to confirm the etilogy of the disease. Mycoplasmas are known to be sensitive to oxytetracycline and resistant to penicillin. This different response will give indirect evidence on the etiology of root(wilt) disease.

Quarterly application of oxytetracycline and penicillin (3g/tree) through stem injection (using pressure injector) into coconut palms of age group less than 10 years infected with root (wilt) disease and not superimposed with leaf rot was done and disease indices worked out. The data collected so far indicated that treatment effects were not statistically significant. Though not significant statistically, there was a reduction in disease intensity in oxytetracycline treated palms whereas in penicillin treated and control palms an increase in disease intensity was observed.

INTERCROPS IN COCONUT GARDENS

(Pepper, dowpea, banana, bhindi, brinjal, cassava, minor crops, bamboo)

7. Varietal Improvement

Regional Agricultural Research Station, Kumarakom

7.1. Evaluation of vegetable type cowpea for intercropping in the coconut gardens of Kuttanad

Objectives: The objectives are to screen out high yielding vegetable type cowpea for intercropping in the coconut gardens of Kuttanad and to identify varieties that can be used as donor parents in breeding programme.

Using the germplasm available, an initial evaluation trial was conducted and the varieties which performed well were subjected to comparative yield trials for four seasons. Two top yielders from the comparative yield trial was put under multilocational trial in different locations of Kuttanad with Kurutholapayar as check.

Three varieties viz., Manjeri Red Plain (13.6 t/ha), Manjeri Mottled (11.6 t/ha) and Kurutholapayar (11.0 t/ha) were selected for conducting the multilocational trial in the farmers' fields. Farmers from Edathua, Veliyanad, Pulinkunnu, Changanacheiry and Kumarakom were selected and the trial was laid out during July 1987. Observations were taken on number of green pods per plant and yield of green pods. The results are presented in Table 36.

The variety Manjeri Red Plain gave the maximum yield of green pods (10.9 t/ha) followed by Manjeri Mottled (9.5 t/ha). With regard to the number of green pods per plant, Manjeri Red Plain recorded the maximum (135.86) followed by Manjeri Mottled (133.85). The variety Manjeri Red Plain will be proposed for release.

Table-36. Yield performance of vegetable cowpea varieties (kg/plot of 20 m^2 unless otherwise mentioned)

Variety	Location I RARS Kumarakom	Location II Edathua	Location III Edathua	Location IV Veliyanad	Location V Changanacherry	Location VI Pulinkunnu	Location VII Pulinkunnu	Location VIII Kumarakom	Mean	Mean yield (kg/ha)
Manjeri Red Plain	25.6	21.3	18.4	16.5	23.0	21.8	24.2	23.7	21.81	10900
Manjeri Motled	22.3	18.2	16.3	13.7	20.2	20.7	21.8	18.2	18.93	9465
Kurutholapayar	20.12	20.1	15.5	12.0	21.5	18.6	18.2	19.7	18.22	9110
Mean	22.673	19.867	16.733	14.067	21.567	20.367	21.4	20.53		

C D at 5% level (a) Location = 2.117 (b) Variety = 1.296

7.2. Varietal trial in Bhindi

The main objective of the experiment is to identify the best variety of Bhindi suited for the Kuttanad tract.

Using a total of 40 varieties/lines an initial evaluation trial was laid out in randomised block design with two replications. The plot size was 1.8 x 1.2 m^2.

Changanacherry local was found to be a dwarf type with an average height of 1.29 m at maturity. The length of the fruit was also found to be higher in this variety (26.14 cm). The maximum girth of fruits was recorded by local tall (8.95 cm). The variety AE 6 gave the highest number of fruits per plot (128) while AE 126 recorded the maximum weight of fruit per plot (3.187 kg) which worked out to 14.7 t/ha.

By evaluating the performance, ten varieties/lines were selected for conducting a comparative yield trial (Table 37).

7.3. Evaluation of short duration tapioca cultures for reclaimed soils, as intercrop in coconut gardens

Objective: To compare the performance of different short duration local tapioca cultivars and to select the best suited for the reclaimed soils of Kuttanad. The cultivars tested are listed in Table.38.

The crop was planted during May 1987 and harvested when it attained 6 months (maturity). The data on tuber yield, number of tubers per plant and tuber dry matter percentage were statistically analysed (Table 38). Regarding tuber yield there existed significant difference between the cultivar Ramanthala and the other varieties.

Table-37. Performance of Bhindi varieties selected from the initial evaluational trial

Sl. No.	Name of the variety	Heignt of the plant (m)	Length of fruits (cm)	Girth of fruits (cm)	Green fruit yield (t/ha)
1.	AE 126	2.19	19.08	7.10	14.7
2.	Anakomban	1.87	18.92	6.30	13.5
3.	AE 124	1.63	14.55	11.10	12.8
4.	AE 6	2.29	16.93	6.08	12.7
5.	Kilichundan	2.19	19.58	6.37	11.7
6.	AE 2	2.06	19.27	7.20	11.4
7.	AE 3	2.49	16.85	6.55	9.0
8.	Changanacherry local	1.29	26.14	6.20	8.4
9.	Pusa sawani	2.53	17.70	6.10	6.7
10.	AE 8	1.40	16.71	6.01	5.3

Table-38. Evaluation of short duration Tapioca cultures : yield performance

Sl. No.	Variety	Tuber yield Per plant (kg)	Tuber yield Per ha. (tons)	Number of tubers/ plant	Tuber dry matter percentage
1.	Ramanthala	1.615	27.46	8.07	37.68
2.	Ambakkadan	0.787	13.38	4.53	33.01
3.	Mixture	0.883	15.01	5.53	32.05
4.	S 856	0.730	12.41	6.23	31.82
5.	Thodupuzha local	0.520	8.84	3.90	42.93
6.	Thottakkolli	0.773	13.41	7.57	45.37
7.	Sree Visakh	0.787	13.38	6.33	32.41
C D (0.05)		0.450	-	-	9.55

7.4. Trial cultivation of pepper on coconut palm grown under the bund system of planting

Objective: To study the performance of different varieties of pepper in Kuttanad and to select the best variety suited for the tract.

The trial is being conducted under two systems.

a)As an intercrop using coconut palm as a standard.

b)As an intercrop using Thespesia as a standard.

The varieties tested are: (1)Panniyoor-1 (2)Karimunda (3)Narayakkodi (4)Kottanadan (5) Culture-239 and (6) Culture - 331.

Panniyoor-1, Culture-239 and Culture 331 planted during 1985 flowered in 1987. The yield of dry berry per plant was recorded (Table 39).

Table-39. Trial cultivation of pepper in Kuttanad

Sl. No.	Type of standard	Yield of dry berry per plant (g)		
		Panni-yoor-1	Culture 239	Culture 331
1.	(a)Pepper grown as an intercrop using coconut palm as a standard.	16.39	22.37	Not planted
2.	(b)Pepper grown as an intercrop using Thespesia as a standard.	24.66	5.59	77.67

The trend in yield indicates that culture 331 has good potential under the conditions existing at Kumarakom

7.5. Studies on the performance of tuber crops as intercrops in coconut gardens

The main objectives of the experiment are identification of suitable tuber crops for intercropping in coconut gardens and screening different varieties of tuber crops for identifying the best one.

The crops included are Dioscorea alata, D.esculenta, Colocasia, Coleus and Amorphophallus.

So far 31 lines of Dioscorea alata, 24 lines of D.esculenta, 5 lines each of Colocasia and Amorphophallus and 10 lines of Coleus were collected. Initial Evaluation Trial of Dioscorea alata and D.esculenta has been completed.

Among the D.alata lines, NBPGR-35 recorded the maximum yield of 4.98 kg/plant followed by Kaduvakaiyan, a local type with 4.73 kg/plant. Based on tuber yield 14 lines (including check) were promoted to comparative yield trial (Table 40).

Table-40. Field evaluation of tuber crops : Dioscorea alata

Sl. No.	Accessions	Mean tuber yield/plant (kg)	Sl. No.	Accessions	Mean tuber yield/plant (kg)
1)	NBPGR-35	4.98	(8)	Da-122	4.00
2)	Kaduvakaiyan	4.73	(9)	NBPGR-949	4.00
3)	TCR-19	4.18	(10)	TCR-5	3.84
4)	TCR-100	4.13	(11)	TCR-3	3.75
5)	TCR-34	4.08	(12)	Vadakkan	3.44
6)	Athirampuzha local	4.06	(13)	NBPGR-193	3.50
7)	Da-80	4.00	(14)	Da-60	1.88

Among the Dioscorea esculenta lines, DEC-24 recorded the highest tuber yield of 3.35 kg/plant followed by TCR-24 (2.9 kg). Number of tubers/plant was maximum in DEC-24 (33.0) followed by DEC 28 (24.5) and Amayannur-1 (24.5).

From the D.esculenta accessions 14 lines (including check) were promoted to Comparative Yield Trial (Table 41).

Table 41. Field evaluation of tuber crops : Dioscorea Dioscorea esculenta

Sl. No.	Accessions	Mean No.of tubers per plant	Mean tuber yield per plant (kg)	Sl. No.	Accessions	Mean No.of tubers per plant	Mean tuber yield per plant (kg)
1)	DEC-24	33.00	3.35	(8)	DEC-32	11.00	2.00
2)	TCR-24	24.00	2.90	(9)	Amayannur-1	24.50	1.81
3)	DEC-37	20.00	2.45	(10)	Ettumanoor-16	14.00	1.61
4)	TCR-1	18.75	2.10	(11)	TCR-49	20.13	1.53
5)	DEC-27	16.00	2.05	(12)	Kanakkari-II	17.13	1.50
6)	DEC-5	18.00	2.00	(13)	TCR-23	21.6	1.34
7)	DEC-28	24.50	2.00	(14)	Sreelatha	15.13	1.28

The performance of the accessions of Colocasia, Coleus and Amorphophallus, so far collected are encouraging and are maintained.

7.6.Screening of banana varieties for partial shade

Objectives:To study the performance of different cultivars of banana as plant and ratoon crop in coconut gardens and to identify the promising types which are having better

adaptive value other than the commonly grown ones.

The experiment which includes 15 table and culinary types of banana, is in progress.

8. Crop Management

8.1. Effect of different levels of NPK on the yield of brinjal in the uplands of Kuttanad

Objective: To find out the effect of different levels of N, P and K on the growth and yield of brinjal and to work out an economic optimal dose for the crop in the uplands of Kuttanad.

The experiment was laid out in 3^3 partially confounded factorial design with 2 replications. The levels of NPK (kg/ha) tried in the experiment were:

N	P	K
50	20	10
75	40	25
100	60	40

The maximum yield was recorded in the treatment combinations of N_{75} P_{20} K_{25} with regard to the number of fruits (10.8) and weight of fruits per plant (683 g) and also the yield per plot (10.24 kg) followed by the treatment combination of N_{100} P_{20} K_{40}.

The incidence of fruit borer was found to be low in the treatment combination of N_{75} P_{40} K_{10}.

8.2. Effect of different levels of fertilizers on the growth and yield of vegetable cowpea grown as intercrop in the coconut gardens of Kuttanad

Objective: (1)to find out the effect of different levels of fertilizers on the growth and yield of vegetable cowpea

grown as intercrop in the coconut gardens of Kuttanad. (2)to standardise the optimum combination of NPK for vegetable cowpea in the reclaimed soils of Kuttanad.

The second rabi season crop (4th season crop) was taken during the period from July 1987 to November '87. Observations on number of pods per plant, length of pod, number of seeds per pod, yield of pods (t/ha), yield of haulm (t/ha) and harvest index were recorded. Statistical analysis of the data on yield of pods showed no significant variation between different levels of N, P and K tried. However, all the NPK combinations were significantly superior to the absolute control, in their effect on yield of pods.

The experiment was conducted for four consecutive seasons - two rabi and two kharif and concluded. During all the four seasons the applied nutrients gave significantly higher pod yield over absolute control, but amongst the different levels, there was no significant difference (Table 42). This is attributed to the high fertility status of the Kuttanad soils. Therefore, a fertilizer combination of 10:20:10 is suggested for the Kuttanad tract. This NPK combination resulted in a B:C ratio of 2.25 and 3.00 during kharif and rabi seasons, respectively.

Table-42. Green pod yield of Kututholapayar as influenced by fertilizer application (Mean of two kharif and two rabi seasons)

Nitrogen (kg/ha)	Yield (t/ha)	Phosphorus (kg/ha)	Yield (t/ha)	Potash (kg/ha)	Yield (t/ha)
0	10.72	0	10.72	0	10.72
10	13.81	20	15.36	10	15.23
20	14.98	40	14.58	20	15.75
30	16.15	60	15.01	30	13.84
C D (D.05)	2.42		2.42		2.42

EXTERNALLY AIDED PROJECTS

9. ICAR Adhoc Scheme - Development of improved varieties of sesamum and groundnut suited to the rice fallows in Onattukara (R.R.S., Kayamkulam)

The project aims to evolve improved varieties of sesamum and groundnut suited to the rice fallows in the Onattukara region.

The technical programme includes:

i) Collection of sesamum and groundnut germplasm from various centres and their maintenance.

ii) Enrichment of sesamum and groundnut germplasm through regular collection programmes.

iii) The collected varieties/types of sesamum and groundnut will be subjected to initial evaluation. The selected types will be put to comparative yield trials, the comparative yield trials will be repeated for 3 seasons and the types identified as promising ones will be promoted to multi-locational trials. Based on the results of the experiments, the best varieties will be released for cultivation.and

iv, Inter-varietal hybridisation and mutation breeding in sesamum and groundnut will be undertaken to evolve suitable varieties.

Groundnut

9.1. Comparative yield trial of 18 early duration varieties/cultures of groundnut

With the objective of identifying suitable early maturing groundnut varieties for summer rice fallows in the Onattukara tract, a comparative yield trial with 18

groundnut varieties/cultures was conducted in rice fallows during the summer season. The highest pod yield of 5128 kg/ha was recorded by Dh (e 32, followed by ICGS 119 (4643 kg/ha) and both of them were on par and significantly superior to JL-24(Table 43). JL-24 recorded an yield of 3133 kg/ha and TMV-2 recorded an yield of 2934 kg/ha. Dh (e) 32 matured in 100 days, while the other varieties matured in 107-110 days.

Table-43. Yield performance of early maturing groundnut accessions.

Tr. No.	Variety	Mean yield (kg/ha)	Tr. No.	Variety	Mean yield (kg/ha)
1)	RG-141	2649	(10)	ICGS-21	3610
2)	VG-81	1709	(11)	ICGS-35	3419
3)	VG-77	3903	(12)	ICGS-52	3219
4)	VG-86	1624	(13)	ICGS-56	3333
5)	VG-55	3618	(14)	ICGS-81	4188
6)	Dh(e) 32	5128	(15)	ICGS-119	4644
7)	CO-2	3048	(16)	ICGS-121	3704
8)	Alg-9	3048	(17)	JL-24	3134
9)	Alg.33	2849	(18)	TMV-2	2934

.2. Breeding programme to develop early maturing groundnut varieties

A breeding programme with the objective of developing early maturing groundnut varieties is in progress.

The F6 generation derived from the cross viz., TMV-2 x Chico, TMV-2 x 91176 and MK-374 x Chico were raised during summer season and 15 numbers were selected.

TMV-2 x Chico - 5

TMV-2 x 91176 - 5

MK-374 x Chico- 5

These lines will be carried forward for Initial Evaluation Trial with standards during the next summer season.

Germplasm maintenance in groundnut

Germplasm of groundnut is being maintained under the scheme. During the present season 380 groundnut varieties were maintained.

Sesamum

9.3. Hybridisation programme in sesamum for developing high yielding varieties for rice fallows cultivation in the Onattukara tract.

Ten promising sesamum varieties/ cultures viz., ACV-1, CST-765 BS-5-18-6(G), Vinayak, Imp.Sel.5, Thilothama, RAUSS-17-4, ACV-2, B-14 and Kayamkulam-I were selected as parents for breeding programme, and crossing effected in a diallel manner. Another fifty cross combinations were also developed. All the 150, F2 generations were raised in rice fallows during summer. But due to heavy rains, some of the lines were lost. Hence the crop was raised in the garden land with the available seed material. Individual plant selection was resorted to a group which expressed much variability. But a few combinations were selected based on the principles of mass selection. The selected breeding materials will be raised for further studies. The selections are listed below:

31. 3-9-1-BS-5-18-6 x Kayamkulam-I
32. 3-9-2-BS-5-18-6 x ,,
33. 3-9-3-BS-5-18-6 x ,,
34. 5-1-1-Imp.Sel-1 x ACV-I
35. 5-1-2-Imp.Sel-1 x ,,
36. 5-1-3-Imp.Sel.1 x ,,
37. 5-2-1-Imp.Sel.1 x CST-785
38. 5-2-2-Imp.Sel.1 x ,,
39. 5-2-3-Imp.Sel.1 x CST-785
40. 5-6-1-Imp.Sel.1 x Sel.8
41. 5-6-2-Imp.Sel.1x ,,
42. 5-6-3-Imp.Sel.1 x ,,
43. 5-9-1-Imp.Sel-1 x B-14
44. 5-9-2-Imp.Sel-1 x B-14
45. 5-9-3-Imp.Sel-1 x B-14
46. 6-2-1-Thilothama x CST-785
47. 6-2-2-Thilothama x ,,
48. 6-2-3- ,, x ,,
49. 6-9-1- ,, x B-14
50. 6-9-2-Thilothama x B-14
51. 6-9-3 ,, x ,,
52. 6-11-1 ,, x Sel-8
53. 6-11-2 ,, x ,,
54. 6-11-3 ,, x ,,
55. 7-1-1 RAUSS-17-4 x ACV-I
56. 7-1-2 ,, x ,,
57. 7-1-3 ,, x ,,
58. 7-2-2 ,, x CST-785
59. 7-2-3 ,, x ,,
60. 7-2-7 ,, x ,,
61. 7-3-1 ,, x BS-5-18-6
62. 9-8-1 B-14 x RAUSS-17-4

Mass selection from F2

1. 1-1-ACV-1 x CST-785
2. 1-5-ACV-1 x Thilothama
3. 2-2-CST-785 x BS-5-18-6
4. 2-3-CST-785 x Vinayak
5. 2-7-CST-785 x RAUSS-17-4
6. 3-6-CST-785 x Sel-8
7. 4-1-Vinayak x ACV-1
8. 4-2-Vinayak x CST-785
9. 4-3-Vinayak x BS-5-18-6
10. 4-4-Vinayak x Imp.Sel.5
11. 4-6-Vinayak x Sel-8
12. 4-8-Vinayak x ACV-2
13. 4-10-Vinayak x Kayamkulam-I
14. 4-11-Vinayak x TNAU-10
15. 5-4-Imp.Sel-5 x Vinayak
16. 5-5-Imp.Sel-5 x Thilothama
17. 5-7-Imp.Sel-5 x TAUSS-17-4
18. 5-10-Imp.Sel-5 x TNAU-10
19. 5-11-Imp.Sel-5 x Kayamkulam-I
20. 6-3-Thilothama x BS-5-18-6
21. 6-4-Thilothama x Vinayak
22. 6-8-Thilothama x TNAU-10
23. 7-4-Thilothama x Vinayak
24. 7-5-Thilothama x Imp.Sel.5
25. 7-6-Thilothama x Thilothama
26. 7-7-Thilothama x Sel-8
27. 7-8-Thilothama x ACV-2
28. 7-9-Thilothama x TNAU-10
29. 7-10-Thilothama x B-14
30. 7-11-Thilothama x Kayamkulam-I

31. 8-1-ACV-2 x ACV-1
32. 8-2-ACV-2 x CST-785
33. 8-3-ACV-2 x BS-5-18-6
34. 8-4-ACV-2 x Vinayak
35. 8-5-ACV-2 x Imp.Sel.5
36. 8-6-ACV-2 x Thilothama
37. 8-7-ACV-2 x Sel-8
38. 8-10-ACV-2 x Kayamkulam-I
39. 9-2-B-14 x CST-785
40. 9-3-B-14 x BS-5-18-6
41. 9-3-B-14 x Vinayak
42. 9-5-B-14 x Imp.Sel.5
43. 9-6-B-14 x Thilothama
44. 9-7-B-14 x Sel-8
45. 9-9-B-14 x ACV-2
46. 9-10-B-14 x TNAU-10
47. 9-11-B-14 x K-I
48. 10-2-Kayamkulam-I x CST-785
49. 10-4-Kayamkulam-I x Vinayak
50. 10-5-Kayamkulam-I x Imp.Sel-5
51. 10-7-Kayamkulam-I x Sel-8
52. 10-8-Kayamkulam-I x RAUSS-17-4
53. 10-9-Kayamkulam-I x ACV-2
54. 10-10-Kayamkulam-I x TNAU-10
55. 10-11-Kayamkulam-I x B-14
56. 11-1-S1-3 x UT-43
57. 11-2- ,, x RAUSS-17-4
58. 11-3- ,, x TNAU-10
59. 11-4- ,, x Vinayak
60. 11-6- ,, x C-6

61. 11-7-S1-3 x Kayamkulam-I
62. 11-9- ,, x AT-12
63. 12-2-ACV-I x Vinayak
64. 14-3-CST-785 x Timbi-4
65. 15-1-Timbi-4 x AT-12
66. 16-3-AT-12 x Klm-I
67. 16-6-AT-12 x UT-43
68. 17-6-K1 x JLT-3
69. 17-7-K1 x Vinayak
70. 18-1-Vinayak x TC-229
71. 18-2-Vinayak x K1
72. 18-3-Vinayak x CST-785
73. 18-4-Vinayak x CST-785
74. 19-1-Vinayak x S1-3
75. 20-1-TNAU-10 x K1
76. 20-2-TNAU-10 x SI-3
77. 21-1-JLT-3 x ST-3
78. 22-1-JLT-3 x AT-12
79. 22-2-JLT-9 x Vinayak
80. 25-AT-91 x Klm-I

9.4. Mutation breeding programme for evolving a suitable sesamum variety for the rice fallows of Onattukara tract.

With the objective of developing a sesamum variety suitable for summer rice fallow cultivation in Onattukara region varieties ACV-I and Klm-I were subjected to gamma rays at doses 3, 6, 9, 12 krads. The M2 generation was raised in the crop season, expression of variability was less. However, fes plants in the following treatments were selected for advancing to M3 generation.

Kayamkulam - I	-	6 kr.
,,	-	12 kr.
,,	-	15 kr.
Soma	-	6 kr.
Soma	-	9 kr.

9.5. Germplasm maintenance in sesamum

A germplasm numbering 210 varieties/cultures is being maintained under the scheme.

STEC Funded project on Bamboo (R.A.R.S., Kumarakom)

1C. Investigations on the diseases of bamboo and reeds in Kerala

The main objective of the project is to enumerate important diseases affecting bamboo and reeds and reveal their etiology and describe the symptomatology in detail.

Technical programme include, survey on the diseases of natural bamboos of plains and forests, periodical collection of specimens, detailed studies on the etiology and symptoms.

Studies so far conducted have shown that bamboos are affected by a large number of diseases, some of which could being considerable yield loss every year. The important diseases recorded during the period are:

1) Three distinct types of "Leaf and branch blight of bamboo caused by Ascochyta phaseolarum, Fusarium semitectum, and Curvularia lunata.

2) Grey blight of culms by Geotrichum sp.

3)Abnormal defoliation and withered culms of B.vulgaris by Taphrina deformans.

4)Rotting of growing culms by Fusarium spp.

5)Shrinking and withering of basal culms by Ganoderma lucidum.

6)Leaf and culm blight (thread blight) of reeds by Pellicularia salmonicolor.

The etiology of the above diseases were proved by standard techniques and symptoms described in detail.

FISHERY AND INTEGRATED FARMING SYSTEMS

R.A.R.S., Kumarakom

11.1 Culture of the giant freshwater prawn, Macrobrachium rosenbergii.

The feasibility of the culture of freshwater prawns in the channels of the coconut gardens in the RARS, Kumarakom was studied under two feeding treatments, viz.,

i) Freshwater prawns fed on a daily diet of oil cake + rice bean @ 3.5% of body weight and

ii) no artificial diet (Monthly manuring of pond water with cowdung, urea and superphosphate).

After extensive preparatory work like desilting, strengthening of embankments, lining and manuring, the experimental channels were stocked with seeds of Macrobrachium rosenbergii at a density of 10,000/ha. The average length and weight of seed at the time of stocking were 43.3 mm and 0.71 g. respectively. Harvesting of both the experimental and control channels will be carried out after 6 months of culture.

11.2. Experimental culture of common carp and giant freshwater prawns in cages.

The feasibility of intensive culture of common carp by rearing in cages with artificial feeding in the changed ecological conditions of Kuttanad was investigated in this experiment.

Three flexible cages consisting of a framework of nylon rope and the sides of nylon netting of the mesh

size 20mm were fabricated. The size of the cages were 3½ x 2½ x 1½m. The site of cage culture was relocated from the channels within the station to the running waters of the river adjoining the station (Kavanar). Cages were fixed in position using wooden and bamboo poles. The fingerlings of Cyprinus carpio were used for stocking.

Three separate trial runs carried out during January to March resulted in total mortality of carps within 1 day, 3 days and 6 days after stocking due to the acidic conditions of the river water. The pH was in the range of 5.0 to 5.5. With the onset of the monsoon and an inflow of freshwater into the river, a fourth trial was initiated on 6.7.88. Sixty percent mortality was observed after a month and the average weight of the fish had increased from 53 g. at the time of stocking to 60g.

11.3 Organic recycling in integrated farming utilization of livestock waste for fish production.

Objective: To investigate the use of cowdung and cow urine as fertilisers for fish production in ponds and channels of coconut gardens.

The fortnightly manuring rates for the experiment is as follows:

	Cowdung(Kg)	Cow Urine(Kg)
Treatment 1	100	-
Treatment 2	-	40
Treatment 3	40	18

Three new channels in the coconut gardens having areas of 0.067ha, 0.057ha and 0.048ha were identified and were prepared for fish culture. Basal manuring with FYM @ 5000 Kg/ha was carried out. The species Catla catla, Labeo rohita and Cirrhinus mrigala were used for stocking the channels at the density of 8000/ha. Due to the heavy and unchecked growth of weeds in the culture channels, 10 nos. of grasscarp and 5 nos. of common carp were stocked in each of the channels. The initial stocking size of the fish species is given below:

Sl.No.	Fish species	Length(cm)	Weight(g)
1.	Catla catla	11.3	13.65
2.	Labeo rohita	6.5	4.0
3.	Cirrhinus mrigala	6.5	3.4
4.	Grass carp	6.4	3.8
5.	Common carp	11.7	60.0

The size of the fish seven months after culture is presented in Table 44.

Table 44. Size of fish after 7 months of culture

Sl. No.	Fish Species	T1 (Cowdung) Length (cm)	T1 (Cowdung) Weight (g)	T2 (Cow urine) Length (cm)	T2 (Cow urine) Weight (g)	T3 (Cowdung + Urine) Length (cm)	T3 (Cowdung + Urine) Weight (g)
1.	Catla	-	-	24.9	229.2	37.3	680.0
2.	Rohu	20.1	95.8	25.8	150.0	32.3	498.6
3.	Mrigal	-	-	27.5	208.0	37.0	260.0
4.	Grass carp	-	-	20.0	137.5	27.3	266.3
5.	Common carp	-	-	40.0	1300.0	-	-

The experiment is in progress and fish will be harvested after an year for assessing the final yield.

11.4 Assessment of productivity and ecology of fish ponds, channels and openwater in and around RARS Kumarakom.

Objective: To study the fish production potential, flora fauna and changes in the Physico chemical conditions of the cultivable waters in and around the station.

In the first phase of the programme, three representative stations, a typical dugout pond, open channel of the station and paddy field plots were monitored at monthly intervals for various physicochemical and biological factors.

In the second phase 6 stations in the Vembanad lake proper extending from Thanneermukkom on the north to Punnamada on the south were sampled for various physical, chemical and biological parameters. Both, surface and bottom samples were collected, the analysis work was carried out on board and in laboratory.

Results:

Variations in physicochemical factors in various stations are summarised in Tables 45 and 46.

Table 45. Assessment of Productivity and ecology of Fish Pond (First phase)

Station	pH	Do ml/l	Salinity ppt	Productivity (GPP GC/M^3/hr.)
Fertilised fish pond	7-9	0.68-5.47	0.57-2.01	Nil - 1125.20
Open Canals	6-7	0.79-2.71	0.21-4.18	Nil - 370.32
Paddycum fish culture plot	6.50-8.0	1.14-3.99	0.57-3.27	Nil - 854.58

Table 46. Assessment of Productivity and ecology of OPEN LAKE STATIONS (II Phase)

(Surface & bottom samples - range in variation upto March 88)

Station	Water temp. °C	pH	Salinity (ppt)	Do ml/l
Thanneermukkom North	27-32.50	6.75-7.50	0.28-34.28	1.38-5.78
Thanneermukkom South (Vechoor)	27-34.00	6.50-7.50	0.28-5.43	2.51-9.67
Kumarakom (Kavanattinkara)	29-32.50	5.75-6.50	0.34-4.05	Nil-16.20
Pathiramanal	27-33.00	6.50-7.75	0.15-7.80	1.60-10.20
Muhemma	25.50-33.50	6.25-7.00	0.28-12.27	1.20-7.39
Punnamada (Boat race tract)	27.00-33.50	6.25-7.50	0.15-0.39	1.20-20.57

Black clam villorita cyprinoides dominated the benthic populations. Lymnae sp. Littorina sp. polychaete worms (nereids), insect larvae, chironomids were also observed in varying frequencies. Meretix sp the white clams were rather uncommon. Deadshells outnumbered live ones in all the sample. Benthic biomass was higher at Vechoor and Punnamada transects and sparse at Kumarakom-Kavanar sites.

The study is continued.

11.5 Fish cum duck farming in ponds and channels of coconut gardens in Kuttanad.

This study was initiated to assess the production per unit area by combining duck farming with fish culture and to work out the economics of the system.

The treatment details were as follows:-

T1 (expt.)	: 300 birds/ha 10,000 fishes/ha
T2 control	: No ducks fish stocking density same as in T1.
Duck varieties	: Khaki campell white Pekin.
Fish species	: Catla, Rohu, Mrigal, Cyprinus, Grass Carp.

A comparison of growth rate of fishes in the experimental and control plots showed promising performance under duck-fish integrated farming system. The total yield of fish was 5.3 t/ha as against 1.2 t/ha in the control. Rearing ducks over the fish pond thus benefited the fishes (Table 47). The duck, however, performed badly. The Pekin variety of duck suffered heavy mortality and the strength was reduced to half.

Table 47. Growth observations and biomass accrual of fish species in the experimental and control plots. (1987)

Species	Average size at harvest				Biomass production (g/day)	
	EXPT		CONTROL			
	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Expt.	Control
Catla	55.00	2750	-	-	9.05	-
Rohu	26.60	261	22.00	137.00	0.89	0.43
Mrigal	33.44	356	28.80	253.18	1.14	0.80
Fimbriatus	30.10	314	21.14	115.35	0.96	0.31
Cyprinus	26.50	288	15.65	82.58	0.95	0.27
Total yield/Plot			214.80	48.195		
" per ha.			5370 Kg/ha	ie. 1204 Kg/ha.		

Biomass production : 207.91 Kg/0.04 ha/10 months.

11.6 Studies on culture of fishes and prawns as a follow-up crop in paddy fields.

Objective: To study the growth and productivity of common carp, IMC, cichlids, g.f.w. prawns in paddy fields when rice and fish are raised alternatively.

Paddy was raised during the rabi season in two plots of 0.2ha. After the harvest of paddy, the stubbles retained and the field was flooded to approximately 0.75m level and fishes were stocked. Manuring was done with FYM @ 25.000 Kg/ha., No supplementary feeds were given to the fishes.

Table 48. Fish culture in rice fields: survival of fish and fish biomass production.

Species	Size at harvest Length (cm)	Weight (g)	Biomass production g/day	Maximum size at harvest Length (cm)	Weight (g)	Survival %
Rohu	36.45	658.50	4.06	50	880	95.45
Mrigal	35.50	570.00	3.15	35.50	510	100.00
Fimbriatus	32.10	467.00	2.85	35.00	640	91.49
Cyprinus	24.60	255.00	1.60	29.00	370	5.87
Etroplus	13.26	66.47	0.38	14.50	85	19.20

Total yield of fish : 555.61 Kg/ha.

The studies show that marketable and table sized fishes could be grown in the interphase period (5-6 months) between two paddy crops. The study points to the viability of rotational cropping of fish and paddy in Kuttanad. More studies are however, needed to ascertain growth rates with supplementary feeds and also to standardise stocking rate and ratios.

11.7 AICARP - Integrated Production Trial

Objective: 1. To evolve a ricebased production technology suitable for the tract and to workout the economics of the system.

2. To study the growth and production of fishes and prawns in paddy fields, when cultured alongwith paddy and to test the feasibility of the system.

Four identical plots, each of 0.15ha, were selected and necessary modifications made to facilitate fish rearing. Considering the inevitability of application of pesticides for hyv of rice, the layout was modified by constructing a lowdyke separating the outer perimeter canal and the central paddy raising area. The dyke allowed the safe separation of fishes at times of pp operations. The treatments were:

Treatment No.	Khariff	Rabi
T1	Rice alone	Fallow
T2	Rice + carps	Year round
T3	Rice + Macrobrachium	"
T4	Rice	Rice
T5	Fish	Rice

The results are presented in Tables 49 and 50.

Table 49. Integrated Production Trial: Yield of Jyothi rice and fish

Yield factor Kg/ha	Treatments T1	T2	T3	T4	T5
Paddy	1440	1757.30	1300	1649.90	550
Straw	1030	1446.00	1089	1389.89	218.40
Fish	-	383.73	-	-	555.61

Table-50. Performance of fishes, specieswise and seasonwise

Species	Size at harvest		Biomass Production (g/day)	Percentage survival
	Length (cm)	Weight (g)		
Catla	45.00 (27.00)	1750.00 (375.00)	8.32 (1.66)	50.00 (5.75)
Rohu	34.65 (26.24)	590.00 (240.00)	2.73 (1.03)	32.69 (82.85)
Mrigal	- (26.98)	- (174.00)	- (0.70)	- (64.18)
Cyprinus	33.33 (24.50)	680.00 (190.00)	3.23 (0.83)	23.91 (97.75)
Fimbriatus	34.30 (30.11)	497.00 (436.07)	2.37 (1.88)	80.85 (7.80)
Etroplus	13.96 -	74.08 -	0.32 -	15.00 -
Macrobrachium	19.75 -	101.82 -	0.48 -	3.78 -

(The figures in parenthesis represent data of first trial 1986-'87).

Fish production ranging from 384 kg/ha to 600 kg/ha could be achieved in the simultaneous production system. The results indicate that carps can be raised along with rice with limited use of pesticides. The ring canal-dyke system is an effective barrier to exclude fishes from the fields at the time of application of pesticides. The study is continued.

Rice Research Station, Vyttila.

11.8. Cropping System Research Project - Integrated Production Trial

The object of the project was to evolve a new cropping system in which rice-fish and prawn combination were

raised under Pokkali condition. The technical programme consisted of three treatments.

Treatments	Area	Fresh water phase	Saline phase
T_1	0.08	Rice	Traditional prawn filteration.
T_2	0.16	Rice Fish	Selective stocking of the prawn.
T_3	0.46	Rice	Selective stocking of the prawn.

Harvesting of rice was carried out on 15-10-87. The rice crop yielded 1369 kg/ha compared to 861 kg/ha during the previous year.

In the treatment (T_2) where fish was grown along with rice peripheral and diagonal trenches were constructed in order to increase the water body. Carps, Catla, Rohu, Mrigal and Common carp were stocked in the ratio of 3:1:2:2 at the rate of 4000/ha on 10-8-87. The sharp salinity increase in October resulted in a total mortality of the fresh water carps. From the experience of the past three years it is concluded that fresh water carps are not suited for culture in Pokkali fields. Further, during the short growth period, the fish do not attain marketable size.

Traditional prawn filteration was carried out in T_1 during the saline phase (15-1-88 to 7-4-88) for 90 days. In 19 fishing operations the total prawn yield was 446 kg/ha. Ninety nine per cent of the yield was contributed by Metapenaeus dobsoni and the rest by Penaeus indicus. The yield of trash fish was 11 kg/ha.

In T_2 and T_3 selective stocking of tiger prawn Penaeus monodon was attempted this year instead of the white prawn Penaeus indicus. The tiger prawn seeds were stocked @ 25,000/ha and recorded a survival of 31.53% and 23.54%, respectively and with yield of 124.78 kg/ha/88 days and 72.6 kg/ha/91 days, respectively in T_2 and T_3. Since the size at harvest was smaller (15 g) compared to the optimum size attainable the live specimens were transferred to another pond for further rearing.

AGRL. ECONOMICS, EXTENSION AND STATISTICS

R.A.R.S., Kumarakom.

11.1 Role of Farm Women in the agrarian economy of Kuttanad

Objectives: The objectives of the project are to record and analyse the following:

1. The productive work participation of the women of Kuttanad in all the processes of crop and livestock production from input investment to produce utilisation.

2. The areas of decision making by farm women in agriculture and allied sectors.

3. Womens' contribution towards family income from wage and non wage labour, domestic services and animal husbandry.

4. Womens' share in the ownership of land and capital.

5. The content of women's awareness and response to new technologies and innovations in agriculture.

Two panchayaths each were selected from all the four farming situations in Kuttanad. The sampling frame work is illustrated below: Primary data will be collected from 1200 households.

	Strata				
	Upper Kuttanad	Lower Kuttanad	Kayal	Kari	Total
1. No. of panchayaths selected for the study	2	2	2	2	8
2. No. of wards selected (five from each panchayath)	10	10	10	10	40
3. No. of households selected to the sample (30 from each ward)	300	300	300	300	1200

The panchayaths selected for the study are Kumarakom, Mannar, Pulinkunnu, Champakulam, Kavalam, Neelamperoor, Pattanakkad and Ambalapuzha. Preliminary enumeration has been started in all the selected panchayaths.

11.2 Economic impact of drought on crops and livestock in Kerala.

Objective: To generate basic data on the losses to crops and livestock on account of drought experienced by the state in the years 1983-84 and 1986-87, compared to normal productivity.

This is a state wide project operated from the K.A.U., Directorate of Research, covering all the NARP Zones.

Four CD blocks were selected from the special zone namely Vyttilla, Anthikad, Champakulam and Pallom. Five panchayath wards were selected from each of the four blocks. After a house to house enumeration of each ward, 80 households were selected at the rate of 20 from each of the four size groups namely landless, marginal holdings, small holdings and large holdings. The survey work commenced in November 1987 and was completed in April 1988. The data are being analysed at Vellanikkara.

Rice Research Station, Monkompu

12.3 Study of Interdependence of climatological factors and yield of paddy with reference to the additional Crop and Puncha Crop in Kuttanadu.

Utilising eratum meteorological factors like monthly rainfall, maximum temperatures, relative humidity etc. and grain production for a period of 20 years from 1964 - 1983 an interdependence study has been taken up. The method of principal componant analysis to pick out the linear combinations of weather factors having maximum variance has been adopted. Production equation using the principal components and grain yield has been set up.

The weather variables utilised for the study were as follows.

Puncha

1. Total Rainfall during the month of October to February.
2. No. of rainy days.
3. Average maximum temperature
4. Average minimum temperature
5. Average relative humidity
6. Average rice yield/hectare tract.