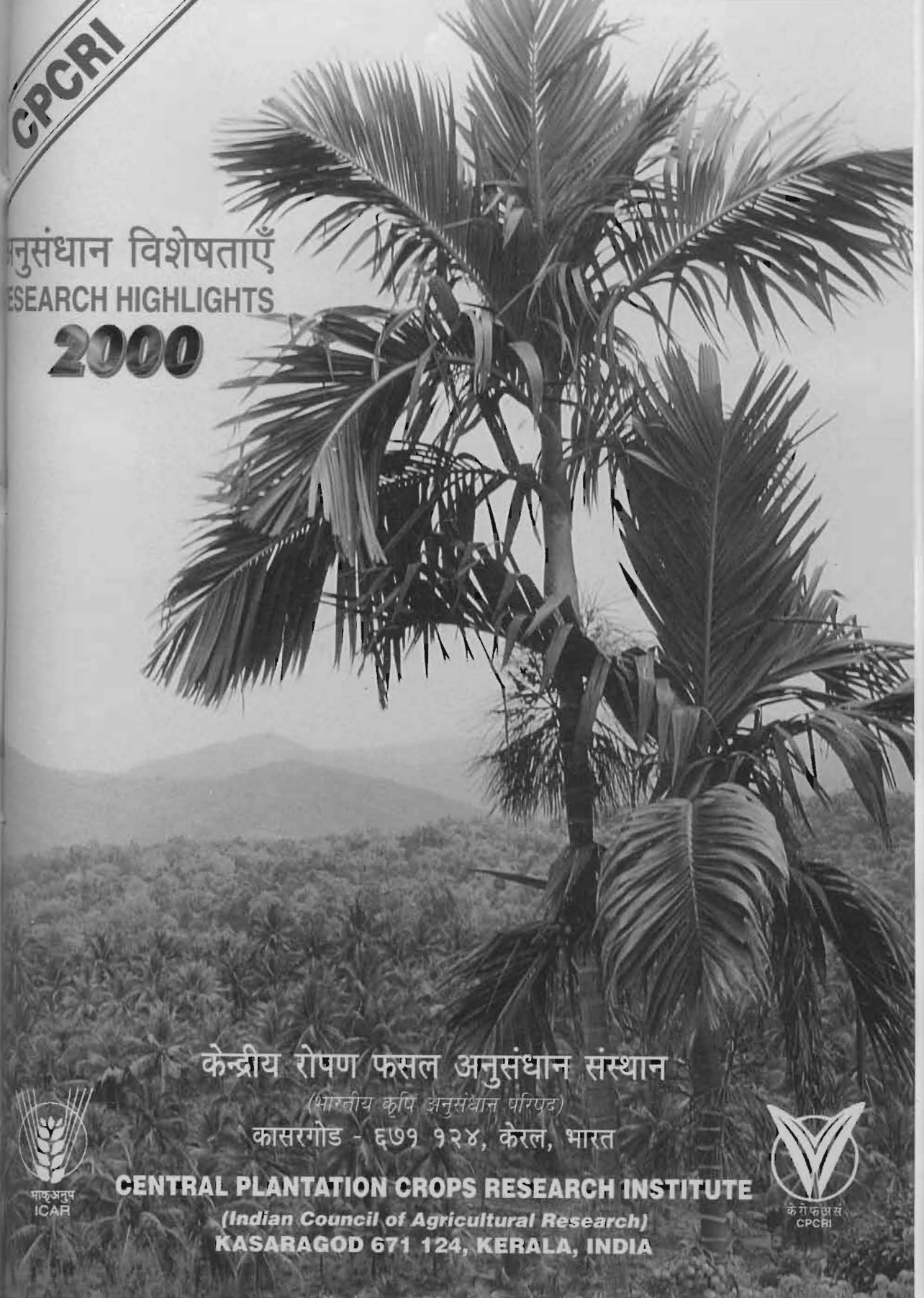

केन्द्रीय रोपण फसल अनुसंधान संस्थान

(भारतीय कृषि अनुसंधान परिषद)

कासरगोड - ६७१ १२४, केरल, भारत

भाकृअनुप
ICAR

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

KASARAGOD 671 124, KERALA, INDIA

केरोफसस
CPCRI

अनुसंधान-विशेषताएँ

RESEARCH HIGHLIGHTS

2000

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प्रस्तावना

केन्द्रीय रोपण फसल अनुसंधान संस्थान के अनुसंधान विशेषताओं की यह रिपोर्ट संस्थान के मुख्य फसलें जैसे नारियल, सुपारी, कोको परियोजनाओं की प्रगति की मुख्य उपलब्धियों का संक्षेप है। इस संस्थान के मुख्य विभागों जैसे फसल सुधार, फसल उत्पादन, फसल संरक्षण, पादप रोग विज्ञान, जैव रासायन विज्ञान, कटाई उपरान्त प्रौद्योगिकी और आर्थिकी एवं सॉख्यिकी इसके अलावा अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के अधीन 16 केन्द्रों में नारियल, सुपारी, तेल ताड और पॉमैरा पर अनुसंधान की मुख्य उपलब्धियॉ सम्मिलित है।

नारियल के 69 और जननद्रव्यों का संग्रहण, नारियल, सुपारी तथा कोको के उपज एवं उसके संघटक लक्षण के लिए वर्तमान जननद्रव्यों का मूल्यांकन, ताड आधारित फसलन/सस्यन पद्धति में पोषण निःशेष एवं पुनः चक्रमण, सुपारी एवं नारियल में सिंचाई उर्वरण से पोषण रक्षण, ताडों में स्थिर उत्पादन के लिए कार्बनिक कृषि प्रौद्योगिकियॉ, नारियल तेल में वसा अम्ल में समजीन भिन्नताएँ, नारियल के पत्ता सडन रोग, ताड एवं कोको के कीट एवं सूत्रकृमि का पारिस्थिति अनुकूल एवं जैविक नियंत्रण, नारियल में जडमुर्झा रोग एवं एरियोफिड कीट का प्रबंधन, सुपारी एवं नारियल में मूल्य वृद्धि का प्रयास आदि क्षेत्रों में अर्थपूर्ण उपलब्धियॉ प्राप्त की है। इस वर्ष कृषि विज्ञान केन्द्र, संस्थान ग्राम संपर्क कार्यक्रम, कृषि प्रौद्योगिकी सूचना केन्द्र के द्वारा प्रकाशन, रेडियो भाषण, दूरदर्शन कार्यक्रम, सी डी रोम, किसान मेला, प्रक्षेत्र प्रदर्शनियॉ एवं प्रशिक्षणों से प्रौद्योगिकी के स्थानांतरण को प्रबल बनाने के लिए संस्थान ने महत्वपूर्ण प्रगति की है। जैव सूचना केन्द्र की स्थापना वर्तमान सुविधाओं में एक नया जोड है। रोपाई वर्ष 2000 में 51, 286 नारियल बीज, 23764 नारियल पौध 11,61,365 सुपारी बीज 73,721 सुपारी पौध 67,362 कोको कलम और 2000 काली मिर्च पौध कृषक एवं विकासन एजेन्सियों को वितरित किए गए।

केन्द्रीय रोपण फसल अनुसंधान संस्थान के स्टाफों के कर्मचारीगण को उनके प्रशंसनीय अंशदान के लिए मैं बधाइयॉ देना चाहता हूँ।

इस रिपोर्ट के प्रकाशन के लिए मैं अपने सहयोगियों को उनकी मदद के लिए धन्यवाद देता हूँ।

वी. राजगोपाल

(वी. राजगोपाल)
निदेशक

14-04-2001
कासरगोड

INTRODUCTION

The Research Highlights of Central Plantation Crops Research Institute for the year 2000 contains the summary of achievements from the research projects on the mandate crops, viz coconut, arecanut and cocoa, which are in progress at this Institute. The salient achievements are presented under the major disciplines of Crop Improvement, Crop Production, Physiology and Biochemistry, Crop Protection, Pre and Post Harvest Technology and Economics and Statistics, besides the brief research achievements of coconut, oil palm and palmyrah in 16 centres under the All India Co-ordinated Research Project on Palms.

The significant achievements during the year were strengthening of germplasm collectings by addition of 69 collections to coconut and evaluation of existing germplasm lines in coconut, arecanut and cocoa for yield and its component traits, nutrient exhaust and recycling in palm based cropping/farming systems, nutrient savings in fertigation in both arecanut and coconut, organic farming technologies for sustainable production in palms, genotype variation in fatty acid profiles in coconut oil, eco-friendly and biological control of leaf rot disease of coconut, insect and nematode pests of palms and cocoa, management of root wilt disease and eriophyid mite in coconut and efforts on value addition in coconut and arecanut. Great strides were also made to transfer the technologies generated at this Institute through KVK, IVLP, ATIC and extension section of Institute by way of publications, radio talks, TV programmes, CD ROM's Kisan Mela's, FLD's, demonstrations and trainings. Establishment of Bioinformatic center is a new addition to the existing facilities. During 2000 planting session, 51,286 coconut seednuts, 23,764 coconut seedlings, 11,61,365 arecanut seednuts, 73,721 arecanut seedlings, 67,362 cocoa grafts and 2000 pepper cuttings were distributed to farming and development agencies.

I must congratulate the staff of CPCRI for their commendable contributions in technologies generation during the year. I acknowledge the help rendered by my colleagues in bringing out this publication.

V. Rajagopal

14-04-2001
Kasaragod

(V. RAJAGOPAL)
Director

CROP IMPROVEMENT

COCONUT

Collection, conservation, cataloguing and evaluation of coconut germplasm

Thirty collections were made from Andaman and Nicobar Islands, twenty two collections from Kerala, one collection from Tamil Nadu, eight collections each from Maldives and Comoros and the Reunion, thus making the total collection of coconut to 265 (117 exotic and 148 indegenous types).

Passport data, recorded in six germplasm exploration trips, of 85 accessions collected from within the country and from six Indian ocean Islands were subjected to Principal Component Analysis. Ten clusters were formed. One accession viz., Coco Gra Tall from Seychelles, a rare type with jelly-like endosperm formed a single cluster and was found to be different from all other accessions.

Analysis of variance in 16 cultivars planted during 1972 in RBD showed significant differences among treatments. Bunch production was highest (8.5) in SS Green. Nut yield was maximum in Laccadive Micro (134/palm/year), while the copra yield was highest in Cochin China (17.5 kg/palm/year) (Fig. 1).

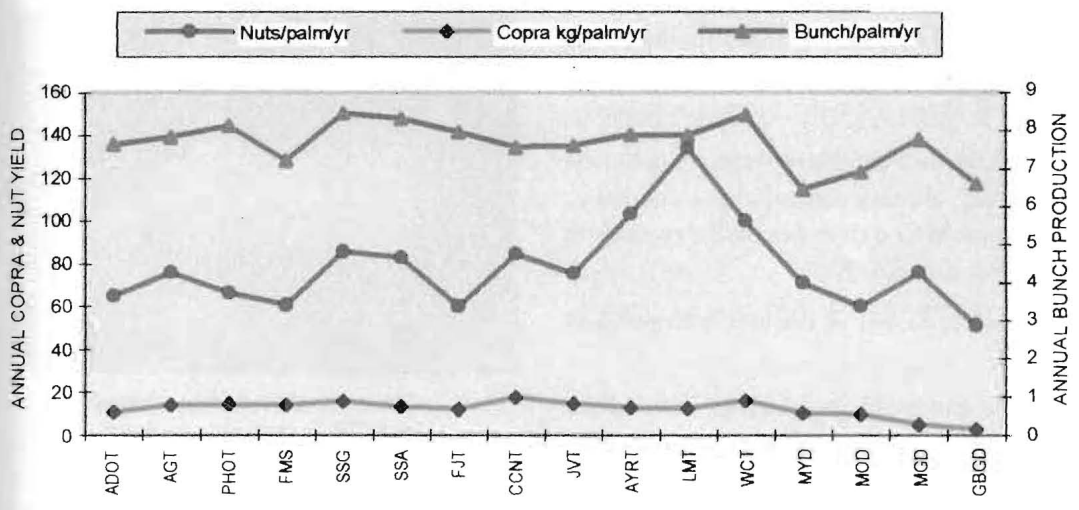


Fig. 1: Evaluation of sixteen accessions planted in 1972 (1997-2000)

Stability analysis was also attempted in these cultivars, but the G x E interaction was non-significant. The data was also subjected to clustering using PCA, Mahalanobis D^2 and Canonical Analysis. Four clusters were formed. Cluster-I had maximum number of eleven accessions, while cluster-IV formed a distinct single cluster containing only one accession viz., Laccadive Micro. Cluster-II contained Ayiram Kachi and WCT, while cluster-III included two dwarfs viz. Malayan Green Dwarf and Gangabondam.

Estimation of oil content in nine accessions (3 Pacific and 6 Nicobar collectios) maintained at World Coconut Germplasm Centre, Andamans had shown that the oil content varied from 61.2 % in Accession No.29 (Katchal, Nicobar Island) to 65.7 % in Accession No. 25 (Auck Chung, Nicobar Island).

Exotic germplasm collection through embryo culture

A total of 1229 embryos belonging to 16 accessions collected from Maldives, Comoros and the Reunion were inoculated for retrieval.

Seventy one embryo cultured plantlets collected during previous expedition (Mauritius, Madagascar, Seychelles) were field planted at ICG-SA, Kidu.

Allozyme variation in coconut cultivars and hybrids

Six talls and eight dwarfs were studied for isozyme polymorphism using seven enzyme systems. Intra population variation was observed with Poly Phenol Oxidase, Esterase, Peroxidase, Malate de hydrogenase, Alcohol de hydrogenase and Glutamate oxy transminase. In general enzyme polymorphism was higher in talls compared to dwarfs.

DNA fingerprinting and character tagging in coconut

DNA from 81 palms representing 20 accessions (15 indigenous and 5 exotic) was amplified with 8 polymorphic primers. These primers detected 77 polymorphic markers. The genetic diversity of dwarf accessions was significantly lower than that for tall accessions, and more variation among exotic collection compared to indigenous. In dendrogram, dwarf accessions formed two main groups whereas, tall accessions were clustered in three main groups.

Tissue culture for rapid multiplication of elite genotype in coconut

Fifteen per cent of the cultures produced shoots in medium containing spermine. These cultures were derived from plumule callus of WCT cultivar (Plate-1).

Plate 1: Shoots produced from plumule callus of WCT in spermine medium

The growth of root was brought down to about 1 mm per month by combining the nutrient content and hormones. The roots, which were kept in slow growth condition for

over 18 months, were found to resume the normal growth on half strength MS containing 0.2mgl^{-1} IBA or 0.5mgl^{-1} NAA. The callus formation was limited to tomentose structures at the cut ends in most of the roots in Y3 based media with 2,4-D concentration above 20 mgl^{-1}. In cultures which were maintained in culture tubes as well as flasks with glass stoppers survived for 22 months so far. Half strength MS medium with 50 mgl^{-1} NAA was the best combination for the root induction from leaf explants. Rachilla explants appear to be a better alternative for the conservation with very slow growth and potential for regeneration.

ARECANUT

Collection, conservation, cataloguing and evaluation of arecanut germplasm

In the main germplasm bank at Vittal, a total of 128 accessions, which include 23 exotic and 105 indigenous have been under evaluation for yield and its component traits since 1985. A significant difference among the accessions was noticed in respect of chali yield/palm/year in seventeen indigenous accessions (Calicut series) along with Mangala (check) and four other varieties. Accessions Cal-33, Cal-32, Cal-17 and Cal-4 showed superiority for yield of chali of 2.70, 2.57, 2.41 & 2.29 kg/palm, respectively among the Calicut series collections. In an another set of 17 indigenous accessions introduced from different areca growing states, significant differences noticed among the accessions for number of nuts produced/palm and chali yield/palm. Accession Sagar continued to record high chali yield of 3.05 kg/palm. Accessions Kahikuchi, Mettupalayam, Kamrup and Shrivardhan-I also exhibited higher yield potential during the year.

Evolving high yielding varieties by selection and hybridization in areca nut

The comparative yield trials (CYT) of released varieties and promising cultivars planted under different agro-climatic conditions at Vittal (Coastal), Thirthahalli (Malnad) and Hirehalii (Maidan) have been in progress since 1987-88. In CYT at Vittal, the data showed significant differences among varieties for girth. Sreemangala exhibited vigorous growth interms of plant height and girth compared to other varieties.

Growth parameters were recorded in hybrid evaluation trial, where 16 hybrid combinations and five parents were planted in 1995 at Vittal. The data revealed significant differences among parents and hybrid combinations for girth, internodal distance, number of nodes per palm, number of leaflets and leaflet breadth. Among the hybrid combinations, Sreevardhan x Mangala, Sreemangala x Sreevardhan and Mohitnagar x Sreevardhan recorded better growth performance with respect to growth parameters.

In CYT at Hirehalli (Plate-2), Hirehalli local followed by Mangala recorded higher tender nut yield compared to other varieties. Fruit component analysis (Plate-3) under malnad region of Karnataka indicated highest tendernut yield in Mangala followed by Thirthahalli local.

Plate-2: Comparative yield trial at Hirehalli

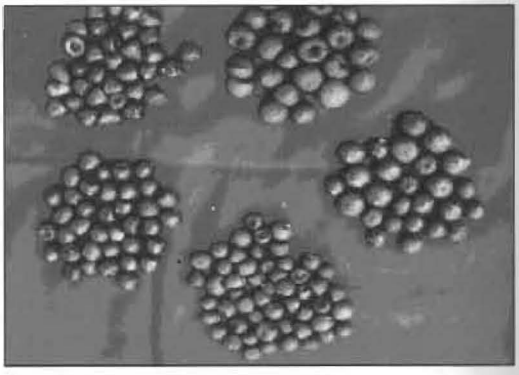


Plate-3: Fruit component analysis

Genetics of dwarfs in arecanut and their exploitation in breeding dwarf varieties

Growth study was undertaken by recording morphological characters namely, plant height, girth of stem, number of nodes, leaf production and stem height in eight hybrids involving Hirehalli dwarf (HD) and released varieties and five parents under evaluation for high yield and dwarfness. There was significant difference among the hybrids and parents for all the characters studied except for production of leaves. In general parents showed vigorous growth in terms of maximum height and crown length. Crosses HD x Sumangala and HD x Sreemangala recorded minimum height and maximum stem girth of 2.42 and 2.50 m and 64.99 cm and 61.11 cm, respectively.

Yield characters such as number of nuts/ palm and ripe nut yield/palm recorded in the trial showed significant differences among the parents and hybrids. Among the hybrids, maximum ripe nut yield of 9.14 kg/palm was recorded in the cross HD x Sumangala. The yield performance of crosses, Mohitnagar x HD, Sumangala x HD and HD x Mohitnagar, were also better. Nut component traits viz., fresh nut weight (g), dry kernel weight (g), length & breadth of fresh nut and kernel and also recovery of chali from fresh nut (%) revealed the significant variations among the hybrids and parents. Overall high yielding parents have recorded higher values for fruit traits compared to their hybrids except in HD, which maintained its identity of small sized nuts and showed significantly higher recovery of chali (28.53%).

COCOA

Collection, conservation, cataloguing and evaluation of cocoa germplasm

Among the young clones planted in October 1995, NC 52 clones had an annual pod yield (No.) of 60.50 followed by NC 22 (53.75) and NC 50 (45.63). The precocious clones had maintained the heavy pod bearing with a moderate canopy volume. Among the 14 Lalbagh collections under trial since 1991, NA 242 clones maintained their superiority over others in withstanding the naturally occurring and annually recurring stress due to alternate seepage water and dry soil for three months each. These particular clones recorded a highest dry bean yield of 1.368 kg followed by those of V 7 (1.349kg) and IMC 10 clones (1.345kg).

CROP PRODUCTION

COCONUT

Coconut based cropping system for sustainable productivity under coastal ecosystem

In the coconut based high density multispecies cropping system, the coconut yield ranged from 113 nuts/palm/year under control treatment to 151 nuts/palm/year at two-third of the recommended fertilizer dose. The productivity of the palm declined with the further reduction in the fertilizer levels. The clove tree did not flower below one-third of the recommended fertilizer treatment. Highest yield was recorded at full recommended dose (1.342g dried clove/ tree), thereafter, the yield declined. A total of 7.3 kg banana/bunch was recorded at full dose of fertilizer, and it was only 3.0 kg/bunch under control treatment. Analysis of nutrient status of soil and plant samples indicated that one-third, two-third and full dose treatments had recorded higher soil N, P and K contents over control, one-fourth and one-fifth fertilizer treatments in both the main as well as component crops. Even though, in case of coconut, the leaf analytical values showed optimum nutrient status, a perceptible decline in the biomass production was recorded in each treatment. Highest coconut biomass was obtained at full dose treatment (22.58 t/ha), which declined substantially to 17 t/ha in the control treatment. The total nutrient exhaust ranged from 131.5, 18.34 and 173.41 kg of N, P and K respectively per ha in the full dose to 86.77, 11.62 and 112.22 kg of N, P and K respectively per ha in the control plot. The extent of possible nutrient recycling in terms of leaflets, petioles, bunch, spathe and husk was highest in full dose treatment (Fig-2).

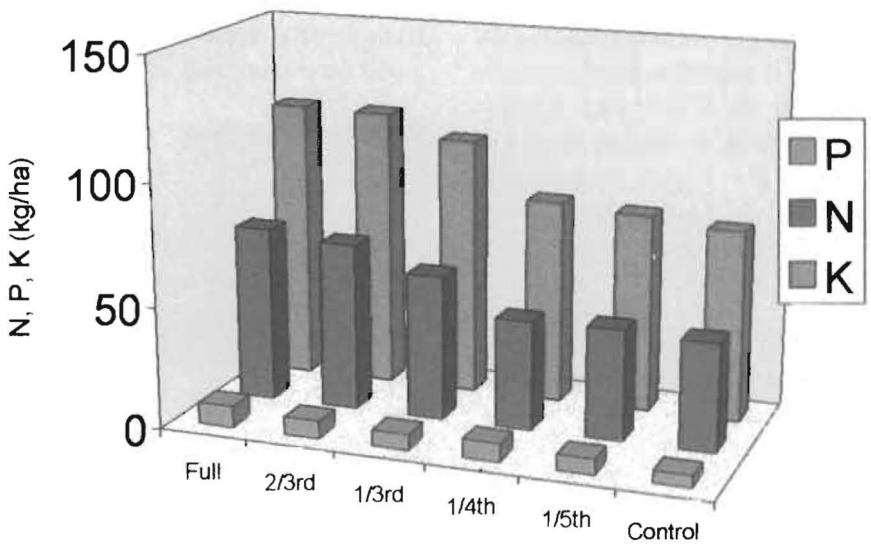


Fig. 2: Extent of nutrient recycling under different fertilizer levels

Higher content of microbial biomass was recorded in root region soils of coconut and component crops at medium level of fertilizer inputs than full-recommended fertilizer dose or at low fertilizer treatments. The quantity of carbon mineralised, phosphatase and dehydrogenase activities of soil also varied under different fertilizer treatments and a decreasing trend was observed with increasing soil depth. Medium level of fertilizer inputs along with recycling of waste biomass resulted in the development of congenial conditions for higher level of microbial activity in the cropping system.

Coconut based farming system for sustainable productivity under coastal ecosystem

Coconut based farming system comprising coconut, grass, dairy, poultry, sericulture and pisciculture is being evaluated to achieve higher productivity and profitability from coconut plantations. Coconut, milk yield and broiler's sale accounted for 98 % of the revenue generated from the system. Feed and labour cost constituted 83 % of the variable cost. The total variable cost involved in maintaining the above system was Rs 1,56,617/ha. The net return obtained from the system was Rs 85,824 per annum. About 60 t of cow dung, 47.4 kg silkworm waste and 457 kg of poultry and quail manure obtained from the system were recycled in the coconut and grass plot, thereby improving the soil physico-chemical and biological properties of the soil. A total of 26.5 t of fodder grass obtained from the one ha grass plot was fed to the milch animals.

Substitution of chemical fertilizers with composted coir pith on the nutrition and productivity of coconut.

In the field experiment on substitution of chemical fertilizers by composted coir pith in coconut, the treatment NPK (50%) + Composted Coir Pith (CCP) (50%), though statistically non-significant gave highest yield of 104 nuts/palm/year followed by the treatment 100 % NPK as inorganic fertilizer (82 nuts/palm/year). The lowest yield of 66 nuts/palm/year was recorded in absolute control. The highest net returns of Rs 18,124/ha was obtained in the treatment NPK (50%) + CCP (50%). This was followed by the treatment 100 % NPK as inorganic fertilizer (Rs 12249). The leaf samples analysis for N, P and K content did not show significant differences between the treatments. Soil organic C, available N and available P also did not show significant differences among the different treatments. Available K content in the soil at 0 - 25 cm depth differed significantly and chemical fertilizer recorded significantly higher available K, though it was on par with the treatment NPK (50%) + CCP (50%).

High density multi species cropping system model for coconut root wilt affected garden

High density multi species cropping system model in root wilt affected garden is in progress at CPCRI, RS, Kayangulam with clove, nutmeg, banana, pineapple, pepper, yam and amorphophallus as component crops. The yield in component crops ranged from, banana-Poovan -11 kg/bunch; Njalipoovan -11 kg/bunch; Palayankodan -17 kg/bunch; Robusta -13 kg/bunch; Nendran -17 kg/bunch; Karpooravally (curry type) -21 kg/bunch, pineapple- average 1.0 to 1.5 kg /fruit, amorphophallus- 6.5 to 7.5 kg /plant and diascorea-5.0 to 6.0 kg/plant. The coconut yield

increased from 28 nuts per palm per year (pre-experimental) to 51.8 nuts per palm per year during 1999-2000 indicating beneficial effect of growing intercrops besides providing additional employment and income under root wilt affected area.

Composting of coir pith using microbial inoculants and earthworms

Large scale production technology for coir pith compost has been standardised using the microbial inoculants of *Marasmiellus troyanus, Pleurotus florida, Trichoderma* species and a newly isolated fungus (Plate-4). Compost with C:N ratio of 17-18:1 was obtained in treatments of *M.troyanus* and *Trichoderma* species with inorganic N and P treatments at 0.5 % level. Among the different types of amendments tested, the efficacy of composting was better either with a combination of organics + inorganics or with inorganics alone when compared to treatments which received only organic amendments.

Plate-4: Large scale composting of coir pith with microbial inoculants

Milky white mushroom, *Calocybe indica* was successfully cultivated using fermented coir pith as substrate (Plate-5). Casing was done with sand + garden soil mixture (1:1) amended with 5% calcium carbonate. Biological efficiency of 45.3 to 49.91 % was obtained in the fermented coir pith. The edible mushroom produced large and milky fruiting bodies with delicious flavour and long shelf life.

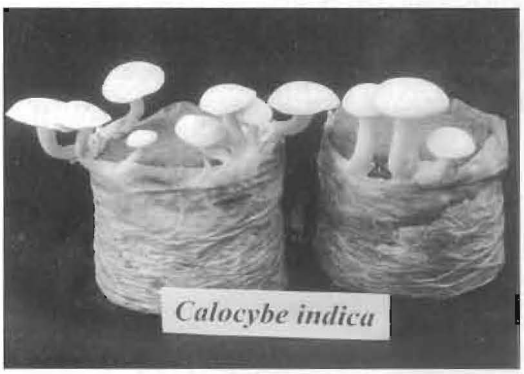


Plate-5: Milky white mushroom, *Calocybe indica* on fermented coir pith

The local strain of epigeic earthworm *Eudrilus* spp. was found suitable for producing vermicompost from fresh coir pith treated with rock phosphate @ 5kg/t and incubated for 3 weeks. This treated coir pith has to be mixed with 10 % cow dung, 10 % fresh vermicompost and 20 % full coconut leaves on weight basis and earthworms have to be released at the rate of 1000 numbers per ton of this mixture. The earthworms form burrows in the bed and vermicastings appeared as surface casts. The compost with 1.2 % nitrogen and C:N ratio of 16.7: 1 gets ready in 2 months . The nitrogen fixing *Actinomycetes* was consistently associated with vermicastings in dilutions $10^4/10^5$.

Biofertilizers for coconut

A large scale inoculation trial in polybag coconut seedlings was conducted using biofertilizers prepared from local isolates of associative nitrogen fixers. The biofertilizers prepared from *Azoarcus, Arthrobacter* and *Azospirillum* spp. benefited the plants to the maximum extent. Root volume, number of healthy roots (Plate-6), secondary roots, collar girth, total dry weight and overall health was consistently higher in plants inoculated with these assocoiative N-fixers. *Azospirillum lipoferum, A.brasilense, Herbaspirillum frisingense, Burkholderia, Pseudomonas* and *Bacillus* also improved seedling growth and health. Inoculation of coconut seedlings in nursery with associative diazotrophs can thus be adopted to get healthy and vigorous seedlings with improved root growth.

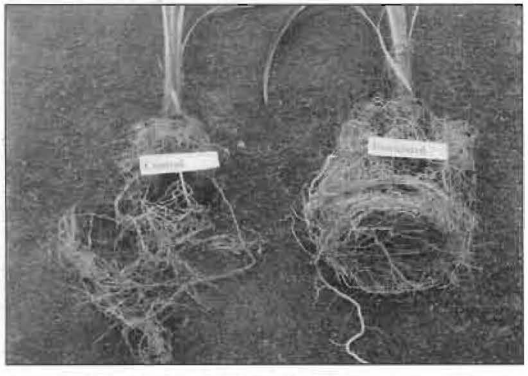


Plate - 6: Effect of biofertilizer prepared from *Azospirillum* spp. on root growth of coconut seedlings

Role of boron in coconut nutrition

Studies on different varieties of coconut showed that the incidence of boron deficiency was more in COD (13%) followed by WCT (12%) than in CGD (6%).

Leaf samples at different ranks from first fully opened to the tenth one were collected from both healthy and disease affected palms and were analyzed for N, P, K, Ca, Mg, Fe, Mn, Cu, Zn and B. The data showed that Fe, Mn, Zn, Cu & B were significantly lower in boron deficient palms in all the leaves irrespective of ranks.

ARECANUT

Fertigation

After four years of experimentation, different fertilizer levels significantly influenced girth and trunk elongation. Percentage of flowering was maximum with 75 % recommended fertilizer level followed by 50 % fertilizer level. Average of four years data on physiological parameters indicated that different fertilizer levels have maintained more or less same level of net photosynthesis, transpiration and stomatal conductance. Fertilizer levels significantly influenced crop growth rate (CGR). Based on growth observations and photosynthetic parameters, it was evident that 50 % of the recommended fertilizer dose was sufficient for pre-bearing arecanut palms through ferti-drip irrigation thus saving considerable fertilizer input. Annual maintenance cost could be reduced considerably through saving in labour and fertilizer input to the tune of Rs.14,450/ha over normal practice of basin application of fertilizers and irrigation.

Vermicompost application

A field trial on utilization of vermicompost for replacing chemical fertilizer for organic farming was initiated during 1997 in a three year old areca garden, to evaluate the influence of vermicompost on soil microflora, fertility and yield of arecanut. The plant height was

significantly higher when the crop was grown with 100% vermicompost. The girth and the number of leaves have shown similar trend. Almost 50% of the plants grown with vermicompost have flowered, as aganist only about 25% with chemical fertilizer. The least flower production was in the control plot.

PRODUCTION PHYSIOLOGY AND BIOCHEMISTRY

Genotypic variation in essential fatty acids and other nutrients in coconut

Freshly fertilized bunches of WCT, LCT x GBGD, COD x WCT, WCT x GBGD and LCT x COD were tagged in the post-monsoon, pre-monsoon and monsoon seasons. These nuts were analyzed for their nutrient contents on the 7, 8, 10 and 12 months after fertilization.

Total carbohydrate content of the kernel increased to a maximum in the 10th month and thereafter decreased, while the reducing sugar content showed the inverse trend, i.e., decreasing to a minimum in the 10th month. The starch and protein content decreased, while the fiber content increased with increasing maturity of the nut.

The fatty acid profile of the oil was studied and it was found that the small to medium chain fatty acids viz., caprylic (C8:0), capric (C10:0), lauric (C12:0) and myristic (C14:0) acids increased with increasing maturity in all varieties. The long chain fatty acids, palmitic (C16:0) and stearic (C18:0) acids were maximum in 7 month old nuts and decreased thereafter. The unsaturated fatty acids showed a marginal increase from 8 to 10 months, contents of 10 and 12 month old nuts being on par. The trend was same in all varieties and at all the three seasons. Lauric acid was the maximum (35-47%), followed by myristic acid (18-24%), palmitic and stearic acids (6-20%). The caprylic, capric and unsaturated fatty acids were the least, ranging from 1-6%. Figure-3 shows the change in fatty acids profile of WCT nuts (tagged in post-monsoon season) of 7, 8, 10 and 12 months maturities.

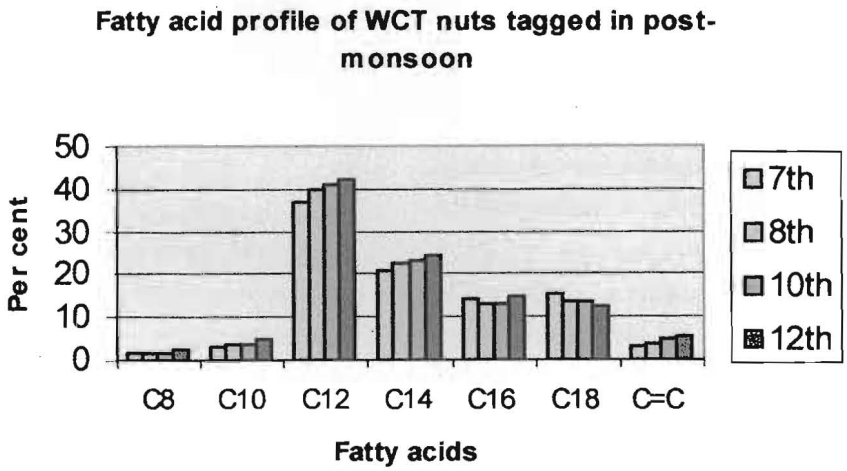


Fig. 3 : Fatty acid profile of WCT nuts tagged in post-monsoon

Ranking of coconut cultivars based on fatty acid profiles

A total of 18 cultivars of coconut were analyzed for fatty acid profile of oil. The results indicated existing variability. Based on the several criteria, the coconut cultivars were ranked. Hybrids had low ratio of saturated to unsaturated fatty acids. Andaman Tall had high concentration of medium chain fatty acids (MCFA's) including high lauric acid concentration. The COD x WCT ranked top when both these criteria were taken to consideration. LCT x GBGD had low ratio of saturated to unsaturated fatty acid and high concentration of lauric acid. When the ranking was done for overall criteria, COD x WCT stood first.

Performance of released varieties/hybrids

Evaluation of coconut cultivars/hybrids viz. WCT, LCT, Benaulim, WCT x GBGD, COD x WCT, LCT x GBGD and LCT x COD revealed an improvement in nut yield over the years (27% - LCT x COD to 114% - COD x WCT) irrespective of the management practices. Higher improvement in yield was observed in the palms receiving 15 kg vermicompost and 50 g boron, with higher increase in LCT x GBGD (136%) and Benaulim (127%) than the palms receiving only normal fertilizer and irrigation.

Pruning and training requirements in cocoa

For optimum productivity, proper canopy management to maintain shape and size is required. Maximum leaf area should be maintained with pruning practices to avoid self-shading of leaves. In order to understand and elucidate optimum canopy shape and pruning regime for cocoa, a spacing and pruning trial was conducted with seedling progeny. The average land equivalent ratio (LER) for different treatments ranged from 0.82 to 1.74, which showed the advantage of mixed cropping of areca and cocoa (Table-1). The maximum LER was found in S_2P_3 treatment. Considering the LER and combined yields, it is advantageous to grow areca and cocoa at S_2 spacing (2.7 x 2.7m).

Table 1. Land equivalent ratio (LER) in Areca-cocoa mixed cropping

Treatment	P1	P2	P3	Mean
S1	1.13	1.34	1.68	1.38
S2	1.34	1.38	1.74	1.48
S3	0.82	1.53	1.67	1.34
Mean	1.09	1.42	1.70	

CROP PROTECTION

COCONUT

Root wilt/leaf rot occurrence in Dindigul District of Tamil Nadu

The presence of root wilt-leaf rot in Dindigul district of Tamil Nadu was confirmed. All the six representative samples of spindle leaves collected from root wilt infected palms in the region tested serologically positive.

Biological control of leaf rot disease using antagonists

An *Actinomycete* isolate was obtained from the leaf rot affected leaves of coconut, which was a very effective antagonist of the two main leaf rot pathogens - *Colletotrichum gloeosporioides* and *Exserohilum rostratum*. Besides, *Actinomycete* exhibited wide spectrum antagonistic activity against a host of other microorganisms.

Phytoplasma from yellow leaf diseased areca palm and spear rot affected oil palm have been purified by percoll density gradient centrifugation. Ultrastructural study of the purified fraction from oil palm revealed the presence of phytoplasma.

Serological testing of leaf samples of disease -suspected palms confirmed the prevalence of root wilt disease in Kasaragod, Kanyakumari and Theni districts and in Goa.

Pouring of 3G Indofil-M45 or Contaf 5EC - 2 ml dissolved in 300 ml water after removing rotten portions of the spear leaf followed by application of Phorate 20 g mixed in 200 g fine river sand to the base of the spindle in April-May and in October-November is recommended for curative and prophylactic treatment against leaf rot and insect pests on all coconut palms in the root wilt prevalent areas. The coconut water, kernel and oil from mature nuts harvested after 45 days of application of Folidol Dust - 50 g, Contaf 5EC - 4 ml, Indofil-M45-3 g and Phorate 20 g were free from residues.

Molecular characterization and detection of the coconut leaf rot pathogens

Genomic DNA was extracted from 10 isolates of *Colletotrichum gloeosporioides* (Cg) and 7 isolates of *Exserohilum rostratum* (Er), the two important fungal pathogens of coconut leaf rot disease (LRD). Initial polymerase chain reaction (PCR), amplifications of the internal transcribed spacer (ITS) region of the rDNA was done using ITS4 and ITS5 primers. The length of the PCR product from both Cg and Er was estimated at 590 basepairs (bp).

PCR amplified internal transcribed spacer regions (ITS4 and ITS5) of Cg and Er were digested with 9 endonucleases (RE). The RE digests yielded banding patterns corresponding to two groups in Er and three groups in Cg. These were further confirmed by sequence analysis.

RAPD profiles of Cg and Er isolates with 10 random decamer oligonucleotides produced varying degrees of polymorphism in Cg whereas only the Tni1 isolate had low similarity with other isolates of Er. The banding patterns were highly specific at the isolate level; and so they could be used as fingerprints'.

Sequencing of the ITS4 to ITS5 region of 6 isolates of Cg and 4 isolates of Er was done. The nucleotide sequences of Cg isolates confirmed the separation into 3 groups and between groups the isolates show 99% or more homology to one another. The sequences of Er isolates showed 99.6% homology or more to one another with the exception of Tni1, which was again shown to be quite different.

The sequence data was utilized for designing specific primers. A species-specific primer pair for Er, ERFWD1/ERREV1 was designed. The sequences of Cg isolates had only a few bp differences from those of other Cg pathogens from different host plants found in the database. Hence the specific primer pair CgInt/ITS4, already available for this fungus, was adopted. The PCR conditions (concentrations of Mg^{++}, primers, template, different Taq polymerases, cycling conditions and annealing temperatures) when optimised for each pair of target primers. These primer combinations, CgInt/ITS4 and ERFWD1/ ERREV1, amplified only the target fungus, Cg and Er respectively, and no amplification of the product was observed with DNA from any other fungi.

Methods have been standardized for the extraction of genomic DNA from LRD infected dry samples and PCR amplification of the extracted DNA using target (specific) primers. PCR products/identical in size to those amplified from pure fungal DNA were produced when primers CgInt/ITS4 and ERFWD1/ERREV1 were used with DNA extracted from LRD infected coconut leaf. No amplification product was observed with DNA extracted from healthy tissue.

The sensitivity of PCR detection was assessed using the PCR product of fungal DNA and DNA from LRD infected leaf. The amplified products from Er and Cg (if both were present in the same infected leaf) could be visualized as separate bands at different distances in agarose gels.

Breeding for resistance/tolerance to coconut root wilt disease

Assisted pollination involving 81 WCT, 104 CGD and 7 COD mother palms was carried out to generate planting materials for establishing nucleus seed gardens and to develop a high yielding coconut variety resistant/tolerant to coconut root wilt disease. Artificial pollination was carried out in 935 inflorescences involving 20990 number of female flowers. A total of 5714 artificially pollinated seednuts were harvested and sown in the nursery. A new nucleus garden consisting of 412 artificially pollinated seedlings was established at the Agricultural Farm, Karunagapally (Kollam district). Besides this, 678 artificially pollinated seedlings were additionally planted in the already existing nucleus seed garden at the District Agricultural Farm, Mavelikara (Alapuzha Dist.).

Starting from 1995, five nucleus seed gardens accomodating 5486 artificially pollinated seedlings have been established in Kannara (Thrissur), Neriamangalam (Ernakulam), Karunagappally (Kollam), Mavelikara and Kayangulam (Alappuzha). These seed gardens when they come to the full bearing stage, are expected to meet the acute demand for quality planting materials in the disease prevalent tract.

First report of immature nut fall of coconut caused by *P.meadii.*

An isolate of *Phytophthora* causing immature nut fall of coconut (Plate-7) collected from Kodagu district of Karnataka differed from *P.palmivora* in its cultural and morphological criteria. This isolate exhibited chyrsanthemum pattern of growth with no aerial mycelium. Sporangia are caducous and are shed with thin and narrow stalk. The sporangial dimensions were 40.45 ± 3.49 x 25.10 ± 1.67 µm with L / B ratio of 1.61. The length of pedicel was 24. 35 ± 3.74 µm .It infects arecanut but not cocoa and black pepper. Based on these criteria, this isolate was identified as *P. meadii.*

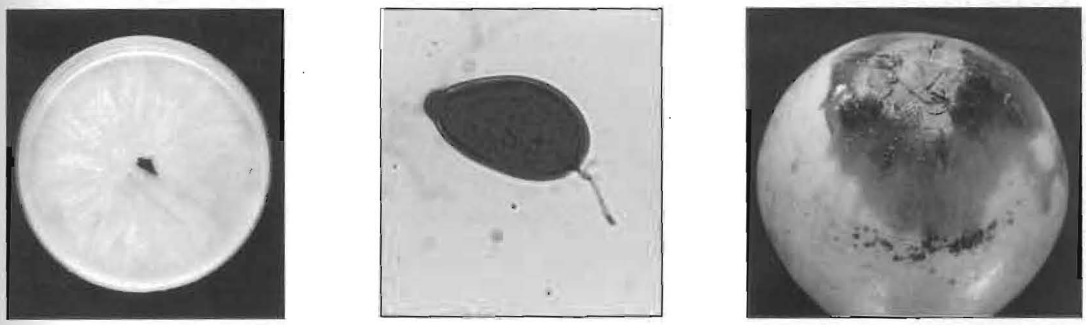


Plate-7: Colony morphology, sporangia and symptoms of coconut isolate causing immature nut fall.

Biological control of pests of coconut

Corcyra cephalonica was found to be an ideal alternate host for the mass multiplication of *Apanteles taragamae*, the early instar parasitoid of *Opisina arenosella.*

Castor oil and coconut oil based bacterial suspension emulsion (at 5-6%) of the bacterial isolate RPW - PSI gave 36% and 28% mortality of the red palm weevil grubs in laboratory studies. *Pseudomonas alcaligenes*, the oppurtunistic bacterial pathogen of *Oryctes* has been scored for its intrinsic antibiotic resistance. Use of antibiotics would help to reduce the *Baculovirus* inoculum loss during its *in vivo* lab maintenance.

An isolate of *Heterorhabditis indicus* from Kayangulam could gave 100% kill of *Oryctes* grubus within one week in cowdung in glass troughs under laboratory condition. *Metarhizium flavouiride* an entomogenous fungi was reported from *Oryctes rhinoceros* beetle for first time in the World from Kerala.

Based on the spore encumbrance on nematode cuticle, *Pasteuria penetrans* (PPMI) recovered from root knot nematode, *Meloidogyne incognita* and *Pasteuria* isolate (PPHO) collected from cyst nematode, *Heterodera oryzicola, Radopholus similis* (females, males and larvae) was host to PPHO and non-host to *M. incognita,* whereas with PPML, *H. oryzicola* was a host and others were non-hosts.

Eriophyid mite in coconut plantations

Studies on population abundance of the eriophyid mite showed that higher temperature combined with high relative humidity were congenial for rapid multiplication of the mite. Intermittent summer rains followed by dry weather were favourable for the population build up. On laboratory maintainance, the mites survived for a period of 15 days at 15-25°C when the detached spikelets were dipped in water/sucrose solution.

The innermost two sepals harbored higher population of predatory mite. On examination of the infested nuts 56% of them lodged the predatory mite. Attempts have been made for mass multiplication and colonization.

ARECANUT

Occurrence of *P. heveae*

A homothallic isolate of *Phytophthora* (AR.30) causing fruit rot of arecanut was isolated from Puttur taluk of Dakishna Kannada district of Karnataka, which produces non-caducous sporangia (Plate-8), oogonia,

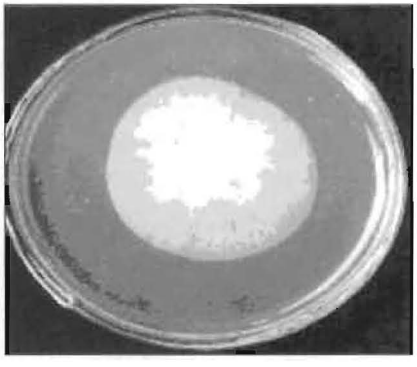


Plate-8: Colony morphology of *palmivora*

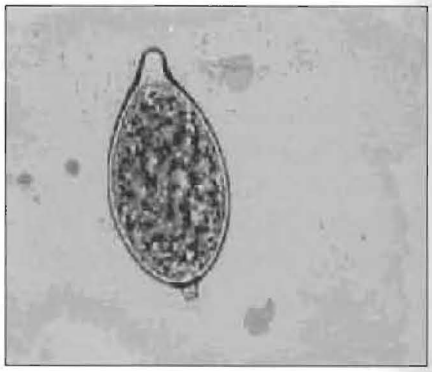


Plate-9: Sporangia of *P. palmivora*

oospores (Plate-9) and chlamydospores abundantly on carrot-agar. The size of the sporangia were 37.02 ± 5.38 X 25.34 ± 3.94µm with L/B ratio 1.48 ± 0.24. The average size of oospores and chlamydospores is 25.69 ± 3.65 and 26.03 ± 2.20µm respectively. This is the first report of occurrence of *P. heveae* on arecanut.

Natural enemies on major insect pests

Survey was conducted mainly in the areca gardens of the Institute to collect the natural enemies of insects infesting areca palm. Two species of *Stethrous*, a phytoseiid and a species of thrips were collected from mite colonies as predator (both *Oligomychus indicus* and *Raotella indica*). No parasite/ predator could be collected so far from spindle bug and pentatomid bug infesting areca palm.

Thirty two types of spiders were collected inhabiting the leaves, spindle areas and inflorescences of area palm. Out of these, six species were sent for identification to ZSI, Calcutta.

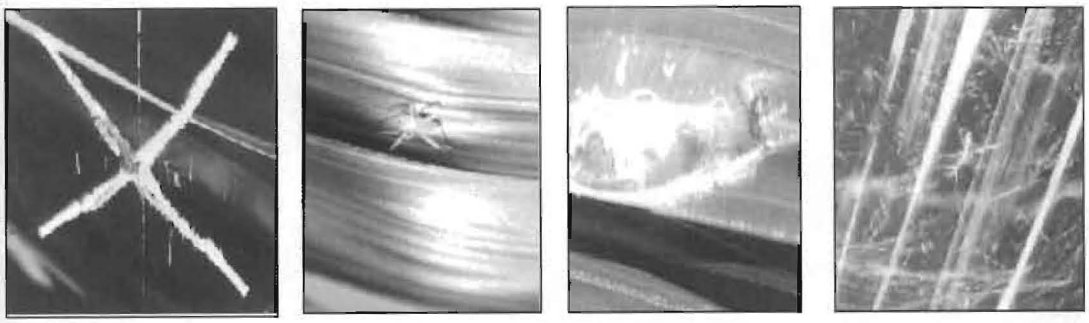


Plate-10: Spiders in areca ecosystem

Reduviids and chrysopids were the other general predators collected. Two egg masses of the reduviid were collected from areca leaves. Nymphs emerged from one of the egg masses were reared in the laboratory using aphids and caterpillars as prey materials. The nymphal period lasted 85 days. The adult is *Sycanus* sp.

Management of *Phytophthora* diseases

Five fungicides viz., stopsin (systemic 0.1 and 0.2), dithane M45 flowable (0.3 and 0.4%), baycor (0.1 and 0.2%), cuprous oxide (0.5%) and Ovis-20 were tested against *Phytophthora meadii* isolates. Out of the five fungicides, cuprous oxide and Ovis-20 (Plate-12) were fungicidal.

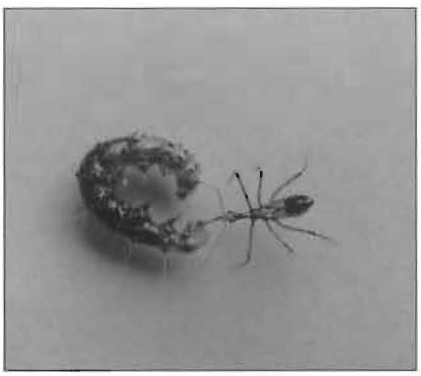


Plate-11: Nymph of reduviid

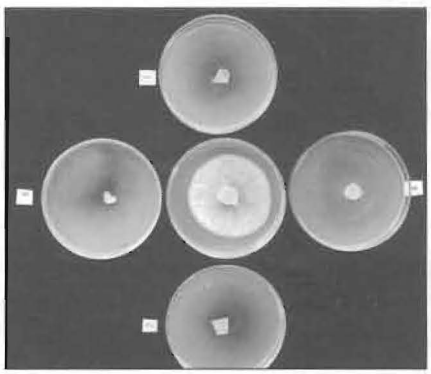


Plate-12: Ovis-20 fungicidal to *P. meadii*

Insect pathogens infecting scale insects and whiteflies were brought to pure cultures. These included *Beauveria* sp., *Fusarium* sp and four indetermined fungi. Pathogenecity of these will be done under laboratory conditions on scale insects and white flies.

Water extract of five plant species were tested *in vitro* for their efficacy to check *P. meadii*. The medium added with extract of 'Kiriath' (*Andrographis paniculata* Nees) showed reduced radial growth (maximum 22mm) at the end of five days of incubation period.

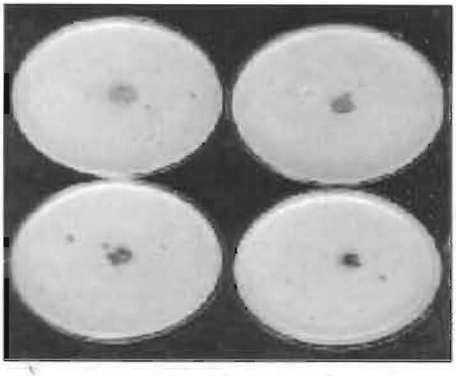


Plate-13:*Trichoderma* Spp on medium ammended with fungicide Dithane M-45

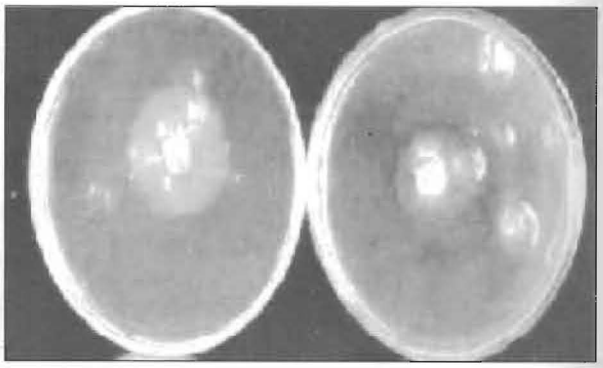


Plate-14: *Trichoderma* Spp growing on medium ammended with fungicide Ovis-20

The compatibility studies with *Trichoderma* spp. and the fungicides dithane M45 (Plate-13) and Ovis-20 (Plate-14) showed Ovis-20 as compatible.

The promising antagonists *Trichoderma* (two spp.), *Pseudomonas* (nine solates) and *Bacillus* (one isolate) were tested for their efficacy in checking *Phytophthora* growth on plant tissues. Bits of tender rachis of about 10-12 mm in length were used for inoculation (Plate-15). Both the species of *Trichoderma* and seven isolates of *Pseudomonas* arrested the pathogen establishment on host tissue.

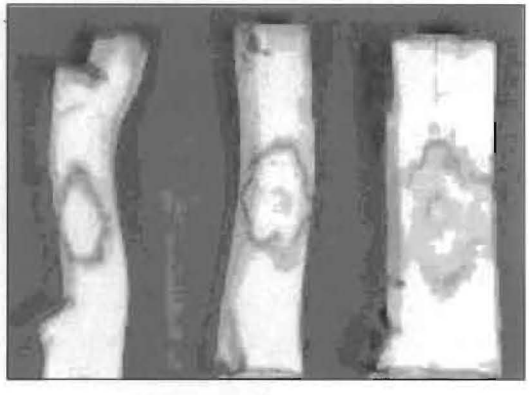


Plate-15: Inhibition of *Phytophthora* growth by *Trichoderma* Spp on tender rachis

COCOA

Etiology and management of vacular streak die-back

A garden to garden survey in Mysore, Mandya, Chamarajanagar and Bangalore rural districts of Karnataka indicated that the disease incidence, number of plants killed (8147) in relation to total number of plants (1,21,600) as on September 2000, was 6.69% (Table-2).

Table 2: Incidence of cocoa wilt in Karnataka

District	No of cocoa plants planted	No of plants killed	% of Incidence
Mysore	59,000	5252	8.90
Mandya	18,100	942	5.20
Chamarajanagar	31,600	1630	5.15
Bangalore Rural	12,900	323	2.50
Total	1,21,600	8147	6.69

The cocoa plants of 2-5 years old were found to be more susceptible for infection under field conditions. The disease appears in September, after South-West monsoon period and reach maximum during October-March and declines to a minimum thereafter (Fig-4).

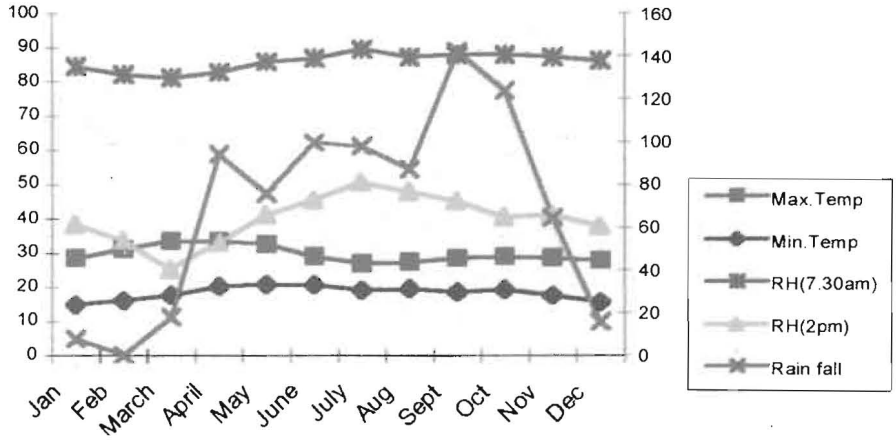


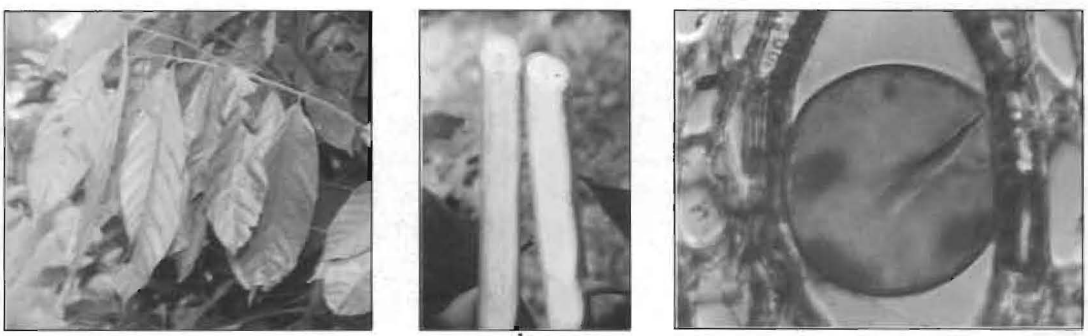
Fig 4: Environmental variables in relation to cocoa wilt at Hunsur.

The visible symptoms of the diseased plants are yellowing or browning of the leaves, wilting of branches and finally death of whole plants (Plate-16).

The disease invariably starts from tip of one of the branches and spreads rapidly to other branches, killing the tree between 20-45 days. The pods on the trees remain green for several days and slowly shrivel. These symptoms are invariably associated with borings of the branches that are about one mm in diameter and are inhabited by *Xyleborus* beetles (Plate-17).

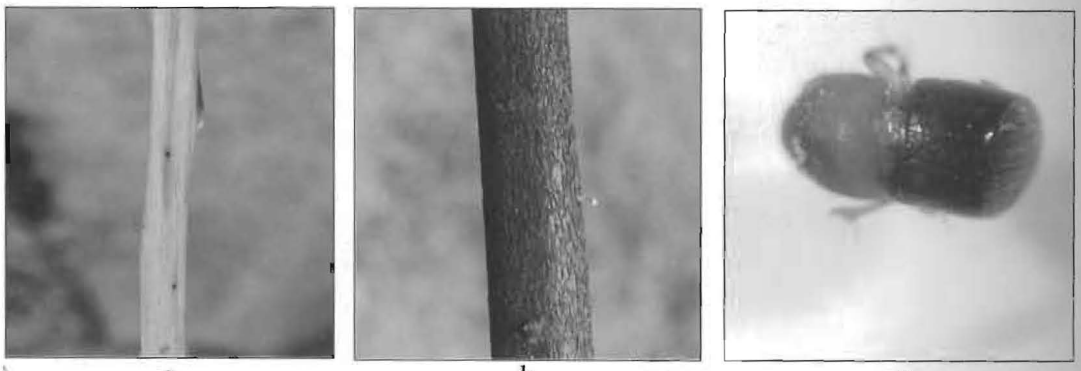
Some coiled plugs or powdery mass protrude from these shot holes (Plate-17).

Longitudinal and transverse sections in the region of bore show fungal mycelium and spores in the xylem vessels. The sections away from the bore exhibit blocking of the xylem vessels through accumulation of materials and large number of tyloses (Plate-16). Electron



a b c

Plate-16: a) Symptoms b) Vascular streak in the wood c) Tyloses in the xylem vessels



a b c

Plate-17: a) Insect bores b) Coiled frass c) Xyleborus beetle

microscopic examination of infected tissues did not reveal the presence of sub microscopic pathogens. A total of 600 isolations from infected plants were made using water agar, nutrient agar, carrot agar, potato carrot agar, host stem agar, host leaf agar, potato dextrose agar and potato sucrose agar. The inoculum material included leaf, petiole, stem bits with streaks, frass, insect bores and beetles.

Fungal species like *Fusarium, Pestalotia, Botryodiplodia, Graphium, Mucor, Aspergillus, Pencillium, Chlamydomyces, Monilia, Streptomyces, Melanconium, Helminthosporium, Colletotrichum, Trichophyton, Cephalosporium* and five unknown isolates were recovered from infected plants. *Graphium* is the synnematal stage of *Ceratocystis*, while conidial stage of some other species of *Ceratocystis* are placed in the form genus *Cephalosporium* (Plate-18).

The suspected causal organisms obtained from various isolations were used for inoculation. The isolates were inoculated onto seedlings under glass house and also onto five

Plate-18: *Graphium*

year old plants in the field. The methodology followed was stem inoculation by bark flap method. Till date (13th January, 2001), no symptoms were observed in inoculated plants. However, few plants inoculated with *Graphium* showed positive indication after two months of inoculation. Field trial with systemic fungicides (Triadimefon, Bitertanol, Hexaconazole, Tebuconazole, Propiconazole, Benomyl, Carbendazim and Tridemorph) and antibiotic (Streptocycline) are being continued.

PRE AND POST HARVEST TECHNOLOGY

Solar cum Electrical Dryer

A hybrid dryer with solar energy as the main source of energy and electricity as the alternate source of energy was designed (Plate-19). This is a semicircular shape dryer based on the glass house principle there by avoiding the extra insulation normally necessitated in the conventional solar cabinet dryers. It consists of a double pass parallel plate solar collector with UV stabilized HDPE film used as transmitter and black HDPE film used as absorber sheet. The temperature inside the drying chamber was 25 to 30°C higher than the ambient and humidity 20% lower than the ambient. When the temperature inside the drying chamber reduces below a pre set level and electronic control system will activate electric heaters to maintain the temperature inside the drying chamber. A separate electronic control system is incorporated to switch off the dryer when the drying is completed. The capacity of the dryer is 3000 coconuts per batch and the drying time taken is 32 hours.

Plate-19 : A hybrid copra dryer

Snow Ball Tender Nut (SBTN) making machine

Snow ball tender nut is a tender coconut without husk, shell and testa which is ball shaped and white in colour. Important operation while making SBTN is making a groove in the shell, just before scooping out the SBTN from the shell cups. A suitable machine has been developed for this purpose. By using this machine, any unskilled person can make a SBTN in 5 minutes, which could be brought down to 3 minutes by practice. In this machine two persons can work simultaneously. Cost of the machine is Rs.20,000.

SOCIAL SCIENCES

Institutional Training Programmes

During the year, 14 short term Institutional Training Programmes were organized. The topics covered included crop management technologies for coconut, arecanut and cocoa and post harvest technology for plantation crops and experimental techniques in plantation crops. About 225 officials from five States were benefited from these training programmes.

A familiarization visit was organized for four Technical Officers from Sri Lanka during May-June 2000.

Frontline Demonstrations

High density multispecies cropping system in coconut, root wilt management in coconut and arecanut based cropping systems were the aspects for Frontline Demonstrations being conducted at Kasaragod, Kayangulam

and Mohitnagar centres. A number of visitors were taken to the Frontline Demonstration plots to convince them on the technologies evolved at this Institute.

Publication of extension literature:

a) **CPCRI, Kasaragod** - Mushroom cultivation on coconut wastes (English, Malayalam and Kannada), Stem bleeding disease of coconut (English, Malayalam and Kannada).

b) **CPCRI RS, Kayangulam** - Root wilt & other pests and diseases of coconut (Malayalam); Eriophyid mite (English & Malayalam).

c) **CPCRI RC, Kahikuchi** - Research accomplishment of CPCRI RC, Kahikuchi (English), Arecanut cultivation practices for Assam (Assamese), Anabe roga/ Ganoderma disease of arecanut in Assam and its management (Assamese).

Kisan Mela

a) **CPCRI, Kasaragod :** Kisan Mela was organised at CPCRI, Kasaragod on December 10, 2000. Hon'ble Union Minister of State for Textiles Shri. V. Dhananjayakumar participated in the Kisan Mela as the chief guest (Plate-20). More than 400 farmers participated in the mela.

Plate-20: Shri.V. Dhananjayakumar, Hon'ble Union Minister of State for Textiles lighting the lamp to inaugurate the Kisan Mela

b) **CPCRI RS, Lakshadweep:** Shri. Mohammed Kudage, Deputy Collector inaugurated the Kisan Mela at CPCRI RS, Lakshadweep on 22-11-2000. About 250 farmers participated.

c) **CPCRI RC, Kahikuchi:** Kisan Mela was organised at CPCRI RC Kahikuchi on 24-11-2000. Shri.C.M.Patowary, Hon'ble Minister for Agriculture, Govt. of Assam inaugurated the Kisan Mela. About 500 farmers attended the programme.

Supply of planting materials

The following planting materials were supplied to the farmers during the year for commercial cultivation.

i. Coconut seednuts: 51,286; ii. Coconut seedlings: 23,764; iii. Arecanut seednuts: 11,61,365; iv. Arecanut seedlings; 73,721; v. Cocoa grafts: 67,362; vi. Pepper cuttings: 2000.

Technology dissemination through newspapers, farm journals and radio

Fourty five popular articles were published in Farm Magazines and the Agriculture column of newspapers. Thirteen Radio Talks discussions were given by the scientists of this Institute for broadcast through All India Radio.

Production of Video Films

Two Video Films entitled "**About CPCRI**" and "**Integrated pest and disease management in coconut**" were released during the year. These films were produced in collaboration with National Academy of Agricultural Research Management, Hyderabad.

gricultural Technology Information Centre

CAR sanctioned a project entitled Establishment of Agricultural Technology nformation Centre (ATIC)" during Phase II der NATP for implementation at CPCRI, asaragod during 1999-2003 with a total udgetary provision for Rs.42.575 lakhs. Dr. M.S. Swaminathan, inaugurated the ATIC ervices on 2nd February, 2000. Services vailable at ATIC includes guidance on chnologies of CPCRI; Farm literature - priced nd free publications; Video show (for farmers nd development personnel visiting the ATIC); Mini exhibition; Expert electronic information ackage - in the form of CD ROM on coconut nd arecanut cultivation; Soil and water sample nalysis; Planting materials for coconut and recanut; Earth worm for vermicompost; Vermicompost; Mushroom Spawn and Farm roducts - coconut and tender coconut. During the period under report, a total number f 9079 farmers and other clients visited the TIC primarily for the purchase of quality lanting materials and other technological nputs and products in addition to availing uidance on the establishment of coconut and recanut gardens. Crop management echnology was the major area of interest vinced by the farmers followed by crop rotection. A large number of farmers showed nterest in understanding the comparative erformance of different varieties of coconut nd arecanut and measures for ensuring etter establishment of coconut and arecanut vhile they purchase seedlings of these crops. Total value of sale of technological services, roducts and publications during this period vas Rs. 6,56,299/-.

Field level performance of microirrigation technologies in coconut

Technical performance of drip irrigation systems installed in farmers' holdings in Kasaragod and Kannur Districts of Kerala State under the guidance of the State Department of Agriculture were assessed. It was observed that only 13% of the plots were working excellently. Thirty seven per cent of the plots could be categorized as good, while 30% plots are working fairly good and the remaining 20% of the plots are poor.

Price spread analysis

The price-spread analysis for coconut and its products was conducted in Kasaragod, Kozhikode and Ernakulam markets in Kerala State. The marketing channel for coconut consists of intermediaries such as village merchants, commission agents/wholesalers and retailers. Fully husked nuts are sold in the retail market for local consumption. Mature nuts with full or partial husk are traded in the assembling markets for interstate transaction. Since the marketable surplus is very less, the involvement of middlemen is unavoidable. The share of the producer at the end price ranged from 60-70 per cent depending upon the size and quality of the nuts.

Crop loss estimation

A sample survey was taken up during January 2000 to study the severity and geographical distribution of the eriophyid mite infestation in Alleppey District in Kerala State and to estimate the consequent production loss. A total of 61,138 palms, spread over 29 Krishi Bhavans in the district were observed for this purpose. For studying the yield loss, observations were

recorded for 867 bearing palms. For studying the nut characters, 102 mature nuts were also collected from farmers' fields. There was a general reduction in the range of 21 to 28 % in weight of nut, weight of husk, weight of copra and recovery of oil due to eriophyid mite.

Database administration and computer applications

To place CPCRI in the arena of Internet, a website of CPCRI was developed and hosted under NIC Server (http://www.cpcri.nic.in) on 10th April, 2000. Dr S.P. Ghosh, DDG (Horticulture), ICAR inaugurated the facility. Continuous updating of the information also was carried out. The website include information on CPCRI, organization structure achievements of various divisions and centres future thrust, events, personnel, transfer of technology, training programmes and other links.

Four CD ROM's on Arecanut Cultivation, Coconut Descriptors Part-II, Coconut Cultivation and An overview of CPCRI were prepared and released for use by the Scientists, Extension Personnel, Students and Farmers. Copies of these CD ROM are being made available for sales at ATIC counter at nominal cost.

KRISHI VIGYAN KENDRA

KVK conducted a total number of 77 trainings for the benefits of 1373 people during this year. Out of the above trainings, 44 were 'On-campus' and 33 were 'Off-campus' trainings, conducted for the benefit of 799 and 574 people respectively. Feed back information was also collected to know the impact of the trainings. During this year, 12 beneficiaries started their own self- employment units by utilizing imparted skill and knowledge.

Front-Line Demonstrations (FLD)

FLD on Cereals and Horticultural crops implemented in Pathur Village of Vorkady Grama Panchayath, which is 46 Kms away from Kasaragod. This programme was conducted in 8 ha area belonging to 22 farmers. The topics such as a) Introduction of high yielding paddy varieties i.e. Aishwarya and Jaya against the local Khayame variety, b) Introduction of high yielding blackgram (T-9) and greengram (China moong) varieties in the paddy fallows for effective utilization of residual moisture and higher economic returns and c) Introduction of high yielding cucumber variety against local variety in the paddy fallows.

The salient results are, Aishwarya variety yielded 3.9 and Jaya yielded 4.1 t/ha as against

Plate-21: Front line demonstration on cereals and horticulture crops at Pathur village under KVK

1.7 t/ha of local Khayame variety. The yield of improved variety of cucumber was 10 t/ha, as against 8 t/ha of local variety. The yields of blackgram and greengram were 0.39 t and 0.46 t/ha respectively. These yields were considered as an additional returns to the paddy growers.

On-Farm Testings (OFT)

On-farm testings on different aspects such as a) Management of rhinoceros beetle in coconut, b) Stem bleeding disease control in coconut and c) Management of important pests of vegetables were undertaken in farmer's plots.

Rhinoceros beetle control experiments were conducted in 10 plots of 0.5 acre each, by selecting pre-bearing palms of age below 4 years. Treatments showed that fresh incidence of infestation reduced drastically by 21.92% in leaf axil filling with naphthalene balls and by 12.34% in placement of phorate sachets as against the initial infestations of 72.67%.

In stem-bleeding management of coconut, different treatments such as i) removal of affected tissues + calixin smearing and coal tar application, ii) treatment I + calixin root feeding iii) treatment I and 0.1% calixin drenching, were undertaken in 5 plots of 0.4 ha each. It is found that, the treatments taken at initial stages resulted in an increase of about 5 - 6 nuts per palm per year.

Control of jassids and white flies was introduced in three plots of 25 cents each of brinjal crop (Haritha variety). The results showed that alternate sprays of nimbicidine and fenvalerate at fortnightly intervals gave the best yield (14150 kg/ha) with higher economic returns as against the farmer's practice, which gave 12000 kg/ha yield.

Demonstrations were conducted in 4 plots of 25 cents each on management of epilachna and pumpkin beetles in bittergourd (Priyanka variety) and cucumber (Local). The treatments used in the brinjal crop were repeated here. Alternate sprays of nimbicidine and fenvalerate resulted in significant increase in yield of both crops (13500 kg and 15750 kg/ha) as against the control plot i.e., 12000 kg of bittergourd and 14250 kg of cucumber.

Demonstration on management of fruit flies of bittergourd was conducted in four plots of 25 cents each. In this programme different treatments such as i) prompt disposal of damaged fruits, ii) trapping of adult flies using various traps, iii) need based sprays of malathion were compared with farmer's existing practice (weekly sprays of rogor/ekalux). The IPM package adopted gave the higher yield (14000 kg/ha) as compared to 12250 kg/ha in farmer's practice.

Farmers - Scientists Meet

KVK has organized an interaction programme of "Farmers-Scientists meet", where Dr. S.P. Ghosh, Dy. Director General (Horticulture) attended and interacted with scientists, selected 66 farmers of Kasaragod district and KVK faculty.

Plate 22: Dr S.P. Ghosh, DDG (Hort.), ICAR, New Delhi addressing the farmers and scientists at KVK, Kasaragod

Women's Cell Activities

A total number of 18 trainings (12 On-campus and 6 Off-campus) were conducted for the benefit of rural women. About 60% of the beneficiaries adopted new skills at back home situations.

IVLP FOR TECHNOLOGY ASSESSMENT AND REFINEMENT

Twenty interventions covering six micro farming situations have been undertaken for Technology Assessment and Refinement through Institute Village Linkage Programme in nearby villages under National Agricultural Technology Project.

The OFT on assessing the performance of green manure crops in coconut basins revealed that the total amount of green matter obtained per palm from *Mimosa* (5.125 kg/ palm) was more than that obtained from *Calapogonium* (3.75 kg/palm).

In the Verification Trials on the application of biofertilizers to rice crop during the Kharif season an average grain and straw yield of 3.38 t/ha and 2.31 t/ha was obtained in the treatment plots while 2.86 t/ha and 2.28 t/ ha grain and straw yield was obtained from the control plots.

The farmers seem to be less convinced on the treatment of Mahali by covering arecanut inflorescence with polythene covers. Though the required critical inputs (polythene cover) were provided, farmers were hesitant to take up this treatment.

Quality seedlings of coconut varieties, coconut hybrids, cashew varieties, mango, clove, sapota and varieties of pepper for mixed crop in coconut and arecanut gardens were planted during June, 2000. More than 90% establishment of seedlings was ensured.

Plate-23: Field demonstration on control of Mahali disease of arecanut at farmers garden

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON PALMS

COCONUT

Crop Improvement

At Aliyarnagar, Arasampatti Tall (148) and Malayan Green Dwarf (164) nuts/palm/year continued to perform well. The other accessions showing promise are St.Vincent (136) and Spicata (131).

At Veppankulam, compared to ECT (63 nuts), Andaman Ordinary performed well producing 116 nuts followed by Ayiramkachi (102nuts) palm/year.

At Ratnagiri, Laccadive Ordinary continued to record the highest average yield of 156 nuts/palm/year.

In the evaluation trial at Aliyarnagar, MYD x ECT (133 nuts/palm/year) was promising when compared to other hybrids viz. VHC-2 and GBD x PHL.

Under the trial on promising seed material, LCM (180.7 nuts/palm/year) followed by WCT x COD (164.1) were found to be promising.

Crop Production

At Aliyarnagar under drip irrigation cum fertilizer experiment on young palms, the results indicated that basin irrigation at IW/CPE ratio of 1.0 at 4 cm depth and drip irrigation at 100% Eo increased the functional leaves, bunches, female flowers nut and copra yields. The mean yield from these treatments were 145 and 143 nuts/palm/year, wheras the palms which were not receiving any irrigation, recorded only 66 nuts/palm/year. At Veppankulam, the cumulative mean yield data for seven years showed that palms under drip irrigation @ 100% Eo recorded the highest mean nut yield (115 nuts/palm) and under basin irrigation treatment recorded 103 nuts/palm/year.

Under nutritional requirements of coconut at Veppankulam, higher dose of fertilizer nutrition with balanced form, improved the coconut yield. In control treatment, the yield reduced from 168 to 98 nuts/palm indicating the higher requirement of nutrition for higher productivity. The hybrid vigour in combination with balanced quantity of fertilizer nutrition for higher production was well exhibited in the treatment combination of 1.0:0.25:2.0 kg NPK/palm/year (225 nuts/palm/year). At Aliyarnagar, application of NPK @ 1000:250:2000 g N/palm/year recorded the highest yield of 163 nuts/palm/year.

Under inter and mixed cropping system in coconut at Veppankulam, the coconut yield registered a mean increase of 39 to 59% for a period of 5 years due to continuous intercropping with frequent irrigation and manurial schedules followed separately for main and inter crops. In general, intercropping study indicated that, the coconut yield increased in all the models and coconut with the age of 25 years and above can accommodate different intercrops with varying morphological structures and rooting habit.

In Kahikuchi, the model coconut + black pepper + banana + lemon + pineapple + ginger was found to be more profitable giving highest net return of Rs. 83,167.30 per ha.

Crop Protection

In the pathogenicity trial on Ganoderma at Aliyarnagar, by split root inoculation technique showed 60% of disease incidence. In the new management trial, neem cake @ 5 kg per palm per year as soil application and root feeding of tridemorph 2 ml in 100 ml of water for 3 times at quarterly interval recorded the minimum disease incidence of 6% against 24% under control.

Aliyarnagar center conducted a survey for the occurrence of root wilt disease and basal stem rot disease and 56,900 trees examined in an around Pollach tract from 52 gardens. The data showed that 80 trees were infected with basal stem rot disease. At Veppankulam, the survey conducted in the coastal districts revealed that 201 coconut trees out of 7844 trees in 33 gardens found affected by basal stem rot disease.

In the control of *Opisina arenosella*, a study at Aliyarnagar indicated that monocrotophos 10 ml + 10 ml of water alongwith larval and pupal parasitoids viz., *Bracon hebator, Goniozus nephantidis* and *Trichospilus pupivora* at 28 days interval for 2 times consecutively can effectively reduce the mean pest population(808.48 to 6.36).

OIL PALM

At Vijayarai, the hybrid 128 D x 291 P yielded 61.75 kg FFB/palm.

PALMYRAH

At Pandirimamidi, 16 more germplam were identified and trees marked for collection of nuts. At Killikulam, the study on growth and development of Palmyrah fruits was initiated.

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