wreaking havoc across the ocean floor. The ocean near Sumatra is
faced with the floor that travels at a speed of 15 to 30 m and weighs in at the shore is repeated several times virtually caught unaware resulting in death and destruction.

Research Institute (CPCRI), Kasaragod, and Andhra Pradesh to

irrigation to overcome water salinity up to 500m it, tamarind and breadfruit trees, mangroves, and high density multi-
temperate crops. A range to the socio-economic scene from various agencies are all the relief measures.

Central Plantation Crops Research Institute
(Indian Council of Agricultural Research)
Kasaragod 671 124, Kerala, India
प्राकथन

केंद्रीय रोग फसल अनुसंधान संस्था एवं अंतर्देशीय समिति तात्त्विक अनुसंधान परियोजना के चौंड़े के वृक्ष अनुसंधान मुद्राशा इन रिपोर्ट के अंतर्गत संस्थान की अड्डी रोग फसल नैरियल, सुपी, की कुछ उपलब्धियों का संचार न्यूज़ दिया गया है। इस संस्थान के पाँच गुणा प्रभाग - फसल सुधार, प्रशासन, शैक्षणिक विज्ञान, कटाई उपरांत प्रौद्योगिकी, फसल संरचना एवं सामाजिक विज्ञान के अंतर्गत वृक्ष नैरियल परियोजनाएँ सम्मिलित हैं।

नैरियल एवं सुपी जननक्रिया के संग्रह, संरचना, शैक्षणिक एवं मूल्यांकन का प्रयास और नैरियल के मूल रोग रोग के संरचना प्रतिरोध के लिए प्रजनन फसल सुधार प्रभाग की ओर से किया हुआ है। जननक्रिया के मौलिक क्षेत्रों की मेहनत और ताजा और कोई में उत्पाद की उत्पन्न के तीर्थों के विकास पर अध्ययन जैवज्ञानिक का लक्ष रहा।

फसल उत्पादन प्रभाग द्वारा सूचकांकों के प्रभाग का तात्त्विक और उन्मादन पर प्रभाग, कम लागत कानून कंपनियों बनाने की तकनीकियों और रोग फसल आधारित समीकृत तक्षियों और संयोग प्रदान पर अध्ययन किया गया।

फसल संरचना द्वारा नैरियल के मूल रोग-रोग सूचक रोग के संरचना प्रयास पर अध्ययन, नैरियल तात्त्विक के कोडों के जैव नियंत्रण एवं पर अनुसंधान एवं शैक्षिक फसल विज्ञान का तकनीकियों पर अध्ययन किया गया।

शैक्षणिक विज्ञान, जैव स्थापना एवं कटाई उपरांत प्रौद्योगिकी प्रभाग में नैरियल की विभिन्न प्रजातियों/किस्मों में फसल रोग की विभिन्न अवशेषों में स्वाद और अन्य रोगकष्ट तक्षियों में विभिन्नता और हत-चालित द्रविक पंप एवं कर्म का विकास प्रमुख उपलब्धियों रहा। तात्त्विक के कोडों का उपयुक्त एवं मूल्यांकन, संरचना प्रजातियों का निर्धारण प्रमुख, शैक्षिक विवेश, नैरियल, सुपी एवं कोडों में प्रौद्योगिकी हस्ताक्षर, विज्ञान, अनुसंधान रोगक्रियाओं एवं कुछ का प्रशिक्षण आदि सामाजिक विज्ञान प्रभाग के महत्वपूर्ण कार्यक्रमों में प्रमुख है।

इस वर्ग हमसे संस्थान के दो वैज्ञानिक, डॉ. पी. अर्नात कुमारी और के. सुबहन क्रमशः वामन सहभागिता संस्थान वैज्ञानिक/कर्मचारी पुरस्कार वर्ष 2002-2003 तथा लाल बहादुर शासी युवा वैज्ञानिक पुरस्कार से पुरस्कृत हुए।

इस वर्ग की अवधि में केंद्रीय रोग फसल अनुसंधान संस्था के कर्मचारियों की तरफ से विभिन्न प्रौद्योगिकियों के विकास में लिए 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
cसालगोड़

(सी. 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 summarised 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.

21-2-2006
Kasaragod

(V. RAJAGOPAL)
Director
mandate crops namely, institute and 14 centres comprised in this publication. viz., Crop Improvement, Technology, Crop Protection

Coconut germplasm collections

Bhavanagar, Amreli, Junagadh and Purbandar 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.

Bassakal 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, Maharashatra, 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 populations 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 Chowgheat 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) whereas 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.

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 (1200 nuts/palm) but maximum fresh weight was recorded in Sweet Areca nut 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 ones 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
numbers of arecanut are planted for their sub Himalayan terai in different phases. Vittal 21 produced (1200 nuts/palm) but weight was recorded in accessions (2.007 kg/palm) Vittal 29(a) 1.287 kg/y. Selection of the accessions in the sub states is better than the other places. Maximum (1.55) was recorded in with a challi nut weight by K & J Hills (521.16 170 kg challi).

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 gM 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. 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 un inoculated 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.

**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. Vermicasst 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 were 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. An increase was significantly injurious to vermicasts as indicated in a field test using Nessler's reagent.

The changes in microbial numbers in the vermicasts when coconut leaf vermicast was stored for 6 months, was observed that there was a decrease in total heterotrophic bacteria and a decrease in the fungal population increase during the storage period and then a reduction in population reduced significantly after 3 months of storage.

A trial was conducted to determine the productivity when crop residues of coconut leaves individually tested in cowdung. The rice straw, efficiency and rate of nutrient utilization by *Eudrilus* sp. varied when tested individually. Higher recovery of nutrients was recorded with coconut leaves while the nutrient recovery was comparatively less (58%) with banana and pineapple leaves.

In the composting trial, poultry manure amended with coconut leaves showed higher CO₂ evolution during the initial two months indicating an increase in the rate of decomposition during this period. The values changed from high CO₂ evolution to low during the composting period. The composted coir pith and coir dust were of superior quality with respect to physical characteristics of plant beneficial properties.
Conditions for mass-production of PGPR *Pseudomonas* sp. in a fermenter of 7 litres standardised. Study of *P. fluorescens* in CAS produced a halo of 26 mm clear growth medium. It produced 71% low cost composting & increased the productivity of coconut grazing populations of the produced by *Eudrilus* sp. Nut leaves and cowdung by dilution plate method were added. Vermicast produced when coconut leaves were attained significantly high nitrogen, free-living nitrogen solubilizers, fluorescent silicate solubilizers. As was the substrate, the complemented with aerobic bacteria, actinomycetes and Spore formers were higher numbers in both the presence of *Azotobacter* was Vermicast 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 CO₂ 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 microorganisms particularly the bacteria involved in nutrient transformation and growth promotion such as *Azospirillum*, free living *N₂* 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 96.831/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.
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 in open condition. The yield of 735 q/ha was recorded in shade condition whereas, it was 681 q/ha.

Nutrient movement from nutrient basin under drip fertigation

Studies on nutrient movement in soil under drip fertigation in sandy soil revealed that nutrient movement along the wetting zone of the basin. Higher concentration of N was observed in the close to the top layer and decreases with the depth increased. Sr. concentration of N was observed to be higher horizontally with increase in distance from the dripping points. The movement pattern was different in both the conventional (soil application) and drip fertigation.

Development of Linear Model based GA for Identification of Root Health of Affected Coconut Palms using Remote Sensing and GIS

A GA based back propagation network was developed for supervised classification to map the coconut palm root health. The GA parameters were a gene length of seven, maximum number of generations 2000 and population size 200 and mutation rate 5%. The model was able to classify a limited area of 512 x 512 pixels for root (wilt) diseased areas.
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. Similarly, 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.

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.
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 standardised 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 redivid bug was recorded as a predator of coreid bugs in the field.

PHYSIOLOGY, BIOCHEMISTRY AND POST HARVEST

Genotypic variations in fatty acids and other stages of fruit development

In the study of kernel and nut water potentials, LCT, COD and maturities – 7, 8, 9, monsoon fertilization at 20 days interval, and post-monsoon and non-monsoon fertilization, indicated the effect of monsoon fertilization on the water content of kernel and nut.

In both kernel and nut the essential fatty acids (C12:0) was the predominant acid; the content was higher in kernel than in nut.

The essential fatty acids (linoleic and linolenic acids respectively) were higher in kernel than in nut.

Post-monsoon and non-monsoon kernels had maximum protein content in kernel and nut.

In the nut water potentials, LCT, COD and maturities – 7, 8, 9, monsoon fertilization at 20 days interval, and post-monsoon and non-monsoon fertilization, indicated the effect of monsoon fertilization on the water content of kernel and nut.

The free amino acid content in kernel and nut showed an increase from post-monsoon to non-monsoon. The kernel amino acid content was lower than in nut. The content increased with maturities and monsoon fertilization in kernel and nut.

In the nut water potentials, LCT, COD and maturities – 7, 8, 9, monsoon fertilization at 20 days interval, and post-monsoon and non-monsoon fertilization, indicated the effect of monsoon fertilization on the water content of kernel and nut.

In the kernel and nut water potentials, LCT, COD and maturities – 7, 8, 9, monsoon fertilization at 20 days interval, and post-monsoon and non-monsoon fertilization, indicated the effect of monsoon fertilization on the water content of kernel and nut.
results were also evaluated from biotreated monas fluorescens (left: Control).

control agents of of nanonasella viz., Goniozus

management of coreid affect

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 GBD and least in WCT x COD.

Reducing sugars in both kernel and nut water decreased with maturity; while COD had maximum kernel reducing sugars, GBD 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/-.

If this device is popularized then there will be tender nut parlors in every nook and corner of our country.
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.

Large number of farmers adopted vermicomposting 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, backwards and chutney powder.

Special training programmes of 20 farmers each in Gandhigram Rural University and Agriculture, Assam. were integrated plantation crops'.

A State level Telecast Scientists Interface organised at CPCRI, objective to enlighten community about the better utilisation of increases income from 

A radio serial about achievements of CPCRI episodes was broadcasted Radio, Kannur.

Agricultural Technology Centre (ATIC) continue advisory services, answer and sale of planting material produces. Similar activities carried out at the regional research centers.

A Karshakasangam was organized in Alappuzha collaboration with Travancore, Kayamkulam and Fruits Promotion (VFPCK).
CPCRI RESEARCH HIGHLIGHTS 2005-06

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

CPCRI RESEARCH HIGHLIGHTS 2005-06

dents, leaf rot in spindle (compared to 12.89% incidence; incidence reduced from 56 to 8%); incidence reduced from 12.89% (wilt) disease reduced in these gardens. Inter cropping (tubers, and spices) increased demonstration of project.

(wilt) affected garden of farmers adopted as a source of organics for the root (wilt) affected garden. ginger root (wilt) affected of farmers adopted as a source of organics for the root (wilt) affected garden. 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).
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.

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 newspapers.
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 EDP programme during the period of November 2005- January 2006. The sessions were on mushroom cultivation, vermiculture, 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.

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.