

अनुसंधान विशेषताएँ

RESEARCH
HIGHLIGHTS
2004-05



केन्द्रीय रोपण फसल अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद्)
कासरगोड, केरल - 671124 भारत



CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

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Research Highlights

2004-2005



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Front : A view of the island eco-system

Back : Green belt which saved Nalluvethapathy village in Nagapattanam Dt. from
Tsunami waves.

Word processed by

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Hindi translation : Smt. K. Sreelatha

March 2005

Printed at

M/s Digantha Mudrana Ltd., Mangalore - 8 Ph. 0824 2212551

केंद्रीय रोपण फसल अनुसंधान संस्थान एवं अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के 14 केंद्रों के कृषि अनुसंधान मुख्यांश इस रिपोर्ट के अंतर्गत संस्थान के अधिदेश फसल जैसे नारियल, सुपारी, कोको की मुख्य उपलब्धियों का संक्षिप्त ब्यौरे में दिया गया है। इस संस्थान के 5 मुख्य अनुभाग जैसे : फसल सुधार, फसल उत्पादन, शरीरक्रिया विज्ञान, कटाई उपरान्त प्रौद्योगिकी, फसल संरक्षण एवं सामाजिक विज्ञान के अंतर्गत 11 बृहत परियोजनाएँ सम्मिलित है।

नारियल एवं सुपारी जननद्रव्यों के संग्रहण, संरक्षण सूचियांकन एवं मूल्यांकन का प्रयास फसल सुधार अनुभाग की ओर से किया गया है। 'मैक्रो साटलैट निशानों के विश्लेषण' परियोजना निष्कर्ष में है। फसल उत्पादन प्रभाग द्वारा दक्षिण केरल में नारियल के जड़मुर्झा रोग के लिए उच्छ घनता बहुजातीय सस्यन पद्धति मॉडल, पहाड़ी एवं द्वीप परिस्थिति में समीकृत सूत्रकृमि प्रबंधन प्रगति पर है। मिश्रित सस्यन प्रणाली में रोपण फसल प्रबंधन के लिए महत्वपूर्ण आंकड़े का संग्रहण किया गया है।

फसल संरक्षण द्वारा केरल में नारियल रोपण में गुठली पर संक्रमित एरियोफिड कीट पर अध्ययन नारियल के जड़मुर्झा रोग का सक्षम प्रतिरोध के लिए प्रजनन, नारियल ताड़ के कीट का जैव नियंत्रण एजेंट पर अनुसंधान, बिलकारी एवं मूल - गांठ सूत्रकृमि का जैविक नियंत्रण एवं शोधित फाइटोप्लास्मा का लसीय प्रतिक्रिया पर अध्ययन किया गया।

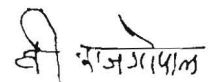
शरीर क्रिया विज्ञान, जैव रसायन एवं कटाई उपरान्त प्रौद्योगिकी अनुभाग द्वारा नारियल के मूल्य वर्धन एवं गुण सुधार के लिए विधायन का विकास, सस्य संसाधन विकेंद्र की स्थापना आदि मुख्य उपलब्धियाँ प्राप्त की गई है। ताड़ एवं कोको का उत्पादन एवं विपणन, सुधारित प्रजातियों का निर्धारण प्रभाव, आर्थिक विश्लेषण, नारियल, सुपारी एवं कोको में प्रौद्योगिकी हस्तांतरण कार्यक्रम, विस्तार अनुसंधान कार्यकर्ताओं एवं कृषकों का प्रशिक्षण आदि सामाजिक विज्ञान अनुभाग के महत्वपूर्ण कार्यक्रमों में प्रमुख हैं।

केंद्रीय रोपण फसल अनुसंधान संस्थान के कृषि विज्ञान केंद्र को प्रौद्योगिकी हस्तांतरण, संस्कार एवं प्रशिक्षण में उनके उत्कृष्ट योगदान के लिए 2002-03 द्वैवार्षिक अवधि का उत्तम कृषि विज्ञान केंद्र पुरस्कार से सम्मानित किया गया।

अनुसंधान परियोजना की मुख्य क्षेत्रों के लिए बाहरी निधि स्रोत से दो करोड़ रुपये हमारे संस्थान को प्राप्त है। वैज्ञानिकों द्वारा आंध्र प्रदेश, केरल, पोंडिचेरी एवं तमिलनाडु राज्यों में सुनामी प्रकोप पीडा का विस्तृत सर्वेक्षण किया गया।

इस वर्ष की अवधि में केंद्रीय रोपण फसल अनुसंधान संस्थान के कर्मचारियों की तरफ से विभिन्न प्रौद्योगिकियों के विकसन में दी गई योगदान के लिए बधाइयाँ देना चाहता हूँ।

इस रिपोर्ट के प्रकाशन के लिए मैं अपने सहयोगियों को उन की मदद के लिए धन्यवाद देता हूँ।



(वी. राजगोपाल)

निदेशक

10.03.2005

कासरगोड़

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 Coordinated Research Project on Palms are summarised in this publication. There are 11 mega projects distributed under five major divisions viz., Crop Improvement, Crop Production, Production Physiology and Post Harvest Technology, Crop Protection and Social Sciences.

In crop improvement division, efforts were made on collection, conservation, cataloguing and evaluation of coconut and arecanut germplasm. Project on microsatellite marker analysis has come to a concluding state. In the crop production division, high density multi species cropping system model for coconut root (wilt) affected garden in southern Kerala, INM and integrated farming systems have been under progress under inland, hilly and island ecosystem. Mixed farming units have gathered significant data for sustainable plantation crop management.

In crop protection, studies were undertaken on nut infesting eriophyid mite in coconut plantations in Kerala, breeding for resistance/ tolerance to coconut root (wilt) disease, investigations on biocontrol agents of pests of coconut palm, studies on biological control of burrowing and root-knot nematodes, serological reactions of purified phytoplasma.

In physiology, biochemistry and post harvest technology division, development of process for value addition and quality improvement of coconut and establishment of agro processing center were the major achievements. Production and marketing aspects of palms and cocoa, impact assessment of improved varieties, economic analysis, transfer of technology programmes in coconut, arecanut and cocoa and training of extension and research workers and farmers are the significant programmes in social sciences division.

The Krishi Vigyan Kendra of CPCRI at Kasaragod has bagged the Best KVK Award for the Biennium 2002-2003 for the outstanding contribution in transfer of technology, refinement and training.

This year our Institute could obtain external source of funding for major areas of research projects to the tune of rupees two crores. Scientists have conducted detailed survey of the tsunami affected districts of Andhra Pradesh, Kerala, Pondicherry and Tamil Nadu and prepared the strategies for restoration of coastal agro-eco system.

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.


(V. RAJAGOPAL)
Director

10-03-2005
Kasaragod

CROP IMPROVEMENT

Collection, conservation, cataloguing and evaluation of coconut germplasm

- Under the NATP/PB project, germplasm exploration trips were conducted to Karnataka, Kerala, Goa, Maharashtra and Tamil Nadu for documentation of the germplasm of these regions.
- Nine distinct types were collected from Tiptur and Arasikere taluks of Karnataka. Of these, two accessions, viz., Uddha Gangapani (Fig. 1) and Chitta Gangapani (Fig. 2) are two tender nut varieties of the region.

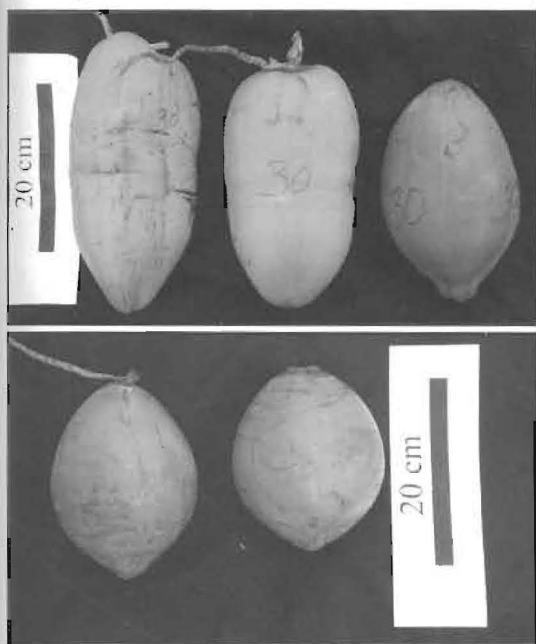


Fig. 1. Germplasm collected from Karnataka

- A germplasm collecting trip was undertaken to Guruvayoor for collecting seednuts from typical COD/CGD palms.
- A total of 1132 seedlings in 87 accessions collected from Bangladesh, Sri Lanka,

Indian Ocean Islands, WCGC (Pacific Ocean collection), Andaman and Nicobar Islands and Maharashtra were planted in the field gene bank for conservation and evaluation.

Genetical investigations and breeding for high yield in coconut

- For production of commercial hybrids and varieties, 10948 female flowers were pollinated during the year. A total of 7553 seednuts of hybrids were sown in the nursery for raising seedlings for distribution to the farmers.

Collection, conservation, cataloguing and evaluation of arecanut germplasm

- Seventy one arecanut accessions were planted for evaluation in sub Himalayan Terai region of West Bengal in different phases. In 1988 batch planting all the accessions (15) produced flowers. Maximum number of nuts/palm (280) was produced by Mohitnagar variety with a fresh nut weight of 16.8 kg/palm/yr.
- All the palms planted in 1990 are in bearing stage. VTL-21 produced maximum number of nuts per palm (442.25) from three number of productive inflorescences whereas, maximum nut yield was recorded in VTL-29(a) (8.75 kg/palm/yr).
- In palms planted in 1992, maximum number of nuts were collected from the accession VTL-18(a) (120) with a fresh nut weight of 7.22 kg.
- The performance of the accessions collected from NE States is better than those collected from other places.



Maximum nuts/palm was recorded in accession from K & J Hills (456.0) but the maximum fresh nut weight/palm/yr was recorded in Chhaygaon accessions (21.1 kg).

Evaluation of coconut varieties in Sub-Himalayan Terai region of West Bengal

- Among the 31 varieties, maximum germination was recorded in Andaman Rangoochan (96.7%) and minimum in Malayan yellow dwarf (MYD) (23.3%).

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

- The CGD X WCT hybrid, planted during

1991, have given a cumulative yield of 71 nuts/palm/year. Sixty five percent of hybrids recorded the incidence of root (wilt) disease.

- Five dwarf varieties of coconut planted at CDB farm Neriamaangalam, during 1993 were evaluated for resistance to root (wilt) disease and yield. Among the dwarf varieties, Malayan Green Dwarf gave the maximum copra yield.
- A total of 6344 artificially pollinated seedlings have been planted so far, for establishing the above five nucleus seed gardens.

CROP PRODUCTION

Management of palm based cropping for sustained productivity under coastal ecosystem

- In the HDMSCS experiment at Hill block the inter crop yields were as follows: banana 2.66 kg/bunch, black pepper 1.25 kg/stand and pineapple 1.03 kg/fruit. The estimated total income ranged from Rs 1,97,846/ha in coconut-black pepper-banana to Rs 1,72,089/ha in coconut-black pepper-banana-pineapple.
- Sustainability of yield in the coconut was estimated by quantifying yield variation over the year. It was observed that the control treatment came closer to other treatments after organic recycling. There was decrease in amplitude after the introduction of organic recycling in the normalized sequence.
- Earthworm activities in the cropping system was estimated. Earthworm population was significantly more in cropping system when compared to

monocrop. It was observed that clove soils had numerically higher number of worms compared to coconut and banana soils. Inter space of the monocrop coconut had the minimum number of earthworms in soil.

High density multi species cropping system model for coconut root (wilt) affected garden

- In the coconut based high density multi-species cropping system involving coconut, nutmeg, pepper, banana, pineapple and vanilla established in 1.0 ha area of coconut root (wilt) affected garden at CPCRI (RS), Kayangulam, the average nut yield of coconut during the year under the system was 65 nuts per palm per year.
- The recyclable biomass obtained per year from the system was: Coconut: 14,600 kg, Banana: 7,122 kg, Nutmeg: 63 kg and Weeds: 3,080 kg. Available waste is being converted into vermicompost and recycled in the system.

- The variable cost of production involved in maintaining one ha of above system during the year 2003-2004 was Rs. 32,455/- and the gross return obtained from the system was Rs. 74,022/- per ha and the net return was Rs. 41,567/-. The gross income obtained from component crops was Rs. 28,595/- during the year.

Feasibility studies of growing intercrops in coconut under coastal littoral sandy soils

- Preliminary results revealed that hybrid napier X bajra Grass (Co 3) and pumpkin can be successfully grown in littoral sandy soils with soil and water conservation measures viz., one layer of husk burial and 5 cm of coir pith application in the rooting zone.



Fig. 2. Intercropping with pumpkin and fodder

Plantation based integrated farming systems under island conditions

- All the six locally produced hybrid

combinations at Minicoy, Lakshadweep continued to maintain their high yield potential over their parents as well as introduced hybrids/cultivars. The hybrid combination LCOT x LCGD continued to maintain its high yield level over the other combinations with 208 nuts/palm/year. The maximum copra content was recorded in LCOD x LCOT hybrid (180 g/nut).

- Crops such as beetroot, radish, turmeric and onion were tried and found suitable for cultivation under island conditions.

Intercropping of horticultural crops in plantation based cropping system for NE region

- Different summer vegetables were tested in arecanut shade as well as open condition. The performance of basella (19.2 t/ha) and snake gourd (5.14 t/ha) were better in shade condition rather than in open condition in terms of yield (12.63 t/ha and 3.69 t/ha, respectively). Performance of ridge gourd was almost similar in both the conditions. Other summer vegetables like pumpkin, ash gourd, bottle gourd, bitter gourd, okra fared better in open condition.

Performance of wilt tolerant pepper lines in areca garden under sub Himalayan Terai region

- Among the fourteen black pepper accessions planted in areca garden to find out the tolerance against *Phytophthora* rot and the growth performance, performance of Karimunda was the best, followed by Panchami and P-24. Maximum vine length and lateral shoots were recorded in Karimunda and P-24. Few vines came to flowering in three years age and maximum number of spikes were recorded in Karimunda (72/ vine), while number of spikes were low in Panchami (23/ vines)



and P-24 (16/ vines). So far there was no disease incidence during the year in all the vines.

Analysis and development of homestead farms of Kerala- A farmer participatory approach

- The salient achievements of the project revealed that there was significant increase in the cropping intensity and resource use efficiency in various homestead farms. This also helped the farmers to realize more yield and economic returns. The increase in base crop yield i.e. coconut ranged from 35 to 60 % in Kasaragod; 23 to 55 % in Kannur, 25 to 65 % in Kozhikode and 11 to 49% in Malappuram districts during the project period. The vermicompost unit installed in various homesteads provided an opportunity to effectively recycle the biomass and helped the farmers to reduce the cost of cultivation on account of purchase of chemical fertilizers. The average quantity of vermicompost produced ranged from 2,165 kg (Kannur) to 3,975 kg (Malappuram). Soil and water conservation measures undertaken in some of the homesteads helped to conserve these valuable resources in a more effective manner. Various interventions also generated more employment opportunities (on an average 53 days/year for all the homesteads together) not only for the farm family (especially for production of vermicompost and use of coconut dryer), but also for hired labour. The coconut dryers supplied to five farmers helped them to dry their coconuts in an efficient way and to fetch better income, which ranged from Rs.10,000 to Rs.18,000. Need based integration of various enterprises in a single unit resulted in cost reduction, higher production, larger

profits, more employment generation and availability of better food.

Development of low cost composting techniques for plantation wastes and evaluating the effect of compost on sustained productivity of coconut and arecanut.

- The favourable conditions for carrying out vermicomposting of coconut leaves by *Eudrilus* sp. was found to be monsoon and post monsoon seasons, while during summer and pre-monsoon periods, it was noted that the increase in temperature and lower relative humidity had affected the vermicomposting capacity of worms. Studies conducted from 2002-2004 demonstrated that at 28-32°C temperature and relative humidity of the range 90-95% the worms were able to produce 65-70% matured vermicompost besides the worms themselves multiplying 4 to 5 times their initial numbers. However, increase in temperature above 32°C and fall in the relative humidity below 80% significantly affected the vermicomposting as well as reproducing capacity of the *Eudrilus* sp. Farmers can earn upto 50% more if they produce vermicompost during the favourable periods.
- For the dissemination of vermicomposting technology, a total of 1.62 lakh earthworms and 2.5 tonnes of vermicompost were distributed to the farmers during this year.
- The effectiveness of poultry manure amendment to compost coir pith has been successfully demonstrated. The composted coir pith (CCP) had a favourable C:N ratio and higher content of macro and micronutrients when compared to the base material. The effect of CCP application to enhance the plant



growth and nodulation has been demonstrated in a green house study using cowpea as test plant.

- Microbial analysis of freshly collected vermiwash revealed that it contained higher bacterial load than fungal population.

Allelopathic studies in coconut based cropping system

- The green house studies conducted to evaluate the effect of coconut root and leaf leachates on growth and rhizosphere microbial activities of pepper and nutmeg revealed a mutually different response from these two crops. Pepper revealed higher intrinsic ability to withstand the allelopathic effects of the leachates flowing from coconut leaves and roots. This could be owing to its growing habitat being the basin of the coconut palm itself, where the soil system would have very well adjusted to the leachates allowing the pepper to adapt well in this condition. On the other hand, nutmeg was considerably dependent upon the activity of the microflora of bulk soil

which possibly modulated the negative effects of the leachates whereby allowing the plants to grow.

- Applying vermiwash improved the fresh biomass yield of green-manure cowpea to the tune of 36%, cob yield of maize by 5-10% and bhendi yield by 21.6 to 33% when compared to irrigation with water. In addition to enhancing the crop growth and yield attributes, vermiwash also acted as stimulant to soil as it improved population of soil microflora besides suppressing the nematode population.

Development of linear spectral reflectance model for identification of root (wilt) disease affected coconut palms using remote sensing and GIS

- GA technique was developed for the parameter fine tuning for sub pixel classification by back scattering technique. In the limited area i.e. 20 X 20 pixel window the estimated sub pixel classification accuracy was 92% for the coconut root (wilt) affected palms.

CROP PROTECTION

Studies on nut infesting Eriophyid mite in coconut plantations in Kerala

- Root feeding of azadirachtin 5 percent at 7.5 ml per palm and azadirachtin 1 percent at 10 ml per palm was found effective for management of coconut eriophyid mite. These botanicals are to be administered at a dilution of 1 : 1 ratio with water. Survey on current incidence of mite in various districts revealed a remarkable reduction in the pest incidence with less than 10 percent of harvested nuts showing index score of 5 (i.e., Puny nuts).

Investigations on biocontrol agents of pests of coconut palm

- Honey feeding throughout the life span of adult while mass multiplication of *Goniozus nephantidis* in the laboratory enhanced progeny production and longevity.

Studies on biological control of burrowing and root-knot nematodes

- The bio-control agents, *Paecilomyces lilacinus* and *Verticillium chlamydosporium* were maintained in the lab on PDA. The endospore forming bacteria, *Pasteuria penetrans* (three



isolates) were maintained on coleus and black pepper in the green house.

- Final observations on the interaction for arecanut, experiment were taken. There were Ten treatments (T1- Control, T2- *R. similis* (N), T3- *P. penetrans* (Pp), T4- *V. chlamydosporium* (V), T5-N+V, T6-N + Pp, T7-N+V+Pp, T8- Pp+N, T9-V+N, T10-V+Pp+N). The results showed that maximum nematode population and root lesion index was noticed in T2 where burrowing nematode was inoculated and the plants were not protected with bio control agents. Among the treatment that received nematode inoculum the total nematode population was lowest in T7 where the biocontrol agents, *Verticillium* and *P. penetrans* protected the plants.

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

- Influence of consortium of antagonistic organisms, *Bacillus subtilis* and *Pseudomonas fluorescens*, in the field management of coconut leaf rot disease in an eco-friendly manner could be achieved.
- Coconut water from mature nuts of WCT and COD was found to be highly suitable liquid medium for growing bacterial antagonists (*B. subtilis* and *P. fluorescens*, independently and in combination).
- Coconut seed nuts have been found to accept the treatment of the bioagents (*B. subtilis* and *P. fluorescens*, independently and in combination), by way of pre-sowing bio-priming, in their germination and establishment.

Characterization of Phytoplasma associated with palm diseases

Serological reactions of purified phytoplasma

- The Percoll-purified phytoplasma preparation from root (wilt) diseased

coconut palm and similar preparation from healthy coconut palm were tested for serological reaction with disease-specific and phytoplasma-specific polyclonal antisera by agar double diffusion test. Undiluted phytoplasma preparations and antisera were used for testing. The phytoplasma-specific polyclonal antiserum strongly reacted with phytoplasma preparation made from root (wilt) diseased coconut palms. However, the disease-specific polyclonal antiserum showed only weak serological reaction with phytoplasma preparation made from diseased coconut palms. The preparation made from healthy coconut palms did not show serological reaction with both the polyclonal antisera.

Isoenzyme pattern of coconut

- Polyphenol oxidase isoenzyme profiles of coconut in relation to resistance to root (wilt) disease of eight cultivars viz. CGD, MGD (highly resistant), MOD, MYD (moderately resistant), COD, CGD X WCT, COD X WCT (moderately susceptible) and WCT (highly susceptible) were studied. Three staining zones were observed in cultivars like CGD, MGD, MOD, MYD, COD, and CGD X WCT, which showed more number of bands. But the second (middle) zone was lightly stained in cultivars like MYD, COD and CGD X WCT. The third staining zone (fast migrating bands) was totally absent in cultivars like COD X WCT and WCT, which showed only three isoenzyme bands.

Bioecology and management of coreid bug *Paradasynus rostratus* Dist. affecting coconut palm

- *Annona* sp. and neem were recorded as alternate hosts for coreid bug. Peak population of coreid in the field is during post monsoon months viz.. October - November. COD and King coconut were least susceptible to coreid attack.

PLANT PHYSIOLOGY**Estimation and analysis of coconut kernel oil**

- In the study of nutrients in coconut kernel and nut water from WCT x COD, LCT, COD and GBGD at different maturities - 7, 8, 9, 10 and 12 months after fertilization and seasons of fertilization - postmonsoon, premonsoon and monsoon, the following trends emerged. In both kernel and nut water lauric acid (C12:0) formed the major fraction of the total fatty acid content. In the kernel, the short to medium chain fatty acids (C8:0, C10:0, C12:0) increased with nut maturity, while the long chain fatty acids (C14:0, C16:0, C16:1, C18:0, C18:1, C18:2, C18:3, C20:0, C22:0, C22:1 and C24:0) decreased with nut maturity. The essential fatty acids linoleic and linolenic acids (C18:2 and C18:3 respectively) were in greater concentration in tender nuts. In the nut water generally very little fatty acids were detected, especially in the tender stage. There were significantly greater amounts of vitamin C in the nut water compared to kernel, which increased up to the 9th month after fertilization after which it decreased; in the kernel also, vitamin C decreased with maturity. In the nut water total protein content decreased with nut maturity. The free amino acid pool in the nut water and kernel increased with maturity up to the 9th month after fertilization. The total sugars and reducing sugars in nut water and kernel increased with nut maturity. The kernel starch content increased up to the 10th month. The kernel dietary fiber content increased with nut maturity.
- All the available and yielding coconut cultivars and hybrids (160 cultivars/hybrid) in India under different agro-climatic zones Kidu (Karnataka), Ratnagiri

(Maharashtra), Veppankulum (TN), Ambajipeta (AP), Kasaragod (Kerala), Mandouri (WB) and Arsikere (Karnataka), Konark (Orissa), Aliyar nagar (TN), Kahikuchi (Assam), Mohitnagar (WB) and Jagadapur (Chattisgarh) were characterized for copra content, oil percentage and fatty acid profile in different seasons.

- The relationship between copra and oil concentration had seasonal variations with possible implication in germplasm evaluation for copra yields. The copra yield/nut varied with cultivar, season and location.
- Variations in fatty acid profile were observed depending on the cultivar and season apart from differences due to agro-climatic zones indicating the environmental impact to certain extent, even though it is a highly conserved character. The variation found in Lauric acid concentration, a major fatty acid in coconut oil, is from 41% to 53%.
- For the first time traces of new long chain fatty acids were detected, which were erstwhile not reported in coconut oil.
- The fatty acid profile in kernel during the development of maturity indicated that the concentration and content of Lauric acid increased rapidly with maturity from 6th month to 10th month. But the concentrations of myristic acid remain more or less same during the nut development, even though its content increased. The concentrations of long chain fatty acids (C14 to C24) are high in 6 month-old nuts. But with nut development their concentration decreased. Seasonal variations were also observed.

■ Abiotic stress like water stress in rainfed palms adversely affected the copra yields, however, oil percentage was high in these nuts compared to those in irrigated palms. The profile of long chain fatty acids also varied due to rainfed and irrigated

condition. Biotic stress like eryiophid mite infestation decreased the oil concentration in copra. The results indicated that the fatty acid composition of coconut oil, even though a conservative character, is variable with cultivar, season and location.

POST HARVEST TECHNOLOGY

Development of process for value addition and quality improvement of coconut

- Canning is an important, safe and economical method for preserving food if practiced properly. A process has been developed for bottling (canning) of the fresh kernel by using boiling water bath method. Acidity may be natural, as in most fruits, or added, as in pickled food. The pickling principle was used. The ratio of the covering liquid to kernel has been optimized as 1 : 1. Three different covering liquid mixer has been selected as best for increasing the shelf-life of fresh kernel to 3 and 5 months at storage temperature of 25 and 15° C respectively. The storage life of the fresh kernel can be further increased by actual canning of the kernel in the suitable cans.

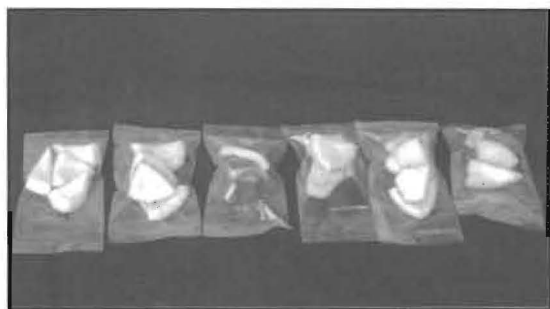


Fig. 3. Packaging fresh kernel for increasing shelf life

- A process has been developed for bottling (canning) of the fresh kernel paste by using boiling water bath method pickling principle

was used. The paste should be prepared from the gratings of the fully mature fresh coconut kernel. Two different preservative mixers were selected for the preservation of paste to extend the storage period of the paste to 3 and 5 months at storage temperature of 25 and 15° C respectively. Packaging of the kernel under the above treatment should be done under hygienic conditions to avoid initial contamination.

Agro processing center was established

- An agro processing center was established with installation of coconut and arecanut processing machineries such as manual and mechanical dehuskers, dryers, oil expeller, filter press, coconut splitting machine, shell removing machine, arecanut dehuskers and leaf cup making machine. Coconuts were dried in the copra dryers and oil was extracted from the copra regularly. During April 2004 to Jan. 2005, 4200 Kg. Copra, and 2600 Kg coconut oil were produced in the APC with a revenue generation of Rs. 1.75 lakhs. During the period, 1100 Kg coconut chips were produced earning Rs. 1.98 lakh. The total number of beneficiaries were 250. Technical know-how of 'coconut chips making' has been transferred to 25 entrepreneurs, technology of snowball tendernut to 7 entrepreneurs. Five batches of training was conducted for farmers on



product diversification of coconut. Training programme on drying of copra using copra dryers was also conducted to 15 Kudumbasree units (women empowerment programme.) The copra dryers developed by CPCRI has become very popular

among farmers. It was successfully demonstrated that the average income that could be generated from processing coconut to different end products was at least 25 to 30% more than the income by selling coconuts alone.

SOCIAL SCIENCES

- During the year, in addition to scheduled training programmes, a few special courses were organised for the benefit of extension personnel, farmers, and researchers.

Special training programme for SC/ST youth

- A special training programme for SC/ST youth on 'Value addition through product diversification in coconut', sponsored by Kerala State Development Corporation for SC/ST Limited was organised in two batches during January 18-22, 2005 and February 1-5, 2005 in which 20 youth from Kozhikode, Kannur and Kasaragod Districts attended.

NATP sub-project on Women Empowerment

- Under the NATP sub project on Women Empowerment, two training programmes on "Product diversification in coconut for higher income and employment opportunities for rural women" were organised in Kuttikol, Iriyanni and Devikulangara, in which 75 participants were imparted with technologies.

Training programme on value addition at Lakshadweep

- A demand based training programme on "Value addition technologies in coconut" was organized at Kavaratti in Lakshadweep on February 11, 2005 in collaboration with Department of

Agriculture, Lakshadweep Administration. About 100 farmers and extension officials participated in the programme.

Need based training programmes at Mohitnagar

- Seven training programmes on "arecanut cultivation" and "arecanut based farming system" were organized for the benefit of 178 farmers and field level extension workers.

Women Entrepreneurs -Scientists Interface programme

- A state level programme on "Women Entrepreneurs -Scientists Interface" was organised on 2nd September, 2004 at CPCRI, Kasaragod. The programme was conducted to facilitate interaction between scientists and representatives of women's self help groups functioning in rural areas on various aspects of income generation through the utilisation of technologies available for value addition in coconut. Demonstrations/skill training on value addition technologies were arranged as part of the programme. 200 members of women's self help groups from Malappuram, Kozhikode and Kasaragod Districts of Kerala State attended the programme.

Kisan Mela

- A Kisan Mela was organized at CPCRI Regional Station, Minicoy campus on February 12, 2005. About 300 farmers



(majority of them farm women) and extension officials attended the programme. The schedule of activities included brief inaugural session, Lecture and discussions on "Value addition technologies in coconut and coconut crop management", visit to exhibition and experimental fields, demonstrations on snowball tendernut preparation and vermicomposting and panel discussions.

Technology dissemination through newspapers, farm journals and radio

- 74 popular articles on different aspects of production, protection and processing of palms and cocoa written by the scientists of the Institute were published in newspapers and farm magazines.
- 19 Radio talks on different aspects of production, protection and processing of palms and cocoa by the scientists of the Institute were broadcast through AIR.
- Scientists participated in 14 television programmes which could enhance the popularity of CPCRI technologies
- A total number of 21 press releases on CPCRI technologies, achievements and activities were issued and were widely published in a number of newspapers.

Agricultural Technology Information Centre (ATIC)

- The total revenue from the sale of technological services, products and publications during this period was Rs.5,41,270/-.

Follow-up action by demonstration farmers

- Follow up studies on the NATP three year demonstration on integrated root (wilt) management practices in Krishnapuram/

Kayamkulam area. The study indicated that 39.2% of the farmers continued to adopt the recommended practices even after the free input supply facility was withdrawn. Analysis revealed that 39.2% respondents gained knowledge and adopted the technology, 50.6% had gained knowledge and 10.2% could not grasp anything.

Poverty reduction programme

- CPCRI had successfully implemented a poverty reduction programme sponsored by IPGRI/COGENT entitled "Developing sustainable coconut based income generating technologies in poor rural communities" in two coconut communities viz., Ariyankuppam (East Coast) and Pallikkara (West Coast) during 2002-04. The salient results obtained in this project are as follows:

Ariyankuppam Community

- The members of Ariyankuppam Commune Coconut Farmers Association (ACCFA) had realized additional net return through intercropping of cereals and vegetables in coconut gardens. The same had ranged from Rs.4000/- per ha in the case of coconut + ragi to Rs.30000/- per ha in the case of coconut + fodder grass. In the case of animal husbandry based interventions, the net returns realized from poultry (layers) ranges widely from Rs.1000/- to Rs. 7000/- per year depending upon the number of birds maintained and the average realized net return was Rs.3360/- per year for layers. The society could also earn a profit of Rs.1000/- through the sale of Snow ball Tender Nut and Rs.6700/- through the sale of coconut chips. ACCFA had produced and distributed 1800 coconut seedlings to the members and non



members in their villages and earned a profit of Rs.9000/- per year through this process.

Pallikkara Community

- Pallikara Community Coconut Development Centre (PCCDC) had raised and sold a total number of 3137 seedlings during the period 2003-05 representing various eco-types/diversity materials.
- Production and marketing of Coconut Chips is being undertaken by the women's self help group functioning under the project with the support of Kudumbasree, the poverty alleviation project of the state government. Production cost of the chips is worked out as Rs. 6.00. Retail price of the coconut chips of 50 gm packet is fixed as Rs. 10.00. Members were trained on the production of snow ball tender nut. Necessary official procedures for the permission to install the snow ball tender nut machine in the premises of Bekal fort, the nearby tourist spot is completed. Wooden structure to house the machinery is being built utilizing the additional seed money provided. Members were trained on the production of Vermi compost from coconut garden waste. Production and marketing of Vermi compost from coconut garden waste is being undertaken by the women's self help group functioning under the project with the support of Kudumbasree, the poverty alleviation project of the state government. A small holder's copra dryer has been installed. Production and marketing of copra is being undertaken by the women's self help group functioning under the project with the support of Kudumbasree, the poverty alleviation project of the state government. Coconuts are being procured from the members of the CBO. Production of

Coconut candies is also in progress and is being sold in the market for Rs 40/- per kg.

Household food and nutritional security for tribal, backward and hilly areas at Mohit Nagar

- MS medium with BAP 3ppm 1-1 was better for multiplication of ginger cv. Garubathan.
- Local weed as mulching materials over arecanut basin was best for maximum water conservation.
- Application of Trichoderma culture and Bordeaux mixture (1%) were best for control of Phytophthora foot rot of black pepper.
- Areca based cropping system has been accepted by the farming community at different locations of North Bengal.

Technology assessment in farmers' fields

- The block demonstrations conducted at farmers' fields on use of copra dryers for quality drying of copra indicated that it is technically feasible and economically viable for using copra dryers on group basis by the farmers for high quality copra production. Clear and pure copra, free of dust particles and microorganisms & fungus could be made available in a shorter time (by 11 hours for drying 400 coconuts as compared to conventional method) and the same had fetched a higher market price (Rs. 385/- more for 400 coconuts as compared to conventional method). The copra dryer was highly useful during the monsoon season.
- An On Farm Trial on assessing the performance of sweet potato varieties in mid land rainfed conditions indicated that

Sree Bhadra (21 t/ha) performed better than the local variety (15 t/ha) and an additional net return of Rs.14900/- per ha was realized.



Fig. 4. Director, CPCRI handing over copra dryer to self help group

- A comparison between the performance of Gramalakshmi and Desi birds reared under similar backyard conditions of village households showed that the Gramalakshmi birds started laying eggs at an earlier age (27 weeks), when compared to the Desi birds, which matured only at an average of 33 weeks. The average weight gain of the Gramalakshmi birds was satisfactory even under the backyard conditions of rearing and poor feeding. Despite the average weight gain, these birds were found to be excellent layers, with better feed efficiency, having an average clutch size of 22 and comparatively lesser inter clutch interval. The number of pauses and the duration of broody days were lesser among the Gramalakshmi. Their eggs weighed 55.3 gm while that of the Desi birds weighed 48.7 gms. Many Desi birds succumbed to diseases to which the Gramalakshmi birds were found to be resistant. Increased susceptibility to predator attacks was the only constraint in rearing Gramalakshmi birds under backyard conditions.

- An On Farm Trial on assessing the

performance of high yielding rice varieties indicated that the average grain yield obtained from Harsha variety (4.25 t/ha) was higher than the other old varieties (3.30 t/ha). The farmers could get an additional net return of Rs.4700/- per ha by cultivating Harsha variety.

Impact assessment of improved arecanut varieties in Karnataka

- Among the inputs, organic manure was the most influencing item determining the incremental yield. But the marginal value productivity was more for the plant protection. This is because; the expenses on plant protection were less in comparison with other inputs. The highest percentage of released arecanut varieties was observed in the holding group of 1-2 acres (35%) followed by 2-5 acres holding group (31.7%). It was seen that more than 80 percentage palms under the age group up to five years were under improved varieties. The percentage share found reduced to 40% for the palms aged more than 10 years. The result shows, of late especially from 1996 onwards the percentage of planting under improved varieties have increased drastically. This can be very well related to the attractive arecanut prices during the period.

Impact analysis of coconut production technologies

- Study on impact of coconut production technologies under farmer's field conditions in four districts of Tamil Nadu indicated that the technology change between low and high adopters was in favour of irrigation, from which one could conclude that availability of irrigation facilities is the primary factor which has major impact on technology adoption for coconut in Tamil Nadu. Tamil Nadu, being a drought prone state, long term strategic measures on drought management and



water management needs to be implemented by the development agencies.

Price forecasting for coconut

- Secondary data on wholesale prices of coconut and its products for the period 1970 to 2003 were analyzed for observing the trend in their growth rates. It was inferred that the Compound Growth Rate (%) was the best fit. The average annual CGR (%) was estimated as 11.79. Segregated analysis indicated that the CGR (%) for the period 1980 to 2003 was 10.29 and for the same for the period 1990 to 2003 was 9.59%. The forecasted demand for 2020 AD is Rs. 14320/- for 1000 nuts. During the same period, the forecasted domestic consumption is 23988 million nuts per year.

Yield loss due to stem bleeding disease of coconut

- Field survey was conducted to estimate the incidence of stem bleeding disease in coconut. The disease affected palms were classified based on the index score. It was found that 60% of the affected palms are in the early stage of disease (with value of index less than 1). In 36% palms, the index ranged from 1 to 50. Only 4% palms were showing a disease index of more than 50. This clearly indicates that palms are lost from the population on advancement of the disease.

Integrated National Agricultural Resources Information System

- Area and production data (All India, State

wise and District wise) was populated for the crops coconut, arecanut, cashew and cocoa. World (country wise and total) area and production for coconut, arecanut, cashew, cocoa, oil palm, rubber and tea was also populated into the designed table. Import and Export data of agro products of coconut, arecanut, cashew, cocoa, coffee, rubber and tea was populated. Price data for different agro products of coconut and arecanut at different markets (Kerala, Karnataka and Tamil Nadu) was included in the data base.

- The Agro techniques database includes general information on crops, cultivars & hybrids, crop production, crop protection and post harvest technology. Information pertaining to agro techniques recommended by the ICAR institutes and also by the State Departments of Kerala, Tamil Nadu, Karnataka (two regions), Andhra Pradesh and Goa were populated. Large number of images on agro techniques was provided in the data base so that the information provided is self explanatory and thereby enhancing the scope of the database for new applications such as cyber extension etc.
- The plantation crops information system (web site) was created on Linux platform. The pages are connected by hyperlinks and are written in an Internet standard code PHP and the database resides in PostgreSQL. The website was hosted from the institute web server and is accessible by connecting to <http://cpcri.ker.nic.in/inarisweb/welcome.htm>.

KRISHI VIGYAN KENDRAS

Kasaragod

- The Krishi Vigyan Kendra of CPCRI at Kasaragod has bagged the Best KVK Award for the Biennium 2002-2003 for the outstanding contribution in transfer of technology, refinement and training.
- KVK of CPCRI at Kasaragod has organised a total of 117 training courses for the benefit of 3177 personnel comprising 1024 male and 2153 female. Out of these training courses, 47 are on-campus and 70 are off-campus which benefited 928 (313



male and 615 female) and 2249 (711 male and 1538 female) participants respectively. The sex ratio regarding participation in training programmes showed that women participants outnumbered men (1024 male and 2153 female).

- Extension methodology developed : KVK has developed a concept of empowering trainee-farmers as resource experts. In this concept, KVK faculty act as facilitators to diffuse the technology through identified trainee-farmers in terms of knowledge and skills as well as to provide critical inputs. (nucleus culture of earth worms) to more farm holdings in a short time. This concept involves mainly two principles : (a) Making trainee-farmers as resource experts by building confidence and competence through scientists-farmers interaction (b) Facilitating door step delivery of technology and inputs through farmer-farmer interaction.
- The concept of trainee-farmers as resource experts is being implemented by the KVK during the last 3 years. A total number of 20 trainees were identified @ 5 each from four blocks of Kasaragod district and were nominated as contact farmers. Technical guidance was extended to these trainee-farmers by the KVK faculty for establishing vermicomposting units in their farms. Regular monitoring and supervision were carried out by the faculty through field visits and help-line services for about one year. Having gained experience in both knowledge and skills, the contact farmers were recognized as resource personnel and their vermicomposting units served as demonstration units for both institutional and off campus trainees of KVK. The technology is being popularized by the contact farmers through teaching and supply of earth worms to the neighbouring farmers.
- Further, the primary trainee-farmers could

identify and train 60 farmers as second level of trainee-farmers who could act as resource experts. This would be a continuous process resulting in high rate of technology spread.

- Benefits derived by the primary trainee-farmers : On an average, 40 t of vermicompost was produced by the 20 identified trainee-farmers in their own farms within a short span of three years by utilizing 64 t of waste biomass there by saving around Rs.10,000/- which they would have spend on inorganic fertilizers. A total of 1,60,000/- earth worms @ 30 paise per worm were sold to fellow farmers as a critical input for establishment of vermicompost units and they could earn Rs 48000/- out of total sale.
- Success stories on the following enterprises based on the training programmes were documented :
 - i. Souparnika Kudumbashree unit (Vermicomposting),
 - ii. Manjaladukkam Kudumbashree unit (Jasmine cultivation), and
 - iii. Soubhagya Kudumbashree unit (Nutrimix supplements).

Kayamkulam

- The Krishi Vigyan Kendra organised 65 training programmes on a variety of topics, out of which 52.3 per cent was on campus and 47.7 per cent as off campus programmes. 11 Seminars were also organised for creating awareness on general agricultural problems and their management through recommended package of practices. A total number of 2796 participants (1571 male and 1225 female) benefited from this programme. Motivated by their participation in the KVK programmes, the participants started the following micro enterprises started during the year.



Mushroom cultivation - 6 numbers,
Food processing units : 3 groups,
Beekeeping - a Group with 10 members,
Vermicompost - 4 units,

Coconut products - 2 units for the
production of Virgin Oil, chutney powder,
Vinegar and coconut oil and
Tailoring and embroidery - 4 units.

ALL INDIA COORDINATED RESEARCH PROJECT ON PALMS

COCONUT

- At Ratnagiri centre, the Laccadive Ordinary recorded the highest yield of 150 nuts/palm/year – mean yield of last 25 years (1978-2003) - and the cultivar could be considered for release at the next Biennial Workshop. The percentage increase in nut yield recorded in Laccadive Ordinary over WCT was 69 per cent. The cultivar was giving a copra yield of 21 kg/palm/year i.e., 3.74 t/ha. The oil yield of the cultivar was the highest with 15.24 kg/palm/year and 2.70 t/ha.
- Under the programme for collection, conservation and evaluation of local germplasm, Kahikuchi centre could collect 12 accessions of coconut while Bhubaneswar centre collected 13 germplasm types. These local germplasm types were maintained at respective State Research Stations for further evaluation.
- In the coconut based high density multispecies cropping system trials conducted at Kahikuchi Centre, the highest net return per ha (Rs. 1,30,468) was recorded under coconut-black pepper-turmeric cropping system followed by coconut-black pepper-ginger intercropping while the lowest net return of Rs. 23,462 only was obtained under control plot (coconut- black pepper).
- In the trial on drip irrigation-cum-fertilizer requirements for young coconut palms, at Aliyarnagar centre, drip irrigation at 100% pan evaporation and basin irrigation have recorded maximum nut yield of 162 and 158 nuts/palm/year. Drip irrigation at 66% Eo has recorded an yield of 127 nuts/palm/year. No irrigation has recorded a yield of 83 nuts/palm/year. Economic analysis revealed that drip irrigation 100% Eo recorded a maximum net income of Rs.44,469/- per ha and a benefit cost ratio of 2.08 against the control with Rs.15,598/- and 1.54 respectively. Basin irrigation, which was on par with drip 100% Eo, recorded the net income of Rs.42,294/- per ha with a benefit cost ratio of 2.01 respectively.
- The basal stem rot management studies being conducted at Aliyarnagar, Ambajipeta, Arsikere and Veppankulam centres indicated the possibility of using biocontrol agents in the management of basal stem rot disease. At Ambajipeta centre, among the three native biocontrol agents, *T. hamatum* (50 g) + neem cake (5 kg) was found highly effective in arresting the spread of basal stem rot disease, the vertical spread of disease being 11.3 cm followed by *T. viride* (50 g) + neem cake (5 kg) and *T. harzianum* (50 g) + neem cake (5 kg) with disease spread of 16.7 cm and 15.3cm respectively as against 68.7 cm in untreated control.
- Based on the trials conducted at Ratnagiri centre on the IPM for black-headed caterpillar, field release of larval parasite *Goniozus nephantidis* at the rate of 20 per cent of the estimated pest population or 3500 parasites per hectare is recommended.



OIL PALM

- The 11 tenera hybrids under evaluation at Aduthurai centre recorded significant variation for FFB yield. The hybrid 104 D x 310 P was found to be the most promising one by recording the highest FFB yield of 9.8 t/ha/year and was followed by the hybrids 115 D x 310 P (7.5 t/ha/year) and 35 D x 310 P (7.2 t/ha/year). The

hybrid 65 D x 291 P registered the lowest FFB yield (5.5 t/ha/year).

PALMYRAH

- A joint survey of palmyrah growing areas of West Godawari and East Godavari Districts of Andhra Pradesh was conducted during the year and 13 accessions were collected.

IMPACT OF TSUNAMI AND RESTORATION OF ECOSYSTEM

Tsunami waves hit India for the first time on 26th December 2004 wreaking havoc across the southern coastline. The waves are triggered by seismic disturbances in the ocean floor. The tsunami waves were caused by a massive earthquake on the Indian Ocean near Sumatra in Indonesia. The result is a gigantic wave, stretching from the sea's surface to the floor that travels horizontally at speeds of up to 500 miles per hour and reaches heights of 15 to 30 m and weigh millions of tonnes. Though the bottom of the wave is slowed down by the sharp elevation of the ocean floor near the coast, its top part keeps moving at the original speed. As a result, vast quantity of water piles up and finally crashes over the shore with amazing force, thus causing massive destruction. The first sign of an approaching Tsunami is the sea tide receding from the shore, which leaves a large part of the sea floor exposed. The ocean water then flows towards the shore faster than before, resulting in high waves. This phenomenon is repeated several times before the Tsunami itself did hit the land. Fisherfolk in Indian coast were virtually caught unaware in the ocean fury as huge waves pounded thickly populated fishing hamlets, resulting in death and destruction.

A multi-disciplinary team of scientists from Central Plantation Crops Research Institute (CPCRI), Kasargod visited the Tsunami affected areas in Tamil Nadu, Kerala and Andhra Pradesh to assess the impact and suggest suitable remedial measures.

The survey team has observed soil erosion and increase in soil and water salinity up to 500m from the coast due to invasion of sea water. Groundnut, arecanut, jackfruit, tamarind and breadfruit are the most affected, which were found desiccating due to salinity. Fishing profession and their homes were also most affected. Poultry farming was completely wiped out due to tsunami waves.

The short term restoration measures suggested were, providing irrigation to overcome desiccation and leaching away salinity of soil. Erection and earthing has been suggested for young coconut seedlings, which were fallen aside. Long term measures suggested include build up of green belt in the coastal line with coconut, cashew, *Cassurina*, *Calophyllum* and *Pongamea*. Mixed farming with vegetables like cucurbits which are tolerant to salinity, high density multi species cropping system are suggested for restoring the coastal ecosystem.

Natural calamities like Tsunami could cause sudden and severe damage to the socio-economic conditions of the affected people. Though the relief measures are being done from various agencies and through different means, a sense of compassion is a pre-requisite in all the relief measures.