

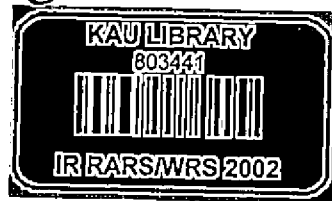
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# Kerala Agricultural University

CENTRAL ZONE

XXIV<sup>th</sup>

Zonal Research and Extension  
Advisory Committee Workshop

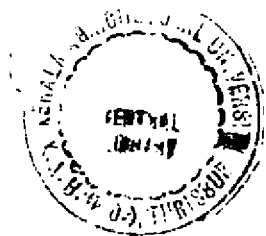


30<sup>th</sup> May , 2002



REGIONAL AGRICULTURAL RESEARCH STATION  
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## REGIONAL AGRICULTURAL RESEARCH STATION, PATTAMBI

### a. Rice – Crop Improvement

#### Salient Results

#### 1. Genetic conservation of rice germplasm: Collection, maintenance, cataloguing and evaluation

A germplasm collection of 853 accessions including varieties developed within and outside the state as well as pre release cultures is being maintained at RARS, Pattambi. 700 accessions were sent for long-term storage to NBPGR, New Delhi. Cataloguing of these rice varieties according to IRRI-IBPGR descriptor is in progress. These varieties were also screened for their reaction to biotic and abiotic stresses and resistant varieties were identified as donor parents in the breeding programme.

#### 2. Conservation of genetic diversity of rice in Kerala

The experiment was started in 1996 with the objective of collection, conservation, characterisation and evaluation of the rich genetic diversity available in Kerala rices and to make it available for future breeding programmes. Now this project is merged with the NATP on plant biodiversity.

#### 3. Breeding high yielding, tall, photosensitive varieties with good straw yield, specifically suited for Mundakan season.

Breeding programme for improvement of photosensitive rice varieties like Chettadi, Konna, Chitteni, etc through selection as well as hybridisation with Purple local, Ramalaxman and other high yielding varieties.

#### 4. Evolution of high yielding rice hybrids suitable for Kerala

The project was initiated during 1993 as a part of the net work programme on Hybrid rice. Under this programme, four CMS lines were evaluated for stability for male sterile characters and their adaptability to Kerala and IR 58025 A was found to be most suitable. More than three hundred crosses were made with varieties available from the germplasm maintained at RARS, Pattambi. Based on the pollen and spikelet fertility, seventeen restorers and seven hybrids were identified. Seven hybrids were evaluated in different seasons and three hybrids were found to be superior to the check varieties. Farm trials with KAURH-2 were conducted in Palakkad and Thrissur Dts during 1999 Khariff. As decided in the last zonal workshop, quality parameters of KAURH 2 were tested.

#### 5. Breeding lodging resistant rice varieties for dry sown conditions during Virippu season.

This project was started in 1977 to screen the popular high yielding varieties of Kerala for their performance under dry sown conditions. During 2001, a short duration, drought tolerant rice variety " Harsha " was released for general cultivation from this project. Another promising culture, Cul. C3-2 which is a semitall culture of medium duration and good tolerance to drought was also identified. Since it was found to be segregating, purification of the culture was resorted to and pure seeds of this culture will be ready for further trials in Kharif 2003. Work is in progress to screen drought tolerant germplasm and combine drought tolerance with high yield.

#### 6. Evolution of Semi tall/dwarf types of tall *indica* rice varieties

a. The experiment was started in 1983-84 with the objective of evolving non-lodging dwarf /semi tall mutants of the important popular tall *indica* varieties of Kerala. A short duration rice culture viz., Cul. 210-25 was identified from this programme for presentation in the Variety Evaluation Committee and the release proposal was submitted.

b. Yield trials with five photosensitive PTB 20 mutant cultures revealed that the culture 20D-1 was promising. The photosensitive culture viz., Cul-20 D-1 was found to be promising with the same duration of that of Ptb 20 with an yield advantage of about 600 - 700 Kg/ha as well as resistance to major pests and diseases. Multi Locational Farm Trials of this culture is being carried out in the districts of Thrissur and Ernakulam at four locations each as per the decision taken in the 23 rd ZREAC meeting of the Central Zone Results are awaited .

#### 7. Identification of suitable Basmathi rice variety for Palakkad district

The project was started in 1999 to evaluate the Basmathi rice varieties developed at the national level for their suitability to Kerala conditions and to identify the best variety for Kerala in terms of yield as well as quality . During 2001, six advanced basmathi cultures selected from AVT-BT were tested along with Tarori basmathi and Pusa Basmathi for their suitability to Kerala. IET 15829 (5194.81 kg/ha) ranked first in yield followed by IET 15820 ( 3390.69 kg/ha), both outyielding the two checks viz., Pusa Basmathi (2127.70 kg/ha) and Tarori basmathi (1713.20kg/ha).

#### 8. Evolving high yielding multiple resistant rice varieties through gene pyramiding

The project was started in 1999 to incorporate the genes for resistance to the major pests of rice like Gall midge, Stem Borer and Leaf folder into one variety and to develop high yielding multiple resistant rice varieties for Kerala. During Kharif 2001 advanced cultures from the different breeding programmes were screened for field tolerance to pests like stem borer, gallmidge, leaf folder and BPH.

Seventeen cultures from the crossing programme during 1994 were included under this programme and an Initial Evaluation Trial was conducted during Kharif 2001 along with varieties Aiswarya, Kanchana and Aathira as check Cul 9412-1 and Cul 9401-1 were found tolerant to various degrees of pest and diseases (Sheath blight, Blast, Brown spot, Stemborer, Leaf folder). Yield of these cultures were found promising and were found on par with varieties Aiswarya and Kanchana. None of the cultures out yielded the checks Aiswarya and Kanchana. The experiment will be repeated during *Kharif* 2002.

#### 9. Participatory varietal selection for improvement of indigenous rice varieties for deep submerged areas of Kerala

The project was started in Kharif, 2000 to collect indigenous rice varieties of the deep submerged areas of the Ponnani Kole area of Kerala and to improve them through pure line selection. A participatory effort has been attempted here to carry out the work with the involvement of farmers at different stages of selection. During March 2000, traditional varieties like *Vellakkoli*, *Kodiyam*, *Kuttadan* etc. were collected from different areas and a mixed population consisting of 500 single plants was raised in the field during Kharif 2000. Based on submergence tolerance and agromorphological characters, 100 single plants were selected from this population. The experiment will be continued for further evaluation.

#### 10. Development of Blast and bacterial blight resistant rice var. Jyothi suitable for cultivation in Kerala.

This is a collaborative programme of KAU with The University of Madras. The objective of the project is to introgress the Blast resistant genes *pi-1* and *Pi-2* and bacterial blight resistant genes *Xa4*, *xa5*, *xa13* and *Xa 21* to the variety Jyothi so as to make it resistant to both the diseases. The initial part of the work was done at Centre for Advanced Studies, University of Madras and during Kharif 2000 and back crossing of the progenies with Jyothi was undertaken at RARS, Pattambi. After evaluation of the progenies for resistance to both blast and bacterial blight, yield testing will be carried out with resistant progenies. Results are awaited.

#### AICRIP Trials

11. Initial Varietal Trial (Irrigated Medium) was carried out with 36 entries with Neeraja as local check. Highest yield was recorded by IET 17529 (5357 Kg/ha) followed by IET 17531 (5089.29 Kg/ha). These out yielded the local check (2827.38 kg/ha).

12. Initial Varietal Trial (Irrigated Mid Early) was carried out with 49 entries received from AICRIP along with Aiswarya as check variety. Highest yield was recorded by IET 17476 (5208.33 Kg/ha) followed by IET 17472 (4910.71Kg/ha) which outyielded the check variety Aiswarya (4315.48 kg/ha).

13. Advanced Varietal Trial 1 (Irrigated Mid Early) was carried out with 13 entries with Aiswarya as local check. Highest yield of 5353 Kg/ha was recorded by IET 16527 followed by IET 17246 (4710kg/ha).

14. Advanced Varietal Trial 2 (Irrigated Mid Early) was carried out with 9 entries with Aiswarya as local check. Highest yield of 4589 Kg/ha was recorded by IET 16536 followed by IET 16555 (4187 kg/ha).

15. Advanced Varietal Trial 1 (Irrigated Medium) was carried out with 26 entries along with Neeraja as local check. Highest yield was recorded by IET 17139 (7253 Kg/ha) This was followed by IET 17114 (6019 Kg/ha).

#### 16. NATP on Sustainable Management of Plant Biodiversity

This project was started in 1999 with the objective of Exploration, Collection Characterization, Evaluation, Genetic Enhancement and Documentation of Rice, Brinjal, Chillies, and other major crops of Kerala region. During the period from 1999-2001, nine exploration trips were undertaken by the scientists involved in the programme to cover North, Central and Southern districts of Kerala as well as the forest ranges of Western Ghats. 649 accessions of different crops were collected which included 110 accessions of rice. This along with the material collected earlier were raised in the main field and one hundred and sixty seven rice varieties were characterized for forty eight characters as per the descriptor list on rice prepared by IRRI-IBPGR. Efforts have been taken for transferring the drought tolerance of Karanellu, Parapilarppan etc. and the pest and disease resistance of the traditional rice varieties to high yielding varieties.

#### PLAN PROJECTS

17. Developing a suitable varietal combination for Koottumundakan cultivation in Palakkad district

The project was initiated in 1999 to identify a suitable varietal combination involving high yielding varieties for use in the Koottumundakan cultivation. Twenty varietal combinations including 5 first crop varieties and four second crop varieties were evaluated for their yield and yield attributes during the year 2001-2002. Similar to the results of previous year, the combination, Cul. C3-2 + Makaram gave the highest grain yield of 8004 kg/ha followed by Remanika + Makaram (7673 kg/ha) and Karthika + Makaram (7616 Kg / ha).

#### b. Seed Technology

##### 1. National Seed Project - Breeder Seed Production

A total quantity of 54.06 quintals was produced during 2001-02 to meet the Central and State indent.

2. Identification of stable diagnostic characters of seed, seedling and plant and preparation of identification manual with coloured photographs.

Sixteen varieties of paddy (Six varieties released from Pattambi and 10 from various parts of the country) were characterised simultaneously at our station as well as at TNAU, Coimbatore during 2001 under NSP-STR component.

### 3. Storability of seeds in different packing materials under seed godown conditions

The experiment was started with the objective of identifying commercially suitable packing material (Jute canvas bag & HDPE Non laminated interwoven bags) for bulk seed storage in paddy variety Matta Triveni. It was found that seeds packed in HDPE bags have retained viability above the minimum germination per cent of 80 upto the late Rabi season (October 2001) that packed in jute canvas bags. Moisture content of seed packed in HDPE bags increased over the period of storage. This may be attributed to the high humidity in our region and poor escape of moisture from the near impervious HDPE bags.

### 4. Studies on joint action of Diflubenzuron (IGR) and fungicide on cereal seed viability during storage under ambient conditions

The experiment was started to study the efficacy of diflubenzuron (IGR), its compatibility with fungicide seed protectants and the storability of treated seed in paddy variety: Matta Triveni. Results showed that Diflubenzuron 2 ppm : 8mg 25 WP/kg seed + Carbendazim 2.5g/kg of seed ) was superior compared to all other treatments with respect to germination and control of seed mycoflora during seed storage. There was no significant difference in the control of pest in storage.

### 5. Evaluation of bifenthrin as seed protectant against bio deterioration in storage

The objective of the experiment was to compare the efficacy of bifenthrin with a standard treatment for protection of seeds from damage by insect pests in storage and to assess the effect of treatment on germination and vigour of seed at different periods of storage in paddy variety Matta Triveni. Results showed that treatment with Bifenthrin 10 EC: 0.25 mg ai/kg seed or 2.5 ml/kg seed) was superior to all other treatments with respect to germination, control of insect pests and seed mycoflora during seed storage.

### 6. Efficacy of treated bags as fabric treatment in protecting the seeds stored under ambient conditions

The experiment aimed at recording the residual efficacy of Deltamethrin as seed protectant through fabric treatment in paddy variety Matta Triveni by using the seed protectants- Deltamethrin 2.5 WP @ 0.0125% (125 PPM), Bifenthrin 10EC @ 0.0125% (125 PPM), Malathion 50 EC @ 0.5% (1000 ppm) –as pre-filled surface treatment and pre-filled soak treatment of packing material viz., gunny bags. Results indicated a significant difference in germination and insect pest incidence in stored seed. T1 (Deltamethrin 2.5 WP @ 0.0125% :125 ppm – pre-filled surface treatment ) was found superior to all treatments both with respect to germination and control of storage insect



pests. T4 ( Bifenthrin 10 EC @ 0.0125% : 125 ppm – prefilled soak treatment ) was the next best effective treatment.

### Seed Technology Unit

Eight hundred and fifty seven seed samples were analysed during 2001-2002. It was observed that 31.04 per cent of the samples analysed were substandard (due to Genetic impurity - 6.07 %, Physical impurity - 8.40 %, Poor germination -15.99 %).

### c. Crop management – Agronomy

1. Cultural management practices for enhancing grain yield of rainfed upland rice  
Results of the trial show that inorganic fertilizers are necessary for getting good yields from upland rice. Reduction in the amount of inorganic fertilizers reduce the yield considerably. Addition of organic manures do not compensate the yield reduction due to reduction in the dose of chemical fertilizers. Application of vermicompost @ 1.25 t/ha in furrows was more effective than its broadcast application @ 2.5 t/ha.

#### 2. Integrated nutrient management in rice based cropping system

The objective was to study the influence of green manuring and FYM application on the productivity of rice based cropping system. The results show that application of FYM give significantly higher yields during kharif season. Among the four fertilizer levels tested, application of 100% NPK dose gave higher yield. Application of 150% NPK gave slightly lower yield; pests and disease infestation was more in this treatment. However, treatments receiving FYM responded favourably to increasing the NPK level to 150% dose. During rabi season, the treatments were repeated in the same lay out. The results during the season show that FYM applied plots registered highest yield but the differences from the other treatments was considerably low. The variation between the fertilizer treatments widened during the season. The increased doses produced significantly higher yields.

#### 3. Evaluating the effectiveness of herbicides for transplanted rice

Fourteen materials were evaluated to test their effectiveness for control of weeds in transplanted rice. The herbicide materials Pyrazosulfuron ethyl, Almix + Butachlor and Pyrazosulfuron ethyl + 2,4-D combinations were more effective in checking weed growth. Among the two butachlor formulations tested, Butachlor (MON 46996) was more effective than Machette.

#### 4. Nitrogen response trials on selected AVT-2 rice cultures under high and low input management

Four cultures each under the groups, very early and early duration, were tested at three nitrogen levels (50%, 100% and 150% of recommended dose). Under very early type,

IET 16804 gave the highest yield. IET 16806 and the local check Annapoorna were on par. The cultures Aditya and Heera gave poor yields. Yields were higher with 50% and 100% fertilizer dose whereas 150% dose considerably reduced the yield.

Under the early type, the local check, Kanchana produced the highest yields. The N levels produced comparable yields suggesting that there is no yield advantage with higher N doses.

#### 5. Evaluation of Teprosyn F on direct seeded rice

The objective was to evaluate the effect of seed treatment with Teprosyn micronutrient seed treatment formulation on growth and yield of paddy. The material was not found to have any promising effect on growth and yield of paddy.

#### 6. Spacing trial of some high yielding varieties

The varieties Aiswarya, Athira, Pranava and Neeraja were tested during kharif season. The variety, Aiswarya gave grain yield of 2671 kg/ha at 15x10 cm spacing whereas at 20x10 cm and 20x15 cm spacings lower yields of 2190 kg/ha and 2002 kg/ha were obtained. Variety, Athira gave comparable yields at 20x15 cm and 20x10 cm whereas at 15x10 cm the yield was significantly low. Pranava yielded higher at 20x15 cm. Both 20x15 cm and 20x10 cm spacing gave comparable yields of 2254 kg/ha and 2477 kg/ha for Neeraja.

#### 7. Manuring schedule of long duration high yielding rice varieties

The varieties, Red Mahsuri, Pranava and Neeraja were tested at three fertilizer levels viz. 70:35:35, 90:45:45 and 120:60:60 kg NPK/ha. Red Mahsuri and Pranava did not give higher yield under the higher fertilizer doses. The yield of Neeraja was 3548 kg/ha, 3325 kg/ha and 3855 kg/ha respectively at the three doses.

### d. Soil Science & Agrl. Chemistry

#### 1. Permanent manurial trial (tall and dwarf indica)

PMT (Tall) has completed 40 years and PMT(Dwarf) has completed 29 years of experimentation.

In permanent manurial trials, both in tall and dwarf varieties, maximum grain and straw yield were obtained in virippu season for the treatment which received cattle manure alone @18 t/ha (for dwarf) and 8.97 t/ha (for tall) to supply 90 kg N/ha. But in mundakan season, highest grain and straw yield were obtained for the integrated use of fertilisers and cattle manure on nitrogen equivalent basis to supply 1/2 N as per POP. Continuous application of nitrogenous fertilisers alone or green leaves alone were found to have detrimental effect on the growth and yield of rice.

## 2. Long Term Fertilizer Experiment (variety Aiswarya)

This experiment has completed 4 years. The effect of treatments on yield and soil fertility parameters are as given below.

### 2.1 Effect on yield

In LTFE, as in the previous years, in both the seasons, highest grain and straw yield were recorded by the treatment T<sub>8</sub> which received 100% NPK (as per POP of KAU) along with FYM @ 5 t ha<sup>-1</sup>. However this was on par with T<sub>3</sub> (150% NPK) and T<sub>10</sub> (100%NPK + *in situ* growing of *Sesbania aculeata* green manure crop for kharif rice only). Lowest yield was recorded by T<sub>12</sub> (absolute control).

### 2.2 Effect on nutrient uptake

The uptake of nutrients followed the same trend as in yield. The uptake of N, P, K, Ca & Mg was higher in both kharif and rabi seasons for T<sub>8</sub> which received 100% NPK (as per POP of KAU) along with FYM @ 5 t ha<sup>-1</sup>.

### 2.3 Effect on soil fertility

With respect to soil pH, no significant variation was made by the treatments after both kharif and rabi seasons. In general the pH of the soil was low in all the treatments. Continuous addition of nitrogenous fertilizers may lower the pH which failed to increase yields due to the increase in the amount of soluble iron and consequent inefficient utilization of added nutrients.

The organic carbon content showed a decline in soil after the rabi season compared to kharif. In the treatments where continuous addition of inorganic fertilizers alone were there, a slight decline in organic carbon content was noticed compared to other treatments. Generally the soil organic carbon content is in the high range. Its influence on nutrient availability as well as yield is not expressed fully, possibly due to the dominance of passive fractions. The high organic carbon content may be due to the degeneration and regeneration of roots and incorporation of stubbles after each harvest.

With respect to available P status in the soil, after the kharif season, it was almost in the medium range while after the rabi season, it was in the high range. Thus in spite of high P fixation in the soil which is acidic with high content of sesquioxides the available P content is in the high range.

The available K content in soil after both the seasons was found to be low. Even in plots where continuous addition of K was there, the available K content was in the low range.

The sandy nature of soil coupled with heavy rainfall would have favoured high leaching of K.

## e. Entomology

### 1. National Screening nursery

Among 324 rice entries screened entries, IET 16923, 17294, 17302, 17494, CSR 7-1 were found resistant to stem borer. Entries IET 17254 & 17284 were found resistant to gall midge. Entries, IET 17258 – 17261, 17527, 17536 and Tarori Basmati showed resistant reaction against leaf folder. Cultures IET 17533, NDR 97 & Jaya were found resistant against whorl maggot. 47 cultures showed resistant reaction against thrips with a score of '0'.

## 2. Gall midge screening trial

Among 75 entries tested, the entry WGL 29033 showed complete resistant reaction to the pest.

## 3. Gall midge biotype screening trial

12 entries tested under four sets of differentials confirmed the presence of Biotype – 5 with R-R-S-S pattern.

## 4. Donor identification against potential and sporadic pests

25 entries were tested for resistance to sporadic pests like thrips, caseworm, blue beetle and rice ear head bug. Among them six entries showed resistant reaction with a score of '0'. For case worm, entry IPR 2054 showed resistance and culture ARC 5764 showed resistance to both blue beetle and ear head bug. T-1477 also showed resistance to ear head bug.

## 5. Insecticides Evaluation trial

In IET (Kharif, 02), none of the insecticides proved effective to insect pests. But highest grain yield were obtained from Neurelle D 505 @ 344 g ai /ha treated plots. In IET (Rabi'02) trial, Neurelle D505 @344g ai/ha, Bulldock star @ 393g ai/ha, Confidor Ultra@ 30 g ai/ha , Ethiprole @ 50 g ai/ha and Monocrotophos @ 500 g ai/ha were effective against stem borer . Confidor Ultra@ 30 g ai/ha were found effective against whorl maggot . None of the chemicals were found effective against rice leaf folder. Highest grain yield were obtained from Neurelle D505, Ezee tab and Monocrotophos treated plots.

## 6. Nursery and early stage pest control trial

In this trial, insecticide Fipronil both as seed treatment @ 0.05 % and nursery drenching @ 100 g ai/ha as well as Calypso as seed treatment @ 0.12 % were found effective against stem borer. Leaf folder were less in Furadan treated plots @ 2000 g ai/ha. No significant reduction in damage in whorlmaggot were observed in any of the treatments. Highest grain yield was obtained from Calypso seed treated plots (@ 0.12 %).

## 7. On Farm integrated pest management

In this trial, two plots were selected in an area of 2000sqm each one under IPM and other under usual farmers practice. Egg parasitoids, *Trichogramma japonica* were released against stem borer and *T. chilonis* were released against leaf folder in the IPM plots. The relative reduction in damage of stemborer and leaf folder were 33.3 % and 31.52 % respectively by releasing the egg parasitoids over farmers practice. The cost benefit ratio were 1.77 and 1.50 in IPM and farmers practice plots, respectively.

## 8. Pest monitoring with Sex pheromones

The trials were conducted in both first and second crop seasons. The peak male moth catches were 11 moths and 24.38 moths per trap during fourth week of Sept '01 in first season and third week of Jan'02 in second season.

## 9. Light trap data collection

The pest collection was studied under Chinsurah trap from Mar.'2001 to Feb. '2002. The results revealed that stem borer catches were maximum during third week of Sept.01 and leaf folder catches were maximum during third week of Jan'02. The relative catches of green leafhopper and white leafhopper catches were highest during fourth week of June'01. Predator on rice BPH (i.e.) green mired bug catches were maximum during first week of Mar'01.

## 10. Monitoring of stemborer composition

The trial was conducted to know the species of stem borer attacking the crop in its different growth period. The study showed that Yellow stem borer, *Scirpophaga incertulas* were most common species occurring in all stages (70-85 %), White stem borer, *S.innotata* were seen through crop stages at very low level (15- 23%) and Pink stem borer, *Sesamia inferens* were noticed in maximum tillering stage and flowering stage in a relatively low level ( 7 %).

Sl.No	Tillering Stage (%)	Max. Tillering stage (%)	Flowering Stage (%)
1.	YSB : 85	YSB : 79	YSB : 70.21
2.	WSB : 15	WSB : 14.05	WSB : 22.70
3.	PSB : Nil	PSB : 7.03	PSB : 7.10

YSB : Yellow stem borer , WSB : White stem borer , PSB : Pink stem borer

## 10. Screening Biocides against pests of Rice

In this experiment three leaf extracts and three plant oils @ 2 % were tested against rice pests. Among these Venga leaf extract had significant effect in reducing white ear damage caused by stem borer. Other plant oils or leaf extract didnot have significant effect in reducing the damage of whorlmaggot and leaf folder . Highest grain yield was obtained in tobacco leaf extract treated plots.

## 11. Integrated pest management of rice

The trial was conducted to evaluate the efficacy of different granular insecticides against rice pests. In first crop season, four granular insecticides were tested in comparison with neem cake @100 kg /ha and a control . The neem treated plots had reduced incidence of stemborer but all granular insecticides were relatively par in controlling the pest. Fipronil @75 gai/ha , Carbosulfan and Carbofuran @ 1000 gai/ha were effective in reducing the

damage of whorlmaggot. Carbosulfan also found effective in reducing leaf folder damage. Highest grain yield were obtained with Cartap @1000gai/ha treated plots.

In second crop season ,five granular insecticides were tested in comparison with neem treatment and a control . Among the insecticides , Carbofuran @1000 gai/ha were superior in controlling stemborer damage followed by Phorate @1000gai/ha , Cartap @1000gai/ha and Fipronil @75 g ai/ha. For whorlmaggot Fipronil @75 gai/ha , Cartap and Carbofuran @ 1000 gai/ha were effective in reducing the damage. Carbosulfan and Fipronil were found effective in reducing leaf folder damage.Highest grain yield were obtained with Cartap and Fipronil treated plots .From the above trials as well as Insecticides evaluation trials conducted under AICRIP trials during 1999 I crop and 2000 I crop. The cartap proved effective in controlling stem borer and increased grain yield.so , I propose the chemical for farm trials. The pooled analysis for four seasons of the chemical are as follows:

Pooled analysis on effect of Cartap on stem borer

Treatments	% DH	% WE	Yield ( kg / ha)
Cartap *@ 1000 g ai /ha	13.67a	11.48a	3113a
Carbofuran@1000 g ai /ha	14.56a	14.03ab	2861ab
Control	21.22b	16.04b	2576b
CD ( 0.05 %)	6.53	3.55	563

## 12 . Efficacy of Prophenopos (Curacron 50 % EC ) against leaf folder

The chemicals Profenophos ( Curacron 50 % EC) were tested as a company trial in 2000 I and II crop as well as under Insecticides trial in AICRIP trials during 1996 I , II crop and 1997 I crop. The chemical proved effective against leaf folder with increased grain yield. so, the chemical proposed for farm trials. The pooled analysis of the chemical for all five season are as follows :

Pooled analysis on effect of profenophos on leaf folder

Treatments	% DL	Yield ( kg / ha)
Profenophos *@ 500 g ai /ha	4.94a	2771a
Chlorpyriphos @500 g ai /ha	5.99ab	2865a
Control	7.73b	2582a
CD (0.05 % )	1.95	297

## f. Plant Pathology

### I.Screening for blast resistance (AICRIP Trial)

Out of the 151 entries tested in National Screening Nursery-1 (NSN-1), only one entry showed resistance reaction, and 44 entries showed moderate resistance to blast. Out of the 328 entries tested in NSN II, two entries were resistant and 76 entries were moderately resistant. In National Hybrid Screening Nursery (NHSN), a total of 54 entries were

screened. Out of these one entry showed resistance reaction and 16 entries were moderately resistant. The Donor Screening Nursery consisted of 59 entries out of which 3 entries showed resistance reaction and 28 entries showed moderate resistance reaction. The disease pressure was moderate.

The upland cultures and varieties of KAU were screened for blast resistance. Among the 35 entries, two numbers showed resistance to leaf blast. The pre released culture C3-2-49-2 showed resistance to leaf blast (Score- 2). Among the released varieties, Aiswarya also showed resistance (Score- 2).

## 2. Screening for sheath blight resistance (AICRIP Trial)

A total of 151 entries were screened for sheath blight resistance. Twenty seven entries showed moderate resistance to sheath blight. The National Screening Nursery II consisted of 329 entries. Out of these 35 entries showed moderate resistance. Out of the 54 entries tested in the NHSN, only two entries showed moderate resistance to sheath blight. In the Donor Screening Nursery, out of the 59 entries tested nine entries showed moderate resistance. The disease pressure was moderate.

## 3. Evaluation of new fungicidal formulations for blast control

Two new formulations, viz., Pyroquilon (Fongorenc) made from indigenously manufactured technical (TIM) and imported technical (TIT), and epoxiconazole-carbendazim (Swing 250 EC) along with two commercially available fungicides viz., Kasugamycin (Kasu - B 3SL) and Carbendazim -Mancozeb (Saaf 75 WP) were evaluated. Tricyclazole (Sivic 75 WP) was used as the standard check fungicide. Leafblast incidence was very high in upland in test variety Triveni (66%) while neck infection was moderate (30-34%) in upland and transplanted rices. Under both ecosystems, all the test chemicals were significantly superior over the untreated check plots, though the standard check fungicide was significantly superior over the test chemicals. However, both indigenous (TIM) and imported (TIT) pyroquilon formulations were on par with tricyclazole in checking the blast infection under upland rice. In the transplanted ecosystem, indigenous (TIM) pyroquilon was superior to all the test chemicals, when it was used at  $1.2\text{g l}^{-1}$ .

## 4. Evaluation of new fungicidal formulations for sheath blight control

Two sets of experiments were conducted to evaluate the efficacy of new fungicides against sheath blight. In the first experiment six triazole based formulations were included with Validamycin (Sheathmar 3 L) as the standard check fungicide. The test variety used was Jyothi. In the second set of experiment, fungicides other than the triazole base were included. The results in general indicate that all the test chemicals were significantly effective, however, Contaf 5 SC (1ml/l and 2 ml/l), RIL F 004 (2g/l), Moncut (1.5 g and 2 g/l), Swing (2.0g/l) and Kitazin (2.5 ml/l) were highly effective and on par with the

standard check fungicides. The superiority of the fungicide Swing was found during the years 1999, 2000 and 2001.

Evaluation of new fungicidal formulations against sheath blight  
(Kharif 1999 and 2000)

	Fungicides	dose / l	Disease severity (0-9 SES scale)		Grain yield (kg ha <sup>-1</sup> )
			T	O	
1	Hexaconazole (Anvil 5 SC)	2 ml	1.98	3.95 <sup>bc</sup>	3333
2	Epoxyconazole 125 g + Carbendazim 125 g (Swing 250 EC)	2ml	1.51	2.45 <sup>d</sup>	3500
3	Tebuconazole (Folicur 250 EW)	1.5	2.08	4.35 <sup>bc</sup>	3408
4	Tebuconazole (Folicur 250 EW)	2.0 ml	1.96	3.87 <sup>c</sup>	3375
5	Propiconazole 15g +Difenoconazole 15 g (Armure 30 EC)	0.7 ml	1.94	3.77 <sup>c</sup>	3242
6	Difenoconazole (Score 10WP)	1.5g	1.70	3.08 <sup>d</sup>	3367
7	Difenoconazole (Score25 EC)	0.5ml	2.00	4.02 <sup>bc</sup>	3275
8	Penzycuron (Monceren 250 SC)	1.2 ml	2.22	4.95 <sup>ab</sup>	3242
9	Penzycuron (Monceren 250 SC)	1.2 ml	2.09	4.42 <sup>bc</sup>	3258
10	Validamycin (Sheathmar 3L)	1.5 ml	1.52	2.43 <sup>d</sup>	3483
11	Control	2.0ml	2.43	5.92 <sup>a</sup>	3317

Evaluation of new fungicidal formulations against sheath blight  
(Kharif 2001)

	Fungicides	dose / l	Disease severity (%)		Grain Yield (kg ha <sup>-1</sup> )
			AT	O	
1	Armure 30 EC	0.7 ml	36.2	35.0	3717
2	Beyleton 25 WP	0.6g	37.8	37.7	3667
3	Contaf 5 SC	1.0 ml	35.7	34.1	3967
4	Contaf 5 SC	2.0 ml	34.4	31.9	4067
5	Opus 12.5SC	2.0ml	36.9	36.0	3800
6	RIL F 004 75 WP	1.0 g	39.2	40.0	3933
7	RIL F 004 75 WP	2.0 g	35.1	33.2	3967
8	Swing 250 EC	2.0 ml	38.8	39.3	3583
9	Sheathmar 3L	2.5 m	40.2	41.7	4033
10	Control		51.7	61.6	3300
	CD (0.05)		4.4		423

## 5. Evaluation of fungicides against brown spot

Commercially available fungicides, having broad spectrum of activity were evaluated against brown spot for two years during 2000 and 2001 *Kharif*. The formulations are carbendazim (Bavistin 50WP), bitertanol (Baycor 25WP), benomyl (Benlate50 WP), hexaconazole (Contaf 5EC), carbendazim and mancozeb mixed formulation (Saaf 75 WP) and propiconazole (Tilt 25 EC). The pooled analysis of the data showed that the fungicides Contaf and Tilt were equally effective and significantly superior to the control in checking the disease.



Evaluation of fungicides against brown spot  
Kharif 2000 and 2001

	Fungicide	Dose / l	Disease severity (%)	Yield t ha <sup>-1</sup>
1	Carbendazim (Bavistin 50 WP)	1 g	28.07 <sup>ab</sup>	4.16 <sup>ab</sup>
2	Bitertenol (Baycor 25 WP)	1g	21.09 <sup>bc</sup>	4.22 <sup>ab</sup>
3	Benomyl (Benlate 50WP)	1g	19.51 <sup>bc</sup>	4.06 <sup>b</sup>
4	Hexaconazole (Contal 5EC)	2 ml	11.16 <sup>a</sup>	4.72 <sup>a</sup>
5	Carbendazim 12% +Mancozeb 63% (Saaf 75 WP)	1.5 g	19.41 <sup>bc</sup>	4.18 <sup>ab</sup>
6	Propiconazole (Tilt 25 EC)	1 ml	13.85 <sup>c</sup>	4.35 <sup>ab</sup>
7	Mancozeb (Indofil M-45)	3g	18.99 <sup>bc</sup>	4.17 <sup>ab</sup>
8	Control	-	34.95 <sup>a</sup>	3.83 <sup>b</sup>

#### 6. Evaluation of botanical formulations against sheath blight

Five botanicals viz., Achook, Neem Azal, Neemgold, Spictaf, Tricure and Wanis were tested using the standard check fungicide Tilt 25 EC. All the botanicals were significantly effective and on par with the standard check fungicide both in checking the disease and increasing the yield.

#### 7. Evaluation of Fuji one against blast (Company trial – Rallis India)

The fungicide Isoprothiolane (Fuji one 40E) was tested against blast. Different doses of the fungicide (1.5ml/l, 2 ml/l and 3ml/l) were tested in comparison with the standard check fungicide, Tricyclazole (Beam 75WP). All the three doses of the fungicides tested were on par and were significantly superior to control in checking the disease and it was reflected in the yield also. Hence the lowest dose 1.5 ml/l will be sufficient for the foliar spray for the control of blast.

### g. Pulses

#### g.1. Crop Improvement

##### 1. Co-ordinated Varietal Trial On Cowpea AVT-II and IVT(EMG)

In this trial 20 AICRP entries were evaluated during 2001 kharif. Result of the trial showed that the yield was significantly different and the seed yield ranges from 409 kg / ha to 689kg / ha. The entry V 625 recorded the highest yield (689.14kg / ha)

## 2. Co-ordinated Varietal Trial On Cowpea AVT-I and IVT (NMG)

Twelve AICRP entries were evaluated in this trial during 2001 kharif. Result of the trial showed that the yield was significantly different and the seed yield ranged from 385 kg/ ha to 955 kg / ha. The entry V-240 recorded the highest yield (955 kg).

## 3. Horsegram Advanced Varietal Trial

Nine AICRP entries were evaluated during 2001 rabi. Result of the trial showed that the yield was significantly different and the variety 8-B recorded the highest yield (496.56kg/ha) followed by AK-44. The seed yield ranged from 221 kg/ ha to 496 kg / ha.

## 4. Mung bean Advanced Varietal Trial

In this trial 17 AICRP entries were evaluated during 2001 rabi. Result of the trial showed that the yield was significantly different and the variety RM1-7 recorded the highest yield (387.31kg/ha) followed by RM1-1. The seed yield ranged from 150 kg/ ha to 387 kg / ha.

## 5. Urd bean Advanced Varietal Trial

Thirteen AICRP entries were evaluated in this trial during 2001 rabi. Result of the trial showed that the yield was significantly different and the variety RU1-1 recorded the highest yield (625.36kg/ha) followed by RU1- 2. The seed yield ranged from 215 kg/ ha to 625 kg / ha

## g.2. Agronomy

### 6. Effect of thiourea application on cowpea

The experiment was started in 1999 to assess the effect of thiourea seed treatment on seedling emergence and crop establishment and to study the role of thiourea in improving seed set and yield of cowpea. Result of the trial conducted during 2001 kharif showed that the yield was significantly different. 500 ppm TU seed soaking + TU sprays at vegetative stage and at flowering stage (534 kg/ ha) recorded the highest yield followed by 500 ppm TU spraying one at vegetative stage (532 kg/ha)

### 7. Effect of micronutrients on cowpea

The experiment was started in 2001 to know the micronutrient requirement of cowpea. Result of the trial conducted during 2001 kharif showed that the yield was significantly different and combined spraying of 0.5% FeSO<sub>4</sub> and 0.5% ZnSO<sub>4</sub> spray at 45DAS recorded the highest yield followed by combined spraying of 0.5% FeSO<sub>4</sub> and 0.5% ZnSO<sub>4</sub> spray at 25DAS.

### 8. Effect of humic substances on cowpea

The experiment was started in 2001 to assess the effect of humic substance on nutrient use efficiency, to assess the effect of humic substance seed treatment on seedling emergence and crop establishment and to study the role of humic substance in improving seed set and yield of cowpea. Result of the trial conducted during 2001 kharif showed that the yield was significantly different. All the treatments were significantly superior to control and application of FYM 20 t ha<sup>-1</sup> recorded the highest yield (640 kg/ha) followed by application of Vermicompost 10 t ha<sup>-1</sup> (538 kg/ ha). Application of humic substances increased the yield of cowpea compared to fertilizer application alone. Result of the trial conducted during 2001 rabi also showed that the yield was significantly different and all the treatments were significantly superior to control. FYM 20 t ha<sup>-1</sup> recorded the highest yield (525 kg / ha) followed by Vermicompost 10 t ha<sup>-1</sup> (505kg / ha)

### 9. Agronomic evaluation of promising genotypes of cowpea

The experiment was started in 2001 to evaluate suitable genotypes of cowpea for obtaining maximum grain yield. Result of the trial conducted during 2001 kharif showed that among the varieties GC-3 recorded significantly higher yield (882 kg/ha) compared to other varieties. Full recommended dose of fertilizer and closer spacing gave significantly higher yield compared to half recommended dose and wider spacing

### 10. Assessment of advantage of various inputs in horsegram

The experiment was started in 1999 to quantify the contribution of different inputs in horsegram productivity. Result of the trial conducted during 2001 rabi showed that the yield was significantly superior. Variety AK – 21 recorded significantly higher yield compared to PHG- 9. All the input management practices increased the yield of horsegram compared to control. Recommended fertilizers + weed control + plant protection recorded 78 per cent more yield in horsegram. i.e., fertilizer application, weeding and plant protection operations increased the yield of horse gram compared to control.

### 11. Effect of thiourea application on horsegram

The experiment was started in 1999 to assess the effect of thiourea seed treatment on seedling emergence and crop establishment and to study the role of thiourea in improving seed set and yield of horsegram. Result of the trial conducted during 2001 rabi showed that there is significant difference among the treatments. T9-500 ppm TU seed soaking + TU spray one at vegetative and one at flowering stage recorded the highest yield i.e., 73% more yield compared to control. All the treatments except T5 and T8 were significantly superior to control.

## 12. Agronomic management of promising horsegram genotypes

The experiment was started in 1999 to work out the agronomy of horse gram varieties , likely to be released in near future. Result of the trial conducted during 2001 rabi showed that the variety DPI-2278 recorded the highest yield. Recommended fertilizer dose and closer spacing recorded significantly higher yield compared to lower doses of fertilizer and wider spacing.

## 13. Arid legumes based intercropping system

The experiment was started in 2001 to find out the suitable intercropping system including arid legumes for the area. Result of the trial conducted during Rabi 2001 showed that in cowpea, intercropping has no significant effect on the yield of cowpea rather than the additional yield from intercrops. In horsegram intercropping with bhindi in 4:1 ratio significantly reduce the yield of horsegram. Other treatments do not have much effect on the yield of horsegram

### g.3. Pathology

## 14. Efficacy of different seed treatment fungicides and bio-control agents to control seedling rot of cowpea

The experiment was laid out during kharif 2001 to control the seedling rot of cowpea caused by *Colletotrichum lindemuthianum* (Sacc. and Magn.). The seeds were treated with different fungicides and bio-control agents namely Carbendazim, Thiram, Mancozeb, Copper oxychloride, *Trichoderma viride* and *Pseudomonas fluorescens* and seed treatment with Thiram followed by 0.1% carbendazim spray at 15, 30 & 45 days after seedling emergence. Seed treatment with Thiram (3 g/ kg of seed) followed by one, two and three rounds of spray with Carbendazim ( 0.1%) was found on par in reducing the disease incidence followed by seed treatment with Carbendazim (2 g/ kg of seed) which was equally effective as that of Copper oxy chloride (3g / kg of seed) and *Trichoderma viride* (4g/kg of seed), both TNAU and KAU cultures, in reducing the disease incidence.

## 15. Effect of different soil amendments and bio-control agents on dry root rot of cowpea

The experiment was laid out during Rabi, 2001 to control the dry root rot of cowpea caused by *Macrophomina phaseolina* (Tassi.). Soil application of Farmyard manure (2t/ha)+ *Pseudomonas fluorescens* seed treatment (10 g / kg of seed) was found effective in controlling the dry rot of cowpea which was found on par with that of *Pseudomonas fluorescens* seed treatment (10g/kg of seed) and Neem cake soil application (20 kg/ha), followed by *Trichoderma viride* seed treatment (4 g/kg of seed), Farmyard manure(2t/ha)+ *Trichoderma viride* seed treatment (4 g/kg of seed) and Neem cake (20

kg/ha) + *Trichoderma viride* seed treatment (4 g / kg of seed) in reducing the disease incidence.

#### 16. Evaluation of Contaf 0.2 % dust against black gram powdery mildew

Bavistin 50 WP @ (0.1%) as spray application was found effective in reducing the Powdery mildew incidence followed by the application of Contaf 0.2% dust @ 25 Kg/ha. The grain yield obtained from Contaf 0.2% Dust @ 25 Kg/ha was found on par with that of Bavistin 50 WP applied as (0.1%) spray.

### ii. Horticulture

#### 1. Identification of suitable varieties/types of Chinese potato

Seed material of the newly released variety *Nidhi* was produced and distributed. Observational trial was conducted on canopy management of the crop and it was found that canopy regulation (skiffing 3MAP) increased the crop yield by 32%.

#### 2. Breeding for mosaic resistant / tolerant cultures of ash gourd

Seed multiplication and distribution of variety *Indu* was carried out. Screening for resistant varieties was continued with collection from NATP on plant biodiversity.

#### 3. Breeding for resistance to mosaic viruses in chilli

Nine selections evolved from the crosses were found to be free from mosaic. Seed multiplication of these genotypes was carried out. Comparative yield trial of the selected lines will be conducted during this season

#### 4. NATP on plant biodiversity: Collection, characterization and evaluation of vegetables

The progress made under the programme in the mandatory crops is as follows.

Sl. No.	Crop	No. of accessions collected	No. of accessions characterized	No. of accessions dispatched to NBPGR
1	Chilli	87	63	30
2	Oriental Pickling melon	28	20	8
3	Ash gourd	21	18	4
4	Pumpkin	24	20	7

#### 5. Plan scheme on Hybrid seed production in brinjal

Fifty five inbred lines were field evaluated for wilt resistance. It was found that nineteen out of the 55 lines were free from wilt while there was complete crop loss in the rest. These entries will be utilized for crossing to develop F1 hybrids.

#### 6. Multilocational trial in *Moringa*

The cultures developed at the College of Horticulture, Vellanikkara were planted for evaluation. The cultures include MO-70, MO-44, MO – 95, MO-190 (perennials) and AD-4 and AD-2 (annuals).

#### 7. Effect of organic amendments and soil ameliorants in coleus cultivation

This observational trial was conducted in coleus variety *Nidhi*. The treatments included nutrient application as recommended along with two levels each of sawdust, coir pith, paddy husk and chaff. There was no significant difference in the yield. But it was found that yields were higher when either sawdust or chaff was applied. Similarly the proportion of large sized tubers were more when soil ameliorants were used. Nematode infestation was minimum in T3, POP + saw dust @ 4 t/ ha. and weevil infestation minimum in treatment T6, POP + paddy husk @ 2t/ ha.

#### 8. Studies on polyembryony in land races of mango

In this experiment, seeds of 46 types were collected from different localities of the districts were evaluated. The observations recorded are presented in the table: 1

Table 1. Stone characters and germination of land races of mango

Sl. No.	Characters	Range
1.	Stone length (cm)	3.9-6.29
2.	Stone breadth (cm)	2.48-4.08
3.	Stone thickness (cm)	1.7-2.39
4.	Stone weight (g)	9.0-25.5
5.	Germination (%)	5.0-72.8
6.	Level of poly embryony (%)	3.0-80.0

Poly embryony was expressed in 27 out of the 46 types studied. It was found that removal of seed coat, soaking in water or insecticide improved germination upto 60%.

#### 9. Pruning studies in mango

Three levels of pruning were given to variety Kalappady during 2000. Pruned trees were treated with 1000 ppm paclobutrazol and 1% KNO<sub>3</sub> as foliar spray during December, 2001. Flowering and fruiting was observed in all the treatments. Average yield in trees subjected to hard pruning was 3.65 kg. In the second level of pruning, which was done on secondary branches, the average yield was 19.2 kg. In T<sub>3</sub> where light pruning was done to open centre, average yield was 33.4 kg.

### 10. Influence of organic and inorganic forms of manures on keeping quality of fruits and seed quality of cucumber and ash gourd.

In ash gourd the highest yield was obtained when manuring was done as per the POP recommendations. Comparable yields were obtained when  $\frac{3}{4}$  th of the total recommendation was given through organic and  $\frac{1}{4}$ <sup>th</sup> through chemical fertilizers. Observations were recorded at bimonthly intervals on decay of fruits and the observations are summarized in the table. 2

Table 2. Influence of sources of manures on yield and storage of ash gourd

Sl. No.	Treatment	Yield kg/plant	% of decay of fruits (months after storage)					
			2m	4m	6m	8m	10m	12m
1.	POP recommendations	8.92	16.7	25	25	41.7	75	75
2.	Inorganic alone	0.42	-	-	100			
3.	Organic alone	6.82	25	50	62.5	62.5	81.3	87.5
4.	1/2organic+1/2 fertilisers	3.72	-	-	20	40	80	80
5.	$\frac{3}{4}$ organic+1/4 fertilisers	8.27	-	14.3	35.7	35.7	85.7	92.6
6.	Absolute control	0.43	100					
		CD(0.05) 0.94						

There was total decay of fruits in the first month itself in the produce from absolute control and in treatments where inorganic fertilizers alone were given, complete decay was seen by 6<sup>th</sup> month.

Seed viability after one-year storage under room temperature was also observed. The data is shown in Table 3.

Table 3. Seed viability after one-year storage

Treatment	Ash gourd	Cucumber
POP	100	85.8
Inorganic alone	48.0	86.0
Organic alone	87.0	97.3
1/2organic+1/2 fertilisers	50.0	87.2
$\frac{3}{4}$ organic+1/4 fertilisers	66.7	92.0
Absolute control	0.0	98.6

Seed viability was retained in cucumber irrespective of the treatments. In ash gourd viability was retained in T1(POP) and T3 (Organic).

### **i. Social Sciences**

#### **1. Evaluation of Agricultural Projects under People's Campaign in Malappuram Dt**

The KRPLLD funded project started functioning June-2001 onwards. The objective is to evaluate the effectiveness of agricultural projects implemented in the IX<sup>th</sup> plan in Malappuram District. The survey for data collection is progressing.

#### **2. Economic analysis of Koottumundakan system with single crops (Virippu & Mundakan) of rice cultivation**

To work out the economics of rice production under the Koottumundakan system and to compare it with single crops (Virippu and Mundakan) in the farmers' field and at the RARS farm, following treatments were laid out in RARS farm.

T<sub>1</sub>. Koottumudakan – Farmers' practice (Chettadi + Thavalakkanan)

T<sub>2</sub>- Swarnaprabha + Makaram T<sub>3</sub>- Kanchana (I) / Aiswarya (II)

T<sub>4</sub>-Farmers' field data

The treatments (T<sub>1</sub>, T<sub>2</sub>&T<sub>3</sub>) were laid out in an area of 22 cents each approximately. The seed combination ratio was 7:3

The results indicated that in farmers' field, Koottumundakan sown with the practice of the broadcasting showed highest B/C ratio (1.70) when compared to single crops of Virippu and Mundakan taken together but in the transplanting system of Koottumundakan the B/C ratio was lower (1.04) than single crops, but still higher when compared to trials laid at RARS farm. The unduly low B/C ratio for T<sub>2</sub> was due to the higher labour cost incurred for removing the weeds in the plots. The experiment will be repeated for two more years.

#### **3. NATP on Technology Assessment and Refinement through Institution Village Linkage Programme (TAR IVLP)**

Field level interventions for enhancing productivity and profitability of small farm enterprises were continued during 2001-02. Apart from regular programmes on agronomic practices in rice cultivation, mechanization interventions for reducing cost of cultivation, integrated pest/ disease management in rice, vegetables, coconut etc., on farm trials on rice varieties, verification trials on use of pheromone traps for coconut pest management and training cum evaluation of home made cattle feed concentrate were taken up during the year.



### 1. Assessment of short/medium duration red rice varieties for direct seeding

Variety	Yield (t/ha)	Increase over local variety (%)	C:B ratio
Revathy	4.10	5.2	2.06
Remanika	4.30	13.1	2.12
Ahalya	3.80	0.00	1.75
Local(Kunjukunju)	3.80	-	1.75

Varieties Remanika and Revathy performed well.

### 2. Assessment of medium duration varieties under transplanting

Variety	Yield (t/ha)	Increase over local variety (%)	C:B ratio
Panchami	2.00	-42.8	0.96
Pavithra	4.80	51.4	2.20
Uma	4.00	14.2	1.84
Kunjukunju	3.50		1.67

Variety Panchami had severe incidence of stem borer and leaf roller and the performance was poor.

### 3. Assessment of varietal combinations in Koottumundakan

Combination	I crop yield Kg/ha	II crop yield Kg/ha
Chenkayama+Chettadi	1820	3900
Chenkayama+ Makaram	1980	3880
Swarnaprabha +Chettadi	2800	4050
Swarnaprabha+ Makaram	2850	4160

Combination of Swarnaprabha with Chettadi or Makaram was found to be the ideal combination.

### 4. Use of pheromone traps for pest management in coconut

Weekly catch of pests from traps (5 locations)

Red palm weevil	Rhinoceros beetles
27	19

### 5. Assessment of homemade feed concentrates for milch cattle

Locally available ingredients were used in the preparation of cattle feed concentrates after training the farmers on the method of preparation. Milch cattle were fed with the home made feed concentrate and milk yield was assessed. Seventy percent participants reported that there was an increase in yield ranging from 0.4 lit to 0.9 lit. Rest of the farmers reported that there was little advantage. All the participants opined that the preparation is cumbersome. (Ingredients used (per kg) : Coconut oil cake: 95g; Ground nut cake: 200g; Rice bran: 400g; Tapioca powder:200g; Gingelly cake : 100g; Minerals : 5g)

## AGRICULTURAL RESEARCH STATION, MANNUTHY

### **Salient findings**

#### **Rice**

1. Identification and development of rice genotypes suitable for mechanised rice farming.

Varieties were selected based on low tiller decline (below 20%) and synchronisation of flowering within a hill. Varieties selected include ADT 43, ADT 36, IR36, PTB 10, PTB 28, Jayathi, Neeraja, Aathira, Aiswarya, Ahalya, MO12 and MO 16. Detailed evaluation of these varieties as well as hybridisation programmes will be carried out.

a. Development of a super rice for organic rich kole lands of Kerala

Based on the selection index formulated, varieties viz; M48-11-3, ADT38, Swarnaprabha, Aiswarya, Kairali, MO 4, Ahalya, Jyothi and PTB 2 were selected as parents for further hybridisation programme and hybridisation programmes were initiated.

### **2. Production technology for rice under mechanised transplanting**

The trial was continued for the second year (second season) during Kharif 2001-02. The crop was planted on 7/2/2001 and harvested on 6/10/2001.

#### **A. Yield of grain**

Neither the method of planting i.e. mechanical transplanting using different densities of mat nursery or manual planting with conventional nursery nor variation in varieties could significantly alter the yield level of the crop. The interactive effects of densities of nursery and varieties were also not prominent. Numerically the highest yield of 3508kg grain ha<sup>-1</sup> was recorded in case of 0.4 kg m<sup>-2</sup> mat nursery mechanically planted crop. Lowest yield was recorded in case of conventional nursery manual planting i.e. 1730kg ha<sup>-1</sup>. Among the varieties highest yield was seen in Jyothi and least with Matta Thriveni. Yield of grain is given in Table I.

During the current year of investigation, the grain yield data indicated that mechanised transplanting using various densities of mat nursery or conventional planting did not affect yield and no significant variation could be seen between them. However varieties significantly differed from each other. The combination of varieties and densities of mat nursery as well as conventional planting using root wash nursery differed significantly between them. The variety Mattatriveni recorded the highest yield of 3240kg/ha and the yield of Kanchana was on par with it. Ahalya recorded the lowest yield. Among the combinations highest yield was recorded with the variety Kanchana (3700kg/ha) conventionally planted, followed by Mattatriveni mechanical transplanted using mat nursery @ 0.4kg/m<sup>2</sup> (3508kg/ha). The lowest yield of 2067kg/ha was found with conventionally planted Ahalya.

Table No. 1 Grain Yield kg ha<sup>-1</sup>

Density of Mat Nursery	Variety				Mean
	V <sub>1</sub> Malta thriveni	V <sub>2</sub> Jyothi	V <sub>3</sub> Ahalya	V <sub>4</sub> Kanchana	
D <sub>1</sub> 0.2kg m <sup>-2</sup>	3370	2939	2915	3464	3172
D <sub>2</sub> 0.4kg m <sup>-2</sup>	3508	2686	2584	3488	3067
D <sub>3</sub> 0.8kg m <sup>-2</sup>	3254	2613	2567	2686	2780
D <sub>4</sub> 1.6kg m <sup>-2</sup>	3091	2741	2142	2425	2525
D <sub>5</sub> Conventional Nursery	2979	3140	2067	3700	
Mean	<del>3242</del> 3240	<del>3530</del> 2824	<del>3069</del> 2477	<del>3941</del> 3153	

SE (mean) between densities (A) = 144

CD (mean) between varieties(B) = 233

CD (mean) between combination of variety and density (AB) = 520

## a. Straw Yield

With respect to straw yield (Table 2), densities of mat nursery and conventional nursery did not affect straw yield significantly. However its combination with varieties had significant effect. Among the varieties Kanchana produced maximum straw yield of 2513kg/ha, significantly superior to all other varieties. The variety Jyothi produced least straw 1724 kg/ha.

Among the combinations Kanchana under mechanical transplanting using 0.2 kg/ m<sup>2</sup> mat nursery produced significantly the highest yield of 3085kg/ha. The least straw was produced (1458kg/ha) with Jyothi mechanically transplanted using 0.5kg/ m<sup>2</sup> mat nursery.

Table No. 2 Straw Yield kgha<sup>-1</sup>

Density of Mat Nursery	Variety				Mean
	V <sub>1</sub> Malta thriveni	V <sub>2</sub> Jyothi	V <sub>3</sub> Ahalya	V <sub>4</sub> Kanchana	
D <sub>1</sub> 0.2kg m <sup>-2</sup>	2021	1660	2379	3085	2286
D <sub>2</sub> 0.4kg m <sup>-2</sup>	2211	1458	1945	2571	2046
D <sub>3</sub> 0.8kg m <sup>-2</sup>	1663	1644	1759	2200	1817
D <sub>4</sub> 1.6kg m <sup>-2</sup>	2320	1766	1536	2007	1907
D <sub>5</sub> Conventional Nursery	2201	2010	1717	2634	2141
Mean	2083	1708	1867	2499	

SE (0.05) between densities (A) = 124

CD (0.05) between varieties(B) = 211

CD(0.05) between combination of variety and density (AB) = 472

## 3. Evolution of short duration rice varieties/ cultures for kole lands

## AGRONOMIC RESEARCH STATION, CHALAKUDY

### I. ICAR Projects

(i). Assessment of water availability at regional level and to devise interventions for matching water supply with the agricultural production systems demands

The command area in Kodakara village benefited by the Blachira Branch Canal of Chalakudy Irrigation Project was selected for the studies under theme I. The designed data of the canal system were recorded. The water availability through various spouts of the distributary was continuously monitored during different seasons during previous years.

Two projects were finalised as on farm research to be conducted at the Blachira command area in Kodakara village.

(i) Trial on comparative study of irrigation in coconut garden using bubbler Irrigation system

Bubbler Irrigation system developed at Agronomic Research Station, Chalakudy, is an intermediary system between drip and sprinkler. The system can dispense with clogging problem usually met with other micro irrigation system. This system can be designed fabricated and installed by farmer in a cost- effective way using locally available material.

Objectives of this experiment includes (1) To introduce the improved micro irrigation system in coconut garden, (2) To reduce wastage of irrigation water, since Bubbler irrigation system is designed to cover only the crop basins (3) To compare the efficiency of different methods of irrigation on the yield of coconut. Under this project farmers' practice of the locality is being compared with Bubbler irrigation- 90 litres of water/tree on alternate days.

### (ii). Trial on yield maximisation in rice

A technology package developed at Kerala Agricultural University was found to raise the yield of rice compared to the current yield level of 3-3.5t/ha. The package included application of high dosage of potash (120 Kg/ha), 250 Kg/ha. of Silica as sodium silicate ( $\text{NaSiO}_2$ ). Nitrogen and potassium can be applied in three splits. Basal application of nitrogen can be done with urea or factomfos and third split of nitrogen is to be applied as ammonium sulphate. Lime and silica to be applied basally. An area of 50 cents can be considered as one unit; out of which half of the area can be taken for each treatment.

Treatments:

T1- POP; T2- 70:35:120 kg/ha+ 150 kg lime; T3 – T2+Top dressing N as  $(\text{NH}_4)_2 \text{SO}_4$ ; T4 – T3+Apln. Of Silica 250 kg/ha

The results of the trial conducted at two different locations are presented below:

Treat-ments	Ist crop				IInd crop					
	Grain yield (kg/ha)		Straw yield (kg/ha)		Grain yield		Straw yield		Pooled mean	
	Chalakkudy	Pattambi	Chalakkudy	Pattambi	Chalakkudy	Pattambi	Chalakkudy	Pattambi	Grain yield	Straw yield
T1	3483	4070	3405	7011	2475	3383	2875	4777	3352	4547

T2	3873	4272	3394	6170	3875	4240	3250	4740	4065	4428
T3	3955	4705	3475	6122	3900	4338	3050	4430	4225	4311
T3	4365	5240	3832	6621	4785	4918	3540	4070	4827	4616
CD (0.05)	299.9	220.0	NS	NS	487.3	465.7	NS	NS	585.3	NS

## 2. Comparative study of drip method of irrigation on soil water status, growth and yield of coconut

The objective is to study the effect of drip irrigation on soil water status and yield of coconut. The crop was planted during September 1996 and installed the drip systems for starting irrigations as per technical programme during this year.

## 3. Studies on fertigation through bubbler irrigation system on ladies finger

In order to verify the feasibility of application of nitrogen along with the irrigation water through the Bubbler Irrigation System in Bhindi, a field experiment was newly laid out during the Rabi 1998. The treatments consisted of factorial combinations of four irrigation levels and four nitrogen levels.

Application of irrigation water through BIS significantly increased the fruit no./plant over control (I<sub>4</sub>-Farmer's practice) and the treatment I<sub>1</sub> (BIS at 100% PE) recorded the maximum no. of fruits(645/plant). Similar trend was observed with fruit yield also. Maximum fruit yield of 16.4 t/ha was recorded by irrigating I<sub>1</sub> in which irrigation was given at 100% PE through BIS and was on par with I<sub>2</sub> and I<sub>3</sub> which recorded a fruit yield of 14.2 t/ha and 15.6 t/ha respectively. The percentage increase in yield over control was 37.8, 19.3 and 31.1 respectively in I<sub>1</sub>, I<sub>2</sub> and I<sub>3</sub>.

The data on no. of fruits and yield showed significant effect with levels of irrigation, but was not influenced by fertilizer levels as well as their interactions.

Application of water through BIS significantly increased the fruit no./plant over control(I<sub>4</sub>-Farmer's practice) and the treatment I<sub>1</sub> (BIS at 100% PE) recorded the maximum no. of fruits(645/plant) which was on par with I<sub>2</sub> and I<sub>3</sub>. Similar trend was observed with fruit yield also. Maximum fruit yield of 16.4 t/ha was recorded by I<sub>1</sub> in which irrigation was given at 100% PE through BIS and was on par with I<sub>2</sub> and I<sub>3</sub> and recorded a fruit yield of 14.2 and 15.6 t/ha respectively. The percentage increase in yield over control was 38.7, 19.3 and 31.1 respectively in I<sub>1</sub>, I<sub>2</sub> and I<sub>3</sub>. Non significance of fertilizer levels on fruit number and yield, further revealed that nitrogen requirement of ladies finger can be reduced by 50 percent of its normal requirement if applied through BIS.

The results indicated that in ladies finger BIS is superior to channel irrigation and application of fertilizer N through BIS can save 50% of the normal recommended dose of N.

## 4. Effect of irrigation and mulching on growth and yield of coconut

The planting of the coconut seedlings was done during 1992-93 and the irrigation as per the technical programme was scheduled from January 94 onwards. The biometric

characters did not show significant variation between treatments. It is too early to draw definite conclusion as majority of palms have not yet stabilised the yield.

#### 5. Effect of irrigation on the growth and yield of cashew (*Anacardium occidentale*)

The objective of the experiment is to evolve an optimum irrigation schedule for cashew. The experiment was planted during June 1996. Treatment-wise irrigations were given from January to April. Seventy five percentage of the trees flowered during the period. No significant effect of irrigation could be observed on nut yield, since the trees have not attained stabilization of yield.

#### 6. Response of nutmeg to drip and basin method of irrigation

Lay out and initial field operations were completed. Planting was completed by summer 2001.

#### 7. Comparative studies on continuous and surge flow furrow irrigation on Tapioca

The statistical analysis of the data revealed significant influence of treatments on tuber yield per plant. Maximum tuber yield was recorded by irrigating the crop at 50mm CPE by surge flow method and was on par with continuous flow treatment at 50mm CPE and were highly superior to the rest of the treatments. Considering the yield and the total irrigation water applied, the irrigation water use efficiency was calculated. It was found highest for surge irrigation treatment at 75mm with a saving of 14% water in surge treatment, when compared to continuous flow at the same schedule of irrigation.

Table 1. Effect of different levels of surge and flow irrigation on growth, yield attributes and yield of tapioca.

Treat-ments	Tuber yield Kg/ plant	Weight per tuber (g)	No.of tubers	Length of tuber (cm)	Girth of tuber (cm)	Height of plant	Girth of plant (cm)	No.of leaves per plant
* C50	1.84	475.00	4.85	23.28	12.80	245.30	6.90	78.05
**S50	2.11	510.00	6.10	23.45	17.38	295.60	7.08	111.35
C75	1.58	18.50	5.55	21.50	12.85	247.70	6.40	74.25
S75	1.76	408.50	5.60	23.30	15.55	284.90	7.00	82.80
C100	1.39	310.00	6.45	25.28	13.00	261.00	6.85	97.85
S100	0.97	232.50	5.30	20.83	12.85	242.20	6.38	62.48
Mean	1.61	392.42	5.64	22.94	14.07	262.80	6.76	84.46
CD (0.05)	0.44	152.56	NS	NS	1.94	NS	NS	NS

C - Continuous flow irrigation. S - Surge irrigation.

The surge flow was given in a cycle of six minutes with two minutes ON and four minutes OFF times, in five surges and the quantity of water per irrigation was 0.9m<sup>3</sup>, nullifying the tail water losses. During the OFF times, water was applied to the other furrows by the use of ball valves. For continuous flow, during the observation trial, it could be seen that the time needed by the water front to reach 85% of the furrow length was 11.66 min @ 1.5l/sec. The remaining furrow length was wetted by the water entered into the furrow

before cut off. Hence tail water losses /deep percolation at the downstream side was controlled in both the methods.

The observations on tuber yield, number of tubers, weight per tuber, length and girth of tuber, plant height and girth and number of leaves per plant were taken. The statistical analysis revealed significant influence of treatments on tuber yield, weight per tuber and girth of tuber, whereas other parameters were insignificant (Table 1). Both the methods of irrigation at 50mm CPE were on par in yield. However the surge treatment at 50mm CPE gave highest yield. The continuous flow treatment at 50mm and 75mm CPE and the surge treatment at 75mm CPE were on par with respect to yield, with a saving of 14% water in surge treatment, when compared to continuous flow at the same schedule of irrigation.

The effect of treatment on weight per tuber showed parity of both the methods of irrigation at 50mm and 75mm CPE with the highest weight observed in surge treatment at 50mm CPE.

Considering the yield and the total irrigation water applied, the irrigation water use efficiency was calculated. It was found highest for surge irrigation treatment at 75mm. CPE. It was 51 per cent higher than that of continuous flow treatment at the same level of irrigation. A saving of 17.0 per cent water could be attained in surge flow technique with an increase of 29% yield.

Table 2. Effect of method and levels of irrigation on WUE and Yield of tapioca.

Treatments	No.of Irrigation	Total Water applied (m3)	Yield t/ha	Irrigation WUE t/ha.m3
C50	10	10.5	27.66	2.63
S50	10	9.0	30.64	3.40
C75	6	6.3	15.07	2.39
S75	6	5.4	26.22	4.86
C100	5	5.3	12.87	2.45
S100	5	4.5	20.10	4.47

C - Continuous flow    S - Surge flow

Considering the yield and the total irrigation water applied, the irrigation water use efficiency was calculated. It was found highest for surge irrigation treatment at 75mm. CPE. It was 51 per cent higher than that of continuous flow treatment at the same level of irrigation. A saving of 17.0 per cent water could be attained in surge flow technique with an increase of 29% yield.

### 8. Design criteria for bubbler irrigation system

The results on discharge Vs Head are given in table-1. In the cases, discharge was found to increase with increase in pressure. Among the bubbler heads with 8mm dia., the units having 5cm length gave more discharge at each operating pressure. Among the 12mm dia., the units having 8cm length was providing more discharge, whereas for the bubbler head of 16mm dia., units having 12cm length gave more discharge at all operating pressures.

Table-1 Discharge(lph) vs Head(Kg/cm<sup>2</sup>) Pressure (kg/m<sup>2</sup>)

Bubbler Head dimensions	0.5	1.0	1.3	1.5
*8mm,5cm,1mm,1N	36.24	52.80	68.00	78.50
8mm,8cm,1mm,1N	35.02	46.55	58.00	69.60
8mm,12cm,1mm,1N	33.50	35.88	47.00	65.60
12,mm,5cm,1mm,1N	41.16	43.74	60.00	73.55
12mm,8cm,1mm,1N	44.80	58.47	65.00	76.92
12mm,12cm,1mm,1N	40.44	55.41	59.41	64.56
16mm,5cm,1mm,1N	44.28	47.79	63.20	80.24
16mm,8cm,1mm,1N	44.50	56.43	67.50	83.24
16mm,12cm,1mm,1N	46.50	63.00	75.43	84.84

\* 8mm diameter, 5cm long, 1mm diameter, 1 nozzle.

### Effective wetting radius

Variation of effective wetting radius of different combinations were studied at different pressures and at different height of riser pipes. A general trend of decreasing the wetting radius with increase in length and diameter of unit was observed.

Table 2. Variation in effective wetting radius (cm) with height of riser pipes(cm).

Ht. of riser pipe (cm)	8mm, 5cm	8mm, 8cm	8mm, 12cm
30	98	86	68
50	124	114	85
60	165	145	110
75	175	165	125
90	183	175	138
120	194	190	156
	12mm, 5cm	12mm, 8cm	12mm, 12cm
30	78	62	62
50	98	88	78
60	128	98	90
75	137	122	107
90	140	132	124
120	146	140	132
	16mm, 5cm	16,mm, 8cm	16mm, 12cm
30	65	55	54
50	80	75	73
60	100	80	85
75	120	100	96
90	130	123	115
120	135	128	123

Maximum wetting radius was obtained for the highest unit ie. 8mm, 5cm long. The energy required to rotate the unit along with water will be considerably small and the applied pressure may be sufficient to provide fine uniform spray. In all cases, the wetting radius was found to be increasing with increase in height of riser pipe. (Table-2)

Table 3. Distribution parameters of various bubbler head units at 1 Kg/cm<sup>2</sup>

Bubbler Head	Re Cm	Ac cm <sup>2</sup>	Dis-charge eph	Da mm/hr	D x a mm/hr	D xc mm/hr	Med-ian	Cv
Number of nozzle = one								
8mm,5cm	165	21372	36.2	4.7	9.5	7.7	4.3	0.35



8mm,8cm	145	165054	35.0	19.9	68.5	65.6	10.2	1.01
8mm, 12cm	100	7850	33.5	22.2	140.9	117.0	9.0	1.80
12mm, 5cm	128	12861	41.2	8.5	32.1	28.5	3.6	1.06
12mm, 8cm	100	7850	44.8	12.5	27.2	26.9	11.8	0.51
12mm,12cm	100	7850	40.4	13.8	41.3	35.5	11.8	0.87
16mm, 5cm	100	7850	44.3	8.9	24.3	19.4	7.4	0.86
16mm, 8cm	76	4534	44.5	11.0	29.2	25.2	9.7	0.66
16mm, 12cm	85	5672	46.5	12.6	28.1	24.8	11.4	0.53
Number of nozzle = Two								
8mm, 5cm	136	14519	68.5	13.1	31.8	26.7	12.7	0.48
8mm, 8cm	120	11304	57.6	58.8	248.6	118.2	56.6	1.56
8mm,12cm	90	6359	63.5	72.1	318.1	284.3	63.7	2.55
12mm, 5cm	100	7850	67.1	21.3	46.8	44.0	16.4	0.66
12mm, 8cm	95	7085	74.9	20.5	37.2	34.2	19.1	0.61
12mm, 12cm	90	6359	67.1	18.4	37.0	33.5	19.2	0.94
16mm, 5cm	80	5024	72.1	21.4	50.4	46.8	19.6	1.05
16mm,8cm	50	1963	72.5	19.4	39.5	36.6	18.9	1.02
16mm,12cm	75	4416	74.5	22.7	49.9	47.8	17.5	0.86

#### Application depth and Distribution efficiency.

The average application depth ( $D_a$ ), Absolute maximum application ( $D_{xa}$ ) and the effective maximum application depth ( $D_{xe}$ ) were found to increase with increase in number of nozzles i.e. increase in the area of nozzles. Better performance was observed in bubbler heads of 8mm dia, 5cm long; 12mm dia, 8cm long and 16mm dia, 12cm long units with 1 mm nozzle and large percentage of area were receiving the average application depth. The coefficient of variation was less than 100 for all units except 8mm dia, 8cm; 8mm dia, 12cm and 12mm dia, 5cm long units with 1 mm dia, one nozzle. Clogging was negligibly small in all the units, whereas clogging is a great problem in drip emitters.

#### 9. Comparative studies on wetting front advance of soil moisture under surface and sub-surface drip irrigation for different discharge rates

The experiment is being started.

#### 10. Water Management practices for coconut based cropping systems

The experiment was started during summer 2001. Planting of nutmeg, arecanut and pepper were completed. Irrigation systems were installed as per the technical programme. General performance of crops are satisfactory.

### II. ICAR ad-hoc projects

#### Collection and evaluation of germplasm of betelvine and standardisation of agro-techniques in Kerala

A detailed survey was conducted on the various aspects of the cultivation of the crop, cultural and management practices, harvesting processing and marketing. Information on the size of holding, soil type, choice of variety, planting material type of standards, spacing, manurial practices, pests and diseases and harvesting and yield of leaves could be obtained from the betelvine cultivated areas of Kerala.

Betelvine cultivars collected from major growing areas of Kerala and also from neighbouring states are being maintained in the germplasm bank. The cultivars were screened for host resistance against the bacterial leaf spot disease under natural condition. The cultivars Mundakan, Aluva kodi, Thulasikodi (Cherthala), pampady nadan, Calcutta kodi and Kannidodi were completely destroyed due to this disease. But, cultivars like Mysore kodi, Kalpathi, Vengola kodi and Marakodi recorded the least incidence of this bacterial leaf spot disease. As a part of the germplasm collection programme varieties like Kawai, Vellaikodi, Tellaku, Karpur, Sreenivasanallur, Dindugal, Deswar, Pachaikodi, Karpaku, Godi Bangla, Sangli Kapani, Kapoori chitti kavata, SGM<sub>1</sub>, Shirpur kata, Ghanaghatte, Bangla Ramtek, Banglajel, etc. have been collected from Sugarcane research station, Trichi and they are maintaining well for sufficient growth.

Wide variation was noted on the choice of standards/support for trailing the vines, which include live standards viz. *Erythrina indica*, *Odina wodier*, *Bombaz malabarica*, *Moringa tinctoria* etc. Among the dead standards, reeds were common in Kollam, bamboo or arecanut splits were associated which 'Koottakodi' system of cultivation in Malappuram, coir ropes were found in Thiruvananthapuram and Alappuzha districts.

Regarding the manurial practise followed, the farmers preferred bulky organic manures such as cattle, goat or poultry manure, wood ash and oil cakes to inorganic fertilizers, the quantity of which varied from 60 to 100t/ha/year. The farmers were well aware that application of inorganic fertilizers alone would tend the plants more susceptible to diseases.

The yield of betel leaves was found to vary from place to place depending up on the type of standard, variety, age of plantation and also the manorial management practices. Differences were also observed in expressing the yield of leaves as 'kettu' of varying number ranging 15 to 200 leaves.

It was revealed from the survey that the major diseases affecting betel vine were bacterial leaf spot and wilt (*Xanthomonas auxonopodis* pv *betlicola*), foot rot (*Pythium* sp.), and wilt (*Phytophthora parasitica*) disease. Incidence of disease was more in areas having poor drainage and field sanitation, and increased use of chemical fertilizers.

The results of study of the 22 betel vine cultivars screened against the artificial inoculation of *Xanthomonas auxonopodis* pv *betlicola* indicated that none of them was immune to the bacterial leaf spot disease. However, certain cultivars showed comparatively less disease score namely, Poy kodi, Mysore kodi, Thulasi kodi (Vytila), Marakodi etc. ranging from 2.4 to 3.6, whereas the maximum score was found in Mundakan, Pampady nadan, Thulasi kodi (Cherthala), Kanni kodi, Panniyur local, Aluva kodi and Pancholi kodi with a score from 11.0 to 9.0 which were the most susceptible ones.

The experiment on the influence of various rooting hormones on the germination of different types of cuttings of betel vine showed only little effect of hormones on the germination and survival percentage in betel vine. However, among the hormones the IAA was found to be the best in registering the highest percentage of germination (71.7). Among the two different types of vines used, the matured plagiotropes were found to be the best with a germination percentage of 89.0. As regards the different cuttings tried,

maximum germination (72.0) was observed in three noded cuttings indicating the suitability for rapid multiplication of betel vine.

Influence of levels of hormone on the percentage germination of betel vine cuttings.

	Hormones				Mean
	H1	H2	H3	Control	
C1	74.3 (58.43)	72.3 (58.43)	61.5 (51.67)	73.9 (59.29)	70.7 (57.23)
C2	63.8 (53.04)	53.7 (47.11)	56.3 (48.69)	70.5 (57.11)	61.2 (51.48)
C3	76.5 (61.03)	60.6 (51.11)	52.6 (46.49)	92.0 (73.58)	72.0 (58.05)
Mean	71.7 (57.86)	62.5 (52.21)	56.9 (48.95)	79.9 (63.32)	
V1	90.4 (71.99)	89.1 (70.62)	88.2 (69.93)	88.5 (70.2)	89.0 (70.68)
V2	47.8 (43.74)	31.1 (33.81)	22.0 (27.97)	69.4 (56.45)	42.2 (40.49)
Mean	71.7 (57.86)	62.5 (52.21)	56.9 (48.95)	79.9 (63.32)	

Data in parenthesis are angular transformed

CD(5%) – Vines : 3.45 CD(5%) – Cuttings : 4.22

CD(5%) - hormones : 4.87

V1- Plagiotropes C1-Single noded cutting H1 -IAA L1 - 50 ppm

V2- Orthotropes C2-Two noded cutting H2 -IBA L2 - 100ppm

C3-Three noded cutting H3 -NAA L3 - 150ppm Control-water L4-200ppm

Cuttings	Levels of hormone				Mean
	L1	L2	L3	L4	
C1	72.8 (58.55)	79.6 (63.11)	68.2 (55.72)	61.3 (51.54)	70.7 (57.23)
C2	62.4 (52.18)	61.6 (51.70)	60.1 (50.84)	60.8 (51.23)	61.2 (51.48)
C3	83.3 (65.87)	68.3 (55.75)	63.6 (52.88)	71.5 (57.7)	72.0 (58.05)
Mean	73.3 (58.86)	70.1 (56.85)	64.0 (53.15)	64.6 (53.49)	

Data in parenthesis are angular transformed CD(5%) – levels of hormone : 4.87

While comparing the integrated use of both organic and inorganic source of manures at various levels on the growth of betel vine, it was observed that the bio-metric characters namely, mean height of plants, no. of leaves per plant and the inter nodal length registered significant increase on application of either 100 per cent organic sources along or in combination of both organic as well as inorganic sources at 50:50 proportion.

The results of the experiment on the post harvest storage of betel leaves revealed that the hydro-cooled betel leaves packed in polythene films when stored under ambient condition retained freshness and remained green even after ten days of storage. The storage of betel leaves under frozen/refrigerated conditions were found to be undesirable as it becomes leathery and will not retain the freshness or green colour of leaves.

Effect of different packing material and storage conditions on retention of quality (%) of betel leaves

Pre cooling	Packing material			Mean
	P1	P2	P3	
C1	34.5 (35.92)	23.1 (28.72)	31.9 (34.39)	29.7 (33.02)
C2	19.8 (26.39)	10.8 (19.16)	34.3 (35.82)	20.8 (27.12)
Mean	26.8 (31.17)	16.5 (23.94)	33.1 (35.10)	

Pre cooling	Storage conditions			Mean
	S1	S2	S3	
C1	69.1 (56.20)	33.5 (35.36)	1.7 (7.50)	29.7 (33.02)
C2	43.5 (41.29)	29.1 (32.57)	1.7 (7.50)	20.8 (27.12)
Mean	56.5 (48.75)	31.2 (33.97)	1.7 (7.50)	

Data in parenthesis are angular transformed

CD(5%) – Cooling methods : 4.075 CD(5%) - Packing material : CD(5%) Storage conditions : 4.991

C1 – Hydro cooling P1 – Banana sheath S1 – Ambient condition C2 – Contacting P2 – Banana leaf  
S2 – Refrigerated condition S3 – Frozen condition

Another experiment coming under the agrotechniques is rapid multiplication of betelvine. Both orthotropic and plagiotropic vines were used in this experiment. Three types of cuttings such as single noded, two noded and three noded cuttings were taken from both types of vines. Three types of cuttings from each vines were dipped for five minutes in four levels of (50 ppm, 100 ppm, 150 ppm & 200 ppm) of the hormones IAA, IBA, NAA along with control. Observations are going on in this experiment.

It can hence be concluded that location specific varieties having good disease resistance should be selected for the experiment. It requires day today attention in management such as racking and earthing up, tying the growing tip, irrigation etc. For attaining good growth of the vine proper shade is an important factor.

### III. KAU Projects

#### 1. Response of coconut to different methods of irrigation.

The drips and laterals were laid out freshly around the coconut palms. Irrigations were given as per schedule and observations are being taken. Definite conclusions can be inferred only after getting stabilised yields from the palms.

#### 2. Integrated nutrient management to increase productivity of sandy soils.

The experiment is ongoing. Observations on biometric characters and yield attributes for the first year of the experiment shows no significant difference between the treatments. The experiment is being continued for confirmatory results.

#### 3. Irrigation cum nutrient management of cowpea and Sesamum.

Statistical analysis of the data on yield showed that among the different treatments and their combinations, Variety and method of irrigations significantly influenced the yield of cowpea. Levels of P did not influence the yield. Among the varieties Kanakamani recorded the maximum yield of 7305 kg/ha and was superior to Sarika (5760kg/ha). Sprinkler irrigation was found to be superior to common practice of channel irrigation.

#### 4. Evaluation of different kinds of organic and inorganic nutrients under bubbler irrigation system for cucurbits.

The field experiment was conducted during the summer seasons of the year '99, 2000 and 2001. Among the different sources of organic manures tried poultry manure is found to be significantly superior to farm yard manure and coirpith compost.

## CASHEW RESEARCH STATION, ANAKKAYAM

### Salient findings

#### 1. Collection, maintenance and evaluation of cashew germplasm.

A total of 95 types collected from different places have been maintained in the filed. Observations on morphological characters, flowering characters, and scoring for pests were recorded.

Vigour of plants was more in ABD-2-1, BLA-121-2, BLA-176-4, BR2-18-0, H-3-2, H-4-7, UL-10-2 and UL-28-2.

#### 2. Breeding improved varieties of cashew by hybridization.

One hundred and fifty (150) hybrid progenies planted during 1975-76 are in the filed for evaluation. Hybrid H-8-6 was found performing well with all the desirable characters. Three hundred and twenty one hybrid seedlings planted during 1996 involving 29 parental combinations were planted in the field. Morphological characters were recorded at half yearly interval.

Vigour of seedlings was more in the progenies involving following combinations:

- |                  |                    |                    |
|------------------|--------------------|--------------------|
| 1. H-8-6 x AKM-1 | 2. K-22-1- x H-8-6 | 3. H-9-1 x K-22-1  |
| 4. H-8-6 x T-505 | 5. UL 28-1 x H-8-6 | 6. H-8-6 x UL-28-1 |

Flowering and fruit set were obtained in the following combinations.

- |                  |                   |                   |
|------------------|-------------------|-------------------|
| 1. H-8-6 x AKM-1 | 2. K-22-1 x H-8-6 | 3. H-8-1 x K-22-1 |
|------------------|-------------------|-------------------|

#### a. Study of promising clonal progenies of cashew

The yield data revealed that the clonal progenies of the hybrids H-3-6, H-3-9 and the clonal progenies of the selections K-10 and K-22-1 have superior yields and they have a stable performance. The trees in the 1975 planting contain high yielding type and this can be utilised for canopy management studies. The other desirable attributes of the types can be studied and can be utilized for breeding purpose and for scion collections.

#### b. Comparative yield trial on cashew

The types BLA-139-1, BLA-39-4-, H-3-17 and K-10-2 were released as KAU varieties Anakkayam-1, Madakkathara-1, Dharashree and Sulabha respectively for large-scale cultivation.

## CASHEW RESEARCH STATION, MADAKKATHARA

### Research projects in operation

1. Germplasm collection, maintenance, evaluation and description of types
2. Multi locational trial with 18 cashew varieties / hybrids from Vitttal, Bapatla, Vengurla, Vridhachalam and Madakkathara.
3. New multilocational trial with varieties from Bapatla, Vengurla, Vridhachalam and NRCC, Puttur.
4. **Hybridization and selection.**
5. NPK fertilizer experiment.
6. Fertiliser application and pruning trials in high-density cashew plantation.
7. Intercropping trail in cashew with Tuber crops.
8. Onfarm trial in cashew.
9. Chemical control of pest complex in cashew – 3 experiments
10. Control of stem and root borer in cashew – 2 experiments.
11. Bio ecology of pest of regional importance and survey of pest complex and natural enemies.
12. Screening of germplasm to locate tolerant/ resistant types to major pest of the region.

### External aided projects

1. NATP project: "Developing integrated production package for enhancing productivity of cashew".
2. ICAR project: "Soil test based and productivity linked approach for cashew nutrition".

### Salient findings

1. A clonal germplasm conservation block with 135 accessions was established. Five accessions with nut weight more than 10 g are now available in the germ plasm (H 1589 - 10.8 g, H 1593 - 12.6 g, H 8-7 - 10 g), H 8-8 - 12.3 g and Kiliyanthara - 11 g). Twelve accessions in the germ plasm were characterised using RAPD markers. 20 primers were used for the study and 10 primers gave polymorphism. During 2001-02, four new types were collected and 57 bold nuts were planted.
2. Eighteen high yielding cashew varieties evolved at six Cashew Research Centres of India are under evaluation at this centre. The varieties V5, M 26/2, H-1598, H-1608 and Anakkayam-1 were found to be the best. These varieties can be considered for large scale cultivation under Kerala conditions considering their production potential.
3. A total of 213 hybrid seedlings were planted in the field during the period 1993-2000. 124 new hybrid seedlings were planted in the field during June 2001. During 2001-02 period 145 hybrid nuts from 19 cross combinations were sown in the field.
4. Three promising hybrids H-1600, H-1593 and H-1610 are in the pipeline for release.
5. Spraying Endosulfan 35% EC @ 0.05% at flowering followed by Carbaryl 0.1% at fruiting was found to be most effective against tea mosquito bug.
6. Application of Prophenophos 0.05% was found to be the most effective treatments against tea mosquito and other miner pests.
7. Application of neem oil 5 percent on tree trunk and exposed roots is effective in preventing stem borer infestation for 2 months. Sevidol granules @ 75 g/tree, prevented infestation for three months.
8. Four varieties H-3-17, Priyanka, Kanaka and K 22-1 are found to be apparently tolerant to tea mosquito bug.

## PINEAPPLE RESEARCH STATION, VAZHAKKULAM

### I. KAU Plan Projects:

#### 1. Improvement of pineapple var. Mauritius through hybridization and induced mutation

This project intends to develop a high yielding short duration variety suitable for both fresh fruit market and processing industry and acceptable to farmers.

##### a. Hybridization between selected varieties to develop hybrids

This project is being continued. About 10000 hybrid seedlings have been developed from a six parent crossing programme and are in the process of field evaluation. The parents included are Kew, Mauritius, Reply Queen, Seln-1, Pampakuda Local and Kakkoor Local. At present there are about 3000 hybrids in field. Harvesting of fruits started and about 500 hybrids were harvested and evaluated for various quality parameters.

##### b. Induced Mutation

Irradiated suckers at various doses have been planted for evaluation. About 100 plants are in the field, harvesting of fruits has started. Irradiated hybrid seeds were planted and about 500 plants are in the field and are at various stages of evaluation.

##### c. In vitro mutation

Irradiation of in vitro pineapple cultures are done at six doses and the multiplication of the cultures are going on. The work is being done at College of Horticulture, Vellanikkara. About 500 TC plants were transferred to pots for hardening.

#### 2. Intraclonal variability in pineapple var. Mauritius

The objective of the projects is to make use of the natural variability available, if any, in pineapple for crop improvement programmes. Surveying and collection of plant types is in progress. One plant type with plant characters of the Mauritius variety and fruit characters of Kew variety was harvested and quality analyzed. It is found that the quality characters are comparable to that of Kew variety. The duration of the crop is approximately 12 months. Thus with this plant fruits similar to Kew variety can be obtained within one year (similar to Mauritius variety) instead of 22-24 months in the case of Kew variety. Now, the second CYT is going on. Observations are being continued.

#### 3. Evaluation of organic manures with bio fertilizers for maximizing the yield and quality in pineapple var. Mauritius

This trial was planted on 14th June, 2000. Influence of various organic manures and bio fertilizers was compared to select the most suited manure for maximum yield and quality of pineapple var. Mauritius. Farm yard manure (600 g/plant), poultry manure (250 g), vermi-compost (250g), neem cake (50g), azospirillum (625mg) and phospho bacteria (625g/plant) were tested along with the recommended dose of chemical fertilizers (N,

P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O @ 8:4:8g/plant) against a no-organic manure control (N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>) @ 8:4:8 g/plant alone) treatment. Data recorded on the vegetative growth of plants, yield and quality parameters of fruits indicated that the different treatments were on par and had no significant influence in the first year (Plant Crop). However, plots applied with 250g poultry manure + azospirillum and Phosphobacteria @ 650 mg each along with N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O @ 8:4:8 g/plant, recorded higher values in terms of plant height and number of leaves, and juice percentage and quality parameters of fruits. Soil fertility parameters such as available P and K of the experimental plots increased after one year. Organic carbon of soil also increased significantly, when compared to the control plots. The experiment is being continued.

#### 4. Nutrient requirement of pineapple var. Mauritius

Objective of this trial is to standardize the optimum, requirement of N, P and K. This trial compares 64 nutrient combinations -four levels each of N, P and K in all combinations - along with a no-fertilizer control. The work is in progress.

## II. Externally Aided Projects

1. IPL Project on "Studies on the use of potassium fertilizers for improving yield and quality of pineapple of main production sites of Kerala State".

The objective of the project is to compare different doses of two types of potassium fertilizers (MOP and SOP) to get quality fruits. The project started on 1.11.2001. The experiment under garden lands has been planted on 24.11.2001.

2. ICAR ad-hoc scheme "Evaluation of pineapple hybrids for higher yield, quality and suitability for inter cropping".

This scheme started w.e.f. 1.1.2002 and the trials are going on.



## BANANA RESEARCH STATION, KANNARA

### Salient findings:

#### I. BANANA

##### 1. Collection, conservation and evaluation of banana germplasm

A field gene bank of 240 accessions was maintained. Sixteen new additions were made to the existing collection. There are introductions from NBPGR, New Delhi and comprise improved varieties/ hybrids and some natural germplasm. These accessions have been regenerated *in vitro* and field established. FHIA - 1 and FHIA - 3, with high yield potential and resistance to leaf spot, Panama Wilt and borer were selected as promising. Characterization of germplasm using isozyme/ molecular markers is in progress.

##### 2. Improvement in banana through hybridization

Out of twelve cross combinations tried, with the objective of evolving improved diploids, seed set could be obtained in Matti x Pisang Lilin, Matti x Calcutta - 4, Tongat x Calcutta - 4 and Pisang Jaribuaya x Calcutta - 4.

##### 3. Effect of bunch cover on yield and quality of banana

Covering the bunches with blue polythene took the lowest number of days to reach maturity. Highest bunch weight was also recorded for this treatment. Uncovered bunches took more days to ripen. Covered bunches showed a marked improvement in bunch appearance.

##### 4. Time of planting in banana var. Nendran (AAB)

The different planting time (bimonthly intervals) did not have significant influence on plant height and girth of pseudostem, whereas, number of leaves was affected. Highest bunch weight was recorded in October and December planting and lowest in August. Lowest infection index for Yellow Sigatoka Leaf Spot was noticed in June planting, whereas it was highest in February followed by December and October.

##### 5. Standardization of optimum dose and time of nitrogen application in banana var. Poovan (AAB)

The experiment aims to find out the effect of application of nitrogen during the vegetative and reproductive phase and to standardize the optimum dose and time of nitrogen application in Poovan(AAB). The various treatments did not have significant influence on yield. However, the highest yield was recorded in T6 (200 + 150 g N 4 + 3 splits). Second crop has been laid out and observations are in progress.

##### 6. Standardization of optimum dose and time of K application in banana var. Poovan (AAB)

Application of 200 g K<sub>2</sub>O in two equal splits 75 and 165 days after planting was the best treatment for obtaining high yield in banana var. Poovan (AAB). The results prove that for obtaining high returns, potassium application should be done in the vegetative phase. Third season's crop has been laid out and observations are in progress.

7. Standardization of organic and inorganic fertilizer requirement in banana var. Poovan  
The best combination of organic and inorganic nutrients for high yield in first ratoon crop of banana var. Poovan (AAB) was 25% N as FYM + Green manure and the rest 75% N in the inorganic form. This was followed by application of 25% N as farmyard manure and 75% N in the inorganic form. Third season's crop has been laid out and observations are in progress.

#### 8. Spacing trial in banana var. Poovan (AAB)

The highest bunch weight was observed for widest spacings (2.1 m x 2.1 m), in Poovan. Spacing of 1.2 x 1.2 x 2.0 m accommodating 5028 plants/ha had the highest per hectare yield. Third season's crop has been laid out and observations are in progress.

#### 9. Estimating losses from weeds at growth and development of banana and identification of critical stages

In banana variety Palayankodan (AAB), weed management practices influenced both the yield and crop duration. Withholding weeding upto 3 MAP or during 6<sup>th</sup> to 9<sup>th</sup> MAP, drastically reduces both the yield and B:C ratio. When no weeding was undertaken throughout the crop cycle, there was an increase in crop duration.

#### 10. Chemical control of weeds in banana var. Palayankodan (AAB)

Considering the economics and crop duration, raising a single crop of cowpea in the interspace of banana and its incorporation is an effective weed control measure in Palayankodan. Followed by this, raising one more crop of cowpea or giving one spray of Gramaxone 1.8 l/ha at 5 MAP also can be taken up if needed, to control weed growth. Observations are in progress in the second season's crop.

#### 11. Screening germplasm against leaf spot, Fusarium wilt and Bunchy top disease in banana

Among the different varieties screened, the varieties Chakkarakeli, Kadali and Krishnavazha were highly susceptible. Karivazha (AAA), Manoranjitham (AAA), Thiruvananthapuram (AAB) and Dudhsagar (AAB) were free of infection and recorded infection index of 0% at 6 months after planting. The varieties Pisang Lilin (AA), Sannachenkadli (AA), BRS-1 and BRS-2 were highly tolerant to the disease and recorded an infection index less than 1%. The experiment is being continued.

#### 12. Survey of fungal and viral diseases of banana

The important diseases recorded in banana were various leaf spot disease, Panama wilt, Rhizome rot, Banana bunchy top disease, Banana bract mosaic disease, Infectious Chlorosis (CMV). Among these, Sigatoka leaf spot disease, Banana bunchy top disease and Banana bract mosaic disease were recorded on all the commercial cultivated varieties like Nendran (AAB), Poovan (AAB), Palayankodan (AAB) and Robusta (AAA), while Rhizome rot which is caused by a bacterium was recorded in Nendran (AAB), Poovan (AAB) and Monthan (ABB). Panama wilt was recorded only on Poovan (AAB) and Monthan (ABB). The fruit diseases recorded were tip rot caused by *Dieghthoniella* sp. in Robusta, Sooty blotch and *Verticillium* cigar end rot disease.

### 13. Control of Sigatoka leaf spot disease of banana

In this experiment, new commercial fungicides were tested for their efficacy in controlling Sigatoka leaf spot disease in banana. The results indicated that the Sigatoka infection index at flowering was least in treatment sprayed with Tebuconazole 0.025%, while control (unsprayed) plants recorded an infection index of 36.57% at the shooting stage.

### 14. Studies on *Fusarium* isolates in relation to Panama wilt disease of banana

Isolation of *Fusarium oxysporum* f.sp. *cubense*, the causal organism of Panama wilt disease of banana viz. has been carried out from the infected rhizome of varieties Manoranjitham (AAB) and Rasthali (AAB). The isolation from the soil around the rhizome of diseased banana var. Rasthali also yielded an antagonist (*Aspergillus* sp) which inhibited the growth of *Fusarium* under *in vitro* conditions. Studies on the possibilities of biocontrol of *Fusarium oxysporum* f.sp. *cubense* using *Aspergillus* (the name of the species is to be confirmed) are in progress.

### 15. Control of Panama wilt disease of banana

Carbendazim - 2% (3 ml) injection at 5<sup>th</sup>, 7<sup>th</sup> and 9<sup>th</sup> month after planting was found to be the most effective in controlling the Panama wilt disease of banana and it also enhanced the yield.

### 16. Chemical control of Rhizome rot (Tip over) of the banana

Among different chemical treatments tried for control of rhizome rot of banana, maximum yield was recorded in the treatment where the suckers were pared and dipped in 0.75% Monocrotophos before planting and later drenching with Bordeaux mixture 1% twice at fortnightly intervals. This treatment recorded no disease incidence and yielded maximum bunch weight of 10.045 kg. Isolation of a bacterium (*Erwinia* sp) has been carried out from the infected rhizomes. The experiment is being continued.

### 17. Virus diseases of banana

Some of the important virus diseases recorded are Banana Bract Mosaic Disease, Bunchy Top and Infectious Chlorosis. Banana Bract Mosaic disease caused by Banana Bract Mosaic Virus was recorded in varieties like Nendran (AAB), Robusta (AAA), Gandevi selection (AAA), Rasthali (AAB), Palayankodan (AAB) and in culinary varieties like Alukhel (ABB), Govakkai (ABB), Gauria (ABB), Madavazha (ABB), Bibutia (ABB). The effect of this disease on the yield of selected commercial varieties like Nendran (AAB), Palayankodan (AAB), Robusta (AAA), Dwarf Cavendish (AAA), Njalipoovan (AA) were studied. The study revealed that maximum yield reduction was recorded in Nendran and Robusta. In Palayankodan, there is no significant effect on the yield.

### 18. Survey studies on insect pests of banana

Fixed plot as well as roving surveys in different parts of Kerala were conducted. The incidence of various pests were noted at fortnightly intervals in fixed plot surveys. The important pests noted were pseudostem borer, leaf feeding caterpillars, banana aphids, rhizome weevil, etc. Mild incidence of thrips, scales, mealy bugs, mirid bugs and lacewing bugs was also noted.

### 19. Biology and population dynamics of pseudostem borer of banana

Studies on population dynamics were continued. Infestation on selected banana varieties was monitored. Nendran, Palayankodan and Chenkadali, the important commercial varieties, were highly susceptible to attack, while Njalipoovan was seen to be resistant. Varieties like Poovan and Robusta were moderately susceptible. Lesser cultivated varieties like Monthan, Dwarf Cavendish and Kadali were seen to be less preferred hosts. However incidence was noted on Monthan during the last season. Maximum infestation of the pest was noted during May – July.

### 20. Evaluation of commercially available neem based insecticides for control of Pseudo stem borer of banana

Data of two seasons indicate that among the various treatments tried, the neem based insecticide Neemazal 10,000 ppm @ 5 ml/l is effective in controlling the attack of pseudostem borer of banana and comparable to the recommended chemical viz. Sevin (0.2%). The third season crop is now in the field.

### 21. Management of pseudostem borer of banana using different bait traps

Placement of pseudostem traps in a plot of a resistant variety, Njalipoovan showed very negligible catch. This shows that traps are effective only when the field population of adult weevils is high. Studies to observe the most suitable length of the pieces, orientation (horizontal/vertical) and height of placement, etc. are in progress.

### 22. Screening of banana germplasm for resistance/tolerance to nematodes

Screening of new additions to the germplasm collection is in progress.

### 23. Survey of banana nematodes

Survey was carried out in parts of Ernakulam, Thrissur, Palakkad, Malappuram, Kozhikode, Kannur and Kasargod districts. In most areas surveyed the nematode population ranged from 0-25 per 10 g soil and 0-50 per 100 g root. The highest nematode counts were observed in samples from Kasargod district (726 per 100 g soil and 347 per 10 g roots). Symptoms on the roots, corms and on the plant, if any, were noted.

### 24. Management of banana nematodes using intercrops in banana var. Dwarf Cavendish

The first season trial of this experiment is over and the second seasons' crop is in the field. The trends shown by nematode counts recorded in the different treatments indicate that sunhemp is the best intercrop with respect to control of nematodes, followed by marigold. Cowpea did not have any effect on controlling nematodes.

## II. Jackfruit

### 1. Survey, identification and selection of mother plants to establish high yielding, superior clonal stocks

Survey for elite clones of jackfruit was continued. 156 trees were evaluated so far. Wide variation was observed in all the characters studied. Five elite trees were identified for table purpose fruits, two for chip making and another five for culinary purpose.

### 2. Standardization of propagation methods for jackfruit

Soft wood grafting was tried using rootstocks of different ages. Grafting was successful till the rootstocks were six-month-old. Graft take was nil in older rootstocks.

### 3. Survey and incidence of insect pests on jackfruit

Survey for pests of jackfruit was continued. It was noted that the incidence of pests was higher in the monsoon and winter seasons compared to summer. The different pests noted were leaf feeding caterpillars (*Margaronia bivitalis*), stem borer (*Batocera rufomaculata*) and spittle bug (*Cosmoscarta releta*).

### 4. Survey and incidence of diseases on jackfruit

Survey on jack diseases was conducted in Kerala Agricultural University campus and NBPGR campus, Vellanikkara and also in farmers' homesteads. The major diseases noted were leaf spot diseases (anthracnose) and Rhizopus Fruit Rot.

## **Pineapple Research Center, Vellanikkara**

### **Salient findings**

#### 1. Analysis of growth and yield in staggered production of pineapple var. Kew

The experiment is concluded. By staggered planting, fruit could be harvested throughout the year. For maximum yield with minimum crown weight and sweeter fruits, planting in May is suggested.

#### 2. Collection, conservation and evaluation of pineapple germplasm

All the varieties available are replanted and maintained well.

#### 3. Breeding new varieties of pineapple

Under the trial on breeding new varieties of pineapple, four inflorescences of H7 and three of H8 were backcrossed with Kew with a view to improve the fruit size and reduce the spiny character. Fruits from the back crossed varieties were harvested, seeds collected and sown in sand. They have now been transplanted to the secondary nursery in the multiplication plot, 50 more suckers were planted. Slips and crowns in the nursery are well managed.

The two selected hybrids, after farm trial are being multiplied using suckers and slips. In the multiplication plot, 120 suckers of H7 and 100 suckers of H8 were planted during the period. 50 small slips and crowns of both the hybrids were planted in the nursery. The other crosses are being observed.

#### 4. Rapid asexual multiplication of hybrid seedlings in pineapple

The experiment on the comparison of different planting materials is over. Harvesting and fruit analysis are in progress.

#### 5. Clonal variation studies in pineapple var. Kew

All the available clones are well maintained in the germplasm plot. Multiplication of the selected clones by conventional method is in progress. Two more clones yielding good quality fruits weighing 8.5 and 9 kg were obtained and included in the selection. Their stability of performance is to be tested.



Table 3. Grain qualities of *Kunjukunju* cultures.

Parameter	K6	K10-3	K68-6	Local Kunjukunju	Kanchana
1000 grain weight	25.90	24.75	25.45	24.90	24.40
L/B ratio	2.39	2.34	2.39	2.43	2.44
Hulling %	76	69	81	70	68
Milling %	67	57	65	62	62
Volume expansion	2.2	2.2	2.1	2.2	2.4
Amylose content	27.3	31.0	30.0	26.0	28.0
Kernal elongation	1.4	1.39	1.37	1.37	1.30
Grain tip Pigmentation	Pigmented	Pigmented	Non-pigmented	Mixed type	Non-pigmented

## 2. Proposal for farm trial on photo insensitive coleus mutant

*Coleus* (*Solenostemon rotundifolius* syn. *Coleus parviflorus*) is a photosensitive vegetable tuber crop. A photo insensitive variety if available will be a boon to farmers. Three photosensitive cultivars evolved at the department are mutants 131, 61 and TC 9.

Character	Mutant 131 Induced mutant of Mullurkkara L-3 with a dose of 0.6% for 30 minutes	Mutant 61 Induced mutant of Parikkada local Using gamma Rays with a dose of 0.6% for 30 10 gy	Mutant TC-9 Tissue Culture mutant of Payipra Local Using 0.5 gy gamma ray
Mean tuber Yield during Cropping season	52.5t/ha	65t/ha	58t/ha
No. of tubers /plant	162	91	68
HI	0.46	0.63	0.58
Protein	0.13%	0.04%	
Starch	9%	9%	
Yield during Three seasons Dec-May	10.32t/ha	17.5t/ha	
Feb. -July	32 t/ha	16.8t/ha	
April-Oct.	27.36 t/ha	16.5t/ha	

## Department of Olericulture

### 1. Effect of different seed extraction methods on recovery and quality of brinjal seeds

Treatments:

T<sub>1</sub> – Fermentation in water for 24 hours      T<sub>2</sub> – Fermentation in water for 48 hours

T<sub>3</sub> – Acid fermentation @ 5 ml / kg of pulp for 30 minutes      T<sub>4</sub> – Acid fermentation @ 5 ml / kg of pulp for 45 minutes      T<sub>5</sub> – Acid fermentation @ 10 ml / kg of pulp for 30 minutes      T<sub>6</sub> – Acid fermentation @ 10 ml / kg of pulp for 45 minutes

## Recovery percentage

Treatment	1998-99	1999-2000	2000-2001	Mean
T <sub>1</sub>	5.44	5.17	5.21	5.27
T <sub>2</sub>	5.41	5.25	5.45	5.37
T <sub>3</sub>	4.93	5.00	4.74	4.89
T <sub>4</sub>	5.20	5.11	5.24	5.18
T <sub>5</sub>	5.10	5.08	4.69	4.96
T <sub>6</sub>	5.09	5.16	5.18	5.14

CD (treatment means) = 0.132

## Inference

The treatments differed significantly for seed recovery over the years.

Extraction of brinjal seeds by fermentation in water for 48 hours is recommended for maximum seed recovery and germination.

## 2. Time of sowing and spacing levels on seed yield of okra

Treatments:

Sowing dates: D<sub>1</sub> - 15<sup>th</sup> May      D<sub>2</sub> - 30<sup>th</sup> May      D<sub>3</sub> - 15<sup>th</sup> June

Spacing      S<sub>1</sub> - 60 x 30 cm      S<sub>2</sub> - 60 x 45 cm      S<sub>3</sub> - 45 x 45 cm

## Seed yield (kg/plot)

Treatments	1997-98	1998-99	1999-2000	Mean
D <sub>1</sub> S <sub>1</sub>	1.11	0.83	0.83	0.92
D <sub>1</sub> S <sub>2</sub>	0.86	0.76	0.76	0.80
D <sub>1</sub> S <sub>3</sub>	1.17	0.91	0.91	1.00
D <sub>2</sub> S <sub>1</sub>	0.90	0.73	0.73	0.79
D <sub>2</sub> S <sub>2</sub>	0.70	0.72	0.72	0.71
D <sub>2</sub> S <sub>3</sub>	0.92	0.82	0.82	0.85
D <sub>3</sub> S <sub>1</sub>	0.79	0.66	0.66	0.70
D <sub>3</sub> S <sub>2</sub>	0.62	0.61	0.61	0.61
D <sub>3</sub> S <sub>3</sub>	0.83	0.77	0.77	0.79

CD (treatment means) = 0.09

## Inference

There was significant difference among the treatments over the years for seed yield in okra. Maximum seed yield was in the treatment D<sub>1</sub>S<sub>3</sub>. Maximum seed yield of okra (Arka Anamika) can be obtained by sowing on 15<sup>th</sup> May at spacing of 45x45 cm.

## 3. Effect of different levels of Nitrogen and Phosphorus on growth and seed yield of bittergourd var. Preethi

Treatments:

N levels : 0, 40, 80 and 120 kg/ha, P levels : 0, 20, 40 and 60 kg/ha

Recommended dose of K as : 25 kg ha<sup>-1</sup> per POP recommendations of KAU

Seed yield

Treatment	1998-99	1999-2000	2000-2001	Mean(g/plot)	Mean(q/ha)
N <sub>0</sub> P <sub>0</sub>	13.95	20.57	16.50	17.01	14.12
N <sub>0</sub> P <sub>20</sub>	11.18	24.68	17.78	17.88	14.84
N <sub>0</sub> P <sub>40</sub>	12.27	80.92	15.94	36.38	30.19
N <sub>0</sub> P <sub>60</sub>	9.95	74.70	26.78	37.18	30.86
N <sub>40</sub> P <sub>0</sub>	8.63	83.00	29.68	40.43	33.56
N <sub>40</sub> P <sub>20</sub>	13.50	48.63	28.89	30.34	25.18



N <sub>40</sub> P <sub>40</sub>	8.68	68.05	53.23	43.32	35.96
N <sub>40</sub> P <sub>60</sub>	14.25	43.98	55.67	37.97	31.51
N <sub>80</sub> P <sub>0</sub>	13.48	58.48	58.45	43.46	36.07
N <sub>80</sub> P <sub>20</sub>	15.20	48.70	37.85	33.92	28.15
N <sub>80</sub> P <sub>40</sub>	19.38	113.63	120.47	84.49	70.13
N <sub>80</sub> P <sub>60</sub>	14.78	61.10	59.03	44.97	37.32
N <sub>120</sub> P <sub>0</sub>	13.80	105.55	74.06	64.47	53.51
N <sub>120</sub> P <sub>20</sub>	16.70	83.68	84.85	61.74	51.24
N <sub>120</sub> P <sub>40</sub>	16.65	54.95	79.28	50.29	41.74
N <sub>120</sub> P <sub>60</sub>	15.98	47.70	100.74	54.81	45.49

CD (treatment means) - 16.21

CD (interaction means)

- 28.08

#### Inference

There was significant difference between the treatments over the years. The interaction between treatment and year is also significant. Over the years, the application of Nitrogen and Phosphorus at 80 and 40 kg/ha respectively and Potash at the recommended dose of 25 kg/ha has given higher seed yield in bitter gourd var. Preethi

#### 4. Heterosis and breeding for yellow vein mosaic resistance in Okra

An investigation on development of yellow vein mosaic virus (YVMV) resistant F<sub>1</sub> hybrids in Okra (*Abelmoschus esculentus* L.(Moench)) was under taken at the Department of Olericulture during 1999-2001. Fifteen Okra lines were crossed with two testers having high levels of resistance to YVMV in a line x tester mating design to produce 30 hybrids. These hybrids along with the patents were evaluated for several quantitative and qualitative characters and resistance to YVMV. Among them two hybrids AE-238 x AE-190 and AE-265 x AE-190 were disease free in field screening, grafting and vector transmission studies. These F<sub>1</sub> hybrids were also heterotic expressing 75 and 80 per cent heterosis respectively with respect to the standard variety.

#### 5. Varietal trial in cucumber

AAUC - 2, a cucumber variety from Assam Agricultural University was found high yielding. It produces light green fruits. Average fruit weight is 410g and average length 22 cm at vegetable maturity. Crop duration is 70 days.

##### Fruit yield

Sl.No.	Varieties	Yield (tones/ha)			
		1997-98	1998-99	1999-2000	2000-01
1	PCUC -28	41.12	14.27	55.32	28.41
2	AAUC-1	36.08	12.12	46.85	18.00
3	AAUC - 2	46.72	19.50	63.99	38.03
4	Poinsettia ①	32.34	7.29	36.92	24.52
5	DC - 1	31.69	11.98	34.80	22.58
6	AAUC - 3	38.77	11.59	-	-
7	CHC - 2	28.77	9.09	-	-
8	Sci 752 -10	33.91	-	-	-
9	PCUC - 8	-	8.07	26.07	180.44
10	PCUC - 15	-	10.76	53.33	23.09
11	CH - 20	-	10.83	45.90	17.10
12	CHC - 1	-	11.29	46.71	-
13	VRC -11-1	-	-	18.42	-
14	DC - 2	-	-	23.83	21.14

## 6. Control of nursery diseases of vegetable crops

## Treatments

T1- Thiride seed treatment @ 2g/kg seed, T2-Captaf seed treatment @ 2g/kg seed  
 T3- Apron seed treatment @ 2g/kg seed, T4-Dithane M-45 seed treatment@ 2g/kg seed, T5-Bavistin seed treatment @ 2g/kg seed, T6- Copper oxychloride seed treatment @ 2g/kg seed, T7-T1 + Thiride soil application 0.2% - 2 application. First after germination, second 20 days after germination, T8-T1 + Ridomil M-2 soil application (0.5%) as in T7, T9-T4 + Dithane M-45 soil application (0.2%) as in T7, T10- T2 + Captaf soil application (0.2%) as in T7, T11- T5 + Carbendazim soil application (0.1%) as in T7, T12- T6 + Copper oxychloride soil application 0.3% as in T7, T13- Soil inoculation with mucorrhiza, T14-Chlorothalonil seed treatment @ 2g/kg seed + soil treatment 0.2% as in T7, T15- Control

Average percentage of damping off incidence in tomato

Treatments	Rainy Season			Pooled mean
	1995	1996	1997	
T1	36.61	29.83	33.77	33.40
T2	20.09	31.26	14.96	22.10
T3	35.96	37.27	30.32	34.52
T4	34.30	41.02	34.29	36.54
T5	45.62	53.34	39.93	46.3
T6	28.15	37.53	26.6	30.76
T7	24.29	53.97	35.38	37.88
T8	20.34	13.34	26.47	20.05
T9	20.47	61.61	33.71	38.6
T10	16.96	6.48	11.83	11.76
T11	32.75	18.36	30.0	27.04
T12	18.22	27.29	26.18	23.9
T13	32.26	35.2	25.53	30.99
T14	22.0	13.99	21.7	19.23
T15	59.31	64.32	57.78	60.47
CD at 5%	22.171	13.088	14.161	13.66

Average percentage of damping off incidence in brinjal

Treatments	Rainy Season			Pooled mean
	1995	1996	1997	
T1	29.14	50.86	33.1	37.70
T2	19.24	37.01	23.42	26.56
T3	37.42	31.14	27.82	32.13
T4	41.40	55.88	43.89	47.06
T5	36.61	52.89	48.03	45.84
T6	19.2	35.33	24.76	26.43
T7	19.06	12.52	20.38	17.32
T8	19.97	22.5	21.8	21.42
T9	15.28	41.45	32.77	29.83
T10	13.06	18.34	13.81	15.07
T11	20.49	29.34	43.39	31.07
T12	18.15	22.35	20.95	20.48
T13	33.13	34.76	29.52	32.47
T14	24.38	27.39	31.78	27.85
T15	52.93	59.27	51.51	54.57
CD at 5%	18.913	19.938	16.712	10.32

Average percentage of damping off incidence in chilli

Treatments	Rainy Season			
	1995	1996	1997	Pooled mean
T1	33.23	37.19	24.47	30.96
T2	21.11	36.47	20.27	25.95
T3	32.8	29.42	20.99	27.74
T4	44.06	53.97	20.39	39.47
T5	26.7	62.22	23.27	37.4
T6	21.49	33.78	23.46	26.24
T7	18.8	34.62	16.24	23.22
T8	23.52	15.09	11.18	16.6
T9	23.73	39.92	22.59	28.75
T10	15.23	22.33	18.94	18.83
T11	18.18	50.39	36.85	35.14
T12	16.37	29.11	29.78	25.09
T13	33.25	36.0	25.96	31.74
T14	17.22	26.26	14.79	19.42
T15	58.33	74.05	47.09	59.82
CD at 5%	19.626	14.110	17.761	12.945

## Department of Plantation crops

### 1. Evaluation of Medicinal Plants

Adapathiyam and chittadalotakam are two medicinal plants suggested for commercial cultivation in Kerala. Collection and evaluation of germplasm accessions of adalotakam and adapathiyam was initiated during 1995 at the Department of Plantation Crops & Spices as a part of an ICAR Ad hoc project. Preliminary evaluation of 52 adalotakam accessions and 24 adapathiyam accessions revealed wide variability in economic and qualitative attributes. In adalotakam, 13 accessions found promising in PYT were compared in a CYT laid out in an RBD with 13 replications for two consecutive seasons (1997-1999 and 1999-2001). The four accessions found typical of chittadalotakam viz., AB5, AB 21, AB 3 and AB 9 which were high yielding were proposed for farm trial. In adapathiyam, six accessions found promising in PYT were compared in a CYT laid out in an RBD with four replications for two consecutive seasons (1997-1999 and 1999-2001). Two accessions, HA 8 and HA 7 which were high yielding and with high quality were proposed for farm trial.

#### a. Chittatalodakam

Description of the test variety

1. AB 5 Clonal selection from a collection from Malappuram, 2. AB 21 Clonal selection from a collection from Nilleshwar, 3. AB 3 Clonal selection from a collection from Pillicode, 4. AB 9 Clonal selection from a collection from Kozhikode

Performance of test cultures of Chittadalotakam

Accessions	Plant ht (cm)	No. of branches	No. of leaves	Leaf length (cm)	Leaf breadth (cm)	Yield g/plant				Vasicine content (%)
						Leaf	Stem	Root	Whole plant	
AB 5.	97.0	10.5	147	15.9	4.3	900	550	450	1.90	1.59
AB 21	120.0	12.0	129	15.97	3.87	500	300	262.5	1.06	1.65

AB 3	90.0	17.0	149	16.17	4.2	505	200	225	0.93	2.46
AB 9	93.5	10.5	167	17.7	4.3	370	200	237.5	0.81	2.55

Comparative yield trial on Chittadalotakam (1997-2001)

Accessions	Whole plant yield kg/plot			Yield (t ha <sup>-1</sup> )
	1997-1999	1999-2001	Pooled mean	
AB 3	5.79	7.11	6.45	39.78
AB 4	7.80	7.50	7.65	47.18
AB 5	10.95	9.6	10.28	63.39
AB 6	4.59	4.8	4.70	28.98
AB 9	5.10	6.15	5.63	34.72
AB 15	6.60	6.45	6.53	40.27
AB 18	2.76	2.73	2.75	16.96
AB 21	6.87	7.89	7.38	45.51
AB 23	4.17	4.17	4.17	25.72
AB 40	3.21	3.24	3.23	19.92
AB 43	5.43	4.15	4.79	29.54
AB 44	2.52	3.33	2.93	18.07
AB 50	4.39	3.72	4.06	28.37

## a. Adapathiyam

Description of the test variety

HA 8 Clonal selection from a collection from Ernakulam, HA 7 Clonal selection from a collection from Mundoor

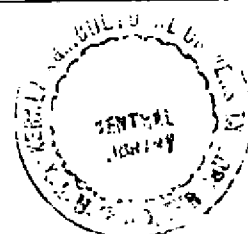
Performance of test cultures of adapathiyam

Characters	Cultures	
	HA 8	HA 7
Length of vine (cm)	200.0	340.0
No. of leaves	49.0	51.50
Leaf area (sq.cm)	62.19	43.17
Collar girth (cm)	3.0	2.75
Internodal length (cm)	4.6	4.50
Fresh root yield (g plant <sup>-1</sup> )	275.0	200.0
Root length (cm)	154.0	4.0
Root girth (cm)	180.0	4.5
Total free amino acids (%)	0.62	0.60
Protein (%)	0.86	0.79
Soluble sugar (%)	6.33	6.09
Insoluble sugar (%)	35.26	34.89

Comparative yield trial on adapathiyam (1997-2001)

Accessions	Fresh root yield (g plant <sup>-1</sup> )			Yield (t ha <sup>-1</sup> )
	1997-1999	1999-2001	Pooled mean	
HA 1	442.5	478.2	460.35	2.84
HA 4	483.75	491.1	487.43	3.01
HA 7	605.10	639.3	622.2	3.84
HA 8	713.40	750.05	731.73	4.51
HA 19	516.00	499.65	507.83	3.13
HA 21	548.25	554.40	550.83	3.40

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## 2. Farm trial results on turmeric

Farm trial on turmeric was conducted in nine locations, three each in Ernakulam, Thrissur and Palghat districts during 2001- 2002. The data on rhizome yield gathered from eight locations revealed the superiority of the test cultures (VK 146 < VK 96 < VK 230) over the check variety Sobha. The yield increase over the check variety ranged from 25.9 % (VK 230) to 49.26 % (VK 146). Rhizome rot disease was not reported in any of the cultures. Shoot borer attack was reported from three locations which ranged from 1.0 % to 30.0 %

Farm trial data on turmeric

Locations	Fresh rhizome yield kg/3m <sup>2</sup>			
	VK 96	VK 146	VK 230	Sobha
Kandanasseri	3.25	3.30	3.18	3.10
Thekkumkara	21.6	46.8	21.6	8.4
Neriamangalam	21.0	17.0	20.0	20.0
Vyttila	2.3	2.0	1.2	2.0
Okkal	8.6	8.7	9.8	9.9
Tarur	13.0	12.0	4.7	7.5
Peruvamba	17.5	21.5	21.0	18.5
Kannambra	48.0	45.0	56.0	39.0
Mean	16.90	19.54	17.19	13.55
Green rhizome yield (t ha <sup>-1</sup> )	32.19	37.22	32.74	25.81
Driage (%)	19.05	18.88	18.10	18.23
Dry rhizome yield (t ha <sup>-1</sup> )	6.13	7.03	5.93	4.71
Per cent increase over check variety	30.14	49.26	25.90	

## 4. Farm trial results on kacholam

Farm trial on kacholam was conducted in nine locations, three each in Ernakulam, Thrissur and Palghat districts during 2001- 2002. The data on rhizome yield gathered from six locations revealed the superiority of the test cultures (KG 27 < KG 6 < KG 19 < KG 2) over the check variety Sobha. The yield increase over the check variety ranged from 91.21% (KG 2) to 167.03 % (KG 27).

Very mild incidence of leaf spot disease ( 1%) was reported from two locations.

Farm trial data on Kacholam

Location	Green rhizome yield kg/2m <sup>2</sup>				
	KG 2	KG 6	KG 19	KG 27	Local
Kadangode	2.5	2.0	1.75	3.0	
Madakkathara	4.5	5.1	4.5	4.2	
Neriamangalam	3.0	4.5	5.0	4.5	
Vyttila	1.0	1.7	0.75	1.0	
Okkal	1.1	1.5	2.7	2.0	
Ottapalam	0.9	1.1	1.25	1.2	0.95
Mean	2.17	2.65	2.66	2.65	0.95
Raw rhizome yield (t ha <sup>-1</sup> )	5.79	7.07	7.09	7.07	2.53
Driage (%)	30.0	32.86	32.78	34.48	36.0
Dry rhizome yield (t ha <sup>-1</sup> )	1.74	2.32	2.32	2.43	0.91
Percent increase over local check	91.21	154.94	154.94	167.03	

## AROMATIC AND MEDICINAL PLANTS RESEARCH STATION, ODAKKALI

### Research projects in operation

1. Integrated management of the banana pseudostem weevil, *Odoiporus longicollis* Oliv. (Curculionidae : Coleoptera) - ICAR Adhoc- Project
2. Development of agrotechnology for medicinal plants used in ayurveda, siddha, unani and homoeopathy – CSS (Min. of Health & Family Welfare, GOI)
3. KAU Plan Projects
  - i. Synthesis of commercially important compounds from cinnamon leaf oil.
  - ii. Collection, maintenance and evaluation of germplasm of *Garcinia cambogia* Desrous
  - iii. Yield and chemical characterisation of selected accessions of lemongrass in the germplasm.
  - iv. Evaluation of *Ocimum* species for yield and quality of oil
  - v. Germplasm collection, maintenance and evaluation of lemongrass and palmarosa.
  - vi. Germplasm collection, maintenance, evaluation and multiplication of medicinal and aromatic plants
  - vii. Isolation and characterisation of principal constituents of *Piper longum*, *Alpinia* sp. and *Coleus aromaticus*

### Salient findings

#### Banana

Integrated management of the banana pseudo stem weevil, *Odoiporus longicollis* Oliv. (Curculionidae : Coleoptera)

#### Salient findings

- Even though different treatments were found as effective repellents for management of the pseudostem weevil, swabbing with mud slurry at monthly interval from 5<sup>th</sup> month of planting was the cheapest. Since this method is practicable in small gardens only, application in leaf axil and spray on pseudostem with emulsions of 2% neem oil/2% punna oil/2% pongamia oil/0.1% chlorpyrifos 20EC at monthly interval from 5<sup>th</sup> month of planting may be resorted to in large plantations.
- Covering of the pseudostem with colourless polythene or with plastic gunny is effective in reducing damage by *O. longicollis*.
- Injection of monocrotophos 36EC (the use of monocrotophos is banned) or chlorpyrifos 20EC or neem oil at 2.0% concentration in already infested banana plants reduces the damage by the banana weevils.
- Economic damage by the infestation of banana pseudostem weevil is caused only when the infested plants topple down due to heavy damage before maturity of the bunch resulting in the loss of saleable bunch.
- The application of carbofuran @ 750 mg a.i./plant in soil at 0, 2<sup>nd</sup> and 5<sup>th</sup> month followed by leaf axil application @ 375 mg a.i./plant at 7<sup>th</sup> month is a safe, effective and economical management measure against the banana pseudostem weevil, *O. longicollis*.
- From the results of the experiments for developing an integrated strategy for the management of pseudostem weevil, it was clear that either 0.1% chlorpyrifos spray in leaf axil and pseudostem or carbofuran 3G application at 375mg ai/plant at 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> month in leaf axil need to be resorted to in the successful management of pseudostem weevil. Two percent neem oil spray in leaf axil and pseudostem or swabbing mud slurry alone or covering pseudostem with colourless polythene shall be resorted to for the management of *O. longicollis* in small gardens and to avoid synthetic insecticide applications since these

treatments were also comparable with the most effective treatments such as chlorpyrifos spray or carbofuran application. If placement of split pseudostem is done in the field, it acts as an attractant trap for the adult weevils. The data are presented in Tables 1 & 2

### Medicinal Plants

Development of agrotechnology for medicinal plants used in ayurveda, siddha, unani and homoeopathy

- Two species of *Curculigo* were identified. The commonly used species *Curculigo orchioides*, is seen in midlands where, the soil is generally lateritic and the other species, *Curculigo trichocarpa* is present exclusively in forests and prefers rich humus soil for its growth. The morphological variability of the two species was studied and described in detail.
- It was noticed that the *Holostemma ada-kodien* when planted in the field, continue to produce thin hairy roots and the root thickening will start only when elongation is hindered by a hard pan /obstruction. Commercially it is more advantageous to raise the plants in large polybags where the root elongation can be restricted. The optimum stage of harvest for obtaining maximum tuber yield is between 6 and 12 months while for obtaining better quality harvesting at 18 months is found to be optimum. Thus, the importance of quality criteria is brought out while fixing optimum time of harvest and the study has to be continued for fixing the optimum time of harvest.
- Manuring trials in *Saraca asoka* is in progress and the morphological observations so far collected indicate that the plant is responding more to organic manures. The common adulterant of crude drug of *Saraca asoka* is the bark of *Polyalthia longifolia*. The anatomical studies of the two species show distinct variations. Plant samples of different ages are collected from different locations and the quantitative estimation of alkaloids of different parts of the plant samples were carried out. The maximum tannin content was seen in bark. The tannin content of the bark of the adulterant *Polyalthia longifolia* is only 50% than that of Asoka.
- *Strychnos nux-vomica* responded positively to organic manures. Extraction and HPLC method for estimation of the alkaloid strychnine is standardised. Strychnine and brucine contents varied with plant part as well as age of the plant.

#### I. *Curculigo orchioides*

##### a. Morphological description of *Curculigo* species

During collection of *C. orchioides* from wild, another type could be identified as one belonging to the species *trichocarpa* and they are described.

##### b. Effect of shade and spacing on the yield and quality of *Curculigo orchioides*

The data showed that *Curculigo orchioides* requires low light intensity for proper growth and development. It is a shade loving plant and requires only 25% light penetration (below 25000 lux). The plant can be successfully grown under a 3-tier intensive intercropping system. The closer spacing of 10 x 10 cm is found to give higher tuber yield. The experiment is being continued.

##### c. Manurial requirements of *Curculigo orchioides*

The data so far collected indicate no substantial effect of manuring on the growth of *Curculigo orchioides*. The trial is being continued.

##### d. Effect of sources of nutrients on yield and quality of *Curculigo orchioides*

Treatment: 8x2=16 Sources of nutrients: Control, FYM 10t/ha, Vermicompost 1.3 t/ha, Poultry manure 2.7 t/ha FYM 10t/ha + *Azotobacter* 10 kg/ha, FYM 10t/ha + *Phosphobacter* 10 kg/ha FYM 10t/ha + VAM 10 kg/ha, Fertiliser N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O: 40:30:20 kg/ha

Mulching: With and with out mulching

Among the various sources of nutrients tested application of FYM with biofertilisers (Azotobater, Phosphobacter and VAM) showed better growth of the plant. The study is being continued.

## II. *Saraca asoca*

### a. Manurial requiriments of *Saraca asoca*

Treatments: Control, NPK- 100: 50: 50 kg/ha, FYM - 20 kg /pt, Vermicompost - 10 kg /pt Biofertilizer- 20gm/pt + 10 kg FYM, (Rhizobium + Phosphobacter), NPK + FYM -full dose, NPK + FYM -half dose

Mean plant height, No of branches and No of leaves after two years of growth was 29.85, 4.42 & 13.28. It can be seen that the plant responds well to organic manuring and also to biofertilisers as evident from the treatments T<sub>3</sub>&T<sub>5</sub>. Here the plants respond very positively for fertilizers when applied along with Farm yard manure (T<sub>6</sub>).

## III. *Holostemma ada-kodien*

### a. Manurial requirements of *Holostemma ada-kodien*

Treatments: Control, NPK-100:50:50, FYM -30 Kg/ pt, Vermicompost- 10 Kg/pt Biofertiliser-20 gm/pt +K@ 50 Kg /ha, NPK+FYM full dose, NPK+FYM half dose

The maximum yield was obtained in farm yard manure plots. The biofertiliser treatment did not show any benefit. Though yield increased with NPK application over control, the yield was only 50% of that of farmyard manure treatment. Application of FYM along with NPK increased the yield substantially over NPK alone. This again confirms the beneficial effect of FYM. The yield from the combined application of NPK and FYM was significantly lower than FYM alone (Table 3).

Table.3. Yield of tubers at harvest.

Treatment	Fresh weight (gm/pt)	Dry weight (gm/pt)
TI Control	14.33	2.75
NPK -100:50:50	74.00	12.40
FYM -30 Kg/ pt	150.00	47.75
Vermicompost- 10 Kg/pt	54.00	13.00
Biofertiliscr-20 gm/pt +K	21.00	3.25
NPK+FYM full dose	127.33	33.33
NPK+FYM half dose	85.00	25.75
Mean	75.09	34.55

The maximum yield was obtained in farmyard manure plots. The biofertiliser treatment did not show any benefit. Though yield increased with NPK application over control, the yield was only 50% of that of farmyard manure treatment. Application of FYM along with NPK increased the yield substantially over NPK alone. This again confirms the beneficial effect of FYM. The yield from the combined application of NPK and FYM was significantly lower than FYM alone.

### b. Yield and quality of *Holostemma ada-kodien* at different stages of growth.

*Holostemma ada-kodien* was planted in plots as well as in poly-bags to find out the optimum stage of harvest. Plants were uprooted at the end of 6 months, 12 months and 18 months. Data are presented in table 4. Nitrogen, protein, ash, crude fibre and crude fat contents of rhizomes also increased progressively with age up to 18 months with a concomitant decrease in the content of starch.

Table 4. Yield and quality of *Holostemma ada-kodien* at different stages of growth.

Stage of harvest (months)	Yield of Rhizomes (g/plant)		Nitrogen (%)	Protein (%)	Ash (%)	Crude fibre (%)	Starch (%)	Crude fat (%)
	Fresh wt.	Dry wt.						
6	220.05	99.65	1.13	7.56	3.01	7.69	56.43	1.98



12	178.62	126.42	1.81	11.28	4.71	16.70	52.79	2.10
18	103.01	25.5	2.43	15.18	6.20	23.30	42.38	3.23
24	46.04	11.37	1.87	11.68	4.97	22.05	35.82	1.76

The best harvest stage would be the one when the rhizome yield is maximum and protein, ash and crude fat contents are high. The data available so far are insufficient to identify the optimum stage of harvest. The study will be continued for one more year for ascertaining this stage.

#### IV. *Strychnos nux-vomica*

##### a. Manurial requirements of *Strychnos nux-vomica*

Treatments: 7 Control, NPK- 100: 50: 50 kg/ha, FYM - 20 kg /pt, Vermicompost - 10 kg /pt  
Biofertilizer- 20gm/pt + 10 kg FYM, (Azatobacter + Phosphobacter)

NPK + FYM -full dose, NPK + FYM -half dose

Manuring was done as per treatment two times in a year during the months of June and September. Mean plant height, No of branches and No of leaves after one and half years of growth is 33.07, 5.74 & 22.01 respectively. It can be seen that the plant responded very well to organic manuring as evident from the treatments T<sub>3</sub> & T<sub>4</sub>. An interesting observation is that fertilizer application is generally detrimental to the growth of *Strychnos*. However, when farmyard manure is applied in fertilizer applied plots, the negative effect of fertilizer could be neutralized to some extent.

##### b. Quality analysis of different plant parts of different age groups of *Strychnos nux-vomica* as well as from various localities

The study has revealed that in *Strychnos nux-vomica*, root bark is the most concentrated source of strychnine (1.775%) followed by stem bark (0.963%). Although strychnine was present in leaf and seed to the extent of 0.235% and 0.379% respectively, the levels were much less than those in root and stem bark. Mean brucine content of *Strychnos nux-vomica* was highest in root bark (2.887%) followed by stem bark (2.140%). Root wood and stem wood also contained brucine but at very low levels, 0.440% and 0.015% respectively. Small amounts of brucine were also available in leaf and seed (0.474% and 0.591% respectively). In summary, root bark is the richest source of the alkaloid brucine followed by stem bark.

##### c. Quality evaluation of *Strychnos nux-vomica* and *Strychnos wallichiana*

Brucine content of stem bark ranged from 0.364% to 1.247% with an average of 0.800% and it was the best source of the alkaloid when compared to other plant parts. The alkaloid contents of other parts were too low to be considered as important. Root bark and stem bark were found to be the richest source of both the alkaloids in *Strychnos nux-vomica* where as in *Strychnos wallichiana* root bark was the best source of strychnine and stem bark the best source of brucine. No relationship was apparently noticed between the alkaloid content of different parts and age of the plant. On the other hand, plants having same age collected from different places of the state showed wide variations in the total alkaloid content (strychnine + brucine). This variation can be attributed to the genetics, age and ecological factors. The genetic difference if any among the plants studied and the influence of eco-climatic factors on alkaloid content require detailed examination.

##### d. Phytochemical investigations on selected medicinal plants

Analytical methods for estimation of curculigosides in *Curculigo orchioides*; solacidin in *Solanum* spp. and hydroxy citric acid in *Garcinia cambogia* have been standardized. Chemotypical variability of the above plants available in the state was studied.

Table 1. Effect of different management methods on growth and yield attributes of banana *var.* Nendran (Expt. 2., 2000-01)

Treatments (Monthly from 5 <sup>th</sup> MAP)	No. of green leaves at			Ht. of plant (m)	Girth of plant at			No. of hands/ bunch	Wt. of bunch (kg)
	7 <sup>th</sup> MAP	8 <sup>th</sup> MAP	9 <sup>th</sup> MAP		Base (cm)	Centre (cm)	Top (cm)		
1) Fresh pseudostem split into two equal halves and placed vertically	9.4 ab	10.5	8.6	3.49	53.3	39.3	29.4	5.0	7.1
2) Fresh pseudostem split into two equal halves and placed vertically + Spraying 2% neem oil on pseudostem and leaf axils	10.0 a	10.3	8.8	3.56	49.7	37.3	28.4	5.0	7.1
3) Fresh pseudostem split into two equal halves and placed vertically + Spraying 0.1% chlorpyrifos 20EC on pseudostem and leaf axils	7.8 e	9.7	8.0	3.74	52.7	39.5	30.0	4.8	7.5
4) Fresh pseudostem split into two equal halves and placed vertically + swabbing with mud slurry	8.1 de	9.3	8.5	3.58	52.4	38.6	28.4	5.3	7.6
5) Fresh pseudostem split into two equal halves and placed vertically + covering with colourless polythene	8.4 cde	10.0	8.0	3.49	50.9	38.5	28.3	4.6	5.5
6) Fresh pseudostem split into two equal halves and placed vertically + Spraying 2% neem oil on pseudostem and leaf axils + covering with colourless polythene	9.3 abc	10.5	8.7	3.52	53.5	40.8	30.2	5.0	7.3
7) Fresh pseudostem split into two equal halves and placed vertically	8.8 bcd	9.8	8.3	3.63	52.5	38.3	29.3	4.4	5.3
<b>Significance</b>	**	NS	NS	NS	NS	NS	NS	NS	NS
CDat5%level	0.9	--	--	--	--	--	--	--	--

MAP- Months after planting. NS- Not significant. \*\* Significant at 1% level. Figures in a column followed by same letters are not significantly different.

Table 2. Effect of different management methods on damage by *O. longicollis* on banana var. Nendran (Expt. 2., 2000-01)

Treatments (Monthly from 5 <sup>th</sup> MAP)	No. of Adults	No. of larva	No. of pupa	Total no. of live stages	Length of damage(cm)	Height of damage (cm)
1) Fresh pseudostem split into two equal halves and placed vertically (Check)	2.8 (1.62) bc	5.8 (2.13)	0.3 (0.90) ab	8.9 (2.58) bc	43.0(5.57) bcd	13.2
2) Fresh pseudostem split into two equal halves and placed vertically + Spraying 2% neem oil on pseudostem and leaf axils	0.7 (1.06) ab	1.0 (1.17)	0.1 (0.77) ab	1.8 (1.42) ab	36.4 (5.11) abcd	12.5
3) Fresh pseudostem split into two equal halves and placed vertically + Spraying 0.1% chlorpyrifos 20EC on pseudostem and leaf axils	0.0 (0.71) a	0.0 (0.71)	0.0 (0.71) a	0.0 (0.71) a	0.0 (0.71) a	No damage
4) Fresh pseudostem split into two equal halves and placed vertically + swabbing with mud slurry	1.1 (1.20) ab	0.9 (1.14)	0.2 (0.80) ab	2.2 (1.53) ab	24.0 (4.25) abc	17.8
5) Fresh pseudostem split into two equal halves and placed vertically + covering with colourless polythene	2.4 (1.56) bc	2.3 (1.53)	0.6 (1.05) b	5.4 (2.18) bc	87.9 (9.32) d	28.3
6) Fresh pseudostem split into two equal halves and placed vertically + Spraying 2% neem oil on pseudostem and leaf axils + covering with colourless polythene	1.2 (1.23) ab	1.0 (1.10)	0.2 (0.84) ab	2.4 (1.54) ab	11.3 (2.52) ab	7.2
7) Fresh pseudostem split into two equal halves and placed vertically (Check)	4.0 (2.10) c	5.6 (2.47)	1.4 (1.39) c	11.1 (3.40) c	104.2(10.13) c	67.0
<b>Significance</b>	*	NS	**	*	*	
<b>CDat5%level</b>	(0.71)	—	(0.30)	(1.41)	(4.67)	

MAP- Months after planting. NS- Not significant. \* Significant at 5% level. Figures in parenthesis are transformed  $\sqrt{x+0.5}$  values. Figures in a column followed by same letters are not significantly different.

## CROPPING SYSTEM RESEARCH SUB CENTRE, VADAKKENCHERY

### I. Substitution of transplanting and hand weeding methods by drum-seeding and cono-weeding techniques in lowland rice in Kerala

The study was conducted to evaluate the methods of drum-seeding and cono-weeding techniques for replacing transplanting or broadcasting methods and hand weeding under on-farm conditions in various rice cropping systems and seasons, in Kerala, at various locations in Kerala, viz., Kuzhalmannam during *rabi* 1999-00, Kollengode during *kharif* and *rabi* 2000-01 (irrigated rice-rice system) and Rayamangalam during summer 2001 (irrigated rice-rice-rice systems).

#### Methodology

The TNAU seed drum, which is of combined type to sow sprouted paddy seeds and un-sprouted green manure seeds in alternate rows, was used for seeding in lines. Paddy seeds, with radicle just emerging was used for sowing with the seed-drum. Seeds were soaked in water for 24 hours and incubated for 12 hours. Green manure seeds and paddy seeds were placed in hoppers alternately fixed. The seeder has one ground wheel in the centre with 318 mm diameter. Two floats are provided to facilitate smooth sliding of the seeder on soft puddled mud. It is light and easy to pull manually by one person. Drum-seeding was done after settling of the puddled soil. The paddy seed hoppers are provided with large holes and green manure hoppers are with small holes. On pulling the seeder paddy seeds are placed in three rows at spacing of 25 cm, with one row of green-manure in the middle of the paddy rows.

For direct broadcasting, well-germinated paddy seed, i.e., soaked in water for 24 hours and incubated for 24 hours, was broadcasted over puddled soil. For drum-seeding and broadcasting treatments the water level was maintained at 1 cm above the soil. For transplanting, nursery was sown on the same day of seeding the treatments, uprooted on 25<sup>th</sup> day and planted at a spacing of 15 cm x 10 cm, by manual method. First hand weeding as per treatments were done on the 21<sup>st</sup> day before the first top dressing of fertilizers and the second hand weeding done on 45<sup>th</sup> day before the next top dressing of fertilizers. For chemical weed control pretilachlore @ 1 kg ai ha<sup>-1</sup> and 2,4-D @ 1.25 kg ai ha<sup>-1</sup> were sprayed as pre and post-emergent herbicides, respectively. On 20<sup>th</sup> day of sowing in T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub>, cono-weeder was operated for incorporation of green manures or weeds as per the treatments. All plots were kept weed free up to 45 days after sowing or 20 days after transplanting.

#### Results obtained

The trial conducted at Kuzhalmannam during *kharif* 1999-00 revealed that the direct seeded crop gave a yield as good as transplanted crop. The highest yield was observed in the crop sown by drum-seeder and the weed control effected through incorporation by cono-weeder. At Kollengode, during both *kharif* and *rabi* (2000-01) seasons, the direct seeded crop was found better than transplanted crop. During *kharif* season, all the direct seeded plots, whether drum-seeded or broadcasted, were similar in performance but superior to transplanting. During *rabi* season, the highest yield was observed in plots where the combined seeding of paddy and *Sesbania rostrata* was done and the weeds and green manures incorporated by cono-weeder. However, other treatments involving combined seeding of paddy and *Sesbania aculeata* + cono-weeding; and drum seeding paddy alone + cono-weeding also gave comparable yield. These treatments gave yield

levels equal to transplanting+ hand weeding. The performance in broadcasted plots, whether hand weeded or chemically weeded and also drum-seeding with chemical weeding were significantly poor, evidently due to less plant population and low panicle density. The trials conducted in Ernakulam district during summer 2001, also revealed that there was no yield reduction when the crop was sown by drum-seeder. Similarly, the weed removal by hand weeding did not have any yield advantage over herbicidal weed control or cono-weeding.

Drum-seeding of paddy and green manure seeds and incorporation of weeds and green manures by cono-weeder resulted in a saving of Rs. 2490 ha<sup>-1</sup> over that of broadcasting and hand weeding, and of Rs.4490 ha<sup>-1</sup> over transplanting. Seeding of paddy alone by drum-seeder and weed incorporation through cono-weeding saves Rs.2690/ per hectare over broadcasting + hand weeding and Rs.4690/ per hectare over transplanting + hand weeding. The results revealed that the grain yield by drum seeding method was better than direct sowing and transplanting, and hence, direct drum seeding can be safely introduced as a substitute for transplanting without sacrificing productivity.

Both lone paddy seed-drums and combined seed-drums are available. Various types of lone paddy seed-drums (six row, eight row etc) are also available. It is possible to fabricate the seed-drums and cono-weeder according to the local requirements. Large scale adoption of this technology requires the efforts of development agencies for transfer of technology and supply of the machineries. (Table 1&2)

Participatory technology evaluation and adoption programme on Drum-seeding technology by KAU and Department of Agriculture (Collaborative work of CSR Sub-Centre, Nalleppilly, Polpully and Erimayur Krishi Bhavans)

(i) Frontline demonstration

Location: 1. Nalleppilly, 2. Polpully, 3. Erimayur Season – Rabi, 2001-02.  
(October-March 1<sup>st</sup> wk)

Location	Variety	Area (ha)		Yield (kg/ha)	
		Transplanting	Drum-seeding	Transplanting	Drum-seeding
(1)Chittur	1. Jyothy	0.20	0.20	4250	4920
	2. Jyothy	0.40	0.40	5100	5400
	3. Jyothy	0.20	0.20	5100	6460
	4. Karishma	0.40	0.40	3600	4050
(ii) Kuzhalmannam	ASD-16	0.20	0.20	4875	5200

(ii) Feed back analysis of drum-seeding technology (Chittur-Nalleppilly pilot project)

Salient results of survey conducted among the farmers who adopted drum seeding during mundakan, 2001-02 at Nalleppilly, in Chittoor taluk.

Number of farmers	:	19
Area covered	:	42 ha
Varieties used	:	Jyothy, Kanchana, Karishma, Uma, Santhi, Pavithra and Bhadra
Crop establishment method previously used	:	Manual transplanting
Reason for drum seeding	:	High cost in transplanting method, lack of availability of labour, and high labour charge

Varieties previously used	:	Jyothy, Jay, Ponmany, Santhi, Kanchana, Mushuri, Vellapponni
Whether conoweeder used	:	Yes (80% farmers)
Reason for not using conoweeder	:	Lack of timely availability of Cono-weeder, less intensity of weeds
Use of weedicide	:	Refit – 1 farmer Fernozone – 1 farmer Nil – 90%

Hand weeding: For supplementary weed control after conoweeding. On an average 25 labourers per hectare was utilised.

Opinion of farmers: Better crop geometry, optimum plant population and higher yield. Less labour requirement, low cost of production. Cono-weeding replaces the requirement of labourers for hand weeding. Fertilizer application after cono-weeding increases the efficiency.

Adoption constraints

Suitable varieties for drum seeding to be identified. Location-specific improvement of the machine required. Lack of adequate number of seeder and conoweeder has to be solved. Modifications required to evolve seed-drums suitable for monsoon period and also for *poonthalpadams*.

## **II. Site-specific identification and recommendation of rice varieties for group management in rice cropping systems in the central zone**

Multiplicity of varieties with varying duration and other characteristics in a farming situation often hinders effective group management of rice. Identification and cultivation of the most suitable variety on system basis in each farming situation should be the topmost priority to increase production and productivity of rice in Kerala. Once the appropriate variety is identified, the local development agencies and Peoples Planning Programmers could pursue further action to make available the required seeds and promote group management in rice cultivation.

The relevant results with yield data obtained during 2001-02 are presented in the section.

Palakkad district

### **1. Alathur Block**

The results reveal that, if the cropping system demands varieties of about 114 days for virippu, Harsha would be the appropriate variety suitable for dry sowing, For mundakan, if the crop period available is short, ASD-16 (white rice) would be the most suitable variety. If red rice is preferred, Harsha or Mattatriveni should be selected. If about 120 days crop period available, Bhadra would be the best one. The next choice can be Athira, Aruna or Kanchana. If it is possible to go for 130 days varieties, Uma would be definitely better than all other varieties.

### **2. Kuzhalmannam Block**

In Kuzhalmannam block, during virippu, ADT-43, a white rice variety was found the best among the short duration group. It was followed by ASD-16 (white rice) and Mattatriveni, Aiswarya and Harsha (red rice varieties), but significantly less yield than ADT-43. Among the medium duration varieties, Cul.210-25 out-yielded all other varieties. Panchamy and Remanika occupied the second and third positions respectively. During mundakan, ASD-16 was found the best, among the short duration group. It was closely followed by Athira and

Kanchana. Among the medium duration varieties, highest yield was observed in Aruna. Bhadra also gave comparable yield.

### 3. Kollengode and Chittur blocks

The results of the trials conducted at Kollengode and Chittur blocks, reveal that varieties of duration 117 to 137 days would be appropriate for virippu season. If the crop could be transplanted by June middle varieties upto 137 days viz., Cul. 210-25, Bhadra, Athira or Remanika can be included in the cropping scheme. If the crop season period available is less, it would be better to go for ASD-16, Mattathriveni or Aiswarya. For mundakan season, varieties must be selected to suit the harvest latest by February end to achieve maximum efficiency of irrigation water. If the nursery sowing is possible only after virippu harvest, varieties of duration 120-130 days must be selected. If white rice is preferred, ADT-38 or CO-43 can be chosen. If red rice is the preference, Uma, Bhadra or Aruna should be the choice. Long duration varieties would be possible if the nursery could be sown before the virippu harvest. The variety, IET.14735 and Pranava (140 days) gave comparable yield to that of Ponmani with 161 days.

### 4. Nemmara block

Among the short duration varieties, Jyothy (118 days) gave the highest yield (4100 kg/ha). Aiswarya and Harsha also performed better with an average yield of 3825 kg ha<sup>-1</sup> and 3675 kg ha<sup>-1</sup> respectively. Among the medium duration varieties, Revathy gave the highest yield (4800 kg ha<sup>-1</sup>). Renjini and Athira (4100 kg/ha) occupied the second position. During mundakan, Jyothi (123 days) gave the highest yield (5000 kg ha<sup>-1</sup>) followed by ADT-38 (4750 kg ha<sup>-1</sup>) and Aiswarya (4625 kg ha<sup>-1</sup>).

#### Thrissur District

1. Wadakkanchery Block : In Wadakkanchery block, which is a dry sown belt for Virippu season, short duration varieties are preferred. Remanika (115 days) gave the highest yield (4221 kg ha<sup>-1</sup>) give significantly better yield than the predominant variety Ahalya (3631 kg ha<sup>-1</sup>). Harsha and Aiswarya (107 days) gave yield comparable to Remanika. During mundakan, Kanakam recorded the highest yield (4078 kg ha<sup>-1</sup>) followed by Krishnanjana (3853 kg ha<sup>-1</sup>) and Uma (3738 kg ha<sup>-1</sup>). These varieties took 117 days for maturity.

2. Chalakudy Block : The trials were conducted at Koratty Panchayath during virippu only. In this region, Aiswarya gave the highest yield (3713 kg ha<sup>-1</sup>) followed by Kanchana (2925 kg ha<sup>-1</sup>) and Matta Thriveni (2813 kg ha<sup>-1</sup>). In group II, Renjini (127 days) was found better (3840 kg ha<sup>-1</sup>). Jyothi and Athira with less duration (116 days) gave comparable yield (3450 and 3368 kg ha<sup>-1</sup> respectively). However these varieties did not out yield the local variety viz., *Ponmani*.

3. Kole (Puzhakkal Block) : The trials were conducted during Mundakan period (kole first crop) in Adat Panchayath. Among the short duration varieties, Bhadra was found the best one (6128 kg/ha) suitable for mundakan kole. Cul-210-25 and Renjini also gave less yield (5425 and 5255 kg/ha, respectively), they were statistically on par with Bhadra.

Among the medium duration varieties, Uma (123 days) be the highest yield of 6389 kg ha<sup>-1</sup>. Pavithra, Pavizham, and Kanakam (118-123 days) also give comparable yields. While deciding the varieties for the region, the cropping period available has to be taken into account.

## Ernakulam District

1. Koovappady Block : The yield level during virippu season was very poor. Among the group I varieties, Kanchana (115 days) gave the highest yield 2853 kg ha<sup>-1</sup> followed by Cul-210-25 (2590 kg ha<sup>-1</sup>) and Mattathriveni 115 days with 2521 kg ha<sup>-1</sup>. Consider the less duration, Kanchana or Matta Thriveni would be the better choice, if crop period is about 115 days. If medium duration varieties are preferred. Athira (130 days) would be the better one.

2. Vadavukod Block : During Virippu, Kanchana has be the better short duration variety. During mundakan season, Kanakam be the highest yield (3343 kg ha<sup>-1</sup>) followed by Revathy (3230 kg ha<sup>-1</sup>) and Pavizham (3115 kg ha<sup>-1</sup>). The yield of PTB-20-D-1 was significantly lower than Kanakam.

## III. Rice production and HY variety coverage in Palakkad – revelations of survey

### (j) HYV coverage

Analysis of the area under high yielding varieties (HYV) (Farm Guide, 2000 and previous issues) show that its coverage is very poor in Palakkad district as compared to State average. The HYV coverage during virippu and mundakan are 21.0 and 23.77%, respectively. The documentation of low HYV coverage during virippu may possibly due to the cultivation non-descript varieties. Similarly, during mundakan season, tall and long duration varieties are taken up in many parts of the district, which have not been documented as HYV varieties. The results of field level survey on variety coverage in eastern Palakkad reveal that the HYV coverage is very high in the region. Mostly varieties released from KAU are cultivated.

#### Variety distribution in eastern Palakkad

Sl. No.	Virippu			Mundukan		
	Variety	Area (ha)	% coverage	Variety	Area (ha)	% coverage
1	Kanchana	10535	19.22	Ponmany	11903	22.94
2	Kunjukunju	9164	16.72	Kanchana	8215	15.87
3	ASD-16	6433	11.74	ASD-16	4835	9.32
4	Aiswarya	3484	6.36	Kunjukunju	4129	7.96
5	Kanakom	3385	6.18	Ponni	4014	7.74
	Total		60.22			63.83
	31 vars		39.78	30 vars		36.17

### (ii) Rice productivity vs uniform cropping pattern

Although the district enjoys better soil and irrigation facilities, productivity is almost on par with state average. The state average yield of rice at 1542 kg ha<sup>-1</sup> during 1975-76 has increased to 2023 by 1998-99 i.e. an increase of 433 kg ha<sup>-1</sup>. However, in Palakkad district it has been very slow by a mere increase of 152 kg/ha by 25 years.

The major constraints for rice production, with efficient water management, in eastern Palakkad are non-uniformity of crop activities and prolonging the mundakan crop even upto the middle of summer. The temporal pattern of crop activities over the panchayats in eastern Palakkad is discussed in this section. Modified cropping patterns suggested for various ayacuts in the region are also included.

#### 1. Alathur block

It is suggested to have a cropping pattern that gets completed by February middle availing the following options.



- (i) Dry sowing of virippu with 130 days duration varieties and of less than 150 days duration in mundakan, if nursery could be raised before virippu harvest.
- (ii) If virippu is dry sown and sowing of mundakan nursery is possible only after virippu harvest, the mundakan varieties should be of less than 130 days.
- (iii) If virippu is transplanted (130 days) and sowing of nursery is possible before virippu harvest, mundakan crop can be upto 160 days.
- (iv) If virippu is transplanted and the mundakan (140 days) nursery possible only after virippu harvest, varieties of less than 120 days and 140 days should be selected for virippu and mundakan, respectively.

## 2. Kuzhalmannam

A uniform cropping pattern according to the availability of water from irrigation projects is suggested. It is necessary to complete the crop period by latest by January middle in Pudusseri (Walayar ayacut) and by February middle in other areas (ayacut of Chitturpuzha and Malampuzha). To achieve this different options are available.

- (i) Virippu dry-sowing (April 20-May 15) with varieties of 130 days duration and mundakan transplanting by October 1<sup>st</sup> week with varieties of not more than 150 days. This can be made applicable, if nursery could be sown before the harvest of virippu.
- (ii) Virippu dry-sown with 130 days varieties, and if nursery could be sown only after the harvest of virippu, the mundakan varieties should be of less than 130 days.
- (iii) Virippu transplanting by June middle with 130 days varieties and mundakan varieties with 160 days, if nursery could be sown before the harvest of virippu.
- (iv) Virippu transplanting by June middle with 120 days varieties, if nursery is raised only after virippu harvest, the varieties should be less than 140 days.
- (v) For Pudusseri, since Walayar dam closes by December end the mundakan crop should be ready for harvest latest by January middle. Here also two options are available: (a) virippu dry sowing with varieties of 130 days and mundakan transplanting with 130 days, provided nursery is raised before virippu harvest. (b) if nursery is sown only after virippu harvest the first crop should be of 110 days varieties and II crop with that of 125 days.

## 3. Nemmara

The irrigation projects, Pothundy, Mangalam, Gayathri and Malampuzha, which serves irrigation to the region, give water from middle of October to the end of January according to water availability. Hence it is necessary to complete the harvest latest by February middle. To achieve this, different options are suggested.

- (i) Virippu dry sowing (April 15-May 10) with varieties of 120 days and mundakan transplanting (September middle) with varieties of less than 165 days. Nursery should be sown in identified plots before the harvest of virippu main crop that is by August middle.
- (ii) Virippu dry-sowing with varieties of 120 days and mundakan transplanting (September 20) with varieties of less than 150 days.
- (iii) If necessary sowing could be possible only after virippu harvest option II can be followed i.e., virippu dry-sowing (April 25-May 10) with 120 days. Nursery raising after harvest of virippu (September 20) and transplanting by October 10<sup>th</sup>, then mundakan varieties should be of less than 145 days duration.
- (iv) In areas where transplanting with long duration varieties is followed in virippu, varieties of less than 125 days have to be chosen for mundakan. Mundakan nursery must be sown by October 10<sup>th</sup> and transplanting by November 5<sup>th</sup>, so that harvesting would be over by February middle.

#### 4. Kollengode

To ensure uniform cropping pattern and efficient irrigation management, the following options are put up.

Virippu- For virippu, varieties of less than 125 days duration must be selected. Transplanting would be possible by June middle and harvesting would be over by September third week.

Mundakan (i) Grow varieties of 160-170 days duration (e.g., Ponmany) by transplanting during October second week so that harvesting would be possible by February end. This can be made applicable to Elappully and Polpully where LDVs are preferred by a majority of the farmers and water is likely to be made available upto February middle, from Chitturpuzha project. (ii) In Kodumbu, Koduvayur, Kollengode, Muthalamada, Pudunagaram and Vadavannur, varieties of less than 140 days are to be chosen for mundakan, since LDVs are preferred only by a very few farmers and also that irrigation from Malampuzha and Gayathri get stopped by January third week.

#### 5. Chittur

To ensure uniform cropping pattern for efficient water management, it is suggested to have the virippu crop with varieties of less than 120 days, so that harvest could be over by September third week. The mundakan varieties must be selected according to the availability of water for irrigation. In Nallepilli, Thathamangalam and Perumatti, if varieties of about 120 days are grown during virippu, varieties of upto 170 days can be grown during mundakan. The harvesting can be completed by February end. In Pattencheri and Vadakarapathy, which are ayacuts of Walayar projects, although LDVs are preferred, it is necessary to limit the duration to 135 days.

In other panchayats, observing the cropping seasons for virippu as May-August, mundakan crop establishment could be completed at the most by September end. If transplanting is resorted to, varieties of duration upto 150 or 160 days could be selected. If wet seeding is done, varieties should not be of more than 125-135 days duration. If transplanting method were to be followed for virippu, it would be better to select varieties of not more than 120 days during virippu and of not more than 130-135 days during mundakan. In areas where short or medium duration varieties are not suitable due to drainage problems, there is no other option, but to limit to single crop with long duration varieties. If both seasons are covered with LDVs, the season gets prolonged upto March end or even April middle. In these situations irrigation water cannot be assured and the crop may fail as experienced in most of the years. However, two LDV crops can be taken provided *in-situ* irrigation facilities are developed.

#### 6. Palakkad

Although virippu crop is rainfed, mundakan crop depends on canal irrigation. For transplanting and direct seeding, varieties must be adjusted so that the harvesting would be completed by February second fortnight. In Palakkad block, irrigation water is received for mundakan crop from Malampuzha project and the supply is from October 3<sup>rd</sup> week till January end. Hence, the cropping pattern must be planned to complete the crop period by February 2<sup>nd</sup> week. To achieve this two possibilities are: (i) If dry sowing with 130 days varieties is adopted for virippu, mundakan crop can be with varieties of even upto 160 days provided the nursery is raised before virippu harvest. (ii) If nursery raising is possible only

after virippu crop, then mundakan varieties must be of less than 130 days. (iii) If virippu is transplanted (130 days) and nursery is possible before virippu harvest, mundakan crop can be upto 160 days. (iv) In virippu transplanted area, if mundakan nursery is possible only after the harvest of virippu, varieties of less than 120 days and 140 days must be selected for virippu and mundakan respectively.

#### IV. Field problems in the Central zone (for the attention of specialists)

I. The solutions evolved, if any, for the field problems identified and reported during the previous workshop needs discussions.

(i). Iron toxicity in wetlands

(ii). Problem of *Salvinia*

This issue has been taken up by the CSR sub Centre for on-farm research and the work is going on.

(iii). Mat of *Chara* (blue payal)

(iv). Foot rot disease (*Fusarium moniliformae*)

(v). Crab attack on paddy

#### II. New issues

(i). Control of *Sphenoclea* in kole paddy

*Sphenoclea zvelanica* has emerged as a serious weed in kole lands during the last mundakan crop. Application of 2,4-D was found non-effective. Although there was a slight wilting of the plants, it got recovered/regenerated after a few days. Suitable control measures against this weed are to be suggested.

(ii). It needs the collaboration of Agricultural Engineers for the refinement and fine tuning of dry sowing Tractor Mounted Paddy Seed Drill.

Table 1. Effect of different methods of crop establishment and weed control on tiller and panicle production and grain yield of rice

Season & Location	Kuzhalmannam, Rabi 1999-00			Kollengode, Kharif 2000			Kollengode, Rabi 2000-01			Rayamangalam, Summer 2001		
	Total tiller/m <sup>2</sup>	Panicles/m <sup>2</sup>	Grain yield (q/ha)	Total tiller/m <sup>2</sup>	Panicles/m <sup>2</sup>	Grain yield (q/ha)	Total tiller/m <sup>2</sup>	Panicles/m <sup>2</sup>	Grain yield (q/ha)	Total tiller/m <sup>2</sup>	Panicles/m <sup>2</sup>	Grain yield (q/ha)
Broadcasting + manual weed control	415	379	47.92	595	538	47.53	660	618	58.33	532	489	28.91
Broadcasting + herbicidal weed control	395	345	45.50	645	580	51.61	665	610	52.77	531	470	24.77
Drum-seeding + herbicidal weed control	408	379	46.50	562	515	45.16	675	615	59.50	548	485	27.90
Drum-seeding + cono-weeding	441	411	52.92	595	535	47.52	690	648	64.50	565	494	29.20
Drum-seeding paddy and S.aculeata + cono-weeding	447	412	48.33	582	523	49.62	682	630	67.50	532	473	29.13
Drum-seeding paddy and S.rostrata + cono-weeding	465	437	49.17	545	508	48.24	705	635	68.33	521	483	29.28
Manual transplanting and hand weeding	513	457	50.83	508	423	39.13	695	622	64.44	535	478	25.15
CD (0.05)	NS	NS	NS	105	76.5	7.5	24	27	5.75	NS	NS	NS

Table 2. Economics and cost savings on different methods of crop establishment and weed control in rice (average over seasons and locations)

Treatments	Seed	Seed preparation and sowing				Transplanting			Hand weeding		Cost of herbicidal weed control		Cono-weeding	Total cost of crop estt+weed control	Cost saving (Rs) over		
		Qty	Cost (Rs)	M	W	Cost (Rs)	M	W	Cost (Rs)	W	Cost (Rs)	M			Cost (Rs)	Broadca sting+ hand weeding	Broadcasti ng+ chemical weed control
T1-Broadcasting + manual weed control	110	880	0.7	0.5	100	-	-	-	62	3720	-	-	-	4700	-	-	2000
T2-Broadcasting + herbicidal weed control	110	880	0.7	0.5	100	-	-	-	22	1320	715	-	-	3015	1685	-	3685
T3-Drum-seeding+ herbicidal weed control	75	600	4	-	360	-	-	-	15	900	715	-	-	2575	2125	880	4125
T4-Drum-seeding + cono-weeding	75	600	4	-	360	-	-	-	10	600	-	5	450	2010	2690	-	4690
T5- Drum-seeding paddy and S.aculeate + cono-weeding	Paddy 75 kg and green manure 8 kg	800	4	-	360	-	-	-	10	600	-	5	450	2210	2490	-	4490
T6-Drum-seeding paddy and S.rostrata + cono-weeding	Paddy 75 kg and green manure 8 kg	800	4	-	360	-	-	-	10	600	-	5	450	2210	2490	-	4490
Manual transplanting and hand weeding	80	640	-	-	-	18	56	4980	18	1080	-	-	-	6700	-	-	-

Table 3. Performance of rice varieties (i) Palakkad district (a) Location - Alathur Block, Puthussode Panchayat

Season - Virippu						Season : Mundakan								
Group I			Group II			Group I			Group II			Group III		
Variety	Durati on (days)	Yield (kg ha <sup>-1</sup> )	Variety	Durati on (days)	Yield (kg ha <sup>-1</sup> )	Variety	Durati on (days)	Yield (kg ha <sup>-1</sup> )	Variety	Durati on (days)	Yield (kg ha <sup>-1</sup> )	Variety	Durati on (days)	Yield (kg/ha)
Ahalva	107	3740	Panchami	126	2545	Bhadra	124	6691	Pavizham	130	6070	Jyothy	106	3816
Mattathriveni	115	4352	Athira	126	2073	Athira	112	5946	Kanakom	130	6050	Manatriveni	106	4309
Aiswarva	115	4248	Remanika	126	2259	Aruna	124	5805	Uma	133	6927	Ahalva	106	3703
Harsha	115	4331	Revathy	126	2590	Kanchana	112	5745	Krishnanjana	130	5623	Harsha	115	4590
Cul-210-25	115	4236	Kanchana	117	2073	Panchamy	124	4602	Pavithra	130	6028	Cul-210-25	115	4009
ADT-43	107	3457							Remya	130	5316	ASD-16	112	4958
ASD-16	118	3682				Remanika	124	5603	Revathy	130	5773	CD (0.05)		349
Kunjukunju (Local)	115	3645							Renjini	134	5383			
CD (0.05)	-	456				CD (0.05)	-	908	CD (0.05)		539			

(b) Location - Kuzhalmannam Block, Kannadi Panchayat

Season - Virippu						Season: Mundakan					
Group I			Group II			Group I			Group II		
Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )
Ahalva	115	5537	Panchami	137	5406	Jyothi	106	3756	Pavizham	135	2592
Matta	118	6085	Bhadra	137	5073	Matta thriveni	106	4455	Kanakom	124	2695
Kanchana	124	5395	Cul.210-25	123	6261	Ahalva	106	3556	Uma	135	3321
Aiswarva	118	5608	Remanika	137	5351	Kanchana	106	4786	Krishnanjana	124	2540
Harsha	115	5537	Renjini	137	4837	Harsha	115	4238	Pavithra	135	2985
Athira	120	4436	Revathy	137	4530	Cul-210-25	115	3615	Remya	135	2935
Jyothy	112	3715	ASD-19 (local)	125	5082	ASD-16	112	4937	Revathy	135	2716
ADT-43	115	6701	Karishma	137	5123	Athira	112	4820	Bhadra	123	5361
ASD-16	117	5679	CD (0.05)		442	CD (0.05)		801	Aruna	128	5723
Kunjukunju	116	4639							Panchami	128	4325
CD (0.05)		590							Remanika	128	4766
									Renjini	133	3692
									CD (0.05)		754

© Location - Kollengode Block, Polpully Panchayat  
Season - Virippu

Group I			Group II			Group-III		
Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )
Ahalya	108	3556	Panchami	137	3863	Uma	142	3500
Matta Thriveni	117	4910	Bhadra	137	5425	Krishnanjana	140	3450
Kanchana	123	4064	Athira	127	3975	Karishma	140	3523
Aiswarya	123	4685	Remanika	127	3675	Pranava	142	4513
Harsha	123	4332	Renjini	134	3563	ASD-16	116	2682
Cul-210-25	123	5023	Revathy	127	3150	CD (0.05)		622.2
Pranava	128	4346	Jyothi	121	3600			
ADT-43	123	3613	CD (0.05)		1257			
ASD-16	117	4910						
CD (0.05)		438						

Season - Mundakan

(i) Medium duration varieties

(ii) Long duration varieties

Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )
Bhadra	124	5700	Krishnanjana	125	4750	Pranava	139	4500
Aruna	124	5700	Karishma	125	4250	IET 14735	140	4850
Jyothi	124	5250	ASD-18	118	3750	Neeraja	136	1400
Athira	124	4425	ASD-19	125	5750	Mangala Mashoori	148	3150
ASD-16	120	4200	CO-47	118	5750	ADT-44	142	3450
CO-43	128	6000	ADT-39	125	5250	Ponmani (Red)	161	4550
ADT-38	128	6600	Santhi	128	6225	CD (0.05)		696
Pavizham	130	3750	CD (0.05)		770			
Uma	127	5750						

(d) Location – Nemmara Block, Eluvanchery Panchayat

Virippu Group I			Group II			Mundakan		
Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )
Ahalya	109	2963	Panchami	134	2850	Jyothi	123	5000
Mattathriveni	109	3450	Bludrn	134	3600	Athira	123	4125
Kanchana	116	2738	Attira	125	4100	Kanchana	123	4250
Aiswarya	116	3825	Remanika	127	3500	ASD-16	123	3750
Harsha	120	3675	Renjini	129	4100	Aiswarya	128	4625
Cul-210-25	120	3000	Revathy	128	4800	ADT-38	128	4750
ADT-43	120	3151	CD (0.05)	Duration (days)	971	CD (0.05)		846
ASD-16	116	3113						
Jyothy	118	4100						
CD (0.05)		673						

(ii) Thrissur district

(a) Location – Wadakkanchery Block, Mullurkkara Panchayat

Virippu			Mundakan		
Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )
Ahalya	107	3631	Panchamy	119	2646
Matta Thriveni	107	3005	Remanika	119	3295
Kanchana	107	2729	Aruna	119	3263
Aiswarya	107	3934	Aiswarya	112	3042
Harsha	107	4034	Pavizham	117	3066
Cul-210.25	114	3282	Kanakom	117	4078
Panchamy	115	3548	Uma	117	3738
Athira	115	3297	Krishnanjana	117	3853
Ramanika	115	4221	Karishma	117	3439
Revathy	115	2808	Revathy	117	3387
CD (0.05)		538	PTB- 20-D-1	124	2614
			CD (0.05)		1138



(b) Location –Chalakkudy Block, Koratty Panchayat

Season - Virippu

Group I

Group II

Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )
Ahalya	101	2363	Panchami	115	2910
Matta Thriveni	109	2813	Bhadra	130	3330
Kanchana	109	2925	Ahira	116	3368
Aiswarya	109	3713	Renjini	127	3840
Harsha	101	1710	Revathy	128	2940
Cul-210-25	101	1058	Jyothi	116	3450
Ponmany	114	788	Ponmany (Red)	110	3420
CD (0.05)		1443	CD (0.05)		NS

Remarks – Harsha and Cul-210-25 severe rodent attack. Ponmany eaten by poultry

© Location –Puzhakkal Block, Adat Panchayat

Season - Mundakan

Group I

Group II

Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )
Panchami	117	4666	Ahalya	106	4420	Pavizham	123	6061
Bhadra	112	6128	Mattathriveni	117	4302	Kanakom	122	5392
Remanika	111	5079	Harsha	111	4031	Uma	123	6389
Renjini	115	5255	Cul-210-25	109	5425	Pavithra	118	6293
Aruna	111	5141	Jyothy	117	4144	Krishnanjuna	123	5093
Kanchana	103	4879	CD (0.05)		994	Karishma	122	4628
Aiswarya	103	4507				Revathy	120	5107
						CD (0.05)		1213

## iii) Emakulam district (a) Location – Koovappady Block, Rayamangalam Panchayat

Season: Virippu Group -I			Season: Virippu Group -II			Mundakan - I.D.V		
Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )
Ahalya	112	2051	Panchamy	134	2352	Neeraja	132	2556
Matta Thriveny	115	2521	Bhadra	137	2117	Nila	143	3072
Kanchana	115	2853	Athira	130	2711	Mangala Mashoori	132	2156
Harsha	115	1162	Remanika	137	1858	Makaram	143	3722
Cul-210-25	128	2590	Renjini	137	1517	Kochumundakan	136	2931
CD (0.05)		292.7	Revathi	137	1862	CD (0.05)		843.1
			CD (0.05)		200.6			

## (b) Location – Vadavukode Block, Muzhuvannur Panchayat

Virippu Group I			Virippu Group II			Mundakan Group I			Mundakan Group II		
Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )	Variety	Duration (days)	Yield (kg ha <sup>-1</sup> )
Ahalya	113	3170	Panchami	132	2200	Neeraja	163	1775	Pavizham	117	3115
Matta Thriveni	110	3836	Bhadra	135	2314	Nila	163	2484	Kanakom	121	3343
Kanchana	113	6073	Athira	129	1007	Mangala Mashoori	147	1505	Uma	117	2607
Harsha	109	4062	Remanika	132	1922	Makaram	163	2200	Krishnamjuna	121	2777
Cul-210-25	128	6010	Renjini	132	2967	CD (0.05)		290.9	Karishma	117	2648
			Revathy	132	2099				Revathy	121	3236
			CD (0.05)		228.5				PTB-20-D-1	117	2932
									CD (0.05)		286.6

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