RECENT ADVANCES IN RESEARCH ON COCONUT, ARECANUT AND COCOA

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Introduction

The Central Plantation Crops Research Institute (CPCRI) was established in 1970 as one of the Agricultural Research Institutes in the National Agricultural Research System under Indian Council of Agricultural Research. The Institute has the mandate to conduct research on production, protection and processing technologies of plantation crops such as coconut, arecanut and cocoa. The research is being undertaken at the headquarters and Regional Stations, Vittal (Karnataka), Kayangulam (Kerala), Minicoy and at Research Centres, Kannara (Kerala), Kahikuchi (Assam) and Mohitnagar (West Bengal). The International Coconut Gene Bank for South Asia (ICG-SA) is now established at its Research Centre at Kidu (Karnataka). The Institute is also serving as headquarters for the All India Coordinated Research Project on Palms with Centres in the coconut growing regions of the country. The progress made in research on crop improvement, production, protection and post harvest technology by the Institute on mandate crops during the last few years are summarised below;

Coconut (*Cocos nucifera* L.)

Coconut (*Cocos nucifera* L.) is a versatile crop providing food, medicine, health drink, shelter, fuel, timber and fibre. It is grown in 92 countries and India, Indonesia, Philippines and Sri Lanka are the major growing countries. In India it is grown in 1.93 million ha with a production of 12832 million nuts and productivity of 6632 nuts per hectare. The recent research findings in the different disciplines are explained below:

Crop improvement

Genetics and plant breeding

Coconut germplasm collection comprising of 360 accessions (228 indigenous and 132 exotic), which is the largest in the world. Coconut cultivars/hybrids WCT, Federated Malay States (FMS), Java Giant, Fiji,

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Andaman Giant, LO x GB an LO x COD have been identified as drought tolerant.

The cultivar, Chowghat Green Dwarf (CGD), has been found to have field tolerance of over 90% to the root (wilt) disease. The coconut hybrid, CGD x WCT was found to have relative tolerance to root (wilt) disease. The CGD x WCT hybrid, planted during 1991, recorded a ten-year cumulative average yield of 71 nuts/palm/year, even though sixty eight percent of hybrids recorded the incidence of root (wilt) disease.

Three high yielding coconut hybrids, Chandrasankara (Chowghat Orange Dwarf x West Coast Tall), Chandralaksha (Laccadive Ordinary Tall x West Coast Tall) and Kerasankara (West Coast Tall x Chowghat Orange Dwarf) were released for commercial cultivation. These coconut hybrids gave 49 to 77% more copra yield over local talls and are not only early bearers but also give higher yield than either of the parent.

COD x WCT hybrid

Biotechnology

A protocol for aseptic collection of embryos in coconut, their storage and successful culturing to develop plantlets has been standardized. This is found to be very useful in field collection of coconut germplasm from distant places. A total of 405 embryo cultured coconut accessions collected from eight countries have been field planted. A protocol for extraction of tender tissues from adult coconut palm without destroying the growing apical meristem has been standardized.

Plantlet development has been obtained from various explants of coconut viz., plumular tissues, inflorescence in Y3 medium supplemented with polyamine and picloram in both dwarf and tall cultivars. *In vitro* active conservation of coconut zygotic embryos (short-term) was standardized.

Embryo cultured plantlet

Cryopreservation of coconut zygotic embryos after desiccation pre- treatment was standardized and these embryos could be retrieved into plantlets.

RAPD/IISR and SSR markers were used to establish the genetic similarity among some indigenous and exotic coconut accessions maintained at CPCRI, Kasaragod. The protocol for AFLP, DAF and micro satellite analysis of coconut DNA for tagging resistance gene for root (wilt) studies was standardized.

Crop production

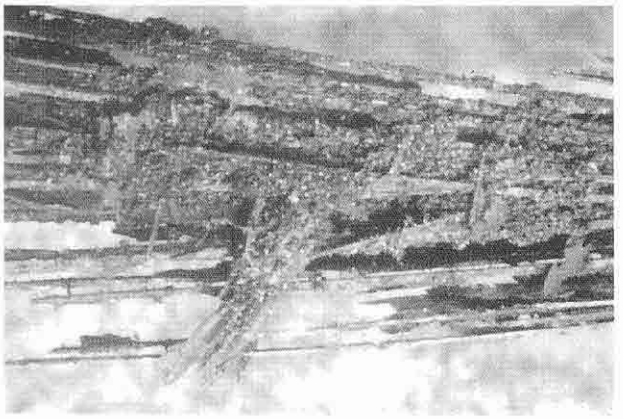
Recomended dose of fertilizer for coconut palm is application of 500g N, 320g P_2O_5 and 1200g K_2O/palm/year in two split doses during May and September along with 50 kg organic manure. Application of magnesium @500g (MgO) per palm was found to be advantageous in areas where palms show yellowing of leaves.

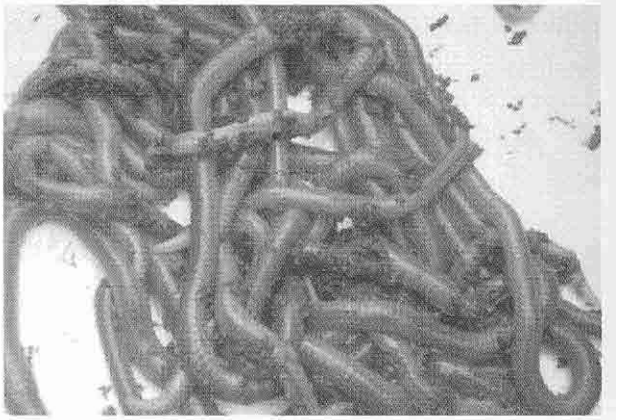
Application of 200 l of water once in four days was recommended for irrigating coconut palms. For the WCT palms in red sandy loam soils on the west coast, perfo irrigation with 20 mm water, when cumulative pan evaporation was 20 mm, was found to be the best irrigation schedule. Sprinkler irrigation or perfo irrigation with 20 mm water was found to be the best suited to inter or mixed cropping systems where the entire surface requires wetting. Drip irrigation @ 66 % of the E_0 (32 litres of water per palm per day under Kasaragod conditions) from December to May is ideally suited for coconut resulting in 34 per cent saving of water. Application of straight fertilizers like urea, muriate of potash and phosphoric acid through drip system (Fertigation) could reduce the fertilizer dose by 50 % and increased fertilizer use efficiency and yield of coconut.

The Institute has developed various bio-engineering measures to sustain crop production in rainfed areas of west coast region. The low cost water harvesting structures developed by the Institute helped in augmenting ground water potential to a great extent. Soil conservation and water management on watershed basis, evaluation of different soil and water conservation measures were also carried out. Moisture conservation methods such as mulching with coconut husk, coir dust, green leaves dried coconut leaves etc., addition of organic manures or green manures, husk burial, inter cultivation, bunding, terracing, etc. were recommended.

The technique for utilization of leguminous cover crops such as *Pueraria phaseoloides, Mimosa invisa* and *Calopogonium mucunoides*, Cowpea as green manures to supply biologically fixed nitrogen and easily decomposable biomass to coconut, to substitute for 50 % nitrogen fertilizer was standardized. A field experiment conducted in a coconut plantation in an acidic laterite soil type revealed the feasibility of substituting upto 50% of fertilizer nitrogen with the nitrogen contributed by leguminous green manures. *M. invisa* and *P. phaseoloides* are well nodulated by native rhizobia in acidic coconut soils. *Marasmiellus troyanus* and a local isolate of *Trichoderma* species were found effective for microbial composting of coir pith. Microbial enrichment of compost with N_2-fixing bacteria and phosphate solubilisers was achieved. Plant growth promoting rhizobacteria *Bacillus coagulans* and *Brevibacillus brevis* were identified for bioaugmentation of coconut seedlings for their growth promotion while raising them in the nursery.

The technology for vermicomposting of coconut palm wastes by using a local earthworm, *Eudrilus* sp., closely related to the African night crawler, was standardized. Multiplication technique for the local *Eudrilus* sp. of earthworm using 1:1 cow dung-decayed leaves mixture was standardized and the earthworm is being distributed to the farmers to initiate vermicomposting.





Vermicomposting of coconut leaves with *Eudrilus* sp

Utilization of coconut wastes for oyster mushroom cultivation (*P. flor*ida, *P. sajor caju, P.flabellatus, P. opuntia* and P.*eous*) was found to be economically feasible.

Coconut based cropping systems involving cultivation of compatible crops like tubers, flowering, medicinal and aromatic crops, fruits, vegetables, spice crops, in the interspaces of coconut was more remunerative compared to coconut monocropping. Coconut-based high-density multi-species cropping systems (HDMSCS) involving many crops like tapioca, elephant foot yam, colocasia, banana, pineapple, nutmeg, clove, pepper, etc. was established. Application of 2/3rd of recommended dose fertilizer for coconut is sufficient under the system to attain maximum yield and return. The total energy input (fertiliser, irrigation and manpower) into the coconut based cropping system has been worked out, which ranges from 17,02,233 to 17,12,294 MJ/ha. Allelopathic studies in coconut based cropping system with standardisation of extraction procedure for coconut leaf and root leachates from young and adult palms were carried out. Laboratory bioassays to determine the allelopathic concentration of coconut root and leaf leachates through seedling vigour index method were initiated. Leaf and root leachates from adult WCT palm at 1:5 and 1:10 concentrations were found to be allelopathic to cow pea seedlings. *In vitro* studies indicated that the diazotrophs were sensitive to the coconut root and leaf leachates, while, the phosphate solubilizers and PGPRs got stimulated.

Coconut based high density multi-species cropping system

Mixed farming in coconut by raising fodder crops in the interspaces with the integration of other enterprises such as dairy, poultry and pisciculture was quite advantageous in increasing the productivity of the system, improving soil fertility and in enhancing the income from coconut plantations. Use of Azolla as animal and

poultry feed found to be low cost technology for attaining higher returns.

Growing Glyricidia as green manure crop was found to be ideal for management of littoral sandy soils and its beneficial effect on soil properties and yield of coconut. Application of Glyricidia prunings from interspace of one hectare of coconut garden can meet a major portion of nitrogen (90%), part of phosphorus (25%) and potassium (15%) requirement of coconut palm. Growing different intercrops in littoral sandy soil with soil moisture conservation measures in the interspaces of coconut found to be beneficial and did not affect the growth and yield of coconut.

For management of root (wilt) disease an integrated approach has been developed involving application of organic manures like farm yard manure or green leaf manure or composted coir pith or vermicompost at the rate of 25 kg/palm along with nitrogen, phosphorus and potassium application @ 500:300:1000 g through application of 1.1 kg of urea, 1.5 kg of mussorie rock phosphate and 1.7 kg of muriate of potash on per palm basis. Application of $MgSO_4$ @ 1kg per palm could reduce the yellowing symptom of the palms. Adoption of intercrop/mixed crop with suitable crops and recycling of available biomass in the system could increase the productivity of the palms and reduce the yellowing symptom of the palms. For boron deficient palms in the root (wilt) disease affected area, Borax application @ 150 g/ seedling and @ 300 g/ adult tree was recommended.

Crop protection

Disease

Coconut root (wilt) disease

The coconut root (wilt) disease is a non-lethal debilitating malady, caused by Phytoplasma, that reduces the production potential of the palm. The symptoms of the disease are characteristic bending of the leaflets termed "flaccidity", along with foliar yellowing and marginal necrosis.

ELISA technique has been refined for the rapid and early detection of root (wilt) disease of coconut. In the modified procedure, leaf bits are being used as test antigen instead of crude leaf extracts.

PCR amplification of genomic DNA from spear leaves and young inflorescence of diseased samples was carried out using P4 and P7 primers, which gave two bands of 400 and 700 base pair. With these 400bp and 700bp PCR products, RAPD was done using 37 oligo primers. Amplification was noticed in OPA 18 and OPD 01 primers. PCR products (400 bp and 700 bp) were gel eluted and given for sequencing.

Leaf rot disease of coconut

Leaf rot disease in coconut is caused by many fungal pathogens, chiefly *Colletotrichum gloeosporioides*, *Exerohilum rostratum* and *Fusarium solani*. The symptoms are seen as presence of tiny spots of various shapes and shades and of different colours on the soft white leaflets of the unopened spindle, which enlarge and coalesce to cause extensive rotting. Integrated leaf rot disease management strategy involves cutting of the rotten portions of the spindle and pouring either Contaf-5 EC

2 ml or Dithane M-45/Indofil M-45, 3 g dissolved in 300 ml of water in the cavity around the base of the spindle leaf.

Bud rot of coconut

The disease is caused by *Phytophthora palmivora*. The symptoms of the disease includes withering of the spindle, rotting of soft tissues of crown emitting foul odour and ultimately the death of the spindle. As a prophylactic measure, all the healthy palms surrounding the diseased palms should be sprayed with 1% Bordeaux mixture on the spindle and base of 2-3 innermost leaves. For management of the disease, root feeding and stem injection of Akomin (16.8 ml) and Calixin (21 ml) can protect the palms for a period of 8 weeks. In early stages of the disease, application of 10% Bordeaux paste on affected portion can check the disease.

Bud rot affected palm

Stem bleeding of coconut

The disease is caused by *Thielaviopsis paradoxa* and is characterized by dark brown patches at the base of the trunk of the palm which grow into longitudinal irregular streaks with dark reddish brown liquid exuding from them. Root feeding of 5% Calixin or 5% Bavistin at quarterly intervals is effective in initial stage of the disease. In advanced stage, the affected bark should be chipped off till the healthy tissue is exposed and painted with 5% Calixin (5 ml Calixin in 95 ml water).

Stem bleeding affected palm

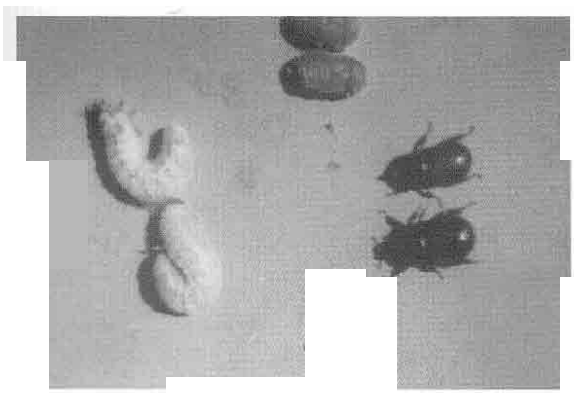
The disease is also called as 'Ganoderma wilt'/ 'Anabe Roga'/ 'Thanjavur wilt'. *Ganoderma lucidum* and *G. aplanatum* are involved in the disease. In this disease, outer whorl of leaves turn brown and droop and bleeding symptoms appear on the base of the stem.

The recommended management practices include phytosanitation measures, digging trenches around affected palms to isolate the diseased palms, application of systemic fungicides like calixin through root feeding (2 g/100 ml), drenching the soil with fungicides (25 litres of calixin 0.1 %) and application of neem cake @ 5 kg/ palm/ year, along with the recommended dose of organic manures.

Pests

Rhinoceros beetle (*Oryctes rhinoceros*)

The IPM package for rhinoceros beetle includes extraction of the adult beetles using a beetle hook during the peak period of pest abundance (June-Sept.) from crown of all the palms, treatment of all possible breeding sites (farm yard manure dump, fallen coconut logs etc.) of the insect with 0.01% carbaryl (50% WP) on w/w basis. Biological suppression of the pest can be carried out by releasing 10-15 beetles inoculated with *Oryctes* virus in one ha of garden and application of 5 x 1011 spores of *Metarhizium anisopliae* fungus/m3 area of the breeding site of the pest, during monsoon period. Prophylactic measure include leaf axil filling of palms with 12.0 g naphthalene balls /palm covered with sand at 45 days interval.



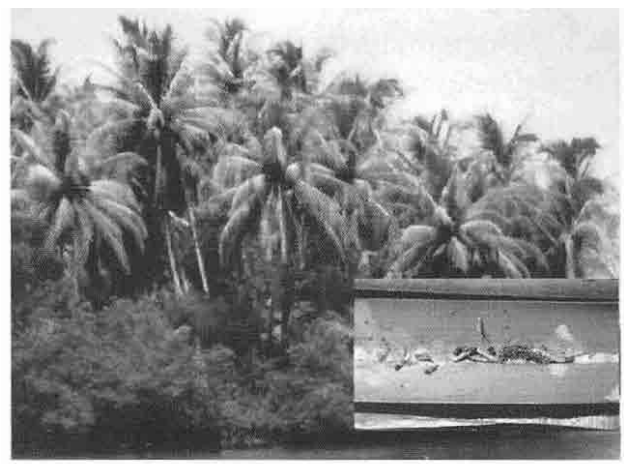
Rhinoceros beetle (*Oryctes rhinoceros*)

Red palm weevil (*Rhynchophorus ferrugineus*)

IPM package for red palm weevil includes cleaning of palm crown periodically to avoid decaying of organic debris, proper cutting, splitting and burning of red palm weevil infested palms, treating of any wounds on the palm with coaltar + 1% carbaryl or 0.1% endosulfan, stem injection with 0.1% endosulfan/ dichlorvos or 1% carbaryl. Trapping of floating population of the weevil can be done by setting up of pheromone traps. Synthesis of Ferrugineol, the aggregation pheromone, is being done at CPCRI.

Leaf eating caterpillar (*Opisina arenosella*)

This pest feeds on the undersurface of the leaflets within silken galleries resulting in considerable reduction of photosynthetic area. An IPM method for controlling the pest includes cutting and burning of badly infested outer leaves/leaflets, spraying of 0.02% dichlorvos if pest is in active larval stage and release of larval parasitoids *Goniozus nephantidis* @ 20.5%, pre-pupal parasitoids like *Elasmus nephantidis* @ 49.4% and *Brachymeria nosatoi* @ 31.9% respectively at fortnightly intervals depending on the larvae, pre-pupal and pupal population of *Opisina.*



Coconut garden affected with leaf eating caterpillar

Eriophyid mite (*Aceria guerreronis*)

The mites suck the sap from the tender nuts resulting in appearance of elongated triangular white patch below the perianth, which in turn becomes pale yellow then brown

with the advancement of the mite infestation. Severe infestation results in poor development of the nuts with reduced kernel weight and poor quality fibre and premature nut shedding. Management of this pest is possible by spraying of 0.004% azadirachtin or 2% neem oil, garlic and soap mixture during April-May, Oct.-Nov. and Dec.-Jan., in such a way that all mite infested palms in an area should be covered at the shortest possible interval coupled with integrated nutrient management to improve the health of the palm.

White grub (*Leucopholis coneophora*)

White grubs damage the roots of palms and also tunnels into the bole and collar region of seedlings. IPM technology includes deep ploughing and digging of soil during pre- and post-monsoon period, collection and destruction of adult beetles during peak emergence period in May-June, setting up of the light traps to attract adult beetles and killing them, insecticidal application with phorate 10G @ 100 g/palm during May-June and September-October.

Coreid bug (*Paradasynus rostratus*)

The adults and nymphs of this pest suck the sap from buttons and developing nuts resulting in nut fall and malformation of the nuts. It can be managed by spraying the crown bunches and leaf axils with 0.1% carbaryl/ endosulfan.

Nematode Management

The burrowing nematode (*Radopholus similis*) infested coconut seedlings exhibit symptoms like yellowing, button shedding, reduction in leaf size and yield. Soil application of phenamiphos or phorate @ 25 kg ai/ha during Sept., Dec. and May completely eliminates *R. similis* in coconut nurseries.

Physiology & biochemistry

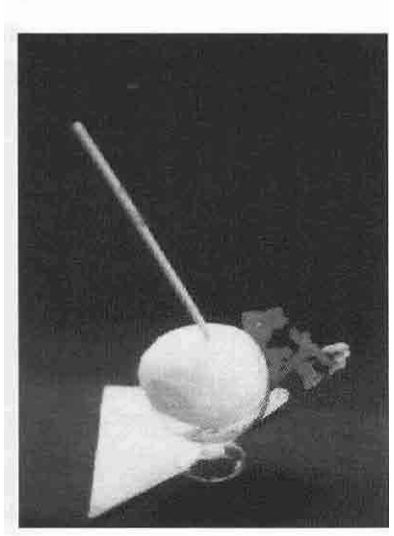
Coconut hybrids such as Keraganga, Chandralaksha, Kerasankara and talls like Chandrakalpa and West Coast Tall were identified as relatively drought tolerant compared to the other varieties and hybrids. Gangabondam Green Dwarf, Malayan Orange Dwarf and Chandrasankara were found to be more susceptible to drought under sandy and sandy loam soil than laterite soil under rainfed condition.

Genotypic variation in fatty acids and other biochemical parameters at different stages in development of coconut were worked out. Shelf life of coconut oil can be enhanced by storing it in brown bottles, plastic cans or clay jars with preservatives like tamarind (2%), common salt (1%) or citric acid (0.05%).

Pre and post harvest technology

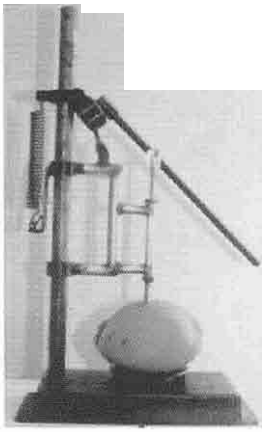
- A manually operated coconut-dehusking machine has been developed with an out turn of 110 nuts/hr.
- A power operated semi automatic coconut dehusking machine has also been developed which can dehusk 500-600 nuts/hour.
- A new processing method for preparing ball copra was developed
- Preservation of fresh kernel upto 4 days is possible by dipping fresh kernels in 1000 ppm propionic acid for 60 minutes.

- Simple smoke free collapsible copra dryers have been developed in which about 1000 coconuts/batch can be dried in 24 hours. The cost of the dryer is in the range of Rs.7000/ to Rs. 25000 depending on the capacity and the fuel used.
- A solar cum electric dryer with agriculture waste as third source of energy has been developed for copra drying with a capacity of more than 3000 nuts/ batch at a cost of Rs.40000/-.
- A technology for making snow ball tender nut (SBTN) from 8 months old coconuts has been developed. Along with the process, a suitable machine has also been developed for making SBTN. The cost of the machine is Rs 22,500/-.



SBTN ready for relishing

- A technology for the production of sweet coconut chips has been developed, by the process of osmotic dehydration, with a shelf life of 6 months. A process for production of coconut chips with different flavours, medicated, spicy as well as instant coconut chips by microwave oven has also been developed.
- A tendernut punch and a cutter has been developed at a cost of Rs. 1365/-.



Tendernut punching device

- Process for the production of the fuel briquette with different composition of pith and shell powder of tender coconut husk has been developed.
- An automatic irrigation system suitable for all high frequency irrigation systems has been developed at an approximate cost of Rs.2000/-, excluding the cost of irrigation system.

Arecanut (*Areca catechu* L.)

In India, the palm is being grown in an area of 0.3 m ha with a production of 0.4 m metric tonnes and productivity of 13,333 kg/ ha.

A total of 146 germplasm accessions of areca are maintained at CPCRI, RS, Vittal. Promising hybrids of areca such as HDxMohitnagar, HDxSumangala, Mohitnagar x HD, Saigon {VTL12} and Mangala (*inter se*) are being evaluated.

The feasibility of long term conservation (cryopreservation) of somatic embryos of YLD

Mohitnagar variety of arecanut

resistant arecanut was studied and revealed that maximum plantlet recovery was obtained from the pre growth treatment of 2M sucrose for 24 hours followed by 4 hours of laminar air current desiccation.

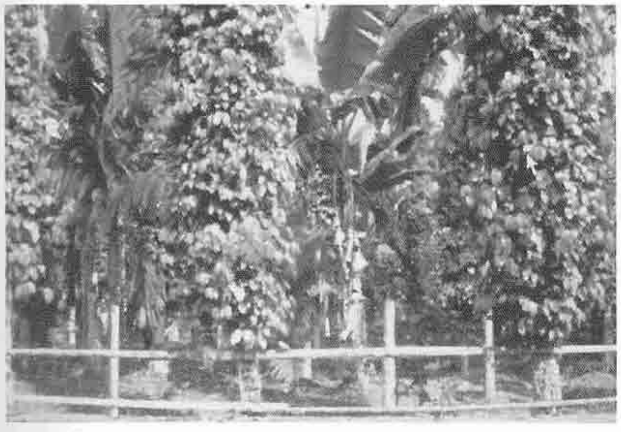
Recommended dose of fertilizer for arecanut palm is application of 100g N, 40g P_2O_5 and 140g K_2O/palm/year in two split doses during May and September along with 20 kg organic manure.

The irrigation schedule for arecanut is 200 litres of water per palm once in 6 days through hose. Drip irrigation @ 20 litres of water/palm/day can save 44% of water. After four years of experimentation, different fertilizer levels significantly influenced girth and trunk elongation. Percentage of flowering was maximum with 75% recommended fertilizer level followed by 50% fertilizer level.

Studies at CPCRI, RS, Vittal have revealed that mushroom and vermicompost production using arecanut wastes such as leaves, leaf sheaths and husk are the promising technologies in terms of waste recycling and employment generation. Production of oyster mushrooms (*Pleurotus sajor-caju*), which are edible and rich in protein content, generates Rs. 17,000/ ha/year. The spent substrates can be reused for vermicompost production. On an average, a net income of Rs. 28,000/ ha / year is realized with mushroom and vermicompost production using wastes from one hectare of arecanut plantation.

The long pre-bearing period, low returns during the initial bearing stage, fluctuations in market prices, unexpected loss due to pests and diseases and natural calamities are some of the problems associated with arecanut cultivation. To overcome these problems, inter/mixed cropping with banana, betelvine, pepper, tapioca, colocasia, dioscorea, pineapple etc. are recommended to realise income during juvenile phase of arecanut.

The system of growing more number of crops of different species mixed with main crop to meet food, fuel and timber needs is called High Density Multi Species Cropping System (HDMSCS). Research efforts at CPCRI,RS, Vittal, CPCRI, RC Hirehalli, Kahikuchi and Mohitnagar revealed that banana, cocoa, pepper, lemon, betelvine, elephant foot yam and tapioca can be grown with arecanut in HDMSCS. At Vittal, cultivation of cocoa, banana and pepper was found profitable with arecanut. At Hirehalli, cocoa, pepper, banana and lemon were found profitable whereas at Mohitnagar, a combination of arecanut, banana and pepper increased the net profits. By following HDMSCS, we can increase the net returns by 2 to 2.5 times over arecanut alone.



Arecanut based high density multi-species cropping system

Management of white grubs in coconut and arecanut

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

The LD_{50} of monoterpenoids, methyl chavicol and linalool (isolates from basil oil) for *Leucopholis coneophora* was fixed as 0.03% and 0.01% , respectively.

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

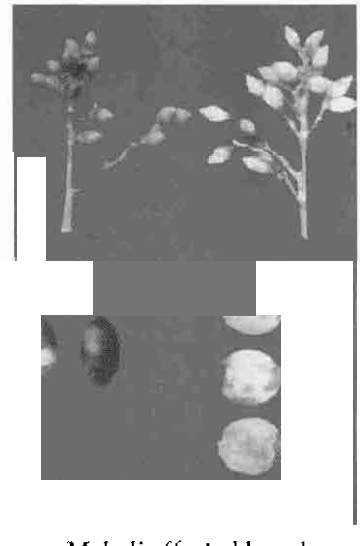
Bio-control studies on arecanut and cocoa

In a study carried out to determine the substrate that supports best growth *in vitro* for growth of the fungal anatogonists *Aspergileus* (2 isolates), *Trichoderma* (3 isolates), *Myrothecium verucaria* (one isolate) and two unidentified fungi, coffee husk was found to be the best. This was followed by cotton seed cake and rice bran, respectively.

Pseudomonas fluorescence (TNAU isolate Pf.1) and six other bacterial isolates collected locally showed antagonistic effect on *Phytophthora meadii*, casual agent of fruit and bud rot of arecanut. A naturally occurring entomopathogenic fungus was found effective for controlling the high populations of the membraciids *Gargara mixta* and *Leptocentrus taurus* on cocoa.

Management of fruit rot of arecanut

Fruit rot (Kole roga) is one of the major diseases of arecanut palm caused by *Phytophthora* spp. (*P. arecae and P. meadii*). The disease is seasonal and occurs during South West monsoon. The present control measure is prophylactic spraying of one per cent Bordeaux mixture before the onset of monsoon. Besides the chemical method, mechanical method of control of the disease by protecting the bunches through covering with polythene is found to be very much effective in checking the incidence and spread of the disease.



Mahali affected bunch

Yellow leaf disease of arecanut

The disease is caused by phytoplasma. It is characterized by interveinal foliar yellowing and reduced leaf size. The disease in the early stages can be managed by application of organic manures and fertilizers and an additional dose of superphosphate with lime with a provision for irrigation during summer months.

Scale insects and mealy bugs (minor pests)

Scale insect infestation is seen on leaves, button and rachillae while mealy bugs colonize on all tender parts like the bases of spear leaf, spadix and inflorescence and inside the perianth of nuts. They can be managed by spraying 0.1% Fenthion/ Malathion on the infested leaves, buttons and rachillae (for scale insects) and 0.05% monocrotophos or 0.1% fenthion (for mealy bugs).

Spindle bug of arecanut (*Carvalhoia arecae*)

The symptoms of attack includes linear water soaked lesions on damaged leaves, which turn necrotic and dry and drop off, the infested spindle do not open completely. The pest can be managed by placing Phorate 10G, @ 2g granules in perforated polythene sachets in the innermost leaf axils.

Cocoa (*Theobroma cacao* L.)

In India, cocoa is being grown in an area of 18,000 ha, with a production of 10000 MT and productivity of 454 kg/ha of beans.

The cocoa germplasm holding at CPCRI consist of 58 indigenous and 91 exotic genotypes. An experiment with 14 accessions in the clonal evaluation programme revealed that the accession Na242 recorded the highest dry bean yield (0.827kg/plant/year). In the four progeny trials for the hybrid evaluation programme, the progenies belonging to Na33 x ICS, I-56 x II-67, ICS6 x Sca6 and II-67 x NC42/94 performed better in terms of dry bean yield.

In vitro screening of majority of the available germplasm against the black pod disease using isolates of prevailing three *Phytophthora* spp. viz., *P. palmivora, P. capsaici, P. citrophthora* has indicated a few good lines with certain degree of tolerance and one among them has been NC 51 (parentage being C 44).

Na 242 clone of cocoa

Recommended dose of fertilizer for arecanut palm is application of 100g N, 40g P_2O_5 and 140g K_2O/palm/year in two split doses during May and September along with 20 kg organic manure.

Social sciences

Statistical methods as applicable to plantation crops have been refined through use of non-parametric data analysis and analysis of data using risk transformation methods. Economic analysis of arecanut based farming systems clearly indicated that intercultivation of vegetables, ornamental crops, spices, tubers along with animal husbandry was more profitable than monocrop systems. Price spread analysis of coconut was carried out and economics of palm based cropping/farming system have been worked out.

Extension activities undertaken by KVK, IVLP, ATIC and extension section at the Institute resulted in enhanced technology adoption by farmers. Interface programmes involving Scientists-farmers, Kisan Melas are being conducted at different places to disseminated the technologies developed at the institute. Recently at CPCRI, teleconferencing facility has been initiated.

The CPCRI website (http://www.cpcri.nic.in) hosted under NIC Server includes history, organization structure, achievements of various Divisions and Centres, future thrust, personnel, transfer of technology, training programmes and AICRP Palms. A new facility for the farmers for online registration of their planting material requirement is provided through the web site facility. Data warehousing of all the information on mandate crops is done. A touch screen monitor was installed at the ATIC for accessing information on coconut, arecanut and cocoa cultivation.

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Email : pkitvm@sancharnet.in

ANALYTICAL DIVISION

Gas Chromatographs (GC, MS, HS, RGA, NGA ....)
High Performance Liquid Chromatographs (HPLC)
UV Visible Spectrophotometers (UV-VIS, UV-VIS-NIR)
Fluorescence Spectrometers (FL)
Polarimeters (POL)
Atomic Absorption Spectrometers (AAS)
Inductively Coupled Plasma Emission Spectrometers (ICP)
Fourier Transform Infra Red Spectrophotometers (FTIR)
Thermal Analyzers (DSC, TGA, TMA, DMA & TG-DTA)
Elemental Analyzers (CHNOS, Nitrogen & Protein Analyzers)
Laboratory Information Management Systems (LIMS)

LIFESCIENCE DIVISION

LIQUID HANDLING PRODUCTS
Apricot
Flex Drop
Mini Trak
Evolution P3
MPII-EP3 Combination
MultiProbe II

BIOMICS PRODUCTS
Microarray
Spotters
Hybridisation systems
Scanners
SNP Array
Nonrad Nucelotides
SNP Acycloprime Kits

HTS Products
Envision plate reader
Viewlix HTS reader
Topcount RAD platereader
Microbeta RAD & Liminescence couter
HTS reagents
Consumables

PROTEOMICS PRODUCTS
ProXpress 2D Image Acquisition
ProFinder 2D Image Analysis
ProXicision Spot Picker
Multiprobe Protein Digestion & Spotting
prOTOF 2000 MALDI O-TOF
Live Cell Imaging Systems
Microarray
SNP Array

RESEARCH PRODUCTS
Wizard Gamma Counters
Liquid Scintillation Counters
Ultra Low Level LSC Quantulus
VICTOR miltilabel plate reader
Radiomatic Flow Scintillation Analyzers
Reagents, Chemical & Supplies

GENETIC SCREENING PRODUCTS
Well Women & Healthy Pregnancy

HEAD OFFICES
: 201, NAND CHAMBERS, L.B.S. MARG, THANE – 400 602
REGIONAL OFFICES
: NEW DELHI, CHENNAI, CALCUTTA, PUNE, BARODA, HYDERABAD, BANGALORE, THIRUVANANTHAPURAM, LUCKNOW, INDORE, GUWAHATI