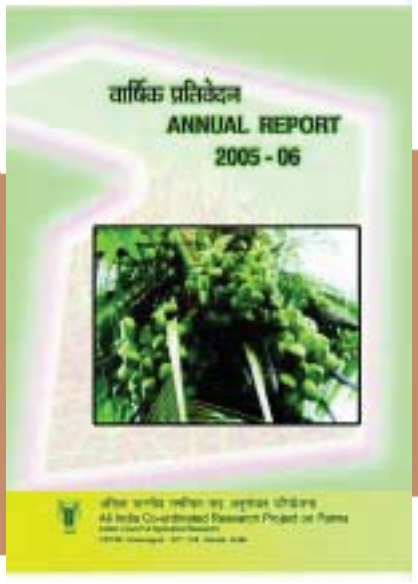
वार्षिक प्रतिवेदन
Annual Report
2005-06

अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना
ALL INDIA CO-ORDINATED RESEARCH PROJECT ON PALMS

(Indian Council of Agricultural Research)

CPCRI, Kasaragod 671 124, India



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Cover Page

A local germplasm type at Andhra Pradesh

Published by

Dr. S. Arulraj

Project Coordinator (Palms)

Tel	:	04994-232733 (Per.)
EPABX	:	04994-232893/4/5 (Office)
		04994-232614 (Resi.)
Fax	:	04994-232733; 232322
Gram	:	RESEARCH Kasaragod
E-mail	:	aicrppalms@yahoo.com
Web site	:	http://www.cpcri.gov.in
		http://www.cpcri.ernet.in

Compiled & edited by

Dr. S. Arulraj

Mr. K. Vijaya Kumar

Hindi translation

Mrs. K. Sreelatha

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Preface

The All India Coordinated Research Project on Palms, the research network system for palms in the country, comprises of 16 Coordinating Centres based at 9 Agricultural Universities and a Central Institute. The 33rd Annual Report of the AICRP on Palms has been prepared as per the revised guidelines issued by ICAR. This report covers the research results in coconut, oil palm and palmyrah and other related information pertaining to the period from April 2005 to March 2006. However, the data on technical parameters cover the 12 month period of the crop season from July, 2004 to June, 2005. During the year, five experiments on crop improvement in coconut, eight on crop management, two on crop physiology, seven on disease management and four projects on pest management were in progress in coconut under the AICRP on Palms. In addition, three experiments in crop improvement and one in crop management in oil palm and a project each in crop improvement and crop protection in palmyrah were in progress. The present report includes results obtained from the 10 Centres that conducted experiments on coconut; four oil palm Centres and two palmyrah Centres. The 17th Biennial Workshop on AICRP on Palms was held at Dapoli, Maharashtra State during December 9-11, 2005. A brief report on the workshop along with the major recommendations to be passed on to extension system is included in this Annual Report. The entire report reflects the collective wisdom and team efforts of the Scientists and staff of the AICRP Centres. I am thankful to all my project Scientists and Staff in different Centres for their sincere work and sustained enthusiasm in achieving objectives of the project.

I am grateful to Dr. G. Kalloo, Deputy Director General (Horticulture and Crop Sciences), ICAR for his sustained keen interest, guidance and encouragement in the progress of the Project. Dr. K.V. Ramana, Assistant Director General (PC) and the staff at ICAR, New Delhi had been very helpful in the functioning of the Project. The support extended by Dr. V. Rajagopal, Director and the Scientists from CPCRI is gratefully acknowledged. I express my sincere thanks to the Vice Chancellors, Directors of Research and Heads of Stations for their active involvement in the smooth conduct of the project.

I acknowledge with thanks the help rendered by Mr. K. Vijaya Kumar, Sr. Scientist (Agrl. Statistics), Smt. K. Narayani, Personal Assistant and Shri. K.S. Ramakrishna, Assistant in Project Coordinator's Cell, Shri. C.H. Amarnath, Technical Officer (Agrl. Statistics) in bringing out this report and Mrs. K. Sreelatha for Hindi translation.

Kasaragod
21.09.2006

S. ARULRAJ
Project Coordinator (Palms)

सारांश

भारतीय ग्रामीण आर्थिकता में नारियल, तेलताड़ और पॉमैरा का महत्वपूर्ण स्थान है। ताड़ों के इस महत्वपूर्ण क्षेत्रों में अनुसंधान के प्रबलीकरण के लिए अखिल भारतीय समन्वित नारियल एवं सुपारी सुधार परियोजना 1972 में शुरु की गई। सातवीं तथा आठवीं योजना की अवधि में मुख्य फसल के रूप में तेलताड़ और पॉमैरा को भी सम्मिलित किया गया और परियोजना का पुनः नामकरण अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के नाम पर किया गया। इस परियोजना में कुल 16 केंद्र हैं जैसे मुख्यालय कासरगोड़ (केरल) वेप्पंगुलम, किल्लिकुलम, अलियारनगर, आडुथुरै (तमिलनाडु), गंगावती, अरसिकरे (कर्नाटक), अम्बाजिपेट पान्दिरिमामिडी, विजयराय (आंध्रप्रदेश), कोणार्क (उड़ीसा), काहीकुची (असम), मन्डौरी (पश्चिम बंगाल), जगदलपुर (चत्तीसगढ़), रत्नगिरी एवं मुल्डे (महाराष्ट्र)। 16 केंद्रों में से 10 नारियल के, चार तेल ताड़ और दो पॉमैरा के केंद्रों में अनुसंधान जारी है। इस परियोजना के व्यापक उद्देश्य इस प्रकार है :

1. नारियल के नए संकरों एवं अधिक उत्पादन क्षमतावाली प्रजातियों का संग्रहण, संरक्षण, सूचीयांकन तथा मूल्यांकन
2. विभिन्न सस्य जलवायु क्षत्रों के लिए कृषि तकनीकी का मानकीकरण तथा उचित अन्तः मिश्रित कृषि पद्धतियों का विकास एवं भूमि उर्वरता पर इन कृषि पद्धतियों के प्रभाव का अध्ययन।
3. प्रभावात्मक तथा कार्यक्षम रोग एवं कीट प्रबंधन
4. विभिन्न सस्य जलवायु परिस्थितियों में तेल ताड़ पर अनुकूलित अध्ययन
5. पॉमैरा में जननद्रव्यों का संग्रहण, संरक्षण, मूल्यांकन तथा उपयोग

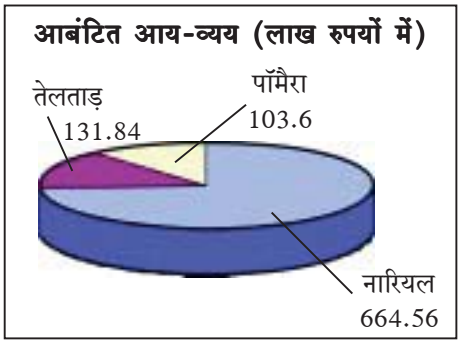
2005 - 2006 वर्ष में इस परियोजना का कुल आय-व्यय 186.67 लाख रुपए था जिसमें 140.00 लाख रुपए भारतीय कृषि अनुसंधान परिषद का भाग हैं।

सापेक्ष प्राथमिकताएँ :

इन फसलों की सापेक्ष प्रमुखता का विचार करके आय-व्यय का 73.84% आबंटन नारियल को दिया गया। जबकि तेल ताड़ को 14.65% और पॉमैरा केंद्रों को 11.51% ही आबंटन दिया गया है।

दसवीं योजना की अवधि में विभिन्न फसलों का आय-व्यय आबंटन :-

फसल	आबंटित आय-व्यय (लाख रुपयों में)	प्रतिशत
नारियल	664.56	73.84
तेलताड़	131.84	14.65
पॉमैरा	103.60	11.51
कुल	900.00	100.00



अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना की सत्रहवीं द्विवार्षिक कार्यशाला :

अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना की सत्रहवीं द्विवार्षिक कार्यशाला दिसंबर 9-11, 2005 तक डॉ. बालासाहेब सावंत कोंकण कृषि विद्यापीठ, दापोली में आयोजित की गयी। डॉ गौतम कल्लू, उप महानिदेशक (बागवानी एवं फसल विज्ञान) भा.कृ.अनु.प, डॉ. एस एस मागर, कुलपति, डॉ बालासाहेब सावंत, कोंकण कृषि विद्यापीठ; डॉ के.वी.ए बावप्पा, डॉ एम.के. नायर, डॉ के.यु.के. नम्पूतिरि, पूर्व निदेशक, के.रो.फ.अ.सं., डॉ एच.एच. खान पूर्व परियोजना समन्वयक (ताड़), डॉ वी. राजगोपाल, निदेशक के.रो.फ.अ.सं., डॉ एम. कोचुबाबु, निदेशक, राष्ट्रीय अनुसंधान केंद्र, तेल ताड़, डॉ बी. चंद्रशेखरन, निदेशक तमिलनाडु चावल अनुसंधान संस्थान, डॉ बालासाहेब सावंत, कोंकण कृषि विद्यापीठ, के.रो.फ.अ.सं., के विभागों के प्रमुख एवं प्रोफेसर तथा अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के वैज्ञानिक सहित 73 प्रतिभागियों ने कार्यशाला में भाग लिया।

डॉ जी कल्लू, उप महानिदेशक, (बागवानी एवं फसल विज्ञान) भा.कृ.अनु.प अंतिम सत्र के अध्यक्ष थे। अखिल भारतीय समन्वित

ताड़ अनुसंधान परियोजना कार्यक्रम के पाँच सत्रों के प्रत्येक अध्यक्ष द्वारा क्रमानुगत सत्रों की गतिविधियों का प्रस्तुतीकरण किया गया। कार्यशाला में हुई चर्चा के आधार पर परियोजना समन्वयक ने वर्ष 2006-08 के तकनीकी कार्यक्रम का प्रस्तुतीकरण किया।

विस्तार पद्धति तक पहुँचाने की मुख्य सिफारिशें

क्रमानुगत क्षेत्रों में बड़े पैमाने पर खेती के लिए नारियल प्रजातियों / संकरों की सिफारिश करनी चाहिए।

1. रत्नगिरी : लक्षद्वीप सामान्य (एल.ओ)
2. वेप्पंकुलम : सी.ओ.डी ह्न पी.एच.ओ.टी
3. अलियारनगर : फिलिपाइन आर्डिनरी, डब्ल्यू.सी.टी ह्न सी.ओ.डी, डब्ल्यू.सी.टी ह्न जी.बी.जी.डी, सी.ओ.डी ह्न डब्ल्यू.सी.टी इन प्रजातियों का विमोचन के.रो.फ.अ.सं. द्वारा किया गया है और इसलिए पोल्लाची क्षेत्रों में इन प्रजातियों को वाणिज्यिक खेती के लिए सिफारिश किया जा सकता है।
4. काहिकुची : एम.वाई.डी ह्न डब्ल्यू.सी.टी.

नारियल विकास बोर्ड के सहयोग से अधिक संकर बीजों के उत्पादन के लिए प्रयास करना है। इसके अतिरिक्त, के.रो.फ.अ.सं/ नारियल विकास बोर्ड से बीज सामग्री प्राप्त कर केंद्र में एम.वाई.डी बीज बाग की स्थापना करनी चाहिए।

फसल प्रबंधन सिफारिश :

1. असम राज्य में बौनी ह्न लंबी संकरों के लिए 500 ग्रा नाइट्रोजन, 500 ग्रा. फोसफोरस, 2000 ग्रा. पोटाश उर्वरक मात्रा सिफारिश की गई है।
2. पश्चिम बंगाल राज्य में नारियल संकर के लिए 500 ग्रा. नाईट्रोजन, 250 ग्रा. फोसफोरस और 1000 ग्रा. पोटाश / ताड़ / वर्ष की सिफारिश की गई है।
3. महाराष्ट्र राज्य में संकर नारियल के लिए 1000 ग्रा. नाइट्रोजन, 500 ग्रा फोसफोरस, 2000 ग्रा. पोटाश प्रति ताड़ / वर्ष की सिफारिश की गई है।
4. तमिलनाडु के तटीय प्रदेशों में संकर नारियल के लिए 1000 ग्रा. नाइट्रोजन, 500 ग्रा फोसफोरस, 2000 ग्रा. पोटाश प्रति ताड़ प्रति वर्ष सिफारिश की गई है।
5. पोल्लाची क्षेत्र, आंध्रप्रदेश के तटीय प्रदेश और कर्नाटक के मैदान क्षेत्रों के लिए समीकृत सूत्रकृमि प्रबंधन के रूप में 50% कंपोस्ट कयर गूथा के साथ अनुमोदित उर्वरक के 50% मात्रा का संयुक्त सिफारिश किया गया है।

फसल संरक्षण सिफारिशें :

नीम केक का मृदा प्रयोग के साथ टी. विरिडे में बीज गुठली भिगोकर कंद सड़न रोग प्रबंधन के जैसे पद्धति पॉमैरा को मशहूर बनाना।

नारियल में कली सड़न रोग के लिए रोगशोधक छिड़काव करते समय नारियल बाग के आसपास के पॉमैरा ताड़ मे भी कली सड़न रोग रोकने के लिए उपचार करना अनिवार्य है।

समूह बैठक :

पंचवर्षीय पुनर्विलोकन टीम सिफारिशों पर अनुवर्ति कार्रवाई के अनुसार पॉमैरा में अखिल भारतीय ताड़ अनुसंधान परियोजना के अधीन के.रो.फ.अ.सं., कासरगोड़ में मार्च 23-24 की अवधि में अनुसंधान के क्षेत्र पर मुख्य सत्र आयोजित किया गया।

डॉ एन.एम. नायर, पूर्व निदेशक, के.रो.फ.अ.सं. एवं डॉ एच. हामिद खान, पूर्व परियोजना समन्वयक (ताड़) की अध्यक्षता में आयोजित चर्चा में अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना केंद्र से पॉमैरा वैज्ञानिक और के.रो.फ.अ.सं. के वैज्ञानिक भाग लिए थे। पॉमैरा पर ज्ञान के वर्तमान स्तर का विश्लेषण किया गया, पॉमैरा में अनुसंधान के मुख्य क्षेत्रों का सूचीयांकन किया गया और सूचनाओं में जो छूट गया है पहचाना गया। मुख्य सत्र में दिए गए सुझाव के आधार पर अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के अधीन पॉमैरा अनुसंधान परिवर्तित किया जा रहा है।

मुख्य उपलब्धियाँ :

नारियल :

फसल सुधार :

आलियार नगर में चूंकि 1990 मूल्यांकन के अधीन 17 जननद्रव्यों में कोचिन चाइना से अधिकतम उपज 136 गुठली / ताड़ / वर्ष और सेइचलस से 116 गुठली / ताड़ / वर्ष और राजपालयम लंबी से 112 गुठली / ताड़ / वर्ष उपज प्राप्त हुई। जगदलपुर में उस क्षेत्र की स्वीकृति के लिए नारियल की दस विदेशी प्रजातियों का मूल्यांकन 1988 से किया जा रहा है। ज़ंजिबार में अधिकतम वार्षिक गुठली उपज 87.2 गुठली / ताड़ और वेरिकोबरी से 85.6 गुठली / ताड़ उपज प्राप्त हुई। इसी प्रकार पूर्व तटीय क्षेत्र में वेप्पंकुलम केंद्र में सेइचेलस से अधिकतम गुठली उपज प्रति ताड़ 167.5 और ज़ंजिबार से 166.3 गुठली / ताड़ और ई.सी.टी. से 152.4 गुठली / ताड़ प्राप्त हुई।

दसवीं पंचवर्षीय योजना में संभांग क्षेत्र के रूप में सात केंद्रों में स्थानीय जननद्रव्यों के संग्रहण, संरक्षण और मूल्यांकन पर बल दिया गया। पिछले दो वर्षों की अवधि में आगे मूल्यांकन के लिए विभिन्न क्षेत्रों से कुल 81 स्थानीय जननद्रव्य प्रजातियों का संग्रहण किया गया है।

सात केंद्रों में नारियल के उचित संकरों का मूल्यांकन किया गया। अलियार नगर में गत कुछ वर्षों में सभी अन्य संकरों की अपेक्षा इ.सी.टी ह्न एम.वाई.डी संकर का निष्पादन अच्छा पाया गया। और स्थिर रूप से लगभग 100 गुठली / ताड़ / वर्ष प्राप्त की गयी। इसी प्रकार तटीय आंध्रप्रदेश में अम्बाजि पेट में जी.बी.जी.डी ह्न पी.एच.ओ.टी और जी.बी.जी.डी ह्न एल.सी.टी. से उच्च उपज क्रमशः 134.65 गुठली / ताड़ और 126.02 गुठली / ताड़ प्राप्त की गयी। जबकि नियंत्रित इ.सी.टी ह्न जी.बी.जी.डी से केवल 88.78 गुठली / ताड़ प्राप्त हुई। वेप्पंकुलम में पूर्व-तटीय प्रदेशों में डब्ल्यू.सी.टी. ह्न सी.ओ.डी. संकर से अधिक संख्या में गुठली / वर्ष (202.9) और एल.सी.ओ.टी ह्न सी.ओ.डी. से 180.8 गुठली / वर्ष, ई.सी.टी ह्न डी.जी - वी.एच.सी-1 से 163.7 गुठली / वर्ष प्राप्त हुई। डब्ल्यू.सी.टी ह्न सी.ओ.डी से अधिकतम संचित औसत उपज 111.6 गुठली प्राप्त की गई।

आठ केंद्रों में 1988 से मूल्यांकन के अधीन के नारियल की अनुमोदित प्रजातियों / संकरों के बीच अलियार नगर में फिलिपाइन्स आर्डिनरी से उच्च संचित औसत उपज 168 गुठली / ताड़ / वर्ष प्राप्त की गयी। इसी प्रकार छत्तीसगढ़ के जगदलपुर में सी.ओ.डी ह्न डब्ल्यू.सी.टी से उच्च गुठली उपज (70) और डब्ल्यू.सी.टी ह्न जी.बी.जी.डी से 65 प्राप्त की गयी।

नारियल संकरों के पितृ में एक जिसका निष्पादन विशेष स्थान पर अच्छा हो, स्थानीय जननद्रव्य जाति था समपित्रैक के उपयोग की प्रमुखता पहचानकर नए नारियल संकरों के मूल्यांकन पर एक नई परियोजना पंचवर्षीय योजना टीम की सिफारिश के अनुसार इस वर्ष शुरु की गई। उपर्युक्त मानदण्डों के अनुसार संकरण कार्यक्रम सात केंद्रों में प्रारंभ किए गए। इस परीक्षण के अधीन विभिन्न केंद्रों में लगभग 40 नए संकरों का मूल्यांकन किया जाएगा।

फसल उत्पादन :

रत्नगिरि केंद्र में आयोजित नारियल आधारित उच्च घनता बहु जातीय सस्यन पद्धति परीक्षण में नारियल बाग में 33% नाइट्रोजन, 3.67% फोसफोरस और 22.96% पोटाश और मसाले में 20-24% नाइट्रोजन, 2-7% फोसफोरस और 20-67% पोटाश के कार्बनिक परिचक्रमण से पोषण की प्रतिस्थापना की जा सकती है।

कर्नाटक राज्य में अरसिकरे केंद्र में गत चार वर्षों के औसत ऑकड़ो से यह देखा गया कि अन्य अंतरफसलों की अपेक्षा अंतर फसल के रूप में केले की खेती से उच्च नारियल उपज प्राप्त होती हैं। नारियल के साथ अंतर फसल के रूप में केला और सजनाफली, वृक्षशिम्बे (फ्रेंचबीन), भिण्डी, तूअर के अंतरफसलन से सकल आय उच्च पायी गयी। केवल नारियल की खेती से सकल आय निम्नतम पायी गयी। इसी प्रकार आसाम में काहिकुची केंद्र में नारियल काली मिर्च-हल्दी सस्यन पद्धति से उच्च निवल आय प्रति हेक्टर (1,13,048 रुपए) और नारियल - काली मिर्च-अदरक से 72,745 रुपए प्राप्त किए गए। नियंत्रित प्लॉट (नारियल-कालीमिर्च) से निम्नतम निवल आय 46,440/- रुपये प्राप्त किए गए।

दसवीं पंचवर्षीय योजना की अवधि में अनुसंधान के संभाग क्षेत्र के रूप में नारियल बाग में अंतरफसल के रूप में औषधीय पौध और सुरभि पौधों के निष्पादन पर अध्ययन नौ केंद्रों में प्रारंभ किया गया। प्रत्येक केंद्र में औषधीय और सुरभि पौधों की खेती पर सर्वेक्षण किया गया। और लगभग 15-20 औषधीय और सुरभि पौधों को निरीक्षण परीक्षण के अधीन मूल्यांकन के लिए चुना गया। प्रत्येक केंद्र के निरीक्षण परीक्षण के निष्पादन तथा विपणन क्षमता के आधार पर प्रत्येक केंद्र में आगे विस्तृत अध्ययन के लिए पाँच प्रजातियों को चुना गया।

सात केंद्रों में नारियल में समीकृत पोषण प्रबंधन पर अध्ययन प्रगति पर है। अलियार नगर में पिछले छह वर्ष से समतुल्य नाइट्रोजन आधार पर कंपोस्ट कयर गूथा के प्रयोग के साथ शेष मात्रा में उर्वरक के रूप में फोसफोरस और पोटाश के प्रयोग से उच्च औसत उपज 160 गुठली / ताड़ / वर्ष और लाभ मूल्य अनुपात 2.39 के साथ कुल आय 62340 / रुपए / हेक्टर / वर्ष प्राप्त हुई।

अलियार नगर, काहिकुची, मन्डौरी और रत्नगिरि केंद्रों में 50% नाइट्रोजन कार्बनिक उर्वरक की प्रतिस्थापना के साथ नारियल की उच्च उपज प्रजातियों / संकरों की पोषण आवश्यकता से यह परिणाम देखा गया कि विभिन्न मृदा परिस्थिति के अधीन नाइट्रोजन के लिए 50% कार्बनिक सामग्री के साथ उपज स्तर लगातार प्राप्त किया जा सकता है। और चार केंद्रों में उच्च लाभ मूल्य अनुपात के बदले अच्छी सकल आय अंकित की गयी।

द्विवार्षिक कार्यशाला की सिफारिशों के आधार पर वेप्पंकुलम केंद्र में पूर्व तट क्षेत्रों में पोषण उपयोग क्षमता बढ़ाने में जैविक और रासायनिक विकृत्य के मिथः क्रिया अध्ययन के लिए और नारियल की अत्यधिक वृद्धि, उपज और गुण के लिए उचित विकृत्य पहचानने के लिए एक नई परियोजना प्रारंभ की गई।

फसल संरक्षण :

अम्बाजिपेट केंद्र के आधार तना सड़न रोग प्रभावित बाग में रोपित एक वर्ष आयु की नारियल पौध में किए गए सिरो खोज से यह देखा गया कि एलिसा द्वारा लघु सिरोलोजिकल परीक्षण से रोग लक्षण प्रकट होने के पहले नारियल पौध में आधार तना सड़न रोग संक्रमण पहचान नहीं किया जा सकता। रुग्ण मृदा में आधार तना सड़न रोग के विरुद्ध छानबीन किए गए 13 पादप प्रजातियों के बीच तूअर पौध के छत्र क्षेत्र में छाल के विपाटन का विशेष लक्षण देखा गया। तूअर के मूल ऊतों से गेंनोडरमा अप्लेनाटम पुनः एकलित किया गया और छाल का विपाटन लक्षण दिखाया। गेनोडेरमा रोग प्रभावित मृदा में यूकालिप्टस पौध (2 वर्ष आयु) और सेसबानिया (आठ महीना आयु में भी) रस रिसाव लक्षण दिखाया।

वेप्पंकुलम केंद्र में गेनोडेरमा के नौ आईसोलेट के व्याधिजनत्व पर अध्ययन से यह देखा गया कि आइसोलेट टी.के.टी I के साथ अन्तः क्रामित पौध 45 दिनों के बाद शोषण लक्षण दिखाया। और आइसोलेट टी.के.टी I प्रचण्ड पाया गया।

नारियल के गैनोडेरमा विल्ट प्रबंधन पर अम्बाजिपेट केंद्र में किए गए प्रक्षेत्र परीक्षण में यह देखा गया कि 25 मि.ली दर से तिमाही के अंतराल में टी विरिडे संवर्द्धन पावन (100% घाटना) मूलवेधन के साथ 5 कि ग्रा नीम केक साथ 50 ग्रा. टाल्क चूर्ण की दर से मृदा में टी विरिडे के प्रयोग से उदग्र रोग फैलाव में अधिकतम कमी पायी गयी।

वेप्पंकुलम केंद्र में आधार तना सड़न रोग की सक्षमता के लिए नारियल की छानबीन से यह देखा गया कि रुग्ण मृदा में बी.एस.आर को अन्य प्रजातियों की तुलना में नारियल की दस प्रजातियों में इ.सी. टी बी. एस. आर सक्षम इसी टी की रोग प्रतिरोध दर उच्च (61.1%) पायी गयी। तमिलनाडु के तेनी, कन्याकुमारी, तिरुनलवेली, डिंडिगल और कोयम्बतूर जिलों में नारियल मूलरोध रोग फैलाव पर बाग से बाग सर्वेक्षण आयोजित किया गया।

तना स्रवण रोग के जैव नियंत्रण पर किए गए प्रक्षेत्र परीक्षण से रोग के विरुद्ध त्रैकोडेरमा जाति प्रभावात्मक पायी गयी। विभिन्न उपचारों में से रस स्राव दरार पर टी विरिडे / टी हरजियानम / टी हमाटम लेपन करने से या 5 कि.ग्रा. नीम केक प्रति ताड़ के साथ 50 ग्रा वही जैव एजेंट संयुक्त रूप से आधार प्रयोग से रस स्राव दरार की परिधि में अधिकतम कमी पायी गयी।

आंध्रप्रदेश, महाराष्ट्र और तमिलनाडु राज्य में नारियल परिस्थिति में प्राकृतिक शत्रुओं तथा राइनोसेरस भृंग, काले सिरवाली रोमिल इल्ली लाल घुन, एरियोफिड कीट के संक्रामण पर कीट निगरानी की गयी।

अम्बाजिपेट केंद्र में नारियल में लाल घुन पर फेरोमोन के प्रभाव पर किए गए अध्ययन से यह देखा गया कि 230 दिनों में केम टिका लुर द्वारा पकड़े गए घुन की तुलना में के रो फ अ सं लुर ट्राप द्वारा पकड़े गए घुन की संख्या कम है।

(के. रो. फ. अ. सं. 1398 सं 2 केम टिका 1865 सं) 438 दिनों की कार्य दिवस की अवधि में रो. फ. अ. सं. लुर द्वारा 2003 घुन पकड़े गये और उसके बाद भी लुर कार्य करता रहा। लेकिन केम टिका लुर ने केवल 230 दिनों तक ही कार्य किया।

तेल ताड़

फसल सुधार :-

सभी चार तेल ताड़ केन्द्रों में तेल ताड़ के विभिन्न संकर संयुक्तों के तुलनात्मक निष्पादन पर परीक्षण किया गया। महाराष्ट्र राज्य में मुल्डे केंद्र में 115 डूरा ह्न 291 पिसिफेरा के संकर संयुक्त से ताजा फल गुच्छ की उच्च उपज 121.75 कि.ग्रा / ताड़ / वर्ष (17.4 टन प्रति हेक्टर) प्राप्त की गयी जबकि 109 डूरा ह्न 291 पिसिफेरा से आधिकतम गुच्छ भार 24.38 कि. ग्रा. पिसिफेरा संकर संयुक्त से अंकित किया गया। आंध्रप्रदेश राज्य में विजयराय केंद्र में 82 डूरा ह्न 266 पिसिफेरा संकर संयुक्त से अधिकतम ताजा फल गुच्छ उपज / ताड़ (79.1 कि. ग्रा/ ताड़) अर्थात 9.8 टन / हेक्टर और 18 डूरा ह्न 32 पिसिफेरा से निम्नतम उपज (38.7 कि.ग्रा / ताड़ अर्थात 4.8 टन ज़ाम्बियन हेक्टर) अंकित किया गया।

गंगावति और मुल्डे केंद्रों में छह और तीन तंज़ानियन सहित नौ समजातिय प्रजातियाँ मूल्यांकन के अधीन हैं। कर्नाटक राज्य में गंगावति केंद्र में ताड़ की ऊँचाई, पत्ता उत्पादन, गुच्छों की संख्या / ताड़ और

ताजा फल गुच्छ में समजतियों के बीच भिन्नता नहीं है। लेकिन विघुदंश उद्विलयन और तरल पेरोक्सिडेशन जैसे शरीर क्रिया वैज्ञानिक गुण में महत्वपूर्ण विभिन्नता पाई गई।

फसल उत्पादन

विभिन्न सस्य जलवायु क्षेत्रों में तेलताड़ के लिए सिंचाई एवं पोषण आवश्यकता के निर्धारण के लिए चार ताड़ केंद्रों में किए जा रहे परीक्षण प्रगति पर है। आडुथुरै केंद्र में 1200 ग्रा. नाइट्रोजन 600 ग्रा फोसफोरस, 2700 ग्रा. पोटाश / ताड़ / वर्ष प्राप्त ताड़ से अधिकतम ताज़ा फल गुच्छ 14.4 टन / हेक्टर / वर्ष प्राप्त किया गया। 800 ग्रा. नाइट्रोजन, 400 ग्रा फोसफोरस, 100 ग्रा पोटाश / ताड़ / वर्ष प्राप्त ताड़ से 11.9 टन / हेक्टर / वर्ष और 400 ग्रा. नाइट्रोजन, 200 ग्रा. फोसफोरस, 900 ग्रा पोटाश के प्रयोग से 9.5 टन / हेक्टर / वर्ष प्राप्त किया गया। बिना उर्वरक उपचार के ताड़ों से निम्नतम ताजा फल गुच्छ प्राप्त किया गया (7.7 टन / हेक्टर / वर्ष) एफ$_3$, एफ$_2$, एफ$_1$ में बिना उर्वरक उपचार (फ) की अपेक्षा 83.1, 54.5 और 23.4% ताज़ा फल गुच्छ में वृद्धि पाई गई। महाराष्ट्र राज्य के मुल्डे केंद्र में आधार सिंचाई के साथ 400 ग्रा नाइट्रोजन 200 ग्रा फोसफोरस, 900 ग्रा पोटाश / ताड़ / वर्ष के I_1F_1 स्तर पर ताज़ा फल गुच्छ का उच्च उपज (16.92 टन / हेक्टर) अंकित किया गय। इसके अतिरिक्त अलवाल सिंचाई में जल उपयोग क्षमता (3.4 कि. ग्रा / हेक्टर मि.मी) की तुलना में ड्रिप सिंचाई में जल उपयोग क्षमता उच्च (5.4 कि.ग्रा. हेक्टर मि.मी) अंकित की गयी। संयुक्त उपचार अर्थात ड्रिप सिंचाई के साथ 1200 ग्रा नाइट्रोजन, 600 ग्रा. फोसफोरस, 2700 ग्रा. पोटाश / ताड़ / वर्ष के प्रयोग से उच्च जल उपयोग क्षमता 7.8 और 5.2 कि.ग्रा / हेक्टर मि.मी अंकित की गयी। इसी प्रकार आंध्रप्रदेश राज्य के विजयराय केंद्र में अलवाल सिंचाई के साथ उर्वरक के एफ$_3$ स्तर (1200 ग्रा. नाइट्रोजन : 600 ग्रा. फोसफोरस : 2700 ग्रा. पोटाश / ताड़ / वर्ष) संयुक्त प्रयोग से उच्च ताज़ा फल गुच्छ उपज 15.6 टन / हेक्टर अंकित की गयी। अलवाल सिंचाई के साथ उर्वरक की उच्च मात्रा के प्रयोग से सकल आय और शुद्ध आय उच्च पायी गयी।

पॉमैरा

१. फसल सुधार :

किल्लिकुलम (तमिलनाडु) और पान्दिरिमामिडि (आंध्र प्रदेश) केंद्रों में पॉमैरा अनुसंधान जारी रहा। देश के विभिन्न भागों से पॉमैरा जननद्रव्य का सर्वेक्षण और संग्रहण कर आगे की उपयोगिता हेतु उसका मूल्यांकन करना इन दोनों केंद्रों का प्राथमिक प्रयास है। परियोजना के प्रारंभ से किल्लिकुलम केंद्र में 173 प्रजातियों का रख -रखाव किया जाता है लेकिन पान्दिरिमामिडि केंद्र में 176 प्रजातियों का संग्रहण एवं रखरखाव किया जा रहा है। वर्ष 2005 की अवधि में तमिलनाडु में सर्वेक्षण किया गया। प्रत्येक प्रजाति से दस फलों का संग्रहण किया गया और स्वीकृत प्रपत्र के अनुसार पासपोर्ट ऑकड़े अंकित किये गए।

पान्दिरिमामिडि केंद्र में पॉमैरा जननद्रव्यों के 1991 ब्लॉक में जहाँ कुछ प्रजातियों का फूलन शुरु हुआ है , टापिंग शुरु किया गया।

दिसंबर से अप्रैल तक टापिंग किया गया। प्रजाति 12/91 से 45 दिनों की अवधि में अधिकतम नीरा उपज 79.9 लीटर / ताड़ प्राप्त हुई। 35 दिनों की टापिंग अवधि में प्रजाति 5/91 से 37.5 लीटर / ताड़ नीरा उपज प्राप्त हुई।

फसल संरक्षण :

किल्लिकुलम केंद्र में रोग निगरानी कार्यक्रम आयोजित किया गया। इस वर्ष की अवधि में कली सड़न, पत्ता अंगमारी रोग *पेस्टलोशिया पॉल्मारंम कारक* और पत्ता चित्ती *स्टिम्फिना पॉल्मिवोरा कारक* पर सर्वेक्षण तूतुकुड़ी और तिरुनेलवेली जिला में आयोजित किया गया।

सर्वेक्षण से यह देखा गया कि पत्ता अंगमारी रोग के लिए रोग सूचकांक प्रतिशत दर 3.00 से 32.00 है और पत्ता चित्ति रोग के लिए 6.00 से 25.00 है।

कंद सड़न रोग कारक व्याधिजन के सात आइसोलेट संग्रहित किये गये। सात आइसोलेट के बीच किल्लिकुलम आइसोलेट ने अधिकतम वृद्धि दिखायी। *पेस्टेलोशिया पॉल्मारम* के विभिन्न आइसोलेट के बीच किल्लिकुलम से पी.पी.आई. आइसोलेट बडे आकर के प्रविकार 3.8 ह्न 1.2 सें.मी. उत्पादन करता है। अन्तोनियारपुरम से संग्रहित आइसोलेट पीपी$_4$ कम प्रचण्ड पाया गया।

EXECUTIVE SUMMARY

Coconut, Oil palm and Palmyrah occupy a predominant place in the Indian rural economy. In order to strengthen the research in the vital sector of palms, the All India Coordinated Coconut and Arecanut Improvement Project was started in 1972. During the seventh and eighth five year plan periods, oil palm and palmyrah were also included as mandate crops and the project was renamed as All India Co-ordinated Research Project on Palms. The project has, at present, 16 centres including its head quarters at Kasaragod (Kerala); Veppankulam, Killikulam, Aliyarnagar, Aduthurai (Tamil Nadu); Gangavathy, Arsikere (Karnataka); Ambajipeta, Pandirimamidi, Vijayarai (Andhra Pradesh); Bhubaneshwar (Orissa); Kahikuchi (Assam); Mondouri (West Bengal); Jagadalpur (Chhatisgarh); Ratnagiri and Mulde (Maharashtra). Out of the 16 centres, 10 centres are conducting research on coconut, four on oil palm and two on palmyrah. The broad objectives of the project are:

1. Collection, conservation, cataloguing and evaluation of germplasm, new hybrids and high yielding varieties in coconut
2. Standardization of agro-techniques for various agro-climatic regions including development of appropriate farming systems compatible with the main crop and the edaphic and climatic conditions
3. Development of efficient pest and disease management strategies
4. Adaptability studies on oil palm in different agro-climatic conditions
5. Collection, conservation, evaluation and utilization of germplasm in palmyrah

The budget for the year 2005-06 was Rs. 186.67 lakhs of which the ICAR share was Rs. 140.00 lakhs.

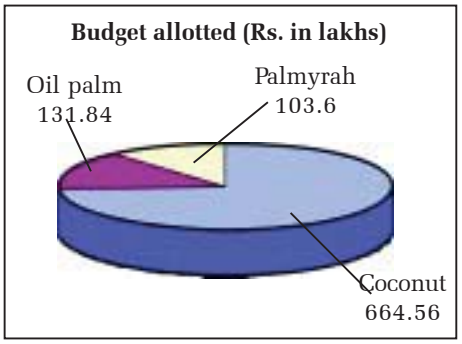
Relative priorities

Considering the relative importance of these crops, 73.84% of budget was allotted to coconut, while oil palm crop received 14.65% of budget and palmyrah centres were allotted with 11.51% (Table 1).

Table 1: Budget allotment to different crops during X Plan

Crop	Budget allotted (Rs. in lakhs)	Percent
Coconut	664.56	73.84
Oil palm	131.84	14.65
Palmyrah	103.60	11.51
Total	900.00	100.00

Budget allotment to different crops during X plan



XVII Biennial Workshop of AICRP on Palms

The XVII Biennial Workshop of All India Coordinated Research Project on Palms was held during December 9-11, 2005 at Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. The Workshop was attended by 73 delegates including Dr. G. Kalloo, Deputy Director General (Hort.& CS), ICAR, Dr. S.S. Magar, Vice Chancellor, DBSKKV, Dr. A.G. Sawant and Dr. Kadrekar, Formerly Vice Chancellors, DBSKKV, Dr. K.V.A. Bavappa, Dr. M.K. Nair, Dr. K.U.K. Nampoothiri, Formerly Directors of CPCRI, Dr. H.H. Khan, Formerly Project Coordinator (Palms), Dr. V. Rajagopal, Director, CPCRI, Dr. M. Kochu Babu, Director, NRC for Oilpalm, Dr. B. Chandrasekharan, Director, Tamil Nadu Rice Research Institute, Professors and Heads of Departments, DBSKKV, CPCRI and AICRPP Scientists.

The Plenary Session was chaired by Dr. G. Kalloo, Deputy Director General (Hort.& CS), ICAR. The Chairman of five Technical Sessions covering the AICRP programmes presented the proceedings of the respective sessions. The Project Coordinator (Palms) presented the Technical Programme for 2006-08 based on the discussions in the workshop.

Dr. Gautam Kalloo, D.D.G.(Hort. & CS), ICAR with other dignitories during the Plenary Session of XVII Biennial Workshop at Dapoli

MAJOR RECOMMENDATIONS TO BE PASSED ON TO EXTENSION SYSTEM

1. **Coconut varieties/hybrids to be recommended for large scale cultivation in the respective region**

- **Ratnagiri :** Laccadive Ordinary (LO)
- **Veppankulam** : COC x PHOT
- **Aliyarnagar** : Philippines Ordinary, WCT x COD, WCT x GBGD, COD x WCT - These hybrids/varieties have already been released from CPCRI and hence these types can be recommended for commercial cultivation in Pollachi region.
- **Kahikuchi:** MYD x WCT – Efforts are to be taken to produce more hybrid seedlings in collaboration with CDB. In addition, the centre is to establish an MYD seed garden by obtaining seed materials from CPCRI/ CDB.

2. Crop Management recommendations

- A fertilizer dose of 500:500:2000 gm NPK/palm/year is recommended for DxT hybrids in Assam State.
- 500:250:1000 gm NPK/palm/year is recommended for hybrid coconut in West Bengal State.
- 1000:500:2000 gm NPK/palm/year is recommended for hybrid coconut in Maharashtra State.
- 1000:500:2000gm NPK/ palm/year is recommended for hybrid coconut in coastal Tamil Nadu.
- As a component of drip irrigation schedule, in summer months, 65 litres of water/ palm/ day may be recommended for Pollachi region in Tamil Nadu.
- A combination of 50% composted coir pith along with 50% recommended dose of fertilizers could be recommended as the INM package for Pollachi region of Tamil Nadu, coastal Andhra Pradesh and maidan tract of Karnataka.

3. Crop Protection recommendations

- Seed nut soaking in *T. viride* combined with soil application of neem cake is to be popularized as a tuber rot disease management practice in palmyrah.
- While taking prophylactic spraying for bud rot disease in coconut, it is essential that the palmyrah palms available near the coconut field also are to be treated to prevent the incidence of bud rot disease.

Group Meeting

As a follow-up action on the QRT recommendations, a Brainstorming Session on "Priority areas of research in palmyrah under AICRP on Palms" was conducted at CPCRI, Kasaragod during March 23-24, 2006. The palmyrah scientists from AICRP on Palms Centres and scientists from CPCRI participated in the discussions held under the Chairmanship of Dr. N.M. Nayar, Formerly Director, CPCRI and Dr. H. Hameed Khan, Formerly Project Coordinator (Palms). The present level of knowledge on palmyrah was critically analysed, gaps in information were identified and thrust areas of research in palmyrah were listed. Prioritization of studies to be taken under the AICRP on Palms was also carried out. Based on the suggestions in the Brainstorming Session, the palmyrah research projects under AICRP on Palms are being modified.

Dr. N.M. Nayar, Formerly Director, CPCRI leading the discussions during the Brainstorming Session on "Priority areas of research in palmyrah"

Major Achievements

COCONUT

1. Crop Improvement

At Aliyarnagar, out of the 17 germplasm types under evaluation since 1990, Cochin China gave the maximum yield of 136 nuts per palm/per year followed by Seychelles (116) and Rajapalayam Tall (112). Since 1988, ten exotic cultivars of coconut are being evaluated at Jagadalpur for their adaptability to this region. The annual nut yield was the highest in Zanzibar with 87.2 nuts/palms followed by Verrikobari yielding 85.6 nuts/palms. Similarly, at Veppankulam Centre in the East Coast region, Seychelles recorded the highest per palm nut yield of 167.5 followed by Zanzibar (166.3) and ECT (152.4).

As a thrust area in the Xth Five Year Plan, emphasis was given on the collection, conservation and evaluation of local germplasm at seven centres. A total number of 81 local germplasm types could be collected at different regions during the last two years for further evaluation.

Promising cross combinations of coconut were under evaluation at seven centres. At Aliyarnagar, the hybrid ECT x MYD performed better than all the other hybrids in the last few years and has given uniformly around 100 nuts/palm/year. Similarly, at Ambajipeta in coastal Andhra Pradesh, GBGD x PHOT (134.65 nuts/palm) and GBGD x LCT (126.02 nuts/palm) recorded significantly higher nut yields compared to the control ECT x GBGD (88.78). At Veppankulam in the East-Coast region, the hybrid WCT X COD recorded the highest number of nuts/year (202.9) followed by LCOT X COC (180.8) and ECT X DG - VHC 1 (163.7). WCT X COD also stood first in cumulative mean nut yield (111.6).

Among the proven/recommended varieties and hybrids of coconut under evaluation at eight centres since 1988, Philippines Ordinary gave the highest cumulative mean yield of 168 nuts/palm/year at Aliyarnagar. Similarly at Jagadalpur in Chattisgarh State, the nut yield was the highest in COD x WCT (70) followed by WCT x GBGD (65).

Realising the importance of utilizing the local germplasm types or genotypes that have performed well at a particular location as one of the parents in the coconut hybrids, a new project on the "Evaluation of new coconut hybrids" was initiated during the year as per the recommendations of QRT. Seven centres initiated the crossing programme as per the above suggested norms. About 40 new cross combinations would be evaluated at different centres under this trial.

2. Crop Production

In the coconut based high density multispecies cropping system studies conducted at Ratnagiri Centre, substitution of nutrients could be achieved through organic recycling to an extent of 33% N, 3.67% P and 22.96% K in coconut and 20-24% N, 2-7% P and 20-67% K in spices.

At Arsikere Centre in Karnataka State, the mean data over the last four years indicated that the coconut yield was higher with banana as an intercrop as compared to other intercrops. Gross returns were higher when banana was intercropped with coconut followed by drumstick, french bean – ladies finger and redgram. Gross returns were the least in pure crop of coconut. Similarly, at Kahikuchi Centre in Assam State, the highest net return per ha (Rs.1,13,048) was recorded under coconut-pepper-turmeric cropping system followed by coconut-pepper-ginger(Rs.72,745). The lowest net return of Rs 46,440 was obtained in the control plot (coconut-pepper).

As a thrust area of research during the Xth Five Year Plan, nine centres initiated studies on the performance of medicinal and aromatic plants as intercrops in coconut gardens. At each centre, a survey on the cultivation of medicinal and aromatic plants was conducted and about 15-20 medicinal and aromatic plants were selected for evaluation under an observational trial. Based on the performance in the observation trials at each centre as well as their market potential, five species were selected at each centre for further detailed studies.

Integrated nutrient management studies in coconut are in progress at seven centres. At Aliyarnagar, application of composted coirpith on equivalent nitrogen basis along with balance amount of P & K as fertilizers

could record the highest mean yield of 160 nuts/palm/year over the last six years resulting in a net income of Rs. 62340 /ha/annum with a benefit cost ratio of 2.39.

Results obtained from the nutrient requirements of high yielding varieties/hybrids of coconut with 50% of nitrogen organic matter substitution at Aliyarnagar, Kahikuchi, Mondouri and Ratnagiri centres indicated that the yield levels could be sustained with 50% organic matter substitution for nitrogen under varying soil conditions, recording better net income subsequently resulting in higher benefit cost ratio at all the four centres.

Based on the recommendations of the Biennial Workshop, a new project on "Substrate dynamics for nutrient management in coconut" was initiated at Veppankulam Centre in East Coast region to study the interaction of biological and chemical substrates to enhance nutrient use efficiency and to find out the suitable substrate for optimum growth, yield and quality of coconut.

3. Crop Protection

Sero detection studies with one year old coconut seedlings planted in basal stem rot diseased garden at Ambajipeta Centre indicated that the basal stem rot disease infection in coconut seedlings could not be detected before symptom expression by simple serological tests and by ELISA. Among the thirteen plant species screened against basal stem rot disease in sick soil, redgram plants showed the specific symptom of splitting of the bark at the crown region. *Ganoderma applanatum* was reisolated from root tissues of the pigeonpea showing bark splitting symptoms. In the *Ganoderma* sick soil, Eucalyptus (2 years old) plants and Sesbania (8 months old) are also showing typical oozing symptoms.

Studies on the pathogenicity of nine isolates of *Ganoderma* at Veppankulam Centre indicated that the seedlings inoculated with isolate TKT 1 showed wilting symptoms at 45 days after inoculation and the isolate TKT1 was found to be a virulent one.

Field experiments conducted at Ambajipeta Centre on the management of Ganoderma wilt disease of the coconut indicated that maximum reduction in vertical disease spread was obtained when *T.viride* was applied to the soil @ 50 g talc powder along with 5 kg neem cake coupled with the root feeding of *T.viride* culture filtrate (100%) @ 25 ml at quarterly intervals.

Screening of coconut types for tolerance to basal stem rot disease at Veppankulam Centre indicated that among the ten coconut types, ECT X BSR tolerant ECT registered a higher rate of survival (61.1 per cent) as compared to other types in BSR sick soil.

Garden to garden survey on the occurrence of root (wilt) disease of coconut was conducted in Theni, Kanyakumari, Tirunelveli, Dindigul and Coimbatore Districts of Tamil Nadu. Per cent incidence of root(wilt) disease in different villages ranged from 0.8 to 4.0.

A field experiment on the biocontrol of stem bleeding disease indicated the effectiveness of *Trichoderma* spp against the disease. Of the different treatments, maximum decrease in bleeding (exudation) patch was obtained when *T.viride*/*T.harzianum*/*T.hamatum* was applied as a paste on the bleeding patch alone or/and coupled with basal application of the same bioagent (50 g) in combination with 5 kg neem cake per palm.

Pest surveillance was carried out on the infestation of rhinoceros beetle, black headed caterpillar, red weevil and eriophyid mite along with the survey for the natural enemies in coconut ecosystem in Andhra Preadesh, Maharashtra and Tamil Nadu States.

Studies on the efficacy of pheromones on red weevil in coconut at Ambajipeta Centre indicated that even though CPCRI lure trapped less number of weevils (CPCRI – 1398 nos. & Chem Tica 1865 nos) when compared to that of the Chem Tica lure in a common period of 230 days, it was observed that CPCRI lure caught a total number of 2003 weevils in a working period of 438 days and the lure continued to function afterwards also. Chem Tica lure worked for only 230 days.

OIL PALM

1. Crop Improvement

Trials on the comparative performance of different cross combinations of oil palm were continued at all the four oil palm centres. At Mulde Centre in Maharashtra State, the hybrid combination of 115 D X 291 P recorded the highest yield of FFB i.e. 121.75 kg per palm per year (17.4 tonnes per hectare), whereas 109 D X 291 P recorded the highest bunch weight (24.38 kg). At Vijayarai Centre in Andhra Pradesh State, maximum FFB yield/palm was obtained in the cross combination of 82 D X 266 P (79.1 kg/palm) i.e.9.8 t/ha and the lowest yield was recorded in 18 D X 32 P (38.7 kg/palm ie 4.8 t/ha.).

Nine genotypes including six Zambian(ZS) and three Tanzanian(TS) Selections of oil palm were under evaluation at Gangavathy and Mulde Centres. At Gangavathy Centre in Karnataka State, palm height, leaf production, number of bunches/palm and FFB yield did not differ among genotypes. However, significant differences were noticed in the physiological parameters like electrolyte leaching and liquid peroxidation.

2. Crop Production

Studies on irrigation and nutrient requirements for oil palm crop was in progress at all the four oil palm research centers. At Aduthurai Centre, the palms applied with a fertilizer dose of 1200:600:2700 g NPK/palm/year (F_3) produced superior FFB yields (14.1 t/ha/year) followed by F_2-800:400:1800 g NPK/palm/year (11.9 t/ha/year) and F_1-400:200:900 g NPK/palm/year (9.5 t/ha/year) and the lowest FFB yield was in palms raised without any fertilizer (F_0) (7.7 t/ha/year). The increased FFB yields in F_3, F_2 and F_1 were 83.1, 54.5 and 23.4 % over F_0-without fertilizer. At Mulde Centre in Maharashtra State, highest yield of FFB (16.92 t/ha) was recorded at I_1F_1 levels (basin irrigation + 400:200:900 g NPK/palm/year). In addition, drip irrigation recorded significantly higher Water Use Efficiency of 5.4 kg/ha.mm as compared to 3.4 kg/ha.mm in basin irrigation. Highest WUE of 7.8 kg/ha. mm was recorded in the treatment combination I_2F_3 i.e. drip irrigation + 1200;600;2700 NPK/palm/year. Similarly, at Vijayarai Centre in Andhra Pradesh State, basin irrigation combined with F_3 level of fertilizers (1200:600:2700g NPK/palm/year) could record the highest FFB yield of 15.6 tonnes/ha. Highest gross returns and net returns were obtained in plots where higher dose of fertilizers was applied in combination with basin irrigation.

PALMYRAH

1. Crop Improvement

Palmyrah research is conducted at Killikulam (Tamil Nadu) and Pandirimamidi (Andhra Pradesh) Centres. The primary task of these two centres is to survey and collect palmyrah germplasm from different parts of the country and evaluate the same for further utilization. 173 accessions are maintained at Killikulam centre while 176 accessions have been collected and maintained at Pandirimamidi centre since the inception of the project. During the year 2005, survey was continued in Tamil Nadu and nine accessions were collected and passport data were recorded as per the approved proforma.

Disease surveillance programme was continued at Killikulam centre. During the year, survey on bud rot, leaf blight disease (caused by *Pestalotia palmarum)* and leaf spot (caused by *Stigmina palmivora*) was conducted in Thoothukudi and Tirunelveli districts. The survey indicated that the PDI ranged from 3.00 to 32.00 for leaf blight disease and 6.00 to 25.00 for leaf spot disease.

At Pandirimamidi centre, tapping was initiated in the 1991 block of palmyrah germplasm as a few palms in some of the accessions have reached the flowering stage. Tapping was initiated in the month of December and extended upto April. Maximum neera yield of 79.9 litres/palm was obtained in the accession 12/91 over a period of 45 days, which was followed by accession 5/91 that has yielded 37.5 litres/palm in a tapping duration of 35 days.

2. Crop Protection

Seven isolates of pathogen causing tuber rot disease were collected. Among the seven isolates, Killikulam isolate showed maximum growth. Among the various isolates of *Pestalotia palmarum*, isolate PP1 from Killikulam produced larger size lesions (3.8 x 1.2cm). Isolate PP4 collected from Anthoniarpuram was the least virulent.

CENTRES OF THE AICRP ON PALMS

State	AICRP-Palms Centre	University	Areas of research
Andhra Pradesh	Agricultural Research Station, Ambajipeta 533 214, East Godavari District	Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad 500 030	Coconut Crop Improvement, Agronomy, Pathology and Entomology
	Agricultural Research Station, Vijayarai 534 475, West Godavari District	Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad 500 030	Oil Palm Crop Improvement and Agronomy
	Horticultural Research Station, Pandirimamidi, Ramapachodavaram, PO 533 288, East Godavari District	Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad 500 030	Palmyrah Crop Improvement and Pathology
Assam	Horticultural Research Station, Kahikuchi, Guwahati 781 017, Kamrup District	Assam Agricultural University, Jorhat, Assam 785 013	Coconut Crop Improvement and Agronomy
Chhatisghar	Saheed Gundadhoor College of Agriculture & Research Station, Kumharawand Farm, Jagadalpur 494 005, Baster District	Indira Gandhi Krishi Vishwavidyalaya, Raipur 492 012	Coconut Crop Improvement and Agronomy
Karnataka	Agricultural Research Station, Arsikere 573 103, Hassan District	University of Agricultural Sciences, G.K.V.K., Bangalore 560 065	Coconut Crop Improvement, Agronomy and Pathology
	Agricultural Research Station, Gangavathy 584 227, Raichur District	University of Agricultural Sciences, Dharwad 580 005	Oil Palm Crop Improvement and Agronomy
Kerala	Central Plantation Crops Research Institute, Kasaragod 671 124	Indian Council of Agricultural Research	Coconut Crop Production
Maharashtra	Regional Coconut Research Station, Bhatye 421 612, Ratnagiri District	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli 415 712, Ratnagiri District	Coconut Crop Improvement, Agronomy and Entomology
	Agricultural Research Station, Mulde 416 520, Kudal Taluk, Sindhudurg District	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli 415 712, Ratnagiri District	Oil palm Crop Improvement and Agronomy
Orissa	Department of Horticulture, Orissa University of Agriculture & Technology, Bhubaneshwar 751 003	Orissa University of Agriculture & Technology, Bhubaneshwar 751 003	Coconut Crop Improvement and Agronomy
Tamil Nadu	Coconut Research Station, Aliyarnagar 642 101, Coimbatore District	Tamil Nadu Agricultural University, Coimbatore 641 003	Coconut Crop Improvement, Agronomy, Pathology and Entomology
	Coconut Research Station, Veppankulam 614 906, Thanjavur District.	Tamil Nadu Agricultural University, Coimbatore 641 003	Coconut Crop Improvement, Agronomy, Physiology and Pathology

	Tamil Nadu Rice Research Institute, Aduthurai 612 101, Thanjavur District	Tamil Nadu Agricultural University, Coimbatore 641 003	Oil palm Crop Improvement and Agronomy
	Agricultural College & Research Institute, Killikulam 628 252, Vallanad, Tuticorin District	Tamil Nadu Agricultural University, Coimbatore 641 003	Palmyrah Crop Improvement and Pathology
West Bengal	Department of Plantation Crops, Faculty of Horticulture, BCKV Mondouri, Kalyani 741 235, Nadia District	Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia 741 252, West Bengal	Coconut Crop Improvement and Agronomy

COCONUT

3.1 Crop Improvement

Gen.1: Utilization of existing germplasm and description of varieties

(Aliyarnagar, Arsikere, Bubaneshwar, Jagadalpur, Ratnagiri, Veppankulam)

The germplasm evaluation trial was continued at six centres to assess the performance of indigenous and exotic cultivars in different regions of the country. The planting materials for the centres were supplied by CPCRI, Kasaragod.

Aliyarnagar

A total of 43 cultivars in 3 sets of planting are maintained under Gen.1.First set consists of 15 types(planted in 1988), second set consists of 17 types(planted in 1990) and third set consists of 15 types (planted in 1994), of which four genotypes are in duplicates.

Germplasm Set I (planted in 1988)

This set of 15 genotypes , is under evaluation for the last 17 years. The growth characters and yield of the genotypes as recorded from July,2004 to June,2005 are given in Table 1.

Among the 15 Set I types, Arasampatti Tall continued to record the maximum nut yield of 187.5 during 2004-05, followed by Tiptur Tall (169.6) and MGD (165.4) (Table 1). Regarding the number of bunches harvested, Tiptur Tall had the highest number (12.8) followed by Arasampatti Tall (12.7).

Table 1 : Growth characters and yield of germplasm – Set I(Aliyarnagar, 2005)

Sl. No.	Genotype	No. of leaves produced	Height from the perm. mark (cm)	Girth at permanent mark (cm)	No. of bunches harvested	Nut yield (2004-05)	Cumulative mean nut yield
1	Zanzibar	11.6	1176.3	187.3	11.4	87.8	67.1
2	Sanramon	10.1	1014.6	194.2	10.8	46.8	43.2
3	Gonthembili	12.1	1138.4	183.0	11.4	80.4	52.5
4	Java	10.9	1269.4	218.3	10.6	98.6	86.6
5	FMS	10.3	1213.5	196.8	11.0	76.5	52.8
6	BSI	10.6	1164.5	181.4	10.2	100.2	57.3
7	St.Vincent	10.4	867.4	178.8	9.8	94.5	75.6
8	Arasampatti Tall	12.7	1288.7	125.2	12.7	187.5	201.6
9	Tiptur Tall	14.3	833.5	175.1	12.8	169.6	143.3
10	ADOT	11.7	826.4	131.4	11.9	84.6	61.5
11	ECT	12.9	998.8	168.6	11.6	148.4	115.7
12	Kenthali	11.1	736.4	111.2	10.9	79.4	53.1
13	MOD	11.3	617.5	93.1	11.7	86.2	59.8
14	MYD	11.5	707.6	92.7	10.4	84.2	67.0
15	MGD	12.1	1326.4	212.9	12.1	165.4	132.1
	Mean	11.6	1012.0	163.3	11.3	106.0	84.6

Germplasm Set II (planted in 1990)

Under Set II germplasm trial, out of the 17 types evaluated during 2004-05, Cochin China gave the maximum nut yield of 136.4 followed by Seychelles (116.4) and Rajapalayam Tall (112.3) (Table 2). Regarding the number of bunches harvested, Rajapalayam Tall produced the maximum number (12.0) followed by LCOT (11.8) and Cochin China and Seychelles (11.6).

Table 2: Growth characters and yield of germplasm – Set II (Aliyarnagar, 2005)

Sl. No.	Genotype	No. of leaves produced	Height from the perm. mark (cm)	Girth at permanent mark (cm)	No. of bunches harvested	Nut yield (2004-05)	Cumulative mean nut yield
1	Calangute	10.9	286.9	161.3	7.4	47.4	32.1
2	Nicobar	11.9	429.6	242.0	7.2	49.4	30.9
3	Guam	11.7	406.7	144.9	6.8	72.4	51.9
4	Ceylon Tall	11.4	448.8	214.6	8.9	94.3	70.5
5	Nadora	9.3	284.7	109.2	5.8	49.8	28.8
6	Spikeless	11.4	286.9	127.5	6.7	70.1	39.5
7	A.Ranguchan	7.9	300.2	155.1	7.6	49.7	24.7
8	Jamaica	9.2	327.4	175.2	7.2	69.3	53.5
9	Seychelles	10.6	460.4	157.4	11.6	116.4	82.4
10	LCT	12.1	464.8	177.2	11.8	104.5	76.3
11	Rajapalayam Tall	12.2	410.7	170.3	12.0	112.3	84.3
12	CGD	11.9	334.3	141.9	9.4	63.2	57.1
13	Hazari	11.5	378.7	144.4	8.4	74.8	56.2
14	Ayiramkachi	12.0	414.6	127.8	8.6	96.7	71.1
15	Andamon Giant	11.2	369.6	197.5	8.4	46.4	35.5
16	Cochin China	12.8	374.3	178.3	11.6	136.4	98.9
17	GBGD	11.9	391.4	167.4	11.0	101.4	79.9
	Mean	11.2	374.7	164.2	8.8	79.7	57.2

Germplasm Set III (planted in 1994)

In Set III germplasm comprising 15 types, ADOT gave the maximum nut yield of 143.6 (Table 3) during 2004-05 followed by Kenya (130.8). ECT and Kenya recorded the maximum number of bunches harvested (10.4), followed by ADOT (10.1), PHOT (9.8) and WCT (9.8).

Table 3 : Growth characters and yield of germplasm – Set III (Aliyarnagar, 2005)

Sl. No.	Genotype	No. of leaves produced during the year	Height from the perm. mark (cm)	Girth at permanent mark (cm)	No. of bunches harvested	Nut yield (2004-05)	Cumulative mean nut yield
1	Sanblass	11.2	297.7	119.2	6.7	47.6	28.0
2	Nadora Tall	11.6	334.4	170.8	7.2	59.5	41.4
3	ECT	13.1	355.4	170.5	10.4	126.4	76.4
4	WCT	12.8	310.6	131.7	9.8	120.2	84.4
5	Andamon Giant	7.7	412.3	190.4	4.6	31.4	18.7
6	Etamozhi Tall	12.0	369.7	192.9	9.7	87.6	58.7
7	Fiji	10.9	412.4	186.3	8.8	117.5	84.1
8	Thailand	11.6	306.2	148.4	9.6	78.8	46.6
9	COD	9.8	311.3	121.9	6.8	41.4	33.3
10	New Guinea Tall	10.8	327.6	151.3	8.7	40.3	21.4
11	PHOT	11.5	466.5	180.8	9.8	117.5	93.1
12	Kappadam	10.7	432.4	172.0	7.2	36.7	22.6
13	Siam	10.4	336.4	195.1	6.9	71.4	45.4
14	Kenya	11.3	261.3	181.9	10.4	130.8	103.6
15	ADOT	11.9	428.9	167.4	10.1	143.6	105.4
	Mean	11.2	357.5	165.4	8.4	83.4	62.6

Arsikere

The germplasm trial was initiated to assess the performance of indigenous and exotic cultivars in this region of the country. The planting materials were supplied by CPCRI, Kasaragod. This trial consisting of 12 coconut cultivars was laid out during 1994 in a non-replicated design in red soil. The observations on growth parameters and yield of nuts were recorded and it was seen that among the 12 cultivars being tested, the tree height was higher in Nufella and the girth was more in San Ramon while the number of functional leaves was higher in Malayan Yellow Dwarf (MYD) (Table 4).

Table 4: Growth characters and yield of germplasm (Arsikere, 2005)

Sl. No.	Cultivar	Tree height (m)	Tree girth (cm)	Number of functional leaves	Coconut yield (nuts/palm/year)	
					2004-05	Cumalative mean (7 years)
1.	Zanzibar	4.16	99.2	18.1	16.7	20.73
2.	San Ramon	3.68	106.9	18.7	6.0	6.03
3.	Phi-Lono	4.53	99.1	22.0	11.0	13.80
4.	Nufella	4.71	91.6	24.7	17.3	29.59
5.	Nuguli	3.45	93.1	17.3	16.8	22.48
6.	Nuwehung	3.68	87.7	21.9	20.5	28.25
7.	Jawa	3.43	96.1	19.1	6.6	10.66
8.	BSI	3.68	88.7	21.4	5.8	16.61
9.	MYD	3.45	81.2	25.0	19.0	23.53
10.	MOD	3.91	85.0	23.8	20.0	19.26
11.	Kenthali	2.08	70.1	16.3	11.3	10.80
12.	Tiptur tall	2.54	88.1	16.8	13.0	10.33

The coconut yield was higher in the cultivar Nuwehung (20.5 nuts/palm) during 2004-05 while the cumulative mean nut yield over 7 years was higher in Nufella (29.59 nuts /palms/year).

Bhubaneshwar

The experiment was planted during December, 2003 at Bhubaneshwar (OUAT campus) with 15 types which include four dwarf types, 10 tall types with the local as check. The initial growth parameters of 15 types are given in the Table 5. The height of the types ranged between 66.5 and 109.4 cm in COD and Andaman Ordinary respectively. Andaman Ordinary, WCT, Guam and SSG were observed to be vigorous types. It was noticed that, though number of leaves produced per year in dwarf types as compared to tall types is at par, the number of leaves on the crown was found to be more in dwarf types than in tall types in the second year of growth phase.

Jagadalpur

The trial was started during June 1988, with ten exotic cultivars. The yield-attributing characters and yield were recorded and are presented in Table 6.

The data showed that, maximum number of functional leaves (32) were recorded in cultivar Fiji Tall, followed by MOD and BSI (29). However, annual leaf production was higher in cultivar Zanzibar and MOD (13.8) and the lowest in cultivar MYD (11.8). The number of inflorescences produced was in the range of 7.0 to 9.2. The number of female flowers was the highest in cultivar Verrikobari (578.6), followed by MYD (485.6). However, the number of fruits set was the highest in Verrikobbari (298.2) due to the highest number of female flowers. Setting percentage was the highest in MOD (57.9%) followed by MYD (54.3%). The annual nut yield was the highest in Zanzibar 87.2 nuts / palm followed by Verrikobari 85.6 nuts / palm.

Table 5 : Mean growth parameters of existing germplasm(Bhubaneshwar, 2005)

Sl. No.	Genotype	Height (cm)	Girth (cm) Number of leaves	on the crown Number of new	leaves produced
1	GBD	68.0	17.0	9.4	**9.4**
2	COD	**66.5**	**14.0**	9.0	9.2
3	MGD	75.4	14.2	9.6	8.5
4	MYD	63.3	15.8	**8.8**	8.5
5	SSG	95.4	15.0	10.2	7.2
6	Pratap	92.6	16.4	9.8	7.3
7	WCT	105.5	16.5	10.3	7.3
8	Tiptur Tall	93.6	15.6	9.6	7.6
9	Sanramon	88.6	16.4	10.2	7.2
10	Java	96.3	15.3	9.8	**6.9**
11	BSI	86.6	**17.4**	9.2	7.4
12	Guam	104.2	16.8	**10.6**	7.6
13	St.Vincent	92.4	16.8	10.0	8.0
14	Andaman Ord.	**109.4**	17.0	10.0	7.4
15	Sakhigopal Tall	75.6	17.0	9.6	7.2

Table 6: Yield and yield attributing characters of germplasm (Jagadalpur, 2005)

Sl. No.	Cultivar	No. of functional leaves	Annual leaf production	No. of inflorescences/ palm	No. of female flowers/	palm Setting percentage	(%) Nut yield/palm (2004-05)
1.	BSI	29	12.0	8.6	235.0	33.9	59.2
2.	MYD	24	11.8	9.2	485.6	54.3	66.3
3.	Verrikobbari	28	13.4	9.2	578.6	51.5	85.6
4.	MOD	29	13.8	8.0	438.5	57.9	71.7
5.	FMS	28	13.4	9.0	429.1	42.7	72.7
6.	Zanzibar	26	13.8	7.6	459.0	41.3	87.2
7.	San Ramon	24	12.0	7.0	392.6	38.2	77.6
8.	Java	26	12.8	9.0	384.4	53.1	62.8
9.	Gonthembili	28	12.8	9.0	397.4	43.7	70.1
10	Fiji Tall	32	13.6	7.6	437.2	50.7	77.4

Ratnagiri

The project was closed during the year and the conclusions drawn are as follows:

1. In addition to the cultivar "Banawali Green Round" which was released in the name of 'Pratap', two varieties viz., Laccadive Ordinary, Philippines Ordinary and two hybrids T x D (WCT x COD) and D x T (COD x WCT) have been recommended for cultivation in Konkan region of Maharashtra State.
2. All the released/recommended varieties recorded higher yield in terms of number of nuts (20 to 75.28%), copra yield(54.88 to 81.25%) and oil yield/ ha (55.09 to 82.65%) than WCT.
3. The highest nut yield was recorded by the variety Laccadive Ordinary (151 nuts/palm/year)
4. The highest copra per nut was recorded in the variety Philippines Ordinary (214 g). However, highest copra yield was recorded in the hybrid D x T (24.86 kg./ palm & 4.35 t/ha).

5. The highest oil percentage was recorded in the variety Laccadive Ordinary (72%). However, the oil yield was maximum in the hybrid D x T (17.41 kg/palm and 3.05 t /ha).
6. In another set of cultivars, F.M.S. recorded the highest mean yield in terms of number of nuts per palm (113nuts). However, the highest copra yield (18.4 kg/palm & 3.22 t/ha) and oil yield (12.97 kg/palm and 2.27 t/ha) were recorded in Fiji Tall.
7. Among the Banawali types, 'Banawali Yellow Round' recorded the highest yield in terms of number of nuts (120.0 nuts). However, 'Banawali Green Long' recorded highest copra yield (20.29 kg/palm and 3.55 t/ha) and also the oil yield (13.89 kg. per palm and 2.43 t/ha.).
8. The hybrids "D x T" followed by "T x D" were found to have considerable amount of nut water, minerals, sugars with maximum acceptability. The results also suggested that for obtaining adequate quantities of nutrients and sugars in the coconut liquid endosperm, the nuts should be harvested between seven and eight months of maturity. Based on tendernut analysis, it was concluded that "Philippines Ordinary" among the tall cultivars, "Chowghat Orange Dwarf" among the dwarf cultivars, "Banawali Yellow Round" among the Banawali type of cultivars and "San Ramon" among the exotic cultivars are the most suitable cultivars for tender nut water. All the three hybrids are preferred for tender nut water and the hybrid "D x T" is the best among all.

Pratap

Veppankulam

Germplasm Set II (Planted in 1984)

Among the eleven germplasm types studied in this trial, it was seen that Seychelles recorded the highest per palm nut yield of 167.5 followed by Zanzibar (166.3) and ECT (152.4). Cumulative mean nut yield was the highest for WCT (100.8) followed by Zanzibar (99.5) and ECT (92.4). San Ramon registered the highest (14.0 kg) copra yield/palm/year and it was followed by WCT (13.9 kg) and ECT (13.3 kg).(Table 7)

Table 7. Nut yield of germplasm -Set II (Veppankulam, 2005)

Sl. No.	Cultivar	Annual nut yield (2004-05)	Cumulative mean nut yield (18 years)	Copra yield/palm/ year (kg)
1.	BSI	94.6	63.9	9.8
2.	Cochin China	71.6	52.0	8.7
3.	Guam	69.2	47.5	5.8
4.	Kenya	137.7	85.2	11.2
5.	Nigerian Tall	132.4	75.3	11.5
6.	San Ramon	92.3	57.8	**14.0**
7.	Seychelles	**167.5**	84.6	11.9
8.	St. Vincent	127.3	77.0	8.1
9.	WCT	**166.3**	**100.8**	**13.9**
10.	Zanzibar	103.8	**99.5**	12.4
11.	ECT	**152.4**	**92.4**	**13.3**

Gen.1A : Collection, conservation and evaluation of local germplasm

(Aliyarnagar, Ambajipeta, Bhubaneshwar, Kahikuchi, Mondouri, Ratnagiri, Veppankulam)

Aliyarnagar

Under the programme for local germplasm collection in inland areas of Tamil Nadu, the following collections were made from 9 locations during the year 2004-05 and the seednuts were sown in the nursery (Table 8)

Table 8. Important characters of the collected germplasm and location of collections (Aliyarnagar, 2005)

Sl. No.	Accession No.	Place of collection	Category	Crown shape	No. of leaves	No. of bunches
1	ALCO 07	Kulasekaram	Tall	Circular	34	13
2	ALCO 08	Puthalam	Tall	Circular	28	11
3	ALCO 09	Sucindram	Tall	Circular	29	14
4	ALCO 10	Anaimalai	Tall	Semi Circular	31	13
5	ALCO 11	Pethanaickanoor	Tall	Circular	29	12
6	ALCO 12	Kengampalayam	Tall	Circular	31	13
7	ALCO 13	Kaliyapuram	Tall	Semi Circular	38	12
8	ALCO 14	Veelavari	Tall	Semi Circular	24	15
9	ALCO 15	Subbegoundanpudur	Tall	Circular	26	10

Ambajipeta

Under the local germplasm collection programme, survey was conducted in delta region of East Godavari district and the passport data on yield attributes and nut characters of the mother palms were recorded. Among the various ecotypes of the local germplasm collections, the highest nut yield and yield attributes were recorded in Jonnalarasi Ecotype - I & II (1029.68 & 1054.70 nuts/ palm/ year).The maximum copra content were registered in Gangabondam (150.29 g/nut) followed by East Coast Tall Ecotype-II (142.48 g/nut) while oil content was maximum in Jonnalarasi Ecotype-I (70%) followed by Pillalakodi-I (68%). The nuts were sown during August, 2005 and the nursery is being raised.

Pillalakodi

Jonnalarasi

Pillalakodi

Jonnalarasi

Kahikuchi

The 12 local germplasm types collected earlier were planted in RBD for evaluation on their performance. The experiment is in initial stage and observations on growth characters such as plant height and number of leaves were recorded. The data presented in Table 9 showed that the maximum plant height of 1.75 m and number of leaves (7.3) were recorded in the collection HRSCC-01 which was collected from Kamrup district. It was also observed that plant height of different collections of coconut ranged from 0.96 m to 1.35 m and number of leaves ranged from 5.5 to 7.3.

Table 9 : Growth characters of local germplasm of coconut (Kahikuchi, 2005)

Germplasm accession	Plant height (m)	Number of leaves
1. HRSCC-01 (collected from Kamrup Dist.)	1.75	7.3
2. HRSCC-02(Kamrup)	1.32	6.1
3. HRSCC-03(Kamrup)	1.42	6.2
4. HRSCC-04(Nalbari)	1.20	5.5
5. HRSCC-05(Nalbari)	1.15	5.5
6. HRSCC-06(Nalbari)	1.52	6.3
7. HRSCC-07(Borpeta)	1.41	6.0
8. HRSCC-08(Borpeta)	1.52	5.8
9. HRSCC-09(Darrang)	1.64	6.8
10. HRSCC-10(Darrang	1.60	5.6
11. Kamrup	1.66	6.8
12. WCT	1.60	6.6
C.D(P=0.05)	0.07	0.13

Bhubaneshwar

The experiment on the performance of local germplasm types was planted during December, 2003 at Bhubaneshwar with 11 local types viz.Tinisira, Goja, Dhila, Bana, Narangi, Suryabana, Dhanei, Jahaji, Gol, Mamuli and Local giant.The data on initial growth parameters are presented in the Table 10.

All the entries showed increase in growth in respect of vegetative characters. Local giant, Tinisira, Dhila and Narangi types were found to be more vigorous with respect to height and girth during the initial period of growth. Retention of leaves on the crown increased with the consecutive year of growth in all the entries.

Table 10: Mean growth parameters of local germplasm (Bhubaneshwar, 2005)

Sl. No.	Type	Height (cm)	Girth (cm)	Number of leaves on the crown	Number of new leaves produced
1	Tinisira	126.3	21.45	8.1	6.1
2	Goja	91.9	17.87	7.5	6.5
3	Dhila	104.6	24.55	7.7	6.0
4	Bana	94.2	23.30	8.3	6.4
5	Narangi	101.8	23.70	8.2	6.0
6	Suryabana	82.4	18.75	9.7	6.8
7	Dhanei	99.2	18.23	7.7	6.5
8	Jjahaji	69.4	17.10	7.7	6.2
9	Gol	78.8	21.20	8.0	6.3
10	Mamuli	75.6	17.00	9.6	7.2
11	Local giant	148.5	30.45	8.8	6.4

Mondouri

Five local types of germplasm from different districts of West Bengal were identified and field survey for other local types is in progress. Seednuts collected from the selected local types were sown in the nursery.

Ratnagiri

The survey work for collection of local germplasm of coconut was conducted in Konkan region which comprises Thane, Raigad, Ratnagiri and Sindhudurg districts. For actual survey work, coconut growing taluks were selected from each district and from each taluk two villages and in each village two coconut growers were randomly selected. Seednuts of selected types were collected and planted in the nursery.

Veppankulam

Morphological observations and nut characters were recorded on the selected palms. Among the collected local germplasm, the cultivar Kallikadu showed its superiority of morphological appearance through the following characters viz., total number of leaves (37.3), length of petiole (125.2 cm), length of leaflet bearing portion (405.0 cm) and number of leaflets (225.3). The same genotype expressed the highest whole nut weight (1350 g), dehusked nut weight (683.8g), kernel weight (326.5 g) and copra weight (168.0g).

Gen.2 : Production and evaluation of new cross combinations

(Aliyarnagar, Ambajipeta, Arsikere, Bhubaneshwar, Jagadalpur, Ratnagiri, Veppankulam)

The hybrid evaluation trial was initiated to assess the performance of indigenous and exotic crosses along with local cultivars. The planting materials for the trial were produced at CPCRI, Kasaragod as well as AICRP Centres at Ambajipeta and Veppankulam.

Aliyarnagar

The experiment was concluded as per the recommendations of the XVII Biennial workshop held at Dapoli during December 9-11, 2005 and a brief summary of the consolidated report of the trial is presented here:

The experiment with 12 hybrids and 3 cultivars of coconut was started with a view to identify the best performing hybrid for nut yield. The parents of the hybrids studied involved one tall and one dwarf in each case. Dwarfs were used as both male and female parents in the crosses studied. The three cultivars used for comparing the yield of hybrids were, East Coast Tall, Laccadive Ordinary and Pratap. Regarding cumulative nut yield over the entire growth period (Table-11), ECT x MYD ranked top with a cumulative nut yield of 837.4 followed by MYD x WCT (732.6 nuts) and WCT x MYD (722.4 nuts).

In all the years studied, the hybrids recorded higher nut yield than all the three varieties and the hybrid ECT x MYD performed better than all the other hybrids in the last few years and has given uniformly around 100 nuts/palm/year. The other two better performing hybrids, which closely follow ECT x MYD in nut yield are the hybrids having WCT, GBGD, LCO and MYD as their parents. It could be finally concluded that the hybrids involving tall parents ECT and WCT and dwarf parents MYD and GBGD have been found to give better nut yields.

Table 11: Nut yield of coconut hybrids (Aliyarnagar 2005)

Sl. No.	Cross combination	2001-02	2002-03	2003-04	2004-05	Cumulative yield
1.	PHOT x GBGD	63.8	61.4	75.7	84.6	397.5
2.	GBGD x ECT	69.6	57.5	69.6	78.7	338.9
3.	ECT x GBGD	106.1	96.4	76.6	70.4	572.0
4.	WCT x MYD	130.4	117.8	127.6	136.4	722.4
5.	GBGD x PHOT	77.3	50.0	64.7	76.5	400.5
6.	COD x WCT	108.6	97.2	120.6	132.5	669.5
7.	LCT x COD	108.5	100.1	112.6	120.4	606.4
8.	MYD x ECT	110.5	107.1	106.4	138.4	732.6
9.	MYD x ECT	82.8	90.7	97.8	114.6	585.1
10.	ECT x MYD	112.6	135.7	148.4	153.4	837.4
11.	WCT x GBGD	102.7	122.5	123.4	138.4	645.1
12.	LCT x GBGD	150.3	115.1	118.6	98.4	680.4
13.	ECT	85.5	76.9	93.4	104.5	561.6
14.	LCT	88.1	78.9	86.5	95.3	542.1
15.	Pratap	136.5	123.7	108.7	85.8	636.7
	Mean	102.22	95.4	102.04	108.55	-
	CD (P=0.05)	10.3	12.4	13.0	17.6	-
	CV(%)	8.7	11.2	7.6	12.4	-

Ambajipeta

The trial was laid out in 1985 with six hybrids. Data on yield attributes, nut yield and nut quality characters for the year 2004-05 are presented in the Tables 12 and 13. During 2004-05, GBGD x PHOT (134.65 nuts/palm) and GBGD x LCOT (126.02 nuts/pam) recorded significantly higher nut yields compared to the control ECT x GBGD (88.78). However, the highest cumulative mean nut yield/palm during post cyclone period was recorded in the cross combination GBGD x PHOT (631.79) followed by GBGD x LCOT (610.69).

Table 12: Mean nut yield and cumulative nut yield of new cross combinations (Ambajipeta, 2005)

Cross combination		Mean nut yield/palm (2004-05)	Cumulative nut yield per palm	
			Pre cyclone period (1989-1996)	Post cyclone period (1997-2005)
1	ECT x MGD (VHC-I)	102.11	141.12	541.84
2	GBGD x ECT	84.54	231.24	458.29
3	GBGD x Fiji	92.36	224.64	573.35
4	GBGD x PHOT	134.65	152.36	631.79
5	GBGD x LCOT	126.02	165.42	610.69
6	ECT x GBGD	88.78	232.32	601.84
CD (P=0.05)		10.71	6.16	19.42

Regarding nut quality characters (Table 13), the highest nut weight was recorded in cross combination GBGD x PHOT (1466.60 g) followed by GBGD x Fiji (1392.20 g). Highest water content/nut was recorded by GBGD x ECT (446.67 ml) followed by ECT x GBGD (386.68 ml). The copra content in the cross combinations ranged from 134.36 g/nut to 178.65 g/nut and oil content from 60.41% to 66.54%. The highest copra content was recorded in GBGD x PHOT (178.65 g/nut) followed by GBGD x LCOT (168.29 g/nut) compared to 150.93 g/nut of copra in ECT x GBGD (check). The highest oil content was recorded in GBGD x Fiji (66.54%).

Table 13: Nut quality characters in new cross combinations (Ambajipeta, 2005)

Cross combination		Wt. of whole nut (g)	Water content (ml)	Copra content/ nut (g)	Copra wt. (kg/ palm)	Oil content (%)
1.	ECT x MGD (VHC-I)	1346.34	297.67	134.36	14.39	62.18
2.	GBGD x ECT	1219.73	446.67	144.93	13.55	60.41
3.	GBGD x Fiji	1392.20	381.67	156.62	12.18	66.54
4.	GBGD x PHOT	1466.60	358.00	178.65	19.69	65.71
5.	GBGD x LCOT	1366.95	350.00	168.29	20.66	64.67
6.	ECT x GBGD	1358.87	386.67	150.93	18.12	65.57
Mean		1358.45	370.12	152.30	16.03	64.20

Arsikere

Set-I:

This trial consisting of 9 hybrids and one local cultivar was laid out during 1987 in RBD with three replications. Observations on growth parameters and yield of nuts were recorded and presented in Table 14.

Table 14: Growth and yield of hybrids of coconut –Set I(Arsikere, 2005)

Sl. No.	Hybrid	Tree height (m)	Tree girth (cm)	No. of functional leaves	Yield of nuts/palm/year	
					2004-05	Mean (12 years)
1.	CC x LCOT	4.63	85.4	21.3	10.6	18.28
2.	LCOT x PHOT	5.33	82.2	22.2	12.3	28.33
3.	LCOT x CC	5.20	87.2	24.9	25.5	23.34
4.	WCT x COD	4.80	76.6	20.4	21.8	30.78
5.	WCT x GBGD	5.89	86.2	24.1	28.6	36.23
6.	WCT x MYD	5.09	78.7	23.5	29.8	32.12
7.	GBGD x Fiji	5.20	87.9	23.3	39.6	45.55
8.	GBGD x PHOT	4.84	83.6	27.2	36.7	40.92
9.	GBGD x LCOT	4.64	79.6	24.8	56.7	53.06
10.	Tiptur Tall	5.33	85.2	23.0	37.9	29.57
	S. Em ±	0.35	3.80	1.23	4.7	
	CD(P=0.05)	1.04	NS	3.63	13.8	

The tree height was significantly higher in the WCT X GBGD cross, while the number of functional leaves was significantly higher in GBGD X PHOT cross compared to other cross combinations. The coconut yield during 2004-05 and also the cumulative mean nut yield over 12 years was higher in GBGD X LCOT cross followed by GBGD X Fiji cross.

Set-II :

This trial consisting of four hybrids and one local cultivar (Tiptur Tall) was laid out during 1992 in RBD with four replications. The observations on growth parameters and yield of nuts were recorded and presented in Table 15.

Table 15: Growth and yield of hybrids of coconut – Set II(Arsikere, 2005)

Sl. No.	Hybrid	Tree height (m)	Tree girth (cm)	No. of functional leaves	Yield of nuts/palm/year	
					2004-05	Mean (8 years)
1.	COD x WCT	2.10	67.5	16.8	7.2	7.88
2.	LCOT x COD	2.18	76.6	16.4	5.6	8.62
3.	MYD x TPT	2.72	72.5	20.2	22.2	16.49
4.	LCOT x GBGD	2.42	78.4	17.4	8.8	7.94
5.	Tiptur Tall	2.06	78.3	15.9	5.6	7.34
	S. Em ±	0.10	1.70	0.59	0.47	
	CD (P=0.05)	0.31	5.23	1.81	1.45	

The tree height and number of functional leaves were significantly higher in the hybrid MYD X TPT compared to other hybrids and Tiptur Tall. The tree girth was significantly higher with LCOT X GBGD cross which was on par with Tiptur Tall. The coconut yield during 2004-05 and also the cumulative mean yield over 8 years were higher in the hybrid MYD X TPT compared to other hybrids and Tiptur Tall.

Bhubaneshwar

Seed nuts of cross combinations for this experiment were collected from CPCRI, Kasaragod and AICRP Centre, Veppankulam during 2004 and were sown in the nursery bed. Subsequently, the following eight cross combinations were planted in a Randomized Block Design with 4 replications during November-December, 2005. LCOT x COD, ECT x DG, GB x ECT, GB x PHOT, ECT x MYD, LCOT x GBD, WCT x MYD, ECT x GBD & ECT (check)

Jagadalpur

Under this experiment, 10 hybrids and two cultivars were planted during 1991-93. The data on yield attributes were recorded and are presented in Table 16. The number of functional leaves was found statistically at par among hybrids/cultivars and found maximum in hybrid COD x WCT (27) and minimum in cultivar ECT (24). The annual leaf production rate/palm was in the range of 10 to 12.4. Maximum number of inflorescences was produced by LCOT x COD (8.4), followed by COD x WCT (7.2). Significant variation among hybrids was also observed

Table 16 : Mean yield attributing characters and yield of new cross combinations (Jagadalpur, 2005)

Sl. No.	Hybrid	No. of functional leaves	No. of inflorescence	Male phase (days)	Female phase (days)	Setting percentage	Annual nut yield/palm
1.	COD x WCT	27.0	7.2	18.0	4.6	42.2	55.46
2.	LCOT x GBD	24.8	6.4	22.0	4.6	33.3	39.63
3.	PHOT x COD	24.6	6.0	24.6	4.6	37.6	27.03
4.	LCOT x COD	26.0	8.4	17.8	4.2	39.3	40.73
5.	WCT x GBD	25.8	6.0	18.4	4.2	36.7	25.19
6.	ECT x GBD	26.2	6.8	20.4	3.2	37.7	54.35
7.	ECT x MYD	25.0	5.6	18.4	4.0	34.9	26.08
8.	MYD x ECT	26.0	6.0	23.0	4.2	39.2	37.85
9.	ECT	24.0	6.2	21.8	4.2	33.2	21.15
10.	MYDx WCT	26.4	6.0	20.6	3.0	39.5	35.40
11.	LCO	25.8	5.0	20.6	4.8	36.7	29.48
12.	GBD x ECT	26.0	5.8	20.8	4.4	41.3	22.93
	CD(P=0.05)	NS	NS	-	-	77.3	NS

in case of number of female flowers per palm. Highest number of female flowers was produced by COD x WCT (383.4) followed by MYD x ECT (331.8) and minimum in LCOT (214.7). The male and female phase was observed in the ranges of 17.8 to 24.6 days and 3.0 to 4.8 days, respectively. Setting percentage was the highest in COD x WCT (42.2) and minimum in ECT (33.2). Though the differences in annual nut yield was not significant, the maximum annual nut yield was recorded in COD x WCT (55.4) followed by ECT x GB (54.3) and minimum in ECT (21.1).

Ratnagiri

To study the performance of promising hybrids of coconut, a trial was laid out in 1992 with 12 hybrids with 3 cultivars as check in a RBD with 3 replications and 8 palms/plot. The yield data are presented in Table 17.

Table 17: Evaluation of promising coconut hybrids (Ratnagiri, 2005)

Sl. No.	Name of hybrid	Nut yield per palm per year		Mean cumulative yield/ palm/ year (2001-02 to 2004- 05)
		2003-04	2004-05	
1.	GBGD x ECT	95	112	90
2.	ECT x GBGD	87	92	82
3.	PHOT x GBGD	48	75	62
4.	GBGD x PHOT	57	80	63
5.	LCOT x COD	42	51	45
6.	COD x LCT	74	82	81
7.	ECT x MYD	44	52	37
8.	MYD x ECT	54	53	47
9.	COD x WCT	47	69	64
10.	WCT x MYD	64	101	78
11.	LCOT x GBGD	52	80	58
12.	WCT x GBGD	49	82	58
13.	ECT	39	64	55
14.	LCO	53	72	53
15.	Pratap	64	114	80
	SE+	12.23	15.06	10.34
	CD(P=0.05)	NS	NS	29.94

ECT x GBGD- a promising hybrid at Ratnagiri

All the hybrids started yielding from 1998-99. The data for the period 2003-04 and 2004-05 and cumulative yield for the last four years was statistically analyzed. During the period 2003-04 and 2004-05, there was no significant difference in the yield of different cross combinations. As regards the mean cumulative yield during the last four years (2001-02 to 2004-05), the different cross combinations showed significant differences in yield. The cross combinations GBGD x ECT, ECT x GBGD, COD x LCT, Pratap, WCT x MYD, COD x WCT, GBGD x PHOT and PHOT x GBGD recorded higher yield than the remaining cross combinations. The

highest mean cumulative yield was recorded by GBGD x ECT (90 nuts/palm/year) followed by ECT x GBGD (82 nuts/palm/year).

Veppankulam

A total of 14 hybrids planted during 1986 were evaluated in this experiment. Data on yield and nut characters are presented in Table 18. The hybrid WCT X COD recorded the highest number of nuts/year (202.9) followed by LCOT X COC (180.8) and ECT X DG (VHC 1) (163.7). WCT X COD also stood first in cumulative mean nut yield (111.6) and it was followed by WCT X MYD (111.5) and GBGD X PHOT (100.8). COC X PHOT recorded the highest copra yield (19.0 kg) followed by WCT X MYD (17.1kg) and WCT X COD and LCOT X PHOT (16.6 kg). Thus, WCT X COD cross combination showed its overall superior performance in annual nut yield, cumulative mean nut yield and copra yield/palm/year.

Table 18 : Yield and nut characters of hybrids(Veppankulam, 2005)

Sl. No.	Hybrid	Copra weight (g)	Nut yield / palm	Cumulative mean nut yield	Copra yield/palm/ year
1	COD x WCT	152.0	159.7	95.7	14.5
2	WCT x COD	148.4	202.9	111.6	16.6
3	WCT x MYD	153.3	143.5	111.5	17.1
4	WCT x GBGD	148.2	153.6	90.6	13.4
5	GBGD x LCOT	145.4	157.2	98.8	14.4
6	GBGD x PHOT	138.2	147.9	100.8	13.9
7	GBGD x FIJI	135.0	133.6	83.8	11.3
8	LCOT x COC	130.2	180.0	89.1	11.6
9	COC x LCOT	135.9	116.1	73.9	10.0
10	COC x PHOT	178.4	106.5	59.3	19.0
11	LCOT x PHOT	195.8	126.4	84.6	16.6
12	ECT x COD	123.5	145.0	90.8	11.2
13	GBGD x ECT	127.5	92.4	98.9	12.6
14	ECT x DG (VHC 1)	130.2	163.7	98.0	12.8

Gen. 2A: Evaluation of new coconut hybrids

(Aliyarnagar, Ambajipeta, Bhubaneshwar, Kahikuchi, Mondouri, Ratnagiri, Veppankulam)

Aliyarnagar

The following crosses were made at Aliyarnagar during 2004-05 and the number of seedlings available in the cross combinations is detailed below.

	Cross combinations	No. of seedlings
1.	ALR(CN)1 x MYD	14
2.	ALR(CN)1 x MGD	14
3.	Tiptur Tall x MYD	13
4.	Tiptur Tall x MGD	1
5.	COD x ALR(CN) 1	6

It is programmed to take up planting of these seedlings during October - November, 2006. Since the number of seedlings in the combinations is very low, crossing programme is being continued to obtain the required number of seedlings at this Centre.

Ambajipeta

Crossing programme was initiated during the year 2004 with best performing varieties of Gen. 1 trial with seven new cross combinations viz., ECT X PHOT, ECT X CC, PHOT X GBGD, GBGD X PHOT, GBGD X CC, CC X GBGD and GBGD X ECT. The data on setting % among the cross combinations revealed that the setting percentage among the six crosses ranged from 38.46 to 49.85 and it was the highest in GBGD X ECT (49.85%) followed by ECT X CC (48.18%)

Among the five crosses made, a total of 3,362 flowers were pollinated and 2,538 flowers got fertilized. The

percentage set ranged between 48.6 and 64.2. A total of 1,902 nuts were harvested during September, 2005 and 1,790 nuts were sown in the nursery.

Bhubaneshwar

Production of new coconut hybrids was undertaken at this Center as suggested by QRT and finalized in the group meeting held on December 18, 2004 at CPCRI, Kasaragod. The hybridization work is in progress at Konark for the production of SKL x COD, COD x BANA, SKL x GBD, MGD x SKL and GBD x GUAM cross combinations. The matured crossed nuts will be sown in the nursery bed during 2006-07. It is to be noted that the selection of parents for different cross combinations was also due to the following factors: SKL x COD is widely promoted by the State Govt.; MGD showed quick revival after cyclone; Bana is a good performing type in the region and Guam performed well in Gen. 1 trial.

Mondouri

Five cross combinations for developing hybrids in coconut for the Centre has been approved at the Group Meeting and the crossing programme has been taken up during 2005 (Table 19)

Table 19 : Details of hybidisation programme(Mondouri, 2005)

Sl. No.	Cross	No.of flowers pollinated	Approx. seed nuts available
1	Philippines Ordinary x Laccadive Ordinary	104	32
2	Laccadive Ordinary x Philippines Ordinary	132	40
3	East Coast Tall x Laccadive Ordinary	140	36
4	East Coast Tall x Jamaica Tall	124	32
5	East Coast Tall x Java	104	24

After the maturity of the nuts, seedlings of hybrids will be raised and evaluated for their performance.

Ratnagiri

The details on the number of female flowers pollinated and nuts collected from six cross combinations selected for the project are given in Table 20.

Table 20: Details of hybridization for the evaluation trial (Ratnagiri, 2005)

Sl. No.	Cross	No of female flowers pollinated	No. of nuts sown in nursery
1.	BGL x COD	498	277
2.	COD x BGL	342	246
3.	Pratap x COD	422	247
4.	COD x Pratap	436	366
5.	BYR x COD	595	192
6.	COD x BYR	500	229

BGL - Banawali Green Long
BYR - Banawali Yellow Round
COD - Chowghat Orange Dwarf

In addition, as suggested in XVIIth Biennial Workshop of AICRP on Palms held at DBSKKV, Dapoli, pollination for the following cross combinations of T x T has also been undertaken.

1) LCOT x Pratap
2) Pratap x LCOT
3) PHOT x Pratap
4) Pratap x PHOT
5) BGL x PHOT
6) PHOT x BGL
7) BGL x LCOT
8) LCO x BGL
9) BYR x PHOT
10) PHOT x BYR
11) BYR x LCO
12) LCOT x BYR

Veppankulam

The following new cross combinations were allotted to this Centre for production and evaluation.

1. WCT x MOD
2. MOD x WCT
3. WCT x MGD
4. WCT x KTD
5. ADO x COD

Hybridization work was initiated to produce the above hybrids.

Gen. 3: Trial of promising seed materials

(Aliyarnagar, Ambajipeta, Arsikere, Bhubaneshwar, Jagadalpur)

The trial was continued with released/promising varieties and hybrids in five centres along with local tall. The planting materials, except for the local tall cultivars, were supplied from Central Plantation Crops Research Institute, Kasaragod.

Aliyarnagar

A total of 3 hybrids and 7 cultivars planted in 1988 were evaluated. The data on growth and yield parameters are given in Table 21.

Table 21: Growth and yield parameters of promising seed materials (Aliyarnagar, 2005)

Sl. No.	Cultivar/hybrid	No. of leaves produced	No. of bunches harvested	Copra yield (kg/ha)	Oil content %	Nut yield/ palm (2004-05)	Cumulative mean nut yield
1	WCT	12.1	10.7	3965	63.4	141.6	89.6
2	SSG	9.6	8.6	3382	65.3	124.7	109.1
3	LCT	10.7	10.8	2127	63.6	86.8	90.1
4	PHOT	11.5	10.9	4242	59.3	125.6	**168.0**
5	ADOT	10.8	10.8	4223	59.1	127.0	98.6
6	ECT	11.6	11.7	4293	61.7	136.3	114.8
7	WCT x COD	12.4	11.6	4411	58.0	147.4	114.2
8	WCTx GBGD	11.7	12.0	4429	66.4	141.4	114.4
9	COD x WCT	12.1	11.2	4572	62.1	164.3	113.6
10	LMT	8.7	8.7	4064	67.5	**273.2**	112.2
						Mean	146.8
						CV(%)	23.6
						CD(P=0.05)	9.8

The highest nut yield for 2004-05 was recorded by the cultivar LMT (273.2 nuts/palm). However, PHOT was found to give the highest cumulative mean yield of 168.0 nuts/palm/year.

Ambajipeta

The pre bearing performance of the coconut hybrids and certain varieties(planted during 2002) showed considerable difference in girth and number of leaves during 2005-06(Table 22). Entries *viz.*Philippines Ordinary, Chandra Laksha and Godavari Ganga recorded higher plant girth and were more vigorous. Accessions *viz.*, Philippines Ordinary, Lakshaganga and Godavariganga registered higher leaf number/palm. The rate of leaf production was maximum in Philippines Ordinary (11.66) followed by Keraganga (11.61) and Lakshaganga (11.24).

Table 22: Growth characters in coconut hybrids and varieties (Ambajipeta, 2005)

Varieties/hybrids	Mean girth / palm (cm)	Mean height of the palm (m)	Total no. of leaves on the palm	No. of leaves / palm / year
Chandrasankara (COD x WCT)	100.31	5.87	17.28	10.72
Lakshaganga (LCT x GBGD)	99.87	6.84	18.52	11.24
Keraganga (WCT x GBGD)	97.87	6.08	17.44	11.61
Chandralaksha (LCT x COD)	109.56	6.99	18.26	10.89
VHC-I (ECT x MGD)	86.78	5.85	15.75	10.26
VHC-2 (ECT x MYD)	100.67	6.32	18.30	10.84
Chandrakalpa (LCT)	90.76	6.88	15.77	10.82
Philippines Ordinary	112.54	6.45	20.11	11.66
Godavari ganga (ECT x GBGD)	104.34	6.61	19.53	10.48
CD(P=0.05)	1.78	NS	1.49	1.12

Regarding the period taken for attaining the first flowering, Lakshaganga, Philippines Ordinary and Godavariganga recorded lower period for first flowering and were precocious. Lakshaganga, VHC-2 and Godavariganga registered higher number of spadices/palm while VHC-2 and Godavariganga contained higher number of female flowers. In general, VHC-2, Philippines Ordinary and Godavariganga were found to be more vigorous and precocious in the preliminary evaluation.

Arsikere

The trial was laid out with 10 varieties /hybrids during 1994 in RBD with three replications to evaluate the performance of different varieties and hybrids of coconut. The planting materials except local cultivar (Tiptur Tall) were supplied from CPCRI, Kasaragod. The observations on growth parameters and yield of nuts were recorded and presented in Table 23.

Table 23: Growth and yield of different varieties and hybrids of coconut (Arsikere, 2005)

Sl. No.	Hybrids/varieties	Tree height (m)	Tree girth (cm)	No.of functional leaves	Coconut yield(nuts/palm/year)	
					2004-05	Mean (7 years)
1	WCT	4.25	101	22.0	15.8	14.81
2	SSG	3.53	86	22.1	21.7	23.53
3	LCO	3.63	89	20.7	26.8	22.81
4	LM	4.23	97	22.1	19.3	19.53
5	PHO	3.96	88	24.5	32.2	39.53
6	AO	4.99	107	24.4	22.4	31.89
7	WCT x COD	3.82	81	19.9	35.4	45.70
8	WCT x GBD	3.41	86	24.2	28.4	29.96
9	COD x WCT	3.55	87	21.6	34.7	40.27
10	Tiptur tall	4.30	99	23.3	29.6	26.84
	S. Em ±	0.26	3.4	1.51	4.9	
	CD (P=0.05)	0.77	10.2	NS	14.5	

The tree height and girth were significantly higher with Andaman Ordinary (AO), compared to other hybrids and cultivars. The coconut yield during 2004-05 and also the mean yield over seven years were higher in WCT X COD cross followed by COD X WCT cross.

Bhubaneshwar

The experiment was laid out with two promising varieties, three hybrids along with Sakhigopal Tall as check during August, 2004. The seed nuts for this experiment were collected from CPCRI, Kasaragod and

AICRP Centre, Veppankulam during 2003 as suggested in the XVIth Biennial workshop. The data on growth characters are given in Table 24. COD x WCT recorded maximum growth in respect to height, girth, number of leaves on the crown and number of leaves per year followed by LCT.

Table 24: Growth characters of promising seed materials(Bhubaneshwar,2005)

Sl. No.	Hybrid/cultivar	Height (cm)	Girth (cm)	Number of leaves on the crown	Number of new leaves produced	Remarks
1	WCT x GBD			Planted during Nov, 2005 using the seed nuts received		
				from CPCRI during September, 2004		
2	COD x WCT	13.1	83.6	8.6	7.5	Planted in August, 04
3	WCT x COD	13.2	77.8	8.5	7.4	Planted in August, 04
4	PHOT	12.5	70.2	7.6	6.4	Planted in August, 04
5	LCT	12.9	81.8	7.4	5.9	Planted in August, 04
6	SKL	12.5	75.5	7.7	6.2	Planted in August, 04

Jagadalpur

This trial was started during 1988 in RBD with three hybrids and six cultivars. The data on yield attributing characters and yield were recorded and presented in Table 25. The number of functional leaves was in the range of 25 to 29 with the maximum number produced by COD X WCT (29) and minimum in cultivar SSG (24). The leaf production rate/palm/year was in the range of 10.4 to 13.6 with maximum leaf production (13.6) in AO and minimum in cultivars PHOT (10.4). The number of inflorescence/plant was recorded maximum in COD x WCT (9.8) followed by LCOT (9.6) and minimum in WCT x COD and AO (8.4). However, the variation in production of inflorescence was found to be non significant. The male and female phases (days) were in the range of 19 to 22 and 2.4 to 7.0, respectively. The number of female flowers was maximum in variety LCOT (417.2) followed by PHOT (378) and lowest production was in SSG (285.1). The setting percentage was found maximum in cultivar COD x WCT (45.97) followed by LCM (44.03) and minimum in LCOT (29.63) .The nut yield was the highest in COD x WCT (70) followed by WCT x GB (65).

Table 25: Yield attributing characters and yield of promising seed materials (Jagadalpur, 2005)

Sl. No	No.of functional leaves/palm	Annual leaves production rate/year	No. of inflorescence/	palm No.of female	flowers/palm Setting	percentage Annual nut yield/ palm
1	26	12.2	8.4	302.8	41.07	63
2	26	11.2	9.0	317.3	42.50	65
3	29	13.6	9.8	325.9	45.97	70
4	27	12.4	9.0	300.8	40.90	57
5	26	11.8	8.6	300.9	44.03	57
6	25	13.6	8.4	309.0	43.10	60
7	24	11.2	9.2	285.1	38.40	56
8	28	10.4	9.0	378.0	43.70	62
9	27	11.2	9.6	417.2	29.63	61
CD(P=0.05)	-	-	NS	NS	NS	NS

COCONUT
3.2 Crop Production

Agr. 2: Nutritional requirement of hybrid coconut

(Arsikere, Mondouri, Ratnagiri)

The experiment was continued in three centres to assess the performance of D x T palms under graded levels of NPK fertilizer under varying soil conditions. The treatments consist of all possible combinations of three levels each of N, P and K

N(g/palm/year)	P(g/palm/year)	K(g/palm/year)
0	0	0
500	250	1000
1000	500	2000

Design : 3^3 Factorial Confounded
Replications : 2
Number of blocks/replication: 3
Number of palms/plot : 6

Arsikere

The experiment was laid out during 1994 to assess the performance of D x T palms (COD x WCT) under graded levels of NPK. The yield data is presented in Table 26.

Table 26: Effect of NPK on nut yield (Arsikere, 2005)

Fertilizer level (g/palm/year)	Coconut yield (nuts/palm/year)	
	2004 - 05	Mean (12 years)
1. Nitrogen		
N_0 : 0	18.8	24.7
N_1 : 500	19.5	25.4
N_2 : 1000	21.9	27.0
2. Phosphorous		
P_0 : 0	18.3	24.0
P_1 : 250	21.8	27.4
P_2 : 500	20.1	25.7
3. Potassium		
K_0 : 0	18.4	23.8
K_1 : 1000	21.3	26.4
K_2 : 2000	20.4	26.7

The coconut yeild during 2004-05 was the highest with the application of 1000 N, 250 P_2O_5, 1000 K_2O g /palm / year.

However, mean yield over 12 years was the highest with the application of 1000 N, 250 P_2O_5, 2000 K_2O g/palm/year.

Ratnagiri

The experiment has been completed during 2005 and the summary of final report is presented here.

a) Yield:

i. Application of $N_2P_2K_2$ combination (1000 g N + 500 g P_2O_5 + 2000 g K_2O /palm/year) recorded the maximum net profit and proved to be the best among the fertilizer treatment combinations tried for both on total yield and economic consideration and hence this dose could be recommended for adult COD x WCT coconut hybrid.

ii. The main effect of N was significant for nut yield during 1997 – 98 to 1999 – 2000. However, for initial three years prior to this, the response of N was found to be non significant. Effect of P and K also was not significant on annual yield. However, the response was incremental in all the NPK levels. The interaction effects were not significant. N_2K_2, N_1K_2 and N_2K_1 combinations recorded the highest annual yield.

iii. Cumulative yield data on number of nuts for the period from 1990 to 2004 showed that the yield significantly increased in incremental fashion with respect to applied N. The effect of P and K was not significant on cumulative nut yield though the yield was increasing with increase in doses.

iv. The $N_2P_2K_2$ treatment combination recorded maximum mean cumulative yield (117 nuts/palm/year) followed by $N_2P_0K_1$ (99 nuts) and $N_1P_1K_2$ (98 nuts) and minimum in $N_0P_0K_0$ (49 nuts).

v. Application of NPK fertilizers influenced the vegetative and reproductive characters which resulted in higher yield. $N_0P_0K_0$ treatment combination recorded an average of 26.16 number of fronds on the crown. Rate of frond production was 13.16, rate of inflorescence production was 10.91 and number of female flowers/palm/year was 138.56 which resulted in the lowest yield per palm per year (49 nuts). Whereas in the treatment combination $N_2P_2K_2$, the total number of fronds on the crown was 34.66, rate of frond production was 16.58, rate of inflorescence production was 15.50 and total number of female flowers produced/palm /year was 555.85 which resulted in high yield (117 nuts).

vi. Copra production per palm (kg) and per hectare (t) were significantly influenced by N and K fertilizers application. The effect of NPK was found to be incremental on copra production per palm (kg) and per hectare (t). The interaction effects were not significant in copra production. However, maximum copra per palm (20.38 kg) and per hectare (3.57 t) was obtained from N_2K_2 combination.

vii. Oil production per palm (kg) and per hectare (t) were significantly influenced by N and K fertilizers application. The effect of NPK was incremental in fashion.

viii. Total number of leaves on the crown and number of inflorescences produced per palm per year were significantly and positively correlated with yield.

b) Button shedding and fruit setting percentage :

i. Button shedding was maximum in 1st month (31.73 to 35.09 %) followed by 2nd month (20.22 to 20.74 %) which further decreased in 3rd month (7.89 to 9.82 %), 4th month (3.46 to 3.76 %) and 5th month (0.99 to 1.12 %) during the study period.

ii. Nitrogen at higher level significantly reduced the button shedding. The main effect of P and K was not significant; however, higher doses P and K reduced the button shedding.

iii. An apparent increase in setting percentage was observed for N and K. However, the response to P was negative.

c) Soil analysis :

i. Soil analysis for nutrient status in the soil was done at three depths viz. 0 to 25, 25 to 50 and 50 to 100 cm.

ii. The data revealed that continuous application of NPK fertilisers significantly influenced the nitrogen (ppm) up to 25 cm depth. Below the 25 cm depth, no significant difference in soil nitrogen due to NPK fertilizers was observed.

iii. The soil P was significantly influenced by P fertilizer application up to 0 – 25 cm depth.

iv. Continuous application of K fertilizers significantly increased the potassium in all the three depths and also NK interaction was found to be significant for K content of soil.

d) Foliar analysis:

i The N content of the leaves was found to be 1.53, 1.66 and 1.77 per cent respectively for N_0, N_1 and N_2 levels of applied nitrogen. N content increased with increase in applied P and K.

ii There was no significant response to N, P and K application for leaf phosphorus.

iii The K content in the leaf steadily increased with incremental levels of K but not with N or P. Moreover, applied N depressed the leaf content of K. The K content in the leaves ranged between 0.86 to 1.07 percent due to applied K.

iv The correlation between yield and leaf N was not significant though a positive trend was observed. Similar results were also observed for leaf P and K.

Effect of graded levels of NPK on yield ($N_2P_2K_2$ treatment)

Agr. 3: Coconut based high density multispecies cropping system

(Ratnagiri)

Ratnagiri

The experiment was closed during 2005 and the summary of conclusions drawn from the trial is presented here.

1. The excellent growth, good bearing capacity and the positive effect of spice crops viz. cinnamon, nutmeg, pepper and clove planted in coconut gardens as mixed crops proved that these crops could be cultivated commercially in the Konkan region of Maharashtra.
2. The yield of coconut gradually increased over a period after planting the mixed crops irrespective of the crop block. The maximum increase in yield was recorded in clove block (96%), followed by allspice (90%), cinnamon (71%) and nutmeg (69%) blocks.
3. All the blocks recorded higher net returns than the sole crop of coconut. Block with nutmeg recorded the highest net profit of Rs. 93,578/- per ha, followed by kokum block (Rs. 55,493/- per ha.), cinnamon block (Rs. 54,428/- per ha.) and black pepper block (Rs. 50,900/per ha.).Coconut mono crop recorded a net profit of Rs. 25987/- per ha.
4. The coconut sole cropping gave a benefit cost ratio of only 1.47. However the ratio was 2.08 in nutmeg, 1.68 in kokum, 1.65 in cinnamon and 1.64 in black pepper which were quite higher.
5. Adoption of coconut based spices mixed cropping system could provide an additional employment over sole crop of coconut. The maximum employment generation over coconut sole crop was recorded with coconut + nutmeg (117mandays/ha), followed by coconut + cinnamon (102mandays/ha.) while other spice mixed crops recorded less employment generation (46 to 84 mandays/ha).
6. On the basis of mixed cropping experiment on spice crops, the University has formulated the 'Lakhi Baug' concept i.e. mixed cropping of spices, particularly cinnamon, nutmeg and black pepper in the coconut orchards. From 0.40 ha of this kind of planting system, farmer can get one lakh rupees profit & hence it is named as 'Lakhi Baug' which includes Model-I , Model- II and Model-III.
7. The biomass production was maximum in coconut (5 t/ha.) followed by nutmeg (4.11 t/ha.) whereas it was minimum in black pepper (0.21t/ha.), with 2.61 t/ha. for coconut alone followed by nutmeg 1.46 t/ha.
8. The coconut leaf vermicomposting technology to recycle wastes was developed. The earthworm spp E. *euginae* proved efficient in transforming the bulky mass of wastes into granular compost of superior quality.
9. A considerable amount of nutrients was recycled through converting of coconut wastes thereby utilizing on farm waste effectively that would have been used for different purposes. On an average 43.62 kg of N, 9.64 kg of P, 30.13 kg of K, 21.81 kg of Ca and 16.56 kg of Mg per ha was recycled back into the system by the simple and effective technology of vermicomposting.
10. Substitution of nutrients could be achieved through organic recycling to an extent of 33% N, 3.67 % P and 22.96 % K in coconut and 20-40 % N, 2-7 % P and 20-67% K in spices.
11. The addition of organic matter through recycling of wastes generated in the various system as well as mineral nutrient supplementation through organic sources had a positive impact on the phosphorous, potassium, calcium and copper availability in the soil. Though there was no significant increase in nitrogen, magnesium, iron, manganese and zinc, the nutrient availability was neither suppressed nor decreased below the initial soil status.
12. Regarding plant nutrient changes, it was observed that due to the various treatments and organic nutrient applications, the plant nutrient contents were in adequate level.

"Lakhi Baug" garden

Agr. 3A: Coconut based cropping system- Second generation experiments

(Arsikere, Bhubaneshwar, Kahikuchi, Mondouri, Ratnagiri, Veppankulam)

Arsikere

This experiment was laid out during 2001 in RBD with four replications in 40 years old coconut garden to evolve suitable intercropping systems for coconut gardens. There are 5 treatments and details are as follows.

T_1 - Coconut + Banana
T_2 - Coconut + Drumstick
T_3 – Coconut + French bean +Ladies finger (Bhendi)
T_4 – Coconut + Redgram
T_5 – Coconut alone (Control).

The mean data over four years indicated that the coconut yield was higher with banana compared to other intercrops (Table 27). The returns computed based on mean data of coconut and intercrop yields for four years indicated that the gross returns were higher when banana was intercropped with coconut followed by drumstick, french bean- ladies finger and redgram. Gross returns were the least in pure crop of coconut.

A high yielding drumstick plant in the HDMSCS plot at Arsikere

Table 27: Yield of coconut and intercrops in HDMS cropping system (Arsikere, 2005)

	Treatment	Mean nut yield/ha (2001-02 to 2004-05)	Intercrop yield (kg/ha)		Gross returns (Rs/ha)
			Ist intercrop	IInd intercrop	
1	Coconut + Banana	**7695**	**3219**	**-**	**77103**
2	Coconut + Drumstick	7048	1956	-	58712
3	Coconut + French bean – Ladies finger (Bhendi)	7270	1180	1001	58160
4	Coconut + Redgram	6950	827	-	47155
5	Coconut alone (Control)	5912	0	-	29560

Bhubaneshwar

The experiment was planted during December, 2003 at Bhubaneshwar campus as per the decisions made in the workshop. The data on growth parameters of coconut is given in Table 28. Annual moringa had to be replaced by custard apple with other component crops remaining the same. The palms in T_2 recorded maximum height, where as the palms in T_1 recorded higher girth.

Table 28: Growth characters of coconut palms in high density multispecies cropping system (Bhubaneshwar, 2005)

Treatment	Height (cm)	Girth (cm)	Leaves on the crown	Leaves produced / year
T.1 Coconut (control)	66.5	**16.5**	8.5	7.5
T.2 Coconut + Banana + Bhindi	**74.3**	15.6	8.8	7.8
T.3 Coconut + Banana + Tuberose	57.0	16.2	**9.2**	**7.9**
T.4 Coconut + Moringa + Sweet potato	60.2	15.2	8.6	6.4
T.5 Coconut + Moringa + Pumpkin	60.0	16.0	8.8	7.3
T.6 Coconut + Pineapple + Groundnut	65.7	15.8	9.0	6.5
T.7 Coconut + Pineapple + Colocasia	63.2	16.0	**9.2**	7.2

Kahikuchi

The experiment was laid out with six intercrops replicated four times during April 2002 in a twenty eight year old coconut plantation cv. Assam Tall with black pepper var. Panniyur-1(6- years-old). Each intercrop was grown in the interspaces surrounding three adult coconut palms (118.5 $m^{2)}$. The intercrops were: T_1 – Ginger (var. Nadia), T_2 – Turmeric (var. Prabha), T_3 – Perennial brinjal (var. Kuchia), T_4- Banana (var. Chenichampa), T_5 – Pineapple (var. Kew) and T6 – Control (coconut + blackpepper).

The yield of base crop (coconut) and yield data of harvested intercrops are presented in Table 29. It is seen that the highest net return per ha (Rs. 1,13,048) was recorded under coconut-blackpepper-turmeric cropping system followed by coconut-blackpepper-ginger(Rs. 72,745) intercropping. The lowest net return of Rs 46,440 was obtained in the control plot (coconut-blackpepper).

Per cent increase in nut yield over pre experimental yield revealed that the highest increase in nut yield (9.0%) was recorded in turmeric plot as compared to 4.6% under control plot.

Table 29: Yield of base crop, intercrops and their returns (Kahikuchi, 2005)

Crop components	Yield of coconut		Yield of black pepper (g) (dry)		Yield of inter crops (kg/plot)	Projected gross return/ ha (Rs.) Projected	net return/ha (Rs.)
	Nuts/palm/ year	Nut/plot/ year	kg/vine	kg/plot			
Coconut (3) Blackpepper (3) Ginger (var.Nadia)	64	192	0.25	0.75	148	1,42,895	72,745
Coconut (3) Blackpepper (3) Turmeric (var.Prabha)	67	201	0.30	0.90	309	1,86,548	1,13,048
Coconut (3) Blackpepper (3) Brinjal (var. Kuchia) (Perennial)	65	195	0.30	0.90	132	1,35,097	61,897
Coconut (3) Blackpepper (3) Banana (var. Chenichampa) (20)	53	159	0.25	0.75	260	1,23,519	55,319
Coconut (3) Blackpepper (3) Pineapple (var.Kew)	48	144	0.26	0.78	220	1,07,864	47,739
Coconut (3) Blackpepper (3) Control	49	147	0.24	0.72	-	61,940	46,440

Sale price of commodities: Coconut @ Rs. 4.50/nut, Black pepper @ Rs. 100/kg(dry), Ginger @ Rs. 10.00/kg, Turmeric @ Rs. 7/ kg, Perennial Brinjal @ Rs. 10/ kg, Banana @ Rs. 5/kg, Pineapple @ Rs. 5./kg.

Analysis of nutrients (NPK) under different intercrops showed that there was slight increase in soil pH in the coconut basins over the initial level under all the inter crops as compared to control (Table 30).

Macronutrients especially NPK levels increased moderately over pre experimental levels under all the intercrops with highest being recorded in the basin under turmeric plot.

Table 30: Initial and present nutrient status of soil under different intercrops (Kahikuchi, 2005)

Inter crop	pH		N(kg/ha)		P_2O_5(kg/ha)		K_2O(kg/ha)	
	Initial	Present	Initial	Present	Initial	Present	Initial	Present
Ginger	5.0	5.4	265.0	268.0	20.5	22.1	127.0	128.2
Turmeric	4.9	5.2	261.0	284.0	21.7	28.0	125.0	142.6
Brinjal	4.8	5.3	267.0	271.0	20.0	21.6	126.5	132.0
Banana	5.0	5.5	268.5	277.6	21.6	25.0	128.0	135.1
Pineapple	4.8	5.2	263.0	270.0	19.5	23.1	123.8	129.4
Control	4.9	5.0	264.0	264.5	20.0	21.0	125.5	126.0

Mondouri

The experiment was started during 2003 with six crop models including one control.

Model I : coconut, black pepper and guava
Model II : coconut, black pepper and lime
Model III : coconut, black pepper and lemon
Model IV : coconut, black pepper and banana
Model V : coconut, black pepper and pineapple
Model VI : monocrop of coconut (control).

The fruit plants under each model were planted at the center of each 4 palms. The model wise nut yield/ palm as well as the data on yield of different intercrops are presented in the Table 31. Maximum nut yield (13650 nuts/ha) was recorded under Model III as compared to control (11200 nuts/ha).

Table 31: Yield of coconut and inter crops under coconut based cropping systems (Mondouri, 2005)

Model	Intercrop	Intercrop yield (t/ha)	Coconutyield/ha
Model I	Guava	1.2	13125
Model II	Lime	0.7	13475
Model III	Lemon	0.6	13650
Model IV	Banana	4.2	11900
Model V	Pineapple	10.0	12600
Model VI	-	-	11200

Ratnagiri

The experiment was laid out in June, 2004 with five intercrops viz., banana, pineapple, ginger, turmeric and tapioca with coconut as main crop in an RBD with 4 replications. The plot size is 6 coconut palms.

Harvesting of ginger, turmeric aand tapioca have been completed. Turmeric recorded the highest yield of 175 quintals/ha followed by tapioca (105 quintals/ha.) and ginger (104 quintals/ha).

Turmeric inter cropping in coconut garden (Ratnagiri)

Ginger intercropping in coconut garden (Ratnagri)

Veppankulam

The second generation experiment was laid out during June, 2003 with seven models and one control (coconut monocropping). The yield obtained from intercrops are given in Table 32.

Table 32: Yield of intercrops in coconut based cropping systems (Veppankulam, 2005)

Model	Component crops	Variety & Population	Economic yield (kg)		
			I crop	II crop	Mean
I Mono crop	-	-	-	-	-
II Coconut + black pepper + banana	Banana	Monthan (1050/ha)	18,900	17,430	18,165
III Coconut + black pepper + banana + bhendi or brinjal	Banana	Monthan (350/ha)	5,600	5,775	5,688
	Bhendi	Anamica (0.5/ha)	4,854	4,425	4,427
		Arka (0.5/ha)	4,325	4,105	
	Brinjal	PLR 1 (0.5/ha)	6,412	-	6,412
IV Coconut + black pepper + banana + elephant foot yam/greens	Banana	Monthan (350/ha)	5,880	-	5,880
	Yam	Local (0.5/ha)	10,000	9,113	9,557
	Amaranthus	Local (0.5/ha)	2,150	-	2,150
V Coconut + black pepper + banana + turmeric/greens	Banana	Monthan (350/ha)	5,390	-	5,390
	Turmeric	BSR-2 (0.5/ha)	8,880	8,625	8,753
	Amaranthus	Local (0.5/ha)	2,400	1,950	2,175
VI Coconut + black pepper + banana + pineapple	Banana	Monthan (350/ha)	5,530	-	5,530
	Pineapple	Mauritius (0.5/ha)	7,400	-	7,400
VII Coconut + black pepper + banana + tapioca	Banana	Monthan (350/ha)	5,921	-	5,921
	Tapioca	Co-2 (0.5/ha)	4,160	5,000	4,580
VIII Coconut + black pepper + banana + ginger	Banana	Monthan (350/ha)	4,923	-	4,923
	Ginger	Local (0.5/ha)	1,031	1,313	1,172

The nut yield during pre-treatment (1998 – 2003) and 2004 – 05 and the nutrient status during pre-treatment and after two years (June, 2005) are furnished in Table 33.

Table 33: Nut yield and nutrient status of soil in multiple cropping systems (Veppankulam, 2005)

Model	Nut yield /palm/year			Available nutrients (kg/ha)					
	Pre-treatment (1998 -	2003)	2003 - 04	2004 - 05		N		P	
				K Pre-	treatment	2nd year Pre-	treatment	2nd year Pre-	treatment 2nd year
I Mono crop	88	84	96	260	265	7.3	7.7	121	126
II Coconut + black pepper + banana	98	97	105	252	261	6.8	7.7	115	124
III Coconut + black pepper + banana + bhendi	91	95	111	270	278	7.2	8.0	124	135
IV Coconut + black pepper + banana + elephant foot yam/ greens	70	74	86	243	253	6.3	7.2	116	124
V Coconut + black pepper + banana + turmeric/greens	69	60	68	263	271	6.4	7.3	128	135
VI Coconut + black pepper + banana + pineapple	96	90	103	253	260	6.9	7.3	131	136
VII Coconut + black pepper + banana + tapioca	59	55	62	265	274	7.2	7.8	127	134
VIII Coconut + black pepper + banana + ginger	120	140	147	267	273	7.1	7.5	131	136

Agr. 3B: Performance of medicinal and aromatic plants in coconut gardens

(Aliyarnagar, Arsikere, Ambajipeta, Bhubaneshwar, Jagadalpur, Kahikuchi, Mondouri, Ratnagiri, Veppankulam)

Aliyarnagar

A survey on the cultivation of medicinal and aromatic plants in Pollachi region was conducted. A total number of 15 medicinal and aromatic plants were selected and an observational trial was laid out on 16.06.2005 in a farmer's field with these plants. The market potential and availability of planting material were studied.

Among the seven crops harvested, Siriyanangai recorded 363 kg/ha followed by Lemon grass (287 kg/ha) and Patchouli (248 kg/ha).

Ambajipeta

Observational trial was conducted during 2005-06 and the performance of 12 medicinal plants and four aromatic crops were found satisfactory in the coconut gardens.

Bhubaneshwar

The observational trial was laid out during September, 2004 in a farmer's field with 15 species of medicinal and aromatic plants. Out of the 15 species tried, five medicinal & aromatic plants viz., *Arternisia pallens, Alpinia galangal, Pogostemon patchouli, Eclipta alba* and *Stevia rebudiana* were selected for further trials.

Kahikuchi

A survey on the cultivation of medicinal and aromatic plants in the potential areas of the region was done. Based on the survey, fifteen important medicinal and aromatic plants having market potential were selected for an observational trial under coconut garden. After completion of one year, five promising types of medicinal and aromatic plants were selected for conducting a full-fledged trial under coconut garden taking three palms per treatment in a randomized block design replicated four times. The species selected for the trial are: Citronella (*Cymbopogon winterianus*), Pipali (*Piper longum*), Vedailota (*Paederia foetida*), Patchouli (*Pogostemon cablin*) and Madhu shaleng (*Deeringia amranthoides*).

Mondouri

The survey on the cultivation of medicinal and aromatic plants with their market potential in different districts of West Bengal has been conducted. Based on the survey, fifteen important species of medicinal and aromatic plants having economic potential has been selected and laying out of an observational trial with fifteen species (Aswagandha, Sarpogandha, Vashaka, Kalmegh, Bach, Tulshi, Vringaraj, Senna, Stevia, Brahmi, Arrowroot, Aloe, Catharanthus, Mentha and Thankuni) has been completed. The crops were performing satisfactorily.

Ratnagiri

An observational trial with 15 species of medicinal plants was planted in June – July, 2004 with a plot size of 6 coconut trees. On the basis of yield data, Ranwangi, Adulasa, Sadafuli, Gavati Chaha and Citronella are performing well and therefore these medicinal plants will be included in the new experiment.

Wala (*Vetiveria zizanoides* Linn. Nash)

Gavati Chaha (*Cymbopogum citratus*)

Citronella *(Cymbopogon winterianus)*

Veppankulam

The observational trial was initiated during June, 2004. Seventeen medicinal crops and three aromatic crops were raised and the economic yield was recorded. The performance of medicinal and aromatic plants as pure crop and intercrop in coconut garden was compared. Among the 17 medicinal plants, 9 recorded more than 70% yield to that of pure crop. All the three aromatic plants registered more than 70% yield to that of pure crops. Based on the yield performance and marketing potential, five medicinal crops *viz., Centella asiatica, Andrographis paniculata, Aloe vera, Ocimum sanctum, Alpinia galanga* and three aromatic crops *viz., Vetiveria zizanoides, Cymbopogan flexuosus* and *Pogestemon patchouli* were selected for further studies.

Agr. 5 : Drip irrigation experiment in coconut

(Aliyarnagar, Arsikere, Ratnagiri)

In all the centres, the experiment was laid out in a RBD with four replications. The experiment was initiated during 1992. The treatments are as follows:

I_1 – No irrigation (life saving)

I_2 - Drip irrigation at 33% Pan evaporation (Eo)

I_3 - Drip irrigation at 66% Eo

I_4 - Drip irrigation at 100% Eo

I_5 - Basin irrigation at IW/CPE ratio of 1.0 at 4 cm depth

Aliyarnagar

Drip irrigation equal to 100% Eo and basin irrigation at IW/CPE ratio of 1.0 at 4 cm depth recorded higher annual leaf production of 12.2 and 11.8. Lowest level of leaf production was recorded with no irrigation (Table 34).

Drip irrigation equal to 100% Eo and basin irrigation at IW/CPE ratio of 1.0 recorded 12.1 and 12.2 bunches/palm/year. Drip irrigation equal to 66% Eo has recorded 10.0 bunches/palm/year. No irrigation level has recorded lowest number of bunches/palm/year (7.8).

Drip irrigation equal to 100% Eo and basin irrigation have recorded maximum nut yield of 145 and 143 nuts/palm/year. Drip irrigation equal to 66% Eo recorded a yield of 123 nuts/palm/year. No irrigation level has recorded a yield of 84 nuts/palm/year. When the average yield of last 8 years (1997-98 to 2004-05) was considered, drip irrigation equal to 100% Eo and basin irrigation recorded nut yield of 151 and 149 nuts/palm/year respectively.

Drip irrigation equal to 100% Eo and basin irrigation recorded maximum net income of Rs.60394 and Rs.58394 respectively. The same treatments recorded benefit cost ratio of Rs.2.41 and 2.40 respectively.

Table 34 : Yield performance under drip irrigation treatments(Aliyarnagar, 2005)

Treatment	Annual leaf production	Number of bunches/ palm/year	Nut yield/palm (2004-05)	Net income (Rs/ha)	Benefit cost ratio
1. No irrigation	10.7	7.8	84	29788	2.02
2. Drip irrigation at 33% Eo	11.1	8.9	100	31470	1.81
3. Drip irrigation at 66% Eo	11.8	10.0	123	45814	2.13
4. Drip irrigation at 100% Eo	12.2	12.1	145	60394	2.41
5. Basin irrigation	11.8	12.2	143	58394	2.40
CV(%)	4.9	9.8	18.2		
CD (P=0.05)	0.6	1.1	23		

Arsikere

The experiment was revised during 1999 and laid out in 25 years old garden of Tiptur Tall. The quantity of water given through drip system was based on the 10 years average of mean monthly evaporation. The pan evaporation was the highest during the month of April (7.37 mm/day) and requires 75 litres/day/palm under 100% Eo level, while the pan evaporation was lowest during December (4.39 mm/day) and requires 45 litres/day/palm.

The coconut yield during 2004-05 was the highest in the treatment providing drip irrigation @ 100 % Eo which was on par with basin irrigation @ IW / CPE =1.0 Similarly, the mean coconut yield over last 7 years was also the highest in the treatment providing drip irrigation @ 100 % Eo. (Table 35)

Table 35 : Effect of drip irrigation on coconut yield (Arsikere, 2005)

Treatment	Nut yield /palm	Mean yield/ ha (7 years)	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)	B:C ratio
1. No irrigation (Control)	30.4	5603	28015	11335	16680	2.47
2. Drip irrigation @ 33% Eo	38.9	7715	38575	15845	22730	2.43
3. Drip irrigation @ 66 % Eo	47.6	8497	42485	15745	26740	2.70
4. Drip irrigation @ 100% Eo	48.9	9527	47635	15645	31990	3.04
5. Basin irrigation	47.1	9067	45335	17095	28240	2.65
S. Em ±	2.5					
CD(P=0.05)	7.8					

The net returns were higher with drip irrigation or basin irrigation compared to no irrigation level. Similarly, B:C ratio was also higher with drip irrigation or basin irrigation except drip irrigation @ 33 % Eo. The cost of production was higher with basin irrigation compared to drip irrigation, as the labour requirement for basin irrigation is much higher than drip irrigation. Even the cost of drip installation to coconut was compensated over the years by less labour required for drip irrigation as compared to basin irrigation.

Ratnagiri

The experiment was laid out on 36 years old WCT garden grown in sandy soil during 1992. Analysis of data collected from the trial indicated that there was significant difference in the yield of coconut under different treatments during 1997-98 to 2004-05 and mean cumulative yield of eight years (1997-2005) (Table 36). In the year 2004-05, treatments I_2, I_3, I_4 and I_5 recorded significantly higher yield over no irrigation though within themselves they were on par with each other.

The mean cumulative yield data for last eight years (1997-2005) showed that palms under basin irrigation treatment recorded per palm yield of 93 nuts which was significantly higher than the treatments I_1, I_2 and I_3 and at par with drip irrigation at 100% Eo treatment (86 nuts/ palm).

Table 36 : Effect of drip irrigation on yield of coconut(Ratnagiri, 2005)

Sl. No.	Treatment	Mean nut yield/palm (2004-05)	Cumulative mean nut yield/ palm/ year (1997-98 to 2004-	05) Total water applied per	palm (lit.) WUE (Nuts/	ha. -lit.) Total returns	per ha. (Rs.) Net profit per ha. (Rs.)
1.	No irrigation (I_1)	70	62	-	-	65100	16344
2.	Drip irrigation at 33% Eo. (I_2)	87	78	3505	3.09	81900	22966
3.	Drip irrigation at 66% Eo. (I_3)	87	79	7009	1.97	82950	23840
4.	Drip irrigation at 100% Eo. (I_4)	90	86	10524	1.43	90300	31050
5.	Basin irrigation at IW/CPE ratio =1 (I_5)	103	93	12260	1.33	97650	22250
	SE	6.17	4.35				
	CD(P=0.05)	19.03	13.11				

The data regarding total water applied per palm and economics of the different irrigation treatments revealed that the maximum water was applied in basin irrigation treatment (12260 lit.) followed by drip irrigation at 100% Eo (10524 lit) and drip irrigation at 66% Eo (7009 lit.). The maximum net return was recorded in drip irrigation at 100% Eo (Rs. 31050/-) followed by drip irrigation at 66% Eo. (Rs. 23840/-)

Agr.7: Integrated nutrient management in coconut

(Aliyarnagar, Ambajipeta, Arsikere, Bhubaneshwar, Mondouri, Ratnagiri, Veppankulam)

The objective of this experiment is to evolve appropriate technology to supplement chemical fertilizers with organics as a source of nutrients. The study also aims at recycling of plantation crop wastes such as coir pith and farm compost as source of nutrients. The experiment was started in 1996 on adult palms in seven coordinating centres, in a RBD with 4 replications. The treatments consist of :

T_1 - Control (No fertlisers/Farmers' practice from 1999-2000)

T_2 - Recommended dose of chemical fertilizers (500:320:1200g N, P_2O_5, K_2O/palm/year)

T_3 - Composted coir pith (on equivalent nitrogen basis + balance amount of P & K)

T_4 - 50 % N as CCP + balance NPK as fertilizers

T_5 - Neem cake + bone meal + ash (on equivalent nutrient basis)

Aliyarnagar

The trial was laid out in a farmer's field in a twenty year old coconut garden. The design adopted was a RBD with four replications. Required quantities of materials for the treatments from 2-5 were applied on equivalent nutrient basis and the results are presented in Table 37.

Table 37 : Effect of integrated nutrient management in coconut (Aliyarnagar, 2005)

Sl. No.	Treatment	Pre-treatment	yield/palm Nut yield/ palm	(2004-05) Mean nut yield/ palm	(6 years) Net income/ha	(Rs.) Benefit cost ratio
1	Control (Farmers' practice)	114	142	155	55640	2.16
2	Recommended dose of fertilizers (500:320:1200g N P_2O_5, K_2O/ palm/year)	129	118	136	40730	1.87
3	Composted coir pith (on equivalent nitrogen basis + balance amount of P & K as fertilisers)	127	149	160	62340	2.39
4	50 % N as CCP + balance NPK as fertilizers	123	154	158	62036	2.35
5	Neem cake + bone meal + ash (on equivalent nutrient basis)	128	120	134	28990	1.50
	CV (%)		10.6			
	CD (P=0.05)	NS	22			

Ambajipeta

The observations on vegetative growth, nut yield and nut characters (nut quality) were recorded. Data on vegetative characters revealed that the differences in total leaf number/crown were non-significant, while the differences in leaf production/year, number of spadices/palm/year and number of female flowers/spadix were significant. The highest rate of leaf production/palm was registered in T_4 (14.08) followed by T_3 (13.98) and the lowest in T_1 (11.28), while the maximum spadices/palm was recorded in T_4 (13.58) followed by T_2 (13.34). Significantly higher number of female flowers/spadix was produced by T_4 (266.68) followed by T_2 (266.46) during 2005-06. Thus, T_4 resulted in maximum leaf production per year/palm, spadices per palm and female flowers per spadix. The yield details are presented in Table 38.

Table 38: Effect of integrated nutrient management in coconut (Ambajipeta, 2005)

Treatment		Pre treatment nut yield	Mean nut yield/palm (2004-05)	Mean nut yields/palm (2005-06)
T_1	Control (Farmers' practice)	61.23	67.56	46.24
T_2	Recommended dose of fertilizers (500:320:1200g N P_2O_5, K_2O/palm/year)	73.57	132.84	124.78
T_3	Composted coir pith (on equivalent nitrogen basis + balance amount of P & K as fertilisers)	77.46	138.45	126.43
T_4	50 % N as CCP + balance NPK as fertilizers	63.64	154.78	131.05
T_5	Neem cake + bone meal + ash (on equivalent nutrient basis)	60.23	84.80	66.87
CD (P=0.05)		12.56	13.84	—

As regards yield, it was observed from Table 38 that the highest nut yield per palm was recorded by T_4 and T_3 during 2004-05 (154.78 and 138.45 nuts/palm) and by T_4 and T_2 during 2005-06. There was a significant increase in yield when compared to the pre-treatment yield as affected by integrated nutrient management treatments.

Data regarding nut quality characters revealed that T_4 recorded higher whole nut weight (1077.24 gm) while T_4 and T_2 recorded lower husk content. With regard to copra content/nut, T_3 (154.15g), T_4 (143.56g)and T_2 (143.17g) registered higher copra content compared to control. T_4, T_3 and T_2 produced nuts with considerably higher water content and meat content. The highest copra content/palm was recorded in T_4 (19.78 kg/palm) and T_3 (9.86 kg/palm).

Arsikere

The experiment was started in 1996 on adult coconut palms with five treatments laid out in RBD with four replications with the objective to evolve appropriate technology to supplement chemical fertilizers with organics as a source of nutrients. The study also aims at recycling of coconut waste such as coir pith as a source of nutrients.

The INM practices gave higher coconut yield compared to control and recommended dose of NPK through fertilizers (Table 39).

Table 39: Effect of INM practices on coconut yield(Arsikere, 2005)

Sl. No.	Treatment	Coconut yield (nuts/ palm/ year) 2004-05	Mean nut yield/ha (7 years)	Gross returns (Rs /ha)	Cost of cultivation (Rs./ha)	Net returns (Rs/ ha)	B:C ratio
1	Control (Farmers' practice)	38.6	5815	29075	11025	18050	2.64
2	RDF-Recommended dose of fertilizers (500:320:1200g N, P_2O_5, K_2O/palm/year)	50.8	7331	36655	14335	22320	2.56
3	Composted coir pith (on equivalent nitrogen basis + balance amount of P & K)	55.9	8454	42270	13725	28545	3.08
4	50 % N as CCP + balance NPK as fertilizers	59.4	8219	41095	14025	27070	2.93
5	Neem cake + bone meal + ash (on equivalent nutrient basis)	59.7	8501	42505	18525	23980	2.29
	S. Em ±	2.9					
	CD (P=0.05)	9.1					

Bhubaneshwar

The experiment was taken up in a farmer's field during June 2004 and the treatments were given from July, 2004 after recording the initial growth and yield data. The treatment T_4 produced the highest number of functional leaves, number of spadices and highest nut yield.

Mondouri

The trial was taken up during 1996-97 on coconut seedlings as per technical programme. The growth parameters were recorded periodically. Application of recommended dose of chemical fertilizers registered maximum height and number of leaves at 59.3 cm and 13.6 per palm respectively (Table 40). Palms under control recorded lowest height (49.6 cm) and number of leaves (11.3). Maximum number of nuts/palm/year (30) was recorded under recommended dose of chemical fertilizers.

Table 40 : Mean growth and yield characters of coconut (Mondouri, 2005)

Treatment	Stem height (cm)	Number of leaves/palm	Nut yield/palm
1. Control (/Farmers' practice)	49.6	11.3	18
2. Recommended dose of fertilizers (500:320:1200g N, P_2O_5, K_2O/palm/year)	59.3	13.6	30
3. Composted coir pith (on equivalent nitrogen basis + balance amount of P & K)	51.6	12.3	21
4. 50 % N as CCP + balance NPK as fertilizers	57.3	13.3	25
5. Neem cake + bone meal + ash (on equal nutrient basis)	53.3	12.3	22

Ratnagiri

The experiment was laid out in 42 years old WCT palms in sandy soil, during 1998. The yield data recorded during 1998-99 to 2000-05 (Table 41) revealed that during the transit period 1998-99 to 2000-01, no significant variation in nut yield was observed among the treatments. Since 2001-02, treatments started showing statistically significant differences in the yield. In the year 2004-05, T_2 recorded significantly higher yield over the treatment T_1, but it was at par with T_3, T_4 and T_5. As regards mean cumulative yield (2001-02 to 2004-05), treatments T_2 and T_3 recorded significantly higher nut yield over T_1, T_5 and was at par with each other along with T_4 treatment. The T_2 treatment of recommended NPK dose of fertilizers recorded the highest mean cumulative nut yield (96.00).

Table 41: Effect of INM practices on coconut yield (Ratnagiri, 2005).

Sl. No.	Treatment	Mean cumulative yield/palm/year during post treatment period				
		Post treatment period				Mean cumulative yield/ palm/year (2001-02 to 2004-05)
		2001-02	2002- 03	2003-04	2004-05	
1.	Control (Farmers' practice)	58.35	58.19	57.00	54.00	57.00
2.	Recommended dose of fertilizers (500:320:1200g N, P_2O_5, K_2O/palm/year)	97.10	100.65	96.00	96.00	96.00
3.	Composted coir pith (on equivalent nitrogen basis + balance amount of P & K)	93.75	89.50	97.00	92.00	93.00
4.	50 % N as CCP + balance NPK as fertilizers	90.85	76.60	70.00	92.00	81.00
5.	Neem cake + bone meal + ash (on equivalent nutrient basis)	68.35	68.26	74.00	79.00	72.00
SE +		7.63	7.95	6.53	8.29	6.09
CD(P=0.05)		23.51	24.51	20.06	25.57	18.77

Veppankulam

The experiment was laid out with 29 years old ECT palms in sandy loam soil during 1997. Pre treatment nut yield (1992-97) was recorded. Growth and yield attributes were observed and presented in Table 42.

Table 42 : Effect of INM on coconut growth and yield (Veppankulam,2005)

Treatment	No.of functional leaves/palm	No.of bunches/ palm/year No.of	female flowers/bunch No.of	nuts/palm/ year Cumulative	mean nut yield (1997 to 2005)
T1. Control (Farmers' practice)	24.2	7.8	22.1	62.2	67.5
T2. Recommended dose of fertilizers (500:320:1200g N P_2O_5, K_2O/palm/year)	29.3	10.8	29.4	99.0	106.1
T3. Composted coir pith (on equivalent nitrogen basis + balance amount of P & K)	24.1	8.4	26.2	86.5	76.8
T4. 50 % N as CCP + balance NPK as fertilizers	29.3	9.9	25.4	91.0	87.4
T5. Neem cake + bone meal + ash (on equal nutrient basis)	26.1	8.5	24.8	76.7	76.6
T6 .FYM + 100% NPK as fertlisers	32.8	13.4	32.8	120.1	126.9
SEd	2.0	0.6	1.0	10.6	-
CD (P = 0.05)	4.3	1.2	2.1	22.7	-

The nutritional results (Agr. 2) showed that application of FYM + 100 % NPK (T_6) recorded significantly higher leaf number and it was on par with RDF(T_2). Significantly higher nut yield was recorded with FYM +100% NPK applied palms and it was superior to all other treatments. With respect to cumulative mean

nut yield for the seven years (1997-2005), application FYM + 100 % NPK registered highest number of nuts (126.9 nuts/palm/year) and it was 22.4% higher than the yield of palms which received RDF.

Agr. 7A : Nutritional requirement of high yielding varieties/hybrids of coconut with 50% of N organic matter substitution

(Aliyarnagar, Kahikuchi, Mondouri, Ratnagiri)

The objective of this project is to assess the performance of coconut varieties/hybrids under graded levels of NPK fertilizers with 50% organic matter substitution for nitrogen under varying soil conditions. The Design adopted was a 3^3 factorial confounded with two replications. The treatments consisted of all combinations of N, P, K doses which are given below:

N (g/palm/year)	P (g/palm/year)	K (g/palm/year)
0	0	0
500	250	1000
1000	500	2000

Aliyarnagar

The experiment was started in 1988 and 50% of N in organic form was supplied from 2002 onwards. Application of N @ 500g/palm/year recorded more annual leaf production. Levels of P & K did not have any effect on the annual leaf production. The number of functional leaves on the crown did not show any response to levels of P & K and showed little response to N levels. Application of N @ 500 g/palm/year recorded more number of bunches and female flowers/palm/year. Application of P & K @ 250 and 1000 g/palm/year recorded more number of bunches and female flowers/palm/year. Application of N @ 500g/palm/year recorded a mean nut yield of 99 nuts/palm/year (Table 43). Application of P @ 250 g/palm/year recorded an yield of 96 nuts/palm/year. Application of K @ 1000 g/palm/year recorded a mean nut yield of 94 nuts/palm/year.

Table 43: Mean nut yield and economics for different levels of N, P, K treatments (Aliyarnagar, 2005)

N P K Level	Nut yield/palm/year	Net income (Rs/ha)	BC ratio
N_0	61	- 2328	0.92
N_1	99	20711	1.40
N_2	97	24991	1.40
P_0	82	12508	1.31
P_1	96	18578	1.50
P_2	79	12287	1.39
K_0	77	13126	1.32
K_1	94	14854	1.49
K_2	85	12623	1.39
$N_0 P_0 K_0$	56	- 5755	0.78
$N_1 P_1 K_1$	118	34842	1.81
$N_2 P_1 K_1$	125	37028	1.87
CD (P=0.05) for main effects	13		
CV (%)	22.4		

Table 44 : Mean nut yield from different NPK combinations (Aliyarnagar, 2005)

Treatment	K_0	K_1	K_2
$N_0 P_0$	56	47	68
$N_0 P_1$	71	106	68
$N_0 P_2$	40	62	37
$N_1 P_0$	98	110	98
$N_1 P_1$	74	118	106
$N_1 P_2$	87	96	98
$N_2 P_0$	93	90	98
$N_2 P_1$	95	125	104
$N_2 P_2$	76	108	104

Among the NPK levels, $N_2P_1K_1$ and $N_1P_1K_1$ recorded more nut yield of 125 & 118 nuts/palm/year compared to 56 nuts with $N_0P_0K_0$ (Table 44).

The net income and benefit cost ratio increased to Rs. 20,711/ha and 1.40 with 500 g N. Similarly, 250 g $P_2 O_5$ recorded maximum net income and benefit cost ratio of Rs. 18,578/ha and 1.50 For K @ 1000 g/palm/year, the net income and benefit cost ratio was Rs. 14,854 and 1.49 respectively. Among the NPK levels, $N_2P_1K_1$ and $N_1P_1K_1$ recorded maximum net income and benefit cost ratio of Rs.37,028, 34,842 & 1.87 & 1.81 respectively. The control ($N_0 P_0 K_0$) recorded Rs. 5,755 and 0.78 (Table 43).

Kahikuchi

The experiment was laid out in 2003. Data on yield attributing characters are presented in Table 45. For number of functional leaves/palm, rate of leaf production, number of female flowers/bunch and nut yield /palm/ year, main effects of N and K were significant. The highest number of functional leaves (30.3), number of leaves produced (12.0), number of inflorescences (11.8) and no. of female flowers/bunch (24.9) were recorded in the treatment $N_1P_2K_2$. The interaction effect showed that nut yield and copra content/nut increased with the increased graded doses of nitrogen up to 500 g (N_1), whereas yield of nut/palm/year increased with the increasing level of phosphorus and potash. Among the 27 treatment combinations, the highest nut yield of 113.3 nuts/palm/ year and copra content 181.1 g/nut were recorded under the treatment $N_1P_2K_2$ (500: 500: 2000 g/palm/year).

Table 45: Yield and yield attributing characters of COD x WCT palms as influenced by different levels of NPK fertilizers(Kahikuchi, 2005)

Treatment	No. of functional leaves	Rate of leaf production	No. of inflorescences/ palm	No. of female flowers/bunch	Nut yield/palm/ year	Copra wt. (g/nut)
N_0	24.5	9.8	9.5	17.2	60.7	138.5
N_1	26.3	10.7	10.4	18.9	76.5	143.2
N_2	25.3	10.5	10.0	18.6	70.2	145.7
P_0	24.3	9.7	9.5	17.0	61.0	128.8
P_1	25.8	10.7	10.1	18.8	69.6	143.4
P_2	26.0	11.0	10.3	19.0	76.0	148.1
K_0	22.4	9.3	9.0	16.0	58.9	126.9
K_1	25.7	10.8	10.2	18.8	71.0	138.3
K_2	27.0	11.6	11.0	21.0	81.2	154.6
CD(P=0.05)	K	NS	NS	N &K	K	N, P&K
	1.71			1.02	16.34	3.16

Mondouri

The number of bunches/palm showed significant variation due to different levels of nitrogen application. An increase in the dose of N, P_2O_5 and K_2O increased the bunch production. In interactions among the nutrients N_2K_2 treatment recorded 8.6 bunches per palm followed by N_2P_2, N_1K_2, with 7.6 bunches/palm as compared to 6.0/palm under P_0K_0 treatment.

Due to different levels of N, P and K application, nut yield/palm showed an increasing trend from lower to higher levels. The interactions between N_2K_2 recorded highest nut yield/palm (101.3/palm) followed by N_2P_2 (94.6/palm) as compared with 75.3/palm under N_0P_0 treatment (Table 46). The copra yield showed an increasing trend due to different levels of N, P_2O_5 and K_2O application. Highest level of N, P_2O_5 and K_2O recorded maximum copra yield during 2004-05. In interaction, maximum copra yield of 13.6 kg/palm was recorded under N_2K_2 treatment.

Table 46 : Yield of COD x WCT hybrid under various nutritional treatments (Mondouri, 2005)

	P_0	P_1	P_2	Mean	K_0	K_1	K_2
N_0	76.3	87.1	86.3	**81.6**	77.3	83.1	87.5
N_1	81.3	89.5	92.6	**85.3**	78.6	89.6	93.6
N_2	82.6	93.6	94.6	**93.6**	81.3	93.6	101.3
Mean	**80.6**	**86.3**	**91.3**		**82.6**	**89.3**	**92.6**
K_0	75.3	80.1	81.6				
K_1	79.3	83.5	86.7				
K_2	89.3	86.6	91.1				

S.Em 2.6

C.D(P=0.05) for main effects : NS

C.D(P=0.05) for interactions : NS

Ratnagiri

The experiment was started during 2003. The 50% N was applied through vermicompost and remaining 50% N, P_2O_5 and K_2O were applied through chemical fertilizers. The annual nut yield for 2004-05 is presented in Table 47.

Table 47: Effect of N,P,K treatments on nut yield/ palm (Ratnagiri, 2005)

	P_0	P_1	P_2	Mean	K_0	K_1	K_2
N_0	73	89	63	75	78	82	65
N_1	80	104	100	95	103	86	96
N_2	105	92	109	102	109	97	100
Mean	86	95	91		97	88	87
K_0	90	103	97				
K_1	84	85	96				
K_2	85	97	79				

S.E. Plot 4.68 C.V. (%) 27.22

CD(P=0.05) for N 16.82 Gen. Mean 90.68

The results showed that the response to N was significant. N_2 and N_1 levels were found to record significantly higher number of nuts over N_0 level. Between N_1 and N_2 levels, there was no significant difference. None of the interactions was found significant.

Agr. 8 : Substrate dynamics for nutrient management in coconut

(Veppankulam)

This is a new project approved during the biennial workshop held at Dapoli during December, 2005 with the following objectives:

1. To study the interaction of biological and chemical substrate to enhance nutrient use efficiency.
2. To find out the suitable substrate for the optimum growth, yield and quality of coconut.

During the year, vermicomposting with coconut leaves as per the standard procedure was initiated. Lay out and marking of palms was done. Soil samples were taken for pre treatment analysis of soil properties.

Phy. 1: Screening coconut genotypes for drought tolerance using physiological and biochemical parameters

(Veppankulam)

This is a new project approved during the biennial workshop held at Dapoli during December, 2005 with the following objectives:

1. To screen coconut genotypes (available at Veppankulam) for drought tolerance using physiological and biochemical parameters.
2. To identify and characterise the *in situ* drought tolerant coconut palms.

Six palms from each of the 40 genotypes/cultivars available at the Coconut Research Station, Veppankulam were selected for further studies.

Phy. 2: Physiological effects of mulching on crop physiology and yield of coconut

(Veppankulam)

This is a new project approved during the biennial workshop held at Dapoli during December, 2005 with the following objectives:

1. To study the effect of different soil moisture conservation practices on physiological parameters, growth and yield of coconut
2. To study the effect of different soil moisture conservation practices on soil characteristics.

During the year, pre treatment observations were recorded.

Front Line Demonstrations on Integrated Nutrient Management

Aliyarnagar

Three FLDs were laid out in the farmers' fields at Aliyarnagar and Anaimalai in sandy loam soil type. The treatments were imposed during June – July, 2004. The plot size of each FLD was 100 palms. In all the FLDs , 50% of the N was applied through composted coir pith and remaining 50% of N and balance quantity of P and K fertilizers were applied through chemical fertilizers. The age of the coconut garden(WCT variety) was more than 20 years in all the locations. The average yield/palm in 2004-05 ranged from 134 to 149.

Ratnagiri

Three Frontline demonstrations on Integrated Nutrient Management with use of vermicompost as the primary component are being continued.

COCONUT
3.3 Disease Management

Path. 3 : Etiology and epidemiology of Thanjavur/Ganoderma wilt disease of coconut

(Ambajipeta, Arsikere, Veppankulam)

Ambajipeta

a. Basic studies – molecular characterization of *Ganoderma*

During the year 2005, scanning electron microscopy studies on G*anoderma applanatum* and G.*lucidum* were carried out in collaboration with Ruska labs, ANGRAU (Figures 1a & 1b). In collaboration with NRC for Oil Palm, Pedavegi, DNA from G*anoderma applanatum* and G.*lucidum* was isolated. Procedure for PCR of G*anoderma applanatum* and G.*lucidum* was standardised.

Fig. 1a : *G. applanatum*

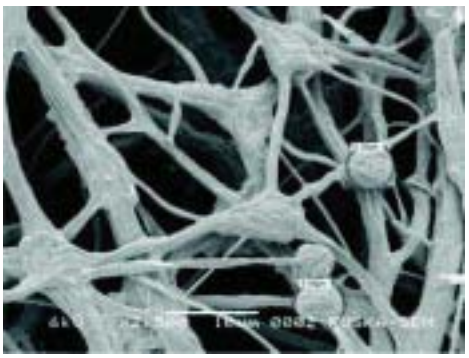


Fig. 1b : *G. lucidum*

b. Epidemiology of *Ganoderma* wilt disease

Correlation studies between weather factors and spread of basal stem rot disease for the period from March, 2000 to March 2006 (6 years data) indicated that number of rainy days, rainfall and relative humidity at 2.22 pm were found to have significant negative relationship with vertical spread of basal stem rot disease in coconut (Fig. 2). Verical spread of the disease could be estimated using the formula

$Y = 21.99 + 5.42$ (Min Temp) $- 1.00$ (Max Temp) $+ 0.848$ (RH Eve) $- 1.579$ (RH Mor)

$R^2 = 0.5417$, $F = 5.31$

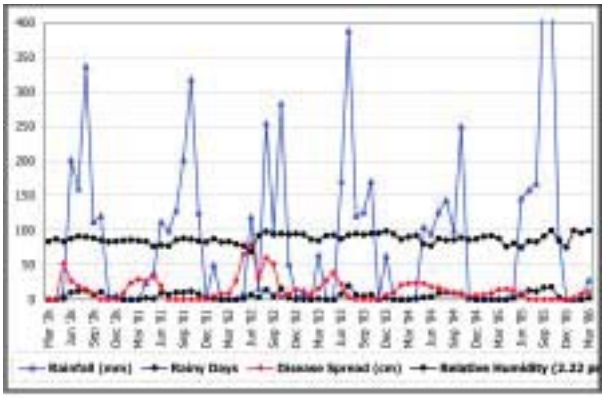


Fig. 2: Effect of weather factors on vertical spread of basal stem rot in coconut (Ambajipeta, 2000-06)

c. Sero detection studies

During the year 2003-04, one year old coconut seedlings were planted in basal stem rot diseased garden. The roots were collected from seedlings by destructive sampling method at monthly interval and subjected to

simple serological tests and ELISA. The study confirmed our earlier results that the basal stem rot disease infection in coconut seedlings could not be detected before symptom expression by simple serological tests and by ELISA.

d. Early detection by indicator plants

During the year 2004-05, among the thirteen plant species screened against basal stem rot disease in sick soil, redgram plants showed the specific symptom of splitting of the bark at the crown region. During the year 2005-06, redgram was re-sown again in sick soil to study the consistancy of the symptoms of bark splitting at the base. Results indicated that bark splitting of redgram at the base was consistant in all the plants that are grown in *Ganoderma* sick soil. *Ganoderma applanatum* was re-isolated from root tissues of the pigeonpea showing bark splitting symptoms. In the *Ganoderma* sick soil, *Eucalyptus* (2 years old) and *Sesbania* (8 months old) are also showing typical oozing symptoms. Studies on isolation of *Ganoderma* pathogen from these plants are in progress.

Arsikere

In adult coconut palms, various inoculation methods viz., stump inoculation, incorporation of bits of diseased tissue of coconut roots to the basins, stem inoculation and insertion of a diseased stem piece to the stem have been carried out from 2003-04 to prove the pathogenicity of *Ganoderma lucidum*. In all the above methods of inoculation, only in case of stem inoculation, three palms showed bleeding symptoms out of five palms inoculated in about 15-18 months after inoculation, whereas in other methods of inoculation, none of the palms showed bleeding symptom or gummosis so far. The causal organism has been re-isolated from the stem inoculated palms and compared with the original culture. Hence, pathogenicity of *Ganoderma lucidum* was established in adult coconut palms (Tiptur Tall) through stem inoculation technique. Pathogenicity of *Ganoderma lucidum* was also established in 3 year old Tiptur Tall coconut seedlings by root inoculation method.

Veppankulam

i. Pathogenicity of *Ganoderma lucidum*

A pot culture experiment was laid out during May, 2003 to prove the pathogenicity of *Ganoderma lucidum* on coconut seedlings by root split; root bit and root tie method of inoculations. The inoculum was multiplied on coconut root bits under *in vitro* conditions. The seedlings were inoculated during June, 2003 with the above methods @ 5 root bits/seedling. There was no symptom development in any of the above treatments even after three years of inoculation.

ii. Standardization of inoculum potential of *Ganoderma lucidum*

A pot culture experiment was laid out during May, 2003 to standardize the inoculum potential of *G.lucidum* for pathogenicity on coconut seedlings. In this experiment also, the inoculum was multiplied on coconut root bits and they were inoculated @ 4, 8, 12, 16, 20 and 24 root bits/seedling as treatments. The inoculation was done in all the treatments during June, 2003 as per the treatment schedule by root bit method. There was no symptom development in any of the above treatments even after three years of inoculation.

iii. Pathogenicity trial

A pot culture experiment was laid out during December, 2003 to prove the pathogenicity of *Ganoderma* isolates on coconut seedlings through soil inoculation. Eleven isolates of *Ganoderma* (CRS 1, CRS 2, CRS 3, CRS 4, CRS 5, TKT 1, TKT 2, VPM 1, PV 1, PV 2 and VRM 1) were mass multiplied separately on sorghum grains in poly bags (as mushroom spawn) and they were used for soil inoculation by mixing it with pot mixture at the time planting itself @ 300 g / pot.

The results revealed that the seedlings inoculated with isolate TKT 1 showed wilting symptoms at 45 days after inoculation. The seedlings inoculated with CRS 1 isolate showed wilting symptoms at six months after inoculation. The pathogen was reisolated from the wilted seedlings. Seedlings inoculated with the isolate TKT 2 showed sporophore production at collar region of the seedlings at 45 days after inoculation. The sporophore production was also observed in the seedlings inoculated with the isolates CRS 1, CRS 4 and PV 2 at 67 days after inoculation. It indicates that the isolate TKT 1 was found to be a virulent one.

Path. 4 : Management of Ganoderma/Thanjavur wilt disease of coconut

(Ambajipeta, Arsikere, Veppankulam)

Ambajipeta

a. Testing varietal resistance

During the year 2004, sixteen coconut varieties / hybrids were planted in basal stem rot sick soil and were continuously monitored for their reaction to basal stem rot disease. The results indicated that (Table 48) out of 5 palms planted, two palms (minimum) each in all varieties / hybrids died indicating their susceptibility to basal stem rot. During the year 2005-06, as per the decisions of the Workshop of AICRP on Palms, germplasm (seed nuts) from Veppankulam reported to be BSR resistant were obtained and were planted in G*anoderma* sick soil for further studies.

Table 48 : Reaction of coconut varieties/hybrids to BSR(Ambajipeta, 2005)

	Variety/hybrid	No. of seedlings surviving *
1.	Andaman Ordinary	2
2.	Chowgat Orange Dwarf	2
3.	Malayan Yellow Dwarf	2
4.	Philippines Ordinary	3
5.	Cochin China	3
6.	VHC – 1	2
7.	VHC – 2	2
8.	Java	2
9.	Ganga bondam	3
10.	Kera ganga	2
11.	Laksha ganga	1
12.	Chandra laksha	1
13.	Godavari ganga	2
14.	Chandra sankara	2
15.	East Coast Tall	3
16.	Laccadive Ordinary	2

* Out of five plants/type

b. Management of *Ganoderma* wilt disease of coconut

During the year 2005, *in vitro* studies as well as field studies were taken up to establish the efficacy of biocontrol agents against the basal stem rot disease. All the three species of Trichoderma were found to produce volatile and non-volatile metabolites specific to both the *Ganoderma* spp. The fluorescent *Pseudomonas* was found to inhibit the growth of both the species of *Ganoderma*. Neem cake and farmyard manure supported the growth of *Pseudomonas flourescens*. Field experiment results indicated that maximum decrease in vertical disease spread was obtained when *T.viride* was applied to the soil @ 50 g talc powder along with 5 kg neem cake coupled with the root feeding of *T.viride* culture filtrate (100%) @ 25 ml at quarterly intervals (Table 49).

Table 49: Field efficacy of *Trichoderma* spp and P. *fluorescens* in controlling the basal stem rot disease of coconut (Ambajipeta, 2005)

Treatment		Mean vertical spread (cm)
T_1	Root feeding of 100% culture filtrate of *T.viride* (25 ml) at quarterly interval	63.25
T_2	Root feeding of 100% culture filtrate of *T.viride* (25 ml) at 6 months interval	65.28
T_3	Root feeding of 100% culture filtrate of *T.viride* (25 ml)/year	64.17
T_4	Basal application of *T.viride* (50 g) + neem cake (5 kg)/ annum	18.15
T_5	$T_1 + T_4$	17.75
T_6	$T_2 + T_4$	18.33
T_7	$T_3 + T_4$	17.96
T_8	Basal application of *P.fluorescens* (50 g) /palm/year	63.26
T_9	Basal application of *P.fluorescens* (100 g)/palm/year	62.35
T_{10}	Neem cake (5 kg) per palm/year	29.24
T_{11}	$T_9 + T_{10}$	28.65
T_{12}	Control	65.57
	CD (P=0.05)	3.24

Replications : 3; No. of palms per replication : 3; Design: RBD

Arsikere

The integrated management trial was laid out in five locations in farmers' gardens including ARS, Arsikere Campus (as one of the replications) during April, 2000. The treatments are being imposed from April, 2000 under irrigated as well as rainfed coconut gardens till date. There are 8 treatments @ five palms per treatment. Observations were recorded on the disease index and yield at quarterly intervals starting from April,2000 to February,2006. Among the eight treatments, the disease progress was less in palms receiving Hexaconazole (1%) root feeding at quarterly intervals along with soil application of neem cake (@ 5 kg/palm/year) + *Trichoderma harzianum* @ 50 g/palm/half yearly) in all the gardens with an increase of 13.95 disease index over initial level which accounted for 71.56% reduction over control (Table 50). It was followed by Tridemorph 2% root feeding + neemcake @ 5 kg / palm/year and Hexaconazole (1%) root feeding + neem cake (@ 5 kg/ palm/year, which accounted for 63.83 and 54.08 percent reduction over control respectively (Table 50). In case of control, the progress in disease was significantly high (an increase of 49.05 over intial). The results also revealed that the combined treatments gave significantly higher nut yield (77.40-93.5 nuts/palm/year) during 2004-05 compared to other treatments and control.The severity of the disease substantially increased in rainfed coconut gardens compared to irrigated coconut gardens in certain treatments. Nevertheless, the progression of the disease in control treatments is of higher proportion and few palms died especially under rainfed coconut gardens. In all the gardens, the disease intensity was lesser in treated palms compared to control. However, there was an increase in disease index values both in treated and untreated palms over the initial values.

Table 50: Effect of Integrated management practices for basal stem rot disease of coconut (Arsikere, 2005)

Treatments	Disease Index				Mean nut yield/palm (2004-05)
	Initial (April 2000)	Up to July 2005	Increase over initial	% reduction over control	
T_1-Tridemorph (2%) root feeding	20.34	50.64	30.30	38.23	73.50
T_2-T_1 + Neem cake @ 5 kg/palm/year	21.67	39.41	17.74	63.83	83.90
T_3-Neem cake @ 5 kg/palm/year + *Trichoderma viride* (@ 50 g/palm/half yearly)	20.41	52.38	31.97	34.82	77.40
T_4-Hexaconazole (1%) root feeding	21.85	54.21	32.36	34.02	72.10
T_5-T_4 + Neemcake @ 5 kg/palm/year	21.77	44.29	22.52	54.08	90.90
T_6-T_5 + *Trichoderma harzianum*(@ 50 g/palm/ half yearly)	21.60	35.55	13.95	71.56	93.50
T_7-*Pseudomonas fluorescens* (@ 50 g/palm/ half yearly)	22.04	60.21	38.17	22.18	75.20
T_8-Control	21.10	70.15	49.05	—	60.70
SE(m) +	0.82	1.14	1.69	—	1.26
C.V (%)	9.39	5.49	16.79	—	3.93
CD (P=0.05)	NS	3.30	4.73	—	3.61

Veppankulam

I. Screening of coconut types in basal stem rot (BSR) sick soil

Ten coconut types were tested for their reaction to basal stem rot (BSR) disease of coconut by planting them in BSR sick soil at Thambikkottai village of Thanjavur district. This experiment was laid out during August 1989. Observations on the per cent survival of palms, number of functional leaves, disease indices of infected palms, annual nut yield of coconut types were made. Among the ten coconut types, ECT X BSR tolerant ECT registered a higher rate of survival (61.1 per cent) as compared to other types in BSR sick soil. ECT recorded 40 per cent survival. In ECT X BSR tolerant ECT hybrid, out of eleven surviving palms, only one palm was found to be infected with BSR disease with a per cent infection of 9.1, while in ECT, out of four surviving palms two palms were found to be infected with BSR disease with a per cent infection of 50. The mean disease index was also low in ECT X BSR tolerant ECT (32.56) as compared to ECT (44.00). ECT X BSR tolerant ECT recorded higher annual nut yield of 80.6 nuts/palm when compared to other types .

Test verification on performance of BSR tolerant materials

Field experiments were laid out in BSR sick soil at two different locations *viz.,* Melasambalur and Coconut Research Station, Veppankulam to test verify the performance of BSR tolerant materials as per the recommendation of the XVIth Biennial Workshop. Seedlings raised from the selfed seednuts of BSR tolerant mother palms were planted in BSR sick soil along with the tall varieties on 11.08.2004 in the above locations. Observations on seedling survival, seedling height, number of leaves and girth of the seedlings were recorded.

II. Management of basal stem rot disease of coconut through biocontrol agents, neem cake and chemicals

A field experiment (laid out during November, 2000) on the management of basal stem rot disease of coconut at Thambikkottai village was continued with 13 treatments.

Among the thirteen treatments, the progress of the disease was significantly less in the treatment Hexaconazole 1% root feeding + neem cake + *T. harzianum* with an increase of 8.33 in disease index over initial index, which was at par with Hexaconazole 1% root feeding + neem cake + *P.fluorescens* with an increase of 8.20 in disease index over initial index and Tridemorph 2% root feeding + neem cake with an increase of 7.25 in disease index over initial index. In control palms, the progress in disease severity was much higher with an increase of 61.45 in disease index over the initial index.

Path. 5: Preventing spread of root(wilt) disease in Tamil Nadu

(Aliyarnagar)

Garden to garden survey on the occurrence of root(wilt) disease of coconut was conducted in Theni, Kanyakumari, Tirunelveli, Dindigul and Coimbatore Districts of Tamil Nadu. In Cumbum block of Theni District, Gudalur, Surilipatti and K.K.Patti villages were found to be severely infected with root(wilt) disease. This was followed by Cumbum (2.0%) and N.T.Patti villages (0.8%) of Theni District. Leaf rot disease symptom was also observed in root(wilt) infected palms. Kombai and Karkodai villages of Uthamapalayam block of Theni District were found to be infected with root (wilt) disease. Sporadic occurrence of root(wilt) disease was noticed in Muthuthevanpatti village of Theni District. In Kanyakumari District, the disease was observed in Thiruparappu, Maniyankuzhi, Thumbakodu, Thirunanthikarai and Mangalam villages. Ilangi (4.0%) and Sengottai (3.5%) villages were found to be infected with root(wilt) disease. In Athur block of Dindigul District, root(wilt) was observed in Ayyampalayam (0.3%) and Sitharevu (0.4%) villages. In Anaimalai-Kerala borders of Coimbatore District, among the 63,020 palms observed from eleven villages, none of the palms was found to be infected with root(wilt) disease. Based on the survey results, a Project Proposal for preventing further spread of root(wilt) disease in Tamil Nadu State was submitted to Coconut Development Board.

Path. 7 : Biocontrol of bud rot and stem bleeding disease of coconut

(Ambajipeta)

a. Biocontrol of bud rot disease

The bud rot pathogen *P.palmivora* was isolated from diseased palm. Dual culture technique with antagonists *viz., T.viride, T.harzianum, T.hamatum* and *P.fluorescens* and pathogen, *P.palmivora* was conducted under *in vitro* conditions. I*n vitro* antagonistic studies revealed that an inhibition of test pathogen to an extent of 75 to 82% was recorded by the *Trichoderma* spp with maximum inhibition from *T.viride* (82.03%) and an inhibition of 50% by *P. fluorescens* was recorded (Table 51).

Table 51 : *In vitro* antagonistic effect of *Trichoderma* spp and *P.fluorescens* on mycelial growth of *Phytophthora palmivora*(Ambajipeta, 2005)

(Values represent the mean of six replicates)

	Antagonists	Radial growth (mm) of pathogen (*P.palmivora*)	Per cent inhibition of *P.palmivora*
1.	*Trichoderma viride*	11.5	82.03
2.	*T.hamatum*	18.0	71.37
3.	*T.polysporum*	15.7	75.39
4.	*T.harzianum*	33.0	63.30
5.	*T.longibrachiatum*	56.0	37.70
6.	*T.virens*	30.0	66.60
7.	*T.viride + P.fluorescens*	45.0	50.00
8.	*T.hamatum + P.fluorescens*	25.0	72.22
9.	*T.polysporum + P.fluorescens*	58.0	35.55
10.	*T.harzianum + P.fluorescens*	42.0	53.33
11.	*T.longibrachiatum + P.fluorescens*	47.0	47.77
12.	*T.virens + P.fluorescens*	55.0	38.88
13.	*P.fluorescens*	45.0	50.00
14.	Control	90	—

b. Biocontrol of stem bleeding disease

During the year 2005, a field experiment was conducted with different treatment combinations and the results indicated the effectiveness of Trichoderma spp against stem bleeding disease. Of the different treatments, maximum decrease in bleeding (exudation) patch (perimeter) was obtained when *T.viride* / *T.harzianum* / *T.hamatum* was applied (Fig. 3) as a paste on the bleeding patch alone or/and coupled with basal application of the same bioagent (50 g) in combination with 5 kg neem cake (T_8), followed by *T.viride* (T_7) and *T.hamatum* (T_9) when applied as a smearing paste in combination as soil treatment (50 g) by mixing in 5 kg neem cake. The decrease in bleeding patch ranged from 7.10 to 8.11 cm. Basal application of *Trichoderma* spp along with neem cake or neem cake when applied alone @ 5 kg par palm/year also reduced the spot size to a tune of 0.22 to 1.10 cm, against control palm where the size of bleeding patch increased by 3.46 cm (Table 52).

Fig. 3 Smearing of talc formulation paste on the patch of stem bleeding disease of coconut

Table 52: Efficacy of *Trichoderma* in managing stem bleeding at field level (Ambajipeta, 2005)

Treatment		Perimeter of the exudation patch (cm)		
		Initial	Final	Decrease
T_1	Basal application of *T.viride* (50 g) + neem cake (5 kg)/year.	7.27	6.17	1.10
T_2	Basal application of *T.harzinaum* (50 g) + neem cake (5 kg)/year.	7.50	7.11	0.39
T_3	Basal application of *T.hamatum* (50 g) + neem cake (5 kg)/year.	6.25	6.22	0.53
T_4	Smearing of talc formulation of *T.viride* paste on stem bleeding patches.	7.49	0.35	7.14
T_5	Smearing of talc formulation of *T.harzianum* paste on stem	8.22	0.32	7.90
	bleeding patches.			
T_6	Smearing of talc formulation of *T.hamatum* paste on stem bleeding patches.	9.27	2.17	7.10
T_7	$T_1 + T_4$	8.15	0.11	8.04
T_8	$T_2 + T_5$	8.22	0.22	8.00
T_9	$T_3 + T_6$	9.11	1.00	8.11
T_{10}	Neem cake @5 kg per palm/year	8.77	8.55	0.22
T_{11}	Untreated control	7.77	11.23	3.46 (increase)
CD (P=0.05)				2.27

Replications: 3; No. of palms per replication : 3; Design: RBD

Path. 8: Survey and surveillance on diseases of coconut

(Aliyarnagar, Ambajipeta, Arsikere, Veppankulam)

Aliyarnagar

Survey on the occurrence of stem bleeding, basal stem rot, leaf blight and bud rot diseases was conducted in different villages of Theni, Coimbatore and Dindigul Districts of Tamil Nadu. In all the three districts surveyed, leaf blight disease is the major problem and the disease incidence ranged from 10 to 20%. In Theni District, the average bud rot disease incidence was 0.6%. In Coimbatore District, out of 11 villages surveyed, the basal stem rot, stem bleeding and bud rot disease incidence was about 0.2% among the 63,020 palms observed. In Dindigul District, four villages were surveyed and the bud rot disease incidence was 0.3% and basal stem rot disease was 0.2%.

Ambajipeta

During the year 2005, survey conducted in various coconut gardens in different mandals of East Godavari, West Godavari, Srikakulam and Visakhapatnam districts indicated that the basal stem rot disease, bud rot and stem bleeding disease commonly occurred in most of the surveyed gardens. Survey indicated that mean per cent incidence of basal stem rot, bud rot and stem bleeding diseases on coconut recorded up to 21.3, 7.9 and 15.0 respectively in Andhra Pradesh. However, no Tatipaka disease incidence was noted in the surveyed areas.

Bud rot disease incidence in various soil conditions and crop situations was also recorded during the survey. Bud rot disease incidence on coconut palm ranged from 1.6% in sandy soils (West Godavari) to 25.0% in black soils (East Godavari) with a grand mean of 13.5% and 4.7% in East Godavari and West Godavari districts respectively. During the survey, it was observed that the coconut gardens with intercrops recorded more incidence of bud rot (5.8 to 16.7%) when compared to sole coconut (1.6 to 13.0%). Presence of palmyrah in coconut gardens also influenced the occurrence of bud rot disease on coconut. Bud rot incidence ranged from 3.5 to 20% and 1.6 to 16.3% in coconut gardens with palmyrah and without palmyrah respectively.

Arsikere

The survey was undertaken in 89 villages of coconut gardens in Hassan, Chikkamagalur and Tumkur Districts of Karnataka, during June – July, 2005. Observations were recorded on the incidence of major diseases (basal stem rot, stem bleeding and budrot) of coconut.

The survey results revealed that Hassan district registered the maximum BSR incidence (7.46%) followed by Chikkamagalur (7.36%) and Tumkur (6.32%) district. The village wise disease incidence ranged from 0 to 14% in the three districts surveyed. The survey indicated that 8 to 40 years old palms were normally affected by basal stem rot disease. Though the disease incidence was observed both in irrigated and rainfed coconut gardens, more incidence were observed in the rainfed and neglected coconut gardens. Low incidence of the disease was observed wherever the coconut palms were intercropped with banana.

Chikkamagalur district recorded the maximum incidence (5.82%) of stem bleeding disease followed by Tumkur (3.96%) and Hassan (3.74%) district. The village wise disease incidence ranged from 0 to 17% in the three districts surveyed. Thuruvanahalli (Chikmangalur District) registered the maximum disease incidence (17%).

While, the maximum incidence (1.14 %) of budrot disease was recorded in Chikkamagalur district followed by Hassan (1.05%) and Tumkur (0.25%) district. The village wise disease incidence ranged from 0 to 5% in the three districts surveyed, Sannenahalli (Hassan District) registered maximum incidence (5%). More incidence of the disease were recorded in the age group of 5 to 20 years old palms. Tiptur Tall is the common cultivar in all these districts.

Veppankulam

Field survey was conducted during 2005-06 in different villages of Thanjavur, Nagapattinam and Thiruvarur districts of Tamil Nadu to assess the incidence of bud rot, stem bleeding and Ganoderma/basal stem rot disease of coconut.

The survey revealed that the incidence of basal stem rot disease of coconut was maximum in Thanjavur district with a mean incidence of 5.3 per cent followed by Thiruvarur (1.3 per cent) and Nagapattinam districts (0.9%). The bud rot incidence was maximum in Thiruvarur district with a mean incidence of 0.52 per cent followed by Thanjavur (0.16 per cent). There was no incidence of stem bleeding in any of the above districts of Tamil Nadu.

Path. 9. Studies on the management of leaf blight of coconut

(Aliyarnagar)

The leaf blight pathogen was isolated from infected leaves using potato dextrose agar medium and the pathogen was identified as *Lasiodiplodia theobromae*. On farm field experiments on the effect of biocontrol agents and fungicides in the management of leaf blight disease of coconut was laid out at Angalakurichi and Subbegoundanpudur villages of Pollachi Taluk, Coimbatore District in Tamil Nadu. Pre-treatment observations on leaf blight disease were made (Table 53). Basal application of biocontrol agents *viz*., *Trichoderma viride, T. harzianum* and *Pseudomonas fluorescens* was done at half yearly intervals. Root feeding with fungicides was done at 2% concentration @ 100 ml/palm at quarterly intervals. Foliar application with Bordeaux mixture 1% and Mancozeb 2% was done two times at monthly interval.

The results revealed that root feeding with Carbendazim 2% @ 100 ml/palm at quarterly intervals significantly reduced the leaf blight disease (15.0% disease reduction). This was found to be on par with foliar spraying with Bordeaux mixture 1%. (15.2% disease reduction). Root feeding with Calixin 2% @ 100 ml/palm at quarterly intervals ranked next. Foliar spraying with Mancozeb (0.3%) or soil application with biocontrol agents alone were least effective in reducing the leaf blight disease which recorded 6.0% to 8.0% disease reduction.

Table 53: Management of leaf blight disease in coconut (Aliyarnagar, 2005) Location – Angalakurichi village

Treatment	Pre treatment PDI	Post treatment PDI	Reduction in disease severity
T1 - SA - *Trichoderma viride* @ 200 g/palm/year	23.6	17.2	6.4
T2 - SA - *T. harzianum* @ 200 g/palm/year	24.3	18.2	6.1
T3 - SA - *Pseudomonas fluorescens* @ 200 g/palm/year	23.7	15.3	8.4
T4 - RF - Tridemorph 2% @ 100 ml/palm	25.8	13.5	12.3
T5 - RF - Carbendazim 2% @ 100 ml/palm	24.4	9.4	15.0
T6 - RF - Thiophanate methyl 2% @ 100 ml/palm	24.2	16.1	8.1
T7 - RF - Hexaconazole 2% @ 100 ml/palm	25.8	15.2	10.6
T8 - RF - Propiconazole 2% @ 100 ml/palm	26.8	15.6	11.2
T9 - FS - Bordeaux mixture 1%	24.6	9.4	15.2
T10 -FS - Mancozeb 0.3%	26.4	18.2	8.2
T11 -SA - *T. viride* + *T. harzianum* + Neem cake – 5 kg/palm/year	26.8	18.6	8.2
T12 -Control	27.1	34.4	-
	SEd		1.2
	CD(P=0.05)		2.4
	CV%		16.4

SA - Soil application; RF – Root feeding at quarterly intervals

FS - Foliar spray (Two sprays at monthly interval)

Front line Demonstrations on Management of BSR disease in coconut

Six Frontline Demonstrations on the management of basal stem rot disease in coconut were continued at Ambajipeta, Arsikere and Veppankulam Centres. The Technology Package includes:

a. Digging of isolation trench
b. Root feeding of Tridemorph @ 2 ml in 100 ml water at quarterly interval (three times)
c. Basal application of talk formulation of 50 g of *Trichoderma viride* + 5 kg neem cake/palm/year (*T.viride* cfu 240 x 10^3 g of talc powder)
d. Fertilizer schedule as per the regional recommendation
e. Green manuring in basin + green leaf mauring @ 25 kg/palm
f. Basin method of irrigation – Flood irrigation to be avoided
g. Injury to root should be avoided
h. If bark beetle incidence is noticed, swabbing of sevin @ 3 g/lt.

Arsikere

The front line demonstrations on the management of basal stem rot disease of coconut was laid out in two locations at Karagunda and Undiganalu villages of Arsikere Taluk during October, 2004. Observations were taken on the disease index and horizontal spread of the disease. The results revealed that the disease progress was less in FLD package treated blocks with a marginal increase over initial index when compared to control blocks (Farmer's practice). At Karagunda village, results revealed that the disease progress was less in FLD package treated blocks with marginal increase of 4.86 disease index (ranged from 1.37 to 9.32) over initial when compared to control block(farmers' practice) which accounted for 13.99 disease index over initial index. The mean nut yield /palm/year ranged from 58-97 in FLD treated blocks as against 41-78 in control blocks with a mean nut yield of 76.8 and 62.0 in FLD package and control respectively. Similar results were observed at Undiganalu village with mean marginal increase of 3.91 disease index over initial index against an index of 10.79 in control blocks. The number of nuts was maximum (67.5) in FLD block compared to control block which recorded 50 nuts/palm/year.

Veppankulam

Two front line demonstrations were laid out on the management of basal stem rot (BSR) disease of coconut in farmers' fields at Veerakuruchi and Kallikkadu locations in 2004. Observations were taken on the disease index, recovery of palms and horizontal spread of the disease. The results revealed that the disease progress was less in FLD package treated blocks with a marginal increase of 1.50 in disease index over initial index when compared to control (Farmer's practice) block with an increase of 7.30 in disease index over initial index. In the FLD package treated block, 8.3 per cent of the BSR infected palms were recovered from the disease. Similarly, there was no horizontal spread in the FLD treated block as against 3.33 per cent spread in the control block.

COCONUT
3.4 Pest Management

Ent. 3 : Survey and monitoring of pest problems in coconut

(Aliyarnagar, Ambajipeta, Ratnagiri)

Aliyarnagar

Pest surveillance was carried out on the infestation of four major coconut pests *viz.*, Rhinoceros beetle, Black headed caterpillar, Red weevil and Eriophyid mite, other emerging pests and available natural enemies in the coconut ecosystem. The per cent incidence of four major pests and their intensities were recorded.

(i) Rhinoceros beetle

In Dindugal district, Ottanchathiram block had the highest per cent infestation of rhinocerus beetle upto 14.50 per cent followed by Sanarpatty (8%) and Thoppampatty (8%), Attur (7 %) and Palani (5%). In Sivagangai district among the eleven blocks surveyed, Singampunari block recorded the highest infestation of upto 15% followed by Thirupathur (14%), Kallal (9%), Manamadurai 9%, Devakottai (8.4%) and Kannangudi (7.3%).

(ii) Blackheaded caterpillar

In Dindugal district, except in Dindugal block (0.32%), other coconut growing areas did not have the infestation of this pest. In Sivagangai district, Kallal block recorded the highest per cent infestation of 7.5 followed by Singampunari (7%), Karaikudi (5.2%) and Sivagangai (5.0%).

(iii) Red weevil

In Theni district, Chinnamanur block had shown the highest level of infestation of RPW upto 13.00 per cent followed by Bodi (6.25%), Kadamalai (5%) and Cumbam (5%) while, other blocks recorded upto 3% only.

(iv) Eriophyid mite

The per cent infestation of eriophyid mite is invariably in higher proportion in all the four districts ranging from, 81% to 90% in Dindugal dt. and 72% to 90% in Theni dt. The intensity of damage was expressed in terms of damage rating grade upto 5 with almost 80-90% nut damage.

v) Survelliance of new emerging pests

Occurrence of coconut button borer *Cyclodes omma* was recorded in Unjavelampaty of Pollachi taluk. Coconut skipper *Gangara thyirsis* and leaf eating caterpillar Turnaca *acuta* were noticed in traces in A.Nagoor village of Pollachi Taluk. Severe outbreak of coconut slug caterpillar *Conthyla rotunda* was observed in 130 hectares of coconut at R.Gopalapuram village of Pollachi in Kerala Border areas. Red ants *Oecophylla smragdina* , sucking pests viz., scales *Aspidiotus destructor* and mealy bug *Pseudococous sp* were also observed in Dindugal and Theni districts.

Ambajipeta

Periodical survey for monitoring the eriophyid mite and other pests was continued in East Godavari, West Godavari, Krishna, Visakhapatnam and Srikakulam districts and the following observations were made. A total of 47 villages in East Godavari, 19 villages in West Godavari, 2 villages in Krishna, one village in Srikakulam and two villages of Visakhapatnam districts were surveyed and data were collected on the incidence of different pests from 2 to 5 randomly selected gardens in

each village. The observations revealed that, an out break of coconut black headed caterpillar occurred in 10 villages in East Godavari and 5 villages in West Godavari districts and incidence of red weevil was also recorded especially in East Godavari Dist. The incidence of rhinoceros beetle was observed in all the areas surveyed at low to medium intensities.

The incidence of coccids i.e., mealy bugs under the perianth of nuts and damage on the nut surface is observed in many gardens in addition to mite damage (Fig. 4 &5).

Fig. 4 : Mealy bugs under the perianth

Fig. 5 : Mealy bug damage on nut surface

Status of eriophyid mite

Periodical survey revealed that the grade index of mite damage continues to be in mild condition since 2002. It was also found that the mite damage scale was of mild intensity in gardens where control measures were taken, while in untreated gardens, it was very high in older bunches. Further, the mite damage scale was in mild intensity on the bunches below 5 months (tender nuts) in all the gardens surveyed (post monsoon bunches).

Ratnagiri

a. Eriophyid mite

To record the intensity of infestation of eriophyid mite in Konkan region, a survey was carried out in Raigad, Thane, Ratnagiri and Sindhudurg Districts. Two gardens in each village and two villages in each taluk were selected for recording the incidence of the coconut eriophyid mite. Intensity of incidence was recorded in 1-5 grade index. Also the number of nuts damaged was recorded to work out per cent nut damage. The November 2005 observations showed that Thane district continued to record higher infestation (71%) than Raigad(13%) and Ratnagiri(17%). Sindudurg district for which survey was not carried out during November 2005 recorded 46% infestation during April 2005.

b. Other pests

To record the intensity of infestation of other coconut pests in Konkan region, a survey was carried out in Raigad, Thane and Ratnagiri districts. Two gardens in each village and two villages in each taluk were selected for recording the incidence. Data **(**Table 54**)** revealed that the infestation of rhinoceros beetle was recorded in almost all the districts of the region. The infestation of red weevil was more in Ratnagiri district. Higher infestation level of black headed caterpillar was recorded in Thane district.

Table 54: Infestation level of different pests in Konkan region (Ratnagiri, 2005)

Sl. No.	Name of district	Percent infestation					
		Rhinoceros beetle		Red weevil		Black headed caterpillar	
		Feb-March 2005	November 2005	Feb-March 2005	November 2005	Feb-March 2005	November 2005
1.	Thane	14.93	17.22	1.94	2.38	25.36	25.10
2.	Raigad	17.91	18.37	1.58	2.59	0.61	0
3.	Ratnagiri	18.22	17.50	12.36	8.72	0	0

Ent. 5 : Management of eriophyid mite in coconut gardens

(Ambajipeta, Ratnagiri)

Ambajipeta

A garden with eriophyid mite incidence was selected for the implementation of recommended package for the management of coconut eriophyid mite. Pre treatment data was recorded on the mite intensity i.e., medium scale of mite damage in all the treatments. Post treatment data is being recorded at 4 months interval. It was found that the mite damage scale was 2.5 (mild intensity) in gardens where Azadiractin 10000 ppm + IPM was followed while in untreated gardens, mite scale recorded was medium i.e., 3.5 (medium intensity). Further it was also observed that mite damage scale was found to be nil on the bunches below 5 months (tender nuts) in all the treatments. However, a difference in scale between treated and untreated could be noticed in the older bunches (6 - 9 months old). Pre and post treatment data indicated that there is no variation in damage index in all the treatments including control.

Ratnagiri

To validate the recommended package for the integrated management of eriophyid mite, a trial was conducted with 100 palms for each treatment in a farmer's field at Malvan village. Pre-treatment observations were recorded before treatment. It was observed that the eriophyid mite infestation was reduced from 66.58% to 6.96% after three sprayings of the 1% Azadirachtin. However, it increased from 65.77% to 72.22% in the control plot.

A new trial was started at this Centre in March 2006 with following five treatments with four replications in a RBD

Treatment details:

T_1 – Root feeding with Neemazal 5% (10 ml + 10 ml water)

T_2 – Spraying of Neemazal 5% (1ml /lit of water)

T_3 – Application of neemcake @ 5 kg/palm

T_4 – Root feeding Neemazal 5% (10 ml + 10 ml water) + application of neemcake @ 5 kg/palm

T_5 – Control

The treatments were applied in the month of March and the observations were recorded.

Ent. 6: Integrated management of red weevil in coconut

(Aliyarnagar, Ambajipeta, Ratnagiri)

Aliyarnagar

a) Surveillance of red weevil in Tamil Nadu

Pest surveillance was carried out on the infestation of red weevil in 10 districts in Tamil Nadu during this period. In Dindugal district, all the coconut growing areas in Palani, Dindugal, Sanarpatty, Natham, Nilakottai and Ottanchathiram blocks have shown only traces level of infestation of (upto 3 %). In Theni district, Chinnamanur block has shown the highest level of infestation of upto 13% followed by Bodi (6.25%), Kadamalai (5%) and Cumbam (5%).

b) Studies on the chemical control of red weevil

In all the three locations where the trials were conducted, root feeding of monocrotophos @ 10 ml+ 10

ml water was found to give the highest percent recovery of the red weevil infested palms followed by azadirachtin and carbosulfan. In control plot, all the palms died.

c) Studies on efficacy of pheromones on red weevil in coconut

The following pheromone traps were installed in three locations viz., Pathanaickanur, Nallur and Kaniyur.
T1- Chemical pheromone lure (Chemtica) – Ferrolure
T2- CPCRI Pheromone lure
No .of treatments : Two
No. of replications : 12 (traps).

Sugarcane molasses @2.5 litres per trap were used as food lure along with yeast 5gm + Furadn 2gm. Food attractant was changed once in 15 days. Pheromone lures were tested for 6 months. Periodical observations on trapping of adult red weevils in each pheromone trap were recorded at regular intervals (fortnightly) and cumulative total was arrived (Table 55).

Table 55: Efficacy of pheromone lure for red weevil management (Aliyarnagar, 2005)

Sl. No	Location	Cumulative total no.of red weevil trapped in Ferrolure (T1)	Cumulative total no. of red weevil trapped in CPCRI lure(T2)
1.	Pethanaikanur	325	284
2.	Nallur	190	165
3.	Nallur	143	110

Ambajipeta

i. Chemical control trial for the management of red weevil in coconut

After one year of imposition of the treatments, it was found that, among the three pesticides tested through root feeding against red weevil, root feeding of monocrotophos @ 10 ml + 10 ml water was found to be the best treatment with 100% recovery of infested palms followed by azadirachtin 5% with 76.7% recovery. Data on pre and post infestation levels of red weevil in treated gardens revealed that 25.0 per cent decrease in infestation level in the garden where Azadirachtin 5% was given as root feeding, where as infestation level increased in the other treatments and control plot. Same treatment was found to be the best in reducing the percentage of dead palms (91.7) followed by monocrotophos when compared to other treatments and control. In control, an increase in both damage and death of the palms was recorded.

ii. Studies on efficacy of pheromones on red weevil in coconut

Studies were conducted with two treatments i.e., (1) Chem Tica lure (800 mg) which costs Rs. 345/lure and (2) CPCRI lure (85-100 micro litres) costing Rs. 40/ample (Fig. 6).

It was observed that more number of weevils were trapped in Chem Tica lure (total weevils -1865 nos. with an average catch of 156/trap) in the working period of 230 days when compared to that of CPCRI lure (total weevils-1398, Average-116.5/trap). When periodical data were analyzed, it was found that the catches in both the treatments were on par with each other in majority of the 24 times except 5 times i.e., 6^{th}, 13^{th}, 14^{th}, 16^{th} & 17^{th} time during which period Chem Tica lure caught significantly higher number of weevils.

Fig. 6: Arrangement of ferrolure trap on the coconut palm

Even though CPCRI lure trapped less no.of weevils (CPCRI - 1398 nos. & Chem Tica 1865 nos) when compared to that of Chem Tica lure in a common period of 230 days, it was seen that CPCRI lure caught a total of 2003 numbers of weevils in a working period of upto 438 days and the lure continued to function afterwards also, Chem Tica lure worked for only 230 days. Hence, it is evident from the data that CPCRI lure is superior when compared to Chem tica as it's cost is lesser, works for a longer time catching more weevils with less quantity of lure (Table 56).When the pre and post infestation levels were observed in the experimental garden and the village in which experiment was conducted, it was observed that the infestation level has come down from 2.4 to 0.5 and 1.5 to 0.1 per cent in both the treatments i.e., T1 and T2, respectively (Table 56).

Table 56 : Comparative efficacy of Chem Tica & CPCRI lures (Ambajipeta, 2005)

Treatment	Quantity	Cost Rs.	Duration	No. of weevils trapped (12 traps)			Average no. of weevils/ trap	Sex ratio
				Male	Female	Total		
T1-Chem tica	800 mg each	345/-	230 days (30.12.04 to 20.08.05)	804	1061	1865	155.4	1.0:1.3
T2 – CPCRI lure	85-100 micro litres	40/- ampule	438 days (30.12.04 to 31.03.06) (Still working)	984	1019	2003	166.9	1.0:1.0

Table 57: Pre and post treatment infestation levels of red weevil in the experimental gardens (Ambajipeta, 2005)

Treatment		Total no. of palms	Percent damage	
			Pre treatment dead palms	Post treatment (dead palms after 12 months)
T1-Chem tica	a) Experimental garden	840	2.4	0.5
	b) Mosalapalli village	—	2.7	0.5
T2 – CPCRI lure	a) Experimental garden	840	1.5	0.1
	b) Erusumanda village	—	1.6	0.1

Ratnagiri

a. Evaluation of different chemicals for the control of red weevil in coconut

To find out the effective chemical for the control of red weevil, a trial with 6 treatments and 12 replications was conducted in a farmer's field. Root feeding of the treatments was given. Before root feeding treatment, pre-treatment details were recorded.

The treatments are :

T_1 – Root feeding of Azadirachtin 5 % @ 10 ml + 10 ml water

T_2 – Root feeding of Azadirachtin 5 % @ 15 ml + 15 ml water

T_3 – Root feeding of Carbosulfan @ 10 ml + 10 ml water

T_4 – Root feeding of Endosulfan 35 EC @ 10 ml + 10 ml water

T_5 – Root feeding of Monocrotophos 36 EC @ 10 ml + 10 ml water

T_6 – Control.

Before giving the treatments, the infestation level ranged from 83.33 to 91.67 per cent. Post treatment infestation was zero in endosulfan and monocrotophos. It was thus observed that the root feeding of endosulfan and monocrotophos was effective in controlling the red weevil. In addition, the re-infestation of the red weevil was not observed up to four months after treatment.

b. Evaluation of different pheromones on red weevil in coconut

To find out effective pheromone for red weevil, a trial was conducted with three treatments of pheromone traps in three locations with 12 replications. Experiment was started in last week of December 2004.

T_1 – Ferrolure $^+$ [Lure from Chem Tica]

T_2 – ISCA lure [Lure from Booklands Exports]

T_3 – CPCRI lure

In each pheromone trap, food lures containing coconut logs + yeast 25g + furadan 2g in one litre of water was kept. Food lure was changed once in 7 days. Pheromone lures were tested for 6 months. It was observed that the efficacy of CPCRI lure, Chem Tica & ISCA lure lasted up to 11, 24 & 15 weeks, respectively. Similarly, maximum weevils (400) were trapped in Chem Tica lure trap followed by ISCA lure trap (84). It indicated that the Chem Tica lure is the best in efficacy as compared to other lures. The lingering effect of the lure was not observed.

Front line Demonstrations

(Aliyarnagar, Ambajipeta, Ratnagiri)

Management of coconut rhinoceros beetle

Aliyarnagar

Frontline field demonstrations on the management of coconut rhinoceros beetle (*Oryctes rhinoceros*) was undertaken in an area of 10ha with coconut palms of 3 to 7 years age group at N.G.Pudur, Pollachi taluk. Pre release screening of beetles and grubs from the experimental area during Jan-May. 2004 revealed total absence of Baculovirus and GMF diseases. Detailed observations on the palms in the experimental area recorded before the introduction of Baculovirus and GMF diseases showed high per cent damage on leaf (42.00), Spathe (13.75) and spindle (22.60).The release of 120 numbers of Baculovirus inoculated adult beetle, application of GMF in manure pit and setting up of 5 Pheromone traps resulted in significant reduction in coconut crop damage. The reduction in leaf, spathe and spindle damage after six months was 31.25, 9.50 and 18.30 per cent respectively. Consequently the baculovirus disease and GMF incidence in the experimental plots were achieved upto 11.5 per cent and 7 per cent respectively. There after there was a steady declining trend in the mean per cent reduction in leaf, spathe and spindle damage after 24 months ie 31.25 to 7.25, 9.5 to 1.65 and 18.2 to 3.12. The intensities of Baculovirus and GMF infection were enhanced from 11.50 to 20.85 and 7.00 to 13.50 in the experimental area.

Ratnagiri

The demonstration is in progress at Juve village of Ratnagiri district. The rhinoceros beetle pheromone lure was purchased and traps were placed in the village to collect beetles.

Management of leaf eating caterpillar

Aliyarnagar

Frontline Demonstrations on IPM for *Opisina arenosella* was conducted during 2003-05.

Root feeding of Monocrotophos @ 10ml+10ml water followed by six periodical releases of larval/pupal parasitoids *Bracon brevicornis, Goniozus nephantidis*, pupal parasitoid *B. nosatoi* @ 30/tree, 10/tree and 1/tree respectively at 15 days interval of time showed significant reduction of *Opisina arenosella* population. The estimated mean population of pest was significantly reduced from 459.91 to 205.63per palm 21 days after root feeding of monocrotophos. Drastic reduction in mean pest population per palm from 205.63 to 4.35 palms after the release of bio agents for six times consecutively at 21 days interval was achieved. Consequently, there was an increase in the level of parasitisation of all the parasitoids *viz.,* Braconids, Bethylids and Chalcids from 4.16, 2.03 and 0.75% to 26.05, 14.85 and 6.40% respectively.

Ratnagiri

The frontline demonstration on IPM for *Opisina* was in progress at Palghar tehsil of the Thane district. Larval parasite *Goniozus nephantidis* was released in 2 ha. area and observations were recorded.

OIL PALM
4.1 Crop Improvement

Gen. 8 : Studies on comparative performance of different hybrid combinations of oil palm

(Gangavathy, Mulde, Vijayarai, Aduthurai)

Gangavathy

The experiment was laid out with 11 tenera hybrids(supplied from Palode)in 1992 in a RBD with three replications. The data on yield and yield contributing characters are presented in Table 58.

Table 58: Yield parameters in hybrid combinations of oil palm (Gangavathy, 2005)

Hybrid combination	Bunches/palm	Mean bunch wt (kg)	FFB yield (t/ha) (2004-05)	Cumulative FFB yield (t/ha) (1998-99 to 2004-05)
18 D x 32 P	2.77	7.93	3.85	32.66
35 D x 291 P	3.03	7.22	3.83	30.70
65 D x 111 P	2.67	7.10	2.83	31.05
82 D x 266 P	2.73	7.36	3.22	37.85
104 D x 98 P	3.00	6.62	3.10	29.43
109 D x 291 P	3.42	9.26	3.95	45.23
115 D x 291 P	3.33	8.44	3.68	36.82
124 D x 266 P	2.72	7.03	3.00	31.85
128 D x 291 P	2.75	7.37	2.87	32.15
148 D x 98 P	2.58	6.10	3.29	41.79
220 D x 98 P	2.73	6.31	2.62	30.72
SE m ±	0.36	0.70	0.44	2.02
CD (P=0.05)	NS	NS	NS	5.97

A promising oil palm hybrid 124D x 266P at Gangavathy Centre

There was no significant difference between the hybrids as regards to bunches/palm, mean bunch weight and the yield of FFB for 2004-05. However, the hybrid 109 D x 291 P was found to record the highest cumulative FFB yield (1998-99 to 2004-05). This hybrid was found to record significantly higher cumulative yield than all other hybrids except the hybrid 148 D x 98 P. The lower levels of FFB yields were mainly attributed to the lack of irrigation facilities during summer months.

Mulde

The experiment was laid out with 11 tenera hybrids in 1991 in a RBD with three replications. The data on yield attributes were recorded and presented in Table 59.

Table 59 : Yield of different tenera hybrids(Mulde, 2005)

Sl. No.	Hybrid	No. of bunches/palm	Bunch wt.(kg)	FFB yield (kg/palm)	FFB yield (t/ha)
1.	V1 - 115 D x 291 P	5.39	22.55	121.75	17.41
2.	V2 - 104 D x 98 P	4.91	17.04	82.73	11.83
3.	V3 - 109 D x 291 P	4.15	24.38	99.41	14.21
4.	V4 - 124 D x 266 P	5.42	21.01	115.55	16.53
5.	V5 - 220 D x 98 P	4.29	15.59	66.71	9.54
6.	V6 - 65 D x 111 P	4.79	20.40	102.47	14.66
7.	V7 - 35 D x 291 P	4.79	18.14	88.36	12.64
8.	V8 - 82 D x 226 P	5.20	17.72	94.30	13.48
9.	V9 - 148 D x 98 P	5.38	20.42	109.20	15.61
10.	V10 - 18 D x 32P	4.80	18.24	87.53	12.52
11.	V11 - 128 D x 291P	5.58	17.78	98.90	14.14
	SE +	0.53	1.75	13.80	1.97
	CD(P=0.05)	NS	NS	NS	NS

The data indicated that different hybrids did not show significant difference for yield attributes. However, hybrid combination 115 D X 291 P (V_1) recorded the highest yield of FFB i.e. 121.75 kg/ palm/ year (17.4 t/ha), whereas 109 D X 291 P (V_3) recorded the highest bunch weight (24.38 kg).

Vijayarai

The experiment was laid out with 11 tenera hybrids in 1992 in a RBD with three replications. The data on yield and yield attributes were recorded and presented in Table 60. The difference between cross combinations was significant in respect of number of bunches/palm, FFB yield/palm and cumulative yield (t/ha). Maximum number of bunches/palm was recorded in the cross combination 82 D x 266 P with 6.9. Lowest number of bunches was recorded in 18 D x 32 P (3.4). Maximum FFB yield/palm was obtained in the cross combination of 82 D X 266 P (79.1 kg/palm) and the lowest yield was recorded in 18 D X 32 P (38.7 kg/palm). The cross combination of 82 D x 266 P recorded the highest yield (9.8 t/ha) and the lowest yield of 4.8 t/ha was recorded in 18 D x 32 P.

The cumulative mean yield recorded for the past ten years from (1995 to 2005) revealed that the cross combination of 148 D X 98 P recorded maximum yield of 8.3t/ha/year followed by 104 D X 98 P and115 D x 291 P with 8.0 t/ha. Lowest yield was recorded in the cross combination 65 D X 111 P with 6.0 t/ha/year. The cross combinations 148 D X 98 P, 104 D X 98 P and 115 D 291 P recorded 38.3% ; 33.3% and 33.3% increase in yield over 65 D X 111 P respectively.

Aduthurai

As per the recommendations by the XVI Biennial Workshop on AICRIP on Palms, 10 hybrid combinations were obtained from NRC for Oil Palm Research Centre, Palode. The seedlings were in good condition and observations on seedling height and number of leaves were recorded. Seedling height and number of leaves showed that height was maximum in hybrid No 21 x 214 with 93.4 cm followed by hybrid No. 61 x 66 with 87.4 cm. The lowest seedling height of 63.2 cm was recorded in the hybrid No. 350 x 66. The same trend was followed for number of leaves also with 9.9 leaves in hybrid No. 21 x 214, followed by hybrid No. 28 x 368. The lowest number of leaves was recorded in 350 x 66 (8.2). The seedlings were subsequently planted in the main field during April, 2006.

Table 60: Comparative performance of different cross combinations in oil palm (Vijayarai, 2005)

Sl. No	Hybrid	Number of bunches	Bunch weight (kg)	Mean yield (kg/ palm)	Mean yield (t/ha)	Cumulative mean yield (t/ha)
1.	128 D x 291 P	5.3	12.6	66.6	8.2	7.2
2	124 D x 266 P	5.6	11.6	64.6	8.0	7.3
3.	18 D x 32 P	3.4	11.5	38.7	4.8	6.6
4.	35 D x 291 P	5.1	13.2	66.7	8.2	7.1
5.	65 D x 111 P	5.2	10.4	54.6	6.7	6.0
6.	104 D x 98 P	4.7	12.7	59.3	7.3	8.0
7.	82 D x 266 P	6.9	11.5	79.1	9.8	6.7
8.	109 D x 291 P	5.2	11.0	57.1	7.1	7.5
9.	115 D x 291 P	6.4	11.9	76.9	9.5	8.0
10.	148 D x 98 P	6.1	12.4	76.6	9.5	8.3
11.	20 D x 98 P	6.0	10.6	63.0	7.9	7.1
	General mean	5.4	11.8	64.0	7.9	7.3
	C.V . %	13.4	9.2	15.6	15.7	8.1
	CD(P=0.05)	1.2	NS	15.0	2.1	1.0

Gen. 8A: Evaluation of oil palm genotypes for drought tolerance

(Gangavathy, Mulde)

Gangavathy

Nine genotypes including six Zambian (ZS) and three Tanzanian (TS) selections were under evaluation for drought tolerance at this Centre. The experiment was planted during October, 1998 in a RBD with three replications. The palms are maintained under rainfed condition. The results are presented in Table 61. Palm height, leaf production, number of bunches/palm and

Table 61: Growth and physiological parameters of genotypes for drought tolerance(Gangavathy, 2005)

Genotype	Height (m)	Leaf production rate /palm	Relative Water Content (%)	Electrolyte leaching (percentage of final	conductivity) Lipid peroxidation	(OD) No.of bunches/	palm FFB yield (t/ha) (2005)
ZS-1	5.95	15.27	89.00	72.53	0.156	2.58	0.81
ZS-3	5.80	14.83	86.56	65.07	0.216	1.00	0.29
ZS-5	5.40	15.27	87.16	69.23	0.224	1.50	0.48
ZS-8	5.77	14.33	85.46	63.80	0.147	1.42	0.48
ZS-6	5.45	15.40	85.88	69.30	0.192	1.00	0.48
ZS-9	5.31	14.43	87.97	66.27	0.143	2.17	0.55
TS-4	6.08	14.23	87.71	65.07	0.187	1.67	0.57
TS-5	6.01	15.17	81.32	65.47	0.239	2.50	0.58
TS-7	5.84	15.20	84.56	71.00	0.169	2.43	1.43
SEm+/-	0.32	0.48	1.58	1.69	0.015	0.62	0.24
CD(P=0.05)	NS	NS	NS	5.07	0.045	NS	NS

FFB yield did not differ among genotypes. However, significant differences were noticed in the physiological parameters like electrolyte leaching and liquid peroxidation. The genotypes ZS-8 (63.8%), ZS-3 (65.07%), TS-4 (65.06%) and TS-5 (65.47%) recorded significantly lower electrolyte leaching than genotypes ZS-1(72.53%) and TS-7(71.0%) but remained on par with other genotypes. The data also indicated that the genotypes ZS-9(0.143), ZS-8(0.147) and ZS-1(0.156) recorded significantly lower peroxidase activity (as indicated by lower OD values) than genotypes ZS-3(0.216), ZS-5(0.224) and TS-5(0.239). As regards Relative Water Content, the differences were not significant.

Mulde

The experiment was started during June 1999 with 18 accessions which include three from Guinea Bissau (GB), eight from Tanzania (TS) and seven from Zambia(ZS). They were planted at a spacing of 9m x 9m in a RBD with three replications. Data in Table 62 revealed that the genotypes differed significantly for height and girth of the palm. Genotype GB 22/311 and GB 21/310 were more dwarf types recording 1.3 m height. Number of leaves per palm was not significant. However, genotype ZS-5 (V_7) and TS-7 (V_{14}) recorded maximum (23) number of leaves. Whereas genotype TS-2 (V_{10}) and TS-10 (V_{17}) were the tallest and recorded 2.2 m height, genotype ZS-6 (V_8) and ZS –9 (V_9) recorded 1.4 m girth. Production of male, productive and total inflorescences differed significantly among the genotypes. Genotype GB 25/314 (V_1) produced significantly higher productive inflorescences (4.5). It also recorded significantly lesser male inflorescences (4.2) than other genotypes. Genotype G.B. 21/311(V_2) produced significantly higher number of male inflorescences (11.4) followed by G.B.21/310 (V_3) i.e. 10.7 male inflorescences. It is seen from the yield data that genotypes differ significantly for the number of FFB. Genotype GB 25/314 (V_1) recorded the highest number of FFB (8.1). Average bunch weight was maximum in genotype TS- 4 (V_{12}) i.e. 3.43 kg. Though differences due to genotypes for FFB yield was not significant, the genotype ZS-8 (V_{11}) was found to record 10.50 kg FFB yield.

Table 62: Flowering behaviour and yield of drought tolerant genotypes (Mulde, 2005)

Genotype		No. of male inflore scences	No. of productive inflorescences	No. of total inflore scences	No. of bunches	Yield of FFB (kg/palm)	Bunch weight(kg/ bunch)
V1	G.B. 25/314	4.2	4.5	8.6	8.1	6.44	0.77
V2	G.B. 22/311	11.4	0.6	12.0	1.1	1.02	1.29
V3	G.B. 21/310	**10.7**	1.8	12.5	**1.4**	1.78	1.17
V4	ZS -1	9.7	2.7	12.3	1.6	3.54	2.09
V5	ZS-2	8.4	1.8	10.2	2.1	6.62	3.12
V6	ZS- 3	8.6	2.1	**10.7**	1.9	4.98	2.50
V7	ZS- 5	8.5	1.1	9.5	1.7	5.66	3.42
V8	ZS- 6	7.7	2.1	9.8	2.7	6.88	2.42
V9	ZS- 9	**8.6**	1.3	10.0	2.4	6.08	2.24
V10	TS- 2	8.6	1.3	9.9	1.6	3.79	2.10
V11	ZS-8	7.0	2.9	9.9	3.4	10.50	3.17
V12	TS -4	10.3	1.7	12.0	0.7	2.46	3.43
V13	TS- 5	8.3	0.5	8.9	0.2	0.96	2.89
V14	TS-7 (Control)	8.7	2.1	10.8	3.0	7.54	2.35
V15	TS-8	8.6	2.2	10.8	1.2	3.27	2.84
V16	TS- 9	8.3	**1.3**	**9.6**	1.6	**3.96**	**2.18**
V17	TS- 10	**9.5**	1.3	10.8	1.3	4.23	3.11
V18	TS -11	**5.9**	0.9	6.8	1.2	4.75	2.48
S. E. ±		0.8	0.7	**0.9**	0.7	1.99	0.84
CD(P=0.05)		2.4	1.9	2.8	2.0	NS	NS

Gen. 8B: Studies on the performance of exotic and indigenous Tenera hybrids of oil palm

(Vijayarai)

This observational trial with three exotic and one indigenous hybrid (Palode) was planted during February, 1995 with 16 palms/plot. The yield data are presented in Table 63. Maximum bunch weight was recorded in Costa Rica (16 kg) and the lowest was recorded in IRHO (14.4 kg). IRHO recorded a mean yield of 59.4 kg/palm (7.3 t/ha) and the lowest was recorded in Costa Rica with 43.9 kg/palm(5.4 t/ha).

Table 63:Yield data of exotic and indigenous tenera hybrids. (Vijayarai, 2005)

Sl. No.	Source of planting materials	Number of bunches/ palm	Bunch weight (kg)	Mean yield (kg/ palm)	Mean yield (t/ha)
1.	Papua New Guinea	3.1	15.2	47.5	5.9
2.	IRHO	4.1	14.4	59.4	7.3
3.	Costa Rica	2.8	16.0	43.9	5.4
4.	Palode	3.3	15.5	51.5	6.4

OIL PALM
4.2 Crop Production

Agr. 6: Studies on adaptability of oil palm in different agro-climatic regions and to assess the irrigation and nutrient requirements

(Aduthurai, Gangavathy, Mulde, Vijayarai)

The experiment was laid out in all the centres in a Strip plot design with three levels of irrigation as one set of strips and four levels of fertilizers as the other set of strips with three replications. The details of treatments are as follows:

Irrigation methods - 3

I_0 : No irrigation (life saving irrigation during peak summer months)

I_1 : Conventional irrigation (basin method)

I_2 : Drip irrigation

Fertiliser levels - 4

F_0 : No fertilizer

F_1 : 400:200 : 900 g N: P_2O_5 : K_2O/palm/year

F_2 : 800:400:1800 g N: P_2O_5 : K_2O/palm/year

F_3 : 1200:600:2700 g N: P_2O_5 : K_2O/palm/year

Aduthurai

The experiment was laid out in 1989. Data recorded during the year indicated that the different irrigation methods influenced the growth parameters like collar girth and number of leaves/palm/year. Basin irrigation (I_1) resulted in higher collar girth (2.7 m) and more number of leaves/palm/year (15.0). Palms under no irrigation (I_0) had lower collar girth (2.5 m) and lesser number of leaves/palm/year (13.2). Levels of inorganic fertilizer had significant effect. Increased application of fertilizer @ 1200:600:2700 g NPK/palm/year (F_3) recorded higher collar girth of 2.7 m. Trees raised without fertilizer application (F_0) were with lesser collar girth (2.5 m). Average number of leaves/palm/year was found less (13.4) at F_0 level and increased when fertilizer levels increased and was maximum (14.9 leaves/palm/year) at F_3 level (1200:600:2700 g NPK/palm/year). Method of irrigation had effect on the number of inflorescences. Basin irrigation (I_1) resulted in the highest number of female inflorescences (7.2), higher number of bunches (6.1) and higher bunch weight (17.3 kg) and was followed by drip irrigation (I_2) with 6.3 number of female inflorescences, 5.5 number of bunches and 16.1 kg bunch weight. Palms raised without irrigation (I_0) produced lower number of female inflorescences (5.4), lower number of bunches (4.5) with average bunch weight of 10.8 kg. Basin method of irrigation resulted in lower number of male inflorescences (2.5) while no irrigation recorded higher number of male inflorescences (3.9).

Fertilizer levels showed significant effect on number of inflorescences, number of bunches and bunch weight. As the levels of N, P and K increased, there was gradual increase in the values of yield attributing characters of oil palm (except no. of male inflorescences/palm/year). NPK fertilizers at 1200:600:2700 (F_3) recorded the maximum no. of female inflorescences (7.4), no. of bunches (6.3) and bunch weight (18.1 g) compared with lower doses (F_0, F_1 & F_2). Increased levels of NPK fertilizers resulted in gradual decrease in no. of male inflorescences and at 1200:600:2700 g NPK/palm/year (F_3), it was 2.6/palm/year compared to F_2, F_1 and F_0 doses of NPK i.e., 3.0, 3.4 and 3.7/palm/year respectively. Data on the effect of irrigation and fertilizers on yield is presented in Table 64.

Table 64 : Influence of irrigation methods and level of fertilizers on FFB yield (t/ha/year) – Aduthurai, 2005

Irrigation/ Fertilizer	F_0	F_1	F_2	F_3	I Mean
I_0	6.8	7.4	9.0	10.9	8.5
I_1	9.2	11.2	14.5	17.3	13.1
I_2	7.2	9.8	12.1	14.2	10.8
F Mean	7.7	9.5	11.9	14.1	

	SEd	CD (P=0.05)
I	0.27	0.76
F	0.21	0.43
I at F	0.41	0.99
F at I	0.36	0.75

It was seen that both irrigation methods and fertilizer levels had significant effect on FFB yield. Palms irrigated by basin method (I_2) produced the highest fresh fruit bunch yield of 13.1 t/ha/year followed by the palms irrigated by drip method (I_2) with an yield of 10.8 t/ha/year. The enhancement in the FFB yields were 54.1 and 27.1 per cent over the palms without irrigation (8.5 t/ha/year).

The palms applied with a fertilizer dose of 1200:600:2700 g NPK/palm/year (F_3) produced superior FFB yields (14.1 t/ha/year) followed by F_2-800:400:1800 g NPK/palm/year (11.9 t/ha/year) and F_1-400:200:900 g NPK/palm/year (9.5 t/ha/year) and the lowest FFB yield was in palms raised without any fertilizer (F_0) (7.7 t/ha/year). The increased FFB yields in F_3, F_2 and F_1 were 83.1, 54.5 and 23.4 % over F_0-without fertilizer.

The interaction effects between irrigation methods and fertilizers levels were found significant. A combination of basin method of irrigation (I_1) with 1200:600:2700 g NPK/palm/year (F_3) registered maximum FFB yield (17.3 t/ha/year).

Soil nutrient availability analysis

Soil Samples were collected to analyse the nutrient availability status of nitrogen, phosphorus and potassium. The data on soil available nitrogen revealed that irrigation levels did not influence the soil available nitrogen. Fertilizer levels had significant influence on the soil available N. The highest value of 164 kg/ha was recorded in F_3 followed by 159.8 kg / ha in F_2 with the lowest value of 147.6 kg / ha recorded in F_0. Interactions were significant and the highest value of 170.0 kg / ha were recorded in $I_1 F_3$ (basin method of irrigation with 1200:600:2700 g NPK palm / year).The data on soil available phosphorus revealed that the irrigation levels did not influence the soil available P significantly. Fertilizer levels had significant influence on P availability. The highest value of 57.9 kg/ha was recorded in F_3 (1200:600:2700 g NPK palm/year). This was followed by F_2 with 54.6 kg/ha of available P. Interaction effect was not significant. However basin irrigation with F_3 level of fertilizer recorded the highest value of 58.3 kg/ha of soil available P. The data on soil available potassium revealed that the irrigation levels did not influence soil available K significantly. Fertilizers levels had significant influence on K and the highest value of 262.2 kg/ha was recorded in1200: 600: 2700 g NPK/palm/year. This was followed by F_2 with 259.3 kg/ha. Interaction effect was not significant. However, basin irrigation (I_1) with F_3 level of fertilizer application recorded the highest value of 263.3 kg/ha of soil available K.

Gangavathy

The experiment was laid out in 1988. Data on FFB yield are presented in Table 65. During the year 2004-05, the FFB yields remained non significant for different irrigation treatments. Basin and drip irrigation recorded numerically higher FFB yield of 6.17 and 6.46 t/ha respectively than no irrigation (control) which had recorded an FFB yield of 4.63 t/ha. As observed in the previous years, the FFB yields exhibited significant response to fertilizer application during 2004-05 also. Application of F_3 level of NPK (1200:600:2700 g NPK/palm) resulted in significantly higher FFB yield (7.7 t/ha) than other levels of NPK wherein FFB yields varied from 3.50 to 6.17 t/ha. The F_3 treatment registered 54 percent higher FFB yield than control. The interaction between irrigation and fertilizers remained non significant on FFB yields. However, the treatment combination I_1F_3 (Basin irrigation with 1200:600:2700 g NPK/palm) recorded numerically higher FFB yield of 8.51 t/ha followed by I_2F_3 (Drip irrigation with 1200:600:2700 g NPK/palm) with an FFB yield of 8.35 t/ha. The FFB

yields of the experimental plots during 2004-05 in general remained lower due to lack of irrigation facilities during the canal closure period.

Basin irrigation improved the bunch number and resulted in significantly more number of bunches per palm (3.94) over no irrigation control which recorded 3.03 number of bunches. Similarly, application of F_3 level NPK (1200:600:2700g/palm) resulted in significantly higher number of bunches per palm (3.92) than all other NPK levels. However, interaction effect was non significant for bunch number. Among the treatment combinations, I_1F_3 (Basin irrigation with 1200: 600:2700 g NPK /palm) recorded numerically more number of bunches per palm (4.74).

Mean bunch weight was significantly higher in the case of drip irrigation (11.09 kg) than basin irrigation (9.4 kg). Similarly, application of F_3 level of NPK (1200:600:2700 g/palm) resulted in significantly higher mean bunch weight (11.9 kg) than no NPK control (8.56 kg) and F_1 level of NPK(10.81 kg) but remained on par with application of F_2 level of NPK(11.37 kg). The interaction effect was significant for mean bunch weight. The combination I_2F_3 (drip irrigation with 1200:600:2700 g NPK/palm) recorded significantly higher mean bunch weight (13.13 kg).

The cumulative FFB yield over a period of six years (Table 65**)** i.e from 1999-2000 to 2004-05, (except the FFB yield of 2000-01) indicated that both basin and drip irrigation with cumulative FFB yield of 37.02 and 37.54 t/ha respectively proved superior to no irrigation control which recorded a cumulative FFB yield of 28.23 t/ha only. Similarly, application of F_3 level of NPK recorded significantly higher cumulative FFB yield (43.06 t/ha) over no NPK control (20.12 t/ha) and F_1 level of NPK(34.86 t/ha) but remained on par with F_2 level of NPK The interaction effect on cumulative FFB yield was also significant. The treatment combination I_2F_3 (drip irrigation with 1200:600:2700 g NPK) recorded significantly higher cumulative FFB yield of 47.75 t/ha than all other combinations except I_1F_3 (43.86 t/ha) and I_2F_2 (44.06 t/ha). Cumulative FFB yield of the year 2000-01was not included in the analysis due to exceptionally high yields obtained in case of I_1F_1 during the year.

Table 65: Fresh fruit bunch yield (t/ha) of oil palm as influenced by irrigation and fertilizer treatments (Gangavathy, 2005)

Irrigation	FFB yield (t/ha) (2004-05)	Cumulative yield (t/ha) (1999-2005)
I_O	4.63	28.23
I_1	6.17	37.02
I_2	6.46	37.54
SE m±	0.51	1.03
CD (P=0.05)	NS	4.05
Fertilizers		
F_O	3.50	20.12
F_1	5.65	34.86
F_2	6.17	39.01
F_3	7.70	43.06
SE m ±	0.26	1.54
CD (P=0.05)	0.90	5.33
Interaction		
I_OF_O	3.41	17.39
I_OF_1	4.08	26.97
I_OF_2	4.77	30.99
I_OF_3	6.27	37.55
I_1F_O	3.25	20.58
I_1F_1	6.56	41.65
I_1F_2	6.38	41.99
I_1F_3	8.51	43.86
I_2F_O	3.84	22.39
I_2F_1	6.32	35.95
I_2F_2	7.34	44.06
I_2F_3	8.35	47.75
SE m ±	0.78	1.30
CD (P=0.05)	NS	4.01

Leaf nutrient availability analysis

Leaf nutrient analysis carried out on 17th frond revealed that leaf P concentration remained non significant for different irrigation treatments. It varied from 0.15% in the case of no irrigation control to 0.156% in the case of basin irrigation. However, fertilizer application had significant effect on leaf P content. Application of F_3 level of NPK recorded significantly higher leaf P (0.16%) than no NPK control (0.14%) and application of F_1 level of NPK(0.151%) but remained on par with F_2 level NPK(0.159%). Interaction of irrigation and fertilizers had no significant effect on leaf P content. The leaf P values observed in different treatments were nearer to the suggested optimum of around 0.15%. Leaf K concentration similarly remained non significant for

irrigation treatments. It varied from 0.80% in no irrigation control to 0.88% in basin irrigation treatment. However, all the NPK levels recorded significantly higher leaf K values (0.78 to 0.99%) than no NPK control (0.69%). Application of F_3 level of NPK maintained significantly higher leaf K concentration (0.99%) than all other NPK levels. Interaction of irrigation and fertilizers had no significant effect on leaf K content. The leaf K values observed in different treatments were slightly below the suggested optimum of around 1.0 percent.

Mulde

The experiment was laid out in 1989. Data on number of bunches per palm, average weight of bunch (kg) and average yield of fresh fruit bunches (FFB kg/palm) for the period July 2004 to June 2005 are given in Table 66. It was seen that irrigation did not show any significant effect on yield attributes. Basin irrigation (I_1) recorded maximum number of FFB (4.64), average weight of FFB (20.88 kg) and yield of FFB (96.33 kg/palm/year i.e., 13.80 t/ha) followed by drip irrigation (I_2). However, fertilizer level was found to significantly affect average weight of bunch and yield of FFB. Present study revealed that FFB yield increases with the increase in levels of fertilizers and it was significantly higher at F_3 level. Fertilizer at F_3 level recorded significantly more number of bunches (4.86), average weight of FFB (21.98 kg) and highest FFB yield i.e. 105.67 kg per palm (15.11 t/ha).

Performance of oil palm under irrigation cum fertilizer experiment at Mulde Centre.

Table 66: Yield of oil palm as affected by the levels of irrigation and fertilizers (Mulde, 2005)

Treatment		No. of bunches/palm	Bunch weight (kg)	FFB yield (kg/palm/year)	FFB yield (t/ha)
Irrigation	I_0	3.86	19.47	74.32	10.63
	I_1	4.64	20.88	96.53	13.80
	I_2	4.05	20.31	83.46	11.93
SE +		0.5	0.69	11.34	1.62
CD(P=0.05)		NS	NS	NS	NS
Fertilizers	F_0	3.22	17.67	56.77	8.12
	F_1	4.35	**19.97**	85.06	12.16
	F_2	4.30	21.27	91.59	13.10
	F_3	4.86	21.98	105.67	15.11
SE +		0.36	**0.83**	**6.65**	**0.95**
CD (P=0.05)		NS	2.87	23.0	3.29
Interaction	I_0F_0	3.22	16.74	54.45	7.79
	I_0F_1	4.34	19.37	82.77	11.83
	I_0F_2	3.39	22.42	75.11	10.74
	I_0F_3	4.49	19.35	84.95	12.15
	I_1F_0	3.78	18.24	67.45	9.65
	I_1F_1	5.33	19.54	101.71	14.54
	I_1F_2	4.56	21.06	98.64	14.11
	I_1F_3	4.88	24.69	118.32	16.92
	I_2F_0	2.67	18.03	48.41	6.92
	I_2F_1	3.39	20.99	70.69	10.11
	I_2F_2	4.94	20.33	101.00	14.44
	I_2F_3	5.22	21.90	113.74	16.26
SE +		**0.63**	**1.61**	**10.31**	**1.47**
CD (P=0.05)		NS	NS	NS	NS

Interaction effects were non significant for any of the characters under study. However, highest yield of FFB (118.32 kg/palm i.e., 16.92 t/ha) were recorded at I_1F_1 levels and it was followed by I_2F_3 level. Number of bunches were maximum at I_2F_3 level (5.33) whereas highest bunch weight (24.69 kg) was recorded at I_1F_3 levels.

Water Use Efficiency analysis

Data regarding quantity of water used and Water Used Efficiency for the year 2003-04 and 2004-05 were collected and presented in Table 67. It was observed that Water Use Efficiency differed significantly among the irrigation treatments during the year 2003-04. Drip irrigation recorded significantly higher Water Use Efficiency of 5.4 kg/ha. mm as compared to 3.4 kg/ha. mm in basin irrigation. Similar trend was observed during 2004-05, though the effect was not significant. Drip irrigation recorded higher Water Use Efficiency i.e. 3.8 kg/ha. mm. Similarly, the WUE was significantly higher in all the fertilizer treatments with increasing trend from F_0 to F_3 level and it was maximum at F_3 level i.e. 6.1 kg/ha. mm and 4.4 kg/ha mm during 2003-04 and 2004-05 respectively. Interaction of irrigation and fertilizer treatments had no significant effect on WUE. However, highest WUE of 7.8 kg/ha.mm was noticed in the treatment combination I_2F_3 i.e. drip irrigation with fertilizer @ 1200: 600 : 2700 g NPK/palm/year.

Table 67: Water Use Efficiency at different irrigation and fertilizer levels (Mulde, 2005)

Treatment		Water use efficiency (WUE) kg/ha.mm (2003-04)	Water use efficiency (WUE) kg/ha.mm (2004-05)
Irrigation	I_0	3.4	3.6
	I_1	3.6	3.3
	I_2	5.4	3.8
SE +		0.3	0.4
CD(P=0.05)		1.2	N.S.
Fertilizers	F_0	2.5	2.4
	F_1	3.5	3.6
	F_2	4.4	3.8
	F_3	6.1	4.4
SE +		0.3	0.3
CD(P=0.05)		0.9	0.9
Interaction	I_0F_0	1.8	2.6
	I_0F_1	3.5	4.2
	I_0F_2	3.3	3.6
	I_0F_3	4.8	4.0
	I_1F_0	2.3	2.3
	I_1F_1	3.4	3.4
	I_1F_2	3.1	3.3
	I_1F_3	5.8	4.0
	I_2F_0	3.5	2.2
	I_2F_1	3.6	3.2
	I_2F_2	6.8	4.6
	I_2F_3	7.8	5.2
SE +		0.6	0.5
CD(P=0.05)		N.S.	N.S.

Soil nutrient status

Soil analysis was done for the different treatments and data regarding available N, P and K at 0-25 cm soil depth are given in Table 68. It is seen from the data that the soil available N and P did not differ significantly due to irrigation and had significant effect on available K only. Available N and K was maximum and P was minimum at I_0 level. Fertilizer levels showed significant effect on available N, P and K. Available P and K increased with increasing levels of fertilizer treatment from F_0 to F_3 level. Interaction of irrigation and fertilizer did not show significant effect on available N and P. However, it was noticed that increase in levels of potash increased the available P in the soil significantly, irrespective of irrigation treatment and levels were higher in no irrigation and fertilizer combination.

Table 68: Soil available nutrient status as influenced by different methods of irrigation and fertilisers (Mulde, 2005)

Treatment		pH	Organic carbon %	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)	E C
Irrigation	I_0	5.7	1.8	434.7	74.6	495.9	0.12
	I_1	5.9	1.8	426.9	77.2	262.1	0.08
	I_2	5.8	1.8	411.2	77.2	308.5	0.13
SE ±		0.1	0.1	8.1	6.3	4.1	0.007
CD(P=0.05)		0.1	N.S.	N. S.	N.S.	16.0	0.03
Fertilizers	F_0	5.8	1.8	408.6	90.0	149.0	0.09
	F_1	5.8	2.0	466.1	96.5	321.7	0.10
	F_2	5.8	1.9	402.9	100.0	381.3	0.11
	F_3	5.9	1.7	419.5	100.0	547.8	0.15
SE ±		0.2	0.1	3.4	5.5	9.9	0.004
CD(P=0.05)		N.S.	N.S.	11.9	19.0	34.3	0.015
Interaction	I_0F_0	5.7	1.9	405.8	8.9	90.0	0.08
	I_0F_1	5.7	1.9	447.8	89.6	493.0	0.12
	I_0F_2	5.8	1.8	428.9	100.0	600.0	0.13
	I_0F_3	5.8	1.7	456. 5	100.0	734.0	0.15
	I_1F_0	5.7	1.7	456.4	9.0	159.0	0.05
	I_1F_1	5.9	2.0	465.1	100.0	240.0	0.10
	I_1F_2	6.0	1.8	391.3	100.0	308.0	0.07
	I_1F_3	6.1	1.6	394.9	100.0	341.3	0.11
	I_2F_0	6.0	1.6	363.7	9.0	198.0	0.13
	I_2F_1	5.8	2.1	485.4	100.0	232.0	0.09
	I_2F_2	5.7	2.0	388.4	100.0	236.0	0.12
	I_2F_3	5.9	1.8	407.2	100.0	568.0	0.19
SE ±		1.7	1.73	20.5	8.65	12.2	-
CD(P=0.05)		N.S.	N.S.	N.S.	N.S.	37.6	0.03

Vijayarai

The experiment was started in 1988. The yield data of fresh fruit bunches furnished in Table 69 reveals that the effect of irrigation, fertilizer levels and interaction were significant.

The treatment I_1F_3 has recorded maximum number of bunches per palm (9.1) and lowest was seen in in I_1F_1 (3.4). The treatment I_2F_2 recorded maximum bunch weight (12.3 kg) and the lowest was recorded in I_0F_0 (9 kg). Maximum yield of fresh fruit bunches per palm was recorded in I_1F_3 (103.4 kg). Lowest yield was recorded in the treatment I_1F_1 (38.8 kg).

Water Use Efficiency was higher in drip irrigation treatment (2.7 kg/ha/mm) than in other treatments(Table 70). Lowest Water Use Efficiency of 1.2 kg/ha/mm was observed in conventional basin irrigation.

Table 69: Effect of irrigation and fertilizer levels on yield of oilpalm (Vijayarai, 2005)

Sl. No.	Treatment	No.of bunches/palm	Bunch weight (kg)	Mean yield/palm (kg)	Mean yield (t/ha)	Cumulative mean yield (kg/palm) (1992-2005)
Irrigation						
	I_0	5.5	10.9	60.2	7.4	5.9
	I_1	5.3	11.5	60.0	7.2	10.7
	I_2	5.8	11.3	65.0	8.0	9.7
	CD(P=0.05)	NS	NS	NS	NS	0.7
Fertilizers						
	F_0	5.1	10.5	52.5	6.5	6.3
	F_1	4.2	11.3	46.5	5.7	7.8
	F_2	5.5	11.8	64.0	7.9	9.4
	F_3	7.4	11.3	83.9	10.1	11.6
	CD(P=0.05)	1.2	NS	12.5	1.5	0.7
Interaction						
1	$I_0 F_0$	5.3	9.0	48.2	6.0	4.5
2	$I_0 F_1$	4.2	11.0	45.6	5.6	5.0
3	$I_0 F_2$	5.9	11.8	69.6	8.6	6.2
4	$I_0 F_3$	6.5	11.7	73.3	9.5	8.0
5	$I_1 F_0$	3.8	11.6	45.6	5.4	7.6
6	$I_1 F_1$	3.4	11.5	38.8	4.8	9.3
7	$I_1 F_2$	3.9	11.2	54.2	6.7	11.6
8	$I_1 F_3$	9.1	11.4	103.4	11.9	14.2
9	$I_2 F_0$	6.1	10.8	65.7	8.1	6.8
10	$I_2 F_1$	4.9	11.3	55.1	6.8	9.1
11	$I_2 F_2$	5.7	12.3	68.2	8.4	10.5
12	$I_2 F_3$	6.6	10.9	70.9	8.7	12.5
	CD(P=0.05)	2.1	NS	21.7	2.5	1.3

Table 70: Irrigation water applied (mm) and Water Use Efficiency (WUE) as influenced by different irrigation treatments (Vijayarai, 2005)

Treatment	FFB yield (kg/ha)	Irrigation water applied (mm)	Water Use Efficiency (kg/ha-mm)
No irrigation (half the qty. of basin irrigation)	7,400	301.4	2.5
Conventional basin irrigation	7,200	602.8	1.2
Drip irrigation	8,000	301.4	2.7

Economic analysis

The economic performance of various treatment combinations averaged over two years FFB yield data and expenses involved for various inputs including labour wages and harvesting charges are presented in Table 71.

In general, the cost of cultivation depended on the level of input used and was maximum (Rs.18,570/) in the plots where the fertilizer level was at its maximum. The gross and net returns depended much on the level of inputs more particularly irrigation and fertilizer levels.

Table 71: Economic analysis of different methods of irrigation and fertilizers (Vijayarai, 2003-05)

Treatment	FFB yield kg/ha	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)	Benefit cost ratio
$I_0 F_0$	7,750	31,000	15,000	16,000	1.06
$I_0 F_1$	7,400	29,600	16,190	13,410	0.82
$I_0 F_2$	9,000	36,000	17,380	18,620	1.07
$I_0 F_3$	9,200	36,800	18,570	18,230	0.98
$I_1 F_0$	8,100	32,400	15,000	17,400	1.16
$I_1 F_1$	8,600	34,400	16,190	18,210	1.12
$I_1 F_2$	12,200	48,800	17,380	31,420	1.81
$I_1 F_3$	15,800	63,200	18,570	44,630	2.40
$I_2 F_0$	9,000	36,000	15,000	21,000	1.40
$I_2 F_1$	9,900	39,600	16,190	23,410	1.43
$I_2 F_2$	10,800	43,200	17,380	25,820	1.49
$I_2 F_3$	11,900	47,600	18,570	29,030	1.56

Sale value of Oil palm fresh fruit bunches – Rs. 4/- per kg.

Cost of cultivation includes all expenses for inputs including labour charges as per the rate prevalent during 2004-05.

Highest gross and net returns were obtained in plots where higher fertilizer doses were applied in combination with basin irrigation. Maximum benefit cost ratio (BCR) was achieved in $I_1 F_3$ (.2.40) followed by $I_1 F_2$ (1.81). The lowest BCR was noticed in $I_0 F_1$ (0.82).

Front line demonstrations on nutrient and irrigation management in oil palm

(Aduthurai, Mulde, Vijayarai)

Aduthurai

Four FLD plots to demonstrate nutrient and irrigation management in oil palm were established with two each representing Old Delta and New Delta areas of the Cauvery Delta Zone. The imposition of treatments and input supply were undertaken as per the technical programme.

Mulde

Two frontline demonstrations were maintained as per technical programme and the required observations were recorded.

Vijayarai

Four FLD plots to demonstrate nutrient and irrigation management in oil palm were initiated in West Godavari District of Andhra Pradesh. The imposition of treatments was initiated from March, 2005. Periodical field visits were made to give suitable suggestions and to record observations. Soil samples were collected from the FLD plots to analyse the available nutrient status.

PALMYRAH

5.1 Crop Improvement

Gen. 9: Survey and collection of palmyrah germplasm and evaluation

(Killikulam, Pandirimamidi)

Killikulam

Programme for the collection of elite germplasm was continued during the current year also. Since 1995, dwarf and high neera yielding genotypes were selected through survey conducted both in Tamil Nadu and Andhra Pradesh. So far, 182 accessions have been collected and out of these, 173 accessions have survived and a minimum of 15 plants are being maintained for each accession. The assembled germplasm were scored for plant height (cm) and number of leaves.

In Block I (1995), the Accession 022 registered the maximum plant height and maximum number of leaves (143.0 cm and 13.4 respectively), while the Accession 033 recorded the lowest values of 62.0 cm and 3.8 for the above traits respectively.

In Block II (1997), the plant height and number of leaves ranged from 94.0 cm and 8.0 (Accession 44) to 238.0 cm (Accession 065) and 12.2 (Accession 052) respectively.

In Block III, Accession 088 recorded maximum plant height of 78.8 cm and Accession 077 recorded maximum number of leaves (8.3), while in Block IV, Accession 091 had the maximum plant height of 68.6 cm and maximum number of leaves was registered in Accession 093 (8.00)

In Block IV (2001), the tree height and number of leaves ranged from12.5 cm and 2.0 (Accession 102) to 63.0 cm and 10.6 (Accession 106) respectively.

In Block V (2002), Accession 114 had the maximum plant height of 55.2 cm and Accession 119 recorded the maximum number of leaves (8.8). In Block Va, maximum plant height of 71.0 cm was recorded in Accession 137, while Accession 139 recorded maximum number of leaves (6.00).

In Block VI (2003), Accession 157 recorded maximum value for plant height (45.0 cm) while Accession 154 had the maximum number of leaves (8.0).

In Block VII (2004), the plant height ranged from 16.0 cm (Accession 167) to 47.5 cm (Accession 166), while the leaf number ranged from 1.5 (Accession 167) to 3.2 (Accession 162).

Germplasm collection during 2005

Survey and collection of elite genotypes of palmyrah was continued during November 2005. Survey was taken in Nanguneri, Aralvaimozhi, Kalakad etc., in Tamil Nadu State. Ten fruits were collected from each accession and observations were recorded as per the approved proforma. Among the nine genotypes collected, the accession TN 07/05 followed by TN 03/05 recorded maximum values for fruit weight (1750 g and 1682 g) and maximum total seed weight (1103.3 g and 1025.6 g) respectively. A total of 15 seeds have been sown per accession in New area (Block VIII) for further maintenance and evaluation.

High yielding palmyrah accessions

Evaluation of accessions for neera/nungu yield

For the past eight years, evaluation of nine elite genotypes of palmyrah viz., E6, F1, F4, E1, F16, F23, F20, F34 and F36 was done for neera yield and based on the results obtained so far, it has been concluded that the accessions viz., F 34 and F 36 were the promising types since they consistently recorded higher neera yield of more than 120 lit./year. Among the accessions, F36, F23, F1 and F4 are male trees. Out of these four, two types viz., F23 and F36 are highly promising in giving consistently higher yield of Neera.

During September 2005, the above genotypes in addition to other accessions which have attained a maturity of 14-15 years were evaluated for nungu/fruit yield.

Among the 20 accessions evaluated, F20 followed by F39 recorded maximum number of fruits per tree. F20 had recorded good neera yield also during the earlier evaluation of palmyrah genotypes for neera production.

Pandirimamidi

A total of 176 accessions have been collected and maintained since the inception of the project. The accessions were planted at 3m x 3m spacing in single rows using 12 stones per accession.

All germplasm blocks are being evaluated regularly for the parameters such as plant height, stem girth, number of leaves, lamina length and lamina breadth and petiole length.

The data recorded on the accessions planted during 1991 (Table 72) have revealed that, mean plant height was maximum in the accession-1/91(6.89 m) followed by the accession-6/91 [6.5 m]. Mean stem girth was maximum in accession-4/91(1.9 m). Lamina length and breadth were found maximum in the accession-1/91 (1.01 and 1.50 m respectively). Petiole length was more in accession-7/91(1.45).

During the year, tapping was initiated in the 1991 block of palmyrah germplasm as a few palms in some of the accessions have reached the flowering stage. Tapping was initiated in the month of December and extended up to April. Maximum neera yield of 79.9 litres **(**Table 73**)** was obtained in the accession 12/91 over a period of 45 days, which was followed by accession-5/91 that has yielded 37.5 litres in a tapping duration of 35 days. Lowest neera yield was recorded with accession-7/91 with only 26 ml in a tapping duration of 4 days.

Table 72: Performance of the accessions planted during 1991(Pandirimamidi, 2005)

Acc. No	Plant height (m)	Stem girth (m)	No. of leaves	Lamina length (m)	Lamina breadth (m)	Petiole length (m)
Acc-1/91	**6.8**	1.7	17	**1.01**	**1.50**	1.36
Acc-2/91	5.7	1.5	16	0.85	1.27	1.24
Acc-3/91	5.6	1.5	17	0.89	1.30	1.28
Acc-4/91	6.2	**1.9**	15	0.93	1.43	1.21
Acc-5/91	5.1	1.6	15	0.99	1.42	1.45
Acc-6/91	**6.5**	1.8	15	0.95	1.35	1.31
Acc-7/91	5.4	1.6	16	0.95	1.32	**1.45**
Acc-8/91	5.8	1.7	16	0.97	1.36	1.30
Acc-9/91	6.0	1.6	16	0.97	1.33	1.24
Acc-10/91	4.5	1.6	15	0.81	1.13	1.27
Acc-11/91	3.8	1.4	14	0.85	1.09	1.37
Acc-12/91	5.8	1.7	17	1.00	1.28	1.35
Acc-13/91	4.9	1.7	16	0.86	1.02	1.35

Table 73: Neera yield of the palmyrah accessions planted during 1991 in germplasm block (Pandirimamidi, 2005)

Sl. No.	Accession No.	Plant number	Sex	Number of spikes	Neera yield (litres)		Total yield/ tree (litres)	Duration of tapping
					Morning	Evening		
1	1/91	4	F	4	4.68	2.27	6.95	31
2	1/91	9	F	1	2.70	1.40	4.10	26
3	5/91	2	M	5	25.40	12.10	37.50	35
4	6/91	12	F	1	0.48	0.21	0.69	7
5	6/91	14	M	7	16.34	6.61	22.95	38
6	7/91	4	F	2	-	0.02	0.02	4
7	9/91	4	F	3	3.44	1.82	5.26	28
8	10/91	2	F	3	7.80	5.60	13.40	28
9	12/91	2	F	7	50.83	29.09	79.92	45
10	13/91	2	M	5	13.60	7.54	21.14	39

Among the 10 accessions planted during the year 1993, mean plant height differed among the accessions under study where as the differences for other parameters remained at par. Maximum plant height was recorded with the accession-4/93 (3.79 m) which was followed by accession-6/93 (3.48 m). Number of leaves produced ranged from 9.2 to 14.6 among the accessions and maximum was found with accession-8/93(14.6). Maximum leaf breadth and petiole length were recorded with accession-5/93(1.08 and1.6m) where as leaf length was maximum in accession-4/93(0.82 m).

Of the 14 accessions collected during 1994, differences were observed for number of leaves and other parameters did not differ among accessions. Maximum plant height of 3.75 was recorded in accession- 14/94 and the lowest was in accession-1/94(1.12 m). Stem girth was maximum in accession-13/94(1.38m). Number of leaves produced ranged between 9 to 16 with maximum being in accession-14/94. Maximum leaf length (0.95 m), leaf breadth (1.38m) and petiole length(1.29m) were noticed in accession-14/94.

Of the 8 accessions that have been planted during 1998, plant height was maximum in the accession-3/98

(2.34m). Mean number of leaves ranged from 5.5 to 11.8 among the accessions evaluated. Maximum leaf length was noticed in accession-3/98 (0.73m) with the maximum breadth of 1.15 m. Petiole length was maximum in accession- 6/98 (1.27 m).

Among the 8 accessions of 1999, mean plant height was maximum with accession-4/99(1.23 m). Average number of leaves ranged from 5.4 to 7.6 among accessions. Accessions did not show difference for the leaf parameters.

Plant height of accessions of the year 2000 ranged from 0.54 m to1.06 m, maximum being observed in accession-2/2000 and 18/2000(1.06 and 1.04 m). Number of leaves produced ranged from3.1 to 5.8. Mean leaf length was the highest in accession-18/2000(0.73 m). However, mean of petiole length was maximum in accession-4/2000(0.44). Leaf breadth was the highest in accession-2/2000 followed by accession 1/2000 (0.94 and 0.90 m).

Among the accessions of 2001, maximum palm height of 0.95 m was recorded in accession Acc-37/2001which also had maximum leaf breadth (0.91 m). Mean number of leaves produced ranged from 2.2 to 4.6. Maximum leaf length and petiole length were found in accession 42/2001 and 35/2001.

Of the 18 accessions that have been collected during 2002 in a joint survey taken up in Nalgonda district of Andhra Pradesh, maximum seedling height was recorded by the accession AP-14/02[0.90 m]. Accession 9/02 produced more number of leaves(4.6). Leaf length, leaf breadth and petiole length were maximum in accessions 3/02,9/02 and 6/02.

Among the 14 accessions collected during 2002 from Tamil Nadu, maximum seedling height was recorded by the accession-TN11/02(0.89 m) and number of leaves produced was maximum in the accession-TN9/02. Accessions TN13/02,TN3/02 and TN2/02 were superior with regards to leaf length, breadth and petiole length respectively.

Of the 13 accessions of 2003, seedling height was maximum in accession AP-12/03(0.32 m) and number of leaves produced ranged from 3.5 to 4.8 among the accessions.

Fourteen accessions collected during the year 2004, in a joint survey taken up in Tamil Nadu State covering three districts viz., Thoothukudi, Tirunelveli and Ramnad were planted at 4 x 4 m apart in single rows in field No.24 of the Centre. Emergence of the seedlings has commenced. Percentage of emergence ranged from 15% to 83.33%.

Accession TN 11/04 - yellow fruit with good eating quality

PALMYRAH

5.2 Disease Management

Path. 6 : Survey and control of diseases in palmyrah

(Killikulam, Pandirimamidi)

Killikulam

Disease surveillance

The survey covered the palmyrah groves in Thoothukudi and Tirunelveli districts. Survey on bud rot, leaf blight disease (caused by *Pestalotia palmarum*) and leaf spot (caused by *Stigmina palmivora*) was conducted. For leaf blight and leaf spot disease, 0-9 score chart was followed and Percent Disease Index (PDI) was worked out.

During the year 2005, the disease survey covered the palmyrah groves in Thoothukudi and Tirunelveli districts. Leaf blight was noticed in ten places, viz., Vallanadu, Vuvari, Anthoniarpuram, Servaikaranmadam, Manakarai, Athur and Srivaikundam of Thoothukudi district and at Kalanthapanai, Nanguneri and Tharuvai of Tirunelveli district. Per cent Disease Index (PDI) ranged from 3.00 to 32.00 (Table 74).

Table 74: Disease status in palmyrah palms (Killikulam, 2005)

Village	Soil type	Grove/Bunds	Age	PDI for Leaf blight	PDI for Leaf spot	Bud rot(% incidence)
Vallanadu	Loam	Bunds	10-50	18.00	12.00	2.00
Vuvari	Loam	Bunds	10-40	9.00	-	-
Anthoniarpuram	Sandy loam	Bunds	10-60	18.00	-	9.00
Servaikaranmadam	Loam	Grove	10-45	32.00	6.00	-
Manakarai	Loam	Bunds	15-40	15.00	-	8.00
Athur	Sandy	Grove	10-60	21.00	-	-
Srivaikundam	Sandy loam	Bunds	10-70	3.00	-	-
Kalanthapanai	Sandy loam	Bunds	40-60	4.50	25.00	-
Nanguneri	Sandy loam	Grove	10-50	12.00	-	-
Tharuvai	Loam	Grove	4-70	32.00	18.00	3.00

Leaf spot disease was recorded at four places with PDI ranging from 6.00 to 25.00. The disease severity on seedlings at Kalanthapanai was the highest. The spots were less than 0.5 cm in length and width, with a deep red margin and grey centre. The causal agent was identified as *Stigmina palmivora*. The imperfect fungus produced coloured conidiophores and conidia are brown and slightly curved with 7-10 septa.

Management trials for nursey diseases

Two field experiments were laid out during the year 2004 and 2005 on the eco friendly management of nursery diseases of palmyrah with the following treatments:

T1 Soaking of palmyrah seed in *Trichoderma viride* –cf

T2 Soaking of palmyrah seed in *Pseudomonas fluorescens*

T3 Soaking of palmyrah seed in *Bacillus subtilis*

T4 Soil application of *Trichoderma viride* –10g/bed
T5 Soil application of *Pseudomonas fluorescens* -10g/bed
T6 Soil application of *Bacillus subtilis* -10g/bed
T7 Soaking of palmyrah seed in *Trichoderma viride* – cf (1%) and soil application of neem cake-20g
T8 Soaking of palmyrah seed in Carbendazim-0.1%
T9 Control

Results (Table 75) indicated that the dipping seed nut in Carbendazim (0.1%) was significantly better in controlling the tuber rot than all the treatments. Carbendazim (0.1%) dip also increased the germination and tuber weight considerably. However, the use of chemical fungicide is being discouraged since the tuber is the edible part. Carbendazim dip was followed by soil application of T. *viride*.

Table 75: Management of tuber rot disease in palmyrah (Killikulam, 2005)

Sl. No.	Treatment	Germination (%)	Tuber rot incidence (%)	Tuber weight (g)
1.	Soaking seednut in *Trichoderma viride*(1%talc)	76.66	26.66	92
2.	Soaking in *Pseudomonas fluorescens*(1%talc)	76.66	26.66	88
3.	Soaking in *Bacillus subtilis(*1%talc)	80.00	30.00	87
4.	Soil application of *Trichoderma viride*	80.00	16.66	99
5.	Soil application of *Pseudomonas fluorescens*	76.66	23.33	95
6.	Soil application of *Bacillus subtilis*	86.67	23.33	92
7.	Soaking in *Trichoderma viride* (1%talc) with soil application of neem cake	80.00	23.33	98
8.	Soaking in Carbendazim (0.1%)	86.00	13.33	108
9.	Control	46.67	43.33	86
	CD(P=0.05)	3.4	5.1	3.9

Studies on variability in isolates of pathogens

Seven isolates of pathogen causing tuber rot disease was collected. Among the seven isolates, Killikulam isolate showed maximum growth. Among the various isolates of *Pestalotia palmarum*, isolate PP1 Killikulam isolate produced larger size lesions (3.8 x 1.2cm). Isolate PP4 collected from Anthoniarpuram was the least virulent. (Tables 76 and 77).

Table 76 : Cultural characters of *M. phaseolina* isolates (Killikulam,2005)

Sl. No.	Isolate No	Isolate source	Mycelial growth (mm)	Sclerotial size(μm)
1.	TRI-1	Killikulam	90	102
2.	TRI-2	Alangulam	87	97
3.	TRI-3	Nanguneri	88	96
4.	TRI-4	Anthoniarpuram	86	89
5.	TRI-5	Tiruchendur	76	92
6.	TRI-6	Munnerpallam	79	93
7.	TRI-7	Keelavallnadu	83	96

Table 77: Characters of leaf blight isolates (Killikulam, 2005)

Sl. No.	Isolate	Isolate source	Leaf blight lesion length (cm)	Leaf blight lesion breadth (cm)	Mycelial growth (mm)	Conidial length (μm)
1.	PP-1	Killikulam	3.8	1.2	90	102
2.	PP-2	Alangulam	3.1	1.0	87	97
3.	PP-3	Nanguneri	3.5	1.2	80	96
4.	PP-4	Anthoniarpuram	2.8	1.1	86	89
5.	PP-5	Tiruchendur	2.9	1.2	76	92
6.	PP-6	Munneepallam	3.5	1.0	79	93
7.	PP-7	Keelavallnadu	3.4	1.2	83	96

6. Budget and Release of funds (2005-06)

(Rs. in lakhs)

Sl. No	Centre	Pay and Allowances	TA	RC	Total Budget sanctioned	Release of funds * (2005-06)
1	Aliyarnagar	15.92	0.65	3.20	19.77	15.09
2	Ambajipeta	17.74	0.75	3.97	22.46	17.13
3	Arsikere	7.88	0.45	1.95	10.28	7.71
4	Jagadalpur	6.50	0.40	1.67	8.57	10.26
5	Kahikuchi	7.60	0.40	1.67	9.67	7.50
6	Bhubeneshwar	6.31	0.35	1.95	8.61	6.45
7	Mondouri	7.00	0.40	1.95	9.35	6.75
8	Ratnagiri	24.27	0.50	3.40	28.17	15.41
9	Veppankulam	19.46	0.60	5.56	25.62	18.35
10	Killikulam	9.15	0.40	1.65	11.20	9.50
11	Pandirimamidi	9.70	0.28	1.50	11.48	6.05
12	Aduthurai	5.00	0.17	1.00	6.17	4.67
13	Gangavathi	5.42	0.20	0.77	6.39	4.79
14	Mulde	5.51	0.20	0.77	6.48	5.33
15	Vijayarai	5.50	0.17	1.00	6.67	5.01
	Total	152.96	5.92	32.01	190.89	140.00

* towards ICAR share

7. Staff Position

HEADQUARTERS

Project Coordinator's Cell, CPCRI, Kasaragod 671 124, Kerala

(Phone & Fax: 04994-232733; E-mail: *aicrppalms@yahoo.com*)

Project Coordinator	:	Dr. S. Arulraj
Scientist (Economic Botany)	:	Mr. C. Jayabose (Study Leave)
		Sri. K. Vijaya Kumar, Sr. Scientist
Personal Assistant	:	Mrs. K. Narayani
Assistant	:	Mr. K. S. Ramakrishna

PROJECT CENTRES

ANDHRA PRADESH

Agricultural Research Station, Ambajipeta 533 214, East Godavari Dist.

(Phone: 08856-243289)

Principal Scientist (Horticulture)	:	Dr. D.V. Raghava Rao
Principal Scientist (Pathology)	:	Dr. B. Srinivasulu
Scientist (Horticulture)	:	Kum. M. Kalpana
Senior Scientist (Entomology)	:	Dr. A. Sujatha
Scientist (Pathology)	:	Vacant
Technical Assistants	:	1. Sri. M. Venkateswarlu2. Sri. S. Ephriem

Agricultural Research Station, Vijayarai 534 475, West Godavari Dist.

(Phone: 08812-225431)

Senior Scientist (Agronomy)	:	Dr. K. Krishna Rao
Senior Technical Assistant.	:	Vacant
Sub Technical Assistant	:	Vacant

Horticultural Research Station, Pandirimamidi, Ramapachodavaram P.O. 533 288, East Godavari Dist.

(Phone: 08864-243577)

Assoc.Professor (Horticulture)	:	Dr. K. T. Venkataramana
Asst.Professor (Plant Pathology)	:	Vacant
Technical Assistant	:	Vacant

ASSAM

Horticultural Research Station, Kahikuchi, Guwahati 781 017, Kamrup Dist.

(Phone: 0361-2842513)

Assistant Professor (Horticulture)	:	Dr. J. C. Nath
Assistant Professor (Agronomy)	:	Dr. Bijit Saud
Field Assistant	:	Mr. P. Bora

CHHATISGARH

Saheed Gundadhoor College of Agriculture & Research Station, Kumharawand Farm, Jagadalpur 494 005, Bastar Dist.
(Phone: 07782-229150; Fax: 229360)

Assistant Professor (Horticulture)	:	Mr. L. S. Verma
Assistant Professor (Agronomy)	:	Mr. A. K. Thakur
Technical Assistant	:	Mr. J. P. Yadav

KARNATAKA

Agricultural Research Station, Arsikere 573 103, Hassan Dist.
(Phone: 08174-232465)

Agronomist	:	Mr. T.B. Basavaraju
Asst. Professor (Plant Pathology)	:	Mr. K.B. Palanna
Senior Technical Assistant	:	Mr. Nagaraj Kusagur
Field Assistant	:	Mr. K. Mylarappaachar

Agricultural Research Station, Gangavathy 584 227, Raichur Dist.
(Phone: 08533-271030)

Assistant Professor (Agronomy)	:	Dr. B. G .Masthana Reddy
Research Assistant (Technical)	:	Mr. Nagabhushan
Field Assistant	:	Mr. Syed Jamaluddin

MAHARASHTRA

Regional Coconut Research Station, Bhatye 415 612, Ratnagiri Dist.
(Phone: 02352-235077)

Agronomist	:	Dr. D. D. Nagwekar
Scientist(Plant Breeding)	:	Mr. V. S. Sawant
Jr. Entomologist	:	Mr. B.N. Bhangare
Sr. Clerk	:	Mr. P. V. Sawant
Junior Agricultural Assistants	:	Mr. P. A. Shinde & Mr. G. B. Bharankar

Agricultural Research Station, Mulde - 416520, Kudal Taluk, Sindhudurg Dist.
(Phone: 02362-244231)

Assistant Professor (Agronomy)	:	Mr. M. S. Gawankar
Senior Technical Assistant	:	Mr. J. P. Devmore
Field Assistant	:	Mr. N. R. Parab

ORISSA

Department of Horticulture, OUAT, Bhubaneshwar - 751 003
(Phone: 0674-2390463)

Associate Professor (Breeding)	:	Dr. D. K. Dash
Associate Professor (Agronomy)	:	Dr. T.K. Das
Technical Assistant	:	Sri. P. K. Jena

TAMIL NADU

Coconut Research Station, Aliyarnagar 642 101, Coimbatore Dist.

(Phone: 04253-288722)

Professor (Agronomy)	:	Dr. R.Venkitaswamy
Associate Professor (Plant Breeding)	:	Dr. N. Meenakshi Ganesan
Assistant Professor (Plant Pathology)	:	Dr. B. Meena
Professor (Entomology)	:	Dr. K. Rajamanickam
Technical Assistant	:	Mr. S. A. Siddique

Tamil Nadu Rice Research Institute, Aduthurai 612 101, Thanjavur Dist.

(Phone: 0435-2472881)

Assistant Professor (Agronomy)	:	Dr. Tamil Selvan
Senior Technical Assistant	:	Mrs. P. Kalaiselvi
Field Assistant	:	Mr. M. Sudhakar

Coconut Research Station, Veppankulam 614 906, Thanjavur Dist.

(Phone: 04373-260205)

Professor (Plant Breeding)	:	Dr. R. Vaithilingam
Associate Professor (Agronomy)	:	Dr. R. Marimuthu
Assistant Professor (Agronomy)	:	Dr. A. Guruswamy
Assistant Professor (Plant Pathology)	:	Dr. A. Ramanathan
Assistant Professor (Crop Physiology)	:	Dr. T. S. Sivakumar
Agricultural Assistant	:	Mr. N. Vinayagamoorthy
Technical Assistant	:	Mr. R. Sekar
Junior Assistant (Administration)	:	Mr. M.Muthumani

Agricultural College & Research Institute, Killikulam 628 252, Vallanad, Tuticorin Dist.

(Phone: 04630-261226)

Associate Professor (Horticulture)	:	Dr. P. Nainar
Associate Professor (Plant Pathology)	:	Dr. E. G. Ebenezar
Technical Assistant	:	Mr. T. Subramanian

WEST BENGAL

Department of Plantation Crops, Faculty of Horticulture, BCKVV, Mondouri (Kalyani) 741 235, Nadia Dist.

(Phone: 033-25827574)

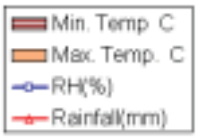
Assoc. Professor (Horticulture)	:	Dr. A. Bandyopadhyay
Asst. Professor (Plant Breeding)	:	Mr. D. K. Ghosh
Technical Assistant	:	Mr. A. K. De

KERALA

Central Plantation Crops Research Institute, Kasaragod 671 124

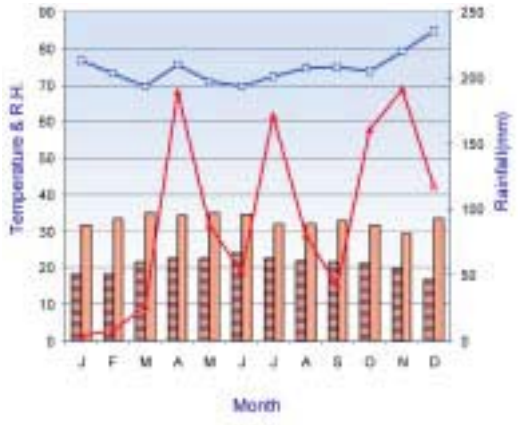
(Phone: 04994-232893/95)

Senior Scientist(Agronomy)	:	Dr. R. Dhanapal



COCONUT CENTRES

Aliyarnagar



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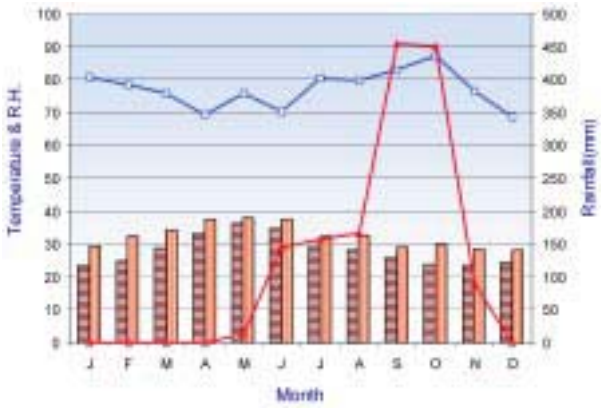

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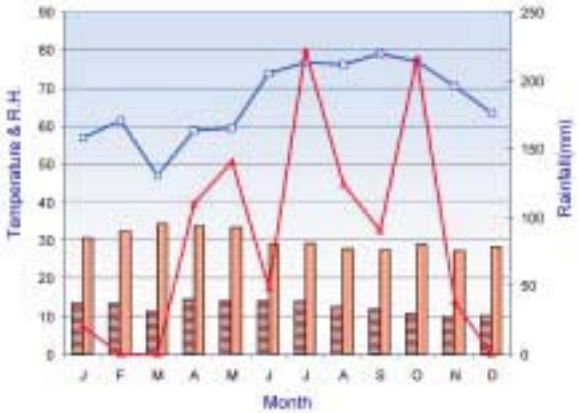

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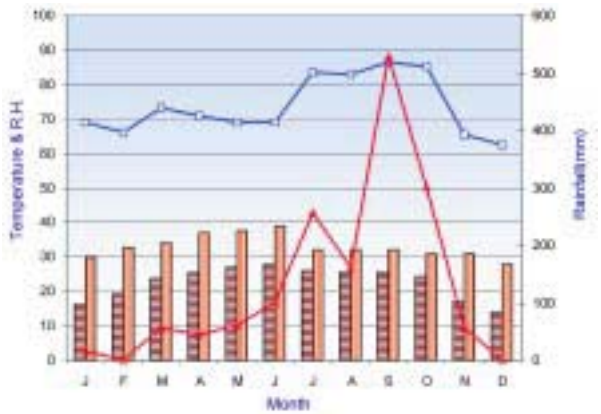
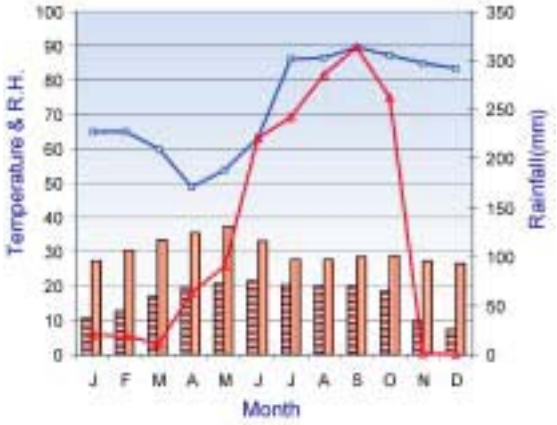


COCONUT CENTRES

Jagadalpur



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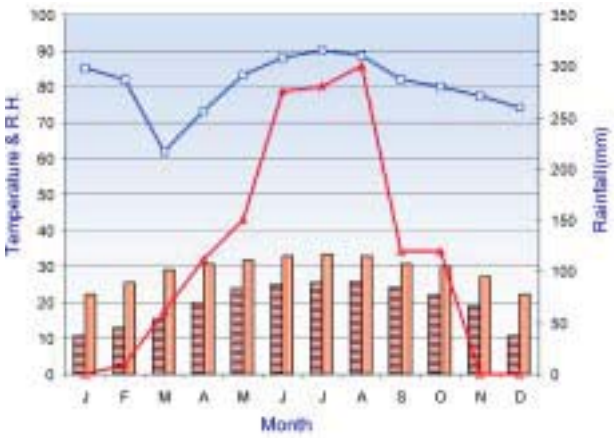

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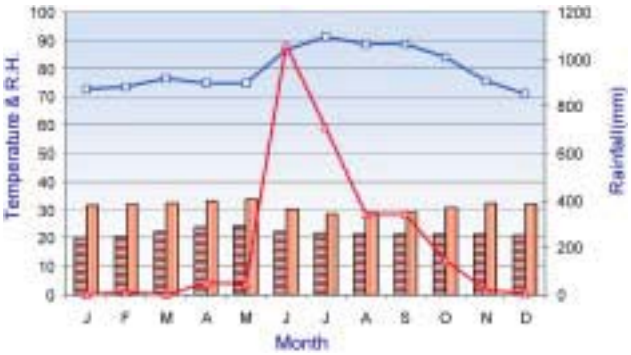

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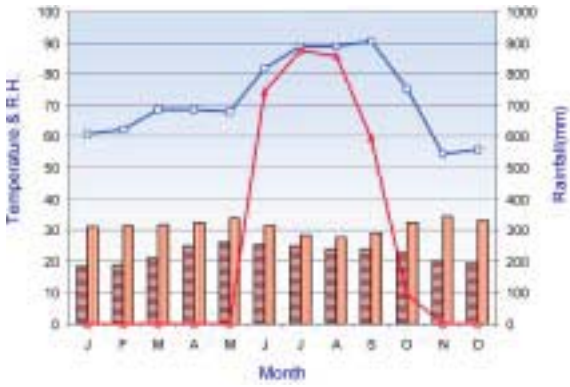

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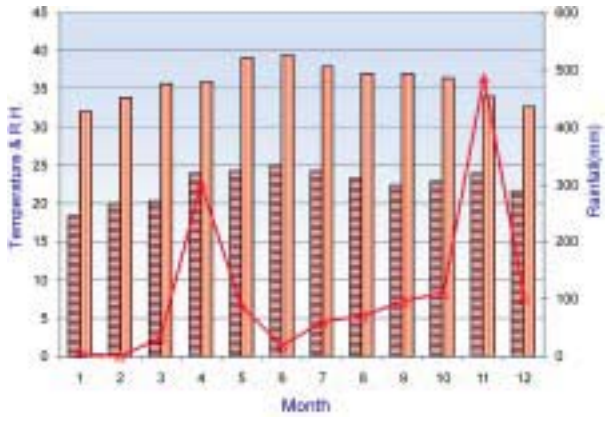

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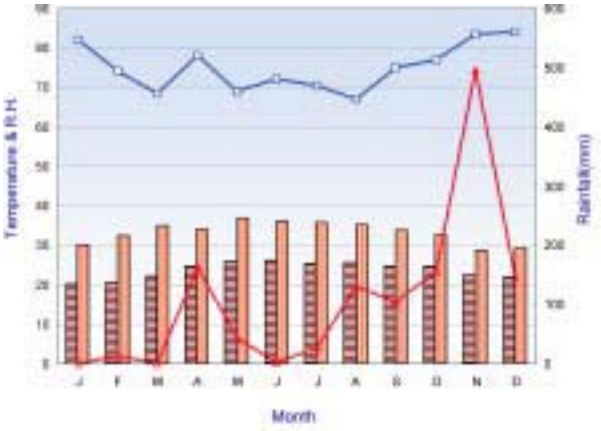

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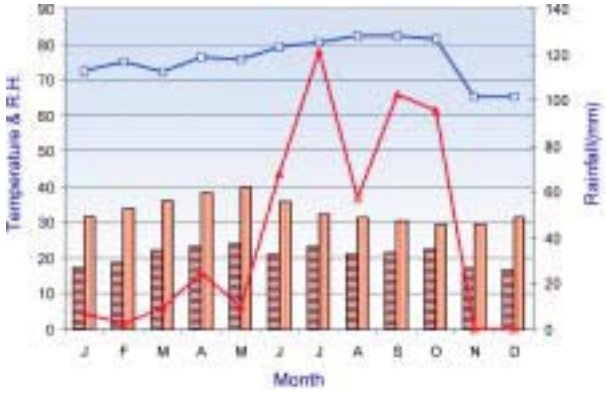

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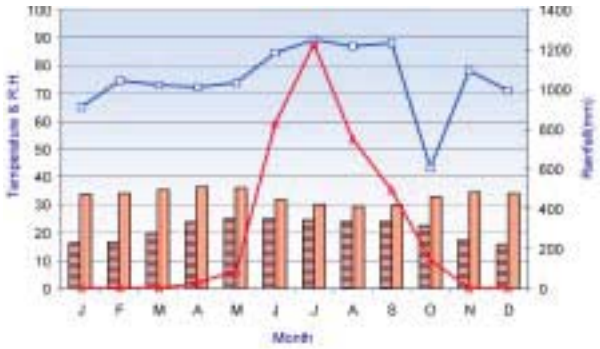
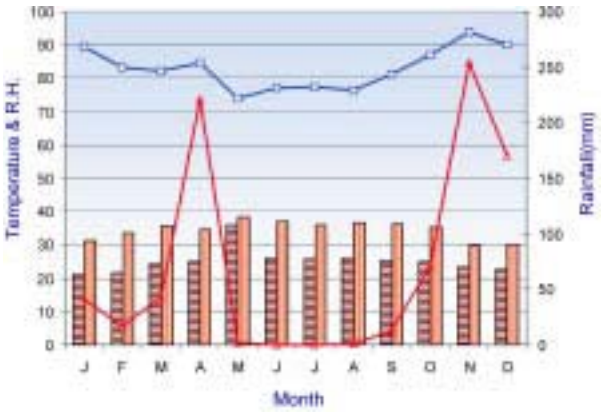


PALMYRAH CENTRES

Killikulam



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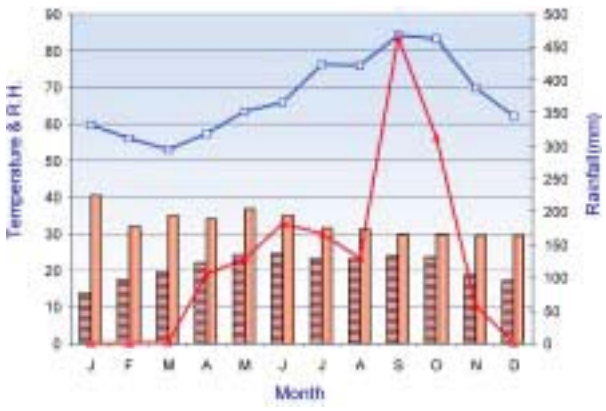

9. Publications

Ebenezar, E.G., P. Paramaguru.and K .Eraivan, 2004. Ecofriendly management of tuber rot disease of Palmyrah incited by *Rhizoctonia solani*. *Journal of Plantation Crops* , 32:375-378

Ebenezar, E.G., 2005. Wilt disease in Jasmine. *Hitech Horticulture, 7*(*3*): 19

Jayasekhara,S., C.T.Jose, C.V.Sairam and S.Arulraj. 2005.Cocoa economy: an international perspective with special reference to Indian scenario. *Journal of Plantation Crops.* 33(2):119-127.

Karthikeyan, G. S.Karpagavalli, C.Natarajan and S.Arulraj. 2005. Evaluation of coconut hybrid ECT x BSR tolerant ECT in basal stem rot sick soil. *Indian Coconut Journal* 36(5):12-14.

Mohanbabu, R., Sajeena.A., Seetharaman K.,. Ebenezar E.G**.,** Senthil raja. A, Bijy K.R., and M. Somprakash, 2004. Induction of phenolics in rice bacterial leaf blight. *J.Ecobiol. 16(1): 1-6.*

Nath, J.C. and Medhi, G. 2003. Effect of GA_3 and ethrel on growth and yield of ginger cv. Nadia. *The Hort. J.*, **16**: 77-87.

Rao, N.B.V.C , Sujatha, A and Rao, D.V.R. 2005. Studies on impact of mite infestation on quantitative characters of coconut J*ournal of Applied ZoologicalRresearch,* 16 (2): 128- 129.

Srinivasulu, B. K.Aruna, K.Vijay Krishna Kumar and D.V.R. Rao 2005. Population status of *Trichoderma* spp in different coconut based cropping systems of Andhra Pradesh. J*ournal of Plantation Crops,* 32 (2): 35-38

Srinivasulu, B., K. Vijay Krishna Kumar, K.Aruna, Sabitha Doraisamy and D.V.R. Rao. 2005. Biocontrol potentiality of *Trichoderma viride* against basal stem rot disease of coconut. *Journal of Plantation Crops, 32 (1)*: 28-31

Srinivasulu, B., K.V. Krishna Kumar, K. Aruna, J. Krishna Prasadji and D.V.R.Rao 2005. *In vitro* antagonism of three *trichoderma* spp against *s.rolfsii* sacc., a collar-rot pathogen in elephant foot yam. *Journal of Biological Control*, 19 (2): 167 – 171

Subramanian, P., Dhanapal, R., Sanil,P., Palaniswami, C., Sairam,C.V.and Maheswarappa,H.P. 2005. *Glyricidia* (*Glyricidia sepium*) as green manure in improving soil fertility and productivity of coconut under coastal littoral sandy soil. *Journal of Plantation Crops* 33(3): 185-189

Sujatha, A, Rao, N.B.V.C.and Rao, D.V.R.2005. Studies on efficacy of azadirachtin 10000 ppm against coconut eriophyid mite, A*ceria guerreronis* (keifer).J*ournal of Applied Zoological Rresearch*, 16 (2): 126- 127.

Sujatha, A and Zaheeruddeen, S.M. 2005. Seasonal incidence of mango fruit borer *Deanolis albizonalis* (hampson) in AP. I*ndian Journal of Applied Entomology,* 19 (2): 95-97

Thamban, C., V.Rajagopal, S.Arulraj and M.P. Rameshkumar. 2005. Utilisation of mass media for transfer of technology in palms and cocoa – an analysis. *Journal of Plantation Crops*. 33(1):69-74.

Thambidurai, G., E.G. Ebenezar and M. Muthusamy,2006. Effect of organic amendments on the sporophore production of *Pleurotus eous J. Ecobiol., 18(2)*: 185-187