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KERALA AGRICULTURAL UNIVERSITY

NATIONAL AGRICULTURAL RESEARCH PROJECT

(SOUTHERN REGION)

SEASONAL SUMMARY OF RESEARCH RESULTS

FOR

KHARIF 1987

N.A.R.P. (SR),
College of Agriculture,
Vellayani,
Trivandrum - 695 522

C O N T E N T S

PART - I

PART - II

KERALA AGRICULTURAL UNIVERSITY

NARP (SOUTHERN REGION)

Seasonal Report for Kharif 1987

(Due at the ICAR in February 1988)

P a r t I

Introduction

Under the National Agricultural Research Project, a sub-project for strengthening the Regional Research Station at Vellayani and for establishing a centre at Kottarakkara was sanctioned by the ICAR for a period of five years from 1-9-81. The project started functioning with effect from 8.2.1982. The first phase of the project terminated on 29-11-86.

The southern region of Kerala covers the districts of Trivandrum, Quilon, Pathanamthitta, Alleppey and Kottayam, except the high ranges and the problem areas (coastal saline tract, Onattukara sandy soils and the problem soils of Kuttanad) for which separate NARP sub projects have been sanctioned. The Training and Visit (T&V) system of Agricultural Extension has already been introduced by the Government of Kerala in these districts.

The lead function of the Regional Research Station at Vellayani is research on tapioca and other tubers, and that of the Special Station at Kottarakkara is research on homestead farming. The leadership for the Kottarakkara Centre is provided by the Regional Research Station at Vellayani. Conducting location-specific research aimed at crop improvement, crop management, crop protection, post harvest technology etc. of tuber crops, developing suitable farming system(s) for the different agro-climatic zones of the project area and developing multi-storied cropping systems for the homesteads are the main research responsibilities of the sub project, in addition to location-specific research (testing and verification) on pulses, oil seeds, cereals (rice) and rice-based cropping systems.

Besides the Regional Research Station at the College of Agriculture, Vellayani, the Kerala Agricultural University has two more research stations in the southern region viz. the Coconut Research Station, at Balaramapuram and the Cropping Systems Research Centre at Karamana, both situated in the

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Trivandrum district. Conducting manurial and agronomic trials on coconut for the red soil tract is the lead function of the former, while conducting manurial and agronomic trials on different high yielding rice varieties, and evolving suitable rice-based cropping system(s) are the lead functions of the latter. The Cropping Systems Research Centre at Karamana is the University Headquarters of the All India Co-ordinated Agronomic Research Project, its ECF Unit at present being in Quilon district

Sanctioned staff and staff position as on 30-6-1988

Designation	Sanctioned posts	Staff in position	Posts vacant
i. Lead Station, Vellayani			
A. Scientists			
Associate Director	1	1	-
Associate Professor			
Plant Breeding	1	1	-
Soil Science	1	1*	-
Agrl. Statistics	1	1	-
Assistant Professor			
Plant Breeding	1	1 (JAP)	-
Soil Science	1	1	-
Nematology	1	1	-
Agrl. Extension	1	1	-
Agrl. Statistics	1	1	-
Horticulture	1	1	-
Special Station, Kottarakkara			
Associate Professor			
Soil Science	1	1**	-
Horticulture	1	1 *	-
Assistant Professor			
Agronomy	2	2 ***	-
Entomology	1	1	-
Plant Pathology	1	-	1
Economics	1	1 (JAP)	-

* Norms Promotee Professor holding the post
** Assistant Professor holding the post
*** One post held by J.A.P.

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B. Supporting staff			
Farm Asst. Gr.I (Agri)	5	5	-
Lab. Asst. Grade I	2	1	1
Driver Grade II	2	2	-
Tractor Driver	1	1	-
Photographer	1	1	-
Duplicator Operator	1	1	-
C. Administrative Staff			
Administrative Officer	1	1	-
Typist Grade I (Steno)	1	1	-
Asst. Grade I	1	1	-
Asst. Grade II	1	1	-
Typist Grade I	2	2	-
ii. Science and Technology Scheme on Mycorrhizae			
Junior Research Fellows	2	1	1
Lab. Assistant	1	-	1
iii. Science and Technology scheme on Mushroom			
Research Fellow	1	-	1
iv. ICAR ad hoc scheme on Rice Cyst Nematode			
Assistant Professor	1	1	-
Junior Research Fellows	2	1	1
v. All India Co-ordinated Project (Nematology)			
Associate Professor	1	1	-
Jr. Asst. Professor	2	2	-
vi. All India Co-ordinated Forage Improvement Project			
Associate Professor	1	1	-
Assistant Professor	2	2	-
Jr. Asst. Professor	2	2	-
vii. Coconut Research Station, Balarampuram			
Associate Professor	1	1	-
Assistant Professor	1	1	-
viii. Cropping Systems Research Centre, Karamana ICAR			
Professor	1	1	-
Assistant Professor	4	4	-
Jr. Asst. Professor	3	3	-

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K.A.U.			
Jr. Asst. Professor	2	2	-
ix. All India Co-ordinated Project on Pesticide Residue			
Associate Professor	1	1	-
Assistant Professor	2*	2	-
x. All India Co-ordinated Project on Oil Seeds			
Assistant Professor	2	2	-

2. Objectives of the station

The main objectives of the sub project is to undertake research on crops (particularly tapioca and other tubers) and farming systems (homestead farming system) aimed at integrated development of the region with a view to maximising productivity of farms and the net income of the farmers, particularly the marginal and the small farmers in the region.

The specific objectives include

- To formulate and undertake research on tapioca and other tubers and on homestead farming system as the lead functions and on rice and coconut-based farming systems as the verification functions
- To supervise and co-ordinate the research work at the Regional Station, the Special Station and the sub stations in the region
- To conduct regional workshop for each season (kharif and rabi) to establish an effective institutional net work for ensuring feed back between research scientists and extension personnel
- To adopt villages (two or three villages) so that the Scientists themselves can work with farmers in different resource situations, study the constraints and find out the measures to overcome these constraints
- To undertake extension work by participation in field work, training etc., thus making research more purposeful and the transfer of technology more rapid
- To maintain a catalogue of problems referred to by the extension personnel and the farmers and those observed by the scientists and
- To take part in the training of extension personnel working in the T&V system of Agricultural Extension

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*In addition to the two, One post of Assistant Professor has been sanctioned for 88-89.

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3. Research requirements of the region

In more than 55% of the area in the region, where coconut or tapioca is the main crop, the existing crop combinations in the homesteads are based on trial and error experience of the cultivators rather than on scientific findings. The main research needs in this area are:

- Evolving suitable poly-crop combinations for the homesteads leading to maximum utilisation of solar, water and soil resources,
- Evolving coconut-based, tapioca-based and rice-based cropping systems suited to different sub-zones,
- Evolving systems of farming which will result in the maximisation of net profit and family labour utilization opportunities, minimisation of soil erosion hazards etc. with particular reference to marginal and small farmers,
- Scrutinising the general recommendations for banana, vegetables etc. and bringing out modifications thereof, suited to different farming situations,
- Evolving cropping patterns suitable for the areas of undulating terrain with steep slopes in the mid upland region,
- Identifying/evolving varieties of annual and seasonal crops for cultivation in the coconut gardens and other partially shaded places.

Since the commencement of the project, nine zonal workshops have been held on 1st March '82, 8th Feb. '83, 19th July '83, 6th & 7th March '84, 12th & 13th Sept. '84, 26th & 27th March '85, 14th & 15th Feb. 1986, 9th & 10th Sept. '86 and 29th & 30th June '87.

The participants to these workshops included the extension personnel of the State Department of Agriculture from Trivandrum, Quilon, Pathanamthitta, Alleppey and Kottayam districts, the Scientists of the Kerala Agricultural University and the representatives from the ICAR institutions in the region.

During the 1st regional workshop, several location specific problems were identified by the extension functionaries of the Department of Agriculture. Based on these problems and other field problems of the farmers which could be identified during a series of discussions with the farmers, sixty five research projects, eight adaptive trials and two observational trials were formulated. These were discussed during the second regional workshop. The projects were inter-disciplinary in nature and reflected the needs of the farming community in the region. The second workshop approved these projects and fixed priority for implementation of the various projects. During the third workshop held on 19-7-83, a detailed review of the work carried out till then was made and the projects proposed for implementation during the rabi season of 1983-84 were discussed. During this workshop, the feed back of location-specific problems received from the monthly workshops conducted under the T&V system was also considered, along with the new problems presented by the extension specialists of the Department of Agriculture.

In the subsequent Workshops (IV to IX), the progress of research was reviewed. From the data generated, production recommendations were identified which were accepted by the State Level Workshop on package of practices held on 13th and 14th June '85. Results of the farm trials conducted in the region were also reviewed besides programming farm trials for the next season. The Mini Workshop on Package of Practices held during March '87 examined the data generated between 1985 & 1987 and identified the findings that can be recommended for acceptance by the State Level Workshop to be held later.

In the meanwhile, the agroclimatic features of the region were critically analysed based on which nine farming situations were identified.

A broad categorisation of the projects was made based on the particular farming situations as existing in the different localities, Four farming systems were identified as follows:

- Homestead farming system
- Tapioca-based farming system
- Coconut-based farming system
- Rice-based farming system

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During the period under report, seventy research projects, including two adaptive trials were being implemented under NARP by the different Departments.

Brief reports on the research projects which were being implemented in the southern region during kharif 1987 have been presented in the following pages. The NARP funded projects and the projects funded from other sources, being implemented in the different departments of the College of Agriculture have been included. Research reports from the Coconut Research Station at Balaramapuram and the Cropping Systems Research Centre at Karamana have also been included, to reflect the research efforts being made in the entire region.

The reports include the objectives, the results obtained during kharif 1987 and a brief account of work in progress during Rabi 87. Results could not be included in the case of all the postgraduate research projects. Wherever possible, salient findings have been listed.

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I. Homestead Farming System

1.1 Collection, Evaluation and Interpretation of the basic statistics about the southern region

1.1.1 Basic Socio-economic survey
(Basic information and constraint)

A pilot survey was conducted during March '83 among 20 homestead farmers (upto 1 acre) covering different localities in the region for pre-testing the questionnaire prepared for collection of data for the basic survey and the questionnaire was revised accordingly.

The collection of data using the pre-tested printed Proforma was started in January, 1985 by the Scientists under the NARP(SR). Two stage stratified random sampling design was adopted for identifying the farmers in the sample.

Full data collection was completed and the data were analysed using computer facilities.

Preparation and typing of the tables generated from the survey data is being continued.

1.1.2 Utilization pattern of farm information sources by homestead farmers in NARP(SR)

The objectives of the project are to study the utilization pattern of farm information sources and the relationship of farm information source use and adoption behaviour of the homestead farmers. Based on these objectives, a pilot study was conducted for the preparation of a questionnaire. A second pilot survey was conducted based on which the questionnaire was modified and data collection was completed during the period under report.

Analysis of the data is being continued.

1.2 Climatological parameters in the southern region

1.2.1 Pattern of occurrence of rainfall in the southern districts of Kerala

Data on daily rainfall amounts for the last 25 years (1960-84) pertaining to five meteorological centres (one centre from each district in the southern region viz. Trivandrum, Punalur, Alleppey, Thiruvalla and Kottayam)

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have been collected and analysed using suitable models for the distribution of rainfall in the southern districts of Kerala. These results were presented in the VIII Zonal Workshop of the NARP(SR) and KAEP held on 9th and 10th September, 1986.

The workshop has suggested that rainfall data from more meteorological centres in the southern districts of Kerala and covering more number of years are to be further collected and analysed for the completion of the project.

There are 25 taluks in the five southern districts of Kerala since it is required to collect data from more centres, one meteorological centre from each taluk is considered for collecting additional data on rainfall amoun in the southern region. The data collection is being continued.

1.3 Soil productivity of the homesteads of the southern region and its improvement

1.3.1 Investigations on the biology and pupulation dynamics of earthworms and their r ole in agricultural productivity

The population survey of earthworms was conducted in Trivandrum dist. and different methodologies were tried to breed earthworms under captivity, to make mass cultures.

During the Kharif 1987 ,

(a) studies were conducted on the soil microflora present in the earthworm castings found in the nearby areas and the following micro-organisms were present

Fungi
1. Aspergillus niger (grey type)
2. Fusarium sp.
3. Rhizopus sp.
4.

Bacteria
1. A whitish type
2. Actinomycetes

It was observed that there is no significant difference between the population present in the castings and in the control soil.

(b) Studies on the multiplication and mass culturing of earthworms under captivity revealed that mass culturing is possible under laboratory conditions provided a suitable soil media with optimum organic content, soil moisture and soil temperature were provided.

During Rabi 1987, feasibility of mass multiplication of earthworms in different soil types was assessed. Survey works in Quilon dist. and Kuttanad are also in progress to assess the population in relation to soil, temperature, soil-moisture, soil pH and organic matter. The effect of undisturbed soil media in mass multiplication during different periods is also being studied to fix the treatments, and assess their role in agricultural productivity.

1.3.2 Studies on homestead farming under different soil fertility status in Quilon district

The objective of the Project is to obtain complete information on all aspects of cultivation of the existing coconut based homesteads of Quilon district. The work involved was the survey of homesteads followed by the analysis of the soil samples collected from the homesteads. Stratified multistage sampling procedure was used for selecting the homesteads. In the strata 'Taluk' , the first stage unit was 'Panchayat' and the second stage unit was 'Homestead'. The Taluks Quilon, Karunagappally, Kunnathur, Pathanapuram and Kottarakkara had 20, 15, 7, 14 and 19 panchayats, respectively.

$$\frac{20, 15, 7, 14, 19}{5} = 4 + 3 + 2 + 3 + 4 = 16$$

So 16 panchayats were selected for the study and five homesteads were surveyed from each Panchayat. Thus the total number of homesteads to be covered under the Project would be 16 x 5 = 80.

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Work is in progress. The survey has been started only from September, 1987 onwards. Soil samples are being collected from the homesteads visited, and these are analysed for their N_1P K , pH and EC.

1.4 Evolution of high yielding varieties of component crops suited to the homesteads of the southern region

1.4.1 Genetic Improvement of Vegetables cultivated in the Southern Districts of Kerala

This experiment was aimed at increasing the yield potential of popular varieties like Bhindi, Bittergourd, Amaranthus, Brinjal, Cucumber, Watermelon, etc.

During the past season, work on germplasm maintenance and evaluation of popular vegetables were done. In Bhindi an elite selection AE-1 was identified as high yielding. The VIII zonal workshop of NARP(SR) has recommended to test this culture in Farm trials.

Bhindi culture AE-1 was tested along with Selection-2 and Pusa sawani and a local check in farm trials during Kharif 1987 in Trivandrum district. Breeder's seed of all the three types were produced and distributed for conducting the trial during the period under report. The yield data is presented in Table 1.1

The result indicated that in Trivandrum dist. Pusa Sawani gave the highest fruit yield, (7714 kg/ha), followed by AE-1 (7210 kg/ha).

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AMARANTHUS: Two high yielding cultures viz. S-8 and S_1 were identified. Proposals were submitted to list these cultures in Farm trials in Trivandrum and Quilon districts. It was suggested to test this along with Standard - Kannara local and a local check during the period.

BITTERGOURD/SNAKEGOURD/WATERMELON

Germplasm of these vegetables were maintained.

During Rabi 1987 and Summer 1987-88, 10 farm trials each were laid out in Quilon district with bhindi types AE-1, Sel.2 and P. sawani. In Amaranthus a total number of 10 farm trials with 2 cultures viz. S_8 and S_I along with Kannara local and a local check were laid out in Trivandrum dist. and Quilon dist. during Summer 1987-88. And in watermelon a 8 x 3 RBD was sown in the summer rice fallows at Vellayani.

FARM TRIAL WITH HYBRIDS & VARIETIES OF BRINJAL

During Kharif '87, crosses were made in cage as shown below, namely SI 6 x PPL and SM-10 x PPL. Crossed fruits were collected and F_1 hybrid seeds produced. F_1 seedlings were produced for testing under farm trials. The other test materials included SM-10, PPC and a local check. The two hybrid (H_1 + H_2) seedlings, SM-10 seedlings, and PPC seedlings were raised and distributed for conducting farm trials during Kharif 1987 in the Trivandrum and Quilon districts.

The yield data of fruits in Tons/ha is presented Table 1.2 separately for Trivandrum and Quilon districts. The result indicated that in Trivandrum district T_4 out-yielded all other entries followed by T_1 & T_2. The location-wise yield data obtained from Quilon dist. is given in Table 1.3

Results from two more locations are yet to be received. The results indicated that T_2 outyielded all other entries followed by T_3 & T_1.

1.4.2 Identification of vegetable types of cowpea suitable for homestead fardens

Thirteen varieties/types of vegetable cowpea were collected from various locations and tried in unreplicated progeny rows and selections were made during Kharif 1983.

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Twenty promising selections were put under progeny row trial fortesting homegenity during Rabi 1983. Replicated preliminary yield trials with the twenty selected types were conducted during Kharif 1984-85. Based on the results of these trials, nine promising lines were selected for promoting to comparative yield trial. Comparative yield trials with nine selected lines and check varieties were conducted during summer '86 & Kharif '86. In the comparative yield trials conducted during summer 1986 & Kharif '86 Selection 16 was the highest yielder of green pods.

During Kharif 1987, comparative yield trials (3rd CYT) were laid out in 14 x 3 RBD. The cultural & manurial practices were done as per the package of practices recommendations. The data on length of pods, number of seeds per pod and yield of green pods are presented in table 1.4. The highest yield of green pods was recorded by Selection 16 (6333 kg/ha) followed by selection-10 (5407 kg/ha). Pod length & number of seeds per pod were maximum for Selection-7.

Work is being continued. Seed multiplication of Selection 16, Selection 7 and Kurutholapayar (check variety) is being done with the intention of promoting these two promising types for the farm trials.

.3 <u>Identification of sweet potato types suitable for uplands</u>

Thirty six different varieties/types of sweet potato from different agro-climatic regions of the State were collected and evaluated in an RBD with two replications during Kharif 1983. Seventeen varieties/types were selected based on yield and other desirable characters and put to replicated trials during Kharif 1984. But the experiment had to be abandoned due to the theft of marketable tubers. The results of the CYT conducted during Kharif 1985 showed that SPC-20 and SPC-18 are promising but in the CYT conducted during Kharif 1986, SPC-13 was the highest yielder, and was on par with SPC-18 & SPC-20.

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The third Comparative Yield trial laid out during Kharif '87 was severely affected by drought. Consequently the tuberisation was below normal. So the experiment was treated as vitiated & hance abandoned.

A third CYT will be repeated during Kharif 1988.

1.5 Agro-techniques for the homesteads and component crops in the southern region

1.5.1 Standardisation techniques for growing vegetables in pots - Standardisation of potting mixtures.

The experiment was laid out with seven treatments and three crops namely brinjal, bhindi and tomato. This is a pot culture experiment and the results showed that there was no significant difference between treatments in all the 3 crops.

The experiment was again laid out with Tomato (L.E.79) Bhindi (AE-1) and Brinjal (Pusa purple cluster) during Rabi 1987. But all the tomato plants have been affected by spotted wilt and hence the experiment was continued with the other two crops. The crop was harvested and analysis is being done.

1.5.2 Flower initiation and fruit development studies on red banana

Under the experiment fifty suckers of uniform age are planted at the Instructional Farm, Vellayani. Starting from the fifth month after planting, four plants were uprooted at random every 15 days and dissected to locate the apical meristem. The meristems were preserved in fixative agent for taking sections using microtome, so as to enable observation and location of the flower primordia. This uprooting was continued upto shooting. The preserved meristems were processed and the sections were taken using microtome. Different staining techniques were tried and a standard procedure has been developed. However, no valid information could be obtained as the age of the suckers was not known.

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With the basic information obtained from the trial, the experiment has been laid out again with suckers of known age. Apical meristems were taken at an interval of 15 days and continued upto shooting. The meristems were preserved in fixative agent (FAA) for 2 weeks and then embedded in paraffin wax. Microtome sections have been prepared from such blocks.

During Rabi 1987 the work was continued and the sections are observed to assess the stage at which flower bud differentiation takes place. The result showed that differentiation takes place at around 10-12 months after planting. But this can be confirmed only after detailed study of the microtome sections. The work is being continued.

1.5.2 B. Nutritional requirement of Red Banana under rainfed condition

With an objective to formulate and recommend a fertilizer schedule for Red Banana, the study was undertaken with 5 treatments based on KAU recommendation and 6th one was included as an ad hoc recommendation based on the recommendation by the TNAU for the Kanyakumari district. The result of this study showed that there was no significant difference between treatments in the number of days taken from planting to shooting. With regard to yield, the treatment T_6 recorded the highest yield of 12.38 kg which was statistically superior to all other treatments. Similar results were obtained with in the case of number of fingers per bunch. In the case of weight of fruit, T_5 was found to be statistically on par with T_6 but superior to all other treatments. The highest TSS of 17.83% was observed at T_6 which was significantly superior to all other treatments.

The experiment is being repeated with changes in the treatment combinations as suggested by the T & V and NARP Workshop. Accordingly the experiment has been laid out during August 1986 as follows:

Design - 3^2x2+1 Partially confounded factorial Design

N - 3 levels - 40, 220, 300 g/plant

P - Two levels - 140, 220 g/plant

K - 3 levels - 280, 440 & 600 g/plant

Replication - 2

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There are 18 fertilizer combinations along with the recommendation made by TNAU for Kanyakumari district (370 N, 40 P and 380 K - g/plant).

Observations such as height of the plant, girth of the plant, number of functional leaves, date of shooting, time taken from shooting to harvest etc. were taken.

During Rabi 1987, harvesting of the crop started and observations such as weight of bunch, no. of fingers, length of fingers, girth of fingers, no. of hands were recorded. The quality analysis of fruits were done. Harvesting is being continued.

1.6 Assessment of crop loss and control of Pests/Diseases of the component crops in the homestead farming system prevalent in the southern region

1.6.1 Studies on the population build up of nematodes in homestead gardens of Trivandrum dist.

A multistratified random survey of nematodes was conducted in 1986 also on the same selected 54 homesteads. Apart from the other nematodes namely Tylenchorynchus, Xyphinema, Tylenchus, Criconemoides, Hoplolaimus, Meloidogyne incognita, Radopholus similis and Helicotylenchus sp., the genus Rotylechulus was also present. Accoraing to the frequency of occurrence, Rotylenchulus ranked first followed by Tylenchorynchus.

During the Kharif season, two samplings - one during April, 1987 & another during August, 1987 were done. Soil and root samples were collected from selected homesteads. Five different crop combinations were studied during this period. The results revealed that homesteads having coconut alone in three types of soil recorded the minimum population of nematodes both in soil and roots. In homesteads having both coconut & banana, the nematode population was maximum in banana compared to coconut.

When homesteads having Tapioca, pepper and arecanut together with coconut & banana were assessed, it was found that the nematode population in banana was reduced, more so in red, sandy soil and laterite soil. It was also found that in these cases the nematode population is distributed to the coconut rhizosphere also.

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Regarding the percentage frequency of occurrence of various nematode species, Helicotylenchus sp. ranked first (65%) followed by Rotylenchulus sp. (60%) and Tylenchorynchus sp. (53%). The percentage frequency of occurrence of R. similis was only 17%, and M. incognita 10%.

Seasonal fluctuations of various nematodes on crops:

Sandy soil: In different combinations the Radopholus similis and Meloidogyne incognita population was high in August '87 as compared to April '87 though the frequency occurrence is low in both the seasons. The population of Helicotylenchus sp. and Rotylenchulus sp. remained almost the same in the two seasons.

RED SOIL: When different crop combinations were studied the R. similis population increased only on banana roots during August, '87 as compared to April, '87. But Helicotylenchus sp. population increased considerably both in the soil & root of different crops during August '87. The Tylenchorynchus sp. and Rotylenchulus sp. population remained almost in the same level during April '87 & August '87.

LATERITE SOIL: In different crop combinations the frequency of occurrence of R. similis in soil increased during August '87, but the population remained almost the same. But the population of Helicotylenchus increased during August, 1987. The Tylenchorynchus sp. and Rotylenchulus sp. population were reduced considerably during August, 1987.

Work is in progress now. Surveys are being conducted in selected homesteads at 4 months interval, for three seasons upto December, 1988.

6.2 Crop loss estimation and economic threshold levels of root-knot nematode infesting vegetables, - Bhindi, Brinjal, Bittergourd

One pot culture experiment and two field experiments were carried out originally to assess crop losses at various levels of nematode population infesting bhindi, brinjal and bittergourd. A third set of field experiments for bhindi and brinjal were also conducted from August '86 to April '87 for assessing crop losses at different levels of nematode population.

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A third field experiment for bittergourd was laid out during the current season, from June '87 to Sept. '87. The results obtained are given in Table 1.5. Yield reduction was noticed in various treatments over the control. The percentage reduction in yield of the various treatments over the control was 12.1, 19.25, 39.13 and 45.85 for the treatments T_1, T_2, T_3 and T_4 respectively. In the case of root-rot count and nematode population in soil, minimum numbers were recorded in control followed by the treatments T_1, T_2, T_3 and T_4. The maximum length of plants were recorded for the control. The maximum root weight was observed in the control (T_5) and the treatment T_1.

The experiments are being repeated for bhindi, brinjal and bittergourd by trying just two treatments instead of the five treatments, - The two treatments tried now are T_1 - field population and the control as suggested by Dr.J.S.Gill, Project Co-ordinator of AICRP on nematodes in the co-ordination meeting held in the Department of Entomology, College of Agriculture on 25-10-87.

1.6.3 <u>Determination of waiting periods of insecticides recommended for the control of pests of vegetables in Kerala</u>

Waiting periods of important insecticides on vegetables like bhindi, cowpea, brinjal, bittergourd and snakegourd were fixed for both washed and unwashed samples during the rainy and summer seasons.

The residues of insecticides viz. monocrotophos 0.05%, dimethoate 0.03%, malathion 0.1%, quinalphos 0.05% and fenthion 0.05% at different intervals after spraying on snakegourd grown in the rainy season were estimated during the period under report and the waiting periods were fixed. The residues were estimated from both washed and unwashed samples.

The mean residue of Monocrotophos on snakegourd fruits on the first day after application was 2.66 ppm in unwashed samples and 2.42 ppm for the washed samples. The residues got reduced to 0.06 and 0.04 ppm respectively in the unwashed and washed samples by the 10th day after application

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In the case of Dimethoate 0.03%, the initial residue was 2.24 and 2.14 ppm in the unwashed and washed samples, respectively. The residues were 2.1, 1.09 & 20.93 ppm on the 3rd, 5th & 7th day after application, respectively in the unwashed samples whereas it was 2.06, 1.08 and 0.86 ppm respectively in washed samples.

The initial malathion residue in the unwashed sample was 0.69 ppm which got reduced to 0.21 ppm on the 5th day after application whereas it was 0.68 ppm & 0.2 ppm, respectively for the washed samples.

The Quinalphos residues on the first day after application was 2.38 ppm in unwashed samples, whereas it was 2.14 ppm in the washed samples. The residue got reduced to 1.63, 0.64 and 0.018 ppm on the 3rd, 5th & 7th day in unwashed samples. In the washed samples, the corresponding residues were 1.42 ppm, 0.4 ppm and 0.012 ppm, respectively.

In the case of Fenthion the initial residue was 1.96 ppm in unwashed samples and 1.68 ppm in the washed samples. The residues got reduced to 0.15 ppm and 0.1 ppm respectively on the 5th day after application (Table 1.6).

Work is being continued and at present waiting periods are being fixed for the following insecticides on the following crops, -

Crop	Insecticide
1. Bittergourd	Dimethoate, Monocrotophos and Fenthion (rainy season)
2. Cowpea	Dimethoate, Monocrotophos, Quinalphos, Malathion (rainy season)
3. Chilli & Tomato	Dimethoate, Monocrotophos, Quinalphos, Malathion, fenthion and Fenetrothion.

.6.4 Efficacy of different granular nematicides for the control of Root-knot nematode in bhindi

Pot culture experiments were conducted with seven different insecticides and one control. Pooled analysis of the two seasons data (Jan. '85 & Jan. '86) showed that in all characters except root weight and nematode

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population, the effect of the treatment was not significant and consistent. Residue analysis of bhindi fruits was also done and the residues were at non-detectable levels from the first harvest itself (ie. 47th day after the application of Furadan & Thimet).

After including the present season's work also, a pooled analysis of the three seasons' data was done. The results showed that the biometric characters like height of the plants, number of leaves, root weight, etc. were not significant. But the weight of the fruits and nematode population in the root were statistically significant. It was also found that the three treatments Phorate, Carbofuran and Aldicarb were on par and superior to the control.

At present, as per the suggestions of Dr.J.S.Gill, Project Co-ordinator of AICRP on nematode pests, four more treatments were also included in the technical programme. These treatments are Carbofuran and BPMC for seed treatment and organic waste and leaves at the time of sowing (The latter two treatments were found effective in AICARP Projects).

1.6.5 Survey and control of Pollu beetle of Pepper

During the past season, a survey on the incidence of pollu beetle in black pepper was conducted at Ranni in six panchayats from June '82 to Dec. '88. Field experiments at Nedumangad on the control of this pest indicated that Endosulfan 0.05% was the best. A trial to study the effect of Endosulfan 0.05% spray when applied at different periods to control the pollu beetle shows that Endosulfan 0.05% spray during May, July and September was the best in controlling this pest. Maximum yield and a high cost benefit ratio was also obtained in the above treatment.

During Kharif '87, the above trial was repeated at Vattappara from May '87 onwards. The different treatments were applied at spike emergence (May) berry formation (July) and berry maturation st ge (September) as per schedule. Observations on pest incidence and damage to spikes and berries were recorded.

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Another trial was also repeated in an infested pepper garden at Ranni from June 1987 for concurrent results. Four commonly used insecticides viz., Monocrotophos, Endosulfan, Quinalphos and Dimethoate were applied in July and September and observations were recorded.

The yield of dried pepper from the treated and untreated vines is being recorded.

1.6.6 Studies on the pathogenicity of the root-knot nematode Meloidogyne incognita and reniform nematode Rotylenchulus sp. on betel vine and their role in the incidence of bacterial wilt

Two pot culture experiments were carried out to study the pathogenicity of root-knot nematode Meloidogyne on betelvine.

A third pot culture experiment was conducted during the current season. The treatments were changed from 10, 100, 1000 to 10,000 larvae per plot to 1000, 2000, 3000, 4000 and 5000 larvae per plot. Fortnightly biometric observations like length of vine, number of leaves and number of vetta were recorded.

A fourth pot culture experiment is being carried out to study the pathogenicity of reniform nematode Rotylenchulus sp. on betel vine.

1.7 Augmenting the unit level income of the homestead farmers of the southern region

1.7.1 Improvement of bee keeping practices in homestead

After a survey in the southern part of Kerala, twenty bee colonies with desirable characteristics were procured from Anchal to start an apiary. The necessary bee equipments were also procured. Wax moth and mite infestations were observed in the bee colonies. Proper cleaning and rearranging the board frames helped improve the condition of the colony and stimulated egg laying by the queen.

During Kharif 1 87 many treatment combinations were tried to develop a pollen substitute and it was observed that honey, yeast, skimmed milk powder and green gram powder mixed in a semi-solid consistency was acceptable to bees.

To find out an alternate food for bees and a cheaper substitute for sugar syrup it was observed that banana fruits (var-Peyan, Poovan) mixed with gur was readily acceptable to the bees.

Division boards were additionally provided to the ISI bee boxes to adjust the space requirments within the broad chamber.

Work is in progress. And it was found that by providing division boards a better management of the bee colonies was possible especially during the lean season.

The mite seen infesting the colonies and feeding on combs was identified as Klemannia sp.

A new predatory Reduvid bug is also seen infesting the colonies. Its identity is yet to be confirmed.

The infestations of the wax moths, mites and the predatory bugs were controlled by proper management and timely cleaning operations.

1.7.2 Studies on the mushroom of Kerala

For the culture maintenance of the following species of mushrooms viz., Volvariella volvacea, Pleurotus sajor-caju, P. opuntiae, P. cornucopiae and Agaricus trisporus, spawn prduction and preparation of beds were carried out. Trials to cultivate P. opuntiae isolated from spent oil palm bunch waste and P. cornucopiae from old stumps of Jakopha gladulifera on paddy straw were found to be successful. A mixture of tamarind seed and wheat at a ratio of 1:1 were tried as a substratum for spawn production of Pleurotus sajor-caju. Good mycelial growth was observed 10 days after the inoculation of the substratum.

During Kharif '87 attempts were made to find out a cheaper and suitable substratum for Volvariella volvacea and Pleurotus sajor-caju. It was observed that the mycelium of Volvariella volvacea grows and spreads well in the substratum prepared out of paddy straw, spent tea waste and oil palm pericarp waste at a ratio of 2:1:1. Growth of Pleurotus sajor-caju on paddy straw mixed with paper waste at a ratio of 2:1 was also tried and found successful.

Further trials are in progress.

2.

2. Cassava Based Farming System

2.1 Evolution of high yielding varieties of component crops in the Cassava based farming system of the southern region

2.1.1 Identification of suitable varieties of companion crop for tapioca

During the past season tapioca variety M_4 was tested along with 10 different groundnut varieties and a control. This was done with a view to identifying the most suitable groundnut variety as companion crop. The 11x3 RBD experiment laid out was vitiated due to theft of groundnut pods.

During this season, a 10 x 3 RBD was planted with M_4 tapioca and 9 different groundnut varieties. In this experiment also groundnut was severely damaged due to various reasons. Tapioca was harvested at 7½ months maturity and yield recorded.

The experiment was concluded as per the directions of the monitory team.

2.

2.2 Improvement of agro-techniques for the cassava based farming system in the southern region

2.2.1 Evolving an intercropping system for cassava for April - May planting

The objective of the experiment is to evolve a suitable intercropping system for cassava, April-May planting. It was undertaken first during 1983-84 at two locations and later during 1985-86 at one location. In all these experiments tapioca grown alone with weeding gave the highest yields followed by the treatment, tapioca intercropped with green gram.

The experiment was repeated at this Station during the period under report ie. May '87, in a RBD with seven treatments and four replications. The performance of the intercrop was very poor and a poor yield obtained.

As per the directions of the Associate Director (M&E), the experiment is being repeated on a multi-locational basis in the farmers' fields.

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2.2.2 Planting geometry and double intercropping in cassava

The experiment aims at determining the suitable planting geometry in a cassava based intercropping system and studying the possibility of raising a second intercrop immediately after the harvest of the first intercrop.

The experiment was laid out during June '87 in Randomized block design with thirteen treatments and three replications. The growth and yield of the intercrop, namely French bean was very poor. But the second intercrop namely Groundnut gave good yields. Since the French bean crop was found unsuitable to the soil type of the concerned locality, the experiment was repleated by replacing French bean with the cowpea variety 'Kanakamoni' during Kharif 1987-88.

2.3 Evolution of low cost technology for cassava based farming system in the southern region

2.3.1 Investigation on the mycorrhizal association of cassava in enhancing the nutrient availability

The common tapioca varieties grown in Kerala were surveyed for the occurrence of VA - mycorrhizal association. All the cultivars observed for VAM association were found positive for VAM colourisation due to native VAM fungi. It was observed that among the varieties, M_4 showed maximum colonisation..

During Kharif 1987, two mycorrhizal cultivars obtained from TNAU were the subject for preliminary multiplication using tapioca as the host plant. Sufficient spore population was achieved in pots, for further mass production of the cultures in Panicum maximum, required for crop response studies.

Studies are in progress. Five standard VAM culture viz. G. fasciculatum , G. etunicatum, G. mossae, G. constrictus and Aculospora morroweae were obtained from UAS, Bangalore & ICRISAT. These cultures are also

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being subject for preliminary multiplication for further mass production in Panicum maximum. When the inoculum is ready, crop response studies will be taken up both under pot and field conditions.

2.3.2 Studies on rhizobia isolation of efficient strains of Rhizobium

During Kharif '87, a field experiment was conducted to evaluate the efficiency of Rhizobium culture for two of the legumes, black gram and groundnut. New work was also initiated on the isolation of rhizobia suitable for various fodder legumes grown in the State.

During the period under review, preliminary isolation of rhizobia suitable for Sesbania, Subabul, Stylosanthes, Mimosa pudica and M. indica were successfully completed. This work was undertaken since it was a part of the objective identified in the project proposal.

and

The isolation work /screening of the primary cultures for nodulation efficiency will be done during the current year.

3. Coconut Based Farming System

3.1 Evolution of crops suited to the partial shaded conditions of coconut gardens in the southern region

3.1.1 Varietal evaluation of cowpea under partially shaded conditions in coconut plantations

The experiment has been conducted since Kharif 1982. The varieties V-26 and HG-22 were found to be promising, when the experiment was conducted during Kharif '82. During 1983 the experiment was vitiated due to severe drought. During 1984 Kharif, the experiment was not conducted. Two trials were conducted during 1985 Kharif season. In the first trial (9 x3 RBD), the variety C-152 was significantly superior to all the other varieties with respect to the grain yield (404 kg/ha). In the second trial (8x4 RBD) conducted by including AICPIP varieties, the variety V-118 recorded the maximum yield (167 kg/ha). During 1986 Kharif the experiment was conducted in a 16 x 4 RBD. The variety 'Cheradi' had the highest yield (250 kg/ha) and was on par with CO-4 & C-152. Earliest maturity was also observed in 'Cheradi'.

Two experiments were conducted during Kharif 1987. The data collected from the first trial which was a 10 x 3 RBD are presented in Table 3.1(a) in kg/ha of grain yield.

It was observed that the variety 'Cheradi' had the highest grain yield (228 kg/ha) followed by CO-4 (211 kg/ha). The second CYT was laid out in a 10 x 4 RBD with AICPIP varieties. The data on grain yield (kg/ha) are presented in Table 3.1(b). The varieties differed significantly in grain yield. The highest yield was recorded by NPRC-3 (212 kg/ha) followed by Co-4 (161 kg/ha).

The experiment will be continued during Kharif 1988 also.

3.1.2 Varietal evaluation for groundnut under partially shaded conditions in coconut plantations

The experiment was started with an objective to identify suitable groundnut varieties with high yield potential and shade tolerance to grow profitably in coconut plantations during Kharif 1982. In this, EC-119704

failed to germinate due to seed dormancy and hence it was continued as 9 x 3 RBD. The varieties did not differ significantly in respect of pod and haulm yield. During 1985 the trial was continued as 7x3 RBD and the varieties did not differ significantly in dry pod and haulms y eld. During Kharif 1986, the experiment (12x3 RBD) was continued. Since three varieties failed to germinate it was continued as a 9x3 RBD. The varieties differed significantly in their dry pod yield. TG-3 recorded the maximum dry pod yield of 417 kg/ha and was on par with Polachi-1 (370 kg/ha) and EC-119704 (343 kg/ha).

A 9x3 RBD was laid out during the 1987 Kharif also. Here too it was observed that the varieties differed significantly in their dry pod yield (kg/ha). The data collected on the number of pods/plant and dry pod yield in kg/ha are presented in Table 3.1(a)

The number of pods per plant was maximum in Pollachi-1 (8.8). The dry pod yield was maximum in TG-3 (444 kg/ha) which was significantly superior to all the other varieties.

As suggested during the monitoring and evaluation conducted on 19-12-87, the Project was concluded. A pooled analysis was done using the data collected during 1984, 1986 and 1987 seasons. Accordingly, the dry pod yield from 1984 to '87 are presented in Table 3.2(b)

It was observed that the varieties differed significantly from each other with respect to their dry pod yield. The variety x season interaction was also found to be significant. TG-3 had the maximum dry pod yield and its mean pod yield for 1984 to 1987 was 511 kg/ha. TMV-2 recorded the second highest dry pod yield (313 kg/ha). Since TG-3 was found to be constantly superior in yield under partially shaded conditions than the recommended varieties, TMV-2 and Pollachi-1, it was recommended for cultivation by the Mini Package of Practices workshop held on 29-1-'88 and subsequently it was recommended by the Package Workshop also.

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The project was concluded and the final report has been submitted to the Director of Research and the Associate Director, NARP(SR).

3.1.3 Varietal evaluation for guinea grass under open and partially shaded conditions in Coconut plantations

An experiment with 12 clones (12 x 3 RBD) was laid out during Kharif 1985 under partially shaded conditions in coconut plantations. Upto May 1987, eight cuttings were taken and observations on green fodder yield and other important attributes recorded.

During Kharif '87, the 9th cutting of the CYT under partially shaded coconut garden condition was taken. The green fodder yield and other important characters of the 12 clones at the 9th cutting are presented in Table 3.3. It was observed that there was no significant difference between the varieties at the 9th cut with respect to green fodder yield, Plant height, No. of tillers per hill and the number of panicles per hill.

The CYT is being continued.

3.2 Standardisation of agro-techniques for component crops in the coconut based farming system in the southern region

3.2.1 Fertilizer management of minor tuber crops in coconut based cropping system

To assess the performance of different tuber crops in coconut garden and also to find out the optimum dose of fertilizer nutrient for tuber crops under partially shaded conditions, an experiment was laid out in RBD during July 1985. Work has been completed and statistical analysis is in progress.

3.3 Assessment of crop loss and control of pests/diseases of component crops in the coconut based farming system in the southern region

3.3.1 Bionomics and Control of Paradasynus rostratus on coconut

Multi locational trials on the control of the pest P. rostratus indicated that BHC 0.2%, Carbaryl 0.1% and Endosulfan 0.1% were effective. Based on these findings, another trial was conducted at Chirayinkil. The results

indicated that application of HCH 0.2% spray, HCH 10% dust and Carbaryl 0.1% spray eight times in an year were effective in controlling the damage by the pest. Correlations were also studied and the characters taken were the area damaged on the husk and the nut characters. The biology of the insect pest on an alternate host viz. Guava was also worked out. Stage susceptibility studies indicated that tender coconuts upto a period of 140 days were highly susceptible to Coreid bug attack. Seasonal incidence studies of coreid bug infestation on coconut showed that maximum damage was caused during August, September and October in 1985 & 1986. An increasing trend was noticed from July onwards and a declining trend from November onwards reaching a minimum in February, March and April.

During Kharif 1987, the seasonal incidence studies were continued.

Seasonal incidence studies will be further continued in the next season also and the role of Phorate in Coreid bug control will also be studied.

3.3.2 Survey on the coreid bug incidence on coconut in Kerala and its control

During the last season a statewide survey on the incidence of the coreid bug on coconut was conducted, involving the Officers of the Department of Agriculture, Kerala State also. The completed proformae from the different districts were compiled and prepared for statistical analysis.

During the period under report, the data from Trivandrum, Quilon, Pathanamthitta, Alleppey and Kottayam districts were analysed and the results are given in Table 3.4 briefly.

Work is being continued. The data from the remaining districts will also be analysed and the results presented. Data on bunch infestation and variety-wise damage in the different sub-divisions of the districts of Kerala are also being analysed.

4. Rice Based Farming System

4.1 Improvement of component crops in the rice based farming system of the southern region

4.1.1 Screening rice varieties and cultures for tolerance/ resistance to BPH, Sheath blight and yield potential

An experiment (15 x 3 RBD) was conducted during 1983 Kharif. Jaya recorded a low sheath blight score and was on par with Cul.1954, Cul. 126, Mo.5, Mo-6 and Cul.25331. No sheath rot was noticed in Jaya, Cul. 1954, Cul. 126, Cul. 25331 and Cul. 4. The grain yield was high in Cul. 4 (3192 kg/ha) and this was on par with Mo-6, Karthika & Jyothi. During 1984 Kharif the experiment was conducted in a 23 x 3 RBD. It was observed that the varieties and cultures differed significantly with respect to their grain - yield and stem borer incidence only. During 1985 Kharif, the experiment was conducted in a 26 x 3 RBD. It was observed that the varieties and cultures differed significantly with respect to the stem borer incidence, sheath blight and sheath rot. As suggested in the VII regional workshop of NARP(SR) and Zonal Workshop of T & V, the trial was continued from 1986 Kharif onwards with medium duration cultures/varieties after eliminating the short duration types. The pooled analysis for three seasons (1983, 84 & 85) on short duration types revealed that Cul. 1954 was tolerant to sheath blight & Jyothi was superior to the others with respect to the grain yield potential. During Kharif 1986, the trial with Medium duration types (18 x 3 RBD) revealed that there was no significant difference for sheath blight and sheath rot disease.

During Kharif 1987, a trial with 18 cultures/ varieties in 3 replications was conducted. The data are presented in Table 4.1. It was observed that the varieties differed significantly with respect to sheath rot and grain yield. No sheath blight disease was noticed in Karthika & Vytila-3. Sheath rot was low in Vytila-3 (0.167). Grain yield was high in Culture-4 (2633 kg/ha) and this was on par with M-6 (2237 kg/ha) and Cul-126 (2222 kg/ha).

The experiment is being repeated during Kharif 1988.

4.1.2 Adaptive trial in dry land agriculture with black gram varieties

The experiment aims at evolving cowpea and black gram varieties suitable to the locality. The trial was first conducted during 1984-85 in farmers' fields at four locations and repeated during 1985-86 at three locations and during 1986-87 at two locations. The yield data of three years showed that the variety KM-1 gave the highest yield followed by TMV-1 and T_9. The experiment was concluded and final report submitted.

4.1.3 Identification of medium duration tapioca varieties suitable for wet land

As part of the M.Sc.(Ag) thesis programme, eight short duration tapioca types were evaluated in a 8 x 4 RBD in the summer rice fallows at Vellayani. The result of this experiment revealed that an ideal plant type of tapioca was one with a dwarf stature, minimum number of branches, an optimum number of leaves with the minimum retained at maturity coupled with a reseasonable number of tubers, maximum single tuber weight and high girth and length of tubers.

During the period under report two more short duration types were added and a total of 10 short duration types were evaluated in a 10 x 3 RBD in the summer rice fallow. This experiment was harvested at eight months maturity and yield data was statistically analysed. The result indicated that there was no significant difference between the treatments. Mean data are presented in Table 4.1.a.

However the highest mean yield was recorded by T_4 followed by T_6 & T_{10}.

The experiment was continued during summer 87-88 in the rice fallows at Vellayani. In this experiment three more short duration types were also included thus making a total of 13 entries. The experiment was laid out in a 13 x 3 RBD on 1-2-'88. But this experiment was totally vitiated due to heavy rains and flooding during the first week of June, 1988.

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4.2 Standardisation of agro-techniques for component crops in the rice based farming system of the southern region

4.2.1 Suitability of high yielding varieties for inclusion in the mixed sowing system of rice cultivation

The primary objective of this experiment is to determine a suitable high yielding variety for using in the mixed sowing system of rice cultivation and to determine the correct ratio of mixing seeds of the first and second crop seasons for obtaining a high yield during both seasons.

The experiment was laid out in a 6 x 3 Randomised Block Design and the variety used for the first crop was a local variety and for the second crop it was 'Lekshmy' , 'Cherady' and Culture 2500. The experiment was taken up at the State Seed Farm, Kottarakkara and at Kadakkal. The first crop was harvested at both the locations. The grain and straw yield are as given in Table 4.2. It was observed that the yield was very low at Kadakkal when compared to that at the State Seed Farm, Kottarakkara

4.3 Evolution of low cost technology for rice based farming system in the southern region

4.3.1 Mass culture technique for the production of blue green algal cultures

The mass culturing of five species of BGA isolated locally w considerably effected during the period under review due to power cut resulting in difficulties to raise initial inoculum for this purpose. The basic technique for mass culturing was standardised for BGA during the previous year. The efficiency of this technique as well as the nitrogen economy possible due to the application of these cultures under field conditions will be tested during the current year when the power position is expected to improve considerably.

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4.4 Assessment of crop loss and control of pests/diseases of component crops in a rice based farming system of the southern region

4.4.1 Control of Bunchy top disease of banana using granular insecticides in rice fallows

Multilocational trials were conducted and the results showed that application of Phorate as per the Package of Practices recommendations caused the least incidence of bunchy top disease, but it was statistically on par with application of Phorate once in 3 months and 4 months.

During the period under report, the technical programme was revised and multilocational trials were laid out in two locations with the following treatments.

T_1 Application of Phorate 10 g at 15g/plant at 20, 95 & 165 DAP

T_2 ,, ,, ,, 25g/plant at ,,

T_3 ,, ,, ,, 15g/plant once in 3 months

T_4 ,, ,, ,, 25g/plant ,, ,,

T_5 ,, ,, ,, 15g/plant once in 4 months

T_6 ,, ,, ,, 25g/plant ,, ,,

T_7 Control

The insecticide applications were done as per the programme and observations on the incidence of the disease taken.

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5. Coordinated and other Projects Attached to NARP(SR)

5.1 AICRP on Forage Crops - (a) Agronomy

5.1.1 Fodder production potential of grass legume mixtures in coconut garden

The experiment was started during Kharif 1986 with an objective to find out the different grass legume mixtures grown in coconut garden. Results showed a significant difference in green fodder yield of legumes, dry fodder yield of legumes and total dry fodder yield. Green fodder yield of legumes was maximum for Setaria & Stylo combination (2.38 t/ha). Maximum dry fodder yield of grass was 4.84 t/ha, maximum dry fodder yield of legumes was 1.03 t/ha and total dry fodder yield was 5.88 t/ha.

The data recorded during Kharif 1987 are presented in Table 5.1(a) and 5.1(b). Leaf stem ratio of grasses was maximum for guinea grass (2.39), and for legumes the highest ratio was 0.97, recorded by Stylosanthes. For all the legume combinations, Congosignal grass recorded the maximum number of tillers per plant, the highest being that of Congo & Centro (35.20).

The experiment is being continued. Analysis of the experimental data of 1987-88 showed an increase of 77% in green fodder yield and 165% (2½ times) in dry fodder yield over 1986-87.

5.1.2 Studies on Physiochemical properties of soil due to continuous grass cropping in coconut garden

In order to find out the changes in physico chemical properties of soil due to continuous cropping in coconut garden, this trial was started during Kharif 1987. The technical programme consisted of 6 treatments viz. Guinea grass, congo signal, Setaria Molasses grass, Hybrid napier and control.

The grasses were harvested once and the data are presented in Table 5.2. Here it was observed that the difference between grasses in green fodder alone was

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significant. A maximum green fodder production of 17.97 t/ha was recorded by Setaria grass which was on par with Congosignal grass (15.69 t/ha). The dry fodder yield was maximum for Congosignal (5.16 t/ha) followed by Setaria grass (4.44 t/ha).

The experiment is being continued . Analysis of data recorded during 1987-88 showed significant different in green fodder yield of grasses which was maximum for Setaria (38.66 t/ha) on par with hybrid napier (33.91 t/ha).

5.1.3 Fodder production potential of Congosignal grass under varying levels of nitrogen and cutting interval

The experiment was started during 1986 with the objective to find out the effect of nitrogen and cutting interval on the fodder production potential of Congo signal grass grown in coconut gardens. The data recorded during 1986 showed that the treatment receiving 150 kg N/ha and harvested at 45 days interval is the best.

Four harvests were conducted during Kharif 1987. The data recorded are presented in Table 5.3. The treatments showed significant difference in plant height, green fodder yield and dry fodder yield. At all the levels of Nitrogen tried, the maximum height was recorded by the treatments harvested at 60 days interval followed by those harvested at 45 days interval and 30 days interval. A maximum green fodder yield of 30.73 t/ha was recorded by the treatment given 150 kg N/ha and harvested at 45 days interval while a maximum dry fodder yield of 11.98 t/ha was obtained from the treatment receiving 100 kg N/ha and harvested 60 days interval. The number of tillers per plant was highest (42.40) for the treatment which was given 200 kg N/ha and harvested at 60 days interval, and this was on par with the treatment receiving 150 kg N/ha and harvested at 45 days interval. A maximum leaf stem ratio of 1.40 was recorded by the treatment receiving 200 kg N/ha and harvested at 30 days interval.

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The experiment is being continued. Pooled data of the first two years showed that the optimum nitrogen dose was 167 kg/ha and the optimum cutting interval was 48 days.

5.1.4 Influence of split application of nitrogen on the fodder production potential of Guinea and Congosignal grass grown in coconut garden

The objective of this experiment is to find out the effect of split and time of application of nitrogen for Guinea grass and Congosignal for obtaining maximum production. The trial was laid out during Kharif 1987 with 3 treatments. The technical programme consisted of 2 grasses (guinea grass and congo signal) and four splits of nitrogen application ie.

Basal (kg/ha)	Top dressing (kg/ha)
0	40 kg/ha after each cut
50	30 kg/ha
100	20 kg/ha
150	10 kg/ha

Entire P_2O_5 & K_2O will be applied as basal and 5 cuts will be made in a year.

The data recorded during the period under report are furnished in Table 5.4. It was observed that the maximum green fodder and dry fodder yield was recorded by Congosignal grass, which was given 100 kg N/ha as basal and 20 kg N/ha after each cut (20.18 t/ha and 6.37 t/ha, respectively). The plant height recorded was maximum for guinea grass receiving 100 kg N/ha as basal and 20 kg N/ha after each cut; and the number of tillers per plant was maximum for the treatment Congosignal grass receiving 150 kg N/ha as basal & 10 kg N/ha after each cut.

The experiment is being continued.

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5.1.5 Seed production of three strains of guinea grass viz. Haritha, Hamil and FR-600

In order to evaluate the seed production of 3 strains of guinea grass under different nitrogen levels this trial was started, during Kharif '87. The technical programme consisted of three cultivars (Haritha, Hamil, FR 600) and five nitrogen levels (0, 60, 120, 180, 240 kg N/ha).

P_2O_5 and K_2O at 30 kg/ha and 90 kg/ha were applied as basal dose uniformly to all the plots.

Seeds were collected from all the three varieties. The data recorded during the period under report are furnished in table 5.5. It was observed that the number of tillers per plant did not show any significant difference. Maximum tiller number of 11.40 was recorded by Haritha receiving 240 kg N/ha. The maximum number of inflorescence per plant was recorded by Hamil grass which was given 180 kg N/ha (5.83). The seed yield was maximum for Hamil grass receiving 180 kg N/ha (275.28 kg/ha) and this was on par with Hamil grass receiving 240 kg N/ha (244.28 kg/ha). Thus it could be seen that Hamil grass produced the highes seed yield and the optimum dose of N was found to be 180 kg N/ha. At all the levels of N tried, the maximum fodder yield was recorded by Hamil grass followed by FR-600 and Haritha in successfion.

Work is being continued.

5.1.6 Agroforesty system involving fodder crops under unirrigated conditions

This experiment was started during 1986 with an objective to find out the forage production capacity of an agroforestry system involving fodder trees and grasses under rainfed condition.

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Date recorded during the year 1986-87 showed that green fodder yield was highest for the treatment Hybrid Napier & Subabul at 2:1 ratio. Dry fodder yield was highest for the treatment Guinea and Subabul at 2:1 ratio but it was on par with Hybrid Napier and Subabul at 2:1 ratio.

The data recorded during the Kharif 1987 are furnished in Table 5.6.

All the observations except green leaf yield showed a significant difference. The number of tillers per plant, plant height, and dry fodder yield were on par for treatments with pure guinea grass, guinea & subabul (1:2) and guinea & subabul (2:1). A maximum plant height of 86.7 cm. was recorded by guinea & subabul (1:2) while the maximum number of tillers per plant and dry fodder yield (2.6 t/ha) was recorded by the treatment with pure guinea grass. The green fodder yield was also maximum for pure guinea grass (7.18 t/ha).

The experiment was continued upto March 1988 and the data recorded during 1987-88 showed that both green fodder yield and dry fodder yield was maximum for guinea grass (pure) plot.

5.1.7 Phosphorus requirement of Centrosema grown in coconut gardens

The objective of the experiment was to find out the optimum dose of P_2O_5 for centrosema grown in coconut garden. The technical programme consisted of 5 levels of P_2O_5 (60, 75, 90, 105, 120 kg/ha). The experiment was laid out during Kharif 1987.

N & K_2O at 20 and 30 kg/ha respectively, were applied uniformly to all the plots.

The crop established well. But the experiment was totally damaged and hence the trial was abandoned.

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5.1.8 Influence of time of harvesting on the yield and quality of seeds of guinea grass (Panicum maximum cv. Mackueni)

The objective of the experiment is to find out the effect of time of harvest on the yield and quality of guinea grass seeds. The trial was laid out during Kharif 1987 with 9 treatments. Flowering of the crop was very poor and hence seed set could not be recorded. So the experiment was abandoned.

(b) Plant Breeding

5.1.9 Final evaluation trial on Guinea grass

To evaluate the fodder production potential of different guinea grass varieties a trial was laid out in a 11 x 4 RBD, during Kharif 1987. The data on plant population, plant height, no. of tillers per plant, no. of leaves per plant, leaf-stem ratio, green fodder yield and dry fodder yield obtained from 4 cuttings are presented in Table 5.7.

It was observed that there was no significant different between varieties in respect of green fodder yield and dry fodder yield. The variety GG-2 recorded the maximum green fodder yield of 16.33 t/ha followed by Harit with 14.10 t/ha in 4 cuttings. With regard to dry fodder yield the variety Harit recorded the maximum of 4.64 t/ha followed by PGG - 13 with xx 4.22 t/ha. Leaf-stem ratio (2.26) and no. of leaves per plant (35) was also maximum for the variety GG-2.

5.1.10 Final Evaluation Trial on Bajra

For evaluating the fodder production potential of different bajra varieties an experiment was laid out in a 12 x 3 RBD during August 1987. The data on plant height, no. of tillers per plant, no. of leaves per plant leaf-stem ratio, green fodder yield, dry fodder yield and plant populations are presented in Table 5.8.
It was observed that there was no significant difference between varieties in respect of green fodder yield, dry fodder yield and leaf stem ratio. The maximum

green fodder yield was recorded by the variety PCB.15 (10.79 t/ha) followed by L.84 with 9.81 t/ha. The dry fodder yield was maximum for the variety UUJ.1 (2.25 t/ha) followed by PCB.15 (2.14 t/ha). The maximum leaf-stem ratio was recorded by L.74 (1.97) and the maximun no. of leaves was recorded by the varieties L.72 & Composite 9 (28).

5.1.11 Final Evaluation Trial on Dinaath grass

A 9 x 4 RBD was laid out during July 1987 to evaluate the fodder production potential of different Dinanath grass (Pennisetum pedicellatum). The data on plant height, no. of tillers per plant, no. of leaves per plant, leaf-stem ratio, green fodder yield, dry fodder yield and plant population are presented in table 5.9. It was observed that there was no significant difference between varieties with respect to green fodder yield, dry fodder yield and leaf-stem ratio. However the higrest green fodder yield was recorded by the variety IGFRI-56-1 (5.67 t/ha) followed by TNDN - 1 with 4.63 t/ha. Dry fodder yield was maximum for (1.99 t/ha) IGFRI. 56-1 followed by IGFRI 4-2-1 with 1.75 t/ha. The highest leaf-stem ratio was recorded by the variety IGFRI 4-2-1 (1.76) followed by PS-3 (1.64). The maximum plant height was recorded by the variety JHP - 3 (1.22), and the maximum no. of tillers per plant was produced by TNDN-1 (8). The maximum no. of leaves was recorded by JHP-2 (27).

5.1.12 Initial evaluation trial on cowpea

A 20 x 3 RBD was laid out during July '87. 20 fodder cowpea varieties received from the Project Co-ordinator (PC) were put under replicated trial. The data collected are recorded in Table 5.10. Plant height, number of branches per plant, number of leaves per plant, green fodder yield, dry fodder yield and the leaf-stem ratio were recorded and statistically analysed. It was observed that the varieties did not differ significantly with respect to any of the characters studied. However the variety EC-4216 recorded the maximum green fodder yield (9.111 t/ha)

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followed by CS-42 (8.751 t/ha). With respect to dry fodder yield UPC-8701 recorded the maximum value (0.848 t/ha) followed by EC-4216 (0.816 t/ha). Leaf/stem ratio was the highest for the variety UPC-5286 (5.81) and the lowest for CS-44 (2.4).

Work on this programme was concluded on November, 1987.

5.1.13 Final evaluation trial on cowpea

In order to evaluate the fodder yield potential of certain promising genotypes of cowpea and isolate most suitable ones to the location, this experiment was laid out during July 1987, With 10 varieties of fodder cowpea obtained from the Project Co-ordinator (FC). At 50% flowering, a cut was taken. The observations recorded on the characters viz. plant height, number of branches per plant, number of leaves per plant, green fodder yield, dry fodder yield, and leaf/stem ratio were tabulated and statistically analysed. The mean data are presented in Table 5.1.1.

It was observed that the varieties differed significantly with respect to height of the plants and the number of leaves per plant only. The variety IFC - 8402 was the tallest (50 cm) and was on par with UPC-5286, CS-38, CS-40, UPC-2201 and UPC-4200.
The variety EC-4216 produced the maximum number of leaves (13.0) and the variety UPC 5286 ranked first in the green fodder yield production (8.59 t/ha) IFC 8402 recorded the maximum dry fodder yield (0.934 t/ha). Leaf stem ratio was maximum for UPC 4200 (5.78).

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5.1.14 Initial Evaluation Tr al on Bajra varieties

The experiment was laid out during August 1987 with the objective to compare and evaluate the fodder yielding potential of certain promising fodder bajra varieties. Twenty varieties of bajra received from the Project-Co-ordinator (FC) IGFRI, Jhansi were put under comparative trial. The data collected on the growth characters viz. plant height, number of tillers per plant, number of leaves per plant and green and dry fodder yields were statistically analysed and presented in Table No. 5.12.

The varieties differed significantly with respect to green fodder yield and number of tillers per plant. The variety PPMP-999 produced the highest green fodder yield (15.13 t/ha) and this was on par with ICMU-82132, HC-4, DPBP-IC-862, L-74, L-72 and LC-12. Camp-8 produced the maximum number of tillers per plant (5.7) and was on par with L-74, LC-12, ICMV-84400, LC-14 and LC-18. Dry fodder yield was maxi..um (1.22 t/ha) in ICMV -82132 followed by PPMP-999 (1.14 t/ha) ICMS 8353 was the tallest variety.

5.2 AICRP on Oil Seeds

This scheme started functioning from 1.6.1987 with an objective to undertake agronomic and plant breeding experiments on oil seed crops.

5.2.1 A. Agronomy : Fertilizer m nagement of some promising groundnut based cropping systems

The objective of the experiment was to find out a fertilizer schedule for groundnut based cropping systems. There are two experiments under this. The first experiment was laid out during Kharif 1987 at Vellayani. The technical programme consisted of 5 treatments during Kharif (crop - Groundnut)

1. No phosphorus (control)
2. 50% of the recommended dose of P_2O_5
3. 75% of the recommended dose of P_2O_5
4. Recommended dose of P_2O_5
5. One and half times the recommended dose of P_2O_5

and 4 treatments during Rabi (crop - Sesamum)

1. No fertilizer
2. 1/3rd of the recommended dose
3. 2/3rd of the recommended dose
4. Recommended dose

Two of the four replications did not have sufficient plant population due to low germination and so these were abandoned. However, the xxx remaining two replications were continued; In the rabi season (1987-88), the main plots were subdivided and sesame seeds were grown.

This crop was harvested and the yield recorded. Analysis is in progress.

5.2.2 Response of promising varieties of sesamum to N levels and plant population

Two varieties Thilothama & Surya (ACV-2) and 3 plant population of about 2 litre/ha (30 x 15 cm), 3 litre/ha (30 x 10 cm) and 4 litre/ha (30 x 8 cm) were the treatments of the main plot. In the sub-plot 4 levels of N namely 0, 20, 40 and 60 kg/ha were tried. The design was a split plot design with four replications.

The experiment was started during October 1987. Observations were recorded & analytical works are under progress.

B. Plant Breeding

5.2.3 Initial Evaluation Trial (Spanish bunch) Early

This experiment with 49 groundnut varieties (including 34 AICORPO test entries, 4 checks and 11 other groundnut varieties) was laid out in simple Lattice Design replicated thrice, ~~xxxxxxxxxx~~ during Kharif 1987 at the College of Agriculture, Vellayani. Observations on days to mature, haulms yield, pod yield and pod quality were taken and the mean data are presented in Table 5.13

Among the 49 varieties J-24 flowered the earliest (23 days) and ICGS(E) 123 matured the earliest (104 days). ICGV 86600 recorded the maximum fresh haulms yield (26.2 t/ha). The highest dry pod yield was recorded by

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ICGV 86020 (3710 kg/ha) followed by PGN-1 (3000 kg/ha) VG.78 is found to be resistant to tikka disease and ICG FDRS 34 to rust (score 1.0). With regard to quality, highest values of shelling was recorded by J.22 (82%), SMK % by TG-14 (95.5%) the local check, HKW by JC-24-M-1 (73.8 g) and Kernel yield by PGN-1 (2250 kg/ha). Hence, among the 49 entries, the variety PGN-1 was found to be superior in pod yield and kernel yield.

During summer 1988, an experiment with 24 groundnut varieties (including 9 AICORPO test entries, 4 checks and 11 other groundnut varieties were laid out in RBD replicated 4 times at R.R.S., Kayamkulam. The trial is in progress.

5.3 AICRP on Pesticide Residues

5.3.1 Pesticide Residues in banana

A field experiment in RBD with three replications was laid out to assess the terminal residues of Phorate in banana (var. Nendran). The planting was completed during September, 1987. The treatments were 15 g and 30 g Phorate per plant, applied three times during the course of its duration.

Accordingly, three applications of Phorate were given at the rate of 15 g and 30 g/plant during October 87, December '87 and March '88.

5.3.2 Pesticide residues in bitterguard when applied for the control of pests of bitterguard

During Kharif '87, the field experiment was laid out, and a basal seed treatment of Carbofuran 0.5 kg ai/ha and 1.0 kg ai/ha was given. The plants were then maintained in a good condition.

The fruits were harvested at maturity and the residues were estimated from raw and cooked samples. Carbofuran at the above rates (0.5 kg & 1.0 kg ai/ha) was given at the fruiting stage and the residues were then estimated at 1, 3, 7, 14, 21 and 28 days after application, from both raw and cooked samples.

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5.3.3 Pesticide residues in cucumber when applied for the control of pests of cucumber

A field experiment was laid out to estimate the residues of Carbofuran in cucumber. An initial seed treatment of carbofuran 0.5 kg ai/ha and 1.0 kg ai/ha was given. The plants were maintained in a good condition.

Again Carbofuran was applied at the rate of 0.5 and 1.0 kg ai/ha at the fruiting stage. Fruits at maturity were harvested at different intervals after application of the insecticide. The residues were then estimated from both raw and cooked samples. Carbofuran applied at the time of sowing and its residues in the fruits was also estimated.

5.4 AICRP on plant parasitic nematodes

5.4.1 Survey of plant parasitic nematodes in Kerala

The occurrence of cyst nematode, Heterodera oryzicola in Trivandrum and Quilon districts of the State was discovered during the past season. The occurrence of rice root nematode, Hirschmanniella oryzae in all rice growing areas of Kerala State was also reported. The nematode pests associated with pepper and banana crops in the State was determined.

A survey of plant parasitic nematodes in Kerala was undertaken during Kharif 1987. Rice soils in Kottayam and Malappuram districts were surveyed, and a total of 71 soil and root samples were collected and processed for nematode estimation. Cyst nematode, Heterodera oryzicola was present in Malappuram, but absent in Kottayam dist. Rice root nematode, Hirschmanniella oryzae was present in all the areas surveyed. The other nematodes present in traces were the spiral nematode Helicotylenchus sp., ring nematode Oriconemoides sp. and stylet nematode, Tylenchorhynchus sp. A survey of medicinal and aromatic plants was also conducted in Trivandrum district. Sixty soil and root samples were collected from Trivandrum district from about 42 different plants and processed for nematode estimation. The predominant nematodes present were

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spiral nematode, - Helicotylenchus sp.
Citrus nematode, - Tylenchulus sp.
Stylet nematode, - Tylenchorhynchus sp. and
Lance nematode, - Hoplolaimus sp.

5.4.2 Integrated Control of Root-knot nematode in brinjal

In order to study the effect of neem cake and other cultural operations on the control of root-knot nematode in brinjal, this experiment was laid out. Work is in progress.

5.4.3 Assessment of yield losses due to nematode complex in ginger and turmeric

Two separate field experiments on ginger and turmeric were laid out to assess the loss caused by nematodes. The experiment is in progress.

5.4.4 Pathogenicity & control of reniform nematode on pineapple

Pot culture experiments to assess the loss caused by reniform nematode on pineapple were done. The nematode build up is being estimated periodically.

In addition to all these, pure cultures of cyst nematode, root-knot nematode, reniform nematode and burrowing nematodes were maintained and multiplied for experimental purposes.

All these experiments are in progress.

5.5 ICAR Ad hoc scheme on cyst nematode Heterodera oryzicola infesting rice in Kerala

Earlier a survey of rice soils in Trivandrum, Quilon & Alleppey districts was conducted. One field trial each on yield loss and control of the nematode was also conducted.

During the period under report survey work was continued in Kottayam, Malappuram and Calicut districts. A total of 83 soil and root samples were collected and processed for nematode estimation. It was observed that cyst nematodes were not present in any location in Kottayam district, but were present in a few locations in Malappuram & Calicut districts.

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Survey of rice soils in other districts are being continued. Life history studies of the nematode & histopathology studies will also be taken up.

5.6 Science and Technology on Mushroom

5.6.1 Trials on large scale cultivation of Pleurotus species under the agro-climatic conditions of Kerala

The Project aims at identification of suitable species of Pleurotus for the large scale cultivation under Kerala conditions and also in standardising techniques suitable for their large scale cultivation utilising locally available raw materials.

During the period under report a number of collections of Pleurotus was made from different parts of the southern districts of the state. From these collections following standard techniques five species were identified and described. These were isolated into pure culture and comparative studies made. The species identified were P. citrinopileatus, P. ostreatus, P. dryinus, P. cornucopiae, P. opuntiae.

A number of isolates of P. sajor-caju and other species of Pleurotus were studied for their comparative performance under cultivation and an isolate of P. sajor-caju identified as suitable for our condition. The bag technique suitable for Kerala conditions was standardised.

Few selected unemployed educated youths were given training in the cultivation of Pleurotus spp. and some of them have taken up commercial cultivation of P. sajor-caju.

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Other Research Activities in the Southern Region

In addition to the research project undertaken in the southern region by the NARP (Regional Station and the Special Station) and the attached schemes, the Cropping Systems Research Centre, Karamana;, Coconut Research Station, Balaramapuram and the College of Agriculture, Vellayani are also involved in a number of research activities. A brief resume of the current research work being carried out by the above research centres is given below:

I. Coconut Research Station, Balaramapuram

1. NPK fertilizer trial starting from young seedlings

The experiment is aimed to study the response of palms from seedling stage to application of NPK at different levels. The trial was started in 1964, with 27 treatments Biometric observations were noted from the fourth year of planting viz. 1968. Some of the palms started bearing in 1972 and observations on the number of female flowers, number of goodnuts, number of barren nuts, setting percentage etc. were made from 1972 onwards. Analysis of the yield data from 1981 to 1985 showed that the number of nuts per palm was found to increase with increase in the application of N and K. The effect of P was not significant. The average of 5 years showed that the nuts increased 1.5 and 2 times respectively with 340 and 680 g of N as compared to zero application of N. In the case of K the yield increase was 8.4 and 9.6 times at K_1 and K_2 levels as compared to zero potash.

Analysis of the yield from 1986 to 1987 showed that Table I(1) only main effects of N & K were found to be significant. None of the interactions were significant. Application of N at N_1 level increased the yield by 57 nuts (ie. 25.5 per cent) and by 79 nuts at N_2 level (ie. 35.5 per cent). However, the difference in yield at N_1 and N_2 levels were not significant. In the case of P no significant

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difference in yield was noticed. A marked increase in yield was seen at different levels of K. Yield increased by 303 nuts with an application of K_1 and 363 times with an application of K_2 ie. the yield was about 7½ times with K_1 applied and 9 times with K_2 applied as compared to control palms. The difference in yield at K_1 and K_2 levels was about 17 per cent.

The experiment is being continued.

2. Spacing-cum-manurial trial

The experiment aims at a study of the effect of different levels of spacing and fertilizer on the growth and productivity of coconut. The trial was started in 1964 as 9 x 3 RBD. The data for the period from 1976-85 were statistically analysed. There was significant increase in per palm yield when the spacing was increased from 5 m x 5 m to 7.5 x 7.5 m and 10 x 10 m. The yield from palm planted at 7.5 x 7.5 m spacing was 2 to 3 times more than that of 5 x 5 m spacing. But no significant difference on yield was observed between palms planted at spacings of 7.5 x 7.5 m and 10 x 10 m. The yield was found to increase with an increase in the level of N, P & K.

Analysis of yield during 1986 and 1987 showed /Table I (ii)/ significant difference in yield with respect to spacing and manuring. The yield per palm increased by 54 nuts with a spacing of S_2 (7.5 x 7.5 m) and by 67 nuts with S_3 (10 x 10 m). However, the increase in yield was not significantly different at S_2 and S_3. There was an increase in yield of 82 nuts when M_1 was applied and 101 nuts when M_2 was applied. Significant interaction was observed for spacing & manuring. In the control palms maximum yield was obtained with S_2 (47 nuts) while palms treated with M_1 gave maximum yield at S_3 (154 nuts) and those treated with M_2 gave maximum yield at S_2 (167 nuts). The experiment is being continued.

3. Progeny row trial for comparison between T x D and T x GB seedlings

The experiment aims to make a comparison of the performance and yield between the progenies of T x D and T x GB coconut seedlings was started in 1970. Analysis of the data for 1985 and 1986 showed that (Table I(iii) a marked increase in yield

was recorded for T x D (85 nuts/palm/year) compared to T x GB (71) ie. 17% increase in yield was obtained for T x D. The progenies within each family did not show any significant difference.

II. College of Agriculture, Vellayani

1) Department of Agronomy

a. NPK requirement of short duration tapioca varieties grown in the uplands of Kuttanad

Work on this was completed during this period. It was observed that maximum tuber yield was obtained from the variety 'Kaduthuruthy local' followed by the variety 'Thottakolli'. And a fertilizer level of 50 : 50 : 100 kg/ha of N P K was found to be the optimum for Thottakolli. For Kaduthuruthy local it was 50:50:50 kg/ha.

b. Effect of nitrogen, Phosphorus and Potassium on the growth, yield and quality of vegetable cowpea variety 'Kurutholapayar' (Vigna unguiculata (L.) Walp) grown as an intercrop in coconut gardens and in the open

This project was completed during the period under report. It was observed that the fresh pod yield increased with nitrogen application upto 30 kg and P_2O_5 application upto 60 kg/ha. Applications of Potassium has no influence on the fresh pod yield. The protein content also showed a similar trend. Plant performance was better when grown in the open than under partial shade. The maximum net income was obtained when the crop was raised in the open by applying 30 kg N, 60 kg P_2O_5 and 30 kg K_2O /ha. The highest return per rupee invested was obtained from plants raised in the open by the application of 20 kg N along with 20 Kg P_2O_5 & 10 kg K_2O per hectare.

c. Integrated weed management in transplanted medium duration rice

The experiment was conducted during 1987. It was observed that Thiobencarb either as spray or as granule at 1.0 - 1.5 kg ai/ha controlled nonsedge weeds better than Butachlor at the same rate. It was also

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observed that hand weeding is more effective than the use of herbicides. Grain yield was maximum in plots treated with thiobencarb and it was on par with completely weed free plots.

e. Nutritional requirement of pre-release sesamum cul.42-1 in garden land

This experiment has also been concluded. It was observed that the seed yield and profit were maximum with 30 kg N, 15 kg P_2O_5 and 75 kg K_2O per hectare. Nitrogen, Phosphorus and Potassium were also found to have significant effect on the oil and protein content of sesamum seed.

e. Response of maize varieties grown in rice fallows to graded levels of nitrogen

It was observed that the grain yields and stover yields were the highest with 140 and 170 kg N/ha respectively although these levels were on par with respect to the grain yield. Variety Ganga-5 recorded the maximum grain yield and stover yield under rice fallow conditions. Application of 140 kg N/ha was sufficient to produce the maximum harvest index.

The experiment was concluded during the period under report.

The following research projects are in progress

1. Agro-techniques for seed production in Stylosanthes gracilis
2. Management practices for betel vine
3. Rice based cropping system analysis in Kerala
4. Phosphorus management in rice based cropping system
5. Weed management in rice based cropping system
6. Fertilizer management in coleus
7. Slow release nitrogen in cassava nutrition
8. Response of rice variety Lakshmi (Kayamkulam-1) to different dates of planting and plant density.

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9. Response of rice to methods of planting under varying seed rates and levels of nitrogen
10. Effect of growth regulators on the growth, yield and quality of groundnut
11. Influence of nitrogen levels on the seed production of guinea grass
12. Residual effect of summer crops in Virippu rice in south Kerala
13. Growth and yield of rice as influenced by potassium and Kinetin.
14. Response of IR-50 to different plant densities and nitrogen levels
15. Biomass productivity of a forage crop based cropping system involving C_3 and C_4 plants.
16. Low cost technology for weed management in rice - Influence of plant population in the competition ability of short duration rice in weed communities

Department of Soil Science and Agrl. Chemistry

11) Effect of drying and wetting on the physical, physico chemical and chemical properties of the submerged soils of Kuttanad

Random soil samples were collected from various parts of Kuttanad and their physico chemical properties such as pH, Elect. Cond., avail N P K and different forms of Fe and Al were estimated in the moist state itself.

Drying the soil (air drying and sun drying) resulted in marked and significant decrease in soil pH. The availability of all major nutrients and exchangeable iron got reduced, which was found more in phosphorus. Specific conductance and exchangeable Aluminium underwent no significant change. Sun drying and air drying behaved similarly.

The effect of intense drying of the paddy field followed by flooding on the release of toxic factors was studied simulating the field conditions in the laboratory

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using Procelain pots and PVC pipes allowing free capillary rise. The results revealed that after an extreme drought when a subsequent crop is raised during the ensuing season, chances for iron and aluminium toxicity existed in Kuttanad. In kari soils the pH failed to get stabilised near neutral. There couldbe a saline water influx, under conditions of extreme drought which could cause salt injury to plants. This was concluded.

b) Nutrient recycling under monoculture conditions in the tropical forest ecosystems

A study was made on the forest soils of the Kulathupuzha range in Kerala to determine the effect of morphological, physical and chemical characters of these soils on eucalyptus teak and rubber plantations. Soils, plant and leaf litter samples were collected from several locations and from adjacent natural forests and their properties were studied which also included among others, the profile description and root distribution. The quantity of nutrients available for recirculation and the effect of each vegetation on the nutrient status of the soil were assessed.

Considerable variation in the physico chemical properties of the soils of the three plantations compared to natural forest existed, indicating the influence of the three plantations. The sand and silt contents decreased and clay increased, with depth in the profile. Higher content of clay observed in rubber and eucalyptus plantations compared to teak and natural forest indicated a greater degree of weathering. Physical properties such as BD, WHC, VE and CEC were positively influenced in organic matter content which was higher in natural forest. C/N ratio narrowed from the surface to lower horizons. The status of low soil nitrogen in the eucalyptus plantation in spite of greater amount of biomass nitrogen for recirculation and the higher soil nitrogen in rubber plantation supplying the least amount of nitrogen, indicated a state of dynamic balance between its uptake and subsequent release from the biomass. The specific influence of the plantations in making more of available phosphorus from the unavailable pool was also indicated. Total soil potassium was higher

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in eucalyptus plantation but exch. potassium was low, thus indicating a lower release as well as greater uptake of the element. Plant tissue analysis indicated higher ash content associated with very high proportion of acid insoluble residue in teak. This was concluded.

c) Exchangeable Aluminium as an index of liming for the acidic upland soils of Kerala

The distribution of water soluble and exchangeable Aluminium in the upland soils and the suitability of exchangeable aluminium as an index for liming them were assessed by studying the growth, yield and nutrient uptake pattern of the two acid sensitive crops viz. cowpea and fodder maize in soils of different higher levels of exchangeable aluminium brought out by different levels of lime. Chemical studies of eighty soil samples from the different upland soil types of Kerala indicated that laterite soils contain the highest amount of exchangeable aluminium and percentage aluminium saturation. Higher levels of exchangeable aluminium adversely affected the growth, yield and nutrient uptake in both the crops. Maintenance of exchangeable aluminium at 1.26 me/100g with a corresponding percentage aluminium saturation value of around 30, by using 500 kg/ha lime appeared to be the optimum for maximising the yield of cowpea. However, in the case of fodder maize this level was found insufficient and maximisation in production necessitated complete elimination of exchangeable aluminium toxicity. This was concluded.

d) Nitrogen balance studies in the rice soils of Kerala

Nitrogen balance studies were carried out under pot culture conditions to assess the rate of efficiency of applied nitrogen and percentage recovery of nitrogen under five different soil types, viz., Karapadom, Kole, sandy loam, low level laterite and black soils and two irrigation levels viz., 5 cm. and 10 cm. with respect to short and medium duration varieties of rice viz., Triveni and Jaya. The effect of soil type, submergence levels and fertilizer nitrogen on growth and yield of rice, N uptake and N P K content in soil, plant, grain and straw were studied and recovery and loss of nitrogen were computed. For Jaya rice variety,

black soil, low level laterite and kole soils were found superior for grain yield, while in Triveni variety, kole soil alone turned out superior. Submergence at 5 cm level was better than 10 cm with regard to available N content of the soil with respect to both the varieties. Available N content of soil, N content and its uptake by plants, grain and straw were influenced by applied fertilizer nitrogen. The three way interaction of soil, level of submergence and nitrogen application was significant on the growth and yield characters, but found varying between varieties. Maximum nitrogen recovery by Jaya variety was in the low level laterite soil under 10 cm submergence and was found to be 44.26 per cent of the applied nitrogen. xxxx In Triveni variety it was in Kole soil under 5 cm submergence and was 44.57 per cent. Nitrogen balance estimates indicated loss of nitrogen from all the soil types studied, probably by ammonia volatilisation and denitrification. This was concluded.

e) Occurrence and distribution of the micro-nutrient elements in the rice soils of South Kerala

The objective is to estimate the status of available micro nutrients like Fe, Zn, Mn, Cu, Mo, B in the rice soils of South Kerala and also to study the correlation if any, with the physico chemical properties of the soil.

The study is confined to a minimum of 30 representative locations identified in the rice growing tracts of South Kerala.

Collection of surface and subsurface soils and analysis in the laboratory after sieving through 2 mm sieve for texture, pH, organic content, total and avail. N P K, and total and available Ca and Mg were done. These smaples were then extracted with DTPA and Fe, Mn, Zn and Cu were estimated. Mo and B were estimated by clorimetric method. Correlation if any between the micronutrient and the other soil constituents are being studied.

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f) Influence of form of organic matter on the mineralisation of applied phosphorus in submerged rice soils

The effect of incorporation of different forms of organic matter to rice soils on the release of phosphorus under submerged conditions and also on the release of available iron.

A field experiment with two forms of phosphorus viz., single super phosphate and Mussoorie rock phosphate each alone and combined with three forms of organic matter, viz. FYM, green leaf and composted Salvinia were included as treatments, in addition to the three forms of organic matter alone and a zero control. Observations were recorded on the growth characters and yield parameters in addition to fractionation of soil phosphorus at weekly intervals for a period of 2 months and at harvest, estimation of exchangeable iron and available phosphorus and plant analysis. P uptake was also found out. Statistical analysis to conclude the effect of forms of organic matter on the release of phosphorus is in progress.

g) Effect of different mulches on soil temperature and soil water retention in relation to seedling emergence and crop growth

Pot culture experiment with bhindi as test crop grown in insulated pots was conducted on a laterite soil. The treatment combinations included straw mulches with water depletion of 20% and 40%, saw dust mulches with water depletion of 20% and 40%, Paddy husk mulches with water depletion at 20% and 40%, dry leaves mulches with water depletion of 20% and 40% and control with water depletion of 20% and 40%. Watering was done based on Tensiometer reading. Four pots were left without plants to study evaporational loss.

Study of the effect of all the above treatments on seed germination and seedling emergence were conducted separately. Observations included various physical properties of the soil, its chemical analysis, physiological characters of the plant such as internodal distance, leaf area, leaf temperature, flowering time, root distribution, root density, dry matter weight and yield and yield components.

The work is nearing completion.

h) Nutricional status of Soi s in relation to foli r nutrient levels in Red Oil Palm (Elae is guineesis).

Assessment of the nutrient status of both the leaves in different whorls of oil palm fronds and also of the soils growing oil palm, testing the suitability of the index leaf already established by IRHO and its modification if possible and formulation of a suitable fertiliser schedule for oil palm are the objectives of the study.

Collection at 3 months intervals, the leaf samples from oil palm plantation of different age groups both bearing and non bearing and also palms receiving various levels of applied fertiliser, and analysis for N P K, Ca, Mg, Cu, Zn, S & B. Collection of soil samples from oil palm plantations and physico chemical analysis, and statistical treatment of the results of chemical analysis are included in the technical programme. The work is nearing completion.

i) Studies on the potassium supplying capacity of Neyyatinkara - Vellayani soil Association and its relationship with potash nutrition of major crops on them

The project forms the basis of a thesis work of a Ph.D. Scholar.

Selection of 100 sites of tapioca and coconut fields falling within the ranges of extensive variability of the soil association and collection of soil samples and analysis for pH, CEC, EC, OC and mechanical composition, testing of the different recommended methods of determination of available K on these soils, sampling of tapioca crop at 4½ months age, sampling of uniformly aged WCT coconut crop, of the 14th leaf and also counting the fully opened leaves, and subjecting the samples for K estimation are the essential items of the technical programme. The data have to be subjected to statistical treatment and levels of K and most suitable extractant for available potassium determination for the soil had to be fixed. The critical levels of potassium has also to be worked out.

The work is in progress.

....59/-

iii) Department of Horticulture

The following PG projects are in progress.

a) Induced mutations in ginger

A VM_2 generation was raised on progeny rows from surviving VM_1 plants which were treated with physical and chemical mutagens. Various biometric parameters were recorded and the crop is approaching the harvesting stage.

As part of the work, another plot of the VM_2 progenies were raised at R.A.R.S., Ambalavayal for screening against soft rot and bacterial wilt of ginger. The surviving plants will be harvested during the second week of Jan. '88 for further conducting confirmatory tests for resistance/tolerance in the VM_3 generation.

b) Effect of mist and growth regulators on the rooting behaviour and growth of ornamental shrubs, which are difficult to root

The work has been completed. The data are being analysed. Thesis preparation is in progress.

c) Standardisation of propagation technique and growing media for Rex begonia

The work has been completed. The data are being analysed. The preparation of thesis is in progress.

d) Nutritional requirement of Hendran banana under rice fields

The work has been completed. The data are being analysed. The preparation of thesis is in progress.

e) Effect of split application of N P K on the growth and flowering of Rose cv. Happiness

The nutrient status of the pot mixture were analysed before the start of this experiment. The treatment combinations (split application of N P & K) were applied at 3 intervals viz., 15 days, 30 days & 45 days during the year under report. Observations were made on plant height, no. of sprouts, length of flower stalk, thickness of flower stalk, number of leaves, number of flowers, number of petals and flower life.

f) Flower bud differentiation in Clove Eugenia caryophyllus

The meristematic stem tips of clove were obtained during the non flowering period (April to August). Later bud samples were collected during the flowering period (Sept. to Dec.). The samples were fixed in Formalin Acetic Alcohol and processed as per standard microtechnique procedure. Medial longitudinal sections of the stem tips and flower buds were taken to study the degree of flower-bud differentiation and the floral morphogenesis. Standardisation of staining techniques are under progress. Leaf samples were also taken from four different aspects of each tree for finding the carbohydrate-nitrogen ratio.

g) Flower bud differentiation in banana

Samples of banana growing tips were collected at fortnightly intervals from Sept. '87 onwards. They were processed for taking sections. Sampling of meristematic tips is under progress and observations on height, girth, no. of leaves and leaf area were made. Leaf samples were collected at fortnightly intervals to determine the CN ratio.

h) Effect of season & position of bud in budding of rose

Budding was done in Ambassador, Pink Panther & Princess. The date of flowering varied for each position of bud according to bud break and bud take. Observations were recorded from each plant after one week of budding and continued upto the second set of flowering. The meteorological parameters were recorded for finding out the correlation with budtake.

iv. Department of Agricultural Botany

Post Graduate Research Projects

a) In vitro techniques in relation to induced mutations in Groundnut

Groundnut embryos of different maturity were grown in modified M.S. medium and different concentrations of E.M.S. (Mutagen) were used to induce variability.

...61/-

The treatment of 0.1% mercuric chloride was found to be the best for surface sterilization of embryos. The modified M.S.medium was found to be the best for growing groundnut embryos. Treatment of embryos extracted from seed nuts collected immediately after harvest with E.M.S. at concentrations between 0.25 and 0.50% gave maximum mutational effects Treatment of embryos and pro-embryos with mutagenic solutions above 0.5% was found to be lethal.

The work was completed and thesis submitted.

b) Intra and inter varietal variability analysis in cardamom (Elettaria cardamomum)

Using the four varieties available at C.R.S. Pampadumpara periodical observations were taken to analyse the intra and inter varietal variability in cardamom.

The data were analysed and it was found that the intravarietal variability was not statistically significant and the inter varietal variability was highly significant for the 8 characters viz. number of productive tillers/plant, height of tillers, no. of panicles per plant, internodal length of the panicles, no. of capsules/panicle, capsule volume, fresh weight of capsules/plant and dry weight of capsules/plant.

No. of panicles/plant, fresh and dry weight of capsules and no. of capsules per panicle showed moderate to high heritability and high genetic gain and hence these characters will show a high response for selection and further improvement.

Yield was strongly and positively correlated with height of tillers, no. of productive tillers/plant, no. of panicles/plant, length of panicle,no. of nodes/panicle and internodal length. The number of panicles per plant showed the maximum direct effect on yield followed by fresh weight of capsules/plant.

Selection based on higher number of panicles/plant and high fresh weight of capsules/plant promise a positive response to increase the yield in cardamom.

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c) Relative biological effectiveness of gamma rays and EMS on cardamom varieties

Dry seeds were exposed to gamma rays at dose levels ranging from 10-70kR at 10 kR interval and the seeds pre-soaked for 16 hours were treated with E.M.S. concentrations ranging from 0.25% to 1.75% at an interval of 0.25% and the seeds were also exposed to gamma rays with 10 & 20 kR.

Direct effect of the mutagen was assessed by analysing the effect on growth metrices. A significant delay in germination was brought about in all the varieties by the various doses of gamma rays and EMS. A dose dependent reduction in germination was observed in the varieties for both the mutagens EMS induced more drastic reduction in germination as compared to gamma rays. In all the three varieties characters like plant height, leaf number and leaf area produced shifts in both negative and positive directions, but negative shift alone was noticed in the case of tiller number per plant. A general reduction in the frequency of mitotic cell division was noticed consequent to radiation treatments in all the three varieties. Chlorophyll deficiency, morphological modifications like split lamina, stem dichotomy etc. were noticed in EMS treatments.

The shift in mean value both in positive and negative directions for various growth metrices indicate that a positive selection response can be created in cardamom by induced mutagenesis.

The work was completed and thesis submitted.

d) Induction of genetic variability in guinea grass (Panicum maximum var. Mackueni)

Seed samples of Panicum maximum cultivar Mackueni were subjected to treatment with EMS at doses ranging from 0.25% to 1% at 0.25% intervals and gamma rays from 15-30 kR with 5 kR intervals. The M_1 crop was raised and germination, survival, growth characters and pollen sterility were studied. From each treatment 50 M_1 clumps were selected and M_1V_1 cloned progeny was raised under partially shaded conditions in coconut gardens. Observations on number of tillers, girth of internode, leaf-stem ratio, grass yield, regeneration after each cut etc. were being recorded.

e) Induced mutations in Banana variety Nendran

As part I of the technical programme suckers of banana variety Nendran in different sizes and maturity were irradiated with gamma rays of doses 1.0, 1.5, 2.0, 2.5 & 3.0 kR. The irradiated material was planted in the field in 24 x 6 x 2 RBD.

The experimental crop was maintained in the field and the following observations were recorded at regular intervals.

1) Survival
2) Growth rate upto 3rd month of planting at 15 days interval
3) No. of suckers produced/plant
4) Rate of growth of suckers for 3 months
5) No. of roots, leaves and height at the 3rd month
6) Frequency of chlorophyll deficient plants

Suckers from the M_1 crop was to be carried forward to VM_2 generation and the variability for the different characters are to be studied as Part II of the technical programme.

v. Department of Plant Breeding

a) Identification of groundnut varieties for southern region

The aim of the trial is to identify varieties of groundnut with high productivity adapted to upland conditions for Kharif and rice fallows during summer for cultivation as a pure crop in the Southern region of Kerala. During Kharif 86, an IET (3B) with 30x4 RBD and an Extra Early Varietal Trial (5B) with 14x4 RBD were conducted. During summer 87 also an IET (New) with 14x4 RBD and IET (early) with 19x4 RBD were also conducted.

1) IET : The following ten groundnut varieties were superior in yield performance proved by the previous trials. Majority of them are also found to be early in maturity.

1) Dh E.20 2) J.11 3) Dh.E.32
4) Dh.29 5) BPC 521 6) ICGS(E) 52
7) I 33E 121 8) ICGS E 123 9) ICGS E 21 and
10) ICGS-35-1

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These entries are simultaneously tested in the AICORPO trial which in total comprised of 49 entries in Lattice Design replicated thrice. Among these varieties, the highest haulms yield was recorded by Dh E 32 (16.7 t/ha) Pod yield by ICGS(E) 121 (2220 kg/ha) and Kernel yield by ICGS(E) 21 (1573 kg/ha).

ii) Segregating early materials, types, mutants and multiplication.

29 early segregating materials (F_5), 21 types and 15 mutants and multiplication of TG_3, TG-14 and Spanish improved were carried out.

The segregating early materials, types and mutants (45 nos.) were laid out during summer 88 in rice fallows.

b) Variability and Correlation in blackgram under partially shaded conditions in Coconut plantations

A field experiment was conducted (19x3 RBD). Data were collected from grain yield and other 17 characters. The data collected were subjected to statistical analysis and genetic parameters like Heritability and Genetic advances were estimated. Association of characters with yield was assessed by correlation analysis. Path analysis was conducted using harvest index as effect and other 6 components as causes.

The variability studies revealed that number of days to blooming, number of days to first pod harvest, LAI at 50 per cent flowering and dry matter accumulation (Photosynthetic efficiency) at 50 per cent and 100 per cent flowering had high heritability and genetic advance Correlation studies revealed that harvest index had the highest genotypic correlation with seed yield followed by number of pods per plant. Leaf area index at 50 per cent flowering had maximum direct effect on harvest index. Among the 17 varieties T9 had the maximum grain yield followed by NPRB-2.

Tabulation and interpretation of results and preparation of thesis are progressing.

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c) Yield and its component in groundnut (Arachis hypogaea L.) under partial shade in coconut garden

Thirty one bunch varieties of groundnut were grown in coconut garden under partial shade in a simple RBD with 4 replications and plot size of 2 x 1.8 m^2 and spacing 30 x 20 cm. Observations on 35 characters of the plants including observations on shade intensity of each plot were taken during the growth period of the crop and subjected to statistical analysis. The interpretation of the results are progressing. From preliminary analysis the following ten groundnut varieties were identified as the best yielders under partial shade condition of coconut gardens.

P.G.Project

d) "Production potential of guinea grass clones under partial shade in coconut gardens"

To evaluate the fodder production potential of different guinea grass clones under partial shade and to isolate superior clones possessing high fodder yield and shade tolerance for intercropping in coconut gardens an experiment was conducted with 15 guinea grass clones in RBD with 3 replications during June, 1987. Three harvests were done and the data on green fodder yield per plot in 3 harvests showed that the highest green fodder yield was recorded by the variety HC-14 (45.2 Kg) followed by Hirit (44.1 Kg).

Statistical analysis of the data is being continued.

vi. Department of Statistics

The following post graduate projects are progressing

a) Pattern of occurrence of rainfall and estimation of rainfall. Probabilities in the northern districts of Kerala

A comprehensive study of daily rainfall data from 6 reporting stations of the northern districts of Kerala for a period of 25 years revealed that the Pattern of occurrence of wet and dry days over a given time could be well described by a two state Markov chain model

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except in a few forthnights at the beginning and at the end of the year. The maximum expected length of wet spell at different centres was observed during the period from the 2nd forthnight of June to the 2nd forthnight of July. First forthnight of February was found to be the driest forthnight. It was also found that there was greater chance for a wet day to be preceded by a wet day than by a dry day. The likely commencement of S-W monsoon was predicted to be in the 11th forthnight (ie. 1st forthnight of June) in almost all centres in normal years. Suitable probability distributions among normal, root normal, log normal and gamma distributions to be fitted and the probabilities of getting a fixed amount or less of rainfall were worked out with 80% & 90% confidence limits for the mean forthnightly rainfall.

vii) Department of Extension

The following projects are implemented in this department.

Departmental projects

a) Evaluative perception of the course curriculum by the under graduate students in Agriculture

b) Development of a scale for measuring managerial efficiency of farmers

c) Problems and prospects of cultivation of banana in Kerala

d) A study on the preferential use of fertilizer and pesticides by rice farmers in Trivandrum district

e) Study on the intercrop variations in adoption of fertilizers and pesticides by the farmers in Trivandrum district.

f) Differential profile of land owner and tenant vegetable growers in Palappooru Village of Trivandrum district

P.G. Projects

a) Structural and functional linkages in the transfer of technology of improved rice varieties released by KAU-A System analysis

b) Sequestial analysis of constraints in increasing production of rice and coconut in Kerala

c) Development and application of a scale to measure the efficiency of adult education centres.

d) Group management in the rice production
An action research

e) Adoption of farm implements and machinery by the Rice farmers of Kerala

f) Training needs in Agriculture of Irulas of Attappady

g) Involvement of farmers in Agro-forestry programmes in Kerala - A critical analysis

h) An experimental study on the relative effectiveness of selected visual aids in teching neo-literates.

i) Job satisfaction of agrl. graduates engaged in selected avenues of employment in Alleppey district

j) Transfer of technology on pulses and oil seed cultivation in the Onattukara tract of Kerala

k) Training strategy for the farmers of Kasaragod district

l) Awareness and training needs of officers of the department of Agriculture in Watershed planning

m) Impact of development programmes in promoting pepper production in Kerala

viii) Instructional Farm, Vellayani

Production and distribution of planting materials and farm produces from the Instructional Farm for the period under report are given below:

I. Planting Materials

a) Grafts/Layers/Budlings /Rooted cuttings

	Production	Distribution
1. Mango	1563	3624
2. Jack	3116	3142
3. Sapota	Nil	388
4. Pomegranate	41	59
5. Guava	1478	1520
6. West Indian Cherry	27	87
7. Lovi lovi	5	152
8. Malta Lemon	273	309
9. Jamba	Nil	3
10. Pepper cuttings (rooted)	11	43

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b) Seedlings

1. Cinnamon	322	153
2. Rambuttan	Nil	23
3. Star apple	Nil	35
4. Papaya	11	43
5. Coconut - Komadan	2690	2554
W.C.T.	13803	15821

c) Suckers

1. Banana - ordinary	91	91
Superior	52	52

d) Seeds

i) Seed coconuts - WCT	4652	7465
Komadan	1544	4239
ii) Paddy seeds - Annapoorna	740 kgs.	80 kg.
Kochuvithu	1060 ,,	80 ,,
Triveni	100 ,,	98 ,,
T9	740 ,,	243 ,,
Jyothi	50 ,,	50 ,,
Onam	200 ,,	85 ,,
iii) Vegetable seeds - Bhindi	22.5 ,,	22.5 ,,
Cucumber	5.85 ,,	5.85 ,,
Amaranthus	10.295 ,,	10.295 ,,
Ash gourd	0.75 ,,	0.75 ,,
Brinjal	5.55 ,,	5.55 ,,
Bittergourd	8.60 ,,	8.60 ,,
Snakegourd	11.35 ,,	11.35 ,,
Cluster beans	10.50 ,,	10.50 ,,
Cowpea	8.85 ,,	8.85 ,,
Pumpkin	1.00 ,,	1.00 ,,
Sword bean	9.6 ,,	9.6 ,,
Tomato	5.70 ,,	5.70 ,,
Winged bean	5.70 ,,	5.70 ,,
Chillies	13.85 ,,	13.85 ,,

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e) Ornamental plants

1. Aglonema (15 x 15)	Nil	1
2. Allocasia (15 x 15)	56	52
3. Allocasia (30 x 30)	Nil	1
4. Anthurium (15 x 15)	2	2
5. Bamboo grass (15 x 15)	Nil	4
6. Begonia (15 x 15)	97	100
7. Bougainvillea(15 x 15)	446	437
8. Bougainvillea(30 x 30)	Nil	19
9. Canna bulb	22	22
10. Canna (30 x 30)	Nil	1
11. Cactus (15 x 15)	14	12
12. Caladium (15 x 15)	7	5
13. Cassia layers	51	35
14. Coleus cuttings	140	140
15. Croton (15 x 15)	Nil	192
16. Croton (30 x 30)	4	14
17. Croton (45 x 45)	Nil	21
18. Dahlia (15 x 15)	14	23
19. Dracena (15 x 15)	25	33
20. Dracena (30 x 30)	20	11
21. Dieffenbachia(15 x 15)	10	38
22. Fern (15 x 15)	Nil	22
23. Ficus layer	30	20
24. Gerbera (15 x 15)	Nil	2
25. Gerbera (30 x 30)	Nil	1
26. Hibiscus ordinary (15 x 15)	Nil	26
27. Hydrangea (15 x 15)	Nil	8
28. Jasmine layers (15 x 15)	400	414
29. Lilly (15 x 15)	13	14
30. Maranta (15 x 15)	131	133
31. Mehra (15 x 15)	20	20
32. Mehra (30 x 30)	1	1
33. Mussaenda Pink/Orange/Rose (15 x 15)	3	3
34. Mussaenda white (15 x 15)	1	1
35. Mussa Red (15 x 15)	5	5
36. Orchida (15 x 15)	5	3
37. Palm (15 x 15)	28	32
38. Palm (30 x 30)	44	30
39. Pepperomia (15 x 15)	9	1
40. Philodendron (15 x 15)	2	2

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II. Farm Produces

a) Coconuts	Mature nuts	117712	104442
	Tender nuts	725	725
b) Rubber	Sheets	895 Kg.	879 Kg.
	Waste	89 Kg.	87.5 Kg.
c) Pine apple fruits		80.5 Kgs.	80.5 Kgs.
d) Banana bunches --	Superior varieties	348 Kg.	348 Kg.
	Ordinary	3018.5 Kg	3018.5 Kg
	Red banana	269 Kg.	269 Kg.
	Nendran	15.5 Kg.	15.5 Kg.
e) Paddy	bulk	41661 Kg.	41661 Kg.

EDUCATION

i) Details of participation of NARP staff in teaching

The following courses were taken by the NARP Scientists during the period under report.

P.G.Programme

Pl. Br. 520	Seed Production, testing and Certification	2+1
Stat. 506	Statistics in Social Sciences	2+1
Ag. Chem.503	Agrl. Biochemistry	2+1
Pl. Br. 551	Seminar	0+1
Stat. 504	Biological Statistics	2+1
Pl. Br. 512	Breeding of Vegetatively propagated crops	2+1
Pl. Br. 515	Breeding of forage crops	2+1
Ent. 517	Nematode diseases of Agricultural Crops	2+1
Pl. Br. 501	Genetic basis of plant breeding	2+1
Ent. 513	Introductory Nematology (Practicals)	2+1
Stat. 507	Elementary biometric methods	2+1

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U.G. programme

Hort. 306	Fruit Crops II (Sub tropical and temperate fruits)	2+0
Ag. Bot. 408	Breeding of Annual and Perennial crops	2+1
Ag.Chem.103	Agrl. Biochemistry (repeat)	2+1
Ag.Ent. 407	Economic Entomology III	1+2
Agron. 101	Soil productivity and management	2+1
W.E.(Agron)202	Homestead farming	0+2
Agron.311	Crop Production III	2+0
Hort. 411	Spices	2+0
Ext. 305	Programme planning	2+1
Ag.Ent. 305	Economic Entomoloty I	2+1
Ag.Ent. 306	Economic Entomology II	2+1
Agron. 412	Crop Production - Practical (repeat)	0+1
Ento. 101	General Entomology	2+1

EXTENSION

a) Seminars/workshops

The IX Zonal Workshop of the southern region, was held on 29th and 30th June, 1987 at the College of Agriculture, Vellayani. Dr.N.Mohanakumaran, Associate Director and all the Scientists of the NARP(SR) actively participated and presented research results in the workshop.

Dr.N.Mohanakumaran, Associate Director participated the National Workshop on 'Utilization of Cashew apple' held at Main Campus, K.A.U., Vellanikkara on 29.4.'87 and chaired the plenary session.

Dr.N.Mohanakumaran, Associate Director participated in the IX Zonal Workshop (Central zone) held at the R.A.R.S., Pattambi on 28.7.1987.

Sri.N.Ramachandran Nair, Associate Professor of Plant Breeding attended the 'One day agricultural seminar and Karshakamela' at Vilakudy organised by the N.S.Scheme, Kottarakkara during August, 1987.

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Dr.N.Mohanakumaran, Associate Director participated in the X Zonal Workshop (Northern region) on 14.8.87 and 15.8.87 at R.A.R.S., Pilicode.

Sri.K.M.Abdul Khader, Junior Assistant Professor of Plant Breeding participated in the Annual Work Group Meeting of the AICRP (Forage) for Rabi 1987 at the Indian Grassland and Fodder Research Institute on 7th and 8th September, 1987.

Dr.N.Mohanakumaran, Associate Director; Dr.A.Visalakshi Professor (Entomology) and Sri.P.A.Rajan Asari, Assistant Professor (Entomology) participated in the IX Zonal Workshop of the NARP/KAEP at the Regional Agricultural Research Station Kumarakom held during 16th and 17th September, 1987. Dr.N.Mohanakumaran chaired the session on Coconut and Coconut-based-farming systems.

Dr.N.Mohanakumaran, Associate Director; Dr.John Kuriyan Dr.A.Visalakshi; Shri.P.A.Rajan Asari; Smt.T.Nalinakumari; Sri.Arthur Jacob; Smt.S.Nazeema Beevi; Smt.M.S.Sheela; Smt.Hebsy Bai, Department of Entomology attended the National Symposium on Integrated pest control progress and perspective held at Trivandrum from 15 - 17th October, 1987.

Dr.Sverup John, Assistant Professor of Plant Breeding attended the VIII Annual Rabi/Summer Groundnut Research workers group meeting at Rajendra nagar from 17 - 20th october

b) Discussions/Group meetings

Dr.N.Mohanakumran, Associate Director, NARP(SR) represented the Director of Research, KAU at the 13th meeting of the Advisory Committee of the Central State Farm, Aralam on 25-5-1987 at the Govt. Secretariat, Trivandrum. He also participated in the meeting convened by Dr.M.Krishnan Nair, Director, Veterinary Research and Education on 28-5-87 at the College of Agriculture, Vellayani to discuss biotechnology research.

Dr.N.Mohanakumaran, Associate Director and Sri.P.R.Ramasubramonian, Professor of Soil Science & Agrl. Chemistry participated in the discussions with Dr.A.R.Seshadri, World Bank official on the status report of the southern region from 18th to 20th June, 1987.

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Dr.G.Raghavan Pillai, Professor (Agronomy) participated in the meeting of the State Level Committee on Fodder Development on 24-7-1987.

Dr.N.Mohanakumaran, Associate Director participated in the meeting on "the survey to assess the economic impact of drought on crops and Livestock in Kerala" convened at the KAU Headquarters, Vellanikkara on 19-9-1987 to finalise the proforma for the ensuing survey.

Dr.N.Mohanakumaran, Associate Director and Prof.V.Sukumara Pillai of the Pepper Research Station held discussions with Sri.M.S.Joseph, Secretary (Agri), Govt. of Kerala on 21-9-87 on the effect of drought on perennial crops and participated in the meeting of the State officials and the Govt. of India Committee, chaired by the Chief Secretary, Sri.V.Ramachandran. A note on the "effect of prolonged drought on perennial crops" was prepared by Dr.N.Mohanakumaran, Professor V.Sukumara Pillai and Sri.P.Suseelan, Director of Agriculture and submitted to the Secretary (Agri.) Dr.N.Mohanakumaran attended the wrap up discussions held on 25-9-87.

Training

Monthly workshops were regularly conducted for the extension officers of the Department of Agriculture working in Trivandrum, Quilon, Alleppey and Pathanamthitta districts.

Papers published/presented

Sri.R.Prakash, Asst. Professor of Extension published one popular article in Kerala Karshakan entitled "

An abstract of papers (10 nos.) were published in the National Symposium on "Integrated Pest Control - Progress and Prospectives" held on 15th to 17th of October, 1987 at Trivandrum.

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Details of visit of experts/supervision/review mission

Name	Station to which attached	Date of visit
Associate Director	NARP(SR)	3-4-87
Associate Director	RARS, Kumarakom	visited the Special Stati Sadanandapura
P.Ramachandran Nair, Professor of Extension	K.A.U.	
Rajan Asari, Asst.Prof. Entomology	College of Agriculture Vellayani	
Dr.M.Aravindakshan, Director of Research	K.A.U.	6-5-87 at Special Station 19.5.87 at CSRC, Karaman
Dr.A.G.G.Menon Director of Extension	K.A.U.	27.5.87
Dr.M.Aravindakshan Director of Research	,,	and 28.5.87 at Vellayani
Dr.M.Krishnan Nair, Director of Vety. Research and Education	,,	
Dr.Bidappa		
Dr.Mohammed Yousef	CPCRI	26-6-87 at C.R.S., Balaramapuram
Dr.C.Kailasom		
Dr.Robert Jackson, Director	FERRO, New Delhi	1-7-87 at Vellayani
Dr.S.C.Adlaka, Asst. Director General	ICAR	
Dr.M.Aravindakshan, Director of Research	K.A.U.	

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Dr. Raghul Raturi Economist Dr. Clement E. Tagoe Agrl. Officer	FAO/World Bank Co-operative Programme Investment Centre	3-7-87 Vellayani
Hon'ble Minister for Agriculture	Karnataka	23-7-87 Vellayani Campus
Mrs. Aruna Bagchee Director (EN)	Govt. of India	30-7-87 Vellayani
Hon'ble Vice Chancellor	K.A.U.	24-8-87 Vellayani Campus
Dr.J.S.Gill Project Co-ordinator	AICRP on Nematode Pests and their control	27-10-87 at Vellayani Campus

Table - 1.1

YIELD OF FRUITS in Kg/ha

Location	AE-1	Sel-2	Pusa Savani	Local
1. Agricultural College, Vellayani	5648	1689	1064	-
2. Nesamony, Madavoorpara	13287	6606	11689	14856
3. Christudas, Thettivila	7555	7949	8990	4995
4. Nelson, Thettivila	2560	3634	3902	2175
5. Manoharan, Vlathankara	8032	15277	20555	10787
6. George, Powdikonam	-	2770	4000	670
7. Saraswathy, Mangalakkal	6180	7540	3800	5900
Pooled Mean	7210.3	6495	7714.2	6563.
Rank	II		I	

Table 1.2

Yield data of fruits (Tons/Ha)

LOCATION	T_1 (H 1)	T_2 (H 2)	T_3 (SMI-10)	T_4 (PPC)	T_5 (Local)	REMARKS
1. Agricultural College, Vellayani	4.35	6.6	3.8	2.2	-	T_1+T_2 severely wilted
2. Sundari, Kattakada	7.40	8.7	5.3	2.3	-	No wilting
3. Bhaskara Pillai Arnadu	3.70	2.7	6.2	15.0	-	T_1+T_2 severely wilted
4. Krishnamoorthy Vlathankara	29.6	26.2	24.6	26.9	22.8	No wilting
5. Raveendran Vlathankara	92.90	80.6	9.6	112.5	24.1	Very high yield recorde
6. George Powdikonam	34.60	28.25	7.22	17.26	1.71	No wilting
Pooled Mean	28.76	25.5	9.45	29.36	16.20	
Rank	II	III		I		

Table 1.3

YIELD DATA OF FRUITS (Tons/ha)

QUILON DISTRICT

Location	T_1 (H1)	T_2 (H2)	T_3 (SMI-10)	T_4 (PFC)	T_5 Local	Remarks
Thankamma Kadakkal	2.17	4.44	4.53	3.19	2.91	
Sombupanickar Poovattoor	7.12	6.96	5.96	6.19	3.68	
Gopalan Nair Sooranadu	27.96	47.40	36.48	12.09	4.30	
Oommen Odanavattom	26.12	24.44	19.32	25.83	22.87	
Mean	15.84	20.81	16.57	11.80	8.44	
Rank	III	I	II			

Table 1.4

Length of pods, number of seeds per pod and yield of green pods.

Sl. No.	Variety	Length of pods (cm)	No.of seeds per pod	Yield of green pods (Kg/ha)
1.	Manjeri Plain	38.1	17.0	4741
2.	Selection 2	35.5	15.6	4556
3.	Selection 4	28.7	13.1	2778
4.	Selection 7	43.5	17.1	3926
5.	Selection 8	30.3	14.2	4518
6.	Selection 10	37.0	16.2	5407
7.	Selection 11	37.9	14.3	3652
8.	Selection 12	27.7	13.9	2593
9.	Selection 14	27.0	14.7	4037
10.	Selection 16	27.7	15.0	6333
11.	5269	26.5	13.7	3556
12.	Manjeri black	25.7	16.2	2185
13.	Vayalat ur red	21.1	14.1	2259
14.	Kurutholapayar	32.5	13.8	3111
	CD (0.05)	5.49	2.12	1829.5

Table 1.5

Yield loss of Bittergourd due to various population levels of Root-knot nematode

TREATMENTS	FRUIT Wt. IN gm.	No.of GALLS	Nematode count in 100 g soil	Length of the plant in cm.	Root Wt (gm)
T_1 (Field population)	4747.50	38.37	121.25	441.56	27.43
T_2 (Two fold increase over T_1)	4361.25	58.68	159.00	415.31	21.10
T_3 (Five fold increase over T_1)	3287.50	92.81	203.25	397.18	18.80
T_4 (Ten fold increase over T_1)	2925.00	238.43	353.75	414.37	18.13
T_5 (Control, Temik 1 Kg ai/ha)	5401.25	10.25	73.23	510.93	27.25

Table 1.6

Mean residues (ppm) of insecticides in snake gourd at different intervals grown during the rainy season

INSECTICIDE	INTERVALS (days)	RESIDUES IN ppm	
		WASHED SAMPLE	UNWASHED SAMPLE
Monocrotophos 0.05%	1	2.42	2.66
	3	2.14	2.08
	5	1.03	1.40
	7	0.20	0.22
	10	0.04	0.06
Dimethoate 0.03%	1	2.14	2.24
	3	2.06	2.10
	5	1.08	1.09
	7	0.88	0.93
	10	ND	ND
Malathion (0.1%)	1	0.68	0.69
	3	0.39	0.43
	5	0.20	0.21
	7	ND	ND
Quinalphos (0.05%)	1	2.14	2.38
	3	1.42	1.63
	5	0.40	0.64
	7	0.012	0.018
Fenthion (0.05%)	1	1.68	1.96
	3	0.43	0.48
	5	0.10	0.15

Table 3.1(a)

Grain yield of cowpea (Kg/ha)

Sl. No.	VARIETIES	GRAIN YIELD Kg/ha
1.	C - 152	198
2.	V - 26	193
3.	Covu. 95	183
4.	Co - 4	211
5.	V - 240	135
6.	NPRC - 3	154
7.	Cheradi	228
8.	S - 488	170
9.	HG 171	191
10.	NPRC - 2	192
	CD (0.05)	NS

Table 3.1(b)

Sl. No.	VARIETY	GRAIN YIELD (Kg/ha)
1.	V - 701	157
2.	UPC - 125	107
3.	V - 105	143
4.	GC 82-7	139
5.	NPRC - 3	212
6.	V - 36	151
7.	V - 240	141
8.	Co -4	161
9.	UPC 126	111
10.	UPC 124	99
	CD (0.05)	48.44

Table 3.2(a)

Dry pod yield (kg/ha) and No. of pods per plant of groundnut varieties -

Kharif 87

Sl. No.	VARIETY	NO. OF PODS PER PLANT	DRY POD YIELD (Kg/ha)
1.	TMV - 2	7.3	168
2.	TMV - 7	6.4	158
3.	TG - 3	8.5	444
4.	TG - 14	6.7	204
5.	Spanish Improved	7.3	204
6.	J.L. 24	5.3	111
7.	Pollachi-1	8.8	195
8.	EC 35999	3.9	102
9.	EC 119704	9.3	352
	CD (0.05)	2.03	57.7

Table 3.2(b)

DRY POD YIELD (Kg/ha) - Pooled data

Sl. No.	VARIETY	1984	1985	1986	1987	Pooled Mean
1	TMV - 2	167	667	250	168	313
2	TMV - 7	148	632	185	158	281
3	TG - 3	185	1000	417	444	511
4	TG - 14	139	-	246	204	196
5	Spanish Improved	185	478	259	204	281
6	J.L 24	149	-	148	111	136
7	Pollachi - 1	222	-	370	195	262
8	BC 35999	204	-	194	102	167
	CD (0.05)	NS	N.S	83.85	57.77	-

Table 3.3

Growth characters and yield of guinea grass

Sl. No.	VARIETY	Plant Ht (cm)	No.of tillers per hill	No.of panicles per hill	Green fodder yield (kg/plot of $12M^2$)
1	FR 426	149	6.7	1.73	7.83
2	FR 428	135	7.6	1.27	8.17
3	PMFR 553	122	7.3	1.53	11.67
4	Mackuenii	120	7.3	1.13	9.67
5	FR 42	129	8.8	2.33	8.67
6	FR 443	177	7.7	2.23	7.67
7	MC - 2	189	8.3	2.47	7.00
8	FM - 429	169	8.5	2.90	12.00
9	FR 552	147	3.7	1.77	11.33
10	FR 559	166	5.2	2.27	8.00
11	FR 600	178	5.8	1.27	9.67
12	Hamil	169	7.3	1.83	6.00
	CD (0.05)	NS	NS	NS	NS

Table 3.4

Corried bug infestion in different districts

	DISTRICT	TOTAL TREES OBSERVED	TOTAL TREES INFESTED	% INFESTATION
1.	Trivandrum	44476	2146	4.80
2.	Quilon	23260	403	1.73
3.	Pathanamthitta	25181	510	2.03
4.	Alleppey	30472	944	3.10
5.	Kottayam	12688	358	2.82

Table 4.1

Disease score of rice cultures

Sl. No.	Variety/Culture	SHEATH BLIGHT (1-9)	SHEATH ROT (1-9)	GRAIN YIELD (kg/ha)
1.	Jaya	0.458	1.028	1399
2.	Bharathy	0.083	0.055	1687
3.	Karthika	0	0.778	1565
4.	Mo-5	0.125	0.917	1975
5.	Mo-6	0.125	0.816	1111
6.	IR 36	0.208	1.153	1235
7.	Vytila-3	0	0.167	1071
8.	Cul.25331	0.042	0.583	1235
9.	Cul.153-1	0	0.389	1318
10.	Cul.200	0.042	0.875	1318
11.	Cul.2533	0.486	0.833	904
12.	Cul.204	0.361	0.458	948
13.	Cul.4	0.792	0.569	2633
14.	Cul.126	0.750	1.111	2222
15.	Cul 169	0.917	0.444	1936
16.	M-2	0.222	0.909	2059
17.	M-6	1.533	0.597	2207
18.	M-210	0.361	1.736	905
	CD (0.05)	N.S.	0.332	520.32

Table 4.2

Mean yield Kg/30m^2 (dry weight)

TREATMENT	STATE SEED FARM, KOTTARAKKARA		S.C.F KADAKKAL	
	STRAW	GRAIN	STRAW	GRAIN
T_1- Local + Cheradi 3:1	10.013	5.52	3.125	2.750
T_2- Local + Cheradi 2:1	10.317	4.896	2.250	1.750
T_3- Local + Culture 2500 3:1	8.849	5.302	2.594	2.261
T_4- Local + Culture 2500 2:1	10.080	5.115	1.750	1.667
T_5- Local + Lekshmy 3:1	10.156	5.855	2.875	2.438
T_6- Local + Lekshmy 2:1	11.970	4.979	2.625	2.146

Table 5.1(a)

Green fodder yield and dry fodder yield of different grass legume mixtures.

Sl. No.	TREATMENTS	Green fodder yield (t/ha)			Dry fodder yield (t/ha)		
		Grasses	Legumes	Total	Grasses	Legumes	Total
1.	Guinea + Stylo	25.01	0.94	25.95	9.16	0.45	9.61
2.	Guinea + Centro	22.33	0.20	22.53	8.96	0.11	9.07
3.	Congo + Stylo	16.80	3.76	20.57	6.73	1.69	8.40
4.	Congo + Centro	15.52	1.01	16.53	6.18	0.58	6.77
5.	Setaria + Stylo	17.93	3.35	25.84	5.28	1.51	6.79
6.	Setaria + Centro	21.39	0.52	21.91	7.04	0.24	7.28
	CD (0.05)	5.452	2.228	5.803	NS	0.304	2.203

Table 5.1(b)

PLANT HEIGHT, NUMBER OF TILLERS/PLANT AND LEAF/STEM RATIO OF DIFFERENT MIXTURES

Sl. No.	Treatments	Plant height		L:S Ratio		No.of til pt.
		Grasses	Legumes	Grasses	Legumes	
1.	Guinea + Stylo	67.27	51.93	2.22	0.67	20.87
2.	Guinea + Centro	66.67	144.0	2.39	0.60	21.00
3.	Congo + Stylo	44.27	72.0	1.15	0.91	30.00
4.	Congo + Centro	43.13	174.73	1.21	0.67	35.20
5.	Setaria + Stylo	65.53	63.60	1.68	0.97	21.27
6.	Setaria + Centro	68.07	164.87	1.58	0.57	19.33
	CD (0.05)	8.287	24.216	2.120	NS	11.307

TABLE 5.2(a)

GREEN FODDER YIELD AND DRY FODDER YIELD OF GRASSES (t/ha)

Sl. No.	TREATMENTS	Green fodder yield	Dry fodder yield
1.	Guinea	13.68	3.93
2.	Congo Signal	15.69	5.16
3.	Setaria	17.97	4.44
4.	Molasses	6.70	2.48
5.	Hybrid Napier	13.78	3.46
6.	Control	-	-
	CD (0.05)	2.717	NS

Table 5.3

Plant height, number of tillers, green fodder yield, dry fodder yield and leaf/stem ratio due to various treatment combinations

Sl. No.	TREATMENT	Plant height (cm)	No.of tillers/ plant	Green fodder yield (t/ha)	Dry fodder yield (t/ha)	L:S Ratio
1.	200 Kg N/ha + 30 days	38.60	23.20	20.62	7.14	1.40
2.	200 Kg N/ha + 45 days	56.80	41.80	27.86	8.76	1.21
3.	200 Kg N/ha + 60 days	67.87	42.40	27.82	11.55	0.94
4.	150 Kg N/ha + 30 days	38.33	19.53	19.92	7.59	1.28
5.	150 Kg N/ha + 45 days	51.67	41.07	30.73	9.87	1.17
6.	150 Kg N/ha + 60 days	66.07	40.20	26.89	11.05	0.94
7.	100 Kg N/ha + 30 days	35.33	17.47	19.22	7.24	1.12
8.	100 Kg N/ha + 45 days	46.93	36.47	24.19	7.91	1.08
9.	100 Kg N/ha + 60 days	68.00	42.20	29.36	11.98	1.19
10.	50 Kg N/ha + 30 days	35.67	20.07	16.36	5.59	1.39
11.	50 Kg N/ha + 45 days	48.67	31.53	21.68	7.37	1.26
12.	50 Kg N/ha + 60 days	62.20	32.00	27.75	10.34	1.03

Table 5.4

Green fodder yield (t/ha), dry fodder yield (t/ha), Plant height (cm) and No. of tillers/plant of two grasses due to split application of nitrogen

Sl. No.	Treatments Crop + Basal Kg N/ha + Top dressing after each cut kg/ha	Green fodder yield (t/ha)	Dry fodder yield (t/ha)	Plant height (cm)	No. of tillers/ plant
1.	Guinea + 0 + 40	11.06	3.16	110.33	3.97
2.	Guinea + 50 + 30	16.96	4.56	133.80	6.00
3.	Guinea + 100 + 20	18.64	5.13	141.20	5.13
4.	Guinea + 150 + 10	19.31	4.58	134.20	6.13
5.	CongoSignal + 0 + 40	9.96	3.20	59.80	15.47
6.	CongoSignal + 50 + 30	17.95	5.48	65.33	16.33
7.	CongoSignal + 100 +20	20.18	6.37	80.47	17.07
8.	Congosignal + 150 + 10	19.50	6.26	73.53	22.87
	CD (0.05)	2.508	1.080	17.553	

Table 5.5

No.of tillers/plant, No. of inflorescence per plant, Seed yield (kg/ha) and forage yield (t/ha) of three grasses due to 5 levels of nitrogen

Sl. No.	TREATMENTS	No.of tillers per plant	No.of inflore-sence per plant	Seed yield (kg/ha)	Forage yield (t/ha)
1.	Haritha+0 Kg N/ha	7.47	2.53	40.30	14.60
2.	Haritha+60 Kg N/ha	7.47	3.13	61.38	20.93
3.	Haritha+120 Kg N/ha	7.73	4.13	60.14	16.93
4.	Haritha+180 Kg N/ha	9.53	3.67	74.40	20.96
5.	Haritha+240 Kg N/ha	11.40	4.80	73.47	18.85
6.	Hamil + 0 Kg N/ha	5.93	3.40	132.99	15.66
7.	Hamil + 60 Kg N/ha	5.67	3.53	180.42	18.23
8.	Hamil + 120 Kg N/ha	7.80	5.27	160.27	19.59
9.	Hamil + 180 Kg N/ha	8.00	5.23	275.28	24.92
10.	Hamil + 240 Kg N/ha	9.13	5.20	244.28	25.05
11.	FR - 600 + 0 Kg N/ha	6.67	2.00	47.12	16.30
12.	FR - 600 + 60 Kg N/ha	6.80	3.53	66.34	21.85
13.	FR-600 + 120 Kg N/ha	7.20	2.93	63.23	21.76
14.	FR-600 + 180 Kg N/ha	7.27	3.73	97.96	24.43
15.	FR-600 + 240 Kg N/ha	9.27	3.53	104.16	26.35
	CD (0.05)	NS	3.137	42.739	4.589

Table 5.6

Plant height, No. of tillers, Green and dry fodder yield of various treatment combinations.

Sl. No.	Treatments	Plant height (cm)	No.of tillers per plant	Green fodder yield t/ha	Dry fodder yield (t/ha)
1.	Subabul (Pure)	-	-	-	-
2.	Hybrid Napier (Pure)	60.86	23.27	6.85	1.59
3.	Guinea grass (Pure)	85.15	25.90	7.18	2.60
4.	Hybrid Napier + Subabul (1:2)	53.87	16.13	2.48	0.70
5.	Hybrid Napier + Subabul (1:1)	62.70	15.15	4.12	1.38
6.	Hybrid Napier + Subabul (2:1)	59.80	8.55	4.03	1.19
7.	Guinea + Subabul(1:2)	86.70	24.05	6.64	2.30
8.	Guinea + Subabul(1:1)	73.65	15.75	5.72	1.86
9.	Guinea + Subabul(2:1)	67.50	18.55	6.70	2.23
	CD (0.05)	26.117	9.540	NS	0.930

Table 5.7

Growth characters and yield of guinea grass

Sl. No.	Variety	Plant popu-lation	Plant height (M)	No.of tillers/ plant	No.of lea-ves/ plant	Leaf stem ratio	Green fodder in 4 cuttings (t/ha)	Dry fodder yield in 4 cutting (t/ha)
1.	PGG - 1	67	1.09	6	31	0.77	13.23	3.57
2.	PGG - 9	76	1.09	7	26	0.67	9.94	3.38
3.	PGG-13	64	1.08	7	27	0.51	13.60	4.22
4.	PGG-14	72	1.07	8	26	0.56	11.76	3.25
5.	PGG-18	70	1.08	7	20	0.42	9.94	2.94
6.	PGG-19	73	1.16	7	25	0.52	8.82	2.73
7.	PGG-20	81	1.11	8	29	0.54	13.31	3.87
8.	TNGG-2	65	1.11	7	24	1.54	13.48	3.57
9.	Hamil	81	1.08	5	27	1.53	14.10	4.15
10.	GG-2	70	1.13	7	35	2.26	16.33	3.99
11.	Harith	98	0.79	6	30	1.73	13.39	4.64
	CD(0.05)	..	..	..	..	..	NS	NS

Table 5.8

Growth characters and yield of bajra

Sl. No.	VARIETY	Plant popu-lation	Plant height (cm)	No.of till-ers/ plant	No.of leaves per plant	Leaf stem ratio	Green fodder yield (T/ha)	dry fodder yield (T/ha)
1	L-72	58	78	3	28	0.84	7.89	0.83
2	L-74	51	85	3	19	1.97	9.56	1.92
3	UUJ-1	51	87	3	19	0.82	9.46	2.24
4	UUJ-IU-17	82	86	4	22	0.94	6.00	0.80
5	PCB-15	45	78	3	13	0.86	10.79	2.14
6	MBH-1	51	74	4	18	0.79	7.03	1.60
7	TNSC-1	16	92	4	20	1.33	5.18	1.06
8	L-82-1	53	85	3	19	0.97	9.19	1.15
9	L-84	55	82	3	19	0.79	9.81	1.69
10	K-84	52	75	3	15	1.25	6.97	1.51
11	Comp-1	41	80	3	21	1.05	3.88	0.46
12	Comp-9	83	87	3	28	1.00	7.09	1.66
	CD(0.05)					NS	NS	NS

Table 5.9

Growth characters and yield of Dinanath grass

	VARIETY	Plant Population	Plant height (m)	No.of tillers per plant	No.of leaves per plant	Leaf stem ratio	Green fodder yield (T/ha)	Dry fodder yield (T/ha)
1.	IG FRI-42-1	47	1.21	4	19	1.76	4.52	1.75
2.	JHP-1	62	0.91	7	23	1.19	2.55	0.90
3.	TNDN-1	75	1.06	8	22	1.25	4.63	1.00
4.	JHP-2	83	1.13	7	27	1.16	3.43	1.11
5.	IG FRI-56-1	70	1.17	7	19	1.45	5.67	1.99
6.	JHP-3	77	1.22	5	18	1.50	4.51	0.49
7.	PS-3	66	1.07	4	18	1.64	3.71	0.65
8.	IGFRI-43-1	72	1.10	5	25	1.63	2.36	0.23
9.	JHP-4	71	1.15	4	19	0.95	3.03	0.81
	CD (0.05)	..	..	..	..	NS	NS	NS

Table 5.10

Growth characters and yield of Cowpea varieties

Sl. No.	Varieties	Plant height (cm)	No.of branches per plant	No.of leaves per plant	Green fodder yield (T/ha)	Dry fodder yield (T/ha)	Leaf/ Stem ratio
1.	IFC - 8504	60.5	1.8	9.6	3.265	0.568	4.7
2.	IFC - 8502	58.5	2.1	12.4	5.481	0.765	2.7
3.	IFC - 8503	49.5	2.5	12.1	4.375	0.631	3.8
4.	CS - 24	55.0	2.7	13.4	5.094	0.563	3.2
5.	PC - 16	61.4	1.9	11.9	4.866	0.612	4.5
6.	UPC - 8706	54.1	2.4	13.6	5.247	0.632	3.6
7.	CS - 88	50.6	1.7	10.5	6.850	0.597	3.0
8.	IFC - 8505	53.3	1.8	12.4	5.327	0.538	2.8
9.	UPC - 8702	58.6	2.1	10.7	6.172	0.579	4.5
10.	PC - 1	46.9	2.3	12.2	5.941	0.570	3.4
11.	EC - 4216	53.2	2.3	10.1	9.111	0.816	4.4
12.	UPC -8701	50.3	2.2	14.0	8.276	0.848	3.4
13.	UPC - 8704	48.1	2.3	14.1	5.704	0.620	2.9
14.	CS - 42	46.9	2.7	14.5	8.751	0.808	4.4
15.	IFC - 8501	45.0	2.1	10.6	6.664	0.593	2.9
16.	UPC - 5286	50.7	3.2	16.7	5.658	0.679	5.8
17.	UPC - 8705	56.3	2.2	14.0	6.229	0.687	2.9
18.	CS - 44	52.7	1.6	12.3	4.631	0.636	2.4
19.	PC - 17	46.5	2.5	13.1	7.542	0.717	3.3
20.	UPC - 8703	49.7	1.4	11.9	7.396	0.772	3.6
	CD (0.05)	NS	NS	NS	NS	NS	NS

Table 5.11

Growth characters and yield of cowpea varieties

Sl. No.	Variety	Plant height (cm)	No. of branches per plant	No.of leaves per plant	Green fodder yield (T/ha)	Dry fodder yield (T/ha)	Leaf/ Stem ratio
1.	UDC-2201	41	1.5	10.4	6.386	0.651	3.6
2.	IFC-8402	50	1.3	12.0	8.055	0.934	3.67
3.	UDC-4200	41	1.4	11.1	6.278	0.605	5.78
4.	UDC-287	37	1.4	11.9	5.862	0.512	3.48
5.	UDC-5286	48	1.4	12.3	8.596	0.809	3.53
6.	CS-35	32	1.3	9.2	5.023	0.692	2.99
7.	CS-40	43	1.1	10.3	5.104	0.702	5.08
8.	CS-38	46	1.3	10.9	5.641	0.661	3.41
9.	IFC-8401	34	1.2	9.1	6.411	0.717	3.33
10.	EC-4216	32	2.0	13.0	6.547	0.744	4.51
	CD(0.05)	12.25	NS	2.37	NS	NS	NS

Table 5.12

Growth characters and yield of bajra varieties

Sl. No.	Varieties	Height of plant (cm)	No.of tillers per plant	No.of leaves per plant	Green fodder yield (t/ha)	Dry fodder yield (t/ha)
1		2	3	4	5	6
1.	L-72	137	4.1	26.1	9.46	1.07
2.	L-74	142	4.9	34.3	10.34	1.06
3.	PPMF - 999	156	3.6	30.4	15.13	1.14
4.	PPM - 500	132	3.7	28.3	7.27	0.86
5.	MH - 123	130	4.1	30.3	8.39	0.99
6.	HC - 4	154	3.8	26.0	11.67	0.93
7.	R-55 B	141	3.3	23.5	5.38	0.71
8.	R-54	133	4.0	28.1	3.41	0.62
9.	ICMV-81111	129	3.5	21.8	6.81	1.04
10.	ICMV-82132	152	3.0	24.9	14.01	1.22
11.	ICMV-8440	143	4.4	30.4	4.53	0.63
12.	DPBT-831	135	3.8	25.7	10.71	0.82
13.	DPBP-832	131	3.8	28.1	3.25	0.79
14.	DPBP-IC-862	146	2.5	16.7	10.64	1.01
15.	ICMB-8353	164	3.8	29.9	6.00	0.85
16.	LC-11	137	3.0	22.8	7.17	0.79
17.	LC-12	151	4.7	32.8	8.58	0.70
18.	LC-14	133	4.3	31.3	7.61	0.80
19.	LC-18	117	4.3	24.3	5.87	0.67
20.	Comp. 8	123	5.7	41.3	6.55	0.93

Table 5.13
Pod yield of 49 groundnut varieties during Kharif 87

Sl. No.	Variety	Days to Flower	Days to Mature	Yield/ha haulms(T)	Yield/ha Pods (Kg)	Disease score 1-9 scale Tikka	Disease score 1-9 scale Rust	Pod quality Shelling %	Pod quality SMK %	Pod quality HKW (g)	Kernel yield Kg/ha
1.	NRGS(E) 2	25	105	10.7	1240	2.8	1.4	76	75.6	53.2	942
2.	NRGS(E)6	24	105	12.9	1220	2.5	1.8	76	72.5	39.9	927
3.	J 19	25	107	13.0	1220	3.0	2.3	70	71.6	48.5	854
4.	J 21	28	111	16.2	2020	1.5	1.3	65	28.6	65.0	1313
5.	J 22	24	106	12.4	1440	3.8	2.6	82	67.0	46.3	1181
6.	J 24	23	105	16.2	1490	3.8	1.5	75	73.7	45.2	1118
7.	ICGV 86124	25	109	17.8	1160	2.1	1.9	70	71.1	48.3	812
8.	ICGV 86127	26	106	18.0	2330	2.6	2.3	72	71.8	51.8	1678
9.	ICGV 86309	30	104	11.1	1090	2.5	1.6	74	82.6	45.1	807
10.	ICGV 86239	25	107	11.1	2220	2.3	1.4	64	58.6	60.0	1421
11.	ICGV 86315	26	109	21.1	2290	1.4	1.9	70	84.1	37.1	1603
12.	AKG 3	24	108	14.0	1180	2.0	1.3	70	71.5	46.0	826
13.	RSHY 12	25	108	16.7	2070	2.1	1.8	38	11.8	45.8	787
14.	TG 22	26	109	8.4	1670	2.0	2.3	73	61.8	67.0	1219
15.	TG 23	25	109	8.9	1560	2.0	1.8	74	95.5	55.6	1154
16.	RG 192	25	106	2.3	2780	3.5	3.1	72	84.9	55.6	1980
17.	JL 24 M1	24	107	10.2	960	2.6	1.6	70	61.5	73.8	672
18.	DH 30	34	109	20.0	1840	2.0	1.8	70	76.5	33.0	1288
19.	DH 31	35	107	14.4	960	1.8	1.3	70	76.9	27.4	672
20.	PGN 3	32	108	18.9	2530	2.6	1.3	64	56.4	48.9	1619
21.	PGN 1	26	109	20.0	3000	1.8	1.4	75	81.6	52.4	2250
22.	NRGS FDRS 1	24	107	5.5	1020	1.5	1.6	76	74.4	43.8	775
23.	NRGS FDRS 2	25	108	7.7	440	1.1	1.4	66	51.7	45.0	290
24.	NRGS FDRS 3	27	105	7.7	1110	1.5	1.1	64	61.9	46.2	710
25.	PGN 2	24	108	16.2	1620	2.8	1.9	70	75.8	42.0	1134
26.	PGN 5	28	109	16.7	1960	1.4	1.4	66	70.0	43.2	1294
27.	ICGV 86600	29	106	26.2	1670	1.9	1.5	72	70.9	49.2	1202
28.	ICGV 86635	26	109	18.9	2020	1.3	1.0	60	46.0	42.4	1212
29.	ICGV 86031	26	109	18.9	1780	2.5	1.6	66	30.0	60.0	1134
30.	ICGV 86020	26	107	16.7	3710	2.1	1.3	63	59.1	42.6	2337
31.	ICGV 86022	25	108	19.6	1400	1.3	1.4	60	60.4	42.1	840
32.	ICGV 86029	25	106	15.1	2440	1.9	1.5	73	65.3	43.8	1781
33.	VG 78	29	106	16.7	820	1.0	1.5	72	64.5	41.7	590
34.	ICG FDRS 34	27	108	21.1	2933	1.3	1.0	63	59.6	37.1	1848
35.	JL 24(MC)	26	106	15.6	2270	3.0	2.9	72	67.8	50.0	1634
36.	TMV.2(ZC)	26	105	14.4	1620	3.5	3.0	66	66.7	38.2	1064
37.	TG 14(LC)	25	106	8.9	1000	4.0	2.5	75	95.5	51.6	750
38.	VG 18(MC)	26	107	12.2	1530	2.3	1.6	74	59.3	50.9	1132
39.	Dh (E)20	25	106	9.3	1510	3.8	2.8	70	73.4	42.8	1057
40.	J 11	25	106	12.2	1160	1.6	3.0	72	76.7	49.2	835
41.	DH 632	24	105	16.7	1440	2.6	2.3	75	75.0	36.4	1080
42.	Dh 29	27	108	10.0	980	1.8	1.6	58	58.0	41.3	568
43.	ICGS 35-1	28	106	8.9	1580	2.6	2.1	76	76.0	42.3	1201
44.	BPG 521	26	108	10.0	1089	1.4	1.6	76	76.0	57.5	828
45.	ICGSE 52	27	101	7.8	1760	3.0	2.3	75	75.0	51.7	1320
46.	ICGSE 121	24	107	14.4	2220	3.3	1.6	67	66.0	50.0	1487
47.	ICGS E123	25	104	9.1	8000	4.1	2.8	63	63.0	52.9	504
48.	ICGS E 21	23	105	12.2	2070	5.0	1.6	76	76.0	43.9	1573
49.	TG 3	25	107	9.5	1470	3.0	1.8	68	68.0	48.0	1000

Table No. I (i)

Yield of coconuts for the two year block of 1986 and 1987

(Average number of nuts/palm for years)

	P_0	P_1	P_2	K_0	K_1	K_2	Mean
n0	244	205	220	68	268	333	223
n1	257	346	238	37	368	346	280
n2	331	289	285	35	412	358	302
Mean	277	280	248	46	349	409	
K0	87	16	37				
K1	353	397	298				
K2	392	427	408				

CD(N) = 52.5

(K) = 51.1

Table No. I (ii)

Yield of coconut for the two year block of 1986 and 1987

Mean table

	m_0	m_1	m_2	Mean
S1	10.96	61.76	75.39	49
S2	46.67	115.85	145.56	103
S3	27.17	154.17	167.42	116
Mean	28.27	110.59	129.46	

CD (S/m) = 18.276

CD (sm) = 31.655

Table No. I (iii)

Yield data for the two year block of 1985 and 1986

		R1	R2	R3	R4	R5	Total for 2 years	Mean/ palm/ year
	1	18	133	192	120	175	538	53.8
	2	95	199	156	115	180	745	74.5
F1	3	107	130	184	137	175	732	73.2
	4	20	70	127	163	260	640	64.0
	5	86	168	198	226	192	870	87.0
Total		326	700	857	761	881	3525	
	1	137	158	182	182	230	896	
	2	101	247	246	239	229	1062	89.6
F2	3	124	108	205	142	263	842	106.2
	4	131	62	213	175	110	691	84.2
	5	118	0	173	145	218	654	69.1
Total		611	575	1026	883	1050	4145	65.4