

RESEARCH HIGHLIGHTS 1989-90



**CENTRAL PLANTATION CROPS
RESEARCH INSTITUTE**
(Indian Council of Agricultural Research)
KASARAGOD 671 124
KERALA, INDIA



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Published by

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Cover Photographs

Top: Intercropping with soybean in coconut gardens

Bottom: *Pleurotus florida* grown on oil palm mesocarp refuse

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INTRODUCTION

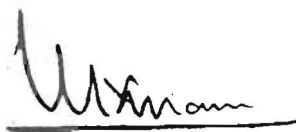
The Central Plantation Crops Research Institute, established in the year 1970, has at present the mandate to conduct and coordinate research on production, protection and post-harvest technology of palms and cocoa. The Institute is also a centre for transfer of technology with respect to these crops.

During the year under report (1989-90), the administrative control of the National Research Centre for Spices was delinked from CPCRI. The ICAR Research Complex for Goa, which was under the administrative control of the Institute also became an independent Institute with the appointment of an Officer on Special Duty. The Central Agricultural Research Institute, Port Blair, Andamans took over the administrative control of the ICAR Research Complex for Lakshadweep, from CPCRI. Thus, the Institute is left with a network of two Regional Stations (Kayangulam and Vittal), five Research Centres (Palode, Kannara, Hirehalli, Mohitnagar and Kahikuchi), a Seed Garden (Kidu) and a World Coconut Germplasm Centre (Port Blair), spread over four states and one Union Territory.

During the year the Institute undertook research programme in 22 research projects, divided into 80 sub-projects, located at various centres of the Institute. Twelve new research projects were initiated and 13 research projects in operation in the earlier years were concluded. This publication presents the important research results that emerged during the year from various research projects.

Recommending WCT $\times$ COD hybrid for release in Kerala, Coastal Karnataka, Goa and Coastal Andhra Pradesh; favourable effect of organic matter amendments on the survival of nitrogen-fixing bacteria; higher availability of phosphate-solubilizing organisms in soils of crop mixed coconut in comparison with coconut pure crop; relative tolerance for drought in MYD $\times$ WCT hybrid compared to MOD $\times$ WCT and COD $\times$ WCT; identification of six more accessions of cocoa tolerant to drought; control measures against the black pod disease of cocoa; identification of clove and Mauritius variety of pineapple as crops immune to 20 common isolates of burrowing nematode, thus making them suitable as intercrops to be grown in coconut gardens; utilisation of arecanut leaf sheath and oil palm bunch refuse as substrates for cultivation of oyster mushrooms and setting up of a pollen processing laboratory at Kottayam for accelerating the production of coconut planting material possessing field tolerance/resistance to root (wilt) disease are some of the major achievements during the year.

The Institute also coordinated and conducted a massive survey for the occurrence of yellow leaf disease of arecanut in six arecanut growing districts of Karnataka, involving the Department of Horticulture, Department of Agriculture and University of Agricultural Sciences, Bangalore.



(MK Nair)

Director

Kasaragod
19 April, 1990

Central Plantation Crops
Research Institute, Kasaragod

भूमिका

केन्द्रीय रोपण फसल अनुसंधान संस्थान (के.रो.फ.अ.सं.) जिसकी स्थापना सन् 1970 में हुई, का वर्तमान कार्य क्षेत्र ताड़ो तथा कोको के उत्पादन, सुरक्षा तथा कटाई-उपरात की शिल्प विज्ञान पर अनुसंधान करने तथा उन पर हो रहे अनुसंधान कार्यों के समन्वयन का है। संस्थान इन फसलों से सम्बन्धित शिल्प विज्ञान के स्थानान्तरण का केन्द्र भी है।

वर्ष 1989-90 में राष्ट्रीय मसाला अनुसंधान केन्द्र, कालीकट के स्थानापन्न निदेशक की नियुक्ति के पश्चात इस का प्रशासनिक नियंत्रण के.रो.फ.अ.सं. से प्रथक हो गया। आपीसर ऑन स्पेशल ड्यूटी के नियुक्ति उपरात, भा.कृ.अ.प. का अनुसंधान समिश्र, गोआ भी जो संस्थान के प्रशासनिक नियंत्रण में था, स्वतंत्र संस्थान बन गया। भा.कृ.अ.प. समिश्र, लक्ष्यद्वीप का प्रशासनिक नियंत्रण केन्द्रीय कृषि अनुसंधान संस्थान, पोर्ट ब्लेयर, अण्डमांस ने ले लिया। इस प्रकार संस्थान में अब दो क्षेत्रीय केन्द्र (कायमगुलम तथा विट्टल), पांच अनुसंधान केन्द्र (पालोड, कन्नारा, हिरेहल्ली, मोहितनगर, तथा काहिकुची) तथा एक बीज-उद्यान (किडू) एवं एक विश्व नारियल जनन द्रव्य केन्द्र (पोर्ट ब्लेयर) रह गये हैं जो चार प्रान्तो तथा एक केन्द्र शासित प्रदेश में फैले हुए हैं।

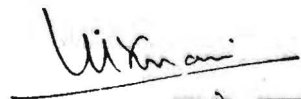
इस वर्ष संस्थान ने 22 अनुसंधान परियोजनाओं के अन्तर्गत 20 उप-परियोजनाओं पर संस्थान के विभिन्न केन्द्रों पर शोध कार्य क्रम चलाया। बारह नवीन परियोजनाएं प्रारम्भ की गईं तथा 13 परियोजनाएं जो गत वर्षों में प्रारम्भ की गईं थीं, बन्द कर दी गईं। इस प्रकाशन में विभिन्न परियोजनाओं से उपलब्ध महत्वपूर्ण परिणामों को प्रस्तुत किया गया है।

केरल, तटीय कर्नाटक, गोआ तथा तटीय आन्ध्र प्रदेश हेतु $WCT \times COD$ संकर नारियल का अनुमोदन; नत्रजन संचित करने वाले बैक्टीरिया पर कार्बनिक अमेडमेंट का अनुकूल प्रभाव पाया गया; केवल नारियल की फसल की अपेक्षा नारियल मिश्रित फसलों से भूमि में फास्फोरस घोलक जीवाणुओं की अधिक उपलब्धता; $MYD \times WCT$ संकर में $MOD \times WCT$ की अपेक्षा अधिक सूखे की सहनशीलता; सूखे की सहन क्षमता वाली कोको के अन्य अभिगमनों की पहचान; कोको के "ब्लेक पाड" रोग का नियंत्रण; लौंग तथा अनन्नास की मौरीसस प्रजाति बरोइंग निमेटोड के 20 सामान्य "आइसोलेट" के प्रति रोगक्षम पाये गये अतः नारियल में मिश्रित फसल हेतु उपयोगी हैं; सुपारी के पत्ती के "सीथ" तथा तेल ताड़ के गुच्छे के अवशेषों का "ओइस्टर" मशरूम के उगाने में प्रयोग तथा नारियल के बीज पदार्थ जिस में "रूट विल्ट" रोग की प्रतिरोधी क्षमता या सहनशीलता हो, के उत्पादन हेतु पराग विधायन प्रयोगशाला की कोटायम में स्थापना, वर्ष की कुछ मुख्य उपलब्धियाँ हैं।

संस्थान ने कर्नाटक के छे सुपारी उगाने वाले जिलों में कर्नाटक के उद्यान विभाग, कृषि विभाग तथा कृषि विश्व विद्यालय, बंगलोर के साथ मिलकर पीत पर्ण रोग (एलो लीफ डिजिज़) का गहन सर्वेक्षण कार्य किया।

कासरगोड

19 अप्रैल, 1990



एम.के. नायर

निदेशक

केन्द्रीय रोपण फसल अनुसंधान संस्थान

कासरगोड

CROP PRODUCTION

Germplasm resources

Cocoa clonal materials consisting of 11 Malaysian and 19 Kew Garden accessions were produced for establishing an alternate cocoa germplasm centre. Soft-wood grafting was more successful than side-grafting and patch budding. The best season for grafting was in August through September. Cross-compatibility studies involving five trees of Malaysian and four of Nigerian origin indicated that all of them are cross-compatible.

Oil palm germplasm now consists of eleven exotic and four indigenous accessions. Initial performance of Nigerian *teneras* was better than those from Ivory Coast. CPCRI material out-yielded the ones from Republic of Zaire. Two *pisiferas* were identified from a segregating population of *tenera* × *tenera*.

Evolving high yielding varieties by selection and hybridization

Under rainfed condition, WCT × COD gave 44.7% more nuts and 54.3% more copra yield over local tall during its 17—20th year at Kasaragod. In Tamil Nadu, it gave 80.3% more nuts and 71% more copra over WCT. In Andhra Pradesh and Maharashtra also, it gave higher yields over the local tall and hence recommended for release in Kerala, coastal Karnataka, Goa and coastal Andhra Pradesh.

The preliminary evaluation of the MAWA (PB 121) planted along with Chandrasankara (COD × WCT) and WCT under rainfed condition indicated that Chandrasankara is superior in nut yield in the initial years. With regard to earliness

in flowering also they were superior to MAWA, having taken 61 months as against 69 months taken by the latter.

In the underplanted arecanut trial, VTL-11 exhibited better growth characters than VTL-3, VTL-17 and Local.

In Oil Palm, 92 d × 30.315p gave the higher yield of 105 kg ffb/palm/year in the comparative yield trial.

An automatic electrically controlled oil palm seed germinator was commissioned at Research Centre, Palode with a capacity of 4 lakh seeds at a time.

Few of the palms in a 20 ha oil palm plantation in Andhra Pradesh in private sector came to flowering in 14 months after planting.

In cocoa, the hybrid combination SCA 6 × IMC 67 and NA 33 × ICS L 14 × IV 20 89 were found to be high yielders.

Tissue Anther, and Cell culture research

A method for making sterile embryo cultures of coconut using very simple portable equipments was developed. Using this all the operations are done in the field and upto 100 embryos can be processed in a test tube measuring 25 × 150 mm. From one batch of embryos processed in the field and cultured on to fresh media, 95% germination was observed.

The entire materials for processing 1000 embryos can be carried in a small brief-case measuring 40 × 30 × 8 cm and weighs only about 4 kg. This method would be very useful for germplasm

collection in coconut as *in vitro* embryo cultures.

Eight tissue cultured oil palm plants planted in January 1989 have flowered.

Nutritional requirement and crop management

The high yielding coconut genotypes, viz., WCT, COD $\times$ WCT and WCT $\times$ COD responded well to fertilizer application both under irrigated and rainfed conditions. The mean yield of nuts at M_1 (500 g N + 500 g P_2O_5 + 1000 g K_2O /palm/year) and M_2 (1000 g N + 1000 g P_2O_5 + 2000 g K_2O /palm/year) levels was however, on par. The mean yield at M_0 , and M_1 , M_2 levels of fertilizer application was 93.7, 142.8 and 154.1 nuts/palm/year, respectively.

In the long term experiment with WCT under rainfed condition, palms receiving inorganic fertilizer + cultivation or inorganic fertilizers + forking of basins only, gave similar yields (84 nuts/palm/year). Palms receiving organics in addition to chemical fertilizers and cultivation yielded 22 nuts more than the above palms.

Increasing nutrient availability and disease alleviation by micro-organisms

Soil amendment with organic materials such as neem-cake, cowdung, coir dust and green manures (*Calopogonium* and *Mimosa*), resulted in 2 to 16-fold increase in the survival of nitrogen fixing *Beijerinckia* as compared to that in unamended soils. Preliminary studies on VAMycorizal colonization in 10 genotypes of coconut revealed higher level of colonization and intensity of infection in drought-tolerant genotypes when compared to that in drought-sensitive genotypes. Population of phosphate

solubilizing micro-organisms was more in different cropping systems as compared to that in monocropping of coconut. The bacterial and fungal isolates solubilized 20–41% and 15–35% of insoluble tricalcium phosphate, respectively, when tested under *in vitro* conditions.

Maximum resting spores of VAM in soil occurred at a distance of 100 cm away from the base of the palm within a depth of 26–100 cm. Maximum colonization was noticed in the fine feeder roots of coconut followed by secondary and main roots. Survey for VAM in coconut in different soil types recorded *Acaulospora bireticulata*, *A. laevis*, *A. trappei*, *Gigaspora aurigloba*, *G. coralloidea*, *G. gilmorei*, *G. margarita*, *G. nigra*, *G. pellucida*, *Glomus faciculatum*, *G. fujianum*, *G. invermaium*, *G. macrocarpum*, *G. microcarpum*, *G. pallidum*, *Sclerocystis coremioides*, *S. rubiformis* and *S. sinuosa*.

Soil fertility, nutrient dynamics and crop productivity

The studies on integrated fertilizer management in coconut gardens indicated that there was no significant difference between different sources of slow release N fertilizers either on soil available N or leaf N content. Between rock phosphate and super phosphate, the former influenced higher available P. Palms receiving N:P tablets had a higher leaf-N content compared to urea treatment. Studies on ammonia volatilization using static trap showed that the N loss from urea was proportional to the quantity of urea applied. Pre-treatment of soils with ammonium sulphate reduced ammonia volatilization loss considerably by activating nitrifiers. Incorporation of urea at a depth of 10 cm was found to reduce N loss to a greater extent. However, the

presence of easily decomposable organic matter in the soil enhanced N volatilization loss upto 28.9%.

Studies on yield-nutrient interactions have shown that the concentrations of N and K and their balance primarily governs the productivity of coconut. The study also showed that the N build up in soil through N fertilization was only marginal, whereas P and K can build up in the soil considerably. The continuous application of chemical fertilizers increased the soil acidity and reduced the soil Mg content. Preliminary studies indicated the importance of Mg:K ratio in governing the Mg nutrition of the palm. Narrow ratios of Mg/K, Mg/Ca and Mg/Na have antagonistic effects on Mg absorption. P and Mg have shown synergistic effect on the absorption of both.

Studies on nutrient dynamics in oil palm have shown that the N concentration in the leaf increases steadily upto 7th leaf beyond which it gradually decreases with age. However, P and K concentrations decrease from 1st leaf to the last leaf. Studies on diurnal variation of nutrients indicated that the concentrations of N, K and Ca progressively increase upto 10–11 a.m. and decrease beyond that period while P and Mg show almost a constant concentration throughout the day.

Skipping of P application to adult coconut palms over a period of 14 years has resulted in the reduction in available soil P from 43.88 ppm (1975) to 12.72 ppm (1989) in the entire core of 0–90 cm feeding zone. Neither the increase in available P due to continuous P application at two levels (160 and 320 g P_2O_5 /palm/year), nor the reduction in available P due to P-skipping had any significant influence on foliar P levels and yield of palms. The

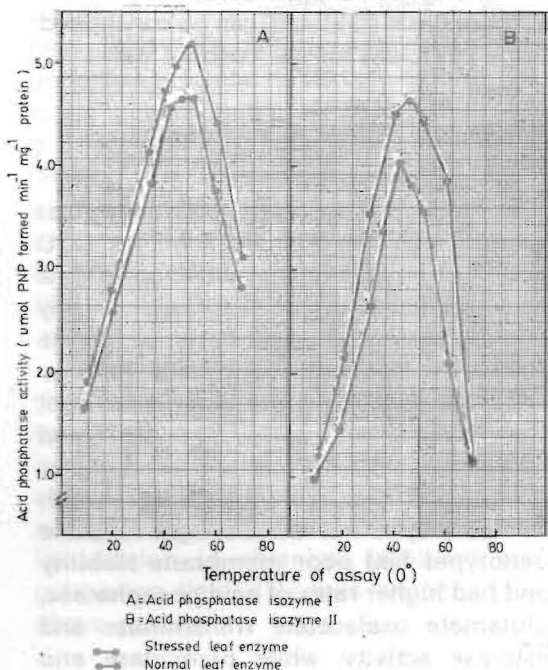
VA Mycorrhizal infection was more in P_0 treatment (79.3%) compared to P_1 (52.1%) and P_2 (47.9%) treatments. The population of P-solubilising bacteria was also higher in P_0 treatment. The study indicates that P application to adult coconut palm can be skipped for 14 years when soil available P (in the feeding zone) is around 40 ppm. A mean available P content of 10-12 ppm (Bray I P) in the coconut basin (0-90 cm) can be considered to be sufficient for the coconut palm.

Water management and stress physiology

Reproductive dry matter production was reduced significantly in WCT, WCT $\times$ COD and COD $\times$ WCT under rainfed conditions as compared to irrigated situations. They could withstand drought better in laterite soils than in sandy loam soils. MYD $\times$ WCT was relatively more drought tolerant than MOD $\times$ WCT and COD $\times$ WCT and had greater stomatal resistance and higher epicuticular wax content coupled with lower transpiration rate. Drought sensitive genotypes had poor membrane stability and had higher rates of acid phosphatase, glutamate oxalacetate transaminase and esterase activity, while peroxidase and superoxidase dismutase registered lower activities during stress development. Studies on the purification and characterization of acid phosphatase (APh) indicated the conformational changes in the APh isozyme-II during stress development as evidenced by the shift in its optimum temperature and Km value towards P-nitrophenyl phosphate. This enzyme also showed the differences in its rate of hydrolysis towards various naturally occurring substrates. Studies revealed that changes in the kinetic properties of the enzyme acid phosphatase occurred during stress development which accounted for its

increased activity during moisture stress in coconut.

Changes in the temperature optimum of acid phosphatase isozyme isolated from normal and stressed coconut leaves



In cocoa, six more accessions including Amel x Na 33 were found to be drought tolerant and these maintained higher leaf water potential during stress.

Production physiology

There was 100% flowering in coconut hybrid MYD x WCT while the corresponding figure for MOD x WCT and COD x WCT was 36% and 21%. Rate of production of leaves and inflorescence also followed the same order. The mean cumulative yield of nuts of the bearing palms was 18.1 for MYD x WCT, 15 for COD x WCT and 5.5 for MOD x WCT.

Perennial crop based farming systems

Mixed farming system in 1.04 ha coconut garden yielded 11,276 coconuts, 60 kg pepper, 250 kg banana and 14,495 litres of milk. The total revenue from the farming system was Rs.67,705 and expenditure including the cost of family labour was Rs.24,051 resulting in a net income of Rs.43,654. Brinjal, Amaranthus and Snake-gourd during kharif, Bottlegourd in rabi, Brinjal, Amaranthus and Chilli in summer, were found to be remunerative vegetable intercrops under Kasaragod conditions. Soybean varieties PK 472, MACS 13 and MACS 48 also are highly promising intercrops in this tract.

CROP PROTECTION

Root (wilt) disease of coconut

Nucleic acid-rich spots in extra nuclear sites indicative of MLO presence were made out in salivary glands of lace bug and plant hopper vectors.

For accelerating the production of field

tolerant/resistant coconut material against root (wilt), a pollen processing laboratory has been set up at Kottayam during June 1989. This laboratory would monitor the hybridization work undertaken in the hot-spot areas, on resistance breeding..

Stem bleeding disease of coconut

Histopathology studies of affected stem tissues showed that the causal agent attacks mainly the soft parenchymatous tissues in the periphery of the stem. A method consisting of inoculation of old leaf frond pieces with air dried, sieved infective soil and subsequent retrieval of the fungus from lesion margins using cane juice agar after 10 days of incubation was standardized to isolate *Thielaviopsis paradoxa* from soil.

Thanjavur/Ganoderma wilt

Fluorescent antibody technique was successfully used with two isolates (Kadur and Arsikere) of *Ganoderma* on coconut. Study of coconut and arecanut isolates of *Ganoderma* showed variation in the size of basidiospore and also serological reaction.

In the field control trials against *Anabe* of arecanut, diseased arecanut palms in the early stage of infection responded well to calixin (1.5%) root feeding.

Yellow Leaf Disease of arecanut

Mycoplasma-like Organisms were observed in yellow leaf disease suspected palms of Sullia and Vittal.

Two experimental areca seedlings inoculated with *Proutista moesta* indicated positive transmission.

The foliage of mid-and outer whorls of diseased palms exhibited significantly higher diffusive resistance, leaf-water potential and decreased transpiration rate than similar leaves from apparently healthy and healthy palms during symptom expression period. Similarly, accumulation of total sugars, reducing sugars and starch was observed in diseased palms during the

period of symptom expression indicating alteration in metabolism.

Disease management

Fortnightly spraying of Bordeaux mixture and monthly spraying of Copper oxychloride and Ridomil-Mancozeb were effective in reducing black pod disease of cocoa. 'Mangala' was found to be least susceptible to leaf spot disease of areca followed by VTL-12 and Sreemangala while Sirsi Local and Sumangala respectively were highly susceptible.

None of the pepper isolates of *Phytophthora* were pathogenic on arecanut.

Pest management

Within two years of introduction of the viral pathogen baculovirus of *Oryctes* for biosuppression of the coconut rhinoceros beetle to Androth, Lakshadweep, the leaf infestation of palms declined from 55% to 14%, spathe damage from 7.3% to 3.2% and fresh incidence on spindle from 23.5% to 5.9%. There was drastic decline in site occupancy of the pest in breeding places as well. The percentage of baculovirus disease infection in the natural population of the pest rose to 60.60%.

Impact of re-release of baculovirus in an already infected contiguous area evaluated at Chittilappally, Trichur district in Kerala, revealed reduction in percentage of leaf damage from 34.44 to 23.76, spathe damage to nil from 12.5%, and fresh incidence to 50% from 68.18%, eight months after rerelease of the virus. In the oil palm plantation at Palode also there was reduction in pest infestation from 8.2% (June, 1986) to 1.8% (June, 1989), three years after re-release of baculovirus.

It was revealed that there was significant

correlation between the population density of predacious mites, Phytoseiidae and Cunaxidae, the natural enemies of the phytophagous mite *Oligonychus isilemae* with maximum temperature and rainfall. Maximum temperature (32-34°C) favoured build-up of population. Even though low relative humidity (88.5-91.5%) also favoured build-up, the results were not significant. Predators and rainfall regulated the population. Almost 71% of variations in population could be attributed to predators and weather factors ($R^2 = 0.706$).

Among the natural enemies of *O. isilemae*, two species of phytoseiid predators viz., *Amblyseius paraerialis* and *A. eucalypticus* dominated with a predator-prey ratio of 1:7.4. The build-up of predator coincided with that of the prey population and the peak period was during May.

Correlations of populations of areca spindle bug *Carvalhoia arecae* with weather parameters revealed that maximum temperature was negatively correlated, while minimum RH% showed positive correlation with spindle bug population.

For the control of *Halyomorpha marmorea*, endosulfan 0.05% was found to be most economical followed by Methyl parathion 0.05% and fenvalerate 0.02%.

Vertebrate pest management

The black rat, *Rattus rattus wroughtoni* developed bait shyness to acute poison such as zinc phosphide from the 3rd day of exposure. Such bait shyness persisted for 15 days in the animals.

The white-tailed wood rat, *Rattus blanfordi* Thomas was recorded as a pest of cashew for the first time. This rat was

observed to gnaw the cashew shell readily and feed on the kernel. Each animal was observed to damage/feed on 5.7 nuts per day.

Integrated nematode management

The studies on the pathogenicity of the burrowing nematode, *Radopholus similis* on coconut showed that an initial inoculum of one nematode in 35,640 cm³ of soil or 100 nematodes per seedling causes 50 per cent reduction in the production of inflorescences and 58 per cent reduction in the total number of nuts produced at the end of 7 years apart from the delay in flowering by six months. All the palms that received more than 100 nematodes per seedling have not flowered so far and exhibit considerable reduction in various growth parameters.

The cyst-forming nematode *Heterodera oryzicola* and lesion nematode, *Pratylenchus coffeae* either alone or in combination were found to be pathogenic to *Nendran* banana grown as intercrop in coconut gardens even with an initial inoculum level of 2500 nematodes per plant.

Clove var. local and pineapple vars. Mauritius and Kew are immune to all the 20 isolates of *R. similis* collected from Kerala, Karnataka and Tamil Nadu. Hence, these could be grown as intercrops in the burrowing nematode infested areas in coconut and arecanut-based farming systems.

Sugarcane var. Co 997 was found to be resistant to *R. similis*.

Regular pre- and post-monsoon application of phorate at recommended doses brought down the population of

plant parasitic nematodes significantly in arecanut crop mixed with banana and pepper.

A survey of the plant parasitic nematodes associated with coconut, arecanut, oil palm and cocoa was conducted in Karnataka. Burrowing nematode was the only endoparasite

recorded from coconut, arecanut and oil palm, while cocoa roots were free from them. Coconut root zone harboured 11 different genera of plant parasitic nematodes, oil palm—19, and cocoa root-zone 5. Of these, *Helicotylenchus* was common in all three cases while *Rotylenchulus reniformis* was also recorded from coconut and oil palm.

HARVEST AND POST-HARVEST TECHNOLOGY

Mushrooms on palm waste products

Freshly fallen areca leaf sheath has been found to be a promising substrate for cultivation of oyster mushroom (*Pleurotus sajor-caju* Fr. Singer). Polythene bags of size 55 cm x 40 cm containing 4 kg of shredded fresh areca sheath could produce on an average 474 g of mushroom per bag.

Edible mushrooms *Pleurotus sajor-caju* and *P. florida* registered better yield on oil palm mesocarp than bunch refuse waste (35% conversion), whereas *Volvariella volvacea* performed better on oil palm bunch refuse than on palm mesocarp waste.

Making ball copra by artificial means

Subjecting fully mature, partially dehusked coconuts to intermittent heating in the 'small holder's dryer' prior to storing in gunny bag helped to turn out 95% of the nuts into good quality ball copra within 3½ to 5 months as against the 9—11 months period required under conventional method. The copra thus produced had lower microflora infestation and yielded superior quality oil.

Fabrication of solar dryer using 'SUNSHEET'



Modified Solar dryer
Using selectively coated aluminium absorber sheet.

The CPCRI solar dryer was modified by replacing the galvanized iron sheet drying surface with a "selectively coated solar aluminium absorber sheet" which helps to raise the temperature inside this dryer by 25° higher than the ambient and reduce the R.H. by 22% less than the ambient. The insulation of the drying surface was provided by lining with less hygroscopic thermocol instead of coir pith. The capacity of the dryer is 80—100 nuts, the drying time taken is 20 hrs (2½ to 3 days) and the

cost of drying per kg of copra works out to be 75 Paise only. The copra samples showed that the population counts of fungi, bacteria and lypolytic micro-organisms per gram of copra were of the order of 0, 5.82×10^2 , 2.45×10^2 , respectively as against the order of 7.75×10^2 , 17.18×10^2 and 5.4×10^2 , respectively, seen in sun-dried samples.

Low cost, portable, green cardamom dryer

A low cost green cardamom dryer of capacity 50 kg of fresh cardamom per batch, using agricultural waste as fuel has been developed. An exhaust fan is provided to remove humid air from the drying chamber. This exhaust fan can be removed away from the outlet of the humid air when power supply is not available. This dryer can also be operated without fan. It dries the cardamom in 30 to 32 hrs by using 25 kg of firewood as fuel, when it is operated with the exhaust fan. Otherwise the drying time is increased to 34-36 hrs and fuel

consumption is decreased to 21 kg of firewood. The cost of the dryer is Rs.55000/- and the exhaust fan along with the fitting is Rs.1500/-. The cost of drying of one kg of fresh cardamom is Rs.1.24 when operated with the fan, and Rs.1.12 without it. The increase in the cost of drying can be compensated by getting premium price for good quality of the produce. The dryer is more useful for marginal and small holdings. It will be suitable for large holdings also during the lean season of harvesting. This dryer can be transported easily from one place to another. The dryer can also be used to dry other spices.

Storage studies on copra

Copra, with a moisture content corresponding to 70% and above of relative humidity cannot be stored for long periods. Copra stored in tins or polythene bags saturated with biogas, neem leaf gas, sulphur dioxide or carbon dioxide was of better quality than that stored in gunny bags or bamboo bins.

REFINEMENT OF EXPERIMENTATION TECHNIQUES IN PLANTATION CROPS

Critical examination of the yield data from experimental plots showed that border effect is significant in coconut field experiments. Border palms in rainfed plots are benefitted by the irrigation given in

adjoining plots. Similarly, palms in the non-experimental border rows are found to behave differently from the experimental palms in inner rows.

ECONOMICS

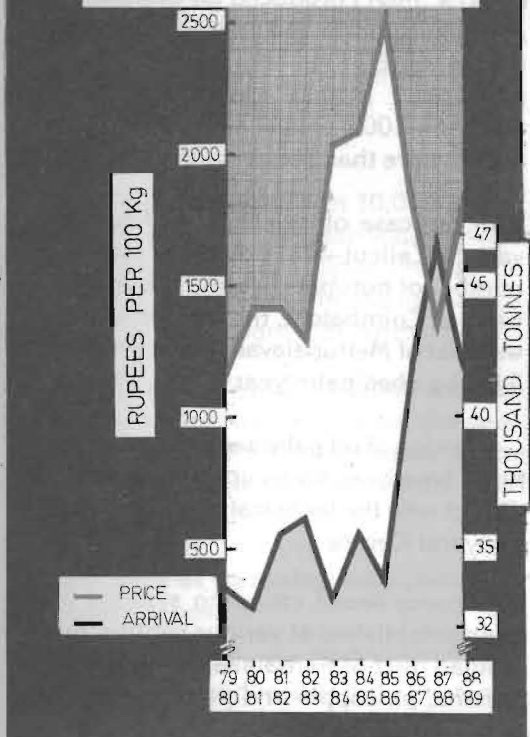
Economic analysis of arecanut sector

During the year 1987-88, the production of arecanut in India registered an increase of 88,000 tonnes over the

1970-71 figure. The economic analysis reveals that the relative shares of area expansion and productivity increase effects to the rise in production of arecanut were 26.74 per cent and 45.73 per cent,

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AVERAGE ANNUAL PRICES AND MARKET ARRIVALS OF ARECANUT AT MANGALORE APMC



respectively, while the interaction effect was found to be 27.53 per cent. The significant contribution of the research input in the production sector of arecanut in the Yellow Leaf Disease-free areas is well established through this analysis.

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON PALMS

Crop improvement

In coconut, a total of 224 accessions comprising of 94 indigenous and 130 exotic are available in the different centres. At Ambajipet, Chandrakalpa (Ladshadweep Ordinary) produced an average yield of 122 nuts/palm/year followed by Andaman Ordinary (121). At

The compound growth rate (CGR) of arecanut production in India during the decennial ending 1987-88 is estimated at 2.17 per cent per annum. However, the production trends in respect of the leading arecanut growing states reveal that the CGR was 3.61 per cent in Assam, 1.80 per cent in Karnataka and (-) 1.29 per cent in Kerala during the period under reference. The negative growth rate in arecanut production in Kerala could mainly be attributed to the severity of the YLD in this state.

Despite the higher growth in arecanut production, the growth in the prices of the processed nuts is positive and significant. The CGR for the prices of matured, dried and dehusked nuts (*Chali* or *Supari*) in Mangalore market was 4.50 per cent per annum during the decennial ending 1988-89, while it was as high as 10.75 per cent for the processed tender nut (*SARAKU*) in Shimoga market. This trend suggests that the scented betel nut (*PAN MASALA*) manufacturing industry has created a sizeable demand for the processed tender nuts.

Figure 3 shows the average annual prices and market arrivals of arecanut in Mangalore market.

Ratnagiri also, Chandrakalpa maintained the highest mean yield of 154 nuts for 10 years followed by Banawali Green Round giving 148 nuts. Chandrakalpa ranked highest for oil percentage in copra (74.2%), highest for oil production/palm (16.05 kg) and highest oil production per hectare (2808.82 kg.). At Veppankulam, genotypes

Kappadam, Spicata, Lakshadweep Micro and Kanyakumari Green gave more than 20% increased yields when compared to East Coast Tall.



'Chandra Kalpa'



Well established oil palm plantations in west Godavari district of Andhra Pradesh.

When performance of the new crop combinations were compared, VHC-2 (ECT × MDY) produced an average yield of 130 nuts/palm during the year followed by VHC-1 (ECT × DG) giving 115 nuts/palm. WCT × CDG recorded an average yield of 100.4 nuts/palm/year which is 159% more than the average yield of ECT.

In the case of arecanut, at Andamans, variety Calicut—31 produced maximum number of nuts/palm during the year (497) while at Coimbatore, the best performance was that of Mettupalayam Local which gave 3.89 kg *chali*/palm/year.

Planting of oil palm seedlings in farmers' fields have been taken up in West Godavari district with the technical support of AICRP Vijayara Centre.

Coconut-based cropping systems have been established at various centres. In the Maidan tract of Karnataka, performance of banana, pineapple and pomegranate was good as mixed crops in coconut. At Kahikuchi, Veppankulam and Ratnagiri all the crop-mixed blocks registered increase in coconut yield.

Button shedding was found to decrease in palms receiving drip irrigation at Veppankulam.

Disease and pest management

In East Godavari district of Andhra Pradesh, of the 6627 palms identified as Tatipaka disease affected, 2676 have been confirmed and these were eradicated by the State Horticultural Department. MLOs were found to be constantly associated in tissues of Tatipaka disease affected palms. Rhinoceros beetles collected at Ambajipet subjected to electron microscopic studies revealed the presence of Baculovirus in 16 out of 30 beetles.

Transfer of technology

Training on oilseed production technology was imparted to State Agricultural Department officers at Udumalpet and Pollachi. Classes were also taken by experts to farmers at Puthukottai, Madukur, Muthupettai and Peravirani.

In addition, at Ambajipet 10,000 hybrid seeds of ECT $\times$ Gangabondam were produced for raising seedlings. Production of cross-combinations involving Gangabondam are in progress at Ambajipet.

At Aliyarnagar, a total of 12000 coconut seedlings were produced during the year. In addition, 4000 nuts were sown in the nursery for seed production and distribution.

Production of parental materials and breeders stock

During the year, over 50,000 WCT seed coconuts were produced at Kidu Farm and distributed. Over 86,000 nuts and 1608 seedlings of COD, 540 seednuts and 125 seedlings of Chandrakalpa (LO), 240

seedlings of Andaman Ordinary, 900 seednuts and 80 seedlings of Malayan Yellow Dwarf were supplied to seed-gardens of Oilseeds Department of Tamil Nadu and CSF, Aralam, and East Coast Coconut Hybrid Centre. Another batch of 200 Andaman Ordinary was supplied to Kerala Agricultural University. Besides this, 1,235 hybrid seedlings and 1,356 cultivar seedlings were supplied to farmers.

In arecanut over 1,50,700 seednuts and 82,000 seedlings in the three released cultivars were supplied from Kidu farm to areca growers.

In the cocoa biclonal orchard, over 50% of the plants have flowered so far.

In oil palm, *tenera* hybrids came to flowering in 15 months time under irrigated condition in West Godavari district of Andhra Pradesh. Over 49,000 sprouts and one thousand seedlings have been distributed during the year in the states of Andhra Pradesh, Tamil Nadu and Karnataka.

TRANSFER OF TECHNOLOGY

During the Year, out of 12 regular training courses scheduled for 1989-90, 11 were organized for 106 officials from 10 states and two Union Territories. The analysis of the pre- and post-evaluation tests conducted revealed that the overall mean performance score of 28.9% in the pre-evaluation has been increased to 61.2% in the post-evaluation, which clearly indicates the effectiveness/usefulness of the programmes.

One of these was organized in collaboration with the Asian Pacific Coconut

Community on agro-economic aspects and extension methodology for intercropping in coconut during 27th March to 7th April, 1989 at Kasaragod for four officers from Indonesia, Papua New Guinea, Micronesia and Sri Lanka.

In addition to scheduled training programmes, special courses on hybridization in coconut for 9 officials, pest and disease management of coconut for 41 unemployed youths of Kerala, oil palm production technology for 18 farmers from Karnataka and Andhra Pradesh and 30

agricultural officers from Kerala were organized during the year under report.

It has been observed that in the existing demonstration plots on mixed cropping and mixed farming at Kasaragod the farmers could realise an yield increase in coconut of 10% and 55% respectively. The net income from coconut based mixed cropping plot at Kasaragod in an area of 0.25 ha was worked out to be Rs.11,336/-.

A total of 27 root (wilt) affected and four senile/unproductive coconut palms were removed from the Operational Research Project area by giving compensation of Rs.150/- and Rs.100/- per palm, respectively.

For the benefit of the farmers and extension workers, two Kisan melas were organized at CPCRI, Regional Station, Kayangulam during 4—6 January, 1989 and ICAR Research Complex for Goa during 14—15 February, 1989. A total of nine exhibitions were also arranged in

different parts of the country during the period under report.

Scientists of this Institute gave 15 radio talks on AIR and four talks on TV on plantation crop technologies in different languages and assisted in shooting a video film on package of practices for coconut by M/s. Madras Fertilizers Ltd., Madras.

During 1989-90, the Institute has revised and printed four pamphlets, brought out eight new folders and three leaflets on different aspects of plantation crops management.

The Institute entertained a total of 647 farmers, 2348 students, 468 officials and 23 foreigners at different centres and explained to them the various research and developmental activities which are in progress. Apart from this, a total of 535 queries on different aspects of plantation crops farming were answered by the scientists during the period.