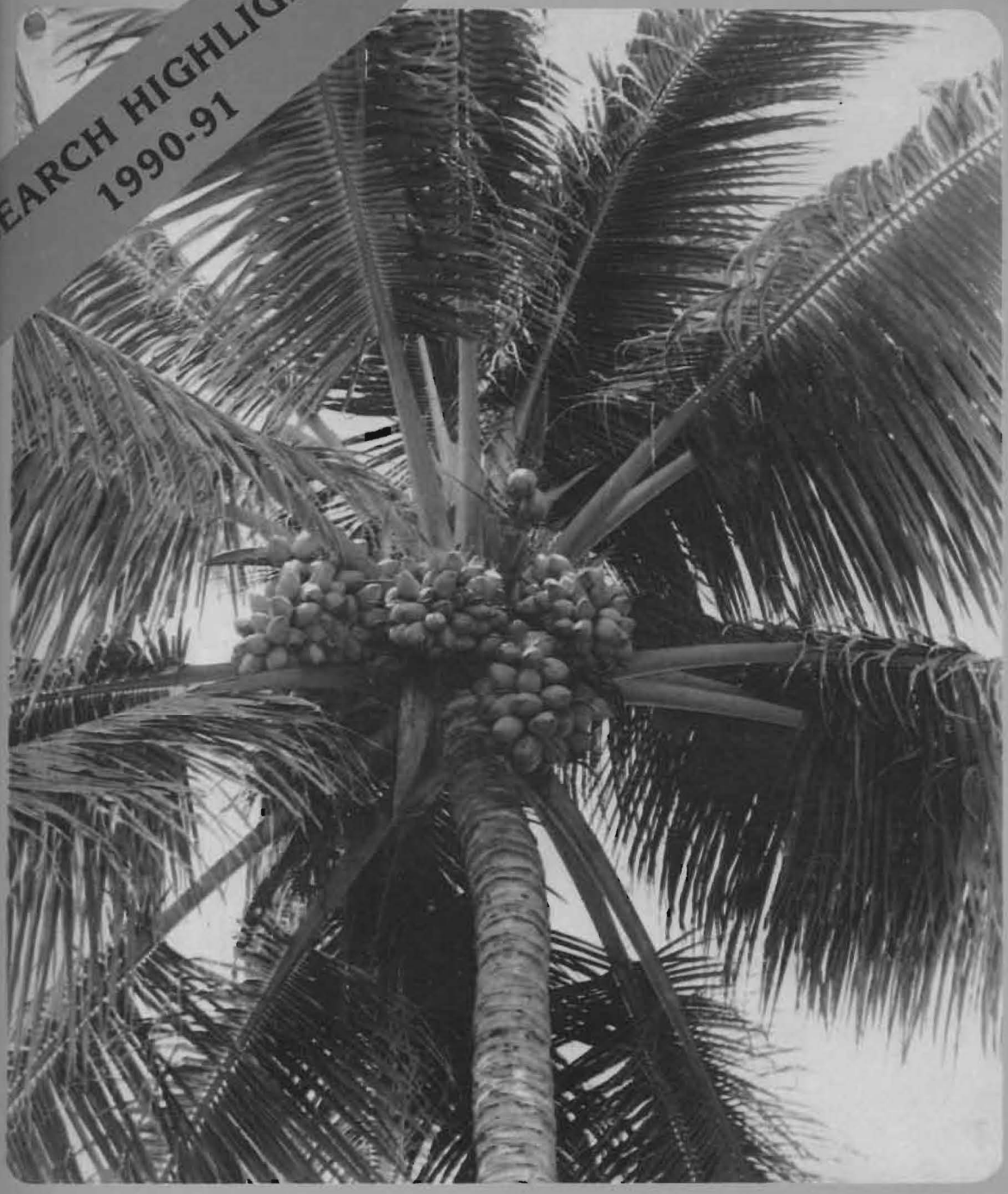
SEARCH HIGHLIGHTS 1990-91



भाकृअनुप
ICAR

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

RESEARCH HIGHLIGHTS 1990-91

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M.K. Nair
Director,
Central Plantation Crops Research Institute,
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Compiled and edited by

George V. Thomas and A.R.S. Menon

Photographs by

M. Narayanan

Cover design by

M.B. Sukumaran

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Laccadive Micro, a high yielding Tall coconut cultivar
from Lakshadweep Islands with highest oil percentage (75%)
and valued for ball copra

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INTRODUCTION

Consequent on the delinking of research on spices and cashewnut from the Central Plantation Crops Research Institute, the mandate of the Institute has been suitably modified to conduct basic research on all aspects of production and protection technologies of coconut, oilpalm, arecanut and cocoa and palm based cropping systems for sustainable production. In addition, the Institute, also co-ordinates adaptive research work on these crops by generating breeding materials, production of nucleus planting materials and provides consultancy and advisory services, towards rapid dissemination of proven technologies. The major research achievements of the year 1990-91 are presented in the following pages of this publication.

During the year, the Institute continued to undertake research programmes in 77 research projects operating at the Headquarters, two regional stations, five research centres, one seed farm and the World Coconut Germplasm Centre at Siphighat. Keeping in view the present policy decision of the ICAR to progressively increase basic research component in our programmes, during the year six projects were closed and four new projects were undertaken.

On the research front, the following are the major achievements of the Institute during the year:

Elaeis oleifera and four other accessions of oilpalm were added to the germplasm assemblage at Palode. An alternate centre for cocoa germplasm assemblage was established at the CPCRI Research Centre, Kannara. A method for multiplication of cocoa through somatic embryogenesis in juvenile cotyledon tissue cultures was also developed.

Higher water use efficiency has been shown by drought tolerant hybrids viz. LO × GB and LO × COD, in comparison with drought susceptible cultivars.

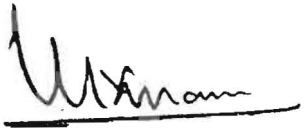
Critical examination of tender roots and rachilla tissues of root (wilt) affected palms ruled out conclusively the involvement of flagellates in the disease. A massive breeding programme is in progress in the 'hot spot' areas around Kottayam and Kayangulam to generate coconut genotypes resistant/tolerant to root (wilt) disease.

For the first time *Rhizopus stolonifer* is being reported as an antagonist against *T. paradoxa*. Further evidences on the vectoral role of plant hopper *Proutista moesta* has been accrued in transmission of yellow leaf disease of arecanut.

A rapid method for conversion of puny nuts into ball copra with lower microflora infestation has been developed.

Correlation studies revealed that the prices of edible oils move very closely with each other as these oils are vulnerable to substitution to a certain extent.

Besides these, the Institute also contributed towards large scale production and distribution of parental materials and breeder's stock in coconut, oilpalm, arecanut and cocoa.



(MK NAIR)
Director
Central Plantation Crops Research Institute, Kasaragod

Kasaragod
5 April, 1991

भूमिका

मसालों एवं काजू सम्बन्धित अनुसंधान के केन्द्रीय रोपण फसल अनुसंधान संस्थान से पृथक हो जाने के फलस्वरूप, इस अनुसंधान संस्थान का विधिक आदेश यथायोग्य परिवर्तित किया गया है । संस्थान का वर्तमान विधिक आदेश नारियल, तेल ताड, सुपारी एवं कोको के उत्पादन तथा सुरक्षा सम्बन्धित तकनीकियों के समस्त पहलुओं पर अनुसंधान करना और ताड-आधारित फसल पद्धतियों का जीविकोपार्जन हेतु विकसित करना हैं । इसके अतिरिक्त संस्थान इन फसलों के अनुकूल अनुसंधान कार्य का समन्वयन प्रजनक बीजों, नाभिक रोपण सामग्री के उत्पादन, तथा प्रमाणित तकनिको को शीघ्र फैलाने हेतु सलाह एवं परामर्श देना है । वर्ष 1990-91 में अनुसंधान की प्रमुख उपलब्धियाँ इस प्रकाशन में प्रस्तुत की गई हैं ।

संस्थान वर्ष में 77 अनुसंधान परियोजनाओं में मुख्यालय, दो क्षेत्रीय स्टेशनो तथा पाँच अनुसंधान केन्द्रों, एक बीज उद्यान तथा विश्व जनन द्रव्य संग्रह केन्द्र, सिपीघाट में कार्यरत रहा । परिषद् की वर्तमान नीति को ध्यान में रखते हुए अपने मूल-आधिरित अनुसंधान कार्यक्रम बढ़ाने हेतु छः परियोजनाओं को बन्द कर दिया तथा चार अनुसंधान परियोजनाए प्रारम्भ की गई ।

अनुसंधान के अग्रिम में संस्थान की निम्नाकित वर्ष की प्रमुख्य अपलब्धियाँ हैं ।

पालोड में तैल-ताड के जनन द्रव्य में *इलाइस ओलीफेरा* तथा चार अन्य *एक्सेशन* की वृद्धि की गई । कोको जनन द्रव्य हेतु कन्नारा में एक एकान्तर केन्द्र की स्थापना की गई । कोको के गुणन की विधि *सोमेटिक इम्ब्रियोजिनेसिस* द्वारा नये बीजपत्रों के टिश्यू कल्चर द्वारा विकसित की गई ।

सूखे की क्षमतायुक्त एल.ओ. × जी.बी. तथा एल.ओ. × सी.ओ.डी. संकर में अन्य सूखे की सहन क्षमताहीन प्रजातियों की तुलना में जल उपयोगिता अधिक पाई गई । रूट (विल्ट) ग्रसित नारियल के वृक्षों के कोमल मूलों एवं पुष्पशाखा के गहन अध्ययन से निर्णायक रूप में सिद्ध हुआ कि इस रोग से *फ्लेजिलेट* सम्बन्धित नहीं है । रोग प्रवल क्षेत्रों कोट्टयम तथा कायंगुलम के आस-पास संपुंजित कार्यक्रम रूट (विल्ट) रोग रोधक संतति के जनन में चल रहा है ।

राइजोपस स्टोलोनीफर सर्वप्रथम उल्लेखित किया जाता है कि यह *थीलिओबसिस पैराडाक्सा का* विरोधी है । सुपारी के पीत पर्ण रोग (एलो लीफ डिसीज़) में पादक फुदक (कीट) *प्रोटिस्टा मोइस्टा* की रोग वाहक भूमिका पुनः प्रमाणित की गई ।

बहुत छोटे नारियलों से शीघ्रातिशीघ्र बाल कोपरा (सूखे नारियल) बनाने की विधि विकसित की गई जिस में सूक्ष्म चादप का न्यूनतम प्रकोप हो ।

अध्ययन से ज्ञात हुआ कि खाद्य तेलों का मूल्य परस्पर आधारित रहता है क्योंकि ये तेल एक दूसरे के स्थान पर प्रयोग किये जा सकते हैं ।

इसके अतिरिक्त, संस्थान ने नारियल, तेल ताड़, सुपारी तथा कोको के मैत्रिक एवं जनक बीजों के बड़े पैमाने पर उत्पादन तथा वितरण में भी महान योगदान दिया है ।

एम. के. नायर.

(एम.के. नायर)
निदेशक
केन्द्रीय रोपण फसल अनुसंधान संस्थान
कासरगोड

कासरगोड
5 अप्रैल, 1991

CROP IMPROVEMENT

Germplasm resources

Among 16 coconut cultivars planted in 1972, Laccadive Micro yielded more number of nuts and copra than West Coast Tall (WCT), the average yield being 128 nuts/palm/year in Laccadive Micro compared to 57 nuts in WCT. Copra out turn was 14.9 kg/palm/year in Laccadive Micro and 10 kg in WCT. Studies on 24 Pacific Ocean accessions planted at World Coconut Germplasm Centre, Andamans indicated that Niu Ui from Tonga among the Talls and Niu Drau from Fiji among the Dwarfs had maximum copra content per nut (253 g and 125 g/nut respectively).

Leaf phenol analyses of 31 genotypes from nine geographical locations indicated that there was large variation in the leaf polyphenol levels in different coconut cultivars ranging from 2.91 mg/g in Seychelles to 11.39 mg/g in Kappadam on fresh weight basis.

1.0,1.5 and 2.0 l/ha amounting to 32 l p[illegible] day was found to be insufficient to mobilise adequate N from urea and NP tablets when applied to littoral sandy soils.

Increasing nutrient availability and disease alleviation by micro-organisms

The nitrogenase activity per plant increased to a maximum of 36.83 and 10.04 μM C_2H_4 h^{-1} in green manure legumes, *Mimosa invisa* and *Calopogonium mucunoides* respectively, four months after sowing in coconut basins, and declined thereafter. A comparative study of nitrogenase activity in coconut roots under enrichment culture revealed higher activity in COD × WCT when compared to that in

A descriptor for 32 accessions of arecanut has been prepared.

An alternate centre for cocoa germplasm has been established at CPCRI, Research Centre, Kannara, Kerala. The cocoa accession Landas - 365 was found to be a potential genetic source for higher mean pod weight (463.2 g) as well as higher wet and dry bean weight. It is also characterised by low proportion of husk (62.8%) and high pulp content (10.2%).

Evolving high yielding varieties by selection and hybridization

The comparative evaluation of progenies obtained from Chowghat Orange Dwarf (COD) by four different methods of pollination, viz., selfing, open pollination, emasculation and controlled pollination with West Coast Tall (WCT) indicated that hybrids from controlled pollination were superior and gave highest cumulative yield

of fertilizers. Among the three genotypes, WCT exhibited higher level of colonization by VAM than the two hybrids. The extent of root mycorrhizal colonization was greater in irrigated palms when compared to that in rainfed palms. *Glomus macrocarpum* was the predominant VAM species under different management treatments in coconut.

Stress and production physiology

The net photosynthetic rate decreased during the stress period to different degrees in coconut genotypes, the reduction being more in drought susceptible than in tolerant genotypes.

In the secondary selection experiment for purification of arecanut variety Mangala by *inter se* pollination, more than 76% palms were typical in 10 out of 15 combinations, and in three combinations 100% Mangala palms were recovered. The Mohitnagar cultivar was found to yield higher than Mangala at Kidu Farm.

In the comparative yield trial of *dura* × *pisifera* combinations of oil palm planted in 1976, 92 d × 30.103p, 61d × 30.4336p, 120d × 30.103p and 65d × 30.103p gave higher yields of 161, 155, 148 and 142 kg of ffb/palm/year, respectively than others.

In cocoa, the hybrid I-14 × IV-20 gave the highest cumulative yield of pods (73.5) among the 17 hybrids evaluated.

Tissue, anther and cell culture research

Callus and somatic embryo induction were achieved in coconut leaf tissue cultures on a modified MS medium within one month after inoculation. Attempts are being made for obtaining germination of these embryoids.

Callus and green coloured somatic embryos were obtained from the leaf and leaf base explants of two and a half year old oil palm seedlings cultured in a modified MS medium with high auxin (25 mg/l 2, 4-D) level. The callusing started after 6-8 months of inoculation and subsequent subculturing in the same medium.

Two more tissue culture-derived oil palm plants planted in January 1989 have flowered. All the ten clonal palms planted at Kasaragod during 1987-88 have started setting fruits.

A method for multiplication of cocoa through juvenile tissue cultures was also developed. Young cotyledonary explants of cocoa excised from immature seeds were surface-sterilized and inoculated in a modified MS semi-solid medium with NAA (0.5 mg/l) BAP (0.5 mg/l) and coconut water (15%). Embryonic callus and somatic embryos were produced after 2-3 subcultures. These embryoids developed into small plantlets with root and shoot when they were transferred to MS liquid media with Zeatin (0.5 mg/l) and Kinetin

CROP PRODUCTION

Soil fertility, nutrient dynamics and crop productivity

Studies on the decomposition pattern of cocoa leaf litter by the nylon bag technique indicated a reduction in biomass over periods of 2, 4 ,6, 8, 10 and 12 months to the extent of 19.1, 33.5, 42.1, 49.5, 53.8 and 55.8 per cent respectively. Nutrient release from the decomposing leaf litter was gradual, and progressively increased for N and P, whereas 75.5 per cent of K was released within two months when the study was initiated in June. Decomposition studies indicated that even after one year following fall of cocoa leaf litter it remained as a potential source of N and P.

In coconut and vegetable intercropping trials, the nutrient removal from the system by amaranthus, bitter gourd, brinjal, snake gourd and cowpea together was estimated to be in the range of 36-82 kg N/ha, 10-18 kg P/ha and 15-36 kg K/ha.

Drip irrigation at discharge rates of 1.0,1.5 and 2.0 l/ha amounting to 32 l per day was found to be insufficient to mobilise adequate N from urea and NP tablets when applied to littoral sandy soils.

Increasing nutrient availability and disease alleviation by micro-organisms

The nitrogenase activity per plant increased to a maximum of 36.83 and 10.04 μM C_2H_4 h^{-1} in green manure legumes, *Mimosa invisa* and *Calopogonium mucunoides* respectively, four months after sowing in coconut basins, and declined thereafter. A comparative study of nitrogenase activity in coconut roots under enrichment culture revealed higher activity in COD x WCT when compared to that in WCT, COD and WCT x COD. The phosphate-solubilising bacteria belonged to three genera viz. *Bacillus, Micrococcus* and *Pseudomonas* and the P-solubilizing fungi were identified as *Aspergillus, Penicillium* and *Fusarium* spp. in coconut-based cropping systems.

A study on five drought tolerant and five susceptible cocoa genotypes belonging to the Nigerian accessions revealed a higher percentage of VAM incidence and infection grading in roots of drought tolerant plants throughout the year. The same trend was observed with regard to spore density in soil also. Spore production and infection grading were highest in November and July respectively, in both the groups.

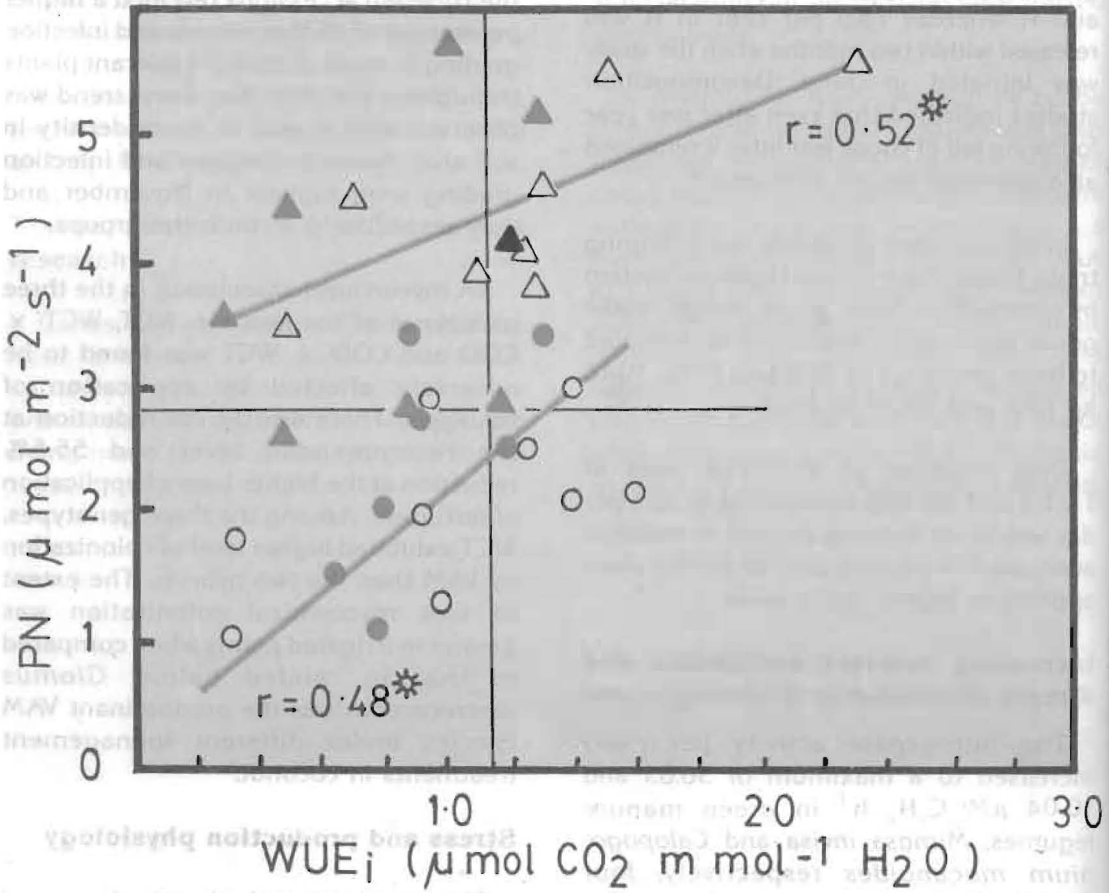
VA mycorrhizal association in the three genotypes of coconut viz. WCT, WCT x COD and COD x WCT was found to be adversely affected by application of fertilizers. There was 32.7% reduction at the recommended level and 55.5% reduction at the higher level of application of fertilizers. Among the three genotypes, WCT exhibited higher level of colonization by VAM than the two hybrids. The extent of root mycorrhizal colonization was greater in irrigated palms when compared to that in rainfed palms. *Glomus macrocarpum* was the predominant VAM species under different management treatments in coconut.

Stress and production physiology

The net photosynthetic rate decreased during the stress period to different degrees in coconut genotypes, the reduction being more in drought susceptible than in tolerant genotypes.

The drought tolerant hybrids LO × GB and LO × COD showed higher water use efficiency as compared to drought susceptible GB and COD. The former group also had high lipid peroxidation. Application of high dose of fertilizers with 2000 g K_2O tended to increase drought tolerance through increased soil moisture availability and regulated stomata. MYD × WCT maintained its superiority in leaf and inflorescence growth and nitrate reductase activity. This hybrid also possessed drought tolerant characteristics.

The instantaneous water use efficiency (WUE) was positively correlated with net photosynthetic rate in cocoa (P = 0.05). Instantaneous WUE was higher in drought tolerant accessions especially during the period of post-monsoon recovery. The drought tolerant accessions maintained higher membrane stability than the susceptible accessions. Lipid peroxidation was also lower under rapid stress development which may contribute to membrane integrity.



Relationship of photosynthetic rate and instantaneous WUE of drought tolerant and susceptible cocoa in October and April

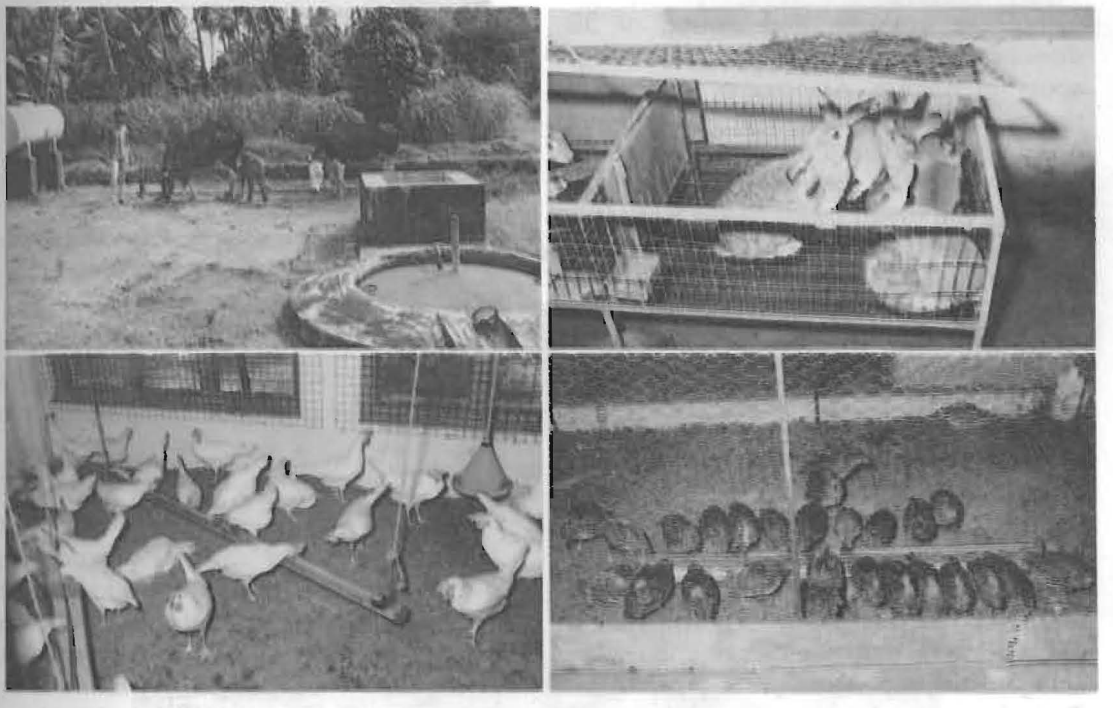
△ — October ▩ — Drought tolerant

○ — April ■ — Drought susceptible

Perennial crop based farming systems

The second generation mixed farming unit started in 1989 in a 30 years old coconut garden yielded 16,787 coconuts, 250 kg banana, 530 kg live poultry birds, 87.5 kg rabbits, 7990 poultry eggs and 3768 quail eggs during the year. The total revenue from the farming system was Rs. 1,41,495 and expenditure excluding cost of family labour was estimated at Rs. 84,445 resulting in a net income of Rs. 57,050. This included Rs. 7,237 realised from sales of poultry birds, eggs and rabbits.

In the coconut-based high density multispecies cropping system at Kasaragod, there was no appreciable difference in the yield of coconut palms receiving one-third, two-thirds and full dose of fertilizers. The mean yield was 182, 188 and 175 nuts/palm/year, respectively in the above treatments.



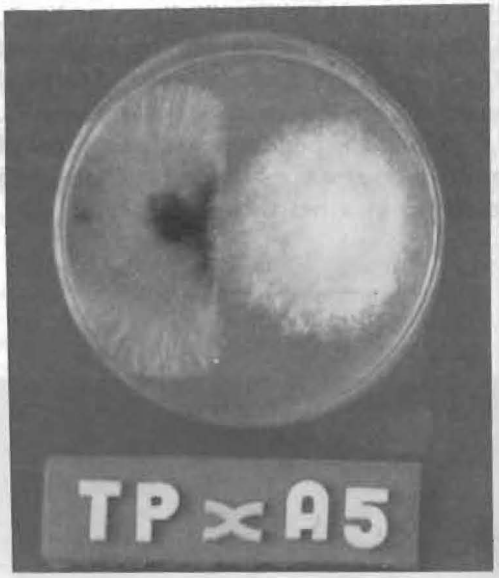
Second generation mixed farming system at Kasaragod

CROP PROTECTION

Root (wilt) disease of coconut

Critical examination of tender root and rachilla tissues of palms exhibiting different intensities of disease, did not reveal the presence of flagellated protozoan. However, the sieve tubes invariably had Mycoplasma-like organisms. This observation while confirming the constant association of MLOs with the root (wilt) disease, rules out conclusively the involvement of flagellates in the disease.

Inter se crossing and selfing of 32 disease-free palms identified in the 'Hot spots' of Kollam, Alappuzha, Pathanamthitta and Kottayam districts are in progress to generate progenies resistant/ tolerant to the root (wilt) disease. In general, the green dwarf palms were free from disease symptoms, indicating their greater tolerance to root (wilt) disease.



Inhibiton of growth of *Thielaviopsis paradoxa* by *Rhizopus stolonifer*

Stem bleeding disease of coconut

The population of fungi antagonistic to *Thielaviopsis paradoxa,* the causal agent of stem bleeding disease of coconut, was more in the treatment of NPK + dolomite + neem cake when compared to that in NPK alone, NPK + dolomite and control treatments. *Rhizopus stolonifer, Thielavia terricola, Trichoderma koningii* and *T. viride* were the fungi which possessed antagonistic properties against *T. paradoxa. T. yiride* (isolate A_4) caused a maximum of 42.8 % inhibition of growth of *T. paradoxa* under *in vitro* conditions. *R. stolonifer* is being reported as an antagonist against *T. paradoxa* for the first time.

T. paradoxa population was found to be considerably low in the neem cake applied soils. Only 4% baits were infected by *T. paradoxa* in neem-cake amended soils when compared to 28% bait infection in control plots.

Studies on mass multiplication of *Trichoderma* using neem cake, cowdung slurry, coir dust, rice bran, wheat bran and sorghum singly and in combination revealed maximum growth and sporulation in rice bran + cowdung slurry followed by that in rice bran + neem cake combinations.

Quantitative determination of Calixin at concentrations as low as 0.1 ppm in coconut stem tissues and 0.05 ppm in tender nut water was found possible by bioassay using *T. paradoxa* as test organism.

Thanjavur wilt/Ganoderma wilt

The coconut isolates of *Ganoderma* were found to be capable of infecting arecanut and the arecanut isolates infected coconut.

Symptoms of *Ganoderma* wilt could be reproduced in healthy coconut palms by planting diseased stump technique. The inoculated palms developed symptoms of gummosis on the basal portion of the trunk.

Yellow leaf disease of arecanut

Mycoplasma-like organisms were observed in Yellow leaf disease affected palms at Koppa, Sringeri and Sagar in Karnataka State. Further evidence on the vectoral role of the plant hopper *Proutista moesta* has accrued with the demonstration of positive transmission of the disease employing this insect. Histochemical staining reaction indicating presence of the organism was observed in five out of the six seedlings inoculated with *P. moesta* and MLOs have been located in three of the seedlings under EM. Accumulation of ortho-dihydroxyphenols and arginine was observed in leaves of diseased palms during symptom expression period.

In the varietal reaction trials, the cross Saigon × Mangala continued to give highest yield with less disease intensity. True Mangala seedlings gave maximum yield and exhibited better tolerance to the disease than its segregants and South Kanara local seedlings. In the management trial, application of additional quantity of 120 g P_2O_5 over the normal package of practices have given the highest yield.

Pest management

All the samples of *Oryctes rhinoceros* collected for screening from Chittilappilly in Trissur District of Kerala, an already infected contiguous area, where re-release

Ganoderma wilt symptom development in coconut by adopting planting disease stump technique

Reproduction of YLD symptoms on healthy areca seedling by experimental transmission using *Proutista moesta*

of baculovirus was done during July, 1989, showed baculovirus disease incidence in different intensities. There was gradual decline in the intensity of pest population and crop damage.

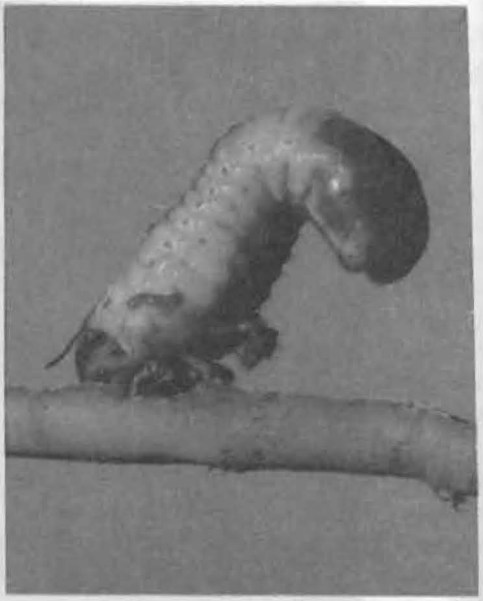
The indigenous scoliid parasitoid *Campsomeriella collaris* could be successfully reared on the fully grown grubs of *Leucopholis coneophora* in the laboratory. It had an egg period of 2 days, larval period of five days and pupal period of 28-30 days.

Of the three species of alternate host plants tested, arrowroot was found to be the best for multiplication of the lace bug *Stephanitis typica* and its mirid predator *Stethoconus praefectus* in the laboratory.

Among the predacious fauna of the phytophagous mite, *Oligonychus iseilemae*, the mite predators such as *Amblyseius paraaerialis*, *A. eucalypticus* and *Cunaxa setirostrix* were the dominant ones, which consumed, on an average, 14.7 ± 1.8, 21.3 ± 2.1 and 35.5 ± 4.2 prey, respectively.

Nearly ten species of scale insects have been recorded from coconut gardens of four southern states of India. Among them, three represent undescribed species and one appears to be a new record from India. One predacious mite *Saniosulus nudus* and a Nitidulid beetle *Cybocephalus* sp. were recorded in association with the scale insects. The coccinellid predator *Chilocorus nigrita* could be multiplied on cultures of *A. orientalis*.

In addition to *Leucopholis coneophora*, two more species of white grubs, *Anomala* sp. nr. *chlorocarpa* Arrow and *Phyllognathus* sp. were consistently observed feeding on the roots of coconut. In cases of severe infestation, besides feeding on the roots, the grubs of *L. coneophora* were observed to make tunnels and holes in the husk of sprouted seednuts in the nursery.



White grub, *Leucopholis coneophora* feeding on coconut root

Lymantria ampla Walker, the caterpillars of which feed on the foliage and bark tissues of cherelles and pods of cocoa possess a female sex pheromone. Cocoa has been observed to be infested by one more species of mirid bug, *Helopeltis theivora* Waterhouse. Its infestation was observed on tender shoots, cherelles and pods of cocoa.

Infestation by the spindle bug, *Carvalhoia arecae* Miller and China was more (12.6%) on oil palm seedlings maintained in areca gardens, than those maintained in oil palm plantation (0.2%). Psychids and Limacodids causing severe defoliations are the major pests of oil palm in Little Andamans.

The pollinating weevil, *Elaeidobius kamerunicus* Faust was introduced into the oil palm demonstration plots in the states of Karnataka and Andhra Pradesh.

An improved local wild boar scaring device developed recently was found to be effective and economical. The device comprises of 20 gauge GI wire fixed around the area to be protected with a simple device having 5 g crackers at intervals of 30 min. Preliminary tests carried out in a demonstration plot (69 sq.m) in a heavily infested jungle area at Palode revealed that the tuber crops raised in the area could be protected from wild boar damage by adoption of the scaring method.

Vertebrate pest management

In coconut plantations the intensity of damage to tender nuts by *Rattus rattus wroughtoni* was highest during late summer (April-May) and lowest during monsoon and post-monsoon period (August-October).

The home ranges of *R. r. wroughtoni* in coconut monocrop were calculated to be 1,160.1 sq.m. for male rats and 932.8 sq.m. for female rats. On an average, the home ranges of male and female rats covered an area of 25 and 19 coconut palms, respectively.

Integrated nematode management

A survey for the plant parasitic nematodes associated with coconut, cocoa and oil palm was carried out in Kerala and Tamil Nadu. The burrowing nematode was recorded from 10 out of 205 root samples from coconut and in two locations from oil palm in Kerala. Root samples collected from coconut and oil palm in Tamil Nadu and from cocoa in Kerala did not yield *R. similis*.

The prior establishment of VAM (*Glomus mosseae*) was found to ameliorate the ill-effects of *R. similis* on coconut seedlings. *G. mossae* inoculated seedlings recorded increased height and leaf area.

The systematic application of phorate and neem cake in different doses significantly brought down the nematode population in arecanut under mixed cropping with banana and pepper.

The levels of Nemacur residues in coconut water and copra obtained from tender as well as matured coconuts harvested six weeks after the treatment of Nemacur @ 100 g/palm at the base and 30 g/palm on crown indicated that the residues were below detectable levels.

Leaf extracts of *Glyricidia maculeata*, *Ricinus communis* and *Crotalaria juncea* were found to have considerable toxic effect on *Radopholus similis*. Addition of *Glyricidia* leaves (20 g) was found to reduce upto 44 per cent of *R. similis* population in potted black pepper vines.

HARVEST AND POST HARVEST TECHNOLOGY

Conversion of puny nuts into ball copra

Partially dehusked puny nuts were subjected to intermittent heating in the CPCRI Small Holder's Dryer at a temperature of 50-55°C for three days (8 hrs. daily) and stored in gunny bags. About 98% of the puny nuts became ball copra within 3 months whereas it took 5 months for the conversion in the conventional method. The copra thus produced had lower microflora infestation and yielded good quality oil.

Mushrooms on oil palm waste

Four species of oyster mushrooms viz. *Pleurotus florida, P. sajor-caju, P. citrinopleatus* and *P. flabellatus* showed higher bioconversion efficiency of 58.4%, 55.7%, 49.7% and 48.5% respectively, when tested on oil palm mesocarp waste.

REFINEMENT OF EXPERIMENTATION TECHNIQUES IN PLANTATION CROPS

Analysis of yield density relationship using inverse polynomial of data available from cocoa-areca mixed cropping trial at Vittal showed that intra-component competition was more severe than the inter-component competition in cocoa, whereas both these types of competition were on par in arecanut.

ECONOMICS

In the study of the price behaviour of the important edible oils it was observed that the rate of increase in the prices of different oils was more or less of the same order during the eighties. While the compound growth rate (CGR) of wholesale prices of coconut oil in one of the major markets — Calicut — was worked out as 9.57% per annum, in the case of wholesale prices of other major edible oils viz. groundnut oil, sesame oil and rapeseed-mustard oil, the CGRs were observed to be between 8.00 and 9.60 per cent. However, the instability in prices was more pronounced in the case of coconut oil than that of the other oils as evident from C.Vs.

The correlation analysis revealed that the degree of price relationship between coconut and copra, copra and coconut oil and coconut and coconut oil was almost close to unity ('r' value being 0.99). Correlation studies further indicated that the prices of edible oils move very closely with each other with correlation coefficients between 0.88 and 0.90. It is because of the fact that, as those oils were vulnerable to substitu-tion to a certain extent, the prices had shown a strong sympathetic move-ment with each other.

Regression equations were fitted to predict the prices of coconut by knowing

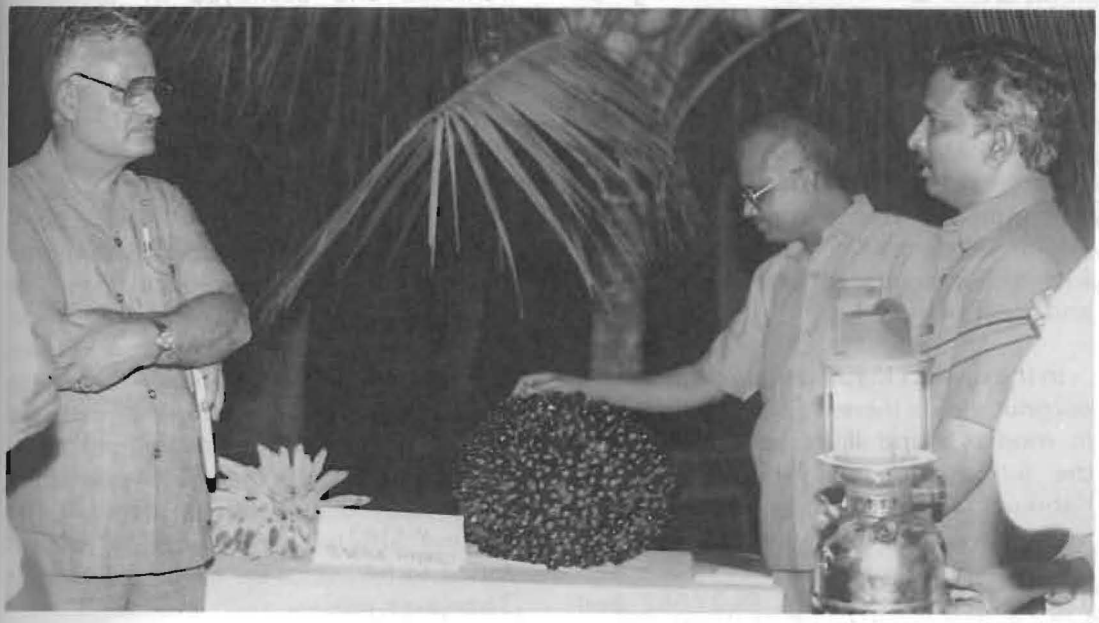
the prices of either copra or coconut oil and also to predict the prices of coconut oil with the help of the prices of either coconut or copra. The prediction models were found out to have very good fit with the r^2 ranging between 0.83 and 0.99.

Similar attempt was made to predict the wholesale prices of one edible oil with the help of another edible oil price. Twelve prediction equations with different combinations could suggest that a higher percentage of variation in one oil price is explained by any other oil price, the value of r^2 varying from 0.78 to 0.90. The psychosis of scarcity, which has been a permanent feature in the Indian edible oil sector for nearly two decades, is the major contributing factor to the price behaviour of these high value commodities.

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON PALMS

Crop improvement

At Ratnagiri, the released variety Banawali Green Round (Pratap) produced an average yield of 157 nuts/palm/year followed by Lakshadweep Ordinary (139 nuts). The 12 year average yield was also the highest for Banawali Green Round (153 nuts/palm/year) followed by Lakshadweep Ordinary (152 nuts). At Veppankulam, Fiji and FMS gave an average yield of 128 and 118 nuts/palm/year, respectively which were 75 and 61 per cent higher when compared to that of ECT.



Dr. K.L. Chadha, Deputy Director General (Hort.) and Dr. P. Rethinam, Asst. Director General (PC), ICAR, New Delhi observing the oil palm bunch during their visit to Co-ordinating Centre of AICRP on Palms at Ambajipet. Dr. K. Pampapathy, Horticulturist of the Centre is also seen.

The released hybrids VHC-1 (ECT × CGD) and VHC-2 (ECT × MYD) gave an average yield of 112 and 125 nuts/palm/year, respectively for the last 10 years. Studies on tender nut varieties revealed that Ayiramkachi was the best for the sweetness of tender nut water and meat. At Ambajipet, Laccadive Ordinary gave maximum yield (148 nuts/palm) during the year followed by COD × WCT (124).

Crop production

NPK dose of 1500:250:750 g/palm/year gave the highest nut yield of 96 nuts/palm/year followed by the dose of 1000:750:1750 g (77 nuts) at Ambajipet when compared to the yield of 37 nuts in the control plot. The interaction effects of N, P and K significantly influenced the copra content/nut. The nine and a half year cumulative yield at Veppankulam was maximum (734 nuts/palm) at the NPK dose of 1000:500:1750 g/palm/year. Button shedding was found to be low in plots where fertilizer was applied. Application of coir dust @ 50 kg/palm/year along with drip irrigation increased the nut yield from 10 to 52 nuts/palm/year in the littoral sandy soils of Kasaragod by the end of third year after starting the treatments. At Konark, additional treatment of Ca and Mg along with NPK increased all growth parameters and yield of coconut.

In the mixed cropping trial at Ambajipet, coconut yields increased by 65 and 67% in models I and II, respectively due to the introduction of various crops. At Kahikuchi, mixed cropping was found more rewarding than monocropping of coconut. Mixed cropping models I and II gave a net return of Rs.27,567 and Rs.24,655/ha, respectively when compared to the net return of Rs.16,699/ha in coconut monocrop. At Ratnagiri, the average yield per palm per year increased from 30 to 6(at the end of eighth year after planting o intercrops when compared to the yield before planting. At Veppankulam, mixe(cropping of turmeric, guava, pepper redgram and banana in coconut was foun(to be remunerative. Banana was the mos promising intercrop and a net return o Rs.51,350 and Rs.39,550/ha was obtaine(in model I and II, respectively compared t(Rs.33,100/ha in the coconut monocrop. I models I and II, the mean coconu yield/palm increased by 118% and 76% respectively compared to pre-treatmen yield.

Disease management

In the East Godavari district of Andhra Pradesh, the survey for Tatipaka disease was completed. Out of 26,689 palms suspected as Tatipaka disease affected 8,179 disease affected palms have beer removed and destroyed by the State Horticultural Department. Under the light microscope, phloem of diseased palms stained deep blue while that of healthy palms did not take the stain. This is typical of MLO infection in plants.

Ganoderma lucidum and *G. applanatum* were isolated from the roots of Thanjavur Ganoderma wilt disease affected palms. At Veppankulam, a significant positive correlation was reported between maximum soil temperature and number of bleeding palms, whereas the number of diseased palms was negatively correlated with mean soil moisture. More than 70% root rotting was observed upto 60 cm depth in the disease affected palms. EDTA test was found to be useful for early diagnosis of Thanjavur wilt.

Aureofungin-sol root feeding, Bordeaux mixture soil drenching and neem cake

application were found to be effective for the management of Thanjavur wilt disease. Instead of Aureofungin-sol, Calixin may be used through root feeding. Tapping for neera helped to reduce the index of the disease and increase the nut yield.

Pest management

The survey and screening studies on rhinoceros beetles at Aliyarnagar revealed the occurrence of baculovirus disease in Tamil Nadu — Kerala border as well as in villages around Pollachi. A combined treatment of root feeding of monocrotophos followed by the release of braconid parasitoids was found to give a good control against the coconut leaf eating caterpillars.

PRODUCTION OF PARENTAL MATERIALS AND BREEDER'S STOCK

During the year, over 50,000 WCT seednuts were produced of which 11,777 were supplied to various agencies for raising seedlings. Over 6,000 seednuts and 3,872 seedlings of COD, 200 seednuts and 403 seedlings of Chandrakalpa (LO), 550 seedlings of MYD, 100 seedlings of MGD, 200 seednuts of AO were supplied to seed gardens. Three hundred and thirty seven *inter se* seedlings of cultivars and 559 hybrid seedlings were given to Co-ordinating Centres. Over 130 seedlings were supplied to Horticultural Departments of Tripura and Assam. Five hundred AO seednuts were procured from Andamans and raised in polybags for planting in Kidu Farm in a compact block. Besides this, over 1,151 hybrids and 2,124 seedlings were supplied to farmers.

In arecanut, over 1,79,250 seednuts and 3,998 seedlings of the three released cultivars were supplied to farmers from Kidu Farm.

Hybrid (1-14 × NC 42/94) pods of cocoa were harvested from the biclonal orchard planted at Kidu Farm and the seedlings were raised.

During the year, 2,38,000 sprouts and 663 seedlings of oil palm were distributed to various agencies. At the oil palm station, Thodupuzha, 178 bunches have been pollinated using selected *pisifera* pollen. Thirteen bunches have been harvested so far.

TRANSFER OF TECHNOLOGY

Eight training courses were organised during the year for 81 officials from 11 states and Lakshadweep on various aspects of plantation crops production technology. In addition, one day training programmes were organised on 55 occassions at Kasaragod and Kayangulam for the benefit of 1,374 officials/students/farmers from different parts of the country. Refresher courses were conducted at Kasaragod and Kayangulam for 42 technical staff of CPCRI for a period of six days each to up-date

their knowledge in new technologies developed by the Institute on plantation crops. The technologies on plantation crops management have been passed on to 2,233 farmers including 13 from Sri Lanka who visited the Institute during the year.

Sixteen Research-cum-Demonstration plots were maintained in farmer's fields at different centres. At Kayangulam, four new plots were selected to demonstrate the management techniques for amelioration of root (wilt) disease of coconut.

Twenty six root (wilt) affected palms from 11 gardens distributed in seven villages have been eradicated. Twenty two coconut palms were confirmed as root (wilt) affected in 10 gardens spread over in 4 villages in operational research project area.

Survey of all the YLD affected gardens in Haleneranki village in Karnataka did not reveal any fresh incidence of YLD during the year.

The Institute has arranged 2 exhibitions and brought out 3 extension publications for the benefit of farmers and extension workers. Scientists of the Institute gave 8 radio talks on plantation crop technologies and published 11 popular articles during the year.