

XXXIst

**Zonal Research and Extension
Advisory Committee Meeting
Central Zone**



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**Regional Agricultural Research Station
Mele Pattambi - 679 306**



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Research Highlights



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**Regional Agricultural Research Station
Mele Pattambi - 679 306**

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REGIONAL AGRICULTURAL RESEARCH STATION, PATTAMBI

RICE

Crop Improvement

1. Genetic conservation of rice germplasm, collection, maintenance, cataloguing and evaluation & Conservation of genetic diversity of rice in Kerala

Sixty three accessions of short, medium and long duration group which have been maintained *in situ* were characterized and catalogued during 2008 -09. These were deposited in Long Term Storage at NBPGR, Thrissur during 2009. The accessions include one variety, thirty-three traditional varieties and twelve cultures raised in *khari*, 2008 and 17 traditional rice varieties raised in *rabi*, 2008-2009 collected from various parts of Kerala and other states of India

2. Evolution of Semi-tall or dwarf types of tall *indica* rice varieties

Selections from TRV 14-1 and photo-period sensitive traditional rice varieties viz., *Makaram* (Selections 1 to 4), *Kochumundon* (Selections 1 to 4), *Munda* (Selection 1 to 4), *Mundakakutty* (1,3,4,5), *Konna* (Selections 1 to 4) and *Chuvannachettadi* Sel -1 are being characterized for further evaluation and development of mutants under this programme aiming to evolve non lodging dwarf or semi tall varieties of the important popular tall *indica* varieties of Kerala.

Breeder seed and Foundation seed of *Anashwara* (Ptb 58) developed and released under this programme have been distributed from the station for large scale multiplication.

3. Identification of suitable varietal combination for Kootumundakan cultivation in Palakkad

The varietal combination *Swarnaprabha* + *Makaram* followed by C3-2KM + *Makaram* were identified to be consistent in their performance in Kootumundakan for over five years. Replicated trials with C3-2 KM and *Swarnaprabha* as the 1st crop component and *Makaram* Selections 1 to 4 as 2nd crop component have been laid out in *khari*, 2008. The grain and straw yield realized from the 1st and 2nd crop components showed that the combination C3-2Km - *Makaram* Sel -1 followed by the combination *Swarnaprabha* - *Makaram* Sel -3 out-yielded all other combinations with respect to grain yield.

Performance of varietal combination in Kootumundakan trial 2008-09

Varietal combination	Mean yield (kg/ha) I Crop		Mean yield (kg/ha) II Crop		Mean yield (kg/ha) I + II Crop	
	Grain	Straw	Grain	Straw	Grain	Straw
C3-2Km - Makaram Sel -1	2540	14921	3940	9683	6480	24604
C3-2Km - Makaram Sel -2	2444	15238	2802	6667	5246	21905
C3-2Km - Makaram Sel -3	2079	15238	3238	10714	5317	25952
C3-2Km - Makaram Sel -4	2048	13968	1971	6508	4019	20476
Swamaprabha - Makaram Sel -1	2460	15079	2827	8810	5287	23889
Swamaprabha - Makaram Sel -2	2540	17381	2821	6667	5361	24048
Swamaprabha - Makaram Sel -3	2587	16508	3424	8095	6011	24603
Swamaprabha - Makaram Sel -4	2413	16111	3235	6349	5648	22460

4. Evolution of high yielding rice hybrids suitable for Kerala

As per the decision of the University maintenance breeding of 15025A & 15025B lines was entrusted with ORARS, Kayamkulam in 2007-08.

5. AICRIP Trials

In the various trials under the co-ordinated programme of AICRIP during *kharif*, 2008 the top ranking entries with desirable attributes suited to our cropping system were identified and selected for incorporation in the future breeding programme in the station. The performance of top ranking entries selected are as given below.

Top ranking AICRIP entries selected (*Kharif*, 2008)

Trial	No of entries	Entry	Yield (kg ha)
IVT- E	49	IET 21105	4166
AVT 1-E	7	IET 20405	3503
AVT -2- E	12	IET 20148	4743
IVT - IME	81	IET 21010	4807
AVT -1 -IME	25	IET 20419	3333
AVT -2 -IME	7	PA 6201	4292
IVT -IM	81	IET 20903	4807
AVT 1-IM	35	IET 20577	4599
AVT 2 - IM	14	IET 19990	4623
AVT SG	14	IET 19817	4040
MLT Aromatic	9	Pusa Basmathy	2167.0

Results of a replicated trial which was laid out to evaluate the performance of the best entries selected over different years from various AICRIP trials indicated that IET Entry 16636 followed by entry IET 17844 out-yielded all other entries with respect to grain yield.

Performance of selected Top ranking AICRIP entries

IET Entry No.	Yield (kg/ha)	
	Straw yield	Grain yield
16636	5682	11269
17284	4735	12784
17467	4830	12689
17844	5208	13542
17869	4167	11553
17886	3788	10417
15068-sel1	2841	7292
18045	4640	10133
18311	3883	8996
18317	4261	9470
18318	2083	9848
18318-sel1	4167	10322
18318-sel2	3977	10322
18477	4072	10417
18509	3220	8807
18540	3977	10038
18913	2936	8049
19044	1894	9659
19131	3125	10511
19132	3220	9564
19304	4072	8523
19358	4545	9943
19387	4830	12500
19554	2367	7481
19586	3220	12405
19554/07	2367	6629
20486	3409	11458
20492	2746	7481
Kanchana	2178	9848
Aathira	4072	11364

APEDA project on aromatic rice

The trial was conducted as a net work programme with 9 entries as test material along with BPT 5204. Details on yield are given below. The quality parameters will be tested by DRR, Hyderabad.

Entry	Plant Height (cm)	Days to 50% Flowering	Grain yield (kg/ha)
Basmathy-370	136	103	1662
Basmathy-380	125	94	1094
Laron Basmathy	125	98	947
Pusa Basmathy	108	100	2167
Vasumathy	116	104	1704
Kalanamak	126	105	1872
Dubraj	110	110	1872
BP1-5204	89.9	113	1473
Basmathy-370 Mutant	104	101	1473

6. Breeding lodging resistant rice varieties for dry sowing during *vaippu* season.

Seed multiplication of Culture C 3-2KM and characterization of this Culture as per DUS Test is being done during *rabi*, 2008-09. Variety release proposal is being prepared.

The F₁s from crosses made between photoperiod sensitive second crop varieties and popular photoperiod insensitive varieties during *rabi*, 2006-2007 have been raised during *rabi* 2008-09 for further evaluation. The cross combination evaluated are as given below.

Female parent	Male parents			
Pranava	Ponmani	Neeraja	Swetha	Jyothy
Neeraja	Ponmani	Uma		
Uma	Neeraja			
Ponmani	Swetha	Neeraja		
Jyothy	Ponmani	Swetha		

7. Breeding high yielding tall photosensitive varieties with good straw yield specifically suited for the Mundakan season of Kerala

The F₁s from crosses made during *rabi*, 2006-2007 between photoperiod sensitive second crop varieties and popular photoperiod insensitive varieties have been raised during *rabi*, 2008-09 for further evaluation. The cross combination evaluated are as given below :

Female parent	Male parents			
Pranava	Karuna	Vellari	Chettadi	Anashwara
Swetha (red husk)	Karuna	Ponmani	Kuruka	
Uma	Makaram			
Karuna	Kuruka			
Chettadi	Jyothy			
Vellari	Uma			

Pure line selections (PLS 1 to 4) made from variety *Makaram* in *rabi*, 2006-07 were evaluated for their performance in the Kootumundakan system. These are being characterized in *rabi*, 2008-09.

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

Promising cultures identified with relatively high pest and disease tolerance during 2006-07, *kharif*, 2007 and multiple resistance under AICRIP National testing programme in 2007-2008 were evaluated along with varieties *Kanchana* and *Aiswarya* during *kharif*, 2008 as replicated station trial

Comparative performance of Multiple resistant rice varieties (*kharif*, 2008)

IET Entry No.	Yield (kg/ha)	
	Grain yield	Straw yield
9401-2	2597	12049
9412-13	1804	10191
F5-14-1	2507	11923
K AU-6661(W)	920	16685
9412-2-Sel-1	631	17785
F5-23-1	1064	13366
F5-23-2	722	11652
F3-11-3	2670	10552
F6-11-1-1	1984	11526
9410-3-Sel-3	1551	16522
Jyothy	1822	7792
Kanchana	1822	10895
Aiswarya	2345	11039

9. Breeding for drought tolerant rice varieties suitable for upland ecosystem

Seed multiplication of Culture Swarnaprabha s/n 3-1 and characterization of this Culture as per DUS Test was being done during *kharif*, 2008. Variety release proposal for submission before the State Varietal Release Committee is being prepared.

Performance of drought tolerant rice varieties suitable for upland ecosystem (*kharif*, 2008)

Variety	Grain yield (kg/ha)
Swarnaprabha Sel 3-1	3680
H-11	2160
Aiswarya	720
Kanchana	720
Swarnaprabha	2000

Culture Swarnaprabha s/n 3-1 has shown consistently superior performance under upland.

10. Identification of genotypes suitable for mechanised farming

Superior Cultures 9401-2, 9409-12 with medium stature good, compact, sturdy plant habit and having pest and disease tolerance were identified under this study during 2006-07. Farm Trial as recommended in ZREAC 2006-07, with Cultures 9412-15 and Culture F5-21-3 could not be evaluated as these cultures showed poor germination in *kharif*, 2007.

The next best entries Cultures 9401-2, 9409-12, 9409-6 were multiplied and evaluated under mechanized planting and harvesting system during *rabi*, 2007 and *kharif*, 2008. The performance of these entries are as given below.

Comparative performance of rice varieties for Mechanized farming (*kharif*, 2008)

Entry	Grain yield (kg/ha)					Mean
	2002	2003	2005	2007	2008	
9401-2	2698	5782	4109	4436	3313	4067.6
9409-6	3866	3830	3934	3860	3893	3876.5
9409-12	2500	5695	4659	4565	4053	4294.4
Jyothy	2209	3970	2966	3816	3387	3269.6

Culture 9409-12 followed by Cultures 9401-2 out-yielded all other entries with respect to grain yield. It is proposed that field trials may be conducted with cultures 9409-12 and 9401-2 during 2009-2010.

11. Performance evaluation of Navara

Seed multiplication and characterization of Navara collections as per DUS Test was done during *rabi*, 2008. TRV 2207 followed by TRV 2092 out-yielded all other entries with respect to grain yield. Ear to row purification of entries will be done during 2009.

Performance of Navara entries (*rabi*, 2008-09)

TRV No.	Grain yield (kg/ha)
2092	2604.167
2093	2276.786
2201	2559.524
2202	2455.357
2203	2529.762
2204	1979.167
2205	1904.762
2206	2276.786
2207	3105.159

Seed Technology Unit

Plan Project

I. Seed Technology Unit (State Seed Testing Laboratory)

The seed quality of 464 samples submitted by the Dept. of Agriculture and Seed production centres of the University were analysed during 2008-2009.

National Seed Project

NSP-Seed Technology Research

I. Seed production, certification and varietal characterisation

1. Correlation between ODV identified in STL samples with genetic impurity in Grow Out Test

The trial was carried out with seed samples obtained from State Seed Testing Laboratory (SSTL) operating at the station in order to find out the relationship of ODV identified by Seed Testing Laboratory (STL) personnel's with that of off-types in Grow Out Test (GOT). 100 per cent of seeds identified as ODV (Uma) in SSTL were confirmed to be ODV's in the GOT conducted. This confirmed the utility of ODV identification as a pointer towards genetic purity in seed quality testing.

2. Pilot project on System of Rice Intensification

SRI trial was conducted with variety *Annapoorna* by planting seedlings aged 10, 15 and 20 days old both under SRI at spacing 20 cm x 15 cm, 20 x 20 cm and 25 x 25 cm and 30 x 30 cm and conventional planting system at spacing (20 x 20 cm) replicated thrice.

Results indicate that the performance of variety *Annapoorna* under SRI with spacing :20 x 15 cm and 20 days old seedlings was superior in grain yield followed by 15 days old seedlings with same spacing to all other treatments under SRI system and conventional method.

Results also indicate that SRI with spacing :20 x 15 cm of 20 days old seedling was superior in straw yield followed by 20 x 20 cm spacing of the same age seedlings of SRI to all other treatments under SRI system and conventional method.

Seed physiology, storage and testing:

1. Suitability of super grain bags for commercial seed storage:

Harvested Jyothy seed has been collected and experiment was initiated in December, 2008. Cowpea experiment was initiated in 2nd week of April, 2009.

2.i. Effect of conditioned storage on subsequent performance of seed

The experiment was conducted with paddy variety Jyothy. The objective of the study was to determine the effect of ambient conditions on seed quality, subsequent to storage under air-conditioned system with low temperature (18-20° C) and low relative humidity conditions. The trial was initiated with seeds produced during both *kharif*, 06 and *rabi*, 06-07. Results indicate that paddy seed stored in jute bags under air-conditioned store retain their viability for a period of two months after they are removed from the air-conditioned environment and then stored under ambient conditions. However seeds stored in polylined jute bags under air-conditioned store retain their viability for a period of four months, after they are removed from the air-conditioned environment and then stored under ambient conditions. Jyothy seed in air condition storage has retained its viability and hence this experiment is continuing.

2.ii. Storability of different paddy varieties under conditioned storage

The experiment was conducted with paddy varieties Jyothy, Jaya, Kanchana, Varsha, Aiswarya and Annapoorna. The objective of the study was to determine the varietal response to storage under air-conditioned system with low temperature (18-20° C) and low relative humidity conditions.

Results indicate that paddy seeds of varieties Kanchana followed by Annapoorna Jaya and Jyothi stored in poly-lined jute bags under air-conditioned store retain their viability for a longer period compared to Aiswarya and Varsha. Seeds stored in jute bags exhibited poor viability compared to that in HDPE bags and poly-lined jute bags both under air conditioned and ambient environment.

NSP- Breeder Seed Production

A total of 90.75 quintals of breeder seed of various HYV's popular in the state was produced for distribution and multiplication in the seed production programme during 2008 - 2009

ICAR Mega Seed Project

A total of 70.00 tonnes of quality seed (variety Jyothy, Aiswarya, Aathira, Makaram, Matta Triveni, Uma) was processed and about 40.0 tonnes of seed is going to be processed during 2008-2009 under this programme involving 60 farmers from various parts of Palakkad and Thrissur dts. The rate of seed procurement was enhanced from Rs.13/kg to Rs.14/Kg in October, 2008. A team of 6 was constituted and trained intensively to undertake rouging of seed crop in farmers' field to maintain the purity standards of the seed production programme.

AICRIP Plant Physiology Trials

1. Studies on photothermic indexing (pti)

Studies on photothermic indexing was done with 20 entries planted at 28 days interval. By delaying sowings, the number of days taken to attain panicle initiation stage was reduced by 2 to 6 days while the flowering and grain filling (ripening) period were reduced by 2- 14 days and 2-13 days respectively except in IET 20312 (2 days less required for panicle initiation stage and 2 days more required for flowering and maturity period)

2. Studies on radiation use efficiency (rue)

Studies on radiation use efficiency was done in 81 entries including Aiswarya as local check. IET 20998 , IET 20981, IET 21032 and IET 21005 recorded 3270 kg, 3140 kg, 3080 kg and 3010 kg yield respectively whereas Aiswarya, local check, recorded an yield of 2690 kg per hectare.

3. Studies on nitrogen use efficiency (nue)

Five entries at four nitrogen levels were evaluated under the study. The number of secondary branches can be improved by management practices and is largely governed by environment whereas primary branches are

determined by genetic background of the cultivar. Higher nitrogen level (200kg/ha) effect was either marginal or in most cases a negative response was noticed beyond 100 kg/ha level due to other factors involved like pest or disease incidence or tendency towards lodging.

4. Studies on aerobic rice

The study was conducted in seven entries including hybrids, varieties and local checks Aiswarya and Swarna Prabha Selection -3-1 with alternate weekly wetting and drying cycles, starting from 15 days after planting till maturity and normal irrigation served as control. Among the entries tested, PHB 71 recorded fifteen per cent more grain yield followed by Swarna Prabha Sel-3-1 and Naveen. Other entries showed negative response under aerobic conditions. Straw yield was significantly increased i.e., thirty three per cent more in Aiswarya (control) followed by PA 6201 and PHB 71 and Naveen recorded 10 to 15 % more straw yield under aerobic conditions.

Crop Management

a. Agronomy

AICRIP trials (2008-09)

1. Integrated Nutrient Management in Rice Based Cropping System

To highlight the importance of integrated nutrient management in rice a trial was conducted with the organic sources viz., green manure and farm yard manure applied along with inorganic NPK. FYM and green manure application along with NPK fertilizers increased the rice yield. Residual crops raised during *rabi* recorded higher yield in plots receiving FYM at 10 t/ha than green manure. Trial clearly indicated that the application of organic manures either as FYM or green manure is good for higher yield of rice and restoring soil fertility in acidic sandy loam soils.

2. Amelioration of acidic soils for enhanced rice productivity

Rice yield is diminishing in acid lateritic soils. The trial was conducted in acidic soils of R.A.R.S, Pattambi with different ameliorants viz., lime @ 600 kg/ha, silica @ 100 kg/ha and FYM at 10 t/ha along with recommended dose of NPK. There was no significant difference among the ameliorants used in the experiments. However increased yields were recorded in treated plots when compared to the control. The increment in yield ranged from 14 to 16 per cent.

3. Cultural management practices for enhancing yield of rainfed upland rice

Developing an effective agronomic package is very important for increasing the yield of rainfed upland rice. The trial was conducted with 5 different weed control treatments viz., pre-emergent herbicide Pendimethalin @ 0.75 Kg a.i./ha with green manures and mechanical weeding and unweeded control. Weed control treatments were tried in sub-plots whereas the three N levels (75, 100 & 125 Kg/ha) were tried in main plots. The yield was significantly influenced by the weed control treatments when compared to control. Similarly the N levels increased the yield of rainfed upland rice. Application of Pendimethalin as pre-emergent herbicide with either dhaincha or cowpea or mechanical weeding was found to be the best management practice for upland rice. More than 65 per cent of yield reduction is noticed in unweeded control plots.

4. Nitrogen response trials on selected rice variety (AVT-2)

Optimum and appropriate use of nitrogen enhances the rice productivity through the best N use efficiency. In order to find out the production potential of different elite cultures of AVT 2 at various levels of N, experiments were conducted in rice fields of R.A.R.S, Pattambi during *kharif* season. The trials revealed that the cultures IET 19569, PR113 NWR, IET-19140, IET-19746, IET-19749 and IET-19766 yielded the best when compared to other cultures including local check varieties. Graded levels of N showed better crop growth and establishment but did not influence the grain yield significantly.

b. Soil Science and Agril. Chemistry

1. Permanent manurial trial (Tall *Indica*)

PMT (T) has completed 48 years and PMT (D) has completed 36 years of experimentation. In permanent manurial trial, during last year, irrespective of the season, maximum grain and straw yield were obtained for the integrated use of fertilizers and cattle manure. Continuous application of nitrogenous fertilizer alone or inorganic fertilizers alone were found to have detrimental effect on the growth and yield of rice. Lowest yield was obtained for Ammonium sulphate alone (N alone) treatment.

2. AICRP on Long Term Fertilizer Experiment-(variety Aiswarya)

This experiment has completed 12 years. The effect of treatment on yield and soil fertility parameters is as given below

Effect on yield

In LTFE, as in the previous years, in both the seasons, highest grain and straw yield were recorded by the treatment which received 100%NPK (as per POP of KAU) along with FYM @5t/ha. However this was

on par with treatment receiving 100@ NPK +in situ growing of *Sesbania aculeate* (green manure crop.) Lowest yield was recorded in absolute control.

Effect on nutrient uptake

The effect on nutrient uptake followed the same trend as in yield .The uptake of N,P,Ca &,Mg was higher for treatment which received 100%NPK (as per POP of KAU)along with FYM @5t/h.

Effect on soil fertility

With respect to the soil pH, no significant variation was made by the treatments after *kharif*. In the treatment where continuous addition of inorganic fertilizers alone were there, a slight decline in organic carbon content compared to other treatments were observed. Generally the soil organic carbon content is in the high range. The high organic matter content may be due to the degeneration of roots and incorporation of stubbles after each harvest. The status of P and K after *kharif* season was almost in the medium and low range respectively.

Crop Protection

a. Entomology

Screening experiments

National screening nursery: During the period 622 entries were screened for resistance for major rice pests. Among them 11 entries exhibited complete resistance to thrips with a score of '0' while 129 entries exhibited moderate resistance with a score of '1'. Against stem borer four entries IET20693, 20341, 20479, 21059, 21060 exhibited complete resistance. Eleven entries showed complete resistance while two entries showed moderate resistance to gallmidge. Entries IET 19462, 26062, 21136and IET20686, 20688 showed moderate resistance to whorlmaggot and blue beetle.

Gallmidge screening nursery: 80 entries were screened for resistance against gallmidge. Among them three entries JGL 16267, RP 4683-32-1-684 and SKC 23-52-03 exhibited complete resistance to gallmidge.

Gallmidge biotype studies: In the study 17 entries were tested under six sets of differentials which showed 2.61, 2.56, 0.00, 16.40, 13.54 & 28.95 per cent damage giving R-R-R-S-S-S pattern indicating the presence of biotype 5.

Insecticides Evaluation trial:

Rabi'08: During the period three new chemicals, Bifenthrin 10 EC @ 50 g a.i./ha, Rynaxypr+ Thiomethoxam and Pymetrozine 50WG at three different doses viz., 40, 50, 60 g a.i./ha and 100,125, 150 g a.i./ha were tested with monocrotophos @ 500 g a.i./ha as check with an untreated control.

The results showed that all the new insecticides tested were equally effective with check insecticide against dead heart and white ear caused by stem borer as well as whorlmaggot. Rynaxypr+ Thiomethoxam @ 50 g a.i./ha treated plots showed least damage by blue beetle. In case of grain yield there is no significant difference in treatments.

Kharif'08: During the period three new chemicals, Flubendiamide 36% + Fipronil 30% @ 33 a.i./ha, Flubendiamide 39.35% SC @ 25 a.i./ha and Fipronil 5% SC @ 50 a.i./ha were tested with monocrotophos @ 500 g a.i./ha as check with an untreated control. The results showed that among the new insecticides tested, Flubendiamide 39.35% SC @ 25 a.i./ha were effective and superior over check insecticide against dead heart caused by stem borer. In early stages other two insecticides were effective against dead heart caused by stem borer. None of the insecticides were effective against white ear caused by stem borer and blue beetle. For whorlmaggot all the treated insecticides were equally effective along with check insecticides. All the insecticides treated plots showed higher grain yield in comparison to untreated plots.

Pesticides compatibility trial

In this trial, new insecticides flubendiamide 20 WDG @ 0.25 g /litre, spinosad 45 SC @ 0.25 g /litre and two fungicides Isoprothiolane @ 1.5 ml/litre and carpropamid @ 1ml/litre alone as well as in combination were evaluated against major rice pests and blast of rice.

Rabi'08: During the period, Insecticides alone as well as in combination were effective against dead heart caused by the stem borer while for white ear damage flubendiamide alone as well as in combination with isoprothiolane were effective. For whorlmaggot all the treatments were effective over untreated control. For caseworm the two insecticides and two fungicides combinations were effective than insecticides alone. There was no significant difference among the treatments in grain yield per plot. The scoring for blast was not done due to its low pressure.

Kharif'08: During the period, insecticides alone as well as in combination were effective against dead heart caused by the stem borer while for white ear damage none of the treatments were effective. For whorlmaggot and blue beetle all the insecticides treatments alone and in combinations were effective. There was no significant difference among the treatments in grain yield. The scoring for blast was not done due to its low pressure.

Influence of agronomic practices on rice pest management

A new trial was conducted in *rabi*, 2008 with both normal system of cultivation (NSC) and SRI involving a normal rice variety (Jyothi) and a hybrid (CORH 2) for evaluating the occurrence of insect pests in both the systems. The results showed that pink stem borer incidence was significantly

higher in SRI plots (9.12 and 8.52 % DH in Jyothi and hybrid) compared to NSC (3.80 and 4.84 % DH in Jyothi and hybrid) while white ear was less in Jyothi under both NSC and SRI and hybrid under SRI. Leaf folder incidence was low under NSC than SRI. There were no significant differences in blue beetle and whorlmaggot infestation in SRI and NSC. Higher grain yield was obtained from Jyothi under both SRI and NSC as well as in hybrid under SRI while yield was low in hybrid under NSC.

On-farm integrated pest management

In this trial four modules viz., IPM (1): Need based application of chemical insecticides, IPM (2): Spraying with eco-neem 1% at 15, 30, 45, 60 & 75 DAT with six release of *Tricogramma japonicum* against stem borer and *T. chilonis* against leaf folder, IPM (3): Spraying with Eco-neem 1% at 15, 45 & 75 DAT and chemical insecticides viz., cartaphydrochloride @ 500 g a.i./ha at 25 DAT & Spinosad at 60 DAT with three releases of *T. chilonis* against leaf folder and IPM (4): farmers practice were evaluated with local variety Kanchana at farmers plot at Karakkad and Ongallur during rabi, 2007. The results showed that all the tested IPM modules viz., IPM (1), (2) and (3) showed less incidence of dead heart caused by stem borer while in case of white ear as well as leaf folder incidence there was no significant difference between the treatments. The blue beetle incidence was less in IPM (2), (3) and FP but high in module (1). Case worm incidence was low in module IPM (2) and IP (3). The IPM modules (2) and (3) showed a higher grain yield of 2500 and 2567 kg/ha while yield was low in farmers practices with 1933 kg/ha. The IPM modules also showed superior cost benefit ratios (1:2.62 to 2.85) than farmers practices (1:1.94).

Light trap data collection

The light trap data were recorded from January, 2008 to December, 2008. The results showed that mean yellow stem borers catches recorded highest values in January (11.64) while white stem borer catches were 2.51 no's in March. Green leaf hoppers both *N. virescens* (147.90) and *N. nigropictus* (40.95) and BPH (8.86) were recorded during the month of January. Low population of gallmidge (3.43) and caseworm (5.25) registered during September while green mired bug catches (601.40), a potential predator of BPH were recorded during the month of January.

Monitoring of stem borer composition trial:

The trial was conducted in rabi, 2008 and same trend was noticed. The major species yellow stem borer, *Scirphophaga incertulas* was dominating during the early tillering and maximum tillering phase while pink borer, *Sesamia inferens* was dominating in reproductive phase of the crop. The white stem borer, *Scirphophaga innotata* was maintaining low status during all the stages of crop growth.

Monitoring of leaf folder composition trial

The trial was conducted during *rabi*, 2008 to find out dominance of different species of leaf folder during the different stages of crop growth. The results showed the common species, *Cnaphalocrocis medinalis* was dominating the early tillering and maximum tillering phase while another species *Marasmia patnalis* was dominating during the reproductive stage of the crop.

Monitoring of gundhi bug composition trial:

The trial was conducted during *rabi*, 2008 to find out the dominance of rice bug species in rice fields of Pattambi. The results showed that the major species dominating is *Leptocorisa oratorius* and other species found were *L. acuta* and a small sized bug (Identity yet to be established).

b. Plant Pathology

All India Coordinated Rice Improvement Programme

1. Screening for sheath blight resistance

In National Screening Nursery 1 (NSN1), 193 entries were screened for sheath blight resistance. 13 entries showed resistance reaction to sheath blight. The National Screening Nursery II consisted of 622 entries of which 152 entries showed resistance reaction. Out of the 76 entries tested in National Hybrid Screening Nursery, 9 entries showed resistance reaction. In the Donor screening nursery out of the 43 entries tested 8 entries showed resistance reaction.

The reaction of ptb cultures against sheath blight

58 rice cultures including pre release cultures and traditional varieties and 57 ptb varieties were screened for sheath blight resistance. Among these 7 cultures 8 traditional rice varieties showed resistance reaction to sheath blight.

2. Screening for blast resistance

In National Screening Nursery 1 (NSN1), 193 entries were screened for sheath blight resistance. Among these 69 entries showed resistance reaction to leaf blast. The National Screening Nursery II consisted of 622 entries of which 228 entries showed resistance reaction. Out of the 76 entries tested in National Hybrid Screening Nursery, 59 entries showed resistance reaction. In the Donor screening nursery out of the 43 entries tested 30 entries showed resistance reaction.

The reaction of ptb cultures against leaf blast

58 rice cultures including pre release cultures and traditional varieties and 57 ptb varieties were screened for sheath blight resistance. Among these 8 cultures, 4 traditional rice varieties showed resistance reaction to leaf blast

3. Screening for bacterial blight resistance

In National Screening Nursery I (NSNI), 193 entries were screened for sheath blight resistance. 52 entries showed resistance reaction to sheath blight. The National Screening Nursery II consisted of 622 entries of which 228 entries showed resistance reaction. Out of the 76 entries tested in National Hybrid Screening Nursery, 20 entries showed resistance reaction. In the Donor screening nursery out of the 43 entries tested 9 entries showed resistance reaction.

The reaction of ptb cultures against bacterial leaf blight

58 rice cultures including pre release cultures and traditional varieties and 57 ptb varieties were screened for leaf blight resistance. Among these cultures, 4 traditional rice varieties showed resistance reaction to leaf blight.

4. Production oriented survey

As part of the AICRIP a production oriented survey was carried out to know the major production constraints in rice. The survey was conducted in Palakkad, Malappuram and Thrissur districts.

5. Farm trial

Evaluation of Isoprothiolane against blast

Farm trials were conducted at Malappuram and Palakkad districts to test the effectiveness of Isoprothiolane (Fuji-one 40E) against blast. The disease severity was significantly less in plots treated with isoprothiolane (20.6 %) compared to control (57.34%). Isoprothiolane was significantly superior to carbendazim and was statistically on par with tricyclazole (beam @ 0.6g/l) in controlling the disease. The yield recorded in plots treated with beam was the highest. The yield recorded in plots treated with isoprothiolane was statistically on par with the yield recorded in plots treated with beam and were significantly superior to control and check fungicide carbendazim. The results showed that Fuji-one 40E @ 1.5ml/l was effective for controlling the disease and can be recommended for the management of blast.

Plan Schemes

1. Development of eco friendly strategies for the management of major diseases and pests of rice.

Among the different treatments, the plant oils lemon grass oil and cinnamon oil, the biocontrol agents *T. viride* and *P. fluorescens* were found to be effective in reducing the sheath blight severity significantly and were statistically on par with the check fungicide propiconazole.

2. Bioinoculant production unit

In this unit biocontrol agents, *Pseudomonas fluorescens*, *Trichoderma*, *Trichogramma*, vermicompost and earthworms are being

produced. During the year 2008-09, 1352 kg of *pseudomonas* 85 kg of trichoderma and 3528 cc trichocards were produced and distributed to farmers.

PULSES

Plant Breeding Trials

1. Cowpea - CIVT

Fourteen entries of cowpea were tested for the yield and disease reaction during *rabi*, 08. Among them, CP-25 recorded significantly higher yield (928.55 kg/ha) with average infection of anthracnose. CP-21 recorded 868.83kg/ha yield and showed moderate resistance to anthracnose disease.

2. Cowpea - CAVT

Seven entries of cowpea were tested for the yield and disease reaction during *rabi*, 08. Among them, CP-11 recorded significantly higher yield (742.31 kg/ha) with moderate reaction to anthracnose followed by CP-12 (622.50kg/ha) and showed moderate resistance to anthracnose disease.

3. Horsegram - HIVT

Seven entries of horse gram were tested for the yield and disease reaction during *rabi*, 08. Among them, HG-41 recorded significantly higher yield (842.99 kg/ha) followed by HG-40 (741.04kg/ha) with no disease incidence.

4. Horsegram - HAVT-I

Ten entries of horse gram were tested for the yield and disease reaction during *rabi*, 08. Among them, HG-30 recorded significantly higher yield (609.18 kg/ha) followed by HG-32 (542.10 kg/ha) with no disease incidence.

5. Horsegram - HAVT- II

Seven entries of horse gram were tested for the yield and disease reaction during *rabi*, 08. Among them, HG-14 recorded significantly higher yield (631.53 kg/ha) followed by HG-9 (531.67kg/ha) with no disease incidence.

Plant Protection Trials

1. Survey, Surveillance and monitoring of diseases in arid legumes growing areas at frequent intervals

Survey for the incidence of diseases in pulse crops was conducted during *rabi*, 2008 in Palakkad district. The incidence of collar rot caused by *Rhizactonia solani*, mosaic caused by cowpea mosaic virus and rust caused by *Uromyces vignae* were noticed in cowpea.

2. Screening of cowpea varieties against anthracnose disease

Nine varieties viz., PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8 received from Hissar and Kanakamony from Pattambi were screened artificially in net house during *kharif* 2008 and found that all the varieties were susceptible to anthracnose disease.

Management trials

1. Integrated Nutrient management in cowpea

The experiment was started during 2006 to know the response of biofertilizers under different fertility levels. Results of the study conducted during *rabi*, 2008 showed that combined application of *Rhizobium* and Phosphorus solubilizing bacteria could produce a higher yield of cowpea when chemical fertilizers were not supplied and this was on par with the yield obtained at 100% recommended dose of chemical fertilizers.

2. Effect of organic manure and PSB on the productivity of cowpea

The experiment was started during 2006 to know the response of organic manure and phosphorus solubilizing bacteria (PSB) on the yield of cowpea. Results of the study conducted during *rabi*, 2008 showed that effectiveness of PSB was higher when it was integrated with higher quantities of organic manure under lower levels of chemical N and this was significantly superior to the treatment with 100% recommended dose of fertilizers. Application of PSB alone as well as PSB with lower quantities of organic manure could not make any improvement in yield.

3. Effect of micronutrients on cowpea

The experiment was started during 2004 to know the micronutrient requirement of cowpea. The study conducted during *rabi*, 2008 showed that foliar application of micronutrients Fe and Zn could increase the yield of cowpea. The highest yield in the trial was obtained when 0.5 % $ZnSO_4$ was foliar sprayed at 25 DAS and this was found on par with the foliar spray of 0.5 % $FeSO_4$ at 25 DAS. The study also showed that soil application of $ZnSO_4$ @ 25 kg/ha could not improve the yield of cowpea.

HORTICULTURE

KAU projects

1. Identification of suitable varieties of coleus for single cropped paddy lands of central zone.

600kg seed tubers of coleus variety *Nidhi* were produced. Germplasm of var. Sreedhara, pre-release culture CP 74 were maintained.

2. Nutrient management in coleus in relation to stage of crop.

Five treatments with varying doses of NPK and time of application is being evaluated. One season's trial completed. There was no significant difference between the different treatments. The trial will be repeated for two more seasons.

3. Optimising the type of cuttings and planting distance in coleus for yield maximisation

Tip cuttings, inter nodal cuttings and entire vine were used as planting materials at different spacings (30x15cm, 30x10cm, 15x15cm and 15x10cm). One season's trial completed. The trial will be continued for two more seasons. Yield reduction was noticed when inter nodal cuttings were used.

4. Breeding for mosaic resistant cultures of ash gourd

Fifteen kg seeds of ash gourd variety Indu were produced. CYT I was conducted with 20 accessions with three replications. Check variety used was *Indu*. Highest yield was recorded from AP 7 followed by AP 3, AP 10, AP 4 and AP 5. These accessions were tolerant to mosaic.

5. Breeding for mosaic resistant varieties in chillies

CYT I with 8 selections from crosses between resistant/ tolerant chilli and commercial varieties is being conducted with Anugraha and Ujwala as check varieties.

Yield in Kg per plot (plot size 3.25m²).

Sl. no	Crosses/varieties	Mean Yield
1	CA 118x Kiran	5.30
2	Ujwala	4.03
3	IRx JM	5.12
4	PBC 535 x JM	5.76
5	IR x KTPL 16x IR	5.39
6	IRx Manjari xIR	6.66
7	PBC 535 x Kiran	4.38
8	CA 118 x JM	4.61
9	IHR 384 x JM x IHR 384	4.62
10	Anugraha	3.54
	CD 0.05	0.904

6. Rain shelter cultivation of vegetables

Tomato, chilli and amaranth were raised under rain shelter and open conditions during July-October 2008. Results indicated that the yield of chilli and amaranth improved under rain shelter. Yield of determinate variety of tomato Mukthi was better under open situations.

Crop/ Variety	Yield (t/ha) Rain shelter	Yield (t/ha) Open	% increase
Tomato var. <i>Mukthi</i>	6.66	7.60	-14.14
Chilli var. <i>Athulya</i>	7.62	4.85	57.11
Amaranth var. CO 1	12.68	9.68	30.99

7. Collection, characterisation and evaluation of pickling type mangoes

74 types were planted in 2004 and performance evaluated. Two accessions flowered in the year but there was no fruit set. Four accessions were added during the year

8. Participatory seed production of vegetables

Participatory seed production of cowpea, ash gourd and okra is being undertaken in 1.5 ha in Pattambi, Ongallur, Trithala and Vilayur villages.

Externally aided projects:

1. Establishment of Model Unit for Production of Pineapple Planting Materials (SHM)

The objective of the project is to establish a production unit for quality planting materials of Pineapple varieties for the region through conventional methods and Tissue culture. 10000 suckers were distributed. TC plants of variety *Amrutha* is in hardening stage.

2. Rehabilitation of Tissue culture lab for banana (SHM)

Objective of the project was to upgrade the existing facility for large scale production and distribution of virus indexed tissue culture plantlets of banana varieties. Banana varieties being produced include Attunendran, NeduNendran, Kadali and GrandNaine. Other plants under production are Anthurium and pine apple. Trainings are also being offered on "Techniques and Applications of plant tissue culture".

3. Tissue Analysis and Crop Management Advisory Facility for Horticultural Crops at Regional Agricultural Research Station, Pattambi (SHM)

Objective of the project is to establish facility for analysis of soil/tissue samples and to provide nutrient management recommendations

for horticultural crops based on the analysis and documentation of soil resource data for effective micro level land use planning. Civil works and procurement of equipments under the project was completed. Project was launched during July, 2008. Services offered include analysis of plant and soil samples for macro and micro nutrients and recommendations for crop management.

SOCIAL SCIENCES

Farmer Participatory Action Research Programme

The Project on Farmer Participatory Action Research Programme (FPARP) is funded by Ministry of Water Resources, Government of India.

Objectives of the Project

To demonstrate the water use efficiency of the selected technologies in the farmer's field covering five districts of the state.

Technology selected

SRI System of Rice Intensification

Micro irrigation in Coconut, Areca nut, Banana.

Mulching in horticultural crops

The technologies selected are demonstrated in the farmer's field covering 5 districts namely Palakkad, Malappuram, Thrissur, Ernakulam, and Kasargod.

SI.No.	Name of the districts & Participating Institutes	Extent of area (Ha)		
		Technology 1	Technology 1	Technology 1
1	Palakkad (RARS,Pattambi)	24.6	4.0	6.8
2	Malappuram(KVK, Thavanur)	4.2	2.0	3.0
3	Thrissur(ARS,Chalakkudy)	-	2.0	0.2
4	Ernakulam	0.4	-	-
5	Kasargod(RARS.Pilicode)	0.8	2.0	-
	TOTAL	30	10	10

All the technologies have been implemented in the farmer's field and the details are given below:

Technology	Number		
	Blocks	Villages	Farmers
SRI	16	28	47
Micro irrigation in Coconut, Areca nut, Banana	13	10	17
Mulching in Horticultural crops	7	15	22

AGRICULTURAL RESEARCH STATION MANNUTHY

RICE

Plant Breeding

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

Six extra short duration rice cultures developed through reselection in rice variety Hraswa were evaluated during last four years. HS -16 recorded highest mean grain yield of 5276 kg/ha followed by HS -13 with mean yield of 5052 kg/ha and HS -1 with 4811 kg/ha. HS -1 and HS-13 are with total duration of 85-90 days and HS-16 is with total duration of 95-100 days. Yield data of these cultures are presented in Table below.

Cultures	Grain yield (kg/ha)				Mean
	2005-06	2006-07	2007-08	2008-09	
HS-1	3857	5384	6034	3969	4811
HS-13	4597	5922	5204	4486	5052
HS-16	4280	5653	5236	5933	5276
HS-26	3678	4083	4470	4767	4249
HS-29	3930	3903	3991	4687	4128
HS-40	4175	4374	3991	4133	4168
Hraswa		3611	3864	3673	3716

2. Breeding for value addition in Rice (*Oryza sativa* L.)

Suitability of rice varieties for different preparations were analysed and rice varieties suitable for different preparations were identified. Detailed biochemical analyses of the varieties were also undertaken and relation between biochemical properties and suitability for different preparations were analysed. Twelve aromatic rice varieties were evaluated during two seasons and PS-2 and PS-3 were identified as promising entries.

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

Twenty four hybrid combinations from a line x tester crossing programme started during 2003-04 were carried forward through F₂, F₃, F₄ and F₅ generations. From among them seven lines from two different cross combinations viz., Jyothi x Swarnaprabha and Uma x Mahsuri were found uniform in F₄ and were tested in Preliminary yield trial during 2008-09. 163 lines from 16 different cross combinations are also under evaluation.

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

F₅ population of 10 different cross combinations were evaluated and single plants with desirable plant and ear head characters were selected.

A total number of 28 single plants were selected from five different cross combinations.

Agronomy

1 Dry seeding rice in kole land

The trial was carried out during 2007-08 at Eravu kole from December 2007 to April 2008. Treatments consisted of the following.

T1: Broadcasting seeds and covering them by drawing pallamutty

T2: Broadcasting seeds after rototilling

T3: Dry seeding with seed drill cum cultivator

T4: Dry seeding with seed drill cum cultivator after rototilling

T5: Broadcasting seeds followed by rototilling

Results obtained during 2007-08 is as follows

Treatment	Seedlings estd/sq.m	Tiller No. (M.T)	Panicle No/sq.m	Tot. grains/panicle	Filled grains/P	Grain Kg/ha	Straw Kg/ha
T1	215	570	340	63	46	4189	4497
T2	140	435	307	57	42	3888	4134
T3	86	394	308	58	43	3688	4093
T4	106	424	321	64	51	4196	4513
T5	178	480	315	61	44	3809	4108
C.D(0.05)	17	43	18	NS	NS	332	NS

Seedling establishment was significantly affected by the treatments. Highest number of seedlings established in T1. Conventional ploughing with cultivator and seeding by seed drill cum cultivator badly affected seed germination. Same trend was observed in tiller count also. Such a wide disparity was not observed among treatments in panicle number per sq.metre. Nevertheless, panicles were highest in T1 followed by T4. Though significant differences were not observed between treatments on total grains and filled grains per panicle, both characters were highest in T4. Grain yield was highest in T4 closely followed by T1.

RKVY Project

Field Testing, Training and Service Centre for Agro Machinery (FTTSC for Agro Machinery)

Objectives:

- To build up a treasury of agro machinery suitable to Kerala
- To provide training on operation, maintenance and servicing of agro machinery and implements in order to create adequate skilled manpower resource base in the State
- To provide a central facility for the farmers of Kerala to meet their agricultural mechanisation demands by providing access to machinery and

their service and maintenance

d. To provide a facility for development and testing of agro machinery for the State's agricultural scenario

Sanctioned budget : Rs. 25.00 lakhs

Physical Progress of work:

The agro machinery for Rs. 15.50 lakhs have been procured

A covered Implement Yard, 19m x 9m, worth Rs. 5.00 lakhs has been built. The work of the training hall worth Rs. 2.00 lakhs, is in the final stages of completion. Audio visual equipments Laptop computer (model Compaq Presario C773TU), LCD projector (Hitachi CX 300) and handy-cam (Sony DCR DVD 810E) purchased.

Eleven trainings in the use of different agro machinery have been conducted at the Station and at various field locations after the commencement of the project.

Demonstrations have been successfully conducted in Andhra Pradesh

A one year long stipendiary training programme on "Operation, Maintenance and Servicing of Agro Machinery" has also commenced at the Station from December 2008 with five trainees. A mobile training unit has also been established to provide on site training in different agro machinery at farmers' fields.

Established a Farm Machinery Facilitation Centre at the Station to provide a comprehensive solution centre for all the agro machinery related problems of the farmers of the State.

An Agro Machinery Operations Service Centre is now in operation at the Station which provides the farmers with repair and maintenance services of all kinds of agro machinery.

A Mobile Agro Machinery Repair and Service Unit has also been established to provide mobile and on-site repair and maintenance facilities to the farmers.

The station has also been instrumental in the setting up Agro Machinery Service Centres at Panchayath level. Seven such AMSCs have already registered in Thrissur district and are actively engaged in mechanised agricultural operations on contract basis.

HORTICULTURE

1. Evaluation of snakegourd (*Trichosanthes anguina L.*) for summer rice fallows.

The trial could not be carried out during the current year

2. Evaluation of Bittergourd (*Momordica charantia L.*) for summer rice fallows.

Ten promising lines identified were multiplied for further evaluation.

3. New projects

a. Development of F1 Hybrids in cucurbits

Parents were multiplied. F1 seeds produced

b. Close house technology centre for vegetables

The project aims to standardize production technology for vegetables under protected environment.

Nine lines of tropical cauliflower (7 from M/s Namdhari seeds pvt. Ltd and two from IARI, New Delhi) and six cabbage accessions were raised during Nov- Feb, 2008- 09 under open field for evaluation and assessment of their performance. All the cauliflower lines except Pusa Sarad put forth marketable curds. All the eight cauliflower lines produced curds weighing on an average ranging from 447-635g. Pusa Meghna was the earliest to produce curds.

All the six cabbage lines put forth marketable heads ranging from 558-1075g. The line NS 43 was flat headed while all other lines had round heads. Three seasons data of cauliflower and cabbage genotypes are being pooled and analysed

Large scale demonstration of two cabbage lines viz. NS 160 and NS 43 and one cauliflower line viz. NS 60 was carried out in an area of 200 sqm.

Preliminary trials conducted with 2 carrot varieties and one beetroot variety also gave encouraging results.

AGRONOMIC RESEARCH STATION CHALAKUDY

Concluded Projects

1. Hydraulics of sub-surface water emission devices for sustainable irrigation in brinjal

An experiment was conducted to standardize sub-surface irrigation technology for close growing row crops using brinjal as the test crop. Three types of emission devices were used, viz. drip tape, inline drippers and online surface drippers. Irrigation was provided at two levels, ie. 100% PE and 70% PE. Drip tape and inline drippers were laid 15cm below ground level, a depth established to be optimum by previous trials. Surface drippers were laid on ground surface. The brinjal crop was planted at a spacing of 75cmx60 cm and all agricultural operations excepting irrigation were provided as per KAU Package of Practices Recommendations. Irrigation was given on alternate days as per the technical programme.

Pooled analysis of data on yield over two years showed significant effect of inline dripper (ID) and drip tape (DT) over surface drip (SD). Yield was maximum in ID at both levels of irrigation and was on par with DT. Among levels of irrigation, irrigation at 100% PE was superior to irrigating at 70% PE in each emission device.

Yield characteristics of Brinjal

Method	Yield at different levels of irrigation (t/ha)		Mean
	100% PE	70%PE	
Drip Tape	11.12	9.27	10.20
Inline Dripper	12.68	10.39	11.53
Surface Drip	9.94	8.54	9.24
Mean	11.24	9.4	
CD(0.05) - Methods	: 1.712		
Levels	: 1.419		Interaction : NS

2. Nutritionmanagement and processing qualities of vanilla (*Vanilla planifolia* Andrews).

1. Influence of organic manures and graded doses of fertilizer on yield and quality of vanilla.

Growth of plants, with respect to height and number of branches were not significantly influenced by the treatments. The crop started flowering from the third year onwards. Flowering was not uniform. Yield characters such as number of inflorescences, no. of bunches and no. of beans were taken. Among the different treatments, foliar application of neem cake @50g/vine gave more growth and more beans.

Observations on bio-metric characters of vanilla

<i>Treatments</i>	<i>Height(m)</i>	<i>No. Branches</i>
T ₁ . Farmers practice(FP)	10.40	1.58
T ₂ . FP + NPK-20:10:30 g/vine-soil	9.90	1.78
T ₃ . FP + NPK-40:20:60 g/vine-soil	8.95	1.16
T ₄ . FP + NPK-60:30:90 g/vine-soil	11.09	1.58
T ₅ . FP + Neem cake-500 g/vine- soil	11.83	1.08
T ₆ . FP +Groundnut cake-500g/vine-soil	10.42	1.25
T ₇ . FP + NPK-20:10:30 g/vine-foliar	8.07	0.58
T ₈ . FP + NPK-40:20:60 g/vine-foliar	10.25	0.58
T ₉ . FP + NPK-60:30:90 g/vine-foliar	9.25	0.50
T ₁₀ . FP + Neem cake-500 g/vine-foliar	13.75	1.25
T ₁₁ . FP+Groundnutcake-500g/vine-foliar	9.00	1.00
CD	NS	NS

Observations on yield characters of vanilla

<i>Treatments</i>	<i>No. of inflorescences</i>	<i>No. Bunches</i>	<i>No. of beans</i>
T ₁ . Farmers practice(FP)	4	1.22	18
T ₂ . FP + NPK-20:10:30 g/vine-soil	5.67	3.6	40.39
T ₃ . FP + NPK-40:20:60 g/vine-soil	1.67	1.67	25.16
T ₄ . FP + NPK-60:30:90 g/vine-soil	0.67	0.67	4
T ₅ . FP + Neem cake-500 g/vine- soil	2.67	1.17	14.16
T ₆ . FP +Groundnut cake-500g/vine-soil	2.33	2	35.67
T ₇ . FP + NPK-20:10:30 g/vine-foliar	0.33	0	0
T ₈ . FP + NPK-40:20:60 g/vine-foliar	3	1.67	15
T ₉ . FP + NPK-60:30:90 g/vine-foliar	3	0.67	7.67
T ₁₀ . FP + Neem cake-500 g/vine-foliar	6	3.8	48.3
T ₁₁ . FP+Groundnutcake-500g/vine-foliar	3	1.17	13.5

2. Studies on foliar absorption of nitrogen by vanilla

Absorption by younger leaf:

The percentage of absorption by the treated leaf, plant part above the treated leaf and the plant part below the treated leaf in relation to duration of absorption and leaf surface is given. The percentage of absorption increased with time up to a duration of 48 hours. At 48 hours after application, the percentage of absorption through the upper surface was 46.98% while through the lower surface it was 39.5%. Percentage of

translocation increased with durations. Percentage of translocation was more when it was applied on the lower surface of the leaf.

Foliar absorption of ^{14}C - Urea by younger leaf in relation to duration of absorption and leaf surface

Treatments	Percent absorption by the treated leaf	Percent translocated to the upper part	Percent translocated to the lower part	Total absorption
Duration of absorption				
2 h	2.988	0.025	0.019	2.99
6 h	10.428	0.117	0.018	8.72
24 h	24.05	0.401	0.026	23.13
48 h	43.24	1.668	0.719	43.1
CD(0.05)	6.69	0.84	NS	8.51
Surface				
Upper	22.29	0.202	0.041	20.99
Lower	18.06	0.904	0.350	17.96
CD(0.05)	NS	0.59	NS	NS
DurationXSurface interaction				
Upper				
2 h	3.84	0.025	0.021	3.83
6 h	10.25	0.119	0.021	10.24
24h	28.10	0.472	0.043	22.9
48h	46.98	0.192	0.078	46.97
Lower				
2 h	2.14	0.025	0.017	2.14
6 h	10.61	0.116	0.014	7.19
24h	20.00	0.330	0.009	23.37
48h	39.50	3.143	1.36	39.23
CD (0.05)	NS	1.18	NS	NS

Absorption by older leaf:

The percentage of absorption by the treated leaf, plant part above the treated leaf and the plant part below the treated leaf in relation to duration of absorption and leaf surface is given in table . The percentage of absorption increased with time up to a duration of 96 hours. At 96 hours after application, the percentage of absorption through the upper surface was 6.097% while through the lower surface was 11.52%. Absorption by the lower surface is significantly superior to upper surface. The difference in absorption is due to the difference in cuticle thickness and stomatal index.

Foliar absorption of ^{14}C - Urea by older leaf in relation to duration of absorption and leaf surface.

Treatments	Percent absorption by the treated leaf	Percent translocated to the upper part	Percent translocated to the lower part	Total absorption
Duration of absorption				
2 h	0.032	0.119	0.017	0.169
6 h	0.258	0.036	0.026	0.320
24 h	0.322	0.140	0.125	0.619
48 h	1.482	0.413	0.234	2.099
72 h	3.255	0.163	0.038	3.383
96 h	8.807	0.052	0.243	9.172
CD(0.05)	2.002	0.0228	NS	2.144
Surface				
Upper	1.629	0.181	0.091	1.936
Lower	3.089	0.127	0.137	3.318
CD(0.05)	1.156	NS	NS	1.237
DurationXSurface interaction				
Upper				
2 h	0.016	0.066	0.006	0.028
6 h	0.188	0.027	0.018	0.232
24h	0.533	0.228	0.122	0.886
48h	1.487	0.707	0.308	2.499
72 h	1.457	0.051	0.045	1.547
96 h	6.097	0.065	0.045	6.423
Lower				
2 h	0.049	0.232	0.0029	0.310
6 h	0.328	0.045	0.033	0.409
24h	0.111	0.052	0.129	0.353
48h	1.477	0.120	0.160	1.699
72 h	5.053	0.275	0.032	5.220
96 h	11.517	0.040	0.440	11.920
CD (0.05)	2.832	0.31	NS	3.032

The result of the trial showed that older leaves absorbed very little compared to younger leaves. At 48 hours after application, absorption by the upper surface of older leaves is only 2.5% while the younger leaves absorb 46.97%.

Studies on leaf anatomy in relation to foliar absorption:

The objective of the study was to study the leaf anatomy in relation to age of the leaf and leaf surface and to explain the influence of anatomical characters on foliar absorption.

Stomatal Index:

The number of stomata per unit leaf area was counted in relation to the age of leaf. Leaf peelings were taken from the upper and lower surfaces using a blade. The peelings were washed with water and stained with safranin for 1 minute. The stained samples were washed in water and mounted on a slide with glycerol. Stomatal counts per unit area were taken from 10 spots from upper and lower surface of the leaves with the help of micro scope and means worked out. The photo micro graph was also taken.

Stomata were found only on the lower surface of the vanilla leaf.

Cuticle thickness:

Cuticle thickness of upper and lower surface of both younger and older leaves was measured. Upper surface of older leaves have more cuticle thickness and lesser absorption. Cuticle thickness and stomatal index determines the extent of absorption.

Root absorption (aerial root) of ^{14}C Urea:

The percentage of absorption by the treated root, plant part above the treated root and the plant part below the treated root in relation to different durations of absorption is given in table. In this experiment, a maximum duration of 96 hours was given. The percentage of absorption increased with time up to a duration of 96 hours. At 96 hours after application, the percentage of absorption was 82.57%.

Absorption of ^{14}C Urea by aerial root of vanilla

Duration in Hours	Absorption by treated root	Absorption by upper part of plant	Absorption by lower part of plant	Total absorption
2	4.55	0.054	0.092	4.696
6	13.17	0.121	0.107	13.398
24	21.45	0.272	0.28	22.002
48	36.45	0.635	0.292	37.38
72	53.27	0.490	0.307	54.067
96	82.57	2.959	1.863	87.392
CD(0.05)	14.55	NS	0.293	

The result of the trial showed that aerial roots are the major nutrient absorbing medium and can absorb about 80- 90% of applied quantity. The study shows that foliar nutrition can be very well practiced in vanilla even if the older leaves absorb only very little quantity.

3. Studies on development of processes for the preparation of value added products of vanilla and its evaluation

Technology was developed for the preparation of vanilla powder from cured vanilla beans without affecting its quality (vanillin content) and the technology was submitted for patenting through KSCSTE. Vanillin content and other flavor components such as vanillic acid, B-hydroxybenzaldehyde, para-hydroxybenzaldehyde of vanilla powder was got tested from an ISO certified agency.

Vanilla powder based products such as cakes, ice cream, pudding, chocolate, milk shake etc have been prepared and evaluated the products using hedonic scale. Hedonic evaluation of the powder based products shows that color and flavor of the products are better than the synthetic vanilla based products. Flavor is found to be retained in the product after one month.

Storage capacity of the powder developed was tested with respect to appearance, vanillin content and moisture content. It has got a very good storage capacity.

Ongoing Projects

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

Different levels of irrigation using drips and basin irrigation were compared. Statistical analysis of data on yield showed that drip irrigation on alternate days at 75% and 100% of pan evaporation and basin irrigation have significant influence on nut yield. Maximum yield was obtained for basin irrigation and lowest yield for rain fed crop. In drip irrigation, the nut yield for irrigation at 75% PE was significantly superior to 50% PE and 100% PE.

2. Hydraulics of subsurface water emission devices for sustainable irrigation in Brinjal

Basic studies regarding the hydraulics of the emission devices like drip tape, inline drippers etc. were completed during previous years and moisture conserved at the point of application (15cm below GL) was found to be more. Pooled analysis of data on yield over two years showed significant effect of inline dripper (ID) and drip tape (DT) over surface drip (SD). Yield was the highest in ID at both levels of irrigation and was on par with DT. Among levels of irrigation, irrigation at 100% PE was superior to irrigating the crop at 70% PE in each emission device.

3. Optimization of plant and lateral geometry for economising micro irrigation (Drip)

In the present study, keeping the plant population in a unit land constant, lateral spacing was varied to determine the optimal design for micro irrigation system. When the distance between the laterals was increased, the spacing of the plants along the row and total length of laterals got reduced. Earlier results indicated that treatment having a lateral spacing of 2.4m & plant spacing of 30 x 30 cm gave higher benefit cost ratio and treatment with 1.2 m lateral spacing & 30 x 60 cm plant spacing gave lesser benefit cost ratio. However during the period under report (2007-2008), the crop was seriously affected by yellow vein mosaic disease and white fly attack and hence the yield obtained was very low. Statistical analysis of yield data was not relevant under this context.

4. Techno economic feasibility of porous pipe subsurface irrigation in Ladies finger.

Porous pipes, inline dripper and on line dripper lateral lines were installed at 22.5cm depth as found optimum in previous studies. Seeds were sown in the second week of November. Irrigation was given at two levels using all the three systems. All vegetative parameters were recorded at periodic intervals. During the period under report (2007-2008), the crop was seriously affected by yellow vein mosaic disease and white fly attack and hence the yield obtained was very low. Statistical analysis of yield data was not relevant under this context.

5. In situ rainwater harvesting through micro catchments and its effect on coconut yield.

Statistical analysis of data on yield showed that in-situ rainwater harvesting through micro catchments (T_1) has significant influence on the number of nuts produced. The yield of coconut plants provided with in-situ rainwater harvesting and drip irrigation at 75% PE (T_2) was significantly superior to the yield of rain fed plant. Maximum yield was obtained for drip irrigation at 75% PE and lowest yield was obtained for rain fed crops (T_3). There was no significant difference between the yield of T_1 and T_2 .

6. Effect of irrigation and mulching on growth and yield of coconut.

The objective of the experiment is to study the influence of different levels of irrigation and mulching on growth and yield of coconut. 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 mulches and irrigation levels were not found to significantly influence the nut yield in coconut in the earlier years. However, a positive effect of sub surface mulching in rain fed palms was observed. Mulches were freshly

incorporated during 2005 and the results during 2006 revealed that mulching significantly increased nut yield. All levels of irrigation showed significant effect on nut yield over rain fed control. Irrigation at 25mm CPE was significantly superior to 75mm CPE and was on par with 50 mm CPE.

The positive effect of sub-surface mulch in rain fed palms observed during early years was not visible during 2007 and 2008

7. Effect of irrigation on growth and yield of cashew (*Anacardium occidentale*)

The objective of the experiment is to study the influence of irrigation on the growth and yield of cashew and to evolve an optimum irrigation schedule for the crop. The experiment was started during June, 1996. Results obtained during the year 2008 indicate that irrigation has no significant effect on number of flushes and inflorescences produced. However yield was significantly influenced by irrigation. All the three levels of irrigation were on par indicating that low level of irrigation is sufficient to get higher yields from cashew.

8. Water Management practices for coconut based cropping systems.

The experiment was started during summer, 2002. Planting of nutmeg, arecanut and pepper was done in existing coconut plantation and irrigation treatments were started in 2004. Due to irrigation coconut yield is found to increase, but the different levels did not show any significant influence. Arecanut has just started bearing and the yield is not stabilized. In nutmeg only few plants started bearing. The influence of irrigation on yield as a System could be analyzed only after the stabilization of yield in arecanut and nutmeg.

9. Optimisation of field water requirement for efficient operation of wet seeder and cono weeder for rice.

Statistical analysis of yield data reveals that weeding using cono weeder has significant influence both on the straw weight and grain weight. All the treatments using cono weeder both with and without standing water, gave significantly higher grain weight than that with hand weeding. Weeding at 20 DAS & 40 DAS using cono weeder and without standing water gave maximum grain weight and treatment with standing water and hand weeding gave minimum grain weight. All the treatments without standing water gave higher yield compared to the treatments with standing water. Among the treatments with standing water, weeding at 20 and 40 DAS was superior to other treatments. Similar trend was observed in

treatment without standing water also.

10. Irrigation scheduling and stress management in vanilla (*Vanilla planifolia Andrews*)

Results of stress management studies showed that vanilla requires 60 days or more period of stress for flower bud initiation. In treatment with less than 60 days of stress period, the flowering was not uniform and showed sparse flowering.

Plan projects

1. Management technology for productivity and sustainability of rice in wetlands.

Objective of the experiment was to study the effect of organic sources in combination with different levels of inorganic fertilisers on productivity and sustainability of rice based cropping systems .

Analysis of the data revealed that yield and yield attributes were not significantly influenced by source of manure and levels of fertilizer. With regard to fertilizer levels, plots with organics alone showed significantly lower yield compared to fertilizer applied treatments.

2. Evaluation of different levels of organic and inorganic nutrients under bubbler irrigation system (BIS) for cucurbits

The experiment is aimed at studying the influence of different sources of organics and levels of inorganic on growth and yield of snake gourd at different moisture regimes under BIS

Analysis of the data on yield attributes and yield revealed that levels of irrigation had significant effect on yield but not the levels of fertilizer. Fruit yield was significantly influenced by irrigating the crop through KAU micro sprinkler and was superior to farmer's practice of pot irrigation (5mm daily). Levels of fertilizer had no significant influence on growth and yield. The increase in yield may be due to increases in number of fruits per plot.

Water Management studies in horticultural Crops

a. Water conservation experiment in coconut

Mulching of the field with coconut leaves, summer ploughing, cover cropping with cowpea and keeping the field undisturbed were done according to the technical programme. Soil moisture content is being recorded at fortnightly intervals.

b. Farmer participatory trials on adaptability of KAU micro sprinkler in horticultural crops

The project aims at standardizing the details of irrigation

requirement in various horticultural crops using KAU micro sprinkler and to popularize the technology by conducting demonstration in farmer's field. Plot was selected for demonstration purpose and KAU microsprinkler was installed for irrigation

c. Performance Evaluation of ground water recharging system of the farm
Ground water recharging systems and storage structures are under construction

d. Micronutrient fertilization in Horticultural crops
Experiment was done to determine the micronutrient requirement of bhendi. Observation is being recorded.

e. Farmer participatory research extension and seed production programme
To conduct adaptive trial in farmers field, suitable plots were selected for cultivating cowpea, var. Anaswara; bhendi, var. Arka Anamika. Trainings are being conducted on seed production

Externally aided Projects

1. KAU RUBBER MARK Centre for Crop Nutrition

The broad objective of the project is to conduct comprehensive field oriented applied research programmes on a farmer-participatory approach to formulate new recommendations; or to modify the existing, nutritional recommendations, to get high productivity in commercial crops of Kerala, especially that in banana, vegetables, coconut, nutmeg, black pepper and pineapple to increase the income of farmers. Field experiments in each crop will be oriented using RUBBER MARK organic manures and fertilizer fixtures to obtain results about the specific products.

It also aims to standardize sustainable crop production practices using organic manures and fertilizer mixtures of RUBBER MARK adopting farmer-participatory research in major crops of Kerala; and popularization of the recommendations among farmers for economic crop production.

There will be two different sub projects to meet the objectives, as mentioned below:

Sub project 1 "Standardization of organic farming practices using Tricoderma-blended organic manures of "RUBBER MARK "

Sub project 2. "Integrated Nutrient Management using fertilizer mixtures of RUBBER MARK"

Specific experiments on selected commercial crops will be conducted in a phased manner. Under INM, two trials will be conducted in

each annual crop, in the Research Station, and two in farmer's field. Trials on organic farming (sub project 1) will be conducted in organically certified/registered farms. Two trials each will be conducted in coconut and nutmeg. Total duration of the project is five years. The field research activities contemplated by this MOU shall commence by December, 2006 (or within two months on its formal approval) and shall continue for five years, and if required can continue for the second phase with new products.

Locations:

Replicated trials will be conducted in Research Stations of KAU. Simultaneously farm trials will be conducted in farmers' field in Ernakulam, Thrissur, Palakkad and Kottayam districts. The projects will be implemented through the proposed Centre on Crop Nutrition, which will function at the Agronomic Research Station, Chalakudy.

Integrated Nutrient Management Trials

INM on vegetables

Vegetable Cowpea

As in previous year, in cowpea, pod yield was maximum in rubber mark treated plots. The treatment receiving rubber mark vegetable Mixture(15-10-10) @ 500 kg/ha was superior to treatments receiving standard mixture available in the market and package of practices recommendations of KAU though the differences between treatment was not statistically significant. Levels of micronutrient and their interaction did not have any significant influence on yield. The experiment has to be repeated one more season in farmer's field for drawing conclusive results.

Bitter gourd

In bittergourd fruit yield was not influenced by fertiliser sources. The treatment receiving Package of practices recommendations through straight fertilisers recorded the highest yield compared to rubber mark mixture and standard mixture. However the result was not statistically significant. Levels of micronutrient and their interaction did not have any significant influence on yield. The experiment has to be repeated for one more season for drawing conclusive results.

INM on Paddy

During first year, application of different sources of fertiliser showed a positive trend on grain yield though the result was not statistically significant. During this year, the difference in yield between the sources of fertiliser was statistically significant and Rubber mark mixture(12-12-6) @ 400 kg ha⁻¹ as basal and (20-0-10) @ 200 kg ha⁻¹ as top dressing gave

maximum yield (4974 kg ha⁻¹) and was significantly superior to other two sources of fertiliser. Levels of micronutrient and their interaction did not have any significant influence on yield. The trial has to be repeated for one more season in farmer's field for drawing conclusive results.

INM on Banana

The data on yield attribute and yield of banana showed significant difference between sources of fertiliser. The rubber mark mixture (10-5-20) recorded significantly higher yield (12.65 kg plant⁻¹) than standard mixture and Package of Practices recommendations of KAU. The higher yield in this treatment may be due to the significant increase in number of fingers per bunch. Levels of micronutrient and their interaction did not have any significant influence on yield. The trial has to be repeated for one more season in farmer's field for drawing conclusive results.

INM on Pineapple

The treatment with Rubber mark fertiliser mixture (12-9-12) @ 100 g per plant recorded the highest yield compared to Package of Practices Recommendations of KAU and standard mixture though the differences were not statistically significant. Levels of micronutrient and their interaction did not have any significant influence on fruit yield. The trial has to be repeated for one more season in farmer's field for drawing conclusive results.

INM on coconut

The treatments were applied according to the technical programme. The general performance of the crop in research station as well as in farmer's field is good. Observation on yield is being recorded continuously.

INM on Nutmeg

The treatments were applied according to the technical programme. The general performance of the crop in research station as well as in farmer's field is good. Observation on yield is being recorded continuously.

Organic manure in Vegetables

cowpea

Statistical analysis of the data showed that the treatment in which Velkathirjaiva was applied is significantly superior to other treatments. The treatment in which Bharathjaiva was given recorded the lowest yield and was on par with control. Same trend was observed in the previous year also. The experiment is being continued for one more season for drawing

conclusive results. Number of pods per plant is also high in Nelkathirjaiva applied plot.

Bitter gourd

In Bharathjaiva treated plots the yield obtained was 13.52 t ha⁻¹ but in Nelkathirjaiva and control it was 10.82 and 8.48 t ha⁻¹ respectively. Statistical analysis of the data showed that Bharathjaiva applied plots recorded significantly higher yield compared to other two treatments followed by Nelkathirjaiva. Lowest yield was in control plots. The experiment is continuing.

Organic manures in Rice

Filling percent, grain and straw yield were more in Bharathjaiva treated plots compared to other two treatments though the difference between treatments are not significant. Similar observation was noticed in the previous experiment also. The experiment is continuing.

Organic manures in Banana

In Bharathjaiva treated plots bunch weight and number of fingers /bunch is higher compared to other two but the different sources of organic manure did not show any significant difference. The experiment is continuing.

Organic manures in Nutmeg

The treatments were applied according to the technical programme. The general performance of the crop in research station as well as in farmer's field is good. Observation on yield is being recorded continuously

Organic manures in Pincapple

The fruit yield data showed no significant difference between treatments. More yield was observed in Nelkathirjaiva applied treatments. The trial has to be repeated for one more year for drawing conclusive results.

Organic manures in Black Pepper

The statistical analysis of the data showed no significant difference between treatments in the berry yield and the reason may be due to high percentage of coefficient of variation. But more yield and drying percentage was recorded in Nelkathirjaiva applied plots. The trial has to be repeated for one more year for drawing conclusive results.

2. Diagnosis and recommendation of micronutrient fertilization in Banana-KSCSTE funded project.

Micronutrient status of soil will be determined to delineate the deficient areas

3. Scaling up of Water Productivity in Agriculture for livelihoods through Teaching cum Demonstration, Training of Trainers and Farmers Training programmes organized.

Nineteen farmer's training and four trainer's trainings were completed during 2008-09. Total number of trainers trained is 100 and total number of farmers trained is 950.

As part of demonstrations different types of micro sprinklers and drip systems with various types of water control facilities are exhibited. A new field water storage structure is developed. Different water measuring devices, mist irrigation system in the green house and roof rain water harvesting devices are installed.

Farmers Training Programmes :

Sl No	Location	Duration	No. of farmers
1	ARS, Chalakudy , Thrissur	24/5/08 to 30/05/08	41
2	College of Agriculture Padannakad, Kasargod	18/08/08 to 26/08/08	47
3	KVK, Kollam	22-9-08 to 29/9/08	53
4 & 5	CARD KVK Pathanamthitta	20/10/08 to 28/10/08 & 9/12/08 to 17/12/08	100
6	KVK Thrissur	20/10/08 to 27/10/08	50
7	KVK, Thiruvananthapuram	8/11/08 to 15/11/08	50
8	KVK Ernakulam	22-11-08 to 28/11/08	50
9	KVK, Kottayam	25/11/08 to 3/12/08	50
10	KVK Malappuram	3/12/08 to 11/12/08	50
11	KVK, Idukki	3/12/08 to 11/12/08	50
12	RARS, Pilicode	11-12-08 to 19-12-08	80
13.	KVK, Palakkad	28-01-09 to 03-02-09	40
14	PRS, Panniyur	25-02-09 to 03-03-09	50
15	CWRDM, Kozhikode	03-03-09 to 09-03-09	50
16	KVK, Ambalavayal	25-02-09 to 03-03-09	50
17	RARS, Ambalavayal	02-03-09 to 09-03-09	50
18	ARS, Chalakudy	02-03-09 to 09-03-09	39
19	TSS, Vellayani	04-03-09 to 10-03-09	50

Trainers Training Programme :

Location	Duration	No. of Participants
ARS, Chalakudy, Thrissur	7/7/08 to 20/7/08	25
Training Service Scheme, College of Agriculture Vellayani, Thiruvananthapuram	10/ 12/08 to 23/12/08	25
KVK, Ambalavayal, Wayanand	2/8/08 to 16/8/08	25
KVK.Palakkad	10/12/2008/23/12/2008	25

Demonstration Programmes:

Details of the technology demonstrated

Different methods of irrigation including micro irrigation techniques are demonstrated.

Micro irrigation

- i. Sprinklers, Mini sprinklers and Micro sprinklers with varying design and discharge rate
- ii. Drip with different discharge rate and emission control devices
- b) Water measuring devices like parshal flume, 'V' Notch, Orifices etc.
- c) Irrigation conveyance Network in the field

Details of the farmers visiting demonstrations

The demonstration plots are laid out in front of the office near the Information cum sales counter of the Research Station. Hundreds of farmers' visiting the station and counter daily used to visit the demonstration plots. Trainer's and farmer's from Krishi Bhavans, Command Area Development Agency and other government and non-government institutions and organizations are taken to this station to get acquainted with irrigation techniques and micro irrigation systems.

CAMPUS DEVELOPMENT VELLANIKKARA, THRISSUR

System of Rice Intensification: A Pilot Study (KSCSTE Project)

1. Assessment of system of rice intensification on the yield and physiology of rice plant

Field experiment was conducted at Agricultural Research Station, Mannuthy during 2006, 2007 and 2008 to elucidate the basis of benefits / demerits of SRI under high humid tropics of Kerala. Treatments comprised planting of seedling viz., 10 days old one seedling per hill and 20 days old two seedlings per hill; Spacings viz., 25 x 25 cm and 20 x 15 cm; Irrigation viz., intermittent irrigation and continuous flooding; Weeding viz., cono weeding and manual weeding. Result of the study indicated that higher grain yield was obtained when planting was done using 20 days old two seedlings per hill at a closer spacing of 20 x 15 cm. This was mainly because the number of panicles Sqm. was significantly higher when 20 days old two seedlings planted at closer spacing of 20 x 15 cm compared to 10 days old one seedling planted at a wider spacing of 25 x 25 cm. In the 1st and 2nd year intermittent irrigation and continuous flooding were found equally effective. But in the 3rd year, treatment with continuous flooding recorded significantly higher yield. The yield obtained with cono weeding and manual weeding was not significantly different. Thus by employing cono weeding, we can save the labour required for weeding by 35 man days and labour cost by Rs. 3125 ha⁻¹. All the 16 treatment combinations were superior to farmers practice.

Results of three year field experiment revealed that SRI method of planting such as planting of 10 days old one seedling at a spacing of 25 x 25 cm was inferior to KAU POP recommendation of planting 20 days old two seedling at 20 x 15 cm. But SRI method of planting was superior to farmer's practice of planting 6-10 seedlings per hill in zig zag manner.

2. Farmer's participatory evaluation of the best management practices

Farmer's participatory evaluation was carried out in farmer's field at 10 locations viz, Kuttoor, Venpala, Kolazhy, Pulimath, Peringottukurussi, Sulthan Batheri, Mala, Puthukkadu, Koduvazhanoor, Marutharoad. Feed back from 15 farmers who have already conducted SRI cultivation was also collected to represent the entire State. Perception of farmers about various management aspects of rice cultivation was collected. General perception of farmers consists of both positive and negative aspects of various management aspects. Reduced seed rate is the first and foremost positive point perceived by all the farmers. From their experience the seed rate can be

reduced to 5-6 kg ha⁻¹ i.e., 10 per cent of the recommended seed rate. The farmers perceived the benefit of planting one or two seedlings per hill compared to 5-10 seedlings per hill. Another positive point perceived by the farmers is that the tiller production can be increased by planting one or two young seedlings at wider spacing compared to farmers practice of planting 5-10 old seedlings per hill in zig zag manner. Other positive points perceived by the farmers include more grain yield, early maturity and water saving. The negative side of farmer's perceptions included the difficulties faced for transplanting one young seedling per hill at specified spacing and difficulties of early and frequent weeding and drudgery of using cono-weeders. In places where rice cultivation was dependent on natural rain fall, keeping the field in saturated condition is difficult.

3. Concurrent growing of daincha in SRI

Excessive weed growth is a major constraint in SRI and the productivity is further affected due to the non application of organic manures in view of their high cost and limited availability. Objective of this study was to formulate strategies to control weeds and make available organic manure at cheaper cost to satisfy the organic manure requirement of the rice production system. Treatments comprised of planting of seedling viz., 10 days old seedling, one seedling per hill at two spacing, viz., 25 x 25 cm and 20 x 15 cm; Irrigation viz., intermittent irrigation and continuous flooding; Weed management viz., cono weeding, manual weeding and by concurrent growing of daincha and its incorporation using 2, 4- D at 30 days after sowing. In cono weeded plots weeding starts at 15 DAP and then 2 weeding at 10 days interval. In concurrently grown daincha plots, daincha seeds (20 kg /ha) were sown on the next day of planting 10 days old one seedling per hill. Daincha was incorporated by spraying 2, 4- D 1.0 kg ha⁻¹ at 30DAS. Results of the study indicated a significant reduction in weed count (74%) and weed dry matter production (64%) in daincha grown plots. Concurrent growing of daincha could add about 12 t ha⁻¹ green matter with minimum investment without any yield reduction. By growing daincha there was a saving of labour cost by 3750 ha⁻¹ for weeding alone and we can save the labour by 44 man days. By employing cono weeding, the saving of labour for weeding was 35 man days and labour cost was Rs. 3125 ha⁻¹.

Farm Trials

Concurrent growing of green manure crops in dry and wet seeded rice

a. Concurrent growing of green manure crops in dry seeded rice

Concurrent growing of cowpea in dry seeded rice crop was done in three locations. Treatments consisted of concurrent growing of cowpea in dry seeded rice and its incorporation at 30-40 DAS by spraying 2, 4- D (T₁)

and dry sowing of rice alone (T_2). In these locations local bush type cowpea variety was used due to non availability of synchronus bush type cowpea variety such as Bhagyalakshmi and Pusa Komal. The cowpea was incorporated at 30-40 DAS by spraying 2, 4- D with out waiting for the flooding of field. The results of the trials revealed that there was a significant reduction in total weed count (48-61 %) with 4-5 t ha⁻¹ green matter addition. There was a yield increase of 5-15 per cent with a saving of labour cost of Rs 1800-2400 ha⁻¹ for weeding.

b. Concurrent growing of daincha in wet seeded rice

Concurrent growing of daincha in wet seeded rice was done in five locations. Daincha seeds were sown along with wet seeded rice and incorporated at 25-30 days after sowing by spraying 2, 4- D. Treatments consisted of concurrent growing of daincha in wet seeded rice and its incorporation at 30 DAS by spraying 2, 4- D (T_1) and wet sowing of rice alone (T_2). The results of the trials revealed that there was a significant reduction in total weed count (60-74%) with 7-8 t ha⁻¹ green matter addition. There was a yield increase of 2-9 per cent with a saving of labour cost of Rs 1600-2000 ha⁻¹ for weeding alone. In two locations they reduced the urea application of rice to 75 percent but there was no yield reduction.

BANANA RESEARCH STATION KANNARA

1. Banana

a. Crop Improvement

284 accessions are conserved in field gene bank which comprise indigenous collection, exotic introductions of natural germplasm, improved hybrids and wild Musa. During 2008-09 the following additions were made. BCB -1, BCB 2 and BCB 3 from BVKV, Kalyani; H 218 from TNAU, Coimbatore; Ankur II, Bangrier, Kapur, Soneri, Borkal Baista, Pisang Jajee from NRCB, Trichy, a set of accessions from NBPGR, New Delhi.

Based on evaluation of improved hybrid introductions, selections were made. The hybrid FHIA 03 is proposed for farm trial.

Large Scale multiplication of commercial banana/Plantain varieties through tissue culture:

Tissue culture facility was established with funding from DAC, SHM and RKVY. The objective is the large scale production and distribution of quality planting material of commercial banana plantain varieties of Kerala.

Proposal for new farm trial

Evaluations of improved hybrid introduction. The evaluation was carried out during 2004-2007.

b. Crop Management

Planting three suckers per pit at a spacing 2m x 3m with 100 % recommended dose of fertilizers recorded maximum per hectare yield.

Stage wise nutrient requirement was standardized for banana var. Nendran. Highest yield was recorded when 100 % recommended dose of fertilizer was applied in 3 split doses with 80 % N and 20 % K₂O in the initial stage.

Studies on irrigation and nutrient interaction in banana revealed that the treatments were not significant for irrigation and fertilizer levels. However, there is an indication that irrigation can be delayed by one day and savings of NPK is possible.

Irrigation at 80 % ER at all growth stages is the most effective to maintain proper growth and yield.

c. Crop Protection

Insect pests and nematodes

Regular surveillance on pests of banana revealed 23 species of insects and mites. The major pests were pseudostem borer, rhizome weevil, leaf caterpillar, *Spodoptera litura*, Slug caterpillar, *Miresa decedens* and root mealy bug *Geocococcus spp.*

The germplasm collection at B.R.S, Kannara was screened for the incidence of pseudostem borer and slug caterpillar. Pseudostem borer infestation was observed on varieties, namely CRPB-39 (AAAB), FHIA-17 (AAAB) Matti (AA), Kadali (AB), Namkanika (AAA), Nendran, (AAB) Big Ebanga (AAB), Bhimkhel, Njockon, Red banana (AAA) Palayankodan (AAB), Dudhsagar and Kanchikela (ABB). Five varieties/accessions were found resistant to the slug caterpillar. These are H-5, Barsain(ABB), Cultivar Rose (AA), Wather (AAA), and Sikuzani (AA). The bird, crow pheasant, *Centropus inensis* was observed feeding on the slug caterpillars. Studied the biology of pseudostem borer and root mealy bug. Field trials on screening of biocontrol agents and botanicals are in progress.

Survey conducted on banana nematodes showed the following genus, namely, *Radopholus*, *Helicotylenchus*, *Meloidogyne*, *Hoplolaimus* and *Heterodera* infest banana.

Disease Management

Surveys on the incidence of diseases revealed that the predominant diseases affecting banana cultivation in Kerala are Sigatoka leaf spot, Rhizome rot and viral diseases. Panama wilt was very severe on cultivars like Rasthali (AAB), Kadali (AB) and Njalipoovan (AB). A new fungus (*Sclerotium sp.*) was recorded on banana var. Kadali (AB). Studies on *Fusarium oxysporum* causing panama wilt disease revealed that there is no variation between different isolates collected from different plots. Disease free suckers from disease free field + dipping in carbendazim (0.2 %) for 45 Min. followed by carbendazim drenching 0.2 % solution, carbendazim injection @ 3 ml of 2 % solution (5th, 7th & 9th month) was effective for the integrated management of soil-borne diseases like panama wilt.

Studies in Sigatoka leaf spot disease revealed that spraying propiconazole (Tilt 25 % EC) 1ml/l + spraying of *Pseudomonas fluorescens* 5 g / litre three times was found to be effective.

Screening of germplasm was carried out for locating sources of resistance against leaf spot diseases, panama wilt and bunchy top disease. The screening using molecular tools are also being attempted.

Virus indexing facility was established at the station and indexing of TC plants and mother suckers are also being carried out.

2. Pineapple

Twenty two accessions are maintained in the gene bank. Multiplication of the selected hybrid-Amritha is in progress. Other hybrids and clones are being evaluated.

3. Jack

Survey to identify unique/superior types was carried out. In the varietal trial Pechiparai-1, Muttom Varikka and Singapore flowered

Twelve numbers of minor pests like spittle bug, shoot borer, leaf caterpillar etc were recorded.

The predominant diseases recorded on jack are leaf spot, pink disease and *Rhizopus* fruit rot.

AROMATIC AND MEDICINAL PLANTS RESEARCH STATION ODAKKALI, ASAMANNOOR P.O.

Ongoing projects

1. "Study of selected adaptogenic plants and Ayurvedic drugs with special reference to polyphenolic composition and antioxidant activity" (KAU-Dushadhi collaborative project financed by National Medicinal Plants Board, Govt. of India).

The project aims at studying the antioxidant capacity of adaptogenic plants and rasayana drugs in Ayurveda in relation to their content of polyphenol compounds. During the period under report, methods were developed for chemical analysis of medicinal plants, crude drugs and formulations selected for the study. Methods of extraction, HPLC analysis of polyphenolic components and assay of antioxidant capacity by five different methods were developed and validated. Seasonal variations in the polyphenolic composition and antioxidant capacity of ten selected adaptogenic medicinal plants were studied on samples collected during August, 2008 and February, 2009. Studies on the changes in quality and activity of selected adaptogenic Ayurvedic drugs during shelf storage was initiated.

2. 'Investigations on anti-inflammatory properties of some selected underexploited medicinal Plants'

Objectives of the project

1. Evaluation of anti-inflammatory activity of selected under exploited medicinal plants namely *Argyrea speciosa*, *Ipomoea mauritiana* and *Artanema sesamoides*
2. Isolation and purification of anti-inflammatory compound/ compounds
3. Chemical characterization of anti-inflammatory compounds

Results

1. Percentage recovery of different solvent extractives

Solvent	% recovery of extractives*		
	<i>Ipomoea mauritiana</i>	<i>Argyrea speciosa</i>	<i>Artanema sesamoides</i>
Hexane	2.43	6.54	2.17
Chloroform	0.73	0.96	1.91
Ethanol	11.66	5.01	12.80
Water	2.08	1.27	1.72

*Values are means of six replications

2. Preliminary phytochemical screening of crude powders

No.	Phytochemical test	Ipomoea		Artanema		Argyrea	
		Root	leaf	Root	leaf	Root	leaf
a	Alkaloids	++	++	+++	++	+++	+++
b	Carbohydrates	+++	++	+	+	+	+
c	Proteins	-	-	-	-	-	-
d	Saponins	++	+	+++	+++++	+	+
e	Phenolic compounds	+	+	+	+++	+	++
f	Tannins	++	++	++	+++	++	++
g	Flavonoids	+	+	+	+	+	+
h	Phytosterols	+	++	+	+	+	++
i	Gum & mucilage	+	+	++++	+	+	+

3. Quantitative analysis of major phyto-constituents of crude root powders

Sl. No	Phytochemical test	Ipomoea		Artanema		Argyrea	
		Root	leaf	Root	leaf	Root	leaf
a	Total Carbohydrates	67.81	18.73	28.21	17.65	35.85	16.85
b	Reducing sugar	4.50	5.34	4.69	12.59	8.11	5.47
c	Non reducing sugar	5.98	8.63	5.77	4.31	13.47	6.77
d	Starch	51.59	4.28	16.20	0.67	12.85	4.15
e	Ash	4.27	8.13	8.86	4.86	5.34	9.90
f	Fibre	10.42	12.58	26.34	9.035	29.24	26.38
g	Total phenolic content	8.21	21.12	16.78	34.17	6.69	21.63

4. Antioxidant activity of crude powders of experimental plants by DPPH method

Sample	EC50 value (ppm)
Ipomoea root	209.45
Ipomoea leaf	209.44
Artanema root	62.3
Artanema leaf	154.8
Argyrea root	151.6
Argyrea leaf	188.24

5. Anti-inflammatory activity of different extractives in mouse ear erythema model

No	Treatment	Average score of cure of inflammation of 8 animals					
		<i>Argyrea speciosa</i>		<i>Artanema sesamoides</i>		<i>Ipomoea mauritiana</i>	
		at 24 hrs	at 48 hrs	at 24 hrs	at 48 hrs	at 24 hrs	at 48 hrs
1	Negative control	0	0	0	0	0	0
2	Positive control (Hydrocortisone acetate)	10	10	10	10	10	10
3	Hexane extract	5	5	2	2	6	6
4	Chloroform extract	2	2	1	1	2	3
5	Ethanol extract	7.5	8	8	8	9	9
6	Water extract	4	4	4	4	3	3

6. Effect of ethanol extractives of roots on rat paw inflammation

Sl. No.	Treatments	Dosage mg/kg	Paw volume	% inhibition
1	Negative control	-	1.186 ± 0.41	
2	Positive control	4 mg/ kg	0.513 ± 0.20*	56.74
3	<i>Argyrea</i> root EE	200 mg / kg	0.833 ± 0.31*	29.76
4	<i>Argyrea</i> root EE	400 mg / kg	0.671 ± 0.22*	43.42
5	<i>Artanema</i> root EE	200 mg /kg	0.829 ± 0.17*	30.10
6	<i>Artanema</i> root EE	400 mg /kg	0.617 ± 0.13*	47.98
7	<i>Ipomoea</i> root EE	200 mg/ kg	1.257 ± 0.22	-5.99
8	<i>Ipomoea</i> root EE	400 mg/ kg	0.683 ± 0.46*	42.41

Values are mean ± SD; n= 8; * ANOVA $p < 0.05$ vs negative control ie vehicle control

Significant Finding

Anti-inflammatory activity of all the three plant species included in the study is confirmed by in vivo studies. Use of *Argyrea speciosa*, *Ipomoea mauritiana* and *Artanema sesamoides* for cure of inflammatory conditions in traditional medicine system is scientifically validated. Ethanol extractives of *Artanema sesamoides* and *Argyrea speciosa* roots were much superior in anti-inflammatory activity. *Artanema sesamoides* root extractives showed highest antioxidant activity and very high total phenolic content compared to other two root extractives. It also showed highest anti-inflammatory activity at a lower dosage at 3 hr observation and also at 7th day of consecutive drug administration.

3. 'CSS (NHM) Aromatic and Medicinal Plants Component'

A well laid out herbal garden is maintained, which houses about 500 species of medicinal plants. Besides, about 50 species of selected medicinal

trees are conserved in large area plots. A nursery centre for multiplication of medicinal plants also is functioning. From the nursery centre seeds and planting materials of high quality worth Rs. 4.5 lakhs was produced and distributed to farmers, NGOs and the Dept. of Agriculture. About 200 kg of lemongrass seeds were produced during 2008-09 which is ready for sale to the cultivators in different parts of the country. Around 30000 vetiver slips of variety ODV- 3 were also distributed to farmers and different institutions during last year. Medicinal and aromatic oil samples received from farmers and industry were analysed for quality and reports provided, on a regular basis from the Regional Analytical Laboratory funded under the scheme. Consultancy was offered to various drug manufacturing units for development and maintenance of in-house quality control laboratories.

4. CSS (NHM) Spices Component

An amount of Rs.3.45 lakhs was earmarked to AMPRS, Odakkali for the production of black pepper rooted cuttings, planting materials of clove/Allspices, curry leaf/cinnamon and nutmeg under the Spices component of the CSS (NHM) scheme implemented at KAU during the year 2008-09. During the current year, around 40000 rooted pepper cuttings were produced and sold to the public through the ISC of the station. Nutmeg seedlings (1000 nos) and budlings (500 nos.) curry leaf (400 numbers), cinnamon (100 numbers) were also produced and distributed to farmers and Dept. of Agriculture.

Under the scheme it is proposed to produce 40000 rooted cuttings of different pepper varieties, 1000 grafts/budlings of nutmeg, 500 clove/allspice seedlings and 500 curry leaf/cinnamon seedlings during 2009-10 for sale to the public through the Information and Sales Centre of the station. The production of rooted cuttings and grafts/ budlings/ seedlings is in progress.

5. RKVY project “Strengthening of analytical laboratory for quality testing and certification of produce of medicinal plants

This project envisages purchase and installation of certain sophisticated items of equipment in the laboratory to strengthen its analytical capability for testing and certifying farmer's produce and standardization of methods fore quality analysis.

The following major items of equipment were purchased and installed.

1. Microwave Sample Digestion system
2. Laboratory Water Purification System
3. Research model weighing balance
4. Maintenance free Battery for laboratory UPS 120 AH 10 nos
5. Other minor equipment, chemicals and reagents.

6. 'Establishment of National Facilitation Centre on Medicinal Plants'

This project sanctioned by National Medicinal Plants Board is mostly a developmental project for the promotion of medicinal plants cultivation in the state.

The data on the annual requirement of raw drugs by various firms in different districts of Kerala state were collected and processed. The raw drugs found to be of high demand for the industries of the state were identified. Action is being taken for popularizing the cultivation of the selected medicinal plants (list attached).

An interactive CD was prepared and released for sale to the public in the month of November, 2008. The CD contains almost all available information on 292 medicinal plants and 28 aromatic crops. The details include, distribution and habitat, uses, properties, botany, agrotechnology and pictures. Information available on lesser known plants is also furnished. The plants in the CD are classified and searchable based on their names (scientific names and vernacular names) or other characteristics (group, family, habit, parts used, and activity). A glossary of terms is also included for easy understanding and navigation of the CD. It is a reference material for students, researchers, entrepreneurs, traders, extension personnel and farmers and may contribute to strengthen the fragrance and drug industry safe guarding our heritage and wisdom. There is very good response from the public with regard to the information provided in the CD. Eventhough the CD could not be prepared in local language, the CD is highly helpful to the Kerala farmers since almost all Kerala farmers are well educated .

Wide media publicity is given about the functioning of the Facilitation Centre for medicinal plants through news papers, periodicals, All India Radio stations, different television channels etc.

Replies to telephonic queries on different aspects of cultivation, harvesting, post harvesting technologies, plant protection, availability of quality planting materials, marketing facilities , market value etc. are given to the cultivators through the wide network of the telecommunication facility provided to each scientist of this station. The scientists of this station make regular field visits to medicinal plants cultivators for giving proper recommendations for cultivation and also to solve their field problems.

7. Conducted 5 training programmes to farmers in Ernakulam, Idukki, Thrissur, Waynad and Calicut districts and one state level stakeholders meet (workshop) at Thopramkudy, Idukki district. Three hundred medicinal plants farmers have attended the trainings and 350 farmers and industry personnel from different districts of the state participated in the workshop.

8. A Malayalam book was prepared and released for sale to the public in the month of March, 2009.

9. Development of good agricultural practices and GAP monograph of *Baccopa monnieri*

The research program include collection and conservation of different ecotypes, characterization of the strains, identification of suitable strain for cultivation, agroecological requirements, propagation methods, agronomic practices, pest & disease control, and quality evaluation aspects.

The work commenced from 1st January, 2009. The first stage is collection and conservation of different ecotypes. District wise information is collected on the natural availability, cultivation, marketing, market price, crude drug traders, pharmaceutical industries and brahmi preparations. The different ecotypes and biotypes of *B. monnieri* available in Ernakulam, Kannur, Vayanadu and Edukki districts were collected and established in the herbal garden of the research centre. Photographs were taken. Observations are taken from the brahmi samples preserved in the herbal garden.

Ernakulam:

Wide extend of brahmi is seen in North Paravoor. Brahmi cultivation is not generally prevalent in this district. The average market value ranges between 10-15 Rs./kg. Parathuvayalil Ayurveda Pharmacy, Kerala Aurveda Pharmacy Ltd., Arjuna Natural Extracts Ltd are Brahmi using companies.

Kannur:

Marshy places, river shores, paddy fields, wet lands in kannur are rich in brahmi. Saline water is good for their growth. Brahmi cultivation started in small scale. The average market value ranges between 25-35 Rs /Kg.

Idukki:

Wet lands in Idukki district harbour brahmi. Brahmi cultivation started in few places. The average market value ranges between 20-30 Rs./Kg.

Wayanad:

Brahmi is seen growing in marshy places and paddy fields. Brahmi cultivation is not observed. The average market value ranges between 20-40 Rs./Kg.

Annual requirement of Brahmi in Kerala
(Pharmaceutical companies-wise) (kg/year)

Name	Total req.	Arjuna Natural	Dhanwan thari	Santhosh Pharmacy	Kerala Ayurveda	Pankaja kasthoori	S D Pharmacy	SV indig	Santhi giri	Vasudeva vilasam
	(kg/year) Fresh wt	Extracts	vaidyasala		Ltd		Alappuzha	enous	Asram	
Brahm	69183	500	25920	24000	7000	9834	736	480	650	63

Concluded projects

1. Development of agrotechniques in selected medicinal trees of Kerala
 - a. Standardisation of nursery techniques in medicinally important *Ficus* species of 'Nalpamaram' group

Fruit and seed characters

Ficus produces a unique fruit called syconium, a fleshy hollow structure lined on the inside with hundreds of tiny seeds; thousand seed weight is not more than 1 g. *F. racemosa* has the largest fruit among the four *nalpamaram* trees. Its fruits are yellowish red in colour with diameter of 20-24 mm. *F. benghalensis* fruits have a diameter of 11-17 mm and that of *F. religiosa* is 4-7 mm. The smallest fruits are in *F. microcarpa* with diameter 3-5 mm. In *F. racemosa*, fruits are borne in clusters on main trunk and branches whereas in other three they are borne on young branches.

Seed germination

Germination percentages in untreated seeds of *F. racemosa*, *F. microcarpa*, *F. religiosa* and *F. benghalensis* were 5.0, 2.3, 27.7 and 82.0 respectively. Soaking seeds in hot water at 65°C for 10 minutes recorded 11.0% germination in *F. racemosa*, 2-3% in *F. microcarpa*, 52.3% in *F. religiosa* and 85.7% in *F. benghalensis*.

In *F. religiosa* germination started on 8th day of incubation, but it prolonged upto 35 days whereas in the other three species, it was completed in 10-15 days

Studies on seed viability

In *F. racemosa* and *F. microcarpa* there was drastic decrease in germination percentage after six months. In *F. religiosa* viability started declining after 12 months whereas *F. benghalensis* seeds retained satisfactory germination even after 18 months. There was no appreciable loss in germination capacity when the seeds were kept in refrigerator.

Influence of sowing medium on germination

Dried litter collected from roof top of buildings which is a highly decomposed porous material was found to be a very good medium and it registered significantly higher germination percentage over ordinary potting medium in *F. racemosa* and *F. benghalensis*. Germination percentage of *F. religiosa* was comparable in coir pith medium and dried litter.

Performance of seedlings in poly-bags

Seedlings of *F. racemosa* showed a fast growth rate compared to the other three species and by 7-8 months the seedlings were ready for transplanting. In *F. microcarpa* and *F. benghalensis*, the growth of seedling was very sluggish.

Vegetative propagation

Stem cuttings

Time of planting

In *F. racemosa* June -October period was found to be the optimum time for planting the cuttings.

Effect of rooting hormone and thickness of cutting

All the four *Ficus spp.* showed poor rooting of stem cuttings. Higher sprouting was noticed in 15-25 mm sized cuttings. In *F. racemosa* and *F. religiosa*, root formation and survival was obtained only in 10-12% cuttings whereas in *F. microcarpa* and *F. benghalensis* 18-20% survival was obtained. Treatment with IBA did not give any added advantage.

Influence of potting medium

Cuttings of *F. microcarpa* were planted in the different potting media and their growth parameters recorded.

Vigour of sprouts was highest in soil: sand: vermicompost (1:1:1) medium. Though there was improvement in vigour, the medium was not effective in increasing rooting percentage and establishment.

Air layering

Air layering during May- June was successful in *F. microcarpa*, *F. religiosa* and *F. benghalensis*. Layering in branches of old trees registered 80-90% rooting. In *F. racemosa* only 40% of the matured twigs rooted which is attributed to the leaf shedding in the plant during this period. When layering was done during August-September, 80-90% success was obtained.

Field establishment and growth of different planting materials

In *F. racemosa* and *F. microcarpa* rooted stem cuttings showed quick and vigorous growth compared to air layers. In *F. religiosa* air layers and seedlings showed easy establishment and growth. *F. benghalensis* exhibited easy seed germination but the growth of seedlings was very sluggish. Air layers showed faster establishment and initial growth.

b. Standardisation of manurial and shade requirement of Palakappayyani (*Oroxylum indicum*)

Propagation

Palakappayyani can be very easily propagated by seeds. Well managed plants starts flowering from third year onwards; however good seeds are obtained from 4-5 year old trees. Numerous thin, flat, silvery winged seeds are stacked within the sword shaped woody pods. Seeds are easily carried away by wind. Thousand seed weight is 138 g. Seeds are easily carried away by wind. Pods mature during February-March; they are harvested before they split open and seeds are collected. Seeds germinate without any pre-treatment; soaking in hot water at 60°C for 10 mts. improves germination to 80-90%. Seed requirement per hectare is only 430 g. For production of seedlings, seeds are sown in sand beds; they germinate in a 12-15 days and are transferred to polybags. Seedlings attain sufficient growth for planting to main field in two months.

Land preparation and planting

The land was cleared of weeds and pits of 45 cm' size are taken and filled with top soil and manures. Seedlings are planted with the onset of monsoon at a spacing of 2 m x 2 m (NMPB, 2008). The plant grows straight as single stemmed with few side branches and very less canopy spread. Hence, about 2500 plants can be accommodated in one hectare.

Effect of shade

Appreciable variation was noticed in the growth of plants under open and shaded situation. At 28 months after planting, the plants grown under open situation had a plant height of 192.5 cm which was more than three times the plant height in shade. Stem girth and leaf production also was significantly higher in plants grown under open condition. The observations confirmed that *O. indicum* is a plant which performs well in situations of sufficient sunlight.

Effect of manurial practices

The plant responded well to manuring. The best manuring schedule for optimum growth is FYM 20 kg/ plant/year or poultry manure 10 kg/ plant/year applied as two doses in May-June and September-October.

Irrigation requirement

It was also observed that frequent irrigation during dry periods is highly essential to ensure establishment and satisfactory growth of this medicinal tree. Deficiency in soil moisture resulted in leaf shedding and sometimes drying up of the growing point during the initial years.

Pest and disease occurrence

No serious diseases are noticed. However, insects like thrips, leaf eating caterpillars, grasshoppers and leaf webbers etc. damage the leaves. Under dry situations, termites cause damage to root and stem bark. Proper measures have to be adopted to check these pest problems.

Root characters Biometric

Plants under open attained a root growth of 52.1 cm in three years as compared to 36.7 cm under shaded situation. Number of roots and diameter also were lower in plants grown under shade. Root biomass of three year old experimental plant under open was 3353 g/plant whereas it was very low under shade (151 g/plant). Weight of root bark which is the officinal part of the tree commonly used in *ayurveda* also showed similar variation. Root shoot ratio of the plant was 1.4 - 2.2 which shows higher accumulation of biomass in root portion compared to shoot.

Chemical

Ash content of experimental plants under open was 6.83% while plants under shade recorded only 4.48%. Total methanol extractives of root bark was 45.1% and 42.0% respectively under open and shaded situations. Ash, fibre and total methanol extractives of the root bark of a twelve year old tree was analysed and the average values were 6.40%, 11.4% and 51.4% respectively.

c. Standardisation of agrotechniques of *Caesalpinia sappan*

Effect of growth modulation on plant characters of C. sappan

A field experiment was conducted during 2005-'08 to study the effects of removal of side branches and modes of support during initial years on plant habit and stem characteristics of *Caesalpinia sappan* Linn. The study revealed that selective pruning did not increase diameter of stems in the clump; on the contrary, it resulted in decreased thickening of the retained stems. Support with poles during the initial years increased the branching height which facilitates easy movement inside the field. Hence, when cultivated as a crop, *C. sappan* should be left unpruned and supported with poles during the initial years for a good crop architecture and higher production of heartwood.

CASHEW RESEARCH STATION

ANAKKAYAM

On going projects

1. Collection, maintenance and evaluation of cashew types (germplasm)

The experiment was started in 1994. There were 121 plants belonging to 71 types. Observation on height, girth, spread and yield were recorded as per the technical programme. The data was analyzed and no significant result was obtained.

Many of the trees in this experimental plot are now lost due to various reasons including pest attack, cyclonic wind etc. Instead of continuing this trial, it is advisable to establish a new germplasm collection for experimental purpose so that we can update the collection as well as avoid experimental error.

2. Breeding improved varieties of cashew by hybridization

a. Release of new varieties; Two varieties have been recommended for release during 2008-09

1. Cashew: Selection 990

This is a clonal variant of the released variety Anakkayam1. Unlike Anakkayam 1, raw nuts of this clone are bold and bigger with high kernel content. The clone is quite early and harvest can be completed before April. The clone shows field resistance to tea mosquito attack Average yield is 18.5 kg per tree per year. Average weight of nuts is 10.4 g and that of kernel is 3.3 g.

2. Cashew: H 8-6

This is a hybrid from the parental combination, tree number 20 (a local accession from Anakkayam) and K-30-1. The hybrid shows fairly good field resistance against tea mosquito attack. Mean yield is 20.4 kg per tree per year and kernel content is high (3.2g). Average weight of nuts is 11.9 g.

b. Evaluation of 96 series hybrids

An experiment was laid out in June 2004 in RBD with 35 selected progenies from 8 combinations (treatments) in 3 replications in block 4 and 6. Observations on height, girth and spread were recorded during May 2008 and November 2008. Analysis of variance showed that there was no significant difference among treatments for the characters studied. About 50% of the hybrid combinations have started yielding and the yield per tree in some of them has reached up to one kg or above. Collection of nuts from individual trees is in progress. The growth of the trees is satisfactory. Comparative data on yield attributes can be obtained after two years.

3. Collection, conservation and management of biodiversity in commercially important ornamental plants available in Western Ghats and developing a livelihood for the tribal population in Wayanad district.

The objectives of the experiment include:

a. Collect and conserve germplasm comprising wild species and local accessions of rose, orchids, ferns and other endangered species of ornamental plants in order to protect the biodiversity of those plant species in the Western Ghats.

b. To train unemployed, educated rural youth, especially from scheduled castes and scheduled tribes of Wyanad district in the collection, preservation and utilization of the germplasm.

c. To train them in nursery production and commercial cultivation of ornamental plants so as to generate employment opportunities for them

The project has been completed successfully and the preparation of final report is in progress.

4. RKVY - Establishing of a polyclonal progeny orchard of cashew at CRS, Anakkayam

Thirty two high yielding/hybrid varieties of cashew released from various research stations of India have been collected and kept ready at CRS, Anakkayam for planting during this season.

5. Establishment of a network centre for production of planting materials

1. The project has been implemented successfully at CRS, Anakkayam.

2. The work of the Sales Counter and other development works have been completed in time.

3. The station has made tremendous achievement in increasing its revenue by utilizing the revolving fund set up under the project

6. Laying out a Cashew Model Nursery at CRS, Anakkayam

The project is funded by the State Horticulture Mission. Work is in progress to make required infrastructures for development of the station (including a rain water harvesting structure to hold 45 lakh litres of water, a polyhouse of 500sq metre, and green houses in 1000 sq. m area etc).

7. Laying out a Pepper Small Nursery at CRS, Anakkayam

Work is in progress to produce one lakh rooted cuttings of Panniyur-1 variety of pepper during this year. Land preparation work for establishing a

progeny garden for rapid multiplication of pepper is in progress

8. Setting up a vermicompost unit at CRS, Anakkayam

The objective of the project is to set up a vermicompost unit in the nursery area of the research station with 200m³ of composting pits (cement tanks) in a compact area of 32mX24m using the revolving funds of the station so as to completely utilize the bio-wastes and crop residues generated in the station. The work is in progress

9. Setting up a Tissue Culture laboratory at CRS, Anakkayam

The Project is funded by state planning board. The existing field laboratory of the station is being modified for the purpose. Work is in progress and it is expected that we can start the functioning of the TC laboratory within a month.

New programmes;

1. Commercial seed production of major vegetable crops under protected conditions

The project will be undertaken to evaluate the performance and explore the economic feasibility of year-round seed production under protected conditions (polyhouses) of commercially cultivated vegetable crops of Malappuram district

2. Product diversification in cashew for empowerment of rural women

The project proposal submitted under RKVY 2008-09 is aimed at setting up a processing unit cum laboratory and training hall with a total financial outlay of 29 lakhs. The project has obtained preliminary approval and it is expected that the project can be implemented during this year.

3. Strengthening Tissue Culture Laboratory facility at Cashew Research Station, Anakkayam.

This has been included under the District Agriculture Plan of Malappuram district for funding under SHM.

Other achievements

Cashew Research Station, Anakkayam has developed a novel technique for **rapid production of jack grafts**. The method can ensure large scale production of grafts in a short period of time. The technique is simple and inexpensive and the success is 100 percent. The whole process of production of a finished graft (seed to field) will take only 60 days.

CASHEW RESEARCH STATION MADAKKATHARA

Cashew

Crop improvement

1. Germplasm collection, evaluation, characterization and Cataloguing in cashew (AICRP on Cashew)

The objective is to collect, evaluate, characterize and catalogue cashew germplasm. A total of 128 accessions, collected till 2007-2008, have been planted for evaluation in the clonal germplasm block. Evaluation was completed for the trees planted in 1988 and limb pruning was done for the maintenance of the existing trees.

2. Multilocational trial II (MLT 1992) in cashew (AICRP on Cashew)

The objective of the experiment is to evaluate the performance of high yielding varieties evolved at different research stations all over India. The trial was laid out during 1992 with thirteen varieties using Dhana as local check. Analysis of data for 2007-08 revealed that genotypes HY 303 (10.25 kg/tree) and Hy- 320 (9.10/ kg) are promising.

3. Multilocational trial III (MLT 2002) in cashew (AICRP on Cashew)

The objective is to evaluate the performance of TMB tolerant accessions and promising hybrids from different states at Madakkathara. The trial was laid out during 2003 planting season with 11 varieties (10 test varieties and Dhana as local check). The accessions which recorded comparatively good yields during 2007-2008 are H 662 (2.200 kg/tree) and BH 85 (1.800 kg/tree).

4. Hybridization and selection in cashew (AICRP on Cashew)

The objective of the experiment is to incorporate TMB tolerant characters in high yielding varieties with better nut size. A total of 1557 hybrids has been planted and are being evaluated in the field during 1993-2008. Hybrid 21 (15.25 kg/tree) and Hybrid 24 (13.50 kg/tree) were found to be promising.

5. Multilocational trial IV (MLT 2006) in cashew (AICRP on Cashew)

The objective of the experiment is to evaluate the performance of all the promising high yielding varieties released from different states of India. The trial was laid out during October 2006 with 29 varieties using Dhana as local check. The trees have not started yielding.

6. Evaluation of promising Madakkathara accessions and hybrids for yield and resistance to biotic stress (Plan Project)

The objective is to evaluate promising Madakkathara accessions and hybrids for yield and yield attributing characters. Eight promising Madakkathara accessions and three promising hybrids were planted during 2003. Accessions M4 (4.0 kg/tree) and M5 (3.0 kg/tree) are found to be promising.

Crop management

7. NPK fertilizer experiment in cashew (AICRP on Cashew)

The main objective of the experiment is to find out the optimum fertilizer requirement of graft-raised cashew. The treatments consisted of three levels each of nitrogen (0, 500 and 100 g N/tree/year), phosphorous (0, 125 and 250 g P₂O₅) and potassium (0, 125 and 250 g K₂O), laid out in confounded factorial experiment. The data on the annual yield of cashew of the reporting year as well as cumulative yield for eight years did not show significant response to graded levels of N, P or K or their 2- way or 3- way interactions.

8. Fertilizer application in high-density cashew plantation (AICRP on Cashew)

The objective of the experiment is to standardize an optimum combination of tree populations and fertilizer doses for obtaining high productivity in cashew and was started during 2001. Combinations of three levels each of fertilizer (75: 25: 25, 150: 50: 50 and 225:75:75 kg NPK/ha) and tree density (200, 400 and 500 plants/ha) constituted the treatments. The growth characters and the yield during the first (2004-05) and second (2005-06) years of yielding did not show significant variations due to tree densities or fertilizer levels except that no yield could be obtained during the second year due to severe infestation of TMB in spite of timely pp measures. During 2006-07 and 2007-08 also, the treatment effects were not significant. However cumulative yield data indicated increasing yield per tree and per hectare with increasing tree density from 200 to 500 trees/ha.

9. Intercropping in cashew (AICRP on Cashew)

The experiment aims to identify suitable intercrops that can be grown in cashew plantations in the early years of establishment and was started in 2004-05. The treatments composed of five intercrops (coleus, colocasia, tapioca, sweet potato and amorphophallus) and a pure crop control. The study showed that among the different tuber crops raised as intercrops in young cashew plantations, tapioca recorded the highest total return per hectare (Rs. 64961), net profit (Rs. 35711) and C: B ratio (2.22).

10. One acre farmer's cashew

The objective of the experiment is to explore the possibility of increasing nut yield and quality by adopting different organic farming systems and to find out the economic feasibility of organic farming of cashew compared to conventional farming. The experiment consists of eight treatments involving different qualities of FYM, vermicompost, and biofertilizer. The experiment was started during 2005. It was laid out in PBD with three replications.

11. One acre fertilizer trial in cashew (AR RP on Cashew)

The objective of the experiment is to assess the effect of fertilizer dose on cashew raised in farmer's field. The trial consisted of five levels, i.e., 100, 150 and 200 per cent of national recommendation, KAU recommendation and a fully organic treatment, laid out at Pachayannur in Thrissur district. The experiment was started during 2005-06 and the treatment effects were monitored from 2005-06 onwards. The data on yield data for 2007-08 indicated the superiority of the NRC dose (200% T_3 T_4 T_5) followed by KAU dose. The organic dose recorded the lowest yield.

12. High density planting observational trial (AR RP)

The main objective of the experiment is to compare the growth and yield of cashew under normal (8m x 8m) and high (4m x 4m) density planting systems. The data showed that the per tree yields were higher under normal density plantings during the eleventh year of planting as well as the cumulative yield (8th year) as compared to high density planting. However, the per hectare yield was appreciably high in high density planting.

13. Growth and yield characters of cashew as influenced by chemical retardants (KAU Plant Project)

The study aims at evaluating the effectiveness of chemical growth retardants in inducing dwarf form in cashew grafts, analyzing the anatomical and biochemical characters of dwarf grafts and comparing the field performance of dwarf cashew. Growth retardants like Cultar, Alar and Cycocel were applied to the cashew grafts (Dhiana grafted to MDK-1) each at 1 and 2 mg/plant at one, three and six month after grafting. Though there was no significant difference between treatments, T_1 (Cultar 1 mg/plant) recorded the lowest shoot length and girth of grafts. Based on the nursery performance, the grafts were planted in the field during the period under report for evaluating the field performance.

Collaborative projects on cashew

1. Cataloguing of cashew germplasm of Kerala with molecular markers and digitalizing the morphological data.

The project funded by KSCSTE, is implemented by Department of Plant Breeding and Genetics of College of Horticulture, Vellayani, in collaboration with the station. The project envisages to develop DNA fingerprints of the indigenous cashew cultivars in the germplasm maintained at three stations viz. Madakkathara, Anakayam and Pilicode, using RAPD and EELP markers and to develop software to store the data.

2. Development of INM package for commercially important plantation crops

This is a DBT Network Project “implemented at this station in collaboration with the NARP (Southern zone), College of Agriculture, Vellayani. The objective of the experiment is to develop an INM package for cashew involving chemical fertilizers, organic manures and biofertilisers. The experiment is conducted in an existing adult cashew plantation with four treatments and five replications.

Transfer of Technology in cashew

1. Revolving fund scheme on Cashew Graft Production

A commercial cashew nursery is functioning under the revolving fund scheme on cashew graft production with facilities for the production of over four lakh grafts per year.

2. Revolving fund scheme on cashew apple processing

A cashew apple processing unit with FPO license is being operated at this station under a revolving fund scheme

3. NHM project on Transfer, demonstration and refinement of technologies for cashew apple processing

The main objective of the project is demonstrating and transferring the technologies developed by KAU for the utilization of cashew apple. The project involves conduct of state level trainings, product refinement and testing and establishment of model demonstration units in major cashew growing areas. The total outlay of the project is Rs. 44.77 lakhs. The project was completed during 30th September 2008. The major output of the project are:

Developed the technologies for the off season storage of cashew apple juice, pulp and pieces of green apple. Refined the technologies for the clarification of juice and de-tanning of ripe and green cashew apples. Developed the technologies for the production of blended squashes, blended RTS beverages, cashew apple pickle and mixed fruit jam.

Developed the technologies for the production of novel products such as fruit bar and chutney and confectionaries such as biscuits, toffee and halwa.

Proposed ten recommendations on cashew apple processing for incorporation in the Package of Practices recommendations (Crops) for state wide adoption. Launched four commercial cashew apple products viz., Cashew Apple Drink, Cashew Apple, Pickle, Cashew Apple Candy and *Cashewman* (Cashew Apple Mango) Mixed Fruit Jam. Established state level Model Cashew Apple Processing Unit at Madakkathara. Established Product Refinement and Testing Unit at Madakkathara. Established state level training centre for cashew apple processing at Madakkathara. Conducted 30 training programmes on cashew apple processing including off campus programmes of different duration including one day, three day and one week. Established three model cashew apple processing demonstration units under the project by extending technical and financial assistance to SHGs at Payyavoor (Kannur District), Kelakam (Kannur District) and Neendakara (Kollam District). Four trainees started commercial production of different cashew apple products on their own. Published six research papers, two booklets, two books and three popular articles on cashew apple processing for its popularization. Put up stalls in major exhibitions for popularization of cashew apple processing technologies and cashew apple products.

4. SHM project on Establishment of model cashew nursery

The objective of this project is to establish a model nursery for production and distribution of quality cashew grafts of high yielding varieties to farmers of Kerala. The total outlay of the project is Rs. 18 lakhs. The project was completed during 30th September 2008. The major output of the project are:-

The production capacity of the model nursery has been enhanced to four lakhs grafts per annum. Substantial improvement in the percentage of grafting success, particularly in rainy season. The disease incidence in rainy season was considerably reduced. Improved health and vigor of grafts. Efficiency in the nursery operation has been substantially improved with better supervision, easy and quick transport of inputs to various nursery points and easy lifting of grafts. Persons coming for buying grafts are given better technical help and facilities to select best grafts and varieties suitable to their area. Production and sale of grafts is better monitored and documented. An electrically operated motor driven machine was fabricated for the efficient retrieval of potting mixture from wasted polythene bags and disposal of polythene components without creating environmental issues. Improved drainage facilities and efficient soil conservation in the nursery area. Better maintenance of scion bank and enhanced availability of scions

of all the recommended varieties. Storage facilities for inputs and equipments improved. Uninterrupted and adequate irrigation water supply ensuring improved growth and vigour of grafts and avoiding damage of grafts due to interruption in water supply due to power failure and other reasons. Labourers working in the nursery are provided with improved amenities.

5. RKVY project on “Cashew apple processing unit at Madakkathara”

The objective of the project is to upgrade the cashew apple processing facility and also to undertake advanced research for the development of new cashew apple products and to facilitate their production on commercial scale. The production of vinegar, wine and carbonated RTS were standardized. Experiments conducted to find out the possibility of replacing sugar with jaggery in the preparation of syrup and candy have not yielded positive results. New equipments like spray drier, water chilling unit and juice expeller were purchased on this project. Modification of the existing processing laboratory to enhance production was also done.

Other crops

1. KSCSTE funded Project on “Standardisation of planting materials and regulation of flowering in bush jasmine (*Jasminum sambac*)”

The objective of the project is to standardize the age and source of planting material for bush jasmine and also to find out methods to enhance flower production during cooler months. Planting materials collected from different aged mother plants were planted and performance is being assessed.

Rooting studies are also progress. IBA 2000 ppm gave better rooting compared to other hormones. Out of the various bioregulators used for enhancing flower production, BA 50 ppm and cycocel 500 ppm gave better results. In the trial with organic supplements, panchagavya and vermiwash yielded more flowers.

2. DBT funded Project on “Popularization of less exploited potential ornamental crops of Kerala through rural women”

The project aims at popularizing the less exploited potential ornamental crops like gladiolus, tube rose, heliconia, gerbera and annual flowers as well as foliage plants among farmers through trainings and making demonstration plots in the farmers' fields as well as in the station. Six trainings of one week duration were offered to 122 women during the period under report. Flower production units of gladiolus, gerbera and heliconia were started by a few farmers who had undergone training under the scheme.

PINEAPPLE RESEARCH STATION VAZHAKULAM

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

The objective of the project is to develop pineapple varieties suitable for processing and table purpose. To achieve the objective hybridization and induced mutations were done. The hybrids and mutants produced are under evaluation.

Among the hybrids evaluated, one hybrid found promising was under farm trial (approved in 29th ZREAC). Evaluation of the remaining hybrids and mutants are continuing.

2. Intra clonal variability in pineapple variety Mauritius.

The objective of the project is to identify a superior clone of pineapple utilizing natural variability. Different types found in farmers field were collected and evaluated. One type found promising was under farm trial (approved in 29th ZREAC).

3. Collection and evaluation of passion fruit germplasm for selection of varieties suitable for low altitude areas.

The objective of the project is to develop a passionfruit variety suitable for low altitude areas in Kerala. Various types collected from southern states were evaluated and one type found promising was under farm trial (Approved in 29th ZREAC).

COLLEGE OF HORTICULTURE VELLANIKKARA

Department of Olericulture

Screening indeterminate tomatoes and salad cucumbers for rain shelter

The plan project on "Screening indeterminate tomatoes and salad cucumbers for rain shelter" was started in the Department of Olericulture during 2004-2005. Indeterminate tomatoes are ideal for cultivation in protected structures. But so far KAU has released only determinate and semi-determinate varieties for cultivation in Kerala. Most of the indeterminate tomatoes available in the market are F_1 hybrids which are very costly and most of them are bacterial wilt susceptible also. Hence this study was undertaken to select an indeterminate, wilt resistant and open pollinated tomato variety. Under this project many exotic and indigenous indeterminate tomato lines were collected and after two preliminary screening trials seven accessions were selected. They were further evaluated along with the released semi-determinate varieties, Anagha and Sakthi. An indeterminate tomato line LE 643-1 was identified as high yielding and wilt resistant both in the polyhouse and open field.

LE643-1 is a high yielding accession of indeterminate tomato which is suitable for cultivation in protected structures and also in open field. It is resistant to bacterial wilt and yield/plant is 3.54 kg under polyhouse and 2.48 kg under open field respectively. Average fruit weight is 59.2g under polyhouse and 56g under open field. Fruits are white, flat-round, medium sized, without green shoulder and jointed pedicel. The above line is presented for consideration for conducting farm trial.

Table-1 Yield data (g/plant) of Tomato accessions (2005-2006)

Acc. No	T ₁	T ₂	T ₃
LE 642	568.2	388.8	794.6
LE 643-1	664.0	624.0	1033.4
Pant T ₃	938.4	652.2	851.8
VT 20	549.6	773.6	871.8
LE 644	739.8	784.6	902.0
LE 645	699.4	448.6	745.4
LE 646	567.6	419.4	556.0
Anagha	968.8	815.4	709.6
Sakthi	794.4	869.0	938.2

T₁- Open field T₂- UV sheet+ shade net T₃- UV sheet

Treatment CD 142.97

Varieties CD 213.07

Table-2 Comparative performance of LE 643-1 and Anagha (2006-2007)

Sl. No	Characters	LE 643-1		Anagha	
		Poly house	Open field	Poly house	Open field
1	Plant height at final harvest (cm)	189.00	115.00	100.00	87.00
2	Days to flower (after transplanting)	30.70	26.45	31.45	29.65
3	Days to harvest	66.48	66.05	67.00	65.88
4	Number of inflorescence	17.20	13.40	15.35	10.73
5	Average fruit weight (g)	59.20	56.00	45.10	42.00
6	Yield/plant (kg)	3.54	2.48	2.34	1.98
7	Fruit cracking (%)	3.52	7.88	0.00	1.63
8	Bacterial wilt incidence %)	5.00	10.00	0.00	5.00

Progress of on-going Farm Trials

Crop	Variety	District	Location	Remarks
			Krishibhavan	
Snake gourd	TA 19-1	Malappuram	Pulamanthole Angadippuram (2 expts.)	Results obtained
		Thrissur	Kuruva Madakkathara Ollukkara Nenmanikkara Kaiparambu	Results obtained Results obtained Results obtained Results obtained
		Ernakulam	Karukutty Manjapra Kunnukara (2 expts)	Results obtained
Cowpea	VS 1112	Palakkad	Nemmara Elavanchery Vandazhy Kannambra	Results obtained
		Palakkad	Nemmara Elavanchery Kizhakkancherry Tharur	
	VS 1187		Nemmara Vandazhy Kizhakkancherry Kannambra	
Amaranth	A-6	Thrisisur	Nadathara Puthur	
		Palakkad	Vadakarapathi Eruthiampathi	
		Ernakulam	Kunnukara Parakkadavu	

Apiculture Unit, Department of Entomology

Fabrication of stingless bee hive

Stingless honey bee, *Trigona iridipenis* is known in Kerala since long for its medicinal honey. However, meliponiculture in Kerala is in a very unscientific manner viz., in mud pot, bamboo, cement pipe, wooden log, etc. Most efforts of the bees go in maintaining the internal atmosphere by reducing the space, sealing the crevices and crakes, etc. This prompted to fabricate a suitable hive for the stingless bee.

Teak or any other hard wood is used for the fabrication. The hive has three components viz., the main chamber, transparent overlay and the lid. The main chamber is made up of 1.25cm thick wooden planks with the dimension of 30 x 12 x 12 cm. The transparent overlay (30x12cm) is placed over the main chamber for easy visibility of hive activities. Over which the sliding top lid (30x12x3 cm) is placed.

The main advantage of the new hive is that the internal atmosphere can easily be regulated by the bees so that much of their efforts can be oriented to hive activities viz., nectar, pollen, propolis collection and brood rearing. Without disturbing the bees, the hive can be inspected just by opening the lid.

AICRP on Medicinal & Aromatic Plants, KAU Campus, Vellanikkara

1. Effect of harvesting time on yield and quality of brahmi (*Bacopa monnieri*)

The experiment was conducted to study the effect of harvesting time on yield and quality of brahmi during 2007-08 and 2008-09. The data on growth, yield and quality revealed that the best time to harvest brahmi is five months after planting.

Effect of harvesting time on growth, yield and quality of brahmi
(2007-08 and 2008-09)

Treatments	Vinelenh (cm)		Noofleaves		Branches		Biomass prodn (g/pl)		Drymatter prodn (g/pl)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
1MAP	39.0	26.0	140.1	105.5	11.9	10.5	4.29	3.55	0.52	0.42
2MAP	68.0	44.0	224.6	187.0	17.4	16.2	6.34	5.64	1.02	0.92
3MAP	75.2	51.6	596.4	660.0	18.9	17.9	16.19	13.81	3.12	2.16
4MAP	89.6	70.0	3698	3600	23.9	22.9	20.46	18.10	4.23	3.13
5MAP	111.0	86.2	4940	5020	25.8	24.8	26.94	24.34	10.94	9.28
6MAP	122.6	103.0	2394	2268	27.7	26.5	21.36	19.70	7.39	6.35
7MAP	156.1	126.9	2398	2322	29.5	28.1	20.83	18.37	5.94	5.66
CD(0.05)	9.53	9.96	986	935	1.5	1.7	4.36	4.25	3.05	3.26

Effect of harvesting time on yield and quality of brahmi

Treatments	Fresh yield (t/ha)		Dry yield (t/ha)		Bacoside content (%)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
1MAP	6.1	5.6	2.8	2.1	3.82	3.70
2MAP	9.2	8.9	3.9	3.8	4.32	4.20
3MAP	10.5	10.0	4.8	4.2	4.93	4.87
4MAP	12.5	11.9	5.9	5.4	5.39	5.33
5MAP	14.9	13.8	6.9	6.1	5.92	5.84
6MAP	12.9	12.0	5.9	5.3	5.38	5.22
7MAP	9.4	9.4	4.3	4.3	5.12	5.04
CD(0.05)	2.53	2.32	1.62	1.52	0.68	0.52

Effect of harvesting time on growth, yield and quality of brahmi (pooled data)

Treatments	Vine Length (cm)	No. of leaves	No. of Branches	Fresh wt (BMP) (g/pl)	Dry wt (DMP) (g/pl)	Fresh yield (t/ha)	Dry yield (t/ha)	Bacoside content (%)
1MAP	32.5	122.8	11.2	3.92	0.47	9.65	2.68	3.76
2MAP	56.0	205.8	16.8	5.99	0.97	13.20	4.56	4.26
3MAP	63.4	28.2	18.4	15.00	2.64	20.16	6.14	4.90
4MAP	79.8	3649.0	23.4	19.28	3.68	24.32	7.98	5.36
5MAP	98.6	4962.0	25.3	25.64	10.11	29.64	11.85	5.88
6MAP	112.8	2331.0	27.1	20.53	6.87	23.85	7.21	5.30
7MAP	141.5	2360.0	28.8	19.60	15.80	20.67	6.08	5.08
CD(0.05)	12.68	1536	1.29	4.89	5.64	4.68	3.65	0.51

Based on the result for two years, the farm trial is proposed.

2. Long pepper (*Piper longum*) Thippali culture 2

Evaluation of the selected eight genotypes along with local check 'Viswam' and hybrid during 2006-08 (2 years) indicated that Acc.No.2 is superior (640kg/ha) to the existing variety 'Viswam' (472 kg/ha) (Table1). It is a high yielding bush type with medium piperine content adaptable to shaded conditions

Table 1. Pooled mean performance of *Piper longum* genotypes with respect to yield and yield contributing traits (2006-08)

Sl. No	Treatment	Height (cm)	Branches per plant	Spike No. per plant	Spike Length (cm)	Fresh Weight of spike per plant (g)	Dry Weight of spike per plant (g)	Dry spike yield per hectare (kg/ha)	Piperin Content (%)
1	Accession 1	70.173	10.457	30.83	1.66	26.37	2.84	178.72	5.803
2	Accession 2	101.533	18.143	234.92	2.5	95.82	10.17	640.00	4.507
3	Accession 3	67.457	8.227	28.83	2.56	12.51	2.29	144.11	6.827
4	Accession 4	136.480	8.357	7.06	2.03	1.49	0.79	49.71	9.627
5	Accession 5	64.350	8.490	10.5	2.23	2.35	0.97	61.04	5.227
6	Accession 6	52.010	6.543	21.71	3.36	21.49	1.94	122.08	4.883
7	Accession 7	89.443	10.067	55.87	2.26	26.42	3.56	224.03	8.330
8	Accession 8	86.990	6.643	10.27	3.56	21.52	2.48	156.07	4.767
9	Viswam	98.500	15.423	41.15	2.26	70.29	7.50	471.98	5.113
10	Local Check	41.723	5.743	10.4	3.43	8.16	1.51	95.02	4.467
11	Hybrid	73.3	7.500	6.53	2.26	2.58	1.62	101.95	4.573
	Grand Mean	82.868	8.058	41.64	2.56	22.27	2.97	202.63	5.829
	CD	5.4	3.66	3.18	0.42	8.1	0.96	60.41	0.38
	CV (%)	3.02	17.19	9.7	10.96	9.45	7.31	4.60	2.92

Centre for Plant Biotechnology and Molecular Biology

In vitro seed germination using embryo rescue technique in Kodumpuli (*Garcinia gummi-gutta* var. *gummigutta*) ICAR adhoc scheme "Micropropagation and development of seedless Malabar tamarind through invitro techniques"

The left embryo portion from immature endosperm of kodumpuli were inoculated on to ½ MS basal medium which could overcome the 8-9 months dormancy of Kodamuli seeds within 7-12 days of inoculation. Efficacy of the finding was tested with different treatments. The inoculation of immature embryos onto the ½ MS basal medium recorded 92% survival in the first year. The same medium was also compared with more media combinations during the 2nd and 3rd year. During 2nd and 3rd year 95% and 96% survival were obtained in the same medium. The successful medium was also tested with large number of explants under three year plan scheme trials. The final survival percentage of germination was 97.56% within 7 days of inoculation.

Invitro germination of excised embryo from 30-45-days immature Kodampuli fruit could cut short the seed dormancy of 8-9 months to 7.0 days without any complicated and strenuous traditional seed treatments resulting in higher germination per cent. These invitro germinated seedlings can be successfully used a root stocks for conventional grafting within six months. The seed dormancy, low germination/survival per cent and dearth of root

stocks for large scale propagation could be overcome with this finding on embryo rescue technique.

Table 1 Breaking seed dormancy through in vitro germination of immature kodampuli seeds during 2001-01 to 02-03

Mediated	Duration of germination	Survival percentage		Average
		2 nd year	3 rd year	
MS+2mg/lit 2,4-D + 1mg/lit kinetin	8	36	50	43
½MS+1mg/lit 2,4-D+0.25mg/l BA+1.8g phytagel	9	25	34	29.5
½ MS + 2% sucrose+0.2% charcoal	7	96	95	95.5
¼ MS+8mg/l 2,4-D + 2mg/l BA	10	15	12	13.5
½ MS+0.5mg/l NAA + 0.2mg/l BA + 0.3mg/l kinetin	9	23	5	14
MS+2mg/l BA + 2mg/l kinetin	8	80	75	77.5
MS+5mg BA	11	85	88	86.5
MS + 3 BA + 3 kinetin	7	87	84	85.5
½ MS+ 2mg/l NAA+1mg IBA	7	32	40	36
½ MS + 1mg IBA + 1 IAA	8	64	67	65.5
½ MS+ 2mg/l 2,4-D + 1mg/l kinetin	11	78	86	82

Table 2 Breaking seed dormancy through in vitro germination of immature kodampuli seeds during 2006-08

Media tried (2006-09)	No of explants inoculated (2006-09)	No of germinated immature seeds (2006-09)	Duration of germination (2006-09)	Survival percentage (2006-09)	Average (2006-09)
½ MS + 2% Sucrose + 0.2% Charcoal	6000	5854	7	97.56	97.56

AICRP on Weed Control

New herbicides for rice

Cyhalofop Butyl (Clincher - for control of *Echinochloa* spp) and 2,4-D/Almix (for control of broad leaf weeds and sedges) are the widely used herbicides for post emergence weed control in rice. A herbicide which can be used as a substitute for Clincher, as well as one which can control broad spectrum of weeds are desired by the rice farmers. Therefore, bio efficacy testing of three new herbicides was conducted during 2006-07 and 2007-08. The results of these trials are summarized below:

1. Rice star 6.9 % EC

Common name	:	Fenoxaprop P ethyl
Commercial name	:	Rice star 6.9% EC
Manufacturer	:	Bayer Crop Science Ltd
Trials conducted	:	2006-07 & 2007-08 in Kole lands, Thrissur
Objective	:	Control of grass weeds (<i>Echinochloa</i> spp.)

Table 1. Effect of rice star on weed control and grain yield (2006-07)

Treatment (g ai/ha)	Dosage (ml/ha)	<i>Echinochloa</i> No./m ² (30 DAA)	Grain yield (Kg/ha)
Rice star 47.44	687.5	2.23 (4.00) b	3932 a
51.75	750.0	1.61 (2.00) bc	3800 a
56.06	812.5	1.30 (1.00) c	3800 a
60.38	875.0	1.00 (0.00) c	4050 a
Clincher 80.00	800.0	1.61 (2.00) bc	3800 a
H.W		1.00 (0.00) c	3900 a
UWC		7.88 (62.00) a	1950 b

Table 2. Effect of rice star on weed control and grain yield (2007-08)

Treatment (g ai/ha)	Dosage (ml/ha)	<i>Echinochloa</i> No./m ² (30 DAA)	Grain yield (Kg/ha)
Rice star 47.44	687.5	1.20 (0.50) b	6373 c
51.75	750.0	1.00 (0.00) b	6557 c
56.06	812.5	1.00 (0.00) b	6639 c
60.38	875.0	1.00 (0.00) b	7303 b
Clincher 80.00	800.0	1.21 (0.50) b	7502 b
H.W		1.21 (0.50) b	8099 a
UWC		13.0 (169.50) a	3452 d

Results showed that Rice star was effective in controlling *Echinochloa* spp. and resulted in grain yield on par with hand weeding and clincher. There was slight phytotoxicity to rice seedlings immediately after spraying. However the crop recovered soon and regained normal growth. The herbicide was not effective against Broad leaf weeds and sedges (as clincher).

2. Azimsulfuron 50 DF

Manufacturer	:	Dupont India Pvt. Ltd
Target weeds	:	Grasses, sedges and b/l weeds
Season of trial	:	2006-07 & 2007-08
Location	:	Kole lands, Thrissur
Time of application	:	15 25 DAS

Table 3. Effect of Azimsulfuron on weed control & grain yield (2006 - 07)

Treatment (g ai/ha)	<i>Echinochloa</i> No. m ² (30 DAA)	Grain yield (Kg/ha)
Azim 25 g - 0.2% surf ¹	1.61 (1.75) c	5329 bc
Azim 27.5 g - 0.2% surf ¹	1.56 (1.25) c	5370 bc
Azim 30.0 g - 0.2% surf ¹	1.51 (0.75) c	5720 b
Clincher - Almix	1.48 (0.50) c	5748 b
LWC	2.14 (13.50) a	3525 d
HW	1.41 (1.00) c	6294 a

Table 4. Effect of Azimsulfuron on weed control & grain yield (2007 - 08)

Treatment (g ai/ha)	<i>Echinochloa</i> No. m ² (30 DAA)	Grain yield (Kg/ha)
Azim 25 g - 0.2% surf ¹	1.71 (2.00) c	8273 ab
Azim 27.5 g - 0.2% surf ¹	1.27 (0.66) de	8330 ab
Azim 30.0 g - 0.2% surf ¹	1.13 (0.33) e	8350 ab
Clincher - Almix	1.27 (0.66) de	8387 ab
LWC	5.28 (27.00) a	4333 d
HW	1.62 (1.66) cd	8567 a

Results showed that Azimsulfuron was an effective herbicide for controlling *Echinochloa* spp. It gave good control of broad leaf weeds and sedges also.

3. Penoxsulam 24% SC

Manufacturer	:	Dow Agrosciences
Target	:	Grasses, sedges and b 1 weeds in direct seeded rice
Season	:	2006 - 07
Location	:	Kole lands, Thrissur

Table 5. Effect of Penoxsulam 24 % SC on weeds (2006- 07)

Treatments (g ai/ha)	Grasses	Sedges	b/l weeds
Penox 20 g (20-25 DAS)	3.15 (6.00) cd	2.41 (2.00) b	2.41 (2.00) b
22.5g (20-25 DAS)	2.41 (2.00) de	2.21 (1.00) b	2.21 (1.00) b
25.0g (20-25 DAS)	1.00 (0.00) e	2.21 (1.00) b	1.00 (0.00) b
Clincher fb. Almix	2.41 (2.00) de	1.00 (0.00) b	1.00 (0.00) b
H W	1.00 (0.00) e	1.00 (0.00) b	1.00 (0.00) b
UWC	6.89 (44.0) a	4.86 (21.00) a	5.15 (24.00) a

Table 6. Effect of Penoxsulam 24 % SC on weeds (2007- 08)

Treatments (g ai/ha)	Grasses	Sedges	b/l weeds
Penox 20 g (20-25 DAS)	3.24 (6.67) bc	3.04 (5.33) c	1.00 (0.00) d
22.5g (20-25 DAS)	2.28 (1.33) d	1.00 (0.00) d	1.00 (0.00) d
25.0g (20-25 DAS)	1.00 (0.00) d	1.00 (0.00) d	1.00 (0.00) d
Clincher fb. Almix	1.00 (0.00) d	1.00 (0.00) d	1.00 (0.00) d
H W	2.28 (1.33) d	2.55 (2.67) cd	2.28 (1.33) d
UWC	5.14 (22.67)a	6.80 (42.67) a	4.59 (17.32) a

Table 7. Effect of Penoxsulam 24 % SC on grain yield (Kg/ha)

Treatments (g ai/ha)	2006 - 07	2007 - 08
Penox 20 g (20-25 DAS)	5595 c	6467 c
22.5g (20-25 DAS)	6210 a	6663 b
25.0g (20-25 DAS)	6056 ab	6732 ab
Clincher fb. Almix	5690 c	6736 ab
H W	6267 a	6849 a
UWC	3525 e	2291 f

Results showed that Penoxsulam was an effective herbicide for control of all type of weeds. The doses 22.5 g/ha and 25.0 g/ha gave yield on par with hand weeding and the present practice of clincher fb. Almix.

Proposal for farm trial

Based on the results of the testing of the above three herbicides, a farm trial is proposed, incorporating the best two doses of the three new herbicides. The details of the trials proposed are given below.

Treatments	Dose (g ai/ha)	Time of application (DAS)
Rice star fb. Almix	56.06 fb 4.0	25 - 30
	60.38 fb 4.0	
Azimsulfuron	27.5	15 - 25
	30.0	
Penoxsulam	22.5	20 - 25
	25.0	
Clincher fb Almix	1000 fb 4.0	15 - 25
HW (Twice)		25 & 40
Un weeded	-	-