

Research Highlights

2002-2003



CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

KASARAGOD 671 124, KERALA, INDIA



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Front Cover: COGENT team visiting ICG-SA, Kidu

Back Cover: Coconut plantation on the banks of Chandragiri River

Word processed by:

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May 2003

Printed at: Niseema Printers and Publishers, Kochi - 18. Ph : 2403760

परिचय

केन्द्रीय रोपण फसल अनुसंधान संस्थान, कासरगोड तथा अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के १४ केन्द्रों की मुख्य फसलों जैसे नारियल, सुपारी एवं कोको के लिए कृषि प्रौद्योगिकियों में नई पद्धतियों को सार गर्भित रूप में इस प्रकाशन में प्रस्तुत किया गया है। पाँच मुख्य प्रभाग जैसे फसल सुधार, फसल उत्पादन, फसल संरक्षण, शरीरक्रिया विज्ञान, जैव रसायन तथा कटाई उपरान्त प्रौद्योगिकी एवं सामाजिक विज्ञान के अधीन ११ बृहत परियोजनाओं का वितरण किया गया है।

लक्षद्वीप तथा तमिलनाडु से २० देशीय प्रजातियों को सम्मिलित कर नारियल जननद्रव्य को पुनः प्रबल बनाया गया है। दो अलग जातियाँ जैसे लकाडीव जायन्ट (गुठली आकार में बहुत बड़ी) तथा लकाडीव मिनी माइक्रो (गुठली आकार में बहुत छोटी) भी सम्मिलित हैं। इस संस्थान द्वारा अक्तूबर-नवंबर 2002 की अवधि में दो मुख्य घटनाओं का आथितेय किया गया है, एक नारियल पर (द्वितीय अन्तर्राष्ट्रीय नारियल जीन बैंक बैठक तथा विश्व तौर पर समन्वित नारियल प्रजनन पर परामर्श) और दूसरा कोको पर (कोको की उत्पादकता बढ़ाने के लिए प्रौद्योगिकियों पर राष्ट्रीय संगोष्ठी)। सुपारी में बौनेपन के लिए प्रजनन, फसलन पद्धति, सूत्रकृमि कीट, एरियोफिड कीट का परिस्थिति अनुकूल नियंत्रण, जड़ मुझा रोग का प्रबंधन, नारियल एवं सुपारी का मूल्य वर्द्धन आदि अन्य विशेष उपलब्धियाँ हैं।

एरियोफिड कीट संक्रामण में उल्लेखनीय कमी तथा नारियल के सूखा प्रबंधन सक्षमता इसमें सारगर्भित है। विकासन विभाग के सहयोग से प्रशिक्षण कार्यक्रम, कार्यशालाएँ, प्रदर्शनियाँ, प्रकाशन, रेडियो वार्ताएँ, दूरदर्शन कार्यक्रम, सी. डी. रोम तथा किसान मेला प्रायोजित कर इन फसलों की उत्पादन क्षमता एवं उपज बढ़ाने की परामर्श सेवाएँ इस संस्थान की ओर से प्रदान की जाती हैं। केरल राज्य के 12 जिलों में कृषकों के साथ हमारे वैज्ञानिकों के 12 अभिमुखीकरण कार्यक्रम आयोजित किए गए। कृषि विज्ञान केन्द्र, संस्थान ग्राम संपर्क कार्यक्रम, तथा कृषि प्रौद्योगिकी सूचना केन्द्र द्वारा प्रौद्योगिकी हस्तांतरण के क्षेत्र में विस्तार गतिविधियाँ बढ़ाने का प्रयास किया गया। प्रौद्योगिकी निर्विष्ट, रोपाई सामग्री, फार्म उपज मूल्य वर्द्धित तथा संसाधित उपज, फार्म साहित्य और सी डी रोम आदि सुविधाएँ कृषि प्रौद्योगिकी सूचना केन्द्र की ओर से कृषकों को प्रदान की जाती हैं। हमारी मुख्य फसलों से संबंधित अधिक प्रश्नों/समस्याओं को हल कराने में संस्थान का वेबसाइट <http://www.cpcri.nic.in> सहायक है।

इस वर्ष की अवधि में केन्द्रीय रोपण फसल अनुसंधान संस्थान के स्टाफ की ओर से विभिन्न प्रौद्योगिकियों के विकासन में दी गई सराहनीय योगदान के प्रति मैं अभिनन्दन प्रकट करता हूँ।

वी. राजगोपाल

(वी. राजगोपाल)

निदेशक

INTRODUCTION

The significant achievements in agricultural research for mandate crops namely coconut, arecanut and cocoa at Central Plantation Crops Research Institute and 14 centres of All India Co-ordinated Research Project on Palms are summarized in this publication. There are 11 mega projects distributed under 5 major divisions *viz.*, Crop Improvement, Crop Production, Crop Protection, Production Physiology & Post Harvest Technology and Social Sciences.

The coconut germplasm was further strengthened by the addition of 20 indigenous collections from Lakshadweep Islands and Tamil Nadu. Two distinct types were included namely, Laccadive Giant (largest nut size) and Laccadive Mini Micro (smallest nut size). Ten arecanut germplasms were also introduced this year. The Institute hosted two major events, one on coconut (IInd International Coconut Gene Bank Meeting and Consultation on Proposed Globally Coordinated Coconut Breeding) and another on cocoa (National Seminar on Technologies for Enhancing Productivity in Cocoa) during Oct-Nov, 2002. Significant results were also obtained from breeding of dwarfness in arecanut, cropping systems, organic farming, fertigation, moisture conservation, biological control of insects, nematode pests, ecofriendly control of eriophyid mite, management of root (wilt) disease and value addition of coconut and arecanut.

The marked reduction in eriophyid mite infestation and efficacy of drought management of coconut are noteworthy. The Institute also provided consultancy services for increasing the production and productivity of these crops through the cooperation of developmental departments by sponsoring training programmes, workshops, demonstrations, publications, radiotalks, TV programmes, CD ROMS and kisan melas. Interface programmes on coconut cultivation for Govt. extension officials and progressive farmers were conducted in 12 districts of Kerala State. Efforts were also made to enhance the extension activities in the field of transfer of technology through KVK, IVLP and ATIC. ATIC facilities were made available to many farmers in the form of technology inputs, planting materials, farm products, value added and processed products, farm literature and CD ROMS. Institute website <http://www.cpcri.nic.in> is directly solving many queries /problems related to the mandate crops.

I wish to congratulate the staff of CPCRI for their commendable contribution to various technologies developed during this year. I acknowledge the help rendered by my colleagues in bringing out this publication.

28.04.2003
Kasaragod


(V. Rajagopal)
Director

CROP IMPROVEMENT

Collection, conservation, cataloguing and evaluation of germplasm

- A total of 20 accessions (12 from Lakshadweep & 8 from Tamil Nadu) were added to germplasm holding making the strength to 321 accessions (132 exotic and 189 indigenous).
- The twelve coconut ecotypes collected from Lakshadweep group of Islands included two distinct types, Laccadive Giant with very large fruit size and Laccadive Mini Micro with small fruit size (Fig. 1).

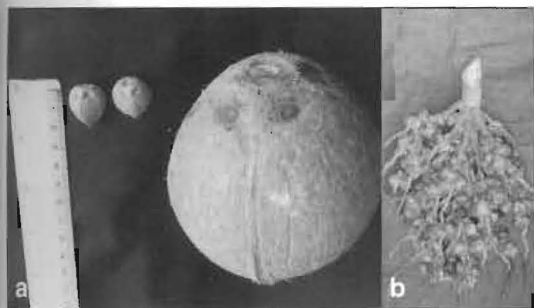


Fig. 1. a). Laccadive minimicro mature nuts in comparison with a WCT nut. b). Laccadive minimicro bunch.

- Thirty-seven germplasm accessions collected under NATP/PB from Kerala, Tamil Nadu, Lakshadweep and Andaman and Nicobar Islands have been field planted at CPCRI, RC, Kidu. Three Nicobari collections were planted in the International Coconut Gene Bank for South Asia (ICG-SA) at CPCRI, RC, Kidu during the current year.
- Biometric analysis of 80 coconut accessions using five breeding traits revealed St. Kudat (an accession with no spikelets) to be a divergent accession.
- Out of 41 characters studied in four hybrids, 14 were statistically significant. Tall x Dwarf has recorded significantly higher cumulative nut yield, average nut yield and average annual female flower production. Dwarf x Dwarf had recorded significant highest no. of leaf scars per meter (47.33)

- Evaluation of 8 hybrids involving COD, MYD as female parents, LCT, ADOT, WCT and WAT as male parents with WCT as control revealed the superior performance of MYDxWAT yielding 92.4 nuts/palm/year.
- In the F_2 progeny trial, Palm no. 114 (progeny of HB 96) recorded highest performance, i.e., highest values for number of bunches (10), annual female flower production (148) and average nut yield (61).
- Out of total of 71 arecanut accessions planted in the germplasm block at CPCRI Research Centre, Mohitnagar, 56 accessions are in bearing stage. Among them, maximum number of nuts per palm was recorded in the accessions native to N.E. states. Higher yield of 231.4 nuts was recorded in accession Nalbari followed by K&J Hills (215.8) and Kamarapur (214.7). Maximum number of inflorescence and fruiting bunch was recorded in K&J Hills (2.33 and 2.33 per palm per year, respectively). In case of non bearing accessions, Cal-17 and Cal-33 performed well for different growth characters like palm height, stem girth and leaf production per palm per year.
- A comprehensive breeding programme for the production of quality planting materials for establishing nucleus seed gardens and to develop a variety resistant / tolerant to coconut root (wilt) disease is being implemented. Artificial pollination was carried out in the farmers' plots of Alappuzha, Kollam, Pathanamthitta and Kottayam districts involving 63 West Coast Tall, 84 Chowghat Green Dwarf and 23 Chowghat Orange Dwarf of Kerala palms. Artificial pollination was carried out in 575 inflorescences on 12492 female flowers and a total of 3576 artificially pollinated seed nuts were harvested and sown in the nursery.



- Yield data of 31 WCTxCGD hybrids planted during 1991 gave an average yield of 78 nuts/palm during 2001-2002 though they had 65% root (wilt) disease incidence. Disease free hybrids gave an average yield of 95 nuts/palm/year. The diseased hybrids gave an average yield of 64 nuts/palm/year indicating their tolerance to root (wilt) disease.
- A total of 391 artificially pollinated seedlings were planted during this year in the existing nucleus seed garden at District Agricultural Farm, Mavelikara. Starting from 1995, about 6344 seedlings have been established so far in the five nucleus seed gardens located in four root (wilt) disease prevalent districts namely, Kannara (Trichur), Neriamangalam (Ernakulam), Mavelikara, Kayamkulam (Alappuzha) and Karunagappally (Kollam). At full bearing stage these seed gardens are expected to meet the demand for quality planting materials in the root (wilt) prevalent tract.
- NC 22 cocoa clone recorded the maximum pod yield of 122 followed by NC 50 & NC 37, each with a yield of 95 pods.

Biotechnology

- Regeneration was achieved from plumular explants of WCT cultivar of coconut using picloram as a callogenic agent. Maximum frequency of embryogenic calli, shoot meristemoid formation and somatic embryoid formation was noticed in cultures supplemented with 75µM picloram (Fig. 2).

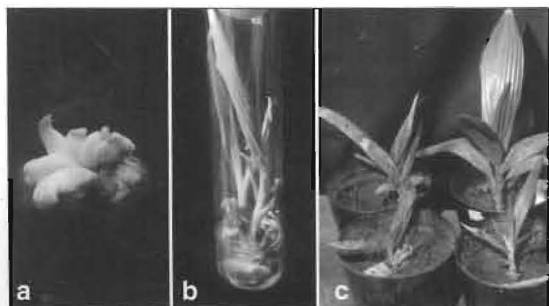


Fig. 2. *In vitro* culture of coconut (WCT) through plumule explant. a. Shoot regeneration from picloram induced callus. b. Plantlet development in liquid media. c. Well established plants in shade net house.

- Somatic embryo development and germination was achieved from inflorescence and adult leaf tissues of arecanut (variety South Kanara Local & Sumangala) (Fig. 3).

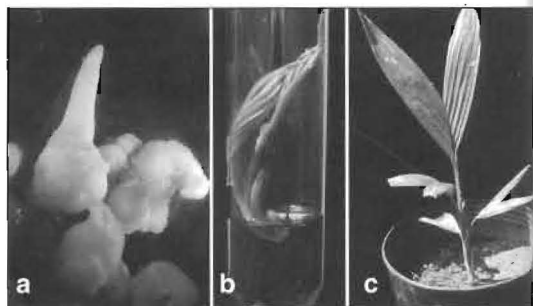


Fig. 3. *In vitro* propagation of arecanut using adult explant. a. Somatic embryo development in hormone free media. b. Somatic embryo germination in liquid media. c. A potted plant.

- Sri Lankan and Bangladesh accessions collected in the form of embryos were *in vitro* retrieved and maintained in the net house (Fig. 4).



Fig. 4. Embryo culture raised coconut seedlings (Sri Lankan accessions) maintained in shade net house.

- Plantlet development in arecanut through callus regeneration and somatic embryogenesis was achieved using seedling tissue.
- Microsatellite analysis of 46 coconut accessions (23 Indian and 23 Exotic) with CAC primers identified 48 alleles with an average of 6 alleles per locus. The within population diversity was 60% and between population variation was 40%. The average gene diversity was 0.315. The average heterozygosity was 0.302. The UPGMA clustering by Nei's standard distance identified three major clusters. 1) Dwarf 2) Indian Ocean group 3) South East Asian group. The Indian accessions KPDT, Spicat

and ADOT clustered with the South East Asian group and Assam green tall with Dwarf group.

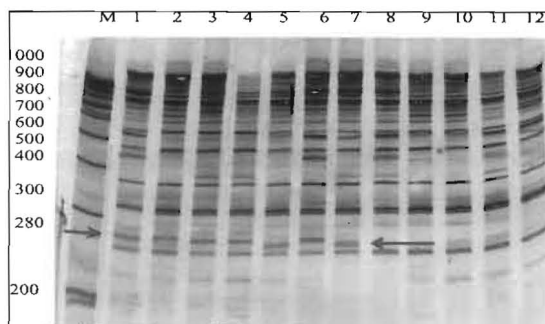
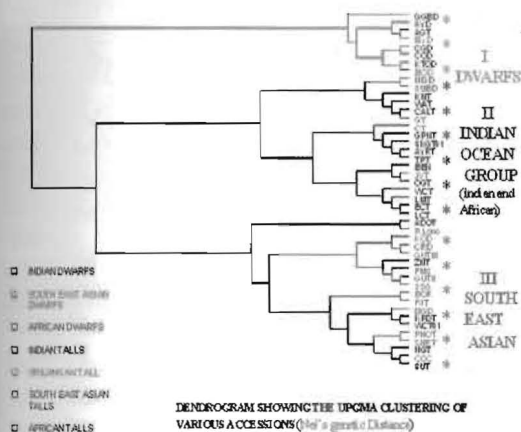


Fig. 5. DAF analysis. M: Molecular weight marker. Lanes 1 to 7: Root (wilt) resistant palms. Lanes 8 to 12: Susceptible palms. Arrow indicates putative marker for resistance around 280 bp.

- The tissue culture and molecular biology protocols developed at CPCRI for coconut, arecanut, cocoa and oil palm have been included in the Bioinformatics Centre website (www.bioinfpcpri.org) to serve as a reference web page to guide research personnel.

CROP PRODUCTION

Coconut Based Cropping System

- In the coconut based high density multispecies cropping system, the coconut yield ranged from 122 nuts/palm/year under 1/4th of the recommended fertilizer treatment to 144 nuts/palm/year at full dose of the recommended fertilizer dose. The productivity of the palm declined with the reduction in the fertilizer levels beyond 1/3rd of the recommended fertilizer treatment.
- The net returns were highest in the treatment, one-fourth of the recommended fertilizer dose (Rs 48320/-) with a cost benefit ratio of 1: 2.
- The canopy storage capacity was determined by a plot of throughfall versus gross rainfall for day with a depth great enough to saturate the canopy (assumed to be > 3 mm). Canopy storage capacity of coconut was 1.8 mm and throughfall was 85 to 90 % of the gross rainfall. Canopy storage capacity of clove was 2.8 mm and

throughfall was 34 to 62 % of the gross rainfall (Fig.6).



Fig. 6. Coconut based High density multispecies cropping system at Kasaragod

- Proliferation of bacteria, fungi, actinomycetes, free living diazotrophs and P- solubilizers were highest in one-third dose of mineral fertilizer treatment along with recycling wastes.
- Allelopathic studies indicated that coconut root and leaf leachates did not have any negative influence on the cowpea seed germination. However, the seedling vigour index was adversely affected by the root leachates of

young and adult palms and by the leaf leachate of adult palm (Fig. 7&8). The leaf leachate from the young palm on the other hand stimulated the growth index at 1:10 concentration.

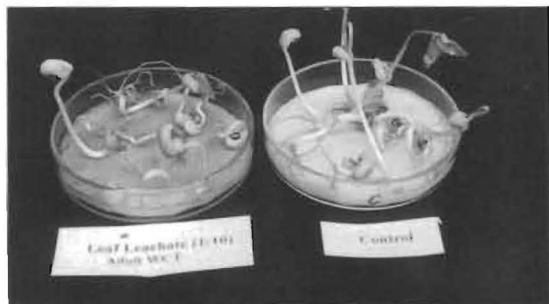


Fig. 7. Allelopathic effect of coconut leaf leachate (left) on growth of cowpea.



Fig. 8. Allelopathic effect of coconut root leachate (right) on growth of cowpea.

Coconut based farming system

- In the coconut-based farming system comprising coconut, grass, dairy, poultry, sericulture and pisciculture, the output obtained during the year was 21830 coconuts, 10850 l milk, 687 kg broiler birds, 127 kg fish, 2476 quail eggs and 70 kg banana. The total revenue obtained from the system was Rs 2,37,600 while the total variable cost involved in maintaining the system was Rs. 1,81,050/-, providing a net return of Rs. 56,550.
- Studies on microbial population dynamics of the system indicated that bacterial (29.22×10^5 cfu/g soil), fungal (19.31×10^3 cfu/g soil) and actinomycetes (14.26×10^5 cfu/g soil) population were more in 100% organics treatment when compared to other treatments in grass plots.
- Microbial biomass ($312.17 \mu\text{g C/g soil}$),

dehydrogenase ($22.95 \text{ formazan/g soil/h}$) and phosphatase activity ($66.84 \mu\text{g p-nitrophenol/g soil/h}$) were highest in 100% of organics treatment in the grass plot.

- High density multi species cropping system model at CPCRI(RS), Kayangulam under root (wilt) affected garden in 1.0 ha area has nutmeg, banana, pineapple, pepper, vanilla, yam, cassava and amorphophallus as inter/mixed crops. The cost of production involved in maintaining one ha system during the year was Rs. 38214 and the gross return obtained from one ha system was Rs. 86604 which gave a net return of Rs. 48390. The gross income obtained from component crops was Rs. 35749 during the year.
- As a green manure crop, cowpea established well and yielded on an average of 24.6 kg of green biomass in 1.8 m radius of coconut basin. On incorporation of cowpea in the basin, it contributed 134.2 g on N, 12.3 g of P and 113.7 g of K per basin per season.

Plantation based integrated farming systems

- New vegetable crops such as cabbage, cauliflower and capsicum were introduced as component crops in coconut farms at CPCRI, RS, Minicoy.
- Results from the observational trial on Nendran variety of banana at Minicoy revealed that it can be profitably cultivated by organic farming under the Island conditions. The average yield was 9.07 kg/plant under the Minicoy conditions.
- In the project on analysis and development of homestead farms of Kerala, system inventory in all the 815 selected homestead farms in 83 panchayaths of four proposed districts through questionnaire and PRA has been completed. Interventions have been suggested in representative homesteads from different districts.
- In the trial of screening promising black pepper varieties/hybrids as mixed crops in adult coconut garden, varieties Panniyur 1, Subakara, Panniyur-2, Sreekara, HP-780

HP-105, Panniyur-4 and Panchami recorded significantly higher plant height (2.5 to 3.3m) compared to rest of the varieties (1.5 to 2.4 m) at one year after planting. The number of pepper laterals recorded at one-meter height on coconut trunk varied from 1.7 to 3.8/vine in different varieties. However, the differences were not significant among the varieties. The varieties Panniyur-1, 2, 3, Sreekara, Subakara, HP-105, HP-1411 and OPKM have started flowering at 11th month itself. Viral disease incidence was observed in Panniyur-1, Panchami, Kottaradar and HP-34 varieties. In severe cases, vines have been uprooted and gap filled with disease free cuttings.

Vermicompost from palm wastes

- The effect of amending coir-pith:soil, 1:1 mixture with vermicompost on the performance of polybag raised WCT coconut seedlings indicated significant positive influence of application of vermicompost on the root biomass of coconut seedlings. The extent of response was more when vermicompost was amended at the rate of 30% of the growth substrates (coir pith: soil).
- Difference in growth rate of *Metarhizium anisopliae* (used for controlling rhinoceros beetle breeding in vermicompost sites) was observed in coconut water from healthy coconut and root (wilt) diseased palms. The growth rate of the pathogen was observed to be higher by 50% in the coconut water collected from healthy palms from root

(wilt) free area when compared to the nut water from root (wilt) diseased palms and not significantly different as compared to nut water of field tolerant palms (Fig. 9).

- Nucleus culture of 58,770 earthworms of the local *Eudrilus* sp. were distributed to the farmers and agricultural/horticultural departments of the different states as a part of disseminating vermicompost technology.

Biopolymer degrading fungi from coconut wastes

- Fungal isolates from decomposing coconut wastes such as *Phanerochaete* sp., *Lentinus* sp., *Chaetomium* sp., *Coprinus* sp. and *Aspergillus* sp. exhibited lignolytic activity, as evidenced by dye-decoloration of poly R-498 and laccase production in coir pith-guaiacol agar plates. These isolates also exhibited cellulolytic activity when tested on Czapek's Dox-Cellulose agar.

Biofertilizers and organics in coconut nutrition

- The field experiment on the role of biofertilizers in the integrated nutrient management of Tiptur Tall coconut palms indicated the effectiveness of treatment such as biofertilizers (*Beijerinckia indica*) and phosphobacteria (*Bacillus* sp.), vermicompost and green manure legume (*Calopogonium mucunoides*) biofertilizer treatment in enhancing the nut yield of coconut palms when compared to palms receiving recommended dose of NPK fertilizers.
- Studies on the effect of organic manures on the growth and productivity of coconut in root (wilt) affected area, indicated maximum response on yield and yield attributes when half of nitrogen was supplied through organics compared to fully organic/inorganic treatments.

Soil and water conservation measures

- Husk filled in trench with single row pineapple border was observed to be the best treatment in soil and water



Fig 9. Difference in growth of *M. anisopliae* in coconut water from root (wilt) affected palm (left), root (wilt) tolerant palm (middle) and healthy palm (right).

conservation measure for coconut gardens, in slopy terrains.

- The fodder grass hybrid CO3 grown for dual purpose (soil conservation/fodder), recorded highest yield of 28.21 t/ha in June harvest and the lowest growth and yield (6.21 t/ha) during monsoon season. Performance of CO3 grass was better during summer than other seasons with an average yield of 100.2 t/ha for eight harvests (Fig. 10).



Fig 10. Hybrid grass (CO3) grown for dual purpose

- The piezometer reading taken to study the level of water table shows that in the treatment T1, (drain between 2 row of areca palm) T2 (drain between 3 rows) and T3 (drain between 4 rows) water level never

raised to active root zone of arecanut (60 cm) during monsoon season. However, in the treatment T4 (drain between 5 rows) occasionally water level rises to root zone for brief period not more than 20 days continuously. This indicates that having drains between two rows is sufficient under a mild slopy land.

GIS for identification of root (wilt) diseased palms

- In the linear spectral reflectance model for identification of root (wilt) disease affected coconut palms using remote sensing and GIS, the pixels were sub classified into proportion of coconut, road, laterite outcrops, constructions, arecanut, others and cloud using GPS ground control points. This improved classification accuracy from 75% to 87%.

Potassium nutrition

- In the field experiment to study the effect of potassium on the nutrition and productivity of coconut, the highest copra content (208.8 g/nut) and copra yield (11.7 kg/palm) were recorded in the palms receiving 1kg KCl/palm/year.

PRODUCTION PHYSIOLOGY

- In a multi-location experiment, different moisture conservation practices in palm basins *viz.*, application of FYM and farm waste, composted coir pith, leaf mulching, husk burial, (Fig. 11,12,13) potassium and synthetic polymer, resulted in conservation of soil moisture at root zone during dry

season for extended period. Prolonged moisture availability in these treatments helped to increase the source number (number of leaves, annual leaf production) and efficiency (increased P_n even during summer for longer periods), and sink number (number of FFP) and efficiency (nut retention). These improved source and sink



Fig 11. Moisture conservation by coir dust/ composted coir pith burial



Fig 12. Coconut leaf mulching.



Fig 13. Husk burial

number and efficiencies resulted in higher nut yield. Palms responded to soil moisture differently under different agro-climatic conditions, indicating the influence of climate and soil type on the source size and sink efficiency thus determining the coconut yield.

- The photo-oxidative stress in two year old coconut seedlings resulted in high lipid peroxidation and chlorophyll bleaching, low quantum efficiency and water potentials leading to leaf scorching and even seedling death in severe cases.
- Arecanut contains polyphenols and condensed tannins which ranges from 40 to 50% during growth period. Semi ripe nut (6-7 month) and ripe nut (9-10 month) of Mangala variety have protein content 9.9% and 9.2% respectively. The major free amino acid content identified in arecanuts are tyrosine, phenylalanine, proline, lysine and tryptophan.

- The pruning regimes in cocoa grafts showed that the canopy spread, height and girth of

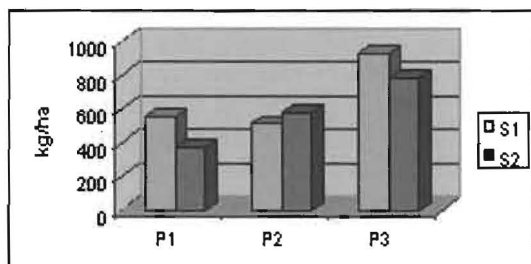


Fig 14. Cocoa bean yield on area basis

stem were higher in P3 (large canopy) treatment. The PAR profiles were highest in S2 spacing (2.7x5.4 m) while low in P3 pruning treatments. The canopy of cocoa intercepted 90 to 98 per cent of light. Highest dry bean yield was recorded in S2P3 treatment on plant basis. However S1P3 and S2P3 treatments showed high yields per hectare basis (Fig. 14, 15).



Fig 15. Canopy architecture in S2P3 treatment of cocoa grafts

CROP PROTECTION

Studies on nut infesting eriophyid mite in coconut plantations

- Azadirachtin based pesticides and neem oil garlic soap emulsion were found to be effective against eriophyid mite attack. Alternatively when wettable sulphur was used for controlling the mite, coreid bug infestation was observed to increase.
- Percentage of predatory mites in sample nuts infested with eriophyid mite showed increasing trend during the year. Severe nut

fall was observed in different locations in Kerala due to rotting in association with eriophyid mite infestation. Pathogenicity tests revealed *Lasiodiplodia theobromae* as the causal organism. The fungus enters the nut tissue through the wounds caused by mites.

Biocontrol agents of pests of coconut palm

- *Apanteles taragamae*, the early instar parasitoid of *Opisina arenosella* is susceptible to temperature above 35°C. Longevity of the parasitoid was very high at lower

temperature 10-15°C with reduced fecundity. The developmental period of the parasitoid was very short during summer and longer during winter months. *Steinernema* isolate collected from Kayangulam when mass multiplied and screened on red weevil and *Oryctes* grubs showed infection to red weevil only. Medium supplemented with coconut oil, coconut cake and coconut water supported maximum multiplication of the EPN *S. glaseri*. *S. glaseri* multiplied on different media were pathogenic to *G. melonella* larvae and there was no loss in virulence.

- Thirty per cent of the soil samples collected from Kerala were positive for EPN. *Steinernema glaseri* isolated from Palakkad is the first report of its occurrence in Asia. Mass multiplication of *S. glaseri* on media supplemented with oil, cake and water from coconut was at par with other known artificial media. Native isolates of *S. glaseri*, *Heterorhabditis indica* and *Steinernema* were highly pathogenic to white grubs.

Integrated management of white grub in coconut and arecanut at Mohitnagar

- Active chemicals from leaves of 50 numbers of different weed/herbs collected locally were extracted by acetone method. Extract of about 30 weeds/herbs were applied to the white grub and percent grub mortality was recorded at 24 hrs interval. The leaf extract (20 ml) from *Bombyx* sp., orchid and vanda gave 100% grub mortality at 48 hrs, 96 hrs and 120 hrs respectively. The chemical control of white grub was demonstrated in farmer's field at Jalpaiguri district.

Studies on the natural enemies of major insect pests of areca-cocoa ecosystem

- Cecidomyiid predators were collected from areca-cocoa system. At least five genera of these midges could be found feeding on mites, aphids and mealy bugs. One of these, a predator of the cocoa mealy bug, *Planococcus lilacinus*, is identified as *Triommata coccidivora* (Fig. 16).



Fig 16. Predator of cocoa mealy bugs

Management of leaf rot disease in root (wilt) affected coconut palms

- The usefulness of talc-based preparation of the bacterial antagonist, *Pseudomonas fluorescens*, in field control of leaf rot has been achieved with considerable suppression of the disease in newly emerged spindle leaves.

Management of bud rot of coconut

- Biological management of bud rot, one of the most lethal diseases of coconut, was attempted using a bacterial strain, *Bacillus amyloliquefaciens*, isolated from the coconut seedlings. Drenching was found to be an effective method of introducing the bacteria than root feeding.

PCR amplification of phytoplasma associated with palm disease

- Total DNA was isolated from various tissues of root (wilt) diseased coconut, yellow leaf diseased arecanut and spear rot diseased oil palm. Purity of the DNA was assessed by agarose gel electrophoresis and concentration determined by spectrophotometry. Standardised parameters for amplification of DNA using phytoplasma-specific primers. Using P4 and P7 oligoprimers, amplification in expected range was recorded with root (wilt) DNA. Consistent results confirming phytoplasma association through molecular studies obtained from two different locations - Indian Institute of Horticultural Research Bangalore and Central Plantation Crops Research Institute have added further evidence to phytoplasmal etiology of the disease.



Demonstration of integrated management of root (wilt) disease of coconut

- Integrated management practice reduced the root (wilt) disease intensity from the initial value of 23.5% to 7.8%. Decline in severity of the leaf rot disease was also recorded.

Management of arecanut YLD

- The intensity of YLD did not increase even after 3 years irrespective of the treatments in the management trial, where the palms are in the early stage of disease (Disease Index less than 6). This indicates that arecanut garden should not be neglected as soon as YLD starts, rather better management practices may be adopted to maintain the garden and to get sustainable yield.

Integrated management of crown rot of arecanut

- Crown rot affected samples from areca palms yielded *Phytophthora meadii* and bacterium. The disease incidence was noticed in 2.5% of palms in a garden of 300 palms.
- Crude acetone extract of *Eucalyptus globulus* inhibited *P. meadii*, *in vitro*. Akomin and phosphonic acid and Ovis (a naturally occurring citronellol) used at 0.3% level were compatible with all the combinations of plant extracts and fungicides and biocontrol agents *Trichoderma viride* while contaf (hexaconazole) totally suppressed the

growth of all the seven tested isolates of *Trichoderma*.

Development and improvement of IPM technology for basal stem rot (*Ganoderma*) disease of arecanut

- Aqueous leaf extracts (1 gm/ml) of forty two commonly occurring plant species were screened against *Ganoderma* spp. under *in vitro* conditions by poisoned food technique. Among these, *Allium sativum* (100%), *Peperomia* sp. (93%), *Clerodendron infortunatum* (80%), *Mycaenia* sp. (50%), *Wedelia trilobata* (42%) and *Strychnos nux-vomica* (40%) inhibited the growth of the pathogen. (Fig. 17)

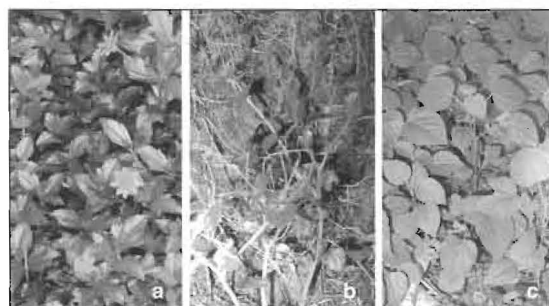


Fig 17. a) *Wedelia trilobata*, b) *Peperomia* sp., c) *Clerodendron infortunatum*

- Four antagonistic fungi (two *Trichoderma* spp., one *Penicillium* sp. and one sterile fungus) was also isolated. It was also observed that with the exception of garlic, none of the other botanicals had any deleterious effect on the antagonistic fungi, thus suggesting that they can be combined for managing the disease.

PRE AND POST HARVEST TECHNOLOGY

Development of process for value addition and quality improvement of coconut

- For the modified atmosphere packaging (MAP) of fresh kernel and edible copra, different films of various thickness, preservatives and their combinations, different gas mixing ratio of O₂, CO₂ and N₂ were selected. Ambient temperature was selected as storage temperature for the packed kernel. Effect of sterilization

of the kernel before and after the packing was included. Biochemical and microbiological quality of the selected treatments were analysed. Based on the results obtained from the laboratory model of a fluidized bed dryer for drying disintegrated fresh coconut kernel, pilot scale fluidised bed dryer of capacity 200 coconuts per batch has been designed and fabricated.



Machinery for removing shell from partially dried coconut

- A sheller was designed and fabricated for separating the kernel from the partially dried coconut cups (moisture content more than 20 %). After partial drying of the coconut for one or two days, and when the moisture content of the kernel becomes nearly 20%, the machine separates the shell from the kernel (Fig.18).
- The capacity of the prototype model is 200 coconuts (400 cups). For partly dried coconut with 22% moisture content, with

an average 25 rotations at speed of 10 rpm, the shelling efficiency was 80%. The total cost of the unit comes to Rs. 65,000, approximately

Fig. 18. Coconut sheller



SOCIAL SCIENCES

The Institute continued to strengthen its Transfer of Technology Programmes covering more number of farmers and extension workers from different regions in the country. The major highlights of TOT programmes conducted during the year are :

- Twelve Interface programmes were organized in various district headquarters in Kerala State as well as in Pondicherry State to discuss the scope for the adoption of technologies for improving returns from coconut cultivation. These programmes evoked tremendous response from farmers and extension personnel in actively discussing the viability of available technologies for enhancing coconut production and productivity in the region.
- A total number of 15 Institutional training programmes were organized on various aspects of coconut, arecanut and cocoa cultivation and post harvest technologies for officials from Karnataka, Kerala, Andhra Pradesh, Orissa, Bihar, Maharashtra and Assam States.
- Frontline demonstrations on root (wilt) management technologies resulted in an average yield improvement in hybrid coconut by 105.6% with an average yield of 74 nuts/palm/annum. Sixty percent reduction in leaf rot disease incidence and

35% reduction in fresh infestation of eriophyid mite was recorded.

- Four audio-cassettes were produced in collaboration with Directorate of Extension, Ministry of Agriculture, Govt. of India. (available for sales at ATIC), viz., coconut cultivation technology, cocoa cultivation technology, arecanut cultivation technology and integrated pest and disease management in arecanut.
- Institute participated in a record number of 10 public exhibitions in various parts of the country including Kisan 2002 at Pune, Agrintex 2002 at Coimbatore, Pooram Exhibition at Thrissur, AHAARA Exhibition at New Delhi etc.
- A total number of 66,000 visitors utilized the facilities at Agricultural Technology Information Centre during this period. The list of users include farmers, extension officials, scientists and students (from school level to college level).
- Total revenue from the sale of technological services, products and publications during this period was Rs. 6.56 lakhs. The sales include 37,000 areca seednuts, 11,000 coconut seedlings, 61,000 earthworms as well as nine arecanut dehuskers and two snowball tendernut machines. A total

number of 900 priced publications and 190 CDROMs were purchased by ATIC visitors.

- CPCRI is implementing IPGRI – COGENT sponsored project on “Developing sustainable coconut based income generating technologies in poor rural communities in India”. A three pronged strategy involving a) cultivation of suitable high yielding coconut varieties b) adoption of inter / mixed cropping and livestock production and c) production of high value coconut products is implemented in the selected coconut communities. Two coconut communities were selected to implement the project; viz, Pallikkara (Fig. 19) in Kasaragod District (representing West Coast region) and Ariyankuppam in Pondicherry State (representing East Coast region). Community Based Organisations were formed in the selected areas for implementing the interventions in coconut gardens with micro-credit system to assist the member farmers. Womens’ Self Help Groups also were organised in the communities for taking up selected coconut based income generating activities.



Fig. 19. Farmers meeting in Pallikkara village under COGENT / IPGRI project.

- Under the Institution Village Linkage Programme, verification trials on using the copra dryer indicated that clear and pure copra, free of dust particles and fungus could be made available in a shorter period of time, which fetched a higher market price. The improved sickle (Nandi model from Central Institute of Agricultural Engineering, Bhopal) was perceived to be

more efficient and women labourers felt less drudgery and risk.

Kudumbashree Unit

- Kudumbashree Unit was inaugurated at Madikai Panchayat of Kasaragod by the Director (Fig. 20) by releasing the “Nutrimix” prepared by the unit, under guidance of womens cell of KVK, CPCRI for distribution through Anganwadis.



Fig. 20. Dr. V Rajagopal, Director inaugurating the Noonhiyl Kudumbashree unit and release of Nutrimix.

Economics and Statistics

- Price spread analysis of arecanut (chali supari) undertaken in Dakshina Kannada District revealed that there were four predominant marketing channels in the arecanut trade. Producer’s share in consumer price was the highest in the channel-4 where co-operative society markets the produce through it’s own sales depot at major consuming centers. The producer’s share in consumer price was found to be lowest for channel-3, which is the longest marketing channel with six levels of market functionaries.
- A field survey was conducted at Kannur district among 100 coconut holdings located in seven panchayats selected through simple random sampling to study the economic analysis of coconut based farming systems. Combinations of coconut, arecanut, pepper, banana with or without animal husbandry were the predominantly existing coconut based farming cropping systems. Net returns from different CBFS models widely varied from Rs. 20,000 to Rs.60, 000/ha

depending upon the planting density of the inter/mixed crop and availability of irrigation facilities in the garden. The realized net returns proved the economic worthiness of investment in crops like pepper, banana, and arecanut and others such as dairy enterprise.

- A semiparametric regression model with treatment effects as parametric component and the positional effect (covariate) as nonparametric component was considered for the field experiments. The proposed spatial technique was applied to analyse the data of irrigation cum fertilizer trial of cocoa + areca mixed cropping system. It was observed that the proposed method is comparatively better than the traditional method for comparing the treatments.
- Input use efficiency in coconut cultivation in Kerala State varied among different coconut growing zones in the State. Application of manures (organic and inorganic) had a decisive role in productivity in Ernakulam and Thiruvananthapuram districts while the effect was less evident in Kozhikode district. In all the districts, the palm density showed a significant negative association with yield.

In Ernakulam district, the combined effect of manures (organic + inorganic) was very much prominent on the yield, substantiating the relevance of manurial recommendations for root(wilt) disease management by CPCRI. Even under rainfed situations, organic manure application had favourable effect on yield in Ernakulam and Thiruvananthapuram districts. Irrespective of irrigation status, application of chemical fertilizers resulted in higher yields. The effect of irrigation on yield was more visible in Thiruvananthapuram district when compared to other two districts.

- "e-Manual on coconut cultivation" CD-ROM was developed and released on October 30, 2002. This CD includes coconut scenario, varieties and hybrids, planting material, garden establishment, garden management, integrated pest management, integrated disease management, harvest & post harvest technology, economic aspects of coconut cultivation and research and development. This information is displayed in two panes, the left pane shows content and the right pane shows details with photograph(s). It provides easy navigation from page to page.

KRISHI VIGYAN KENDRAS

KVK at Kasaragod

- KVK had organized a total of 79 training programmes for the benefit of 1952 personnel comprising of practicing farmers, rural youth, women and extension functionaries. Out of which, 51 were on-campus and 28 off-campus training programmes with the participation of 1158 men and 794 women in different disciplines viz., crop science, horticulture, home science, agricultural engineering, animal science and agricultural extension. Further, eight training programmes were conducted with the collaboration of District Panchayat and Integrated Waste Land Development Programme (IWDP), Kasaragod (Fig. 21)

and trained 306 members of watershed committees and water shed associations belonging to eight Panchayats in Kasaragod district.



Fig 21. Inauguration of training programme on IWDP

- Impact analysis of training programme on vanilla cultivation had significantly

increased the knowledge level of the farmers on this cash crop. Statistical analysis indicated that the maximum participants were under medium knowledge gained category (53.33%) followed by high (24.45%) and low categories (22.22%).

- Frontline demonstrations were conducted for introducing improved varieties of rice, cowpea, bhendi and cucumber crops in Shenry Village (Fig. 22). Improved rice variety Athira (5.50 t/ha) performed better than Karuna variety (5.12 t/ha) and Local (4.40 t/ha). The high yielding varieties viz., Vyjayanthi (Cowpea), Anakombu (Bhendi), Arunima (Cucumber) performed better with the yield of 9.3 t/ha, 9.3 t/ha and 16.7 t/ha than the respective local varieties with 8.6 t/ha, 8.1 t/ha and 14 t/ha, respectively.



Fig 22. FLD site at Shenry village showing the performance of rice varieties

- On farm trials were conducted on performance of pheromone traps against coconut black beetle (*Oryctes rhinoceros*) in coconut. Observations indicated that 744 beetles (455 males & 289 females) were trapped by three pheromone traps over a period of one year as compared to 29 beetles in farmers' practice (Ground nut oil cake traps). Management of inflorescence die back in arecanut by spraying Zineb followed by Ovis (75%) and Mancozeb (60%) resulted in 80% reduction in button shedding from bunches.
- Organized scientists' field visits to IVLP villages and successful farmers/entrepreneurs (Fig. 23) in 11 Panchayats

covering 17 villages viz., Pady, Edneer, Nekraje, Kunnumkai, Vellarikundu, Kannur, Angadimugar, Neerchal, Ednad, Ananthapura, Manjeshwar, Miyapadavu, Yethadka, Padre, Madhur, Mujangavu and Kuntar.



Fig 23. Scientists visiting the vermicomposting unit started by Sri. Josheph Mathew, Kunnamkai.

KVK at Kayangulam

- **RZARS - KVK, CPCRI, Kayangulam** conducted 110 trainings during this year. A total of 2522 trainees participated, out of which 1804 were women and 698 men. Trainings were conducted under different disciplines such as agronomy, horticulture, plant protection, extension, animal husbandry, home science, fisheries and on vocational subjects.
- The impact of the training programmes were measured in terms of adoption of the practices (23- 97%) and success stories established by individuals and groups. The success stories included coconut product diversification, mushroom cultivation, food processing, composting, establishment of nurseries, horticulture crops etc. Introduction of bee keeping as well as intercropping with vanilla/medicinal plants in coconut gardens etc, were some of the initiatives of this KVK.
- The OFTs/FLDs conducted during 2002-03 convinced the farmers on the use of naphthalene balls placed around spindle leaf of coconut to repel rhinoceros beetle, recycling of farm wastes through vermicomposting and soil solarization to prevent pest and disease attack in vegetable crops.



WOMEN EMPOWERMENT

- Training was imparted to 1393 women at KVK, Kasaragod and 1804 women at KVK, Kayangulam on different self supporting ventures through on/off campus training programmes.
- Women's self help group started a food processing unit at Madikai, Kasaragod after undergoing training at KVK, Kasaragod.
- Three women based micro-enterprises *viz*, Muralika - for food processing at Pathiyoor, Priyadarshni - for production of mushroom at Chettikulangara and Kudumbashree group for producing honey at Ala panchayat were started with the collaboration of KVK, CPCRI, Kayangulam.
- A Woman scientist was the recipient of Jawaharlal Nehru Award and two others were part of the group which won ICA Team Award during this year.
- A woman scientist/technical officer participated in National fair on "Women Scientist and Entrepreneurs and Shaping India's Biofuture" at Golden Jubilee Women's Biotech Park organised by M. Swaminathan Research Foundation, Chennai during 7-8 January 2003.
- Six women scientists and seven technical officers were deputed to undergo human resource development training in different fields.
- At the 'Empowerment of women through the intervention of Science and Technology' meeting organised by Swadeshi Science Movement, during 22 March 2003 at Kodaikanal, the Institute was represented by a woman scientist and technical officer.

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON PALMS

Coconut

Crop Improvement

- At Aliyarnagar, Arasampatty Tall (ALR-CN-1) (176nuts/palm); ECT (92.5), WCT (125.5) and MGD (163.1) were the promising accessions. At Jagadapur, a non-traditional area for coconut cultivation, the accessions Java, MOD and Gonthebilibi produced on an average 8 inflorescences per year. At Ratnagiri WCT x COD palms yielded 2.9 tonnes oil/ha followed by Philippines Ordinary (2.7 t/ha). At Aliyarnagar the average yield of promising hybrids planted during 1988 was 132.6 nuts/palm. In the maiden tract of Arsikere, the hybrids started yielding from seventh year onwards producing 61 to 75 nuts/palm.

Crop Production

- At, Aliyarnagar, Kahikuchi and Ratnagiri centres the hybrid palms have shown positive response to nitrogen application

with yields varying from 106 to 142 nuts/palm. At Arsikere and Kahikuchi centres second-generation Coconut Based Cropping System experiments were started.

- In drip irrigation cum fertilizer experiments at Aliyarnagar, drip irrigation (100%Eo) and basin irrigation (IW/CP ratio 1 at 40 cm depth) yielded 143 and 148 nuts/palm respectively. Life irrigation to palms resulted in yield of 72 nuts/palm/year. While basin irrigation produced better results at Ratnagiri, at Veppankulam drip irrigation (95 nuts/palm) was superior to basin irrigation (84 nuts/palm).
- In the INM experiment, at Aliyarnagar application of composted coir pith (50 kg/palm) and 25 kg composted coir pith + 5 kg recommended dose of chemical fertilizer recorded a mean yield of 146 and 145 nuts/palm/year. At Ambajipeta, palms recovering after cyclone damage have responded well to organics.



Crop Protection

- In the studies involving biocontrol agents for basal stem rot, *Trichoderma harzianum* was found to exhibit maximum suppression of *Ganoderma lucidum* (75%) and *G. applanatum* (72%). At Ambajipeta, pathogenicity of *Ganoderma applanatum* isolated from coconut to other palms i.e., arecanut and oil palm was established. During the year, the infestation percentage of *Opisina arenosella* in the Pollachi tract was low. Parasitisation by *B. hebator*, *G. nephantidis* and *T. pupivora* on *Opisina* had increased in this pest infested coconut gardens.

Oil palm

- At Gangavathi, the tenera hybrid 109D x

291P recorded highest mean FFB yield 11.47t/ha followed by 115D x 291P (8.3t/ha). At Gangavathi, palms receiving 400:200:900 g of fertilizers and receiving good irrigation have shown the potential to produce 15-22 t/FFB/ha. Eighteen accessions in Mulde (source: Guinea Bissau, Tanzania and Zambia) and nine accessions (Zambia and Tanzania) are under evaluation for drought.

Palmyrah

- During the year 26 villages of six mandals at Nellore district of Andhra Pradesh were surveyed and 49 accessions were collected in a joint survey involving TNAU and ANGRAU scientists.