



RESEARCH HIGHLIGHTS 1985



Central Plantation Crops Research Institute

Kasaragod 670 124, Kerala, India

Front cover: Laccadive ordinary-coconut cultivar recommended for release



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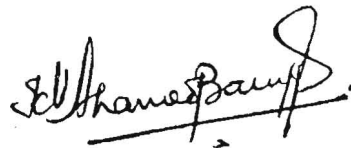
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Introduction

The Central Plantation Crops Research Institute tackles problem oriented research programmes on coconut, arecanut, oil palm, cashewnut, cocoa and spices. Identifying important problems in the plantation crops and finding solutions to them are the primary objectives. To achieve the mandate given to the Institute, it has a net work of 16 centres in four states and in three union territories. Research programmes of the Institute are grouped into 29 mega-projects with multidisciplinary approach and are carried out in more than one centre according to the need. The priorities in research are changed as and when found necessary on the basis of feed back obtained from the field.

The research highlights of the Institute is an annual publication. It presents in a concised form the major achievements and break-throughs made by the scientists in their respective mega-projects. Releasing of one cultivar and three hybrids in coconut, two varieties in arecanut and one in turmeric, confirming the MLO implication in the disease syndrome of root (wilt) disease of coconut and standardising a production technology capable of almost producing one tonne of dry cardamom in the second year of planting, are some of the major achievements made by the Institute during 1985.

From 1986 onwards the research on cashew and spices is being delinked from CPCRI for enabling the concerned centre to take up mission oriented research on these crops. Two National Research Centres, one each for spices (at Calicut) and cashew (at Puttur, Dakshina Kannada) will be established. Thus, the research highlights of 1985 will be the last in the present series covering all the plantation crops and from 1986 onwards the Institute will be concentrating on palms and cocoa research and considerably expanding its research activities on farming systems.



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Kasaragod
8, February 1986

Root (wilt) disease of coconut

Electron microscopy of vascular tissues of coconut in different stages of root (wilt) disease further confirmed the occurrence of mycoplasma-like organisms (MLOs) in sieve tubes of diseased palms and their absence in the healthy. MLOs were detected in the salivary glands of *Stephanitis typica* subjected to 21 and 22 days of acquisition+incubation periods also. MLOs could not be detected in samples of lace bugs from Laccadive Islands. Capability of the dodder, *Cassythia filiformis* to transmit MLOs was established by successfully transmitting the sesamum phyllody agent into periwinkle.

Average increase of 14.4 nuts under rainfed and 30 nuts under irrigated conditions in the yield of root (wilt) affected coconut gardens could be obtained due to the adoption of integrated management practices as evidenced by the results obtained during the third year from a set of field experiments conducted in farmers' fields (Table I).

A decline in the disease index, compared to the pretreatment

conditions was recorded among the palms under irrigation in an experiment in farmers' garden, whereas those under rainfed conditions showed only marginal improvement. Favourable effect of irrigation was also noticed in female flower production, retention of buttons and enhancing the overall nut yield by 75 per cent.

Among 49 cultivars and 32 hybrids tested in 24 plots in cultivators' gardens, D×T had maximum average annual yield per palm with 112 nuts in the healthy, 90 nuts in the '11-25' disease index group, 60 nuts in the '26-50' index group and 21 nuts in the above 50 index group followed by T×D with 97, 89, 59 and 30 nuts respectively, compared to WCT with 76 nuts in healthy, 59 nuts in disease early and 31 nuts in the disease middle categories.

The state-wide survey conducted in collaboration with different agencies has brought out that the disease-free palms in the six districts of disease affected tract yielded an estimated average of 72 nuts per palm, which came down to 49 nuts and 19 nuts per palm in the

Table I. Response of root (wilt) affected coconut gardens to integrated management practices

Disease index group	Mean yield of nuts/palm/year				Increase over control	
	Control		Treatment		Rainfed	Irrigated
	Rainfed	Irrigated	Rainfed	Irrigated		
Apparently healthy (10)	59.7	56.4	83.0	86.2	23.3	29.8
Disease early (11-25)	44.0	30.7	56.5	57.6	12.5	26.4
Disease middle (26-50)	28.1	24.0	32.3	43.2	4.2	17.2
Disease advanced (51)	12.2	No palms	12.4	No palms	0.2	No palms
General mean	49.0	43.2	63.4	73.5	14.4	30.0

disease early and disease advanced categories respectively. The incidence of the disease ranged from 1.5 to 75.6 per cent in the continuously disease affected area. The two border districts of Trichur in the north and Trivandrum in the south had 1.5 per cent and 2.6 per cent incidence respectively.

The impact of systematic eradication of disease affected palms during 1979-1982 was assessed and a significant reduction in disease development was revealed. In general, pattern and spread of disease had a positive correlation with the density of population of diseased palms. The disease was eliminated in the scattered and mildly disease affected areas by prompt roguing.

Yellow leaf disease of arecanut

Out of the three putative vectors of the disease reported, spindle bug (*Carvalhoia arecae*) and plant hopper (*Proutista moesta*) were more abundant in arecanut plantations. The leaf hopper, *Sophonia greeni* Distant (Homoptera : Cicadoidea) which is a new record on arecanut is also likely to be a vector of yellow leaf disease.

Yield of palms in the disease affected garden can be increased by regular fertilizer application at the rate of 100 g N, 160 g P₂O₅, 140 g K₂O and 25 kg cattle manure per palm per year, coupled with irrigation at four days, interval. Mixed farming with NB 21 grass, cowpea and dairy in YLD affected areca gardens was found beneficial in

reducing the disease intensity upto 30 per cent and enhancing the yield by 93 per cent.

Quick and slow wilt diseases of black pepper

Among 13,232 seedlings from 27 cultivars tested for their resistance to *Phytophthora*, three seedlings, one each from Narayakodi, Valiakania-kadan and Vellamunda did not take up infection and are being multiplied for further testing. One hybrid H1-80-1 was also found to be tolerant to *Phytophthora*. *Piper colubrinum* was found to be immune to ten black pepper *Phytophthora* isolates.

In field control trials, Metalaxyl-Ziram combination gave consistently good protection against *Phytophthora* infection in black pepper, compared to two other systemic fungicides (Fosetyl-Al and Terrazole) and Bordeaux mixture.

The comprehensive survey for the association of plant parasitic nematodes with slow wilt affected pepper vines in nine districts of Kerala clearly indicated high frequency of association of *Radopholus similis* (>250 nematodes/g roots) with the affected vines.

In addition, application of nematicides in slow-wilt affected pepper gardens gave remission in foliar yellowing symptoms with the suppression of nematode population.

Rhizome rot of ginger

Rhizome treatment with either 0.3% Bavistin or Dithane M.45 and storing in pits lined with sand gave better recovery of healthy seed rhizomes.

The incidence of bacterial wilt was delayed by more than a month in seed rhizomes treated with streptomycin (200 ppm) or plantomycin (200 ppm) compared to untreated control or hot water treatment at 45°C for 30 minutes.

Thanjavur wilt, ganoderma and stem bleeding complex disease of coconut

Thielaviopsis sp. was isolated from tissues of stem bleeding affected coconut palms at Kasaragod, Appangala and Vittal. When trunks of healthy palms were inoculated with *Thielaviopsis* sp. by stem bore technique at Kasaragod and Appangala, typical bleeding symptoms were observed after two months at Kasaragod and after two weeks at Appangala. At Hirehalli centre, a bacterium was isolated consistently from stem bleeding affected palms.

Pathophysiological aspects of Thanjavur wilt affected palms investigated at Veppankulam (AICCAIP Centre) indicated that there was no difference in the micronutrient status between healthy and diseased tissues, though there was an accumulation of iron in the diseased bark. This might be the reason for the discolouration

of the diseased tissues. Heavy decay of the root system impairing the transport of water and minerals was also noticed.

Tatipaka disease of coconut

Root feeding of tetracycline hydrochloride at 3 and 6 g/palm at monthly intervals reduced the number of atrophied nuts.

Perennial crop based farming systems

Seventeen crop models involving coconut, arecanut and oil palm as base crops, are being evaluated in different centres of the Institute to understand their production potential, input-output relationships, economics and the interaction between component crops.

During the year, two more crop models with arecanut as base crop and suitable for central Kerala and West Bengal were designed and planted in the Research Centres at Kannara and Mohitnagar respectively.

The multistoreyed cropping involving coconut, pepper and cocoa produced 23,118 coconuts, 60 kg dry pepper and 1014 kg dry cocoa beans per hectare at its 13th year under irrigated conditions. The yield of coconut and the interplanted species did not vary much in the coconut based high density multispecies cropping system maintained with full, two-third and one-third dose of the recommended level of fertilizers. This indicated the possibility of scaling down the fertilizer input for different crops under high density

multispecies cropping system. Nutrient addition through rainfall (May to October) in the coconut based high density system was found to be 0.53, 1.56, 87.4 kg/ha for NH_4^+N^- , P and K respectively.

The asymbiotic N_2 fixers were more in the coconut-grass-animal system as compared to coconut monocropping system. The cropping system did not have any influence on the population of nitrifying bacteria such as *Nitrosomonas* and *Nitrobacter*.

Root exudates from arecanut, banana, cocoa, pepper, coffee and clove in the arecanut based high density multispecies cropping system were characterised with respect to sugars, organic acids and amino acids. No major qualitative difference was noticed among the root exudates of the crops studied. The leaf leachate studies revealed that leaching of phenols was least in pepper (6.3%) and highest in arecanut (21.7%).

Water management and stress physiology

In the microirrigation experiment, stress effect was pronounced in $\text{CDO} \times \text{T}$ as indicated by more breaking and buckling of leaves than in WCT.

Comparison of nut yield in $\text{CDO} \times \text{T}$ and WCT during July 1984–June 1985 under rainfed conditions at Kasaragod and Kayangulam revealed that both the genotypes fared better at Kayangulam than at Kasaragod.

$\text{CDO} \times \text{T}$ exhibited low leaf diffusive resistance as compared to WCT and $\text{T} \times \text{CDO}$, thereby showing the degree of variation in moisture conservation among the genotypes in response to stress. In cocoa, two accessions NC 29 and NC 30, showed drought resistant traits like epicuticular wax content and optimum stomatal behaviour leading to conservation of moisture.

Nutritional requirement and crop management

In the permanent observation trial, coconut palms receiving tillage + organics + fertilizer application gave 17 per cent more yield (68 nuts/palm/year) during July 1983 to June 1985, compared to the palms receiving tillage and fertilizer application only (58 nuts). Palms receiving fertilizer application and forking basins, yielded almost four times (51 nuts), compared to the palms getting tillage only (13 nuts). Thus, to get an economic yield under rainfed conditions, fertilizer application is a must.

Soil fertility, nutrient dynamics and crop production

For laterite and red sandy loam soils, a ready reckoner table was prepared to guide the level of K_2O to be applied per palm based on desorption equilibrium model. Preliminary DRIS (Diagnosis and Recommendation Integrated System) norms were developed for coconut using plant analysis data and yield, which indicated the most required nutrient as nitrogen. Studies on

coconut genotype-nutrient relationships indicated variations in respect of K, Mg, Zn and Na.

Soil moisture studies indicated that coconut utilises more water when the soil is comparatively wet.

Evapotranspirative demands of coconut are largely met by 0-70 cm layer while 90-130 cm layer has little contribution. Water applied at 20 to 30 mm/4 days is found to be adequate to meet the evapotranspirative demands of coconut. Leaf analysis indicated that 'crown chocking' affected palms had significantly lower concentration of potassium and boron, whereas all the other nutrients were, in general, higher in diseased palms as compared to healthy palms. Ca/B ratio in the leaf of diseased palms was invariably above 100 whereas the healthy palms had a ratio below 100.

Increasing nutrient availability and disease alleviation by microorganisms in plantation crops

A study on seedlings of 21 cultivars of coconut suggested a genotype dependent preference for root colonisation by VA mycorrhizal fungi. In general, the tall cultivars exhibited more root colonisation by VA mycorrhizal fungi than the hybrids and dwarfs, though the roots of hybrids showed more infection than the dwarfs.

Banana (Mysore variety) planted in the HDMSCS were found to harbour three different species of VAM fungi viz., *Glomus macrocarpum*, *Glomus*

fasciculatum and *Gigaspora decipens* whereas pure crop of banana was found to be infected by only *Glomus fasciculatum*.

Observation on root infection of cardamom from a fertilizer trial at Appangala revealed that the extent of colonisation decreased with increase in phosphorus application.

Though optimum levels of N fertilizers is being supplied to crops, associative nitrogen fixers viz., *Azospirillum lipoferum* and *Azospirillum brasilense* and *Azospirillum* sp. have been found to be associated with roots of plantation crops in HDMSCS, multi-storeyed cropping, mixed farming and agrostology trials. This observation indicates that associative nitrogen fixers could be exploited for meeting a part of N requirement of plantation crops.

Collection, conservation, evaluation and documentation of genetic resources in plantation crops

Collection surveys were undertaken in Tamil Nadu, Karnataka and Goa for collection of indigenous coconut germplasm. In Tiptur Tall (from Karnataka) two distinct types were identified, one with large sized round nuts with a copra content around 250 g and other with smaller angular nuts with about 200 g of copra. Laccadive ordinary performance was found to be superior in evaluation trials in four states (Kerala, Tamil Nadu Andhra Pradesh and Maharashtra)

with 25 per cent more nuts/year and 33 per cent more in terms of copra yield over the local tall cultivars. This cultivar has been recommended for release by the Seventh All India Coordinated Project Workshop on Plantation Crops for the four states mentioned above.

In pepper, 28 cultivated types and 7 wild types were added to the germplasm collection at Calicut. In cardamom, seven accessions were collected from Pampadumpara,

Saklespur and Mudigere and in cocoa, budwood of 15 accessions from Ghana collections of KAU and five Malaysian collections from CPCRI Research Centre, Kannara were collected and introduced into Vittal collections.

In turmeric, three selections *viz*, PCT 2, PCT 5 and PCT 8 gave an yield ranging between 17.21 to 17.77 t/ha compared to 9 t/ha in control. PCT 8 (Fig. 1.) with 8.7% curcumin content was approved for

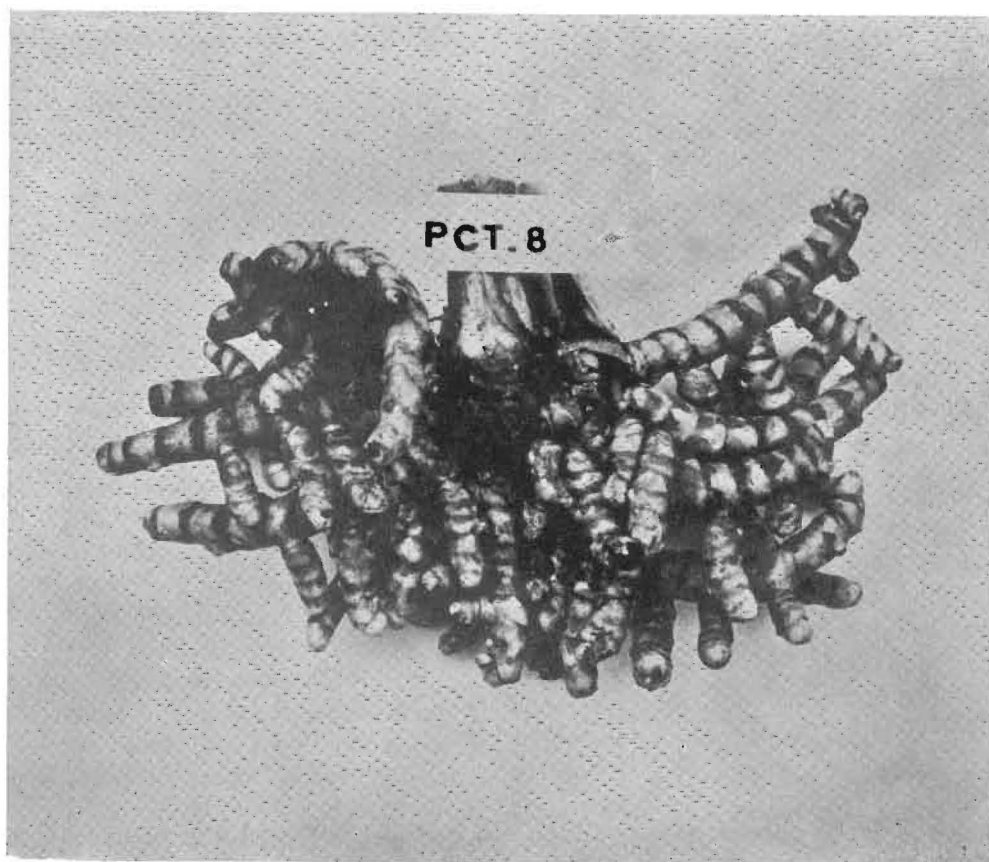


Fig. 1. PCT-8 turmeric variety recommended for release

release by the Seventh All India Coordinated Project Workshop on Plantation Crops.

Evolving high yielding varieties by selection and hybridization

Evaluation of yield performance of 87 hybrid combinations in coconut indicated the superiority of CDO × WCT, LO × GB and LO × CDO under rainfed conditions over the local cultivar WCT. CDO × WCT gave the highest cumulative yield (46% more than WCT) at the end of 18th year. LO × GB and LO × CDO in addition to their higher yield potential over the WCT also gave better yields (140 and 84% more yield over WCT) even during drought affected years. These three hybrid combinations are recommended for release in Kerala.

In arecanut VTL 11 and VTL 17 gave an increased yield of 63 and 48 per cent respectively over local control and 53 and 39 per cent over Mangala. These two cultivars, are recommended for release for the Dakshina Kannada (Karnataka) and Kasaragod (Kerala) districts.

In the oil palm plantations a pollinating weevil *Elaeidobius kamerunicus* (Faust) was observed for the first time in India (Fig. 2).

Tissue, cell and anther culture

Clonal coconut plantlets produced from tender leaf explant of seedling were transferred to soil. The plants are responding to fertilizers.

Somatic embryos were induced in tender leaf explants from mature palms. The 15–30 cm segment of the third leaf inside the unopened spindle of the mature coconut crown produced the somatic embryos. The embryogenesis was directly from the vascular tissue without a callus phase.

Leaf base explants of oil palm incubated on 'R' medium supplemented with 20 mg l⁻¹ 2, 4-D and 0.1 mg l⁻¹ BAP developed callus from the veins. Somatic embryos were produced from callus in 'R' medium with 0.01 mg l⁻¹ 2, 4-D. Somatic embryos then germinated in the same basal medium containing 0.01 mg l⁻¹ 2, 4-D, 1 mg l⁻¹ NAA and 0.1 mg l⁻¹ kinetin. The plantlets have well formed shoot with scale leaves. Addition of 0.01 mg l⁻¹ IBA to the culture medium produced rooting.

Cardamom plants produced *in vitro* from the vegetative and floral buds were successfully transferred to the field.

Callus was produced from the ginger rhizome in MS medium containing 2 mg l⁻¹ 2, 4-D and 18% coconut water. The callus on transfer to MS + 0.01 2, 4-D, 0.1 NAA and 0.01 BAP regenerated plants.

Embryos from tender nuts of areca palm, sterilized in 70% alcohol produced callus on R medium with 1.0 mg l⁻¹ NAA and 0.5 mg l⁻¹ 2iP. The callus on transfer to Heller's medium with 2.0 mg l⁻¹ 2, 4-D and 0.5 mg l⁻¹ kinetin produced somatic embryos.

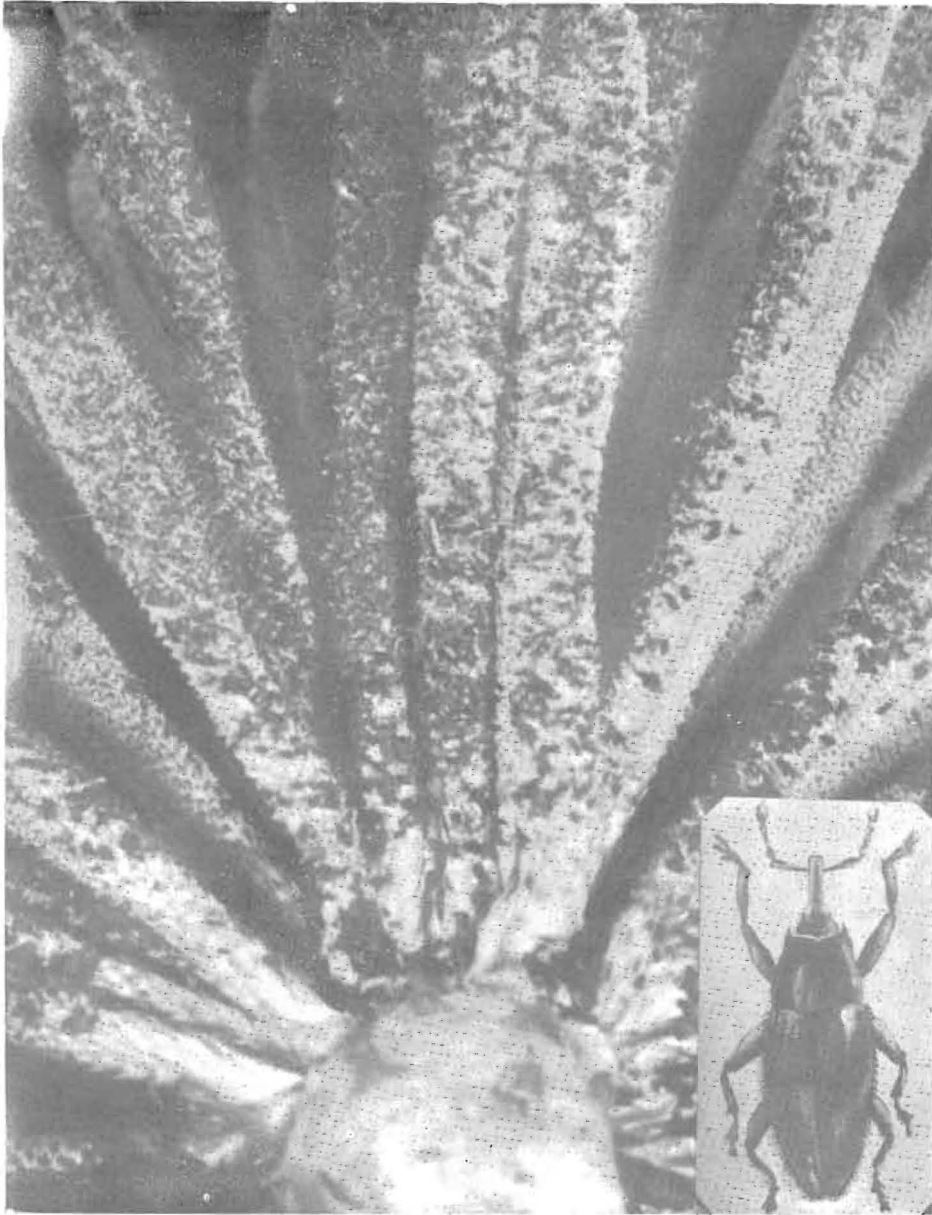


Fig. 2. Pollinating weevil, *Elaeidobius kamerunicus* clustering on male inflorescence during anthesis. (Inset) Weevil, *Elaeidobius kamerunicus* (magnification - 170 times)

Integrated pest management

Oryctes adults collected from Andamans were screened for baculovirus disease incidence and found to be free of the disease.

This opens up the feasibility of introducing baculovirus to Andamans also for biological suppression of *O. rhinoceros*, which poses a serious problem in coconut and oil palm plantations.

Eurytoma albotibialis Ashmead was observed to suppress the population of *Brachymeria* sp. during summer season, which is the peak period of the activity of the parasitoid and the pest.

A hemerobiid predator and a fungal pathogen were recorded as biocontrol agents of the mealy bug and *Stephanitis typica* in nature.

Attractants

A tray trap was devised for attracting red palm weevil adults using coconut petioles as a substitute to tender coconut stem.

Population dynamics of tea mosquito

Out of 20 cashew varieties/types screened for reaction to tea mosquito infestation, five were moderately susceptible and the remaining ones highly susceptible.

Chemical control

A GLC method has been standardised for estimating the residues of endosulfan I, endosulfan II and endosulfan cyclic sulphate in black pepper.

Pest and disease management

Pests

A pentatomid bug was recorded in association with the tender nut

drop in arecanut. The bug was observed to pierce tender nuts and suck the sap, producing characteristic pin prick marks on the pericarp.

Nematodes

A population of one hundred burrowing nematode, *Radopholus similis* was found to be the threshold level for causing economic damage on coconut seedlings. *R. similis* was recorded in association with slow decline (yellowing and defoliation) of betelvine, *Piper betle* trailed on arecanut from Koppa and Sringeri taluks of Chickmagalur district of Karnataka State.

Fumigation of cardamom primary nurseries with Methyl Bromide @ 500 g/100 sq. ft. and EDB @ 200 l/ha under polythene cover for 72 hours showed that MBr increased germination counts of cardamom seeds by 108% compared to 28% in EDB treated beds. In addition, MBr found to control nursery leaf spot and damping off also.

Diseases

Survey on the quick (yellow) decline disease of coconut revealed that the distribution of the disease is sparse and the highest incidence is on young palms. Decline in yield is very sharp and death is very rare. Presence of typical MLOs in the phloem tissues of the affected palms were observed.

The new virus disease namely Nilgiri necrosis of small cardamom was confined to only three pockets in Karnataka and Tamil Nadu.

Eradication of the affected plants was found effective in reducing the spread of the disease.

A new disease in oil palm characterised by yellowing of inner whorl of leaves and spear rot with a subsequent general decline in vigour and productivity has been noticed in oil palm plantations of Kerala. The occurrence is sporadic and the extent of infestation at present is less than 1 per cent.

Vertebrate pest management

In cocoa-coconut mixed gardens seven species of small mammals were found to coexist. Among them *Rattus rattus wroughtoni* Miller was predominant on the branches, and *Mus booduga* Gray on the ground. The efficacy of multiple dose anti-coagulant such as Fumarin in reducing the populations of *R. r. wroughtoni* in coconut plantations could be enhanced upto 94 per cent by applying the poison baits three times with an interval of three days between applications.

Quality and pesticide residue analysis

A GC method for evaluating the quality of pepper oil has been accomplished. Grade evaluation studies indicated that in the cultivar Kottanadan percentage of top grade (46.44) was more compared to Panniyur-1 (30.08).

Extractable fat and oleoresin in nutmeg was found to be 40 per cent and 2.7 per cent respectively. The nutmeg fat has trimyristicin to an

extent of 87 per cent. The fat has all the quality attributes essential for use in perfumery and confectionery purposes.

Nuts and apples from sixteen high yielding varieties of cashew were characterised both quantitatively and qualitatively with respect to phenols. No varietal difference has been noticed with respect to qualitative make up of phenols both in nuts and apples. Cashew proteins showed two bands under native conditions and four bands under denatured conditions which indicates that cashew proteins are dimeric in nature. The two cashew proteins could be separated by fractional precipitation with Zn^{2+} .

Harvest and post-harvest technology research in plantation crops

A copra dryer for 1000 coconuts/ batch capacity was designed and developed. The dryer uses agricultural waste as fuel and it is an indirect heating type dryer working on natural convection principle. The dryer costs about Rs. 3,500/- and 1000 coconuts could be dried from 50% to 6% moisture content in 33-37 hours, or 350 kg of arecanut could be dried in 87 hrs (11 days) or 75 kg of cardamom could be dried in 23-28 hours.

The copra moisture meter was further calibrated for 5% to 40% moisture level range to enable the determination of moisture content in copra at different stages of drying.

Estimation of crop losses

Second round of survey in the eight root (wilt) affected districts (Trichur to Trivandrum) of Kerala was undertaken by CPCRI in collaboration with the Directorate of Agriculture, Coconut Development Board, Directorate of Economics and Statistics, Centre for Development Studies, Kerala Agricultural University, Special Agricultural Development Unit and Central Plant Protection and Training Institute. The loss in nuts due to root (wilt) disease of coconut is re-estimated as 968 million nuts annually.

Cost benefit analysis of crop production and farming systems

Coconut productivity in Kerala

The estimated compound growth rates of coconut productivity in different districts of Kerala during the period 1970-'71 to 1982-'83 revealed that barring Trichur district, the growths were negative. These declining trends could be attributed to the spread of root (wilt) disease to more and more areas and increase in number of palms in 'disease advance' stage, acute pressure on land leading to extension of coconut crop to sub-marginal areas, high cost of labour leading to poor management, and price uncertainty in coconut and its products.

Sensitivity analysis

Sensitivity analysis for pepper, cardamom and cashew grown under ideal conditions was carried out.

In the case of cardamom it was seen that when the price of this spice comes down to Rs. 100/kg, the crop becomes unremunerative under rainfed condition and when it further comes down to Rs. 75/kg, the crop becomes unprofitable even under irrigated condition with higher levels of fertilization.

Profitability of copra making in wet season by using CPCRI dryer

The result of the field evaluation of CPCRI dryer used for copra making during the wet season with coconut shells as fuel revealed that a copra-maker could make a net profit of Rs. 7,455/- during four months wet-season between June and September, 1985 by converting 24,800 nuts into 3968 kg of copra with one unit of dryer. The processing cost comes to Rs. 1-75/kg of copra and the net return from converting 1000 nuts to copra comes to Rs. 300/-.

Agriculture, animal sciences and fishery research at I. C. A. R. Research Complex for Goa (CPCRI)

Crop sciences

Paddy: The short duration variety IET 6223 recorded highest yield (82.2 q/ha) and performed well during both *kharif* and *rabi* seasons.

Sugarcane: Out of six varieties in a comparative yield trial, four performed better than the popular variety CO 740. The highest yield was obtained in CO 7527 (205 t/ha) at 250 kg N/ha.

Animal sciences

Cattle: In red Sindhi × Jersey half bred cattle, ovulation occurred after about 60 hours from the onset of oestrus. The average time for expulsion of placenta was five hours. The calf weight at birth was 16.9 kg.

Poultry: Introduced broiler hybrid chicks performed satisfactorily with respect to body weight (1249 g) and feed efficiency (2.27) at eighth week indicating earlier marketing possibility (6 to 8 weeks).

The drugs Cina-200, Cruminill and Piperazine Hexahydrate were effective in controlling round worm infestation in both chicks and adults. Piperazine although economical was found mildly toxic and should, therefore, be avoided during peak period of egg production.

Use of *Salvinia* and water hyacinth as fish feed (work done at Kayangulam)

A method of partial anaerobic ensiling of *Salvinia* and water hyacinth was evolved which involves initial drying of the weed biomass to 50–60% moisture level, addition of 5% molasses and packing in polythene bags or cement tubs for larger volumes. This process adds good flavour and palatability to the weed ensiled and the silage remains without spoiling until opened for use.

Training on fish seed production and adoption of fish culture technology (work done at Kayangulam)

Training was imparted to farmers to produce fingerlings through the

administration of pituitary gland extract. By the adoption of composite fish culture with four carp species and paddy-cum-fish culture one farmer could get a net profit of about Rs. 5,000/- from only two small ponds and a 0.25 ha paddy field, the same year.

Agriculture, animal sciences and fishery research in ICAR Research Complex for Lakshadweep (CPCRI)

Under Lakshadweep conditions the coconut cultivar Lakshadweep Ordinary showed maximum response to 500 g N, 320 g P₂O₅ and 1200 g K₂O per tree per year. Eighty five per cent of the coconut seedlings (3–5 year old) under this treatment flowered 30 months after treatment as against 40 per cent in the control.

'Agromin' a micro-nutrient compound containing iron, manganese, copper and magnesium in the chelated form was found effective in checking chlorosis, generally observed on vegetable crops grown in the Island.

Production of parental materials and breeder's stock of plantation crops

Over 22,350 nuts and 2480 seedlings of dwarfs, and 25,800 seed nuts of Talls were supplied to various seed gardens in the country. In addition to this, over 4000 D × T hybrids were distributed to farmers and coordinating centres in the eastern region.

Over two lakh seed nuts in arecanut selections were distributed to farmers as well as coordinating centres.

Increasing the production of coconut, cashew, pepper and cardamom

Coconut

The layout plan for tall seed garden, Putlur, and a tall and dwarf seed garden at Chengam in Tamil Nadu were prepared. About 200 farmers of Salem district were given training in the coconut production technology.

Cardamom

Nearly 1000 kg of seed capsules from high yielding clumps of Cl. 37 were supplied to Cardamom Board, Horticultural Department and growers.

All India Coordinated Coconut and Arecanut Improvement Project

At Arsikere, irrigation of 80-100 ASM with a fertilizer dose of 1000:600:1500 g N, P₂O₅ and K₂O/palm/year gave a highest yield of 168 nuts/palm/year. Growing cocoa in coconut garden as mixed crop, besides increasing the nut yield of coconut and increasing the income from unit land, favours the microbial population build up in the root environment of coconut. The disease intensity of Thanjavur wilt affected palms is reduced when tapping was resorted to. The cumulative yield of Mangala is higher than the other varieties at Coimbatore and Shriwardhan.

All India Coordinated Spices Improvement Project

Cardamom

At Mudigere, based on the average of last eight years from the comparative

yield trial, the selections CL-664 and CL-730 were found to perform well.

Pepper

At Panniyur, from the pooled data of last five years, the variety Kudiravalli was found to be the best with an yield of 1678.7 g/vine followed by Panniyur-1 (1621.4 g/vine).

Cumin

Experiment conducted at Jobner to control cumin wilt by soil amendments revealed that application of mustard cake helped to keep the plots with minimum disease incidence with increased yield.

Fennel

At Jobner, UF-112 variety of fennel was found to be promising based on its consistently better performance since last four years.

Fenugreek

Fungicidal trial carried out at Coimbatore to control root rot of fenugreek indicated that drenching twice with Bavistin 0.1% or Brassicol 0.1% was the best treatment in reducing disease incidence and increasing yield.

All India Coordinated Cashew Improvement Project

Vegetative propagation

Research carried out has clearly brought out that large scale multiplication of cashew by vegetative means is possible by adopting soft wood/epicotyl grafting method.

Evolving high yielding varieties

Out of a total of 161 accessions in the germplasm maintained at

Vittal since 1972, nine types gave consistently high yields ranging from 15.4 to 18.9 kg nuts/tree/year (during the last three years). A tree yielding 80 kg nuts/year has been identified at Rajamundri by the Bapatla Centre.

Transfer of technology net work

Lab to land programme

The 479 families adopted under the Phase III of the lab to land programme in Zone VIII at Kasaragod, Vittal, Calicut and Kayangulam and 250 families in Goa under Zone VII continued to get the technical and input assistance.

As a result of this the yield increase noticed in coconut at Kasaragod and Vittal ranged from 53% to 148%, which works out from Rs. 7175-00/ha to Rs. 13,125-00/ha. At Calicut for pepper, the additional increase worked out to Rs. 3,500-00/ha/year. At Kayangulam the per ha increase in income was Rs. 5,250-00 in the root (wilt) affected gardens. In the case of arecanut the yield increase was upto 66.67% and the earning was Rs. 25,000/ha. In the case of cashew the yield increase was 150 kg of raw nuts/ha with additional income of Rs. 1,500-00/ha/year. The bee-keeping enterprise also showed encouraging results and income from the beehive was Rs. 100/year. Mulberry raising for sericulture in 50 cents gave an increase in income by Rs. 2,500/annum by increasing the number of cuttings from 3-5.

Training of research workers, extension workers and farmers

Two hundred and forty seven officials in 30 batches were trained at Kasaragod and other centres of the Institute on different aspects of plantation crops production technology.

Apart from this, training of 1-3 days duration was given to 348 farmers from Goa, Karnataka and Kerala.

In addition two S-1 trainees from NAARM underwent field experience training at Kasaragod and one research fellow from Kenya on spices production at Calicut.

Research-cum-demonstration plots

Twenty eight research-cum-demonstration plots laid out last year in cultivator's fields at Kasaragod, Kayangulam, Vittal, Calicut, Appangala, Mohitnagar, Lakshadweep and Goa to demonstrate the improved technologies available on coconut, arecanut, cashew, pepper, cardamom, inland fisheries and live-stock infertility control were continued. The yield of coconut in the coconut based farming system at Kudlu and Uduma showed an increase of 14% and 22% respectively. The yield of cardamom in the demonstration plot in Lakshmi Estate at Appangala increased to 800 kg/ha and the 'Katte' disease incidence came down to 0.1%.

Kisan melas and exhibitions

Kisan Melas/Field days were organised at CPCRI Research Centres at Kahikuchi, Mohitnagar, Kasaragod, ICAR Research Complex for Goa and CPCRI Seed Garden at Kidu.

An exhibition was organised at ICAR Research Complex (CPCRI) for Lakshadweep, Minicoy, jointly with CMFRI in connection with the

visit of the Prime Minister Sri Rajiv Gandhi.

Production of planting materials

Elite planting materials of coconut (72,410 seeds and 11,178 seedlings), arecanut (6,64,378 seeds and 41,689 seedlings), cardamom (34 kg seeds and 14,400 seedlings), pepper (66,537 cuttings) and cashew (5,900 kg seeds and 4,342 grafts) were distributed to extension agencies and farmers.

