अनुसंधान विशेषताएँ

RESEARCH HIGHLIGHTS 2005-06

केंन्द्रीय रोपण फसल अनुसंधान संस्थान

(भारतीय कृषि अनुसंधान परिषद्)

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प्राक्कथन

केंद्रीय रोपण फसल अनुसंधान संस्थान एवं अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के चौदह केंद्रों के कृषि अनुसंधान मुख्यांश इस रिपोर्ट के अंतर्गत संस्थान की अधिदेशीय फसलों जैसे नारियल, सुपारी, कोको की मुख्य उपलब्धियों का संक्षिप्त ब्यौरा दिया गया है। इस संस्थान के पाँच मुख्य प्रभागों - फसल सुधार, फसल उत्पादन, शरीरक्रिया विज्ञान, कटाई उपरांत प्रौद्योगिकी, फसल संरक्षण एवं सामाजिक विज्ञान के अंतर्गत ग्यारह बृहत परियोजनाएँ सम्मिलित हैं।

नारियल एवं सुपारी जननद्रव्यों के संग्रहण, संरक्षण, सूचियांकन और मूल्यांकन का प्रयास और नारियल के मूल रोध रोग के सक्षम प्रतिरोध के लिए प्रजनन फसल सुधार प्रभाग की ओर से किया गया है। जननद्रव्यों के मोलिक्यूलर लक्षणों और ताड़ और कोको में ऊतों की उत्पत्ति के तरीकों के विकास पर अध्ययन जैवप्रौद्योगिकी का लक्ष्य रहा।

फसल उत्पादन प्रभाग द्वारा सूक्ष्मजीवों के प्रयोग का ताड़ एवं अन्य फसलों की वृद्धि और उत्पादकता पर प्रभाग, कम लागत वाली कंपोस्ट बनाने की तकनीकियाँ और रोपण फसल आधारित समीकृत कृषि और सस्यन पद्धति पर अध्ययन किया गया।

फसल संरक्षण द्वारा नारियल के मूल रोध-पर्ण सड़न रोग के समीकृत प्रबंधन पर अध्ययन, नारियल ताड़ के कीटों के जैव नियंत्रण एजेंट पर अनुसंधान एवं शोधित फाइटोप्लाज़्मा की लसीय प्रतिक्रिया पर अध्ययन किया गया।

शरीरक्रिया विज्ञान, जैव रसायन एवं कटाई उपरांत प्रौद्योगिकी प्रभाग में नारियल की विभिन्न प्रजातियों/किस्मों में फल विकास की विभिन्न अवस्थाओं में आवश्यक वसा अम्लों और अन्य पोषक तत्वों में विविधता और हस्त-चालित डाब पंच एवं कटर का विकासन प्रमुख उपलब्धियाँ रहीं। 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 प्रभाग के महत्वपूर्ण कार्यक्रमों में प्रमुख हैं।

इस वर्ष हमारे संस्थान के दो वैज्ञानिक, डॉ. पी. अनिता कुमारी और डॉ के. सुबहरन क्रमशः स्वामी सहजानंद सरस्वति विस्तार वैज्ञानिक/कर्मचारी पुरस्कार वर्ष 2002-2003 तथा लाल बहादुर शास्त्री युवा वैज्ञानिक पुरस्कार से पुरस्कृत हुए।

इस वर्ष की अवधि में केंद्रीय रोपण फसल अनुसंधान संस्थान के कर्मचारियों की तरफ से विभिन्न प्रौद्योगिकियों के विकासन में दिए गए योगदान के लिए बधाई देना चाहता हूँ। इस रिपोर्ट के प्रकाशन के लिए मैं अपने सहयोगियों को उनकी मदद के लिए धन्यवाद देता हूँ।

21-2-2006
कासरगोड़

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

In crop improvement division, efforts were made on collection, conservation, characterization cataloguing and evaluation of coconut and arecanut germplasm and breeding for resistance/ tolerance to coconut root (wilt) disease. Biotechnological investigation aims at molecular characterization of germplasm and to develop tissue culture protocol in palms and cocoa. In the crop production division, studies were conducted on efficacy of microbial inoculants on growth and productivity, low cost composting techniques and plantation based integrated farming and cropping system.

In crop protection, studies were undertaken on integrated management of coconut root (wilt) - leaf rot disease, investigations on biocontrol agents of pests of coconut palms and serological reactions of purified phytoplasma.

In physiology, biochemistry and post harvest technology division, understanding genotypic variation in essential fatty acids and other nutrients at different stages of fruit development in coconut and development of manually operated tender coconut punch and cutter 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.

Two of our scientists, Dr. P. Anitha Kumari and Dr. K. Subaharan have been awarded Swami Sahajanand Saraswati Extension Scientist/Worker Award 2002-2003 and Lal Bahadur Shastri Young Scientist Award respectively from ICAR, New Delhi during the period.

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

21-2-2006
Kasaragod

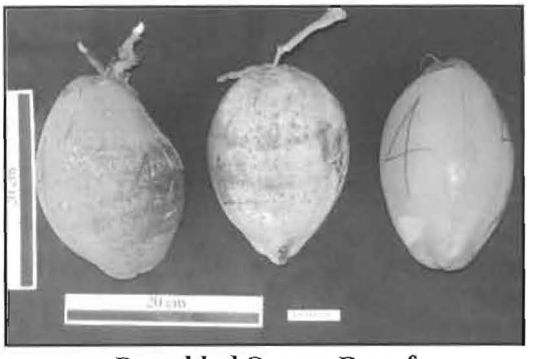
(V. RAJAGOPAL)

Director

CROP IMPROVEMENT

Coconut germplasm collections

Bhavanagar, Amreli, Junagadh and Porbandar districts of Gujarat State were explored for coconut germplasm during 2006 and six distinct coconut accessions were collected. Germplasm exploration was undertaken to Kumta, Honnavar and Ankola taluks of Uttar Kannad district of Karnataka under NATP-PB and three distinct types were collected including the Bassakal Orange Dwarf, a tender nut variety.



Bassakkal Orange Dwarf

Variability in Gujarat collections

National Coconut Gene bank at Kidu has been enriched with planting of about 1300 seedlings representing 100 new accessions collected from Goa, Maharashtra, Andaman & Nicobar Islands, Lakshadweep islands, Assam, West Bengal, Tamil Nadu and Kerala.

Molecular marker based characterization of conserved coconut germplasm was undertaken in six coconut accessions represented by 55 palms. Heterozygosity and Nei's gene diversity values of the six accessions ranged between 0.163 and 0.533 indicating that the accessions studied are neither homozygous like dwarfs nor highly heterozygous. Genetic diversity in the popualtions studied are low to medium.

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

Observations on root (wilt) disease incidence and disease index of dwarf varieties, planted at CDB farm Neriamangalam revealed that Chowghat Green Dwarf (CGD) and Malayan Green Dwarf (MGD) varieties are resistant to root (wilt) disease. Because of the high level of resistance to root (wilt) disease, large-scale cultivation of MGD is potentially capable of revolutionizing the coconut production and productivity in the root (wilt) prevalent tracts.

The CGD X WCT hybrid under evaluation recorded a ten-year cumulative average yield of 74 nuts/palm/year, even though sixty eight percent of hybrids recorded the incidence of root (wilt) disease.

A new cultivar of unspecified origin with high yield and resistance to coconut root (wilt) disease was identified in a farmer's plot (K.K Joseph, Karuvelithara House) located at Mampuzhakary Village (Alappuzha District). Out of the 22 palms studied, four palms were susceptible (18.2% Disease Incidence) where as the WCT palms in adjacent farmers plot showed 73% DI. Both the cultivar and its progenies are high yielding. The low level of root (wilt) disease incidence of the newly identified cultivar and its progenies in relation to the adjacent WCT population clearly indicated that the cultivar is resistant to the disease.

Collection, Conservation, Cataloguing and evaluation of arecanut germplasm

Survey was undertaken in areca growing tracts such as Junagadh, Porabander, Bhavnagar districts of Gujarat and collected seven distinct ecotypes of arecanut making the total holding to 147 at the main germplasm bank CPCRI RS Vittal. Among the collections, the accession 'Kodinar' collected from Junagadh district showed distinct desirable characteristics such as Semi tall growth habit, closer internodal length, partially drooping crown, medium thick stem, heavy bearing nature, deep yellow colour nuts with round shape and medium sized nuts. Special feature of this collection is nuts with less husk and more recovery of dried kernel from ripe nut.

Accession 'Kodiar'

Seventy one numbers of arecanut accessions were planted for their evaluation in the sub Himalayan terai region of West Bengal in different phases. In 1990 batch planting Vittal 21 produced the maximum nuts (1200nuts/ palm) but maximum fresh weight was recorded in Sweet Arecanut accessions (2.007 kg/ palm) followed by Vittal 29(a) 1.287 kg/ palm.The performance of the accessions collected from NE states is better than the once collected from other places. Maximum nuts/ palm (554.55) was recorded in accession Nalbari with a challi nut weight of 4.99 kg followed by K & J Hills (521.16 nuts/palm and 4.170 kg challi).

Genetics of dwarfs in arecanut and their exploitation in breeding dwarf varieties

In the F2 population of dwarf hybrid crosses, Hirehalli Dwarf x Hirehalli Tall showed superiority for yield and produced 674 ripenuts/ palm during the year.

Cocoa trials

The experiment was laid out with cocoa as a mixed crop with arecanut in 1994 at the Regional Station, Vittal and continued

till 2006 to study effect of pruning on performance of cocoa yield. There was significant interaction effect in both bean yield/ plant and yield/ ha basis. Maximum yield was recorded in S1P3 (1336 kg/ ha) and S2P3 (1247 kg/ ha) treatment. Thus, large canopy is optimum for cocoa productivity in arecanut plantations.

Biotechnological Investigations in palms and cocoa

Coconut

Tissue culture of coconut: Plantlet regeneration was achieved from inflorescence explants of West Coast Tall cultivar. Direct conversion of floral primordium to shoot occurred in Y3 basal medium supplemented with 50 gM picloram with spermine 400 gg in low temperature.

Arecanut

***In vitro* multiplication of YLD resistant/ tolerant palms standardized**

The arecanut tissue culture protocol developed was applied for mass multiplication of YLD tolerant palms from hot spot areas in Sullia region of Karnataka.

Direct somatic embryogenesis is reported for the first time in palm tissue culture

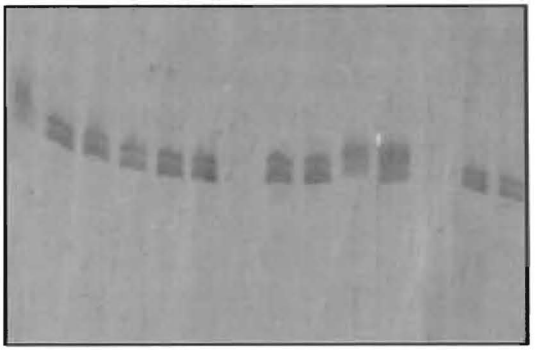
Direct somatic embryos from inflorescence rachilla of Yellow Leaf Disease tolerant/ resistant was obtained. Seven to 10 somatic embryos were obtained from a small rachilla section (0.5mm to 0.7 mm). Secondary somatic embryogenesis was also obtained for mass multiplication.

Cryopreservation of somatic embryos of arecanut

It is possible to cryopreserve the somatic embryos of YLD resistant/ tolerant arecanut palms. Maximum plantlet regeneration was obtained from the pretreatment of 2M sucrose for 24 hours followed by LF dehydration for 4 hours of somatic embryos.

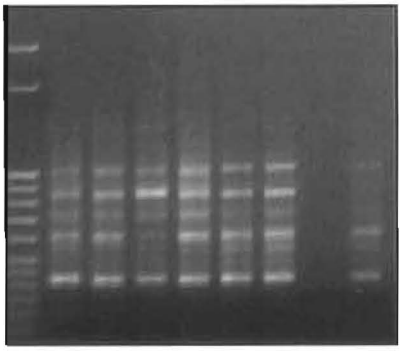
Molecular characterization of South Pacific collections of coconut germplasm

The highest similarity index (0.7654) was observed between the accessions Hari Papua Dwarf (HPD) and Kiriwana Tall (KWT). Dendrogram revealed separate clusters for Solomon Island accessions and New Guinea accessions. French Polynesia accessions were found to be more divergent. The population Natava Tall (NVT) had the highest Shannon's index while the population Kiriwana Tall (KWT) had the lowest index. The average 'with in population diversity' was higher (84.7 %) than between population diversity (15. 3 %) (Fig 4.)



Microsatellite profiles of coconut germplasm accessions

RAPD conditions were standardized for arecanut DNA and good banding pattern was obtained. RAPD markers were used testing the clonal fidelity of arecanut seedlings



RAPD profile of arecanut DNA

CROP PRODUCTION

Studies on the efficacy of microbial inoculants on growth and productivity of coconut and intercrops

PGPRs *Bacillus* sp. BbC, *Bacillus* sp. BbN and their combination stimulated the growth of coconut seedlings of West Coast Tall variety. *Bacillus* sp. BbC increased shoot length, seedling girth, fresh shoot weight and fresh root weight whereas combined inoculation of *Bacillus* spp. BbC and BbN increased root length, shoot dry weight and root dry weight as compared to uninoculated seedlings. These PGPRs also stimulated the soil microflora particularly the beneficial ones such as phosphate solubilizers, free-living nitrogen fixers and azospirilla in the root region of coconut seedlings. *Bacillus* sp. BbC was found to tolerate high concentrations of sodium chloride thus making it a suitable inoculant for saline soils also.

Growth conditions for mass-multiplication of PGPR *Pseudomonas fluorescens* in a fermenter of 7 litres capacity were standardized. Study of growth kinetics of *P. fluorescens* in fermenter revealed its specific growth rate as 0.937 h^{-1}, generation time 0.74 h and division rate as 1.35 h^{-1}.

PGPR *Pseudomonas fluorescens* was found to produce siderophores on CAS agar medium. It produced a halo of 26 mm on MM9 iron-free growth medium. Quantitatively, it produced 71 % siderophore units.

Developing low cost composting techniques for plantation wastes and their effect on the productivity of arecanut and coconut

Abstract microbial populations of the fresh vermicasts produced by *Eudrilus* sp. when fed on coconut leaves and cowdung were enumerated by dilution plate method using several media. Vermicasts produced by *Eudrilus* sp., when coconut leaves were the substrate, contained significantly high population of fungi, free-living nitrogen fixers, phosphate solubilizers, fluorescent pseudomonads and silicate solubilizers. When cowdung was the substrate, the vermicasts was preponderant with aerobic heterotrophic bacteria, actinomycetes and *Trichoderma* sp. Spore formers were present in similar numbers in both the vermicasts. Presence of *Azotobacter* was detected in vermicasts produced from

cowdung substrate. Ammonifying bacteria were significantly high in both the vermicasts as indicated by the qualitative test using Nessler's reagent.

The changes in microbial population when coconut leaf vermicompost was stored for 6 months, were studied. It was observed that there was not much change in total heterotrophic bacterial population during the storage period. However, the fungal population increased after 3 months of storage whereas actinomycetes population reduced significantly after one month of storage.

A trial was conducted to evaluate vermicompost production by *Eudrilus* sp. when crop residues of intercrops were individually tested in comparison with coconut leaves. The vermicomposting efficiency and rate of conversion by *Eudrilus* sp. varied with the agrowastes evaluated. Higher recovery of 60% was recorded with coconut leaves and glyricidia leaves while the conversion was comparatively less (around 50%) with banana and pineapple wastes.

In the composting trial on coir pith by poultry manure amendment, the flux of CO_2 evolution showed high values in the initial two months indicating higher rate of decomposition during the period. pH values changed from acidic to neutral range and electrical conductivity increased during the composting process. The composted coir pith was found to be of superior quality with respect to the content of plant beneficial micro organisms particularly the bacteria involved in nutrient transformation and growth promotion such as *Azospirillum*, free living N_2 fixers, phosphate solubilisers and fluorescent pseudomonads in addition to total bacteria and actinomycetes.

Allelopathic studies in coconut based cropping system

An *in vitro* study conducted using agar cup assay showed that amongst the beneficial rhizospheric bacteria of coconut tested, the diazotrophs were sensitive to the coconut root and leaf leachates, while, the phosphate solubilizers and PGPRs got stimulated.

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

The husk and coir pith application in littoral sandy soil had significantly influenced fodder yield and quality of Co 3 grass during different period of cutting. Higher green fodder yield was obtained under husk application during each cutting (green fodder yield ranged from 10.57 to 16.59 t/cutting with a total yield of 96.83t/ha/year) and it was on par with coir pith application and significantly differed from the control treatment (green fodder yield ranging 8.00 to 11.20 t/ cutting with a total fodder yield of 62.8 t/ha/year). Husk application in the planting zone resulted in higher crude protein yield and was on par with that of coir pith application and both the treatments significantly differed from the control.

Napier

Vetiver as an intercrop in coconut garden

Vetiveria zizanoides (Vetiver/Ramacham) an important medicinal plant cultivated for its roots, could grow well as an intercrop in coconut garden (Fig.1) and yielded about 10 kg to 12 kg of dry root (Fig.2) in one cent area. The crop can also be grown in sloppy land for soil conservation as it is a very good soil binder.

Management of coconut based farming system for sustainable productivity under coastal ecosystem

Azolla has been introduced as a supplement to concentrate feed for poultry. There is no significant difference in live weight of the birds due to the substitution of azolla (90 per cent through concentrate + 10 per cent substituted through azolla for concentrate) when compared to feeding with 100 per concentrate.

Plantation based integrated farming system under island conditions

CO-7 variety of papaya was found to be an ideal fruit crop yielding over 40 kg of fruit per plant under the Lakshadweep conditions.

Vegetable crops such as cabbage, cauliflower and onion were found to be suitable for cultivation as intercrops in the existing coconut gardens of Lakshadweep during July – October season.

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

Different summer and winter vegetables were tested in arecanut shade as well as in open condition. The performance of basella was better in shade condition (18 t/ ha) rather than in open condition (13.5 t/ ha) in terms of yield. The performance of ridge gourd, snake gourd and lady's finger was almost similar in both the conditions. Other summer vegetables like pumpkin, ash gourd, bottle gourd and bitter gourd, was better in open

condition. Radish performed better in shade condition than open condition. An yield of 735 q/ ha was recorded in shade condition whereas, in open condition it was 681 q/ ha.

Nutrient movement pattern in coconut basin under drip fertigation

Studies on nutrient movement pattern in soil under drip fertigation in littoral sandy soil revealed nutrient movement along the wetting zone in accordance with the soil moisture availability in the coconut basin. Higher concentration of nutrients was observed in the dripping points at the top layer and decreased gradually as the depth increased. Smilarly, the nutrient concentration of NPK also decreased horizontally with increase in distance from the dripping point. No clear nutrient movement pattern was noticed under the conventional (soil application) method of fertiliser application.

Development of Linear Spectral Model for Identification of Root(wilt) Disease Affected Coconut Palms using Remote Sensing and GIS

A GA based back scattering technique was developed for sub pixel classification to map the coconut root (wilt) affected palms. The GA parameters were as follows: gene length of seven, population size 100, generations 2000 and crossover rate 80% and mutation rate 5%. This gave a sub pixel classification accuracy of 94.2 % for limited area of 512 x 512 pixel in a heavily root (wilt) diseased area in Kayankulam.

CROP PROTECTION

Mass production and use of biocontrol agents in the integrated management of coconut leaf rot disease

Strains of biocontrol agents (*Bacillus subtilis, Pseudomonas fluorescens and Trichoderma viride*) effective against the pathogens of leaf rot disease could be isolated from coconut eco-system. Techniques were standardized for multiplication of both bacterial and fungal antagonists in various liquid culture media including coconut water media in and out of Fermentor system, as the case may be, and the biocontrol agents mass-produced into bioformulations using talc as carrier material.

Rural people could be trained and enlightened on mass production and use of biocontrol agents. Thus as societal benefit, rural men and women could be enlightened for decentralized production and utilization of biocontrol agents. The mass-produced biocontrol agents were supplied to rural community for integrated disease management practices/bio treatment of coconut seedlings.

Participants in training on mass production of biocontrol agents.

Large scale production of antiserum for identification of disease free elite parental palms of coconut and certification of quality seedlings

Refinement of Elisa

DAC indirect ELISA which was standardized and refined earlier for the early and rapid detection of root (wilt) disease could be modified to a simple diagnostic test. In the modified procedure small bits of spear leaves are being used as test antigen instead of crude extracts. The infected leaf bits also recorded higher absorbance values over the cut off value of negative control. In the modified procedure, process of antigen extraction could be avoided; furthermore the labour involvement could also be reduced. The test is being used for the selection of healthy elite mother palms for producing quality seedlings

Evolving biocontrol and systemic resistance in the integrated management of coconut root (wilt) - leaf rot disease

Consistent disease ameliorative effect of the biocontrol agents, *Bacillus subtilis* and *Pseudomonas fluorescens*, and synergistic effect of these antagonists in the integrated field management of leaf rot disease of coconut could be achieved.

Seed bio priming of coconut with bacterial bioagents, *B. subtilis* and *P. fluorescens* – individually and in combination, has established the acceptability of the organisms to the seed nuts with a normal/positive impact on their germination and without adverse effect. Encouraging results were also obtained with positive impact of the organisms in growth characters of the seedlings and in context of possible induction of systemic resistance in the host against the disease complex.

Coconut seedling raised from biotreated seed nut with *Pseudomonas fluorescens* (Right: Treated; Left: Control).

Investigations on biocontrol agents of pests of coconut

The wax moth, *Galleria mellonella* is an ideal alternate host for mass rearing the parasitoids of *Opisina arenosella* viz., *Trichospilus pupivorus* and *Goniozus nephantidis*

Bioecology and management of coreid bug *Paradasynus rostratus* affecting Coconut palm

Endochus inornatus, the reduvid bug was recorded as a predator of coreid bugs in the field.

PHYSIOLOGY, BIOCHEMISTRY AND POST HARVEST TECHNOLOGY

Genotypic variation in essential fatty acids and other nutrients at different stages of fruit development in coconut

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 at post-monsoon, pre-monsoon and monsoon seasons of fertilization, indicated the following:

In both kernel and nut water lauric acid (C12:0) was the predominant free fatty acid; the content was greater in the talls.

The essential fatty acids linoleic and linolenic acids (C18:2 and C18:3 respectively) were in greater concentration in dwarf, tender nuts.

Post-monsoon fertilized and GBGD nuts had maximum Vit. C in both nut water and kernel.

In the nut water total protein content decreased with nut maturity, significantly greater amounts were present in talls. In kernel the protein content increased to a maximum in the 9th month, least being in LCT.

The free amino acid pool in nut water and kernel showed reverse trends: while kernel amino acid content decreased to a minimum by the 10th month, in nut water it increased up to the 10th month. COD kernel and WCT x COD nut water had greater amounts.

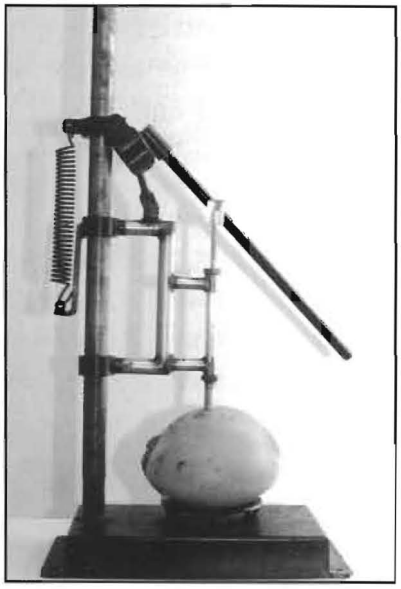
The total sugars in kernel increased to a maximum in the 9th month and post monsoon fertilized nuts; in nut water it decreased with maturity and was maximum in GBGD and least in WCT x COD.

Reducing sugars in both kernel and nut water decreased with nut maturity; while COD had maximum kernel reducing sugars, GBGD had the most in nut water.

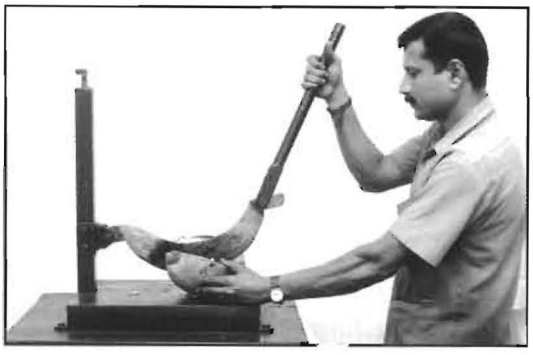
Starch content in the kernel decreased to a minimum by the 10th month; it was highest in monsoon tagged nuts; dietary fiber content was maximum COD and it increased significantly with nut maturity.

Technology devices developed

A simple manually operated tender coconut punch and cutter have been developed. The tender coconut punch consists of a steel punch capable of being moved up and down and carried in the two bushes of a carriage. With a small force the pipe can be pierced into the tender nut. It takes just 5 seconds to make a punch in the nut. Tender nut cutter has also been developed for cutting open the nut after drinking the water to eat the delicious tender meat. The cost of punch is Rs. 750/- and the cost of cutter is Rs. 400/-. This will eliminate the need for skilled labour for operating tender nut parlor. If this device is popularized then there will be tender nut parlors in every nook and corner of our country.



Tender nut punch in operation



Tender nut Cutter

SOCIAL SCIENCES

Transfer of technology programmes

The farmer participatory training and demonstration programme implemented in Kollam district revealed that adoption of recommended technologies for management of root (wilt) affected gardens resulted in increased productivity. The average yield per palm per year was 51 nuts against the district average of 33 nuts. In the adopted gardens, leaf rot in spindle reduced to 2.8% (compared to 12.89% before intervention); incidence of rhinoceros beetle reduced from 56 to 8 %; and eriophyid mite incidence reduced from 49 to 24 %. Besides, the root (wilt) disease severity was also reduced in these gardens. Further, area under intercrops (tubers, vegetables, banana and spices) increased five fold on implementation of project.

Intercrop in root (wilt) affected garden

Large number of farmers adopted vermicompsoting as a source of organics required for managing root (wilt) affected trees. The technology was disseminated among the farmers through training programmes, method demonstration, personal contacts, and farmer to farmer exchange of earthworms free of cost and farmer to farmer problem solving and experimentation.

A SHG formed by a group of women engaged in vermicomposting and production of coconut products earned Rs.60-100/ member/ day in Alappuzha district. The value addition obtained was 67%. The products being prepared are

virgin coconut oil, bakery products and chutney powder.

Special training programmes of three days duration were conducted for groups of 20 farmers each in collaboration with Gandhigram Rural Institute (Deemed University) and Department of Agriculture, Assam. The topics covered were 'integrated pest and disease management in coconut', 'post harvest technology in coconut', and 'cultivation of plantation crops'

A State level Television personnel-Scientists interface programme was organised at CPCRI, Kasaragod with an objective to enlighten the farming community about the opportunities for better utilisation of technologies to increase income from farming.

A radio serial about "Activities and achievements of CPCRI" comprising of 13 episodes was broadcasted by All India Radio, Kannur.

Agricultural Technology Information Centre (ATIC) continued to provide farm advisory services, answer to online queries, and sale of planting material and other farm produces. Similar activities were also carried out at the regional stations and research centers.

A *Karshakasangamom* (farmers' meet) was organized in Alappuzha district in collaboration with State Bank of Travancore, Kayamkulam and Vegetable and Fruits Promotion Council of Kerala (VFPCK).

Agricultural Economics

Demand forecasting for coconut, arecanut, and cocoa for the year 2010 is 13470 million nuts and 4.20 lakh tones, 13180 MT respectively as obtained based on Autoregressive Moving Average model.

Coconut based integrated agro-processing system including integrated production and marketing of edible oil, snow ball tender nut, coconut chips, coir, vermin-compost, and mushroom is technically feasible and economically viable. The realized net return as a medium scale agri-business with an operational capacity of 1750 nuts/ day for seven products viz., coconut oil (120 kg/ day), snow ball (500 nos/ day.), coconut chips (35 kg/ day), mushroom (15kg/ day), coir yarn (1000 kg/ day), coir pith compost (30 kg/ day) and vermi-compost (30 kg/ day) is Rs.2700/ day.

Agricultural Statistics

It was estimated that 4000 coconut trees are lost annually due to stem bleeding disease in Kasaragod district resulting a cumulative loss of 2.4 million nuts every year. With current market price, this loss is equivalent to 10 million rupees a year to the GDP of the district.

Linear relationship of coconut production with average rainfall during past 2 to 4 years, and area under crop was used for prediction of coconut production in Kerala. Accordingly it was worked out that the production for the year 2001 as

5716 million nuts which was found to be very close to the reported statistics as 5744 million nuts.

Computer Applications

The web sites hosted by Agriculture/ Horticulture departments of coconut growing States in India were compared for contents on region specific recommendations on agrotechniques. The database based report generation as followed under INARIS was found to be ideal for providing package of practices specific to district level.

The institute website *(http://cpcri.ernet.in)* updated regularly and many new features added. Every Saturday, the price forecast of coconut oil for the forthcoming week was posted in the website.

To make wide publicity among farmers on successful technologies a new capsule titled **FARMER THEN ... AND NOW** was included in the CPCRI website from 2nd October, 2005, the Gandhi Jayanthi Day and updated periodically. **This capsule highlights** the individual farmer's achievement and his/ her own perception on the impact of technologies that benefited to improve his livelihood and so far four series have been posted.

KRISHI VIGYAN KENDRA

Kasaragod

Training Programmes

Organised a total of 106 training programmes with the participation of 2236 trainees including practicing farmers, farm women, women self help groups, rural youth and extension functionaries on various topics in the disciplines of Agricultural Extension, Agricultural Engineering, Crop Production, Plant Protection, Home Science, Horticulture and allied enterprises.. Out of these training programmes 50 were on-campus and 56 were off-campus wherein 873 (313 men and 560 women) and 1363 (632 men and 731 women) trainees participated, respectively.

Womens' Cell

A total of 5 on campus and 10 off campus training courses were conducted under the Womens' Cell for the benefit of 328 women participants. The topics covered under these training courses are food processing, product diversification in coconut, use of natural ingredients/ medicinal plants for house hold remedies, nutrimix supplements, smokeless chulah for drudgery reduction among women, pineapple preservation, amla based food and medicinal products, annual moringa cultivation, vegetable cultivation, beekeeping and vermicomposting.

Extension Services

The extension activities conducted and services rendered for the benefit of various clientele during the period under report.

Further, faculty participated in 3 exhibitions, 6 radio talks, published 6 popular articles and a total of 24 activities covered in news papers.

Krishi Vigyan Kendra, Kayamkulam

Training programmes

The Krishi Vigyan Kendra organised various training programmes on a variety of topics, out of which 43.08 per cent was on campus and 56.92 per cent as off campus programmes. Seminars were organised for creating awareness on general agricultural problems and their management through recommended package of practices.

A total of 130 training programmes were conducted on various topics in which total of 3744 participants attended. Out of these trainings 56 were on-campus which was attended by 1544 participants and the rest attended off-campus programmes. KVK Alleppey organised 9 seminars during this period in various parts of the districts in which 1142 participants attended. There were very good participation of rural women in KVK programmes. Almost 60 per cent of the participants were women including educated rural youths, farm women, skilled laborers etc,. Women participation was almost on par for both on (62%) and off campus (59%) programmes.

Trainings were provided to various client groups such as extension officials (10.8%), practicing farmers (39.2%), rural youth (24.6%) and women groups (25.4%) on various topics.

Agro clinics were conducted for the benefit of the farmers on an average of 37.4 numbers per month and helpline services to the tune of 56.2 numbers per month.

Entrepreneurship development programme (EDP) for rural youths

A package of technologies for appropriate choices and combination were transferred to 168 rural youth in an ED programme during the period of November 2005- January 2006. The sessions were on mushroom cultivation, vermi composting techniques, nursery management/ techniques, vegetable seed production, use of coconut climbing machine & copra dryer, IPM of vegetables, aquarium making & ornamental fish management, food processing and value addition, coconut cultivation practices & vegetable cultivation. The sessions were mostly practical oriented. Communication and entrepreneurial skills were also imparted to the participants.

ALL INDIA COORDINATED RESEARCH PROJECT ON PALMS

COCONUT

At Mondouri Centre in West Bengal, Jamaica Tall continued to record the highest yield in the germplasm trial with 82 nuts/palm/annum (mean of last 16 years). The cultivar could be considered for release for commercial cultivation.

At Ratnagiri Centre, Laccadive Ordinary continued to record a very high yield (151 nuts/palm/year – mean of last 26 years) and hence was recommended for release for large scale cultivation in the region. Similarly, COC X PHOT was recommended for release in Veppankulam

region. Philippines Ordinary, WCT X COD, WCT X GBGD, COD X WCT were recommended for commercial cultivation in Pollachi region.

More than 100 local germplasm types were collected by AICRP Centres during the period.

Based on the studies conducted on nutritional requirement of high yielding varieties/hybrids of coconut, a fertilizer dose of 500:500:2000 gm NPK/palm/year is recommended for D X T hybrids in Assam state. In West Bengal state the recommended dose for hybrid coconut is 500:250: 1000 gm NPK/palm/year. For Maharashtra state and for coastal Tamilnadu, a dose of 1000:500:2000 gm NPK/palm/year is recommended for hybrid coconut.

As a component of drip irrigation schedule, in summer months, 65 litres of water/palm/day is recommended for Pollachi region in Tamilnadu.

Based on INM trial, a combination of 50% composted coir pith along with 50% recommended dose could be recommended as the INM package for Pollachi region, coastal Andhra Pradesh and maidan tract of Karnataka.

Among the various combinations of coconut based cropping systems tried at AICRP Centre, Kahikuchi (Assam), the coconut-black pepper – turmeric crop combination could yield a net return of Rs, 1,92,575/ha/annum followed by coconut-black pepper-ginger crop combinations.

A survey conducted to assess the extent of spread and intensity of root (wilt) disease of coconut in Coimbatore, Dindugul, Kanyakumari and Theni districts of Tamil Nadu State indicated that in Theni district, severe to very severe root (wilt) disease incidence was observed in Cumbum block. The disease incidence ranged from 22.2 to 30.9%.

OIL PALM

Among the eleven tenera hybrids (supplied from Palode) under evaluation at Mulde Centre in Maharashtra State from 1991, hybrid combination 18 D X 32 P recorded maximum FFB yield of 121.61 kg/palm/year (17.39 t/ha).

Experiments in progress at the four oil palms centres to assess the irrigation and nutrient requirements for oil palm in different agro-climatic regions indicated that. at Aduthurai Centre, the oil palm receiving a fertilizer dose of 1200:600:2700 g NPK/palm/year with basin method of irrigation produced highest FFB yields(17.6 t/ha/year). At Mulde centre of Maharashtra, the same combination of treatments gave FFB yield of 23.34 t/ha /year.

PALMYRAH

In palmyrah, 173 germplasm types, collected from various parts of the country, are maintained and evaluated at the AICRP Centre, Killikulam, (Tamil Nadu). Among these types, the accession TN04-10 showed superiority over other accessions expressing higher fruit weight (1810 g) and seed weight (372 g) and higher value for other characters recorded. The tree is also dwarf and fruits are black in colour.

The inflorescence sap (neera) yield recorded from the existing grown up palmyrah palms available in Killikulam Centre it was observed that the palm F34 gave the highest yield, recording 135.5 litres of sweet sap (Neera). This palm was found to record higher yield consistently over the years.

In the disease status survey covering palmyrah groves in Thoothukudi and Tirunelveli districts of Tamil Nadu, leaf blight was noticed in ten places and the per cent disease index ranged between 3.00 to 32.00.