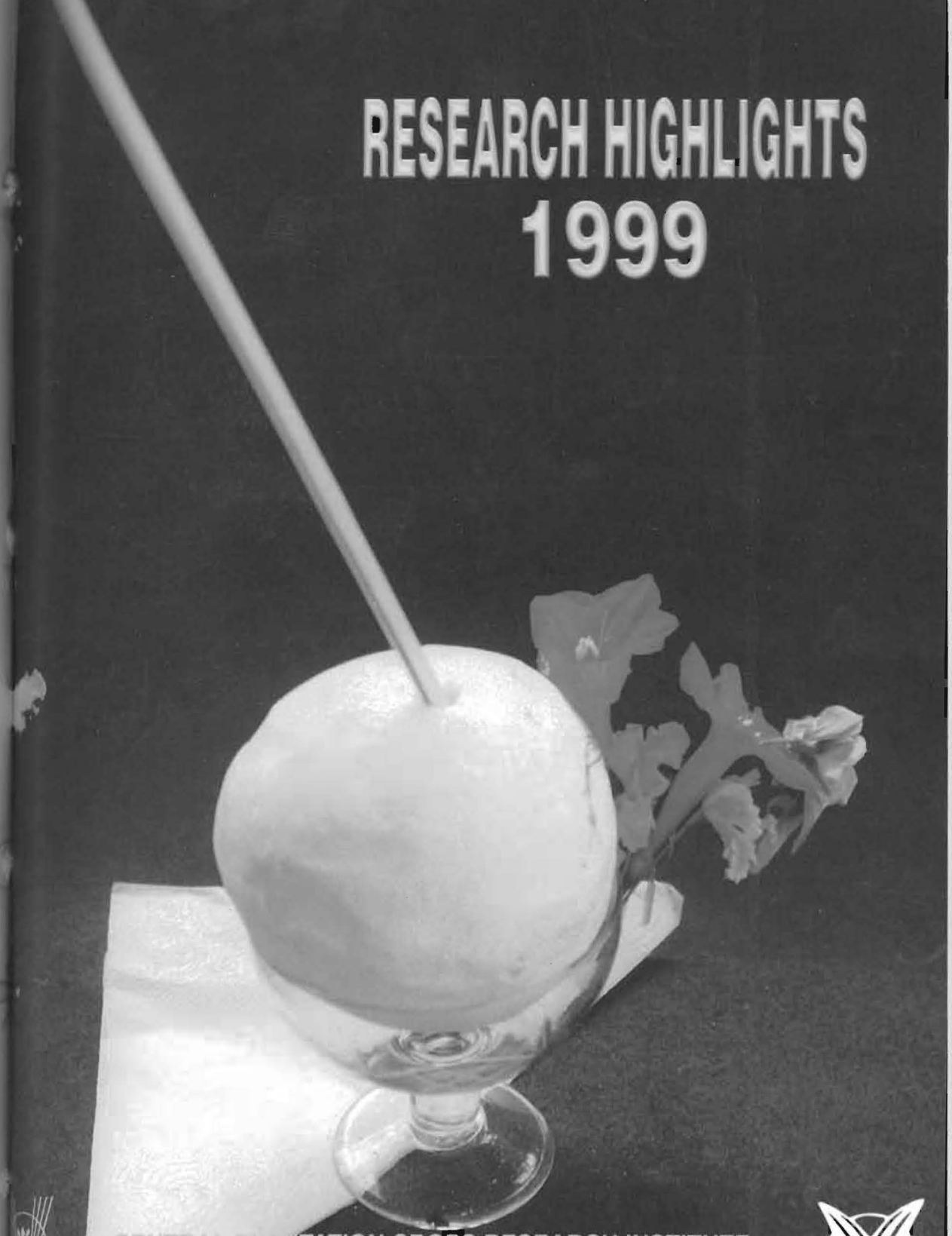
RESEARCH HIGHLIGHTS 1999



CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
KASARAGOD 671 124, KERALA, INDIA

RESEARCH HIGHLIGHTS

1999

केरोफअसं
CPCRI

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

KASARAGOD - 671 124, KERALA

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प्रस्तावना

केन्द्रीय रोपण फसल अनुसंधान संस्थान सन् 1916 से नारियल अनुसंधान के लिए अग्रणी संस्थान है। नारियल के अलावा सुपारी एवं कोको को भी मुख्य फसलों में सम्मिलित किया गया है। यह रिपोर्ट इस संस्थान के मुख्य विभागों जैसे फसल सुधार, फ़सल उत्पादन, फसल संरक्षण, पादप रोग विज्ञान, जैव रसायन विज्ञान, कटाई उपरान्त प्रौद्योगिकी सामाजिक विज्ञान के अधीन विभिन्न विषयों की 1999 की मुख्य उपलब्धियों का संक्षेप है। इसके अलावा अखिल भारतीय समन्वित अनुसंधान परियोजना के अधीन 16 केन्द्रों में नारियल, सुपारी, तेलताड़, और पॉमैरा पर अनुसंधान की मुख्य उपलब्धियाँ भी सम्मिलित है।

इस वर्ष कृषि विज्ञान केन्द्र, संस्थान ग्राम संपर्क कार्यक्रम, कृषि प्रौद्योगिकी सूचना केन्द्र के द्वारा प्रौद्योगिकी के स्थानातंरण को प्रबल बनाने के लिए संस्थान ने अतिरिक्त प्रयत्न किये हैं। रोग एवं कीट नियंत्रण तथा फसल आधारित/ कृषि उद्धति के क्षेत्र में बहुविषय प्रकृति के सामान्य कार्यक्रम आयोजित किये गये। जननद्रव्य संग्रहण, अंतर्राष्ट्रीय नारियल जीनबैंक की स्थापना, सुपारी में बौनेपन के लिए प्रजनन कार्बनिक सस्यन उर्वरक सिंचाई, आद्रता संरक्षण, कीटों एवं सूत्रकृमि का जैविक नियंत्रण, एरियोफिड कीट का नियंत्रण, रूट विल्ट रोग का प्रबंधन और मूल्य जोडना आदि क्षेत्रों में अर्थपूर्ण उपलब्धियां प्राप्त की। विभिन्न राष्ट्रीय एवं अन्तराष्ट्रीय संस्थाओं से मिली आर्थिक सहायता से संस्थान के अनुसंधान कार्यों में मदद मिली। तकनीकी कार्यक्रम एवं अनुसंधान प्राथमिकथाओं के निर्धारण के लिए अनुसंधान सलाहकार समिति, पंचवर्षीय पुर्नावलोकन टीम, स्टाफ अनुसंधान परिषद् और अनुमान - 2020 जैसे दस्तावेज़ से मार्गदर्शन मिला। संस्थान के पुस्तकालय में मुख्य फसलों से सम्बन्धित 50,000 पुस्तकों के अलावा कम्प्यूटरीकृत डेटाबेस अनुभाग भी है। पुस्तकालय में दस्तावेजों के आदान-प्रदान को सुलभ बनाने के लिए बारकोडिंग का कार्य आरम्भ किया गया।

मुझे पूर्ण आशा है कि यह रिपोर्ट रोपण फसल के अनुसंधान और विकास में जिज्ञासु अनुसंधानकर्ताओं, नीतिनिर्धारकों और किसानों के लिए अति लाभप्रद होगी। इस रिपोर्ट के प्रकाशन के लिए मैं अपने सहयोगियों को उनकी मदद के लिए धन्यवाद देता हूँ।

के.यू.के. नम्पूतिरि

कासरगोड
01.04.2000

(के.यू.के. नम्पूतिरि)
निदेशक

INTRODUCTION

Central Plantation Crops Research Institute (CPCRI) is a pioneer Institute undertaking research on coconut since 1916. The mandate crops now include arecanut and cocoa also. This report summarises salient achievements of the Institute during 1999 in the areas of Crop Improvement, Crop Production, Crop Protection, Plant Physiology, Biochemistry, Post harvest Technology and various disciplines under Social Sciences. The highlights of research on coconut, arecanut, oil palm and palmyrah in 16 centres under the All India Co-ordinated Research Project on Palms are also included.

Added efforts were made by CPCRI during the year for strengthening transfer of technologies through KVK, IVLP and ATIC. General programmes of multidisciplinary nature were undertaken especially in the fields of disease and pest control as well as crop based cropping/farming systems. Significant achievements could be made in germplasm collection, establishment of International Coconut Gene Bank (South Asia), breeding for dwarfness in arecanut, organic farming, fertigation, moisture conservation, biological control of insect and nematode pests, ecofriendly control of eriophyid mite (*Aceria guerreronis*) the newly emerged pest, management of root (wilt) disease and value addition. The Institute is assisted through research projects aided by National and International agencies in areas of common interest. We are guided by the recommendations of the Research Advisory Committee, Quinquennial Review Team, Staff Research Council and the documents like Vision 2020 in framing the technical programmes and deciding the research priorities. CPCRI library has an electronic database section in addition to 50,000 documents pertaining to mandate crops and relevant journals. Library is in the process of automation using Libsys database. Barcoding of data base has been taken up for easy handling of library documents.

It is my fervent hope that this report will be useful to researchers, planners and farmers interested in plantation crops research and development. I acknowledge the help rendered by my colleagues in bringing out this publication promptly.

Kasaragod
01.04.2000

(K.U.K. NAMPOOTHIRI)
Director

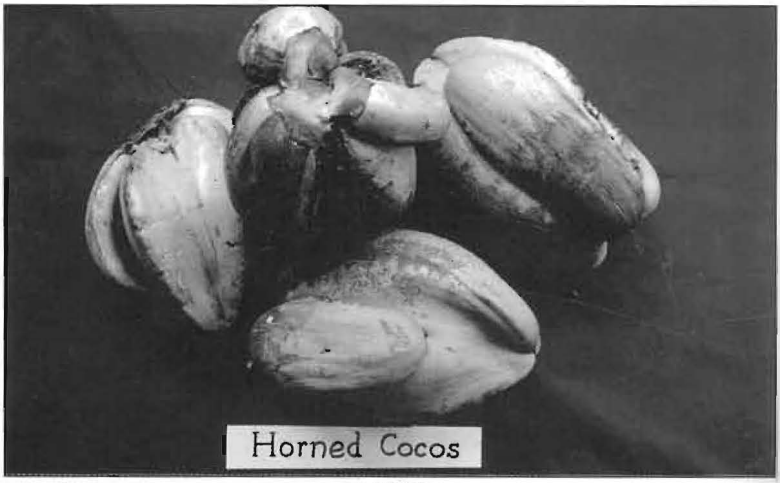
COCONUT

Collection, conservation, cataloguing and evaluation of coconut germplasm

Twenty eight accessions including 17 collections from Andaman and Nicobar Islands and 11 collections from Lakshadweep Islands were added to coconut germplasm bringing up the total number of accessions at CPCRI to 197. Wide variability was observed for colour and shape of the fruit. In the Andaman collections the fruits of Acc. 13 from Trinket Islands are green coloured and papaya shaped, while those of Acc. 14 from Kamorta Island have pointed beak. Fruits of Acc. 17 from Carbyn's Cove have horn-like structures.

ACC 13

ACC 14



ACC 17

In the comparative trial with 16 cultivars planted in RBD during 1972, Laccadive Micro gave the highest nut yield (133 nuts/palm) and West Coast Tall gave maximum copra yield (17.3 kg/palm). Estimation of tannin content in six accessions showed that Niu Leka Dwarf had minimum tannin content (9.80 mg/g FWt) while, SS Apricot had the maximum (19.16 mg/g/FWt).

Tender nut water analysis was done for 7 Pacific Ocean Island accessions, maintained at the World Coconut Germplasm Centre, Andamans. Maximum sugar content (6.9%) was recorded in "Nikkore" (Acc. No. 22/94) from Papua New Guinea, while the quantity of tender nut water was extremely high (832.5 ml/nut) in Tahiti Tall (Acc. No. 13/74) from French Polynesia.

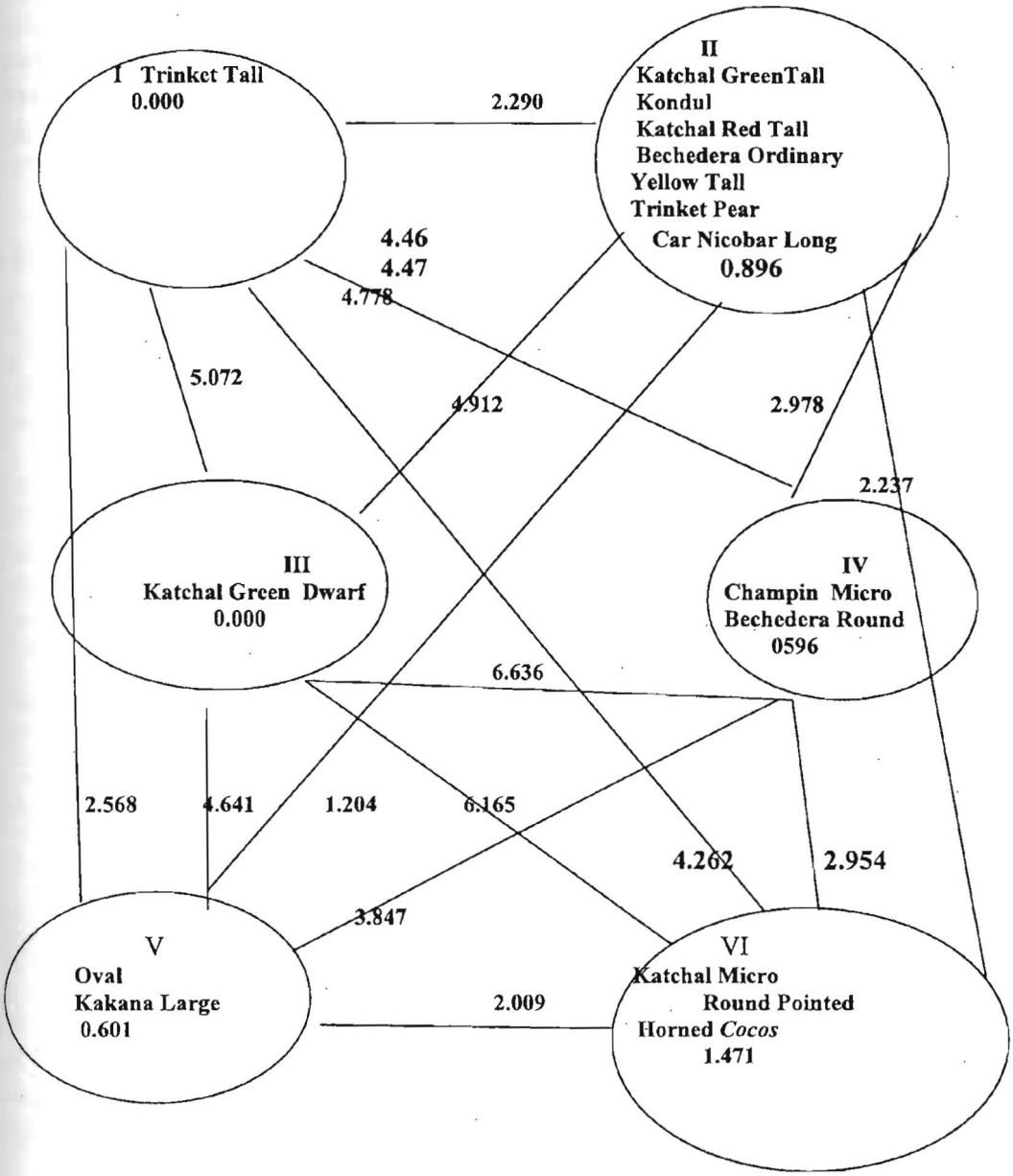
Nut component analysis of two Pacific Ocean accessions showed that Natava Tall (Acc.No.24) from Papua New Guinea had a higher fruit weight of 1290g, nut weight of 760 g and copra content of 190 g/nut. However, Tall Muwa (Acc. No. 21) from Papua New Guinea had a higher oil content of 63%.

Biometric clustering was attempted for Andaman and Nicobar coconut populations and Pacific Ocean collections using selected characters. In 21 Pacific Ocean collections (*in situ and ex situ*), four clusters were obtained from the in *situ* data. Rennel Tall formed a single cluster indicating its uniqueness and Solomon Tall and Tall Kaveing formed a distinct cluster. *Ex situ* data did not provide a similar trend. Fruit weight was found to be the major contributor for the divergence. A total of 26 accessions (14 exotic and 12 indigenous) were planted in International Coconut Gene Bank - South Asia funded by ADB/ COGENT.

Biotechnology

Thirty four percent random primers revealed polymorphism between DNA of West Coast Tall palms and those of Chowghat Orange Dwarf. RAPD analysis of eight tall and six dwarf accessions for genetic distance estimation. revealed wide variation among the tall accessions whereas the dwarf accessions were grouped together.

Allozyme analysis to study inter and intra population diversity in four dwarf accessions viz. COD, MOD, MYD and CGD indicated polymorphism for peroxidase, whereas limited polymorphism was observed for esterase and polyphenol oxidase. Wide intra population variation were also found.



Cluster diagram of Andaman and Nicobar coconut populations using selected characters.

Forty six embryo cultured plantlets from Indian Ocean Island were planted in the field in International Coconut Gene Bank-South Asia at Kidu. Polyamines like spermine and putrescine was found to reduce browning in coconut tissue culture.

Multiple shoots were obtained from oil palm embryo on Blaydes medium supplemented with kinetin (0.5mg/l) and TDZ(2mg/l).

ARECANUT

Evaluation of arecanut germplasm

Nine more accessions collected from Konkan region enriched the arecanut germplasm making the total to 128 at the CPCRI Regional Station Vittal. Seventy one accessions were collected and planted in a phased manner since 1988 as an alternative germplasm bank to serve the North East region. Among the indigenous germplasm under evaluation, the accession Sagar showed highest yield of 2.91 kg chali/palm/year and 15% increase in yield over Mangala was registered.

Comparative yield trials of released varieties under the maidan parts of Hirehalli and Malnad region at Thirthahalli revealed better performance of Mangala both at Hirehalli (6.2 kg chali/palm) and at Thirthahalli (2.28 kg chali /palm)

Dwarf hybrids of Arecanut.

The hybrids Hirehalli Dwarf x Sumangala and Mangala x Hirehalli Dwarf showed higher yield potential as compared to others. Eight cross combinations involving Hirehalli Dwarf and released varieties are under evaluation for high yield.

COCOA

Top working the different cocoa accessions on to the same clonal root stock has been done so that a large number of germplasm within replications can be accommodated along with multi-line varieties involving several compatible cocoa lines and thus enhance the fruit setting to a greater degree.

CROP PRODUCTION

Management of coastal sandy soil through organic farming technologies: Alley cropping of *Glyricidia* in coconut gardens.

Three rows of *Glyricidia* grown as a mixed crop in between two rows of palms has yielded 11,086 kg cropping per ha in three prunings (February, June, October). These prunings could meet the full requirement of N, and partial need for P_2O_5 (25%) and K_2O (15%) of an adult palm. Substitution of 50% N through *Glyricidia* gave superior yield of palms than those with 100% chemical fertilizers and 100% through other green leaf manures in littoral sandy soils.

Cultural cum manurial trial: Long term effects of cultivation, herbicides and manuring.

During the year, palms under the treatment cultivation + organic + inorganic yielded 93.8 nuts/palm compared to 22.4 nuts/palm in plots which are maintained without fertilizer application and cultural practices.

Drip irrigation for coconut

For drip irrigation to coconut 50 L water per palm/day at 66% EO was found to be sufficient for WCT and DxT in sandy or laterite soils. Studies on wetting pattern in the drip zone demands six drippers for sandy soil and four

drippers for laterite soil placed in the basin area of 1.84 m radius, and one meter away from the bole. The yield realized in sandy soil was 69 nuts/palm/year and in laterite soil it was 97 and 101 nuts/palm/year for WCT and DxT respectively.

High density multispecies cropping system model at Kasaragod

In the coconut based cropping system model coconut yield during the current year ranged from 117 nuts/palm/year in one-fifth fertilizer dose treatment to 143 nuts/palm/year when full dose of fertilizers were applied. Coconut showed a declining trend in nut yield with reduction in recommended fertilizers below full dose. The yield of component crops varied due to levels of fertilizer application. In full and two-third levels of recommended dose fertilizer application all the clove trees flowered and gave flower bud yield of 0.77 kg and 0.46 kg respectively of dried clove/tree.

Economic analysis of the model under full dose of recommended fertilizers during 1998-99 revealed that the annual cost of cultivation was Rs. 52,000/ha. Annual net revenue was Rs. 1,41,086/ha with a net profit of Rs. 89,086/ha .

Economics of coconut based HDMSCS under recommended levels of fertilizer application (1998-99)

Crop	Yield and price	Rs./ha
Coconut	2,22,880 nuts @ Rs. 5.20/nut	1,18,976
Banana	1183 kg fruits @ Rs. 9/kg	10,650
Pineapple	490 kg fruits @ Rs. 4/kg	1,960
Clove	63 kg dry buds @ Rs. 150/kg	9,500
Total revenue (Rs./ha)		1,41,086
Total Annual cost of cultivation (Rs./ha)		52,000
Net profit (Rs./ha)		89,086

Effect of organic manure on the growth and productivity of coconut in root (wilt) affected areas.

Root (wilt) affected palms receiving inorganic nutrients with 50% organics gave better yield response. The number of bunches /palm, female flower production and nuts/palm increased. Out of the 252 experimental palms, only 25.79 percent of the palms had contracted the root (wilt) along with leaf rot disease.

Role of boron in coconut nutrition

Field surveys in coconut tracts in southern Kerala indicated the boron deficiency to be 10 % in laterite and alluvial soils , 15% in sandy loam soils,7% in Kari soils of Kuttanad and 5% in coastal sandy soils of Alapuzha district. The deficiency is more severe in sandy loam soils. Application of 300g borax / palm / year was found effective on young palms (below 5 years of age) and 500g borax / palm / year on adult palms in mitigating the deficiency symptoms.

Boron application should be accompanied by irrigation during summer months to prevent the appearance of yellowing and scorching symptoms on the leaves.

ARECANUT

Agronomic aspects of arecanut based HDMCS for West Bengal

HDMSCS in Mohitnagar is in progress since 1983. Higher yields of Chali 1395 kg/ha was recorded in Model -I as compared to 954/Kg/ha from control. The economics of different models were worked out. Income ranged between Rs. 94,858 and Rs 1,68,502 per ha. The minimum net returns recorded in Model -III is due to the cost involved in planting materials of pepper and banana. The per cent increase over control ranged from 12.44 to 55.53 in different models.

NPK requirement of high yielding Arecanut

The study on the performance of Mangala, Sumangala, Sreemangala and Mohitnagar varieties at different fertilizer levels is in progress since 1991. The chali yields ranged from 0.76 to 2.4 kg / plot. The highest yield of chali was recorded in Mohitnagar (3.7 kg/ plot).

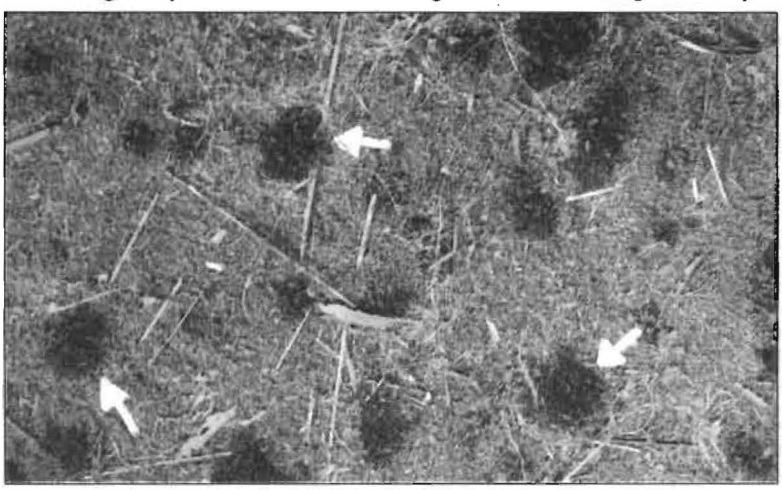
Fertigation studies in arecanut

For pre bearing arecanut palms, 50 per cent of the recommended fertilizer dose is found sufficient when supplied through fertigation . In addition, fertigation reduces annual maintenance cost by about 60 per cent through saving in labour and input cost compared to normal practice of fertilizer application and irrigation

ORGANIC FARMING TECHNOLOGY

Vermicompost production in a coconut garden by heap, trench and basin methods have been standardized and basin method has been found to be the best one. The local strain of *Eudrilus* sp. has been used for large scale composting of coir pith mixed with 20 per cent coconut leaves and 10 percent cow dung on dry weight basis. In a period of 3 months after treatment a good vermicompost of coirpith and coconut leaves is ready for use. Fresh vermicompost have been found to contain high numbers of a non-sporulating actinomycete-like active diazotroph.

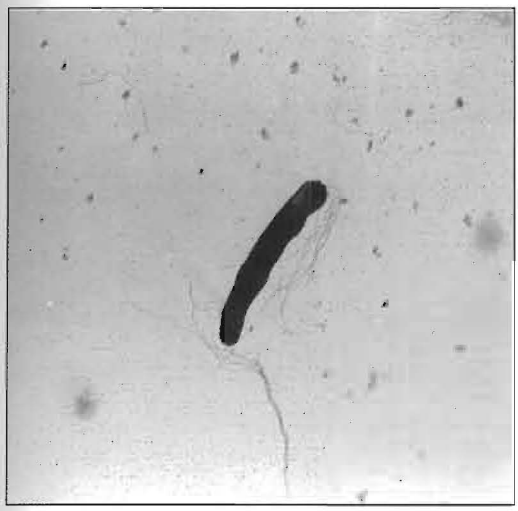
Three species of mushroom fungi isolated from decomposing coconut wastes recorded significant levels of lignocelluloytic enzymes such as laccase, exoglucanase, endoglucanase and B-glucosidase. These fungi were identified as *Marasmiellus troyanus, Lentinus squarrosulus*



Production of vermicastings by *Eudrilus* sp. feeding on coirpith

and a *Polyporus* species. Another mushroom fungus, *Lecocoprinus zeylanicus,* isolated from coir pith produced enzymes of cellulase complex.

For compost production using coirpith as base, eight local isolates of fungi and bacteria were tested after treatment of coir pith with different inorganic and organic materials. A local species of fungus, *M. troyanus* was found to be efficient in compost production.



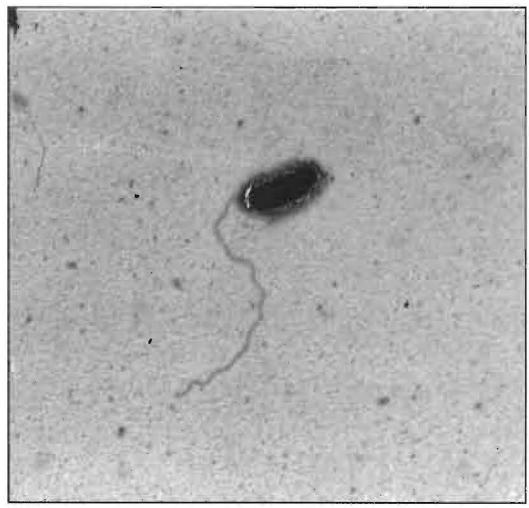
Non sporulating actinomycetes like diazotroph isolated from vermicompost

PRODUCTION PHYSIOLOGY

Screening of coconut seedlings for tolerance to drought revealed that tolerant seedlings recorded lower water loss and lipid peroxidation than the susceptible group. Among the D x T crosses, GBD combinations were most affected than CGD and MYD combinations. Additional evidence for the drought tolerant nature of WCT x WCT, FMS, PO and WCT x COD and the drought susceptible nature of COD x WCT, COD and GB were provided by their anatomical features. Cross compatibility and heterosis have been worked out. Observations indicated that tolerance to moisture stress was significant in LO x CGD and CGD x WCT seedlings.

Biological nitrogen fixation

Over 25 different diazotrophs closely associated with coconut palm have been characterized. Inoculation of coconut seedlings raised in polybags with *Arthrobacter* sp., *Azospirillum brasilense, A.lipoferum, Azospirillum* sp., *Burkholderia* sp. and *Herbaspirillum frisingense* improved the growth of seedlings.



***Azospirillum irakense* - like diazotroph closely associated with coconut palm**

Studies in the fatty acid composition in coconut cultivars/ hybrids indicated that hybrids are more suitable for edible purpose because of their low saturated/unsaturated fatty acid ratios. For example, the hybrids LO x GB, LO x COD and COD x WCT have high lauric acid concentration and low saturated /unsaturated ratio and the oil is suitable for both industrial as well as edible purposes. Oil from AO, LO and COD x WCT are more suitable for medicinal and pharmaceutical industries because of high lauric acid concentration. Oil from Benaulim Tall, WAT, FMS, MYD x WCT and WCT x GB contain high concentration of myristic acid and is therefore suitable for cosmetic industry.

Nutrient content in the nuts of

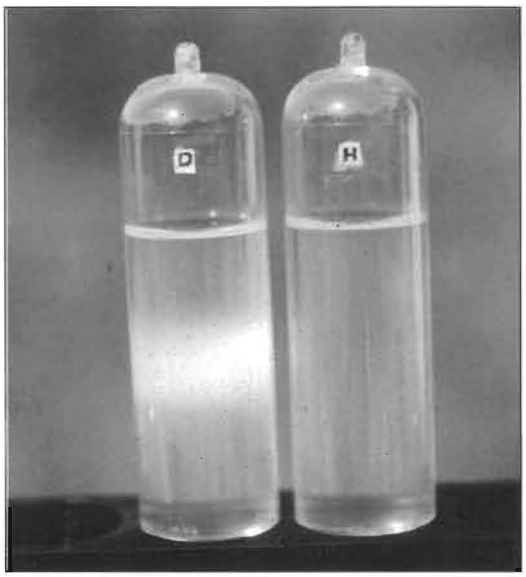
WCT, LO x GB, COD x WCT, WCT x GB and LO x COD - at 7, 8, 10 and 12 months after fertilization were analyzed. The total oil content and protein content increased while the nut water volume, moisture content and carbohydrate fractions decreased with maturity of nuts. Vitamin C content in the kernel was maximum at ten month old nuts while fiber content was highest (26 - 42%) in the eight month old nuts. The trend in the change in nutrient content with maturity was the same in all the five genotypes.

CROP PROTECTION

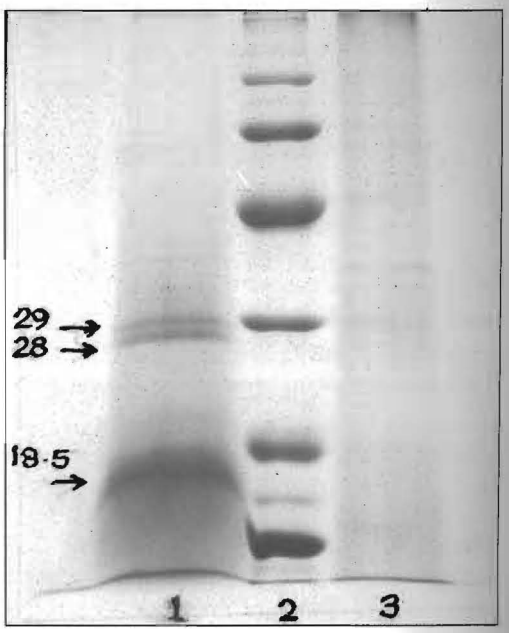
COCONUT

Purification of phytoplasma of root (wilt) disease of coconut

Phytoplasma of Root (wilt) disease of coconut has been purified from tender leaf tissues by percoll - discontinuous density gradient centrifugation. A single turbid zone was observed at the top of 30% step gradient only in diseased leaf sample after centrifugation at 20,000 g for 30 min. This fraction from diseased sample, in contrast to healthy sample, had the absorption maxima near 200 nm in UV-range (190-310 nm). The fractionated protein and nucleic acid components of phytoplasma showed characteristic peaks at 280 and 260 nm respectively. SDS-PAGE of protein showed three peptides of 29, 28 and 18.5 kDa in the preparation obtained from diseased palms. These biochemical results thus substantiate purification of phytoplasma.



Discontinuous density gradient centrifugation of Root(wilt) affected (D) and healthy palms (H)



Protein profile by SDS - PAGE (1) Disease (2) Marker (3) Healthy

Spread of root(wilt) disease

Root(wilt) disease of coconut has also been reported from Kasaragod district which has been considered as the only disease -free district in Kerala. In a survey of 16 gardens under East Eleri Krishi Bhavan, Chittarikal, covering 2140

coconut palms, 402 adult palms, were found to be root(wilt) diseased. Of these, 23 palms were affected by leaf rot disease which yielded *Fusarium* sp. on isolation.

The presence of root (wilt)-leaf rot in Theni district of Tamil Nadu was confirmed, the incidence being severe in Cumbum block. Out of 31 palms sampled, 30 gave strong positive serological reaction. In addition all the seven samples collected from Dindigul district (North of Theni district) also tested serologically positive.

The bacterial isolates, identified as *Pseudomonas aeruginosa,* gave encouraging results, when tested *ex vitro* in detached coconut leaflets, in controlling leaf rot .

Breeding for resistance/tolerance to coconut root(wilt) disease

Assisted pollination involving 81 West Coast Tall, 111 Chowghat Green Dwarf and 12 Chowghat Orange Dwarf mother palms were carried out to generate planting materials for establishing seed gardens. A total of 3090 artificially pollinated seed nuts were harvested and sown in the nursery. A new seed garden consisting of 877 seedlings raised through artificial pollination was established at the Kerala State District Agricultural Farm, Mavelikkara.

Management of major pests of coconut palm

Red palm weevil

Two formulations of pheromone lures, one from ChemTica International, Costa Rica and another from AgriSense, U.K. viz. Ferrolure+ and 078B210 L189A, respectively were equally effective in trapping the red palm weevil of coconut palm. The effective capturing of the weevil is possible only if pheromone is used along with food bait such as plantain and sugarcane .

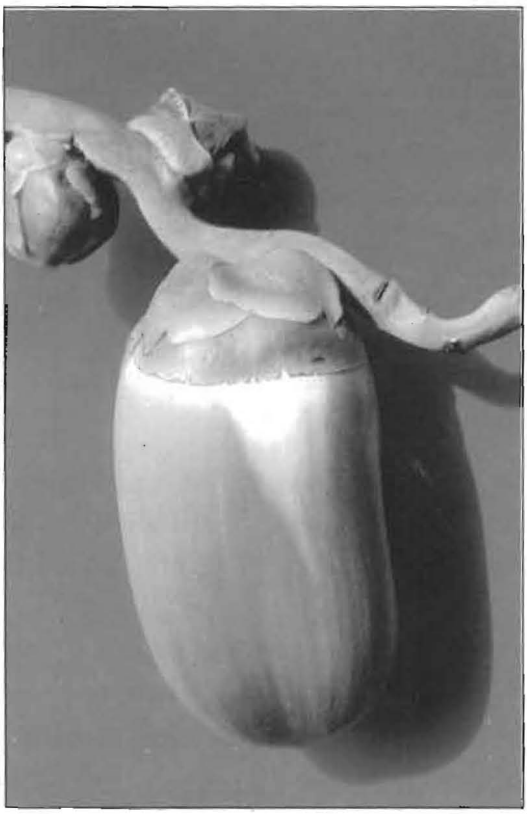
Eriophyid mite

Coconut eriophyid mite was first observed in Mexico and it was reported in India during later part of 1997 in Ernakulam district of Kerala. This was identified by scientists of CPCRI.

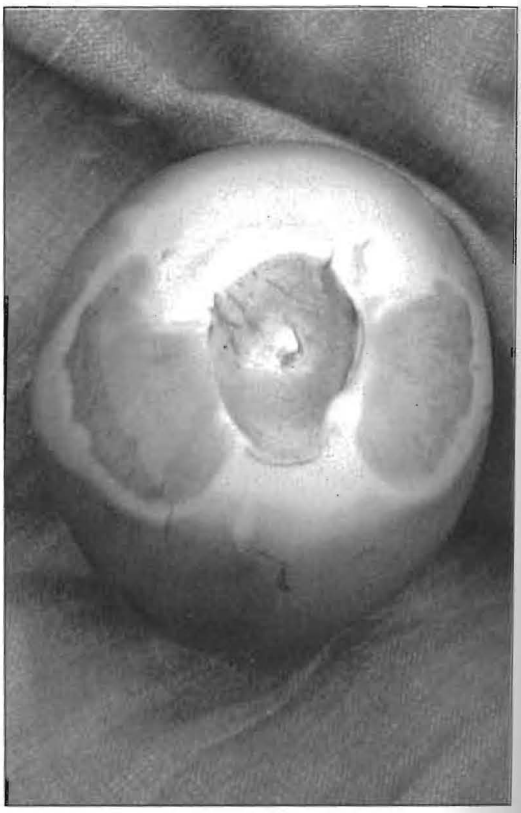
The mites are 200 μ in length and they remain beneath the inner bracts of perianth. These mites infest by sucking the sap from soft tissues of the buttons. In the initial stages, damage occurs as triangular patches close to perianth. Later they become brown colored warts and develop into longitudinal splits on the surface of nuts.

Concerted efforts were undertaken to work out measures for the control of coconut eriophyid mite *Aceria guerreronis.* Root feeding of monocrotophos @ 10 ml +10 ml water caused 81.0% reduction in eriophyid mite infestation. This method demands a safe waiting period of 45 days to harvest the nuts after application of the pesticides.

Spraying neem formulations containing 0.1 % azadirachtin @ 6 ml /litre water resulted in 79.68% reduction in mite infestation, as against spraying monocrotophos, endosulfan, triazophos and carbosulfan that caused 70.58 to 78.15% reduction. Wettable sulphur @ 5 gm/litre of water and neem oil (2%) + garlic extract (2%) + soap was also effective at 73.56 and 68.47% respectively.



Mite attack - Initial symptoms



Mite colony in tender tissues of coconut

Biological control of pests of coconut

Apanteles taragamae, the early instar parasitoid of *Opisina arenosella* effected 64.4% parasitism under laboratory and 35.6% under field cage conditions.

Field study conducted for three years (1996-99) on the seasonal incidence of *Baculovirus*, . *Metarhizium anisopliae* and the gut bacterium on *Oryctes* revealed that the natural population of *Oryctes* grubs carried 5% *Baculovirus* infection whereas the adults had 22.1%. *M. anisopliae* could mycose 3.1% of the grubs, while 19.7% of the larvae had succumbed to the infection by an opportunistic bacterium, identified as *Pseudomonas acaligens*, which was present in the gut of the grubs as normal microflora.

Aspergillus flavus isolate AF1 from *Stephanitis typica* and AF2 from *Opisina arenosella* could cross infect each other. An inoculum density of $8/10^6$ spores/ml of AF1 and AF2 could bring about 100% mortality on *Opisina* and *Stephanitis* respectively by the 5th day.

Eriderisia khallikottosus was isolated from 40% of the soil samples collected from Alleppey Dist. An isolate of *Rhabditis* from Kayangulam effected mortality of *Oryctes* grubs and pupae within 6-10 days of inoculation.

Effect of natural plant products on key pests of coconut palm

Field evaluation of *Clerodendron infortunatum* for the suppression of *Oryctes*

rhinoceros grubs revealed 80% reduction in site occupancy of the pest, when the plant parts as a whole was incorporated at 5% w/w concentration in the manure pits. Thus offering a cheap, easily adoptable , eco friendly and viable indigenous technology for the control of *Oryctes* for the farmers.

Management of white grubs in coconut and arecanut

The entomopathogenic nematodes were trapped from soil samples collected from Nileshwar, Pallikare, Udma blocks of Kasaragod district by using wax moth larvae, *Galleria melanolella.* The trapped nematodes identified as *Steinernema* and *Rhabditis* were assessed for their pathogenicity.

The LC_{50} of monoterpenoids, methyl chavicol and linalool (isolates from basil oil) for *Leucopholis coneophora* was fixed as 0.013 and 0.01% respectively.

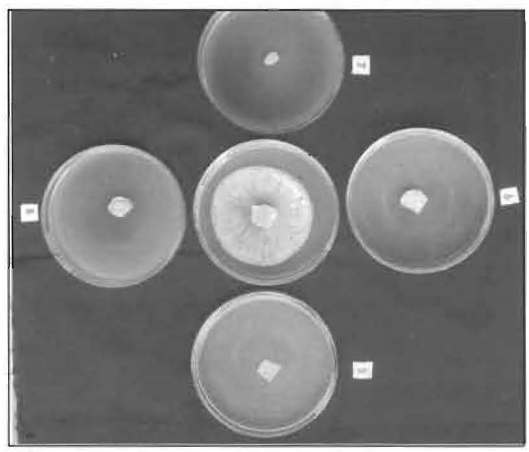
Preliminary field trials on evaluation of newer pesticide molecule showed that application of carbosulfan @ 20g/palm gave 80% control of white grubs.

Integrated nematode management

A new isolate of the nematode hyperparasite *Pasteuria* sp. parasitizing *Radopholus similis* and *Heterodera oryzicola* has the potential for use in the biomanagement of nematode pests. The infective propagules adhered to the cuticle of the adult males, females and juveniles of *R. similis.* One to several endospores were attached to each nematode and adhered to all the body regions. Endospores were found attached to the cuticle of J2 juveniles of *H. oryzicola.* The bacterium reproduces throughout the entire female body and prevent the female from producing eggs. Females were filled with several infective propagules. Endospores were found adhering to labial annules of J2 juveniles. *Dolichodorus heterocephalus* collected from the root zone of coconut were found infested with the fungal pathogen *Nematophthora* sp. Being an obligate parasite of nematodes this fungus could not be cultured in the medium. *Cateneria vermicola* was recorded from *Radopholus similis* and *Rhabditis* sp. from CPCRI, Kayangulam.

ARECANUT

In *vitro* studies with Ovis 20, a natural *Citronelle* sp.was found to be fungicidal to *Phytophthora meadii* isolates causing fruit and bud rot diseases of areca palm.



***Phytophthora meadii* on carrot agar medium (centre) with Ovis 20 treated isolates**

Snow Ball Tender Nut (SBTN)

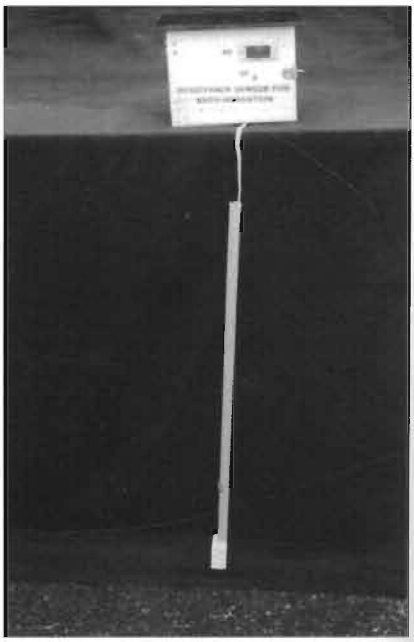
Snow ball tender nut is a tender coconut without husk, shell and testa which is ball shaped and white in colour. Coconut of eight months age is more suitable for making SBTN in which there is no decrease in quantity of tender water and the kernel is sufficiently soft. The process for making the SBTN has been developed. Important steps involved in the process are dehusking of the nut, making a groove in the shell and scooping of the tender kernel in ball shape without any breakage by using a scooping tool.

Sweet coconut chips

A process has been developed for making sweet, crispy coconut chips from the mature and fresh coconut kernel by osmotic dehydration using sugar syrup as osmotic medium and drying of osmotic dehydrated coconut slices.

Electrical Resistance sensor with gypsum block:

An electrical resistance sensor with gypsum block was designed to measure water depletion over a wider range of water tension (1-15 bars). When the soil moisture is reduced below the preset level, the comparator energises the relay circuit, which in turn switches on the solenoid valve or the water pump as the case may be. In the same way the system is switched off when the moisture level moves up to the pre set level. The device can be used with any high frequency irrigation system.



Development of Water Harvesting Structures

Checkdams are envisaged to prevent the surface runoff rain water and to give rainwater more opportunity and time to percolate down contributing to the ground water. A ferrocement check dam, has been constructed at CPCRI, Regional Station, Vittal. The body of the dam is made of locally available soil embedded in ferrocement. It has the capacity to store 70 lakhs litres of water. Cost of construction of this dam is approximately 2.5 lakhs which is much lower than a concrete dam of similar size.

Eventhough the water collected in the check dam augments the ground water storage this will not serve as a source of irrigation water during the peak summer in April and May since

all the surface and ground water sources get exhausted by this time. To overcome this constraint a farm pond with a capacity of 15 lakh liters has been constructed. Among the lining materials tried to prevent seepage, soil cement mixture (10% cement content) and HDPE lining were found to be effective. The pond was lined with HDPE since the cost of the same was less.

Ferro cement check dam- inauguration by Dr. R.N. Pal. ADG (PC)

AGRICULTURAL ECONOMICS

Economic analysis of Arecanut Based Farming Systems

The results of the economic analysis of Arecanut Based Farming Systems (ABFS) under farmer's field conditions revealed that the number of components in the system had increased with the size of holdings and the relative management of ABFS was better in medium and large farms. It was further observed that the net returns from the system had increased with the increase in number of components.

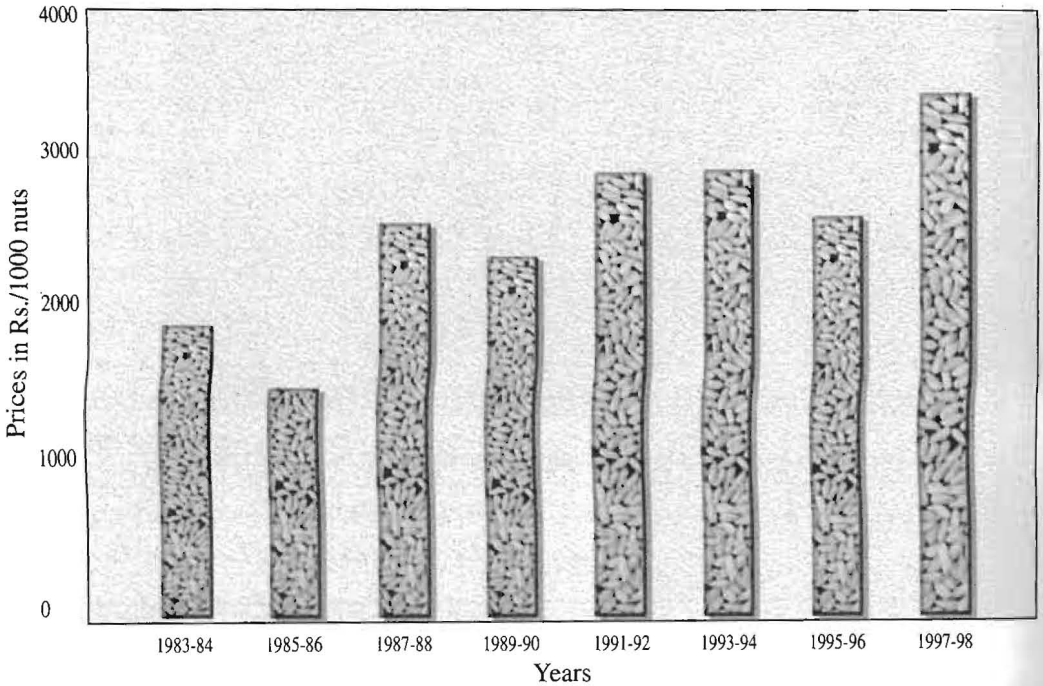
Arecanut + Coconut + Banana + Dairy and Arecanut + Coconut + Banana + Pepper + Dairy were the two most commonly adopted ABFS systems. The average net returns in the former ranged from Rs.69,500 to Rs.2,09,000/ha and in the case of latter the range was between Rs.86,500 and Rs.1,44,800 /ha. However the share of arecanut in the gross return was more than 70 %.

Price analysis of arecanut and coconut

The secondary data analysis of wholesale prices of coconut in different markets for the period 1982-83 to 1997-98 indicated that the Annual Compound Growth Rates (ACGR) was 6.71 % for coconut (unhusked) in Kochi market. The same was 7.23 % and 4.60 % and 5.71% respectively in the case of Alappuzha, Kozhikode and Mangalore markets. The ACGR for dry coconut at Kozhikode market was 6.89 %.

A similar study on arecanut for the period 1989-90 to 1998-99 indicated that the annual compound growth rate was maximum for sun dried type of chali in Calcutta (15.13 %) followed

by Sirsi Safed in Mumbai market (10.94 %). The lowest growth rate had occurred in Delhi market for Mettupalayam variety. The point to point estimation of wholesale price index (base year 1989-90) indicated that the respective increase of wholesale prices were 262 %, 353 %, 313 %, 235 % and 414 % for Choor, Supari, Sirsi Safed, Mettupalayam and Sun Dried types of chali.



Trend in wholesale prices of coconut in Kerala (1983-84 to 1997-98)

AGRICULTURAL STATISTICS

A method was proposed to eliminate the positional effect in field experiments on plantation crops non-parametrically. The proposed procedure is more effective when information about the trend in soil fertility or other location effects influencing the parameter under study to make homogeneous blocks are lacking. A study using 10 years yield data in coconut indicated *that non-parametric Friedman's test is useful in studying overall effects and interaction of* treatments with years.

CD-ROM describing coconut cultivation (Nalikeram[@EB]) "Arecanut Expert" on arecanut cultivation as well as overview of CPCRI were brought out.

TRANSFER OF TECHNOLOGY

1. Training programmes for extension and research personnel

During the year, six scheduled training programmes relating to different aspects of production, protection and processing aspects of coconut, arecanut and cocoa cultivation were organized for the benefit of extension personnel and research workers.

Vittal: YLD of arecanut (at Sringeri and Sampaje), Institutional training programme on pest and disease management of arecanut.

2. Needs and effectiveness of training programmes

Among the 10 training programmes conducted Production technology of coconut and Biological suppression of coconut pests secured I and II ranks respectively based on Training Effectiveness Indices. High level of training needs were expressed by the Agricultural officers in the subject matter areas of crop improvement, transfer of technology, integrated pest and disease management and crop production technologies.

Inauguration of ATIC by Padma Vibhushan Dr. M.S. Swaminathan, FRS

A National Training Course on scientific cultivation of coconut (sponsored by Directorate of Extension, Ministry of Agriculture) and various *Off camp training* programmes were also conducted.

A Familiarisation visit programme was organised for the officials from CRI, Sri Lanka

Kasaragod: YLD of arecanut, vermicomposting palm wastes, Root (wilt) disease of coconut, Institutional training programme on Production technology of coconut, a workshop on YLD of arecanut , and a Research-Extension interphase meeting.

Kayangulam: Training programmes for coconut farmers ,coconut climbers and three batches of BSc.(Ag.) students; one day training programme for the officers of the Dept. of Agriculture.

3. Agricultural Technology Information Centre (ATIC)

Agricultural Technology Information Centre (ATIC) was established at Kasaragod campus as a part of National Agricultural Technology Project, a single window system for services to the farmers. The ATIC would also provide a WEB SITE (home page) facility with **"ask the expert"** programme through Internet.

4. Kisan Mela

During the year one Kisan Mela each were organized at Kasaragod, Kayangulam, Vittal and Mohitnagar, centers in which farmers were educated on advanced technologies on coconut, arecanut and cocoa cultivation as well as various farming systems through exhibitions, study classes and question answer sessions.

5. Publication of extension literature

Extension pamphlets on Package of practices of coconut cultivation, YLD of arecanut, Vermicompost from coconut wastes (English, Malayalam, Kannada and Tamil), Root (wilt) disease and pests of coconut, Eriophyid mite, Red palm weevil, Biological control of coconut pests, leaf rot disease of coconut , About CPCRI (RS), Vittal, Package of practices of cocoa cultivation, Disease management in arecanut and cocoa were published during the year.

6. Frontline demonstrations

Demonstration plots on Coconut and Arecanut Based High Density Multispecies Cropping System and Management of root (wilt) disease affected coconut gardens were maintained in farmers' plots to demonstrate the feasibility and advantages of technologies evolved at CPCRI. A 25 ha demonstration on root(wilt) management has been initiated under NATP at Kayangulam.

7. Supply of planting materials

Planting materials viz., 14,000 coconut seedlings, 35,000 coconut seednuts, 66,01,500 arecanut seednuts, 52,000 areca seedlings and 41,500 cocoa grafts were distributed to farmers during the year.

8. Participation in exhibitions

CPCRI participated in exhibitions organized in connection with the Indian Science Congress at Anna University, Chennai, Flower show'99 by Kasaragod Agri-Hort.Society at Kasaragod, Lions Expo'99 by the Lions Club Kasaragod and the Kisan mela at Thodupuzha.

Institute - Village Linkage Programme (IVLP)

CPCRI is implementing a pilot project on Institute - Village Linkage Programme for Technology Assessment and Refinement in nearby villages under National Agricultural Technology Project. During 1999, 27 interventions covering the five micro-farming situations were tried in the study area. Among the interventions tried, vermicomposting from coconut wastes gave the highest net returns per rupee invested.

TAR through IVLP

On Farm Trial assessing the performance of HYV's of paddy showed that Aishwarya variety with 3.39 t/ha grain and 5.32 t/ha straw yield was the best as compared to Kanchana (2.51 and 2.12 t/ha) and Kayama (2.50 and 4.17 t/ha). The On Farm Trial on the use of biofertilizers for paddy revealed that the *Azospirillum* treated plots obtained a grain yield of 2.96 t/ha and 4.11 t/ha straw yield while the yield obtained from the farmers practice was 2.50 and 4.2 t/ha.

As a part of restructuring existing homesteads, thirty farmers were supplied with quality seedlings of pepper, clove, mango, sapota and guava depending on their choice for planting in the homesteads. Eighteen women farmers were trained at CPCRI on mushroom cultivation technology. Spawn and polythene covers were supplied to the trainees to take up mushroom cultivation utilizing farm residues. On an average, 2.46 kg of mushroom/farm family was produced.

During the year a total of 102 training programmes (55 on-campus and 47 off-campus) were conducted for practising farmers, rural youth, farm women & extension functionaries. Ten of the trainees have started profitable small scale enterprises. Three mass campaigns in plant protection, two field days and 21 farm information exchange club meetings were organized during the period. KVK faculty members attended 42 seminars.

On-farm testing on problems like 'Management of rhinoceros beetle in Coconut', 'Management of stem bleeding in coconut' and 'Management of important pests of vegetables' are being continued.

Under the FLD programme on cereals and horticultural crops, the performance of three high yielding varieties viz. Kanchana, Athira and Aishwarya were taken up at Cheralu, Bayar village during 1998-99. During 1999 - 2000 the programme has been extended to Pathur village.

Watershed Programme

Feed backs from the Yethadka watershed, project has indicated significant achievements in various sectors such as agriculture, bio-resources conservation, socio-economic status of beneficiaries etc.

A new watershed was identified at Manadukkam of Bedadka Panchayath under National Watershed Development Programme for Rural Area (NWDPRA) Scheme for the IX Plan period. The Kerala State Planning Board has selected the Institute as the nodal training institution for giving training for watershed development councils (WDC) of Kasaragod district under the people's planning campaign.

On campus training programme

Under *Women's Cell*, five on-campus and nine off-campus training programmes have been conducted. Around 50 self help groups have been identified and mobilised for suitable technical help by imparting training .

KVK faculties published 11 popular articles, delivered seven radio talks and participated in the national level exhibition conducted at Acharya N.G.Ranga Agricultural University, Hyderabad . A publication on the activities of KVK for the last five years titled "Krishi Vigyan Kendra-In Service of Farmers" was released .

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON PALMS

COCONUT

Crop Improvement

At Aliyarnagar, Arasampatti Tall (141nuts/palm) and Malayan Green Dwarf (148) continued to perform well. The other accessions which showed promise are FMS (80) and Tiptur Tall (89).

At Veppankulam, compared to ECT (63 nuts) WCT and Andaman Ordinary performed better producing 102 and 75 nuts/palm, respectively. Among the dwarfs, Gangabondam, Andaman Dwarf and MYD recorded an average yield of 68.0 nuts/palm. Two local ecotypes were identified at Erandampuikadu and Rasunathapuram villages for coconut gene bank.

Studies conducted for the last 21 years at Ratnagiri showed that Laccadive Ordinary recorded highest average yield of 147 nuts/palm/year followed by Pratap (141), Kerasankara (130) and Philippines Ordinary (105) nuts/palm/year. Among the Banawali types, Banawali Yellow Round yielded 121 nuts and the varieties FMS and Fiji recorded 110 and 107 nuts/palm/year, respectively.

At Mondouri, Jamaica Tall yielded an average of 80 nuts/palm for the past 11 years. Zanzibar and Hazari varieties have also shown promise with an average yield of 65 nuts/palm during the year. At Kahikuchi MOD x WCT showed earliness in flowering with nut yield of 55 in five and a half years.

In the evaluation trial at Aliyarnagar, SSG, WCT x GB, WCT x COD and COD x WCT produced an average of 107 nuts/palm during the year. Other promising materials like ADO, PHO, LCO produced an average 78 nuts/palm.

At Mondouri, LCO (82) and ADO (74) performed better than the local tall and among the hybrids COD x WCT (86), WCT x COD (77) and MYD x WCT (63) have shown promise as seed material for the region.

Crop Production

In the NPK trial at Kasaragod in littoral sandy soil, application of Ca + Mg in combination with 1500g N, 750g P_2O_5 and 1750g K_2O gave a mean yield of 71 nuts/palm compared to the control plot which yielded only 12 nuts/palm. From the Mondouri centre, a fertilizer dose of 500g N, 250g P_2O_5 and 1250g K_2O per palm/year is recommended for the alluvial plains of West Bengal.

At Aliyarnagar, COD x WCT responded well to N application. While N 0 produced 42 nuts/palm, application of N @ 500 g and 1000g produced 178 and 201 nuts/palm, respectively. At Veppankulam similar response to N was observed with N1 (500g) and N2 (1000g) doses recording 142 and 162 nuts/palm compared to 129 nuts/palm in the control plot during the year. Maximum yield of 174 nuts/palm/year was recorded in the treatment 1000g N, 250 g P_2O_5 and 2000 g K_2O. At Ratnagiri the effect of Nitrogen was significant on nut yield. However, N dose beyond 500g decreased the yield. At Mondouri an increase in the dose of N from N 0 to N-500g increased the nut yield from 87 to 102 nuts/palm. While N-1000g decreased the nut yield to 99 nuts/palm. In the coconut based cropping system experiment at Ratnagiri the percentage increase in coconut yield in the mixed crop plot with tree spices increased from 42.0% in *Garcinia* block to 93.9% in clove block. The average yield in the

spice block was 106 and 101 nuts/palm for the full and half of the recommended dose of the fertilizer respectively. Coconut mixed crop with nutmeg gave a net profit of Rs. 82,355 per ha during the year and an average figure for four preceeding years was Rs. 69,593 per ha.

At Mondouri ginger, turmeric and colocasia are performing very well in the coconut cropping system with annuals.

At Aliyarnagar drip irrigation at 100% Eo and basin irrigation produced an yield of 144 and 148 nuts respectively compared to 45 nuts/palm observed under life saving irrigation. At Veppankulam, the figures for the above treatments were 116, 135 and 93 nuts/palm during the year. At Ratnagiri, the coconut yield under drip irrigation at 100% Eo and basin irrigation recorded 101 and 104 nuts/palm/year, respectively. Palms under the control treatment yielded 68 nuts/palm/year.

Crop Protection

In the pathogenicity trial on Ganoderma at Aliyarnagar by split root inoculated technique 100% symptom expression was observed in MYD and MGD while ECT showed none. In the new management trial, the palms with carbendazim (2% root feeding) + 5kg neem cake or Tridemorph (2% root feeding) + 5kg neem cake or Kitazin (2%) root feeding) + 5kg neem cake or Aureofungin sol (2% root feeding) + Copper sulphate (2g/100 ml RF) were effective recording 1-4% disease index compared to 64% in untreated control.

The intensity of basal stem rot (BSR) of coconut was low in the palms with the following treatment viz, *Trichoderma harzianum* with 50 kg green manure or *T. harzianum* + FYM + 1% Bordeaux mixture or *T. harzianum* + 5 kg neem cake. A mean cumulative nut yield of 82-88 nuts was obtained compared to that of control and other treatments. ECT x BSR tolerant ECT registered a higher rate of survival (66.7%) as compared to the 40% survival in ECT.

Among the 4,63,782 palms (210 gardens) surveyed in Pollachi and adjacent areas of Kerala, only three palms were found to be affected by root (wilt) disease and 1105 were affected by Thanjavur wilt. While root (wilt) affected palms were removed, suitable control measures were recommended for Thanjavur wilt affected palms.

In Pollachi, Udumalpet, Erode and Dindigul tracts, out of 58,283 palms only in 3% of the palms, rhinoceros beetle attack was noticed. SIME-RB Rhinolure and Ferrolure traps are effective in attracting rhinoceros beetle and red palm weevils, respectively. For control of rhinoceros beetle, Folidol 2% dust showed better results with 18% leaf and 9.7 % spindle damage compared to other treatments.

The control of *Opisina arenosella* was successfully demonstrated at Navamalai by Aliyarnagar centre. Release of *Bracon* sp. and *B. nosatoi* increased the parasitisation on *Opisina* from 0.4 to 32.0% and 0.0% to 25% respectively. For the control of *Opisina*, release of larval parasite *Goniozus nephantidis* at the rate of 20.5% of the pest population was recommended by Ratnagiri.

OIL PALM

Crop Improvement

At Vijayarai the hybrid 128D x 291P yielded 11.35 t FFB/ha and at Mulde it yielded 15.12 t FFB/ha. Other combinations yielded an average of 11.9 t FFB/ha.

At Mulde a highest yield of 132.7 kg FFB/palm was recorded in the treatment combination of drip irrigation with 1200:600:2700g NPK/palm/year.

PALMYRAH

Crop Improvement

At Pandirimamidi, 51 accessions of palmyrah collected during 1991, 1993 and 1994 from Andhra Pradesh are under evaluation for higher leaf number/palm, higher leaf area, higher fruit yield etc.

At Killikulam, 67 accessions planted in 1995 and 1997 are under evaluation for leaf production, plant height and breadth of leaves.

Crop Protection

Study on the effect of seed treatment and soil drenching on the incidence of tuber rot caused by *Rhizoctonia solani* indicated that the incidence of tuber rot was the least (15.7%) with seednut soaking in 0.1% carbandazim than the control (48.9%.)