वार्षिक प्रतिवेदन
Annual Report
2004-05

All India Co-ordinated Research Project on Palms
(Indian Council of Agricultural Research)
CPCRI, Kasaragod 671 124, India

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भाकृ अनुप
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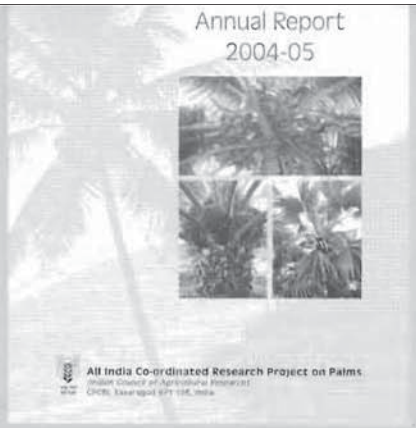

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Preface

The 32nd Annual Report of the All India Coordinated Research Project on Palms has been prepared as per the new guidelines issued by ICAR. The report pertains to the progress made in the AICRP in coconut, oil palm and palmyrah research during the twelve-month period from April 2004 to March 2005. However, the data on growth parameters and yield in the mandate crops cover the twelve-month period from July 2003 to June 2004 coinciding with the crop season. The report includes results from ten experiments on crop improvement, seven on crop management, six on disease control and four on pest management in coconut, oil palm and palmyrah. During the year, 10 centres conducted experiments on coconut while four centres continued the trials on oil palm and two centres strengthened the programmes on palmyrah.

The first part of the report consists of technical aspects while the second part covers various organization aspects of the centres as well as the project. The budget and expenditure statements pertaining to the financial year 2004-05 are also presented. Weather data of AICRP on Palms centres as well as the publications brought out by the Scientists in the project are also presented.

I am extremely grateful to Dr. G. Kalloo, Deputy Director General (Horticulture) for his guidance and encouragement in the progress of the project. I am grateful to Dr. K.V. Ramana, Asst. Director General (PC) and Dr. V. Rajagopal, Director, CPCRI for their keen interest and guidance in the project work.

I am grateful to the Vice Chancellors of the SAUs for agreeing to my suggestions and helping me in the execution of the projects. I am also grateful to Directors of Research/Deans from SAUs, Heads of Stations for their keen interest and active involvement in the conduct of the programmes. I am thankful to all my project scientists in different centres for their enthusiasm and hard work in achieving the objectives 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
10.10.2005

S. ARULRAJ
Project Coordinator (Palms)

परियोजना समन्वयक की रिपोट

ग्रामीण आर्थिकता में नारियल, तेलताड़ एवं पॉमैरा का स्थान है। द्वीप एंव तटीय क्षेत्रों में परिवर्तित परिस्थिति की पोषकता में इसकी भूमिका महत्वपूर्ण है।

इन क्षेत्रों के 20 करोड़ से अधिक लोग इन फसलों के उत्पादन, प्रसंस्करण एवं विपणन में मग्न हैं। इन फसलों पर लंबी अवधि तक का अनुसंधान की प्रकृति, अनुसंधान निवेश से अधिक आय की प्रत्याशंसा, अनुसंधान कृषकों को अनुसंधान उपलब्धियों का वितरण आदि लंबी अवधि के दृष्टिकोण के विकास के लिए अनिवार्य बन गया है।

प्रति हेक्टर उत्पादन क्षमता में सुधार के रूप में नारियल विस्तृत आशा प्रदान करते है और उचित नारियल आधारित कृषि पद्धतियों को अपनाने से विस्तार रोज़गार क्षमता प्रदान करते है। नारियल क्षेत्र में मूल्य वर्द्धित प्रक्रियाओं के बड़े पैमाने पर स्वीकृति अन्य राष्टों की तुलना में भारत में अनुपलब्धता कम है।

ताड़ अधिकतम तेल उत्पादित फसलों में से एक है जो आवश्यक प्रबंधन पद्धतियों के साथ स्थानीय विशेष तेल ताड़ संकरों की कृषि से देश को खाद्य तेल का निर्यात कम करने में सहायता करते है। कृषकों को प्रति हेक्टर से 25 टन से ज्यादा ताज़ा फल गुच्छ, लगभग 5 टन खाद्य तेल हेक्टर प्राप्त किया जा सकता है।

ताड़ की विभिन्न प्रजातियों में से, शक्कर उपज तथा खाद्य एवं अखाद्य उपजों में पॉमैरा का स्थान प्रथम है । ताड़ के फल एवं अन्य भागों से अधिक मूल्य वर्द्धित उपज तैयार की जा सकती है। पॉमैरा ताड़ हवा रोकने और रेत का टीला रोकने में सहायक है।

भौतिक-रासायनिक गुणों के अनुकूलतम स्तर की मृदा में पॉमैरा की वृद्धि हो सकती है।

ताड़ उपज उद्योग के विकास एवं वृद्धि के लिएतमिलनाडु एक सक्षम राज्य है जो ताड़ उपज के आयात के रूप में विदेशी विनिमय आकर्षित करता है।

उद्भव :

सन् 1970 में केंद्रीय रोपण फसल अनुसंधान की स्थापना से देश में रोपण फसल अनुसंधान पद्धति का पुर्नगठन भारतीय कृषि अनुसंधान परिषद द्वारा किया गया। और के. रो. फ.अ.सं का मुख्यालय नारियल अनुसंधान स्टशन, कासरगोड़ को बनाया गया। इसके साथ भारतीय कृषि अनुसंधान परिषद ने अखिल भारतीय समन्वित नारियल एवं सुपारी सुधार परियोजना के.रो.फ.अ.सं., कासरगोड़ मुख्यालय में स्वीकृति दी। सन् 1971 में कासरगोड़ में आयोजित पहली कार्यशाला की अवधि में अनुसंधान कार्यक्रमों के निर्णय के बाद समन्वित अनुसंधान सन् 1977 में प्रारंभ किया गया था।

प्रारंभ में चार केंद्रों जैसे रत्नगिरी और दापोली (महाराष्ट), रज़ोल (आंध्रप्रदेश) और वेप्पंकुलम (तमिलनाडु) में परियोजना प्रारंभ की गयी थी। इस परियोजना के अधीन सक्रिय केंद्रों के रूप में कासरगोड़, कायंकुलम, पालोड़, हिरेहल्ली और अंड मान में के.रो.फ.अ.सं. केंद्रों को सम्मिलित किया गया। तत्पश्चात कासरगोड़ और अंड मान को छोड़ कर के रो फ अ सं के अधीनस्थ सभी केंद्रों को निकाल दिया गया।

इस परियोजना के अधीन के.रो.फ.अ.सं. केंद्रों के लिए स्वीकृत वैज्ञानिक एवं तकनीकी स्टाफों को संस्थान के साथ सम्मिलित किया गया। सन् 1975 में परियोजना का विस्तार पाँच अधिक केंद्रों जैसे अरसिकरे, पिलिकोड़, महुवा, कायंबत्तूर और अम्बाजिपेट में किया गया। 1977 में कोणार्क केन्द्र भी इसके साथ सम्मिलित किया गया। ग्यारहवॉ केंद्र मन्डौरी (कल्याणी) 1980 की अवधि में शुरू किया गया।

सातवीं पंचवर्षीय योजना की अवधि में उत्तर पूर्व क्षेत्रों के लिए एक नया केंद्र खोला गया और 1985 में काहिकुची में यह केंद्र शुरू किया गया। सातवीं पंचवर्षीय योजना की अवधि में 1.4.86 से प्रभावी होकर तीन केंद्रों जैसे पिलिकोड़ (केरल), महुवा (गुजरात) और दापोली (महाराष्ट) को निकाल दिया गया। फिर तेल ताड़ सम्मिलित कर परियोजना का क्षेत्र विस्तार किया गया और परियोजना का पुनः नामकरण अखिल भारतीय ताड़ अनुसंधान परियोजना के रूप में किया गया। परियोजना में नारियल के तीन और तेल ताड़ के चार केंद्रों को सम्मिलित किया गया।

नारियल के दो केंद्रों जैसे जलालगढ़ (बिहार) और जगदलपुर (मध्यप्रदेश) अपारंपरिक नारियल क्षेत्रों के लिए और अलियार नगर (तमिलनाडु) के केंद्र नारियल मूलरोध और तंजावुर/गैनोडेरमा रोग के लिए है। तेल ताड़ के चार केंद्रों में तीन केंद्र जैसे विजयराय (आंध्रप्रदेश) ,मुल्डे (महाराष्ट) और गंगावती (कर्नाटक) 1988 में और आडुथुरै (तमिलनाडु) 1989

में शुरू किया गया। प्रशासनिक और तकनीकी कारणों से 1988 में रज़ोल केंद्र अम्बाजिपेट केंद्र के साथ सम्मिलित किया गया। कायंबत्तूर और अंडमान केंद्र क्रमश: 1990, 1991 में बंद होने के कारण सुपारी आधारित कार्यक्रमे परियोजना से निकाल दिया गया। आठवीं योजना की अवधि में पॉमैरा अनुसंधान के लिए दो केंद्र-किल्लिकुलम (तमिलनाडु) और पांदिरिमामिडि (आंध्रप्रदेश) शुरू किए गए।

अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना :

इस परियोजना में कुल 16 केंद्र हैं जैसे मुख्यालय कासरगोड़ (केरल), वेप्पंगुलम, किल्लिकुलम, अलियारनगर, आडुथुरै (तमिलनाडु), गंगावती, अरसिकरे (कर्नाटक), अम्बाजिपेट, पांडिरिमामिडी, विजयराय (आन्ध्रप्रदेश), भुवनेश्वर (उड़ीसा), काहिकुची (असम), मन्डौरी (पश्चिम बंगाल), जगदलपुर (छत्तीसगढ़), रत्नगिरी एवं मुल्डे (महाराष्ट)। 16 केन्द्रों में से 10 नारियल के, चार तेल ताड़ के और दो पॉमैरा के केंद्रों में अनुसंधान जारी है।

मुख्य उद्देश्य :

अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के मुख्य उद्धेश्य इस प्रकार है:

1. नारियल के नये संकरों एवं अधिक उत्पादन क्षमतावाली प्रजातियों का संग्रहण, संरक्षण, सूचीयांकन तथा मूल्यांकन।
2. विभिन्न सस्य जलवायु क्षेत्रों के लिए कृषि तकनीकी का मानकीकरण तथा मुख्य फसल मृदीय जलवायु परिस्थिति के लिए उचित एवं अन्त मिश्रित कृषि पद्धतियों का विकास।
3. प्रभावात्मक तथा कार्यक्षम रोग एवं कीट प्रबंधन रणनीतियाँ।
4. विभिन्न सस्य जलवायु परिस्थितियों में तेलताड़ के विकास पर अध्ययन।
5. पॉमैरा में जननद्रव्यों के संग्रहण, संरक्षण, मूल्यांकन एवं उपयोग

बजट :

वर्ष 2004-2005 में इस परियोजना का कुल आय - व्यय 144.56 लाख रूपए था जिसमें 118.01 लाख रूपए भारतीय कृषि अनुसंधान परिषद का भाग है।

जारी कार्यक्रम :

इस परियोजना के अधीन वर्ष 2004-05 की अवधि में सस्य सुधार पर दस, सस्य प्रबंधन पर सात, रोग नियंत्रण पर छह, और कीट प्रबंधन पर चार कार्यक्रम प्रगति पर है।

नारियल में वर्तमान जननद्रव्यों के उपयोग पर नौ केंद्रों में तथा तेल प्रजाति पर सात केंद्रों में परीक्षण किया गया। अम्बाजिपेट, वेप्पंगुलम तथा कासरगोड़ से उत्पादित नारियल के विभिन्न संकरों का मूल्यांकन सात केंद्रों में किया गया। स्थानीय जननद्रव्यों के संग्रहण संरक्षण एवं मूल्यांकन और स्थानीय विशेष संकरों के उत्पादन एवं उनके मूल्यांकन के लिए सात केंद्रों में नई परियोजनाएँ प्रारंभ की गई। इसी प्रकार तेल ताड़ में नए संकर संयुक्तों के मूल्यांकन के लिए नई परियोजनाएँ छह तेलताड़ केंद्रों में प्रारंभ की गई।

बौने x लंबी (डीxटी) संकरों की पोषण आवश्यकता पर परीक्षण काहिकुची, मन्डौरी, रत्नगिरि, अरसिकरे, अलियारनगर, तथा वेप्पंगुलम केन्द्रों में प्रगति पर है। अरसिकरे, अम्बाजिपेट, काहिकुची, रत्नगिरि तथा वेप्पंगुलम में नारियल आधारित सस्यन पद्धति पर परीक्षण किया गया।

वेप्पंगुलम, अरसिकरे, रत्नगिरी, और अलियारनगर में ड्रिप सिंचाई का परीक्षण जारी किया गया। अम्बाजिपेट, अलियारनगर, अरसिकरे, कोणार्क, और वेप्पंगुलम केन्द्रों में समीकृत पोषण प्रबंधन पर परीक्षण प्रगति पर है। इसके अतिरिक्त नारियल बागों में औषधीय एवं सुगंध पादपों के निष्पादन के निर्धारण के लिएनई परियोजना सात केंद्रों में प्रारंभ की गई।

तन्जावूर विल्ट/गनोडेरमा विल्ट की हैतुकी, व्यापक रोग विज्ञान एवं प्रबंधन से संबंधित अध्ययन वेप्पंगुलम, अरसिकरे तथा अम्बाजिपेट केन्द्रों में प्रगति पर है। अम्बाजिपेट केंद्र में कली सड़न, तना स्रवण रोग का जैविक नियंत्रण पर एक नई परियोजना प्रारंभ की गई। अलियारनगर केन्द्र द्वारा पालघाट जिले के तटीय प्रदेश में रूट विल्ट रोग के फैलाव पर सर्वेक्षण जारी किए गए।

नारियल में कीट समस्या अनुवीक्षा के लिए तीन केंद्रों में सर्वेक्षण जारी किया गया। एरियोफिड कीट के प्रबंधन तथा लाल ताड़ घुन के समेकित प्रबंधन पर नई परियोजना तीन केंद्रों में प्रारंभ की गई।

तेल ताड़ संकरों के मूल्यांकन पर परीक्षण चार केन्द्रों में प्रगति पर है। सूखा सक्षम के लिए तेलताड़ प्रजातियों का मूल्यांकन दो केंद्रों में गंगावती और मुल्डे में प्रगति पर है। तेल ताड़ पर ड्रिप सिंचाई का उर्वरक परीक्षण आडुथुरै, गंगावती, मुल्डे तथा विजयराय केंद्रों में जारी किया गया।

रोग एवं कीटों से संबंधित अध्ययन के अलावा किल्लिकुलम तथा पांदिरिमामिडी में पॉमैरा जननद्रव्यों का संग्रहण एवं रख रखाव जारी पर है।

समूह बैठक :

प्रक्षेत्र परीक्षण आयोजन के विषय एवं प्रदर्शनी जैसे रोपण सामग्री के क्षेत्र परीक्षणों के आयोजन में व्यय और उसकी पूर्ति समय और संबंधित तकनीक एवं प्रबंधन विषमताओं का विघटन करने पर चर्चा हेतु इस वर्ष के दौरान निम्न विषय/फसल स्तर समूह बैठक आयोजित की गयी थी।

1. तेल ताड़ अनुसंधान में लगे वैज्ञानिकों सहित अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के वैज्ञानिकों की समूह बैठक जून 15, 2004 को राष्ट्रीय तेल ताड़ अनुसंधान केंद्र, पेड वेगी में आयोजित की। डॉ एम कोचु बाबु, निदेशक, राष्ट्रीय तेल ताड़ अनुसंधान केंद्र एवं डॉ एस अरूल राज परियोजना समन्वयक (ताड़) ने बैठक आयोजित की।

2. अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के नारियल में लगे वैज्ञानिकों की समूह बैठक कृषि अनुसंधान स्टशन अम्बाजिपेट में जून 18, 2004 को आयोजित की गयी। डॉ रोहिणी अय्यर, प्रमुख फसल संरक्षण अनुभाग, के रो फ अ सं कासरगोड़ एवं डॉ अरूल राज परियोजना समन्वयक (ताड़) ने विचार विमर्श किया।

3. अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के सस्य विज्ञान एवं बागवानी विज्ञान के वैज्ञानिकों की समूह बैठक जून 25, 2004 को नारियल अनुसंधान स्टशन अलियारनगर में आयोजित की गई। डॉ जॉर्ज वी थॉमस, प्रमुख, फसल उत्पादन अनुभाग, के रो फ अ सं कासरगोड़ एवं डॉ एस अरूल राज, परियोजना समन्वयक (ताड़) ने बैठक आयोजित की।

4. अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना के फसल सुधार वैज्ञानिकों की समूह बैठक दिसंबर 2004 को केंद्रीय रोपण फसल अनुसंधान संस्थान, कासरगोड़ में आयोजित की। डॉ. वी. राजगोपाल, निदेशक, डॉ. पी.एम. कुमारन, प्रमुख फसल सुधार अनुभाग एवं डॉ. एस. अरूलराज, परियोजना समन्वयक (ताड़) ने बैठक आयोजित की। स्थानीय जननद्रव्य संग्रहण के कार्यान्वयन के लिए रीति-विज्ञान (प्रक्रिया) तथा स्थानीय विशेष संकर संयुक्तों के मूल्यांकन पर नए परीक्षण शुरू करने के लिए कार्ययोजना भी बनाई गई।

मुख्य उपलब्धियाँ :

संरक्षण :

लक्षण सुधार :

अलियार नगर में परीक्षण के अधीन नएजननद्रव्यों मे वर्ष 2003-04 में अधिकतम उपज कोचिन चैना (123.3 गुठली/ताड़।) से और आयिरमकाची से (111.4) और सेइचल्लस से 108.4 गुठली/ताड़ प्राप्त की गई। अम्बाजिपेट केंद्र में फिलिपाइन्स आर्डिनरी से उच्च उपज (102.35 गुठली/ताड़/वर्ष) और लकाडीव आर्डिनरी से 99.26 गुठली प्राप्त की गई। ई.सी. लंबी (13.72 कि.ग्रा) की तुलना में फिलिपाइन्स आर्डिनरी से उच्च खोपड़ा उपज (19.23 कि.ग्रा /ताड़/वर्ष) और लकाडीव आर्डिनरी से 18.68 कि.ग्रा. और अंडमान आर्डिनरी से 99.26 गुठली प्राप्त की गयी।

जगदलपुर में परीक्षण की गई दस विदेशी प्रजातियों में से फिजी लंबी से उच्चतम गुठली उपज 106 गुठली/ताड़ प्राप्त की गई।

पश्चिम बंगाल में मन्डौरी में जननद्रव्य परीक्षण में जमाइका लंबी से अधिकतम उपज 82 गुठली/ताड़/वर्ष (विगत 16 वर्षो का मध्यक) यह प्रजाति वाणिज्य रूप से कृषि के लिएविचार किया जा सकता है इसी प्रकार रत्नागिरि केंद्र में लकाडीव आर्डिनरी से अधिकतम उपज (151 गुठली/ताड़/वर्ष - विगत 26 वर्षो का मध्यक) प्राप्त की गई इसलिए राज्य में वाणिज्यिक कृषि के लिए विचार किया जा सकता है। वेप्पंगुलम केंद्र में परीक्षण की गई 11 प्रजातियों में डब्ल्यू.सी.टी से अधिकतम वार्षिक गुठली उपज (115.3 गुठली/ताड़) और ज़ंजिबर से 112.7 प्राप्त की गई। ज़ंजिबर से अधिकतम संचित उपज 98.9 गुठली/ताड़/वर्ष और डब्ल्यू.सी.टी से 91.4 गुठली/ताड़ /वर्ष प्राप्त की गई। सैनरमोन से अधिकतम खोपड़ा उपज 12.8 कि.ग्रा/ताड़/वर्ष और डब्ल्यू.सी.टी से 12.6 कि.ग्रा/ताड़ और जंजिबर से 12.4 कि.ग्रा/ताड़ प्राप्त की गई।

इस वर्ष की अवधि में अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना केंद्र द्वारा कुल 27 स्थानीय जननद्रव्यों का संग्रहण किया गया। चुनी गई प्रजातियों के पौधों का रोपण मुख्य प्रक्षेत्र में आगे मूल्यांकन के लिए 2005-06 वर्ष में किया जाएगा।

अलियार नगर में मूल्यांकित विभिन्न संकर संयुक्तों में ई.सी.टी x एम.वाई .डी संकर से अधिकतम वार्षिक उपज 148.4 गुठली /ताड़ और डब्लू सी टी x जी बी जी डी से 123.4 गुठली/ताड़ प्राप्त की गई। इसी प्रकार रत्नगिरी केंद्र में अधिकतम औसत गुठली उपज जी बी जी डी x ई.सी.टी से (90 गुठली /ताड़) प्राप्त की गई। और ई.सी.टी x जी.बी.जी.डी से 87 गुठली / ताड प्राप्त की गई।

तटीय तमिलनाडु क्षेत्रों में (वेप्पंगुलम) सी ओ डी x डब्लू .सी. टी से अधिकतम वार्षिक गुठली उपज 117.4 गुठली/ताड और डब्लू. सी. टी x सी .ओ .डी से 112.3 गुठली/ताड और डब्लू. सी. टी x एम. वाइ डी से 106.1 गुठली/ताड प्राप्त की गई। डब्लू. सी. टी x एम. वाइ डी से

अधिकतम संचित उपज 106.9 गुठली/ताड /वर्ष और डब्लू. सी. टी x सी.ओ.डी से 98.5 गुठली/ताड/वर्ष और सी ओ डी x डब्लू .सी. टी से 86.8 गुठली/ताड प्राप्त की गई। डब्लू. सी. टी x एम. वाइ डी से अधिकतम 16.4 कि.ग्रा/ताड़/वर्ष खोपड़ा उपज प्राप्त हुई।

फसल उत्पादन :

रत्नगिरि केंद्र में नारियल संकरों की पोषण आवश्यकता निर्णय के परीक्षण से संग्रहित ऑकड़ों के विश्लेषण से यह पाया गया कि 1000 ग्रा. नाइटोजन, 500ग्रा. फोसफोरस और 2000 ग्रा. पोटाश के उपचारों से अधिकतम औसत उपज 117 गुठली/ताड 1990-2004 वर्ष की अवधि में प्राप्त की गई।

नारियल ताड़ में अतिरिक्त मात्रा में नाइटोजन, फोसफोरस, पोटाश उर्वरकों के प्रयोग से प्रतिवर्ष प्रति ताड़ अतिरिक्त आय की प्राप्ति हुई। 1000 ग्रा. नाइटोजन, 500 ग्रा. फोसफोरस और 2000 ग्रा. पोटाश के संयुक्त उपचार से अधिकतम अतिरिक्त आय प्रति ताड़ पायी गयी। (305/ रूपए) और 1000 ग्रा. नाइटोजन, 0 ग्रा. फोसफोरस, 1000 ग्रा. पोटाश के प्रयोग से 231/रूपए का आय और 500 ग्रा. नाइटोजन, 250 फोसफोरस, 2000 ग्रा. पोटाश के उपचार से 220/- रूपए का आय प्राप्त हुई।

इसी प्रकार वेप्पंगुलम में नाइटोजन, फोसफोरस, पोटाश के विभिन्न मात्रा के स्तर पर उपचार से तदनुसार नारियल संकरों की वृद्धि, उपज गुण, एवं गुठली उपज में बढ़ोत्तरी पायी गयी। नाइटोजन के मामले में 1000 ग्रा./ ताड़ नाइटोजन के साथ अधिकतम उपज 164 गुठली/ताड/वर्ष और 500 ग्रा./ताड़ नाइटोजन के उपचार से 149 गुठली/ताड अंकित किया गया। 500 ग्रा./ताड़ फोसफोरस के उपचार से अधिकतम उपज 155.2 गुठली/ताड और 250 ग्रा./ ताड़ फोसफोरस के प्रयोग से 150.8 गुठली/ताड प्राप्त हुई। 2000 ग्रा./ ताड़ पोटाश के प्रयोग से 167.4 गुठली/ताड प्राप्त हुई। 1000 ग्रा. नाइटोजन, 500 ग्रा. फोसफोरस और 2000 ग्रा. पोटाश के संयुक्त प्रयोग से 171 गुठली/ताड/वर्ष और 1000 ग्रा. नाइटोजन, 250 ग्रा. फोसफोरस और 2000 ग्रा. पोटाश प्रति ताड़ प्रति वर्ष के प्रयोग से 170 गुठली/ताड/वर्ष प्राप्त हुई।

कर्नाटक राज्य में अरसिकरे में किए गए पाँच सस्यन पद्धति मॉडल में नारियल + केला के फसल संयुक्त से अधिकतम आय 74340 रूपए/ हेक्टर प्राप्त हुई। इसी प्रकार महाराष्ट राज्य में रत्नगिरी केंद्र में मिश्रित फसलों की रोपाई के कुछ वर्ष के बाद फसल ब्लॉक के अननुक्रमागत नारियल उपज में वृद्धि पाई गई। लौंग प्लॉट से अधिकतम वृद्धि 96 %, मसाले से 90%, दालचीनी से 71% और जायफल से 69% पायी गयी। विभिन्न ब्लॉक की अर्थिकता से यह पाया गया कि नारियल + जायफल अधिक लाभदायक (76495/- रूपए) और नारियल +दालचीनी से 58840/- रूपए लाभ प्राप्त हुआ।

काहिकुची के फसलन पद्धति परीक्षण से अधिक प्रोत्साहनजनक परिणाम प्राप्त किया गया जबकि नारियल, कालीमिर्च, हल्दी सस्यन पद्धति से (1,92,575 रूपए) सकल आय और नारियल, कालीमिर्च, अनन्नास की अंतसलन से प्राप्त किया गया। लेकिन निम्नतम आय नारियल प्लॉट (नारियल, कालीमिर्च) से प्राप्त किया गया। (43,487/- रूपए)

अलियारनगर, अम्बाजिपेट, काहिकुची, भुवनेश्वर, मन्डौरी, रत्नगिरी और वेप्पंगुलम केंद्रो में नारियल बागों में औषधीय एवं सुरभि पादपों के निष्पादन पर परीक्षण किया गया। प्रत्येक केंद्र में औषधीय एवं सुरभि पौधों की कृषि पर सर्वेक्षण आयोजित किया गया। प्रत्येक केंद्र में कुल 10-50 औषधीय और सुरभि पादपों को चुना गया। विपणन क्षमता और रोपाई सामग्री की सुलभता की स्थिति निर्धारित की गई।

तमिलनाडु राज्य में अलियार नगर केंद्र में नारियल के माइक्रो सिंचाई प्रौद्योगिकी के मानकीकरण के लिए परीक्षण आयोजित किया गया। 100 % इ. पेन पादपोत्सजन ड्रिपसिंचाई एवं 4 से. मी गहराई पर 1.0 के IW/CPE अनुपात पर अलवाल सिंचाई से क्रमशः 153 और 152 गुठली/ताड़/वर्ष गुठली उपज अंकित किया गया। सिंचाई के बिना निम्नतम उपज 82 गुठली/ताड़/वर्ष अंकित किया गया। 33% से 100% इ. तक ड्रिप सिंचाई गुठली उपज में 100 से 153 गुठली/ताड़/वर्ष पाई गई।

100% इ. के बराबर ड्रिप सिंचाई से अधिकतम आय 65994 रूपए हेक्टर और लाभमूल्य अनुपात 2.60 पाया गया जबकि नियंत्रण से 28388/- रूपए आय और 1.97 लाभ मूल्य अनुपात पाया गया। आधार सिंचाई जो पेन पादपोत्सर्जन के बराबर के समान हो, से 64/64 - रूपए की आय और लाभ मूल्य अनुपात 2.55 अंकित किया गया। 33 से 100% पेनपादपोत्सर्जन की ड्रिप सिंचाई से आय को 31470 रूपएसे 65994/- रूपए और लाभ मूल्य अनुपात 1.40 से 2.08 तक अंकित किया गया जिनसे ड्रिप सिंचाई की आर्थिक लाभ व्यक्त होते है।

महाराष्ट राज्य में रत्नगिरी में भी समान परीक्षण विगत सात वर्ष के मध्यक संचित उपज ऑकड़े से यह देखा गया कि ड्रिप सिंचाई उपचार से प्राप्त उपज की उपेक्षा अलवाल सिंचाई से उच्च उपज 91 गुठली/ताड़ प्राप्त की गई। पेन पादपोत्सर्जन के बराबर ड्रिप सिंचाई से उच्च उपज प्राप्त किया गया लेकिन अन्य उपचार की अपेक्षा बिना सिंचाई से निम्न

दर्ज पायी गयी।

न पादपोत्सर्जन के बराबर सिंचाई में पानी की लंबाई और चौड़ाई गति क्रमश: 102.95 से.मी. और 90 से. मी. है। 66% पेन पादपेत्सर्जन में 99.75 से. मी. और 84 से. मी. है। और 33% पेन पादपोत्सर्जन में 82 से. मी. और 68 से. मी. है। यह देखा गया कि अलवाल सिंचाई उपचार में अधिकतम पानी 12260 लीटर का प्रयोग किया गया है। 100% पेन पादपोत्सर्जन ड्रिप सिंचाई में 10524 लीटर पानी का और 66% पेन पादपोत्सर्जन में 7009 लीटर पानी का प्रयोग किया गया है।

आन्ध्रप्रदेश राज्य के अम्बाजिपेट केंद्र में मूल्यांकित पॉच समीकृत पोषण प्रौद्योगिकियों में उर्वरक की अनुमोदित मात्रा के 50%+50% कंपोस्ट कयर गूथा से उपचारित ताड़ों से अधिकतम गुठली उपज 154.78 गुठली/ताड अंकित किया गया। 100% कंपोस्ट कयर गूथा के उपचार में 138.45 गुठली/ताड और नियंत्रणाधीन (बिना उपचार से) 72.56 गुठली/ताड प्राप्त हुई। अनुमोदित उर्वरक मात्रा के 50% + 50% कंपोस्ट कयर गूथ के प्रयोग से उच्च गुठली भार 1169.87 ग्रा. और अनुमोदित उर्वरक मात्रा के 100% प्रयोग से निम्नतम गुठली भार 847.52 ग्रा. पाया गया। विभिन्न समीकृत सूत्रकृमि विज्ञान प्रबंधन उपचार में छिलका प्रतिशत 54.97% से 60.40% तक पाया गया। विभिन्न उपचारों में गुठली पानी मात्रा 60.51 मि. ली. से 107.54 मि.ली. पाया गया। अनुमोदित उर्वरक मात्रा के 50%+50% कंपोस्ट कयर गूथा के उपचार में अधिकतम खोपड़ा मात्रा पायी गयी। (144.87 ग्रा. /गुठली) / 100% कंपोस्ट कयर गूथा के उपचार में 136.62 ग्रा / गुठली और बिना उपचार में 101.55 ग्रा /गुठली पायी गयी।

फसल संरक्षण :

मौसम संघटक एवं जनवरी -2000 से मार्च 2005 तक नारियल में आधार तना सड़न रोग के फैलाव के बीच सहसंबंध अध्ययन से यह देखा गया कि वर्षा दिनों की संख्या, वर्षा एवं सापेक्ष आद्रता के साथ नारियल में आधार तना सड़न रोग का उदग्र फैलाव का संबंध सार्थक है।

आधार तना सड़न रोग की पूर्व पहचान के लिए लसी पहचान अध्ययन में रोग प्रभावित नारियल ताड़ों के तना ऊतों में आधार तना सड़न रोग संक्रमण पहचानने का सरल लसीय परीक्षण असफल हुआ।

नारियल ताड़ के मूल, 1 मीटर उँचाई पर तने के आधार भाग के ऊतों में फ्यूजेरियम सोलेनी पहचानने में अधिक ELISA का प्रतिकूल रूप अधिक हष्ट पाया गया।

इस अनुसंधान उपलब्धि की पुष्टि के लिए आधार तना सड़न रोग की पूर्व पहचान के लिए सूचकांक पौध के रूप में तूअर पौध का उपयोग किया जा सकता है।

छाल फटने की तीव्रता के अध्ययन के लिए रूग्ण मृदा में पुन: रोपण किया गया। परिणाम से यह देखा गया कि गैनोडेरमा रोग के रूग्ण मृदा में वर्द्धित तूअर पौध के छत्र क्षेत्र में छाल का विपाटन संगत पाया गया।

गैनोडेरमा के 11 आइसोलेट में TKTI आइसोलेट अंत: क्रामण के 45 दिन के बाद स्रवण लक्षण दिखाया। सी आर एस 1 के साथ अंत: क्रामित पौध अंत: क्रामण के छह महीने के बाद स्रवण लक्षण दिखाया। आइसोलेट सी आर एस 1, सी आर एस 4 और पी वी के साथ अत:क्रामित पौध में अंत:क्रामण के 67 दिनों के बाद बीजाणुधट उत्पादन पाया गया। इस परिण्णम यह दिखाते है कि TKT 1 आइसोलेट प्रचाण्ड है।

गैनोडेरमा अप्लेनेटम और *जी लूसिडम* त्रैकोडेरमा जाति की क्रियाशील की विधी पर इलेक्टॉ माइक्रो स्कोप अध्ययन किया गया और इसके परिणाम से यह देखा गया कि गैनोडेरमा जाति के कवकसूत्र के चारों ओर त्रैकोडेरमा जाति प्रारंभिक अवस्था में छुट पुट और बाद में गहन रूप से कुंड लित होते है। दोनों गैनोडेरमा जाति के कवकसूत्र पर त्रैकोडेरमा कवकसूत्र का लगातार अभि पीड न होते है। टस्ट व्याधिजन के कवकसूत्र में त्रैकोडे रमा जाति घुसने के बाद इसके प्ररसीय अंतर्वस्तु का प्रतिस्थापन देखा गया। अंत में त्रैकोडेरमा जाति द्वारा गैनोडेरमा जाति कवक जाल का अंशन देखा और बाद में गैनोडेरमा जाति के अंशित कवकजाल के अंदर से जैवएजेंट के कूंपीबीजाणु का प्रोद्वर्ध होता है।

अम्बाजिपेट केंद्र में जैवनियंत्रण एजेंट पर प्रक्षेत्र प्रभावी परीक्षण में नारियल के आधार तना सड़न रोग पर त्रैकोडेरमा जाति और पी फ्लूरोसेंस उदग्र रोग फैलाव में अधिकतम कमी पायी गयी।

25 मि. ली. दर में तिमाही के अंतराल में *टी विरिडे* संवर्द्धन पावन (100% घाटता) मूलवेधन के साथ 5 कि.ग्रा. नीम केक के साथ 50 ग्रा. टाल्क चूर्ण के दर में मृदा में *टी विरिडे* प्रयोग किया गया।

तंजावूर जिला में तम्बिकोट्टाइ गाँव के अधार तना सड़न रोग प्रभावित मृदा में नारियल रोपण कर नारियल के आधार तना सड़न रोग की प्रतिक्रिया 10 समजातिय नारियल पर परीक्षण किया गया। आधार तना सड़न रोग की रूग्ण मृदा में अन्य समजातिय की तुलना में दस समजातिय नारियल के बीच इ. सी. टी x बी.एस.आर सक्षम इ. सी.टी. का अतिजीवन दर 40% अंकित किया गया है। अन्य समजातियों की तुलना में इ.सी.टी. x बी.एस.आर सक्षम इ. सी.टी. को कुल फिनोल की उच्च मात्रा है।

इसी प्रकार आधार तना सड़न रोग रूग्न मृदा में इ.सी.टी. x बी.एस.आर सक्षम इ. सी.टी. संकर में पेरोक्सिडेस और पॉल फिनॉल ऑक्सिडेस की क्रियाशीलता ज्यादा है जो सक्षम के लिए मुख्य कारक है।

आधार तना सड़न रोग प्रतिरोध समजातिय (इ.सी.टी. x बी.एस.आर सक्षम इ. सी.टी.) और रोगग्राही समजातिय (इ.सी.टी) में पेरोक्सिडेस का आइज़ोजैम विश्लेषण से यह देखा गया कि प्रतिरोध एवं रोगग्राही दोनो समजातिय में समरूपीय po_2 का प्ररोचन किया गया है। लेकिन प्रतिरोध समजातिय में po_2 प्रबल बन गया है POI समरूप केवल प्रतिरोध समजातिय में मौजूद है।

कायंबत्तूर जिला में नौ गाँवों में तथा थेनी जिला में चार गाँवों में मूल रोध रोग की तीव्रता तथा रोग फैलाव की स्थिति निर्धारण के लिए तीव्रता तथा रोग फैलाव की स्थिति निर्धारण के लिएसर्वेक्षण आयोजित किया गया। थेनी जिला के कुमबुम ब्लॉक में आयोजित सर्वेक्षण में अधिक तीक्ष्ण से तीक्ष्ण मूल रोध लक्षण पाया गया। रोग लक्षण दर 22.2 से 30.9% था। कुमबुम ब्लॉक के गुडलूर और सुरिलिपट्टी में मूल रोध रोग का प्रगतिशील लक्षण देखा गया। अधिक बागों में मध्य भ्रमि पीलापन देखा गया। अधिक ताड़ों में पत्ता सड़न रोग लक्षण भी पाया गया। कायंबत्तूर जिला के सीमावर्ती केरल पोल्लाची में सर्वेक्षण किए गए किन्हीं दस गाँवों में मूल रोध रोग का लक्षण नहीं दिखाई पड़ा। कायंबत्तूर जिला के मीनाक्षिपुरम क्षेत्र में केवल दो ताड़ों में मूल रोध रोग का शक है।

तमिमलनाडु में 20 जिलों में चुने गए गाँवों में एरियोफिड कीट के संक्रामण पर तीक्ष्ण समकालिक सर्वेक्षण आयोजित किया गया। चार जिलों में, ईरोड जिला में 70% से 85% तक, सेलम जिला में 75% से 90% तक, नामकल जिला में 68%-96% तक और कायम्बत्तूर जिला में 82-88% तक एरियोफिड कीट संक्रामण का अनुपात उच्च पाया गया। क्षति की तीव्रता 80-90% गुठली क्षति के साथ 5.00 तक क्षति स्थानीयकर निर्धारण ग्रेड के रूप में व्यक्त करते है। इसी प्रकार आंध्रप्रदेश के तटीय जिलों में किए गए सर्वेक्षण से यह देखा गया कि वर्ष 2002 से कीट क्षति का ग्रेड सूचकांक दीमि परिस्थिति में हो रहा है।

वर्ष 2004 में गुठली का आकार में जरा सुधार आ गया और उपज भी स्थिर हो गया। 2004 में किए गए निरीक्षण से यह देखा गया कि वर्ष 2001 की तुलना में कीट जनसंख्या में 49.9% तक कमी पाई गई। लेकिन महाराष्ट राज्य के कोंकण क्षेत्र के थाने और सिंधुदुर्ग जिला में एरियोफिड़ कीट का संक्रामण प्रतिशत उच्च हो रहा है।

अम्बाजिपेट केंद्र में नारियल में लाल ताड़ घुन के प्रबंधन के लिए रासायनिक नियंत्रण परीक्षण से यह देखा गया कि परीक्षण किए गए तीनों कीटनाशियों में लाल ताड़ घुन के विरूद्ध मूल वेधन से मोनोक्रोटोफॉस 10 मि. ली. पानी के साथ 10 मि. ली. मोनोक्रोटोफॉस की दर में मूल वेधन उत्तम उपचार पाया गया इस उपचार से 100% स्वस्थ हो जाते हैं और अज़ादिशक्टिन से 80% स्वस्थ हो जाते है। लाल ताड़ घुन के फेरोमोन पकड़ से यह देखा गया कि 6 हफ्ते की अवधि में 4.67 घुन टाप /हफ्ते के औसत पकड़ में के रो फ अ सं ल्यूर (21.00 टाप) की तुलना में केम टिका ल्यूर टाप अधिक संख्यां में (28.00/टाप) घुन को आकषित करते है। के रो फ अ सं के ल्यूर की तुलना में केम टिका ल्यूर में टाप किया गया घुन की संख्या/हफ्ता क्रमानुगत हफ्ते में अधिक थी।

तेल ताड़ :

फसल सुधार :

महाराष्ट राज्य में मुल्डे केंद्र के 1991 से मूल्यांकन के अधीन के 11 टनरा संकर के बीच संकर संयुक्त 18 डूरा x 32 पिसिफेरा से अधिकतम ताज़ा फल गुच्छ 121.61 कि.ग्रा/ताड़/वर्ष प्राप्त किया गया संकर संयुक्त 115 डूरा x 291 पिसिफेरा से अधिकतम गुच्छ भार 22.1 कि.ग्रा./गुच्छ पाया गया। अधिकतम गुच्छों की संख्या 104 डूरा x पिसिफेरा संयुक्त से प्राप्त किया गया।

आंध्रप्रदेश में विजयराय में 1992 में किए गए इसी प्रकार के परीक्षण में संकर संयुक्त 18 डूरा x 32 पिसिफेरा से अधिकतम गुच्छ भार प्राप्त किया गया। 115 डूरा x 291 पिसिफेरा के संयुक्त से अधिकतम ताज़ा फल गुच्छ (113 कि. ग्रा. / ताड़ - 13.9 टन / हेक्टर) और 82 डूरा x 291 पिसिफेरा से निम्नतम उपज (57.9 कि. ग्रा./ ताड़ - 7.1 टन / हेक्टर) अंकित किया गया।

कर्नाटक राज्य में गंगावती केंद्र में 1998 से छह ज़म्बियन तीन तानेनिया सहित नौ समजातिय प्रजातियाँ मूल्यांकन के अधीन हैं। इस वर्ष के अवधि में प्राप्त किए गए परिणाम से यह देखा गया कि वृद्धि गुण जैसे ऊँचाई, परिधि, और वार्षिक पत्ता उत्पादन, समजातिय विभिन्नता महत्वपूर्ण नहीं थी। सापेक्ष जल मात्रा में भी सूखा सक्षम समजातियों के बीच भिन्नता नहीं है। लेकिन विद्युदंश्य उद्विलयन अर्थात अंतिम संरचना का प्रतिशत के रूप में अभिव्यक्त च्यवन। समजातियों के बीच विभिन्न है। ZS-9 में च्यवन निम्न है (11.93%) और TS-4 12.18% है।

मुल्डे केंद्र में सूखा सक्षमता के लिए इसी प्रकार के परीक्षण में नौ प्रजातियों के छानबीन में उपज गुणों की आँकड़े से यह देखा गया कि विभिन्न समजातियों में उत्पादित ताज़ा फल गुच्छ के औसत

महत्वपूर्ण विभिन्नता दिखाते है। अधिकतम गुच्छ संख्यॉ समजातिया में से 25/314 में पाया गया और निम्नतम (0.17) समजातिय टी.एस.-[illegible] पाया गया। लेकिन समजातियों के बीच ताज़ा फल गुच्छ में महत्वपूर्ण विभिन्नता नहीं थे। अधिकतम उपज (4.24 कि. ग्रा/ताड़) जी. बी. 25/314 से अंकित किया गया। समजातिय टी.एस 4 में ताज़ा फल गुच्छ का औसत भार अधिक पाया गया (2.44 कि. ग्रा/ गुच्छ)

खजन उत्पादन :

केरल सस्य जलवायु क्षेत्रों में तेलताड के लिए सिंचाई एवं पोषण आवश्यकता के निर्धारण के लिए चार तेल ताड़ केंद्रों में किए जा रहे परीक्षण प्रगति पर है। आडुथुरै केंद्र में 1200 ग्रा. नाइटोजन 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 नाइटोजन 400 ग्रा. पोसफोरस, 1800 ग्रा. पोटाश /ताड।/वर्ष (12.1 टन/हेक्टर/वर्ष) और 400 ग्रा नाइटोजन, 200 ग्रा फोसफोरस, 900 ग्रा.पोटाश के उपचार से 9.7 टन/हेक्टर/वर्ष प्राप्त किया गया बिना उर्वरक उपचार के ताड़ में निम्नतम ताज़ा फल गुच्छ प्राप्त किया गया 1 (8.4 टन / हेक्टर वर्ष) $एफ_3$, $एफ_2$, $एफ_1$, में फ. की अपेक्षा 71.4, 44.0 और 15.5% ताज़ा फल गुच्छ में वृद्धि पाई गई। सिंचाई विधि एवं उर्वरक स्तर के बीच सहसबंध महत्वपूर्ण है। अलवाल सिंचाई के साथ 1200 ग्रा नाइट्रोजन, 600 ग्रा फोसफोरस और 2700 ग्रा पोटाश /ताड़/वर्ष के संयुक्त उपचार से अधिकतम ताज़ा फल गुच्छ 17.6 टन/ हेक्टर/वर्ष प्राप्त किया गया।

कर्नाटक राज्य में गंगावती केंद्र के परीक्षण में पत्ता पोषण विश्लेषण किया गया। सत्रहवॉ पलाश पोषण संघटक के ऑकड़े से यह देखा गया कि पत्ता के नाइटोजन और पत्ता पोटेसियम के लिए सिंचाई उपचार के बीच हुई व्यतियान महत्वपूर्ण था। पत्ता पोषण विश्लेषण में विभिन्न उर्वरक स्तर का महत्वपूर्ण प्रभाव नहीं पाया गया। पत्ता पोटाश में सिंचाई और उर्वरक के बीच का सहसंबंध महत्वपूर्ण नहीं था। बिना सिंचाई के साथ 400 ग्रा नाइटोजन, 200 ग्रा फोसफोरस, 900 ग्रा.पोटाश का उपचार तथा रूढ़िगत सिंचाई के साथ 400 ग्रा नाइटोजन, 200 ग्रा फोसफोरस, 900 ग्रा.पोटाश का संयुक्त उपचार को छोड़कर अन्य संयुक्त उपचार की अपेक्षा ड्रिप सिंचाई के साथ 1200 ग्रा नाइटोजन + 600 ग्रा फोसफोरस, 2700 ग्रा.पोटाश का संयुक्त उपचार से महत्वपूर्ण उच्च पत्ता पोटाश अंकित किया गया।

मुदिस केंद्र के अध्ययन से यह देखा गया कि उर्वरक के स्तर बढ़ने से गुच्छ संख्या और ताज़ा फल गुच्छ उपज में भी वृद्धि पायी गयी। और 1200 ग्रा नाइटोजन + 600 ग्रा फोसफोरस, 2700 ग्रा.पोटाश /ताड़/ वर्ष के उपचार से उच्च उपज पायी गयी। इस स्तर पर उच्च गुच्छ संख्या (6.31) और अधिकतम ताज़ा फल गुच्छ उपज 137.62 कि.ग्रा / ताड़ अर्थात 19.68 टन / हेक्टर प्राप्त किया गया। और 800 ग्रा नाइटोजन, 400 ग्रा फोसफोरस, 1800 ग्रा. पोटाश /ताड़/वर्ष के उपचार से उससे कम प्राप्त किया गया। उर्वरक स्तर और सिंचाई के बीच का सहसंबंध में कोई भी संघटक महत्वपूर्ण नहीं पाया गया। लेकिन रूढिगत सिंचाई (अलवाल विधि) + 1200 ग्रा नाइटोजन + 600 ग्रा फोसफोरस, 2700 ग्रा. पोटाश /ताड़/वर्ष के उपचार से अधिक गुच्छ संख्या (6.99) और ताज़ा फल गुच्छ उपज 162.09 कि.ग्रा / ताड़ /वर्ष (23.34 टन / हेक्टर) और ड्रिप सिंचाई के साथ 1200 ग्रा नाइटोजन + 600 ग्रा फोसफोरस, 2700 ग्रा.पोटाश /ताड़/वर्ष के उपचार से 6.83 गुच्छ संख्या और 159.31 कि.ग्रा / ताड़ /वर्ष ताज़ाफल गुच्छ उपज (22.78 टन / हेक्टर) प्राप्त किया गया। ड्रिप सिंचाई के साथ 1200 ग्रा नाइटोजन, 600 ग्रा फोसफोरस, 2700 ग्रा.पोटाश /ताड़/वर्ष के उपचार से अधिकतम गुच्छ भार 23.35 कि.ग्रा/ गुच्छ पाया गया।

विजयराय केंद्र में सिंचाई, उर्वरक स्तर और उनके बीच का सहसंबंध के कारण भिन्नताएँ महत्वपूर्ण पायी गयी। रूढ़िगत सिंचाई के साथ 800 ग्रा नाइटोजन 400 ग्रा. पोसफोरस, 1800 ग्रा. पोटाश /ताड़।/वर्ष (143.2 कि.ग्रा/ताड़) को छोड़कर अन्य संयुक्त उपचार की अपेक्षा रूढ़िगत सिंचाई के साथ 1200 ग्रा नाइटोजन, 600 ग्रा फोसफोरस, 2700 ग्रा.पोटाश /ताड़/वर्ष के संयुक्त उपचार से उच्च उपज 159.6 कि.ग्रा / ताड़ प्राप्त की गई।

पॉमैरा :

फसल सुधार :

तमिलनाडु राज्य में वर्ष 2004 की अवधि में अक्तूबर महीने में जननद्रव्यों का संग्रहण का एक संयुक्त सर्वेक्षण आयोजित किया गया। दो जिले के विभिन्न जगहों से कुल 14 प्रजातियों का संग्रहण किया गया। अध्ययन के अधीन 14 प्रजातियों के पौध गुणों में विभिन्नता पाई गई। टी एन - 7/04 प्रजाति में मध्यम आकार का फल जो अंदर की ओर टढा हुआ और इन फलों में अधिकांशत: में एक ही बीज पाया गया। इसी प्रकार टी एन - 10/04 प्रजाति में अधिकांश फलों में दो बीज का और अधिकांश का बीज में भ्रूणपोष नहीं पाया गया।

किल्लिकुलम और पान्दिरिमामिडि केंद्रों में क्रमश: 173 और 176 प्रकार का जननद्रव्य प्रजातियों का रखरखाव किया गया था। 1991 में रोपित पौधों में कुछ पौधों का पुष्पन शुरू हुआ है। पान्दिरिमामिडि केंद्र में

वर्ष 1991 में रोपित 13 प्रजातियों का औसत पौध ऊँचाई 6/91 प्रजाति में अधिकतम पाया गया था। (6.89 मीटर) और 1/91 में 6.75 मीटर था 1/91 प्रजाति में औसत तना परिधि, तनुपट्ट चौड़ाई और पर्ण की लंबाई क्रमशः 1.39 और 1.27 मी. अधिकतम पाया गया। प्रजातियों में औसत पत्ता संख्या 13 से 16.2 तक पाया गया।

किल्लिकुलम केंद्र के फार्म में सुलभ बड़े पॉमैरा ताड़ से नीरा उपज अंकित किया गया। एक 34 ताड़ से 135.5 लीटर मीठा नीरा अंकित किया गया। इस ताड़ से वर्षो से उच्च उपज अंकित किया गया था।

फसल संरक्षण :

दक्षिण तमिलनाडु के दो जिले में रोग स्थिति सर्वेक्षण में दस जगहों में तूतुकुडि जिला के वल्लनाडु , वुवराइ, अंतोनियारपुरम, सेरवाइकारंमडम, मनकाराइ, अथुर, श्रीवाइकुंडम तथा तिरूनलवेली जिला के कलन्तपानाई, नंगुनेरी और तरूवाई में पत्ता चित्ती पाया गया। रोग प्रतिशत सूचकांक दर 3.00 से 32.00 तक है।

पॉमैरा के कन्द सड़न के प्रबंधन के लिए किए गए आठ उपचारों के बीच अन्य उपचारों की तुलना में 1% कारबेंडिज़म के साथ बीज डुबाना कंद सड़न नियंत्रण में उत्तम पाया गया था। 1% कारबेंडिज़म में डुबाने से पॉमैरा के अंकुरण में तथा कंद भार में विचारणीय वृद्धि पाया गया। मृदा में नीम केक प्रयोग के साथ *टी विरिडे* में चूषण करने से कंद सड़न रोग के लक्षण 16.66 प्रतिशत कम स्तर अंकित किया गया। नियंत्रित पौधे में रोग लक्षण 46.66 था। कंद सड़न रोग लक्षण कम होने के अतिरिक्त कंद के अंकुरण एवं भार में भी वृद्धि देखी गई । यह देखा गया कि नीम केक के प्रयोग से *टी विरिडे* के प्रभाव में वृद्धि पायी गयी जिससे कंद सड़न लक्षण कम हो गया।

Project Co-ordinator's Report

Scenario analysis

Coconut, oil palm and palmyrah occupy a predominant place in the Indian rural economy. Further, they play an important role in the sustainability of the fragile eco system in island and coastal regions. More than 20 million people in rural areas are engaged in the production, processing and marketing of these three crops. The long term nature of research on these crops, the prospects of higher returns from research investment and the likely distribution of research benefits to the small holders, make it all the more imperative to develop a long term perspective.

Coconut offers wide scope in terms of improvement in coconut productivity and also vast employment potential through the adoption of appropriate coconut based farming systems. Large scale adoption of value addition technologies in the coconut sector is still a less exploited field in India as compared to other countries.

Oil palm is one of the highest oil yielding crops that could help the country to minimize the edible oil imports with the cultivation of location-specific oil palm hybrids along with the required management practices. The farmers would be able to realize more than 25 tonnes of FFB/ha yielding about 5 tonnes of edible oil/ha.

Among the different species of palms, palmyrah ranks first in yielding sugar as well as other edible and non-edible products. Many value added products can be prepared from the fruit and other parts of the palm. The palmyrah also serves as a wind break and arrest sand dunes. Palmyrah could be grown in soil with suboptimal levels of physico-chemical characteristics. Tamil Nadu is a potential centre for the growth and development of palm products industry to a greater extent so as to attract foreign exchange by way of export of palm products.

Genesis

Indian Council of Agricultural Research reorganized the plantation crops research system in the country with the establishment of the Central Plantation Crops Research Institute (CPCRI) in 1970 and the Coconut Research Station, Kasaragod became the Headquarters of the CPCRI. Simultaneously, the ICAR also sanctioned the All India Coordinated Coconut and Arecanut Improvement Project with the Headquarters at CPCRI, Kasaragod. The coordinated research was initiated in 1972 after the finalization of research programme during the first workshop held at Kasaragod in 1971.

To begin with, the Project was initiated with four centres, viz., Ratnagiri and Dapoli (Maharashtra), Razole (Andhra Pradesh) and Veppankulam (Tamil Nadu). The CPCRI centres at Kasaragod, Kayangulam, Palode, Hirehalli and Andamans were included as active centres under the project. Subsequently, all the centres under the CPCRI were withdrawn except Kasaragod and Andamans. The scientific and technical staff sanctioned for the CPCRI centres under the project were also merged with the Institute. In 1975, the scope of the project was extended to cover five more centres viz., Arsikere, Pilicode, Mahuva, Coimbatore and Ambajipeta. In 1977, Konark centre was added. The eleventh centre at Mondouri (Kalyani) was started during 1980. A new centre for North-Eastern Region was sanctioned during the Seventh Five Year Plan period and the centre started functioning in March, 1985 at Kahikuchi. During the Seventh Plan period, three centres viz., Pilicode (Kerala), Mahuva (Gujarat) and Dapoli (Maharashtra) were withdrawn from the project with effect from 1.4.1986. Further, the scope of the project was widened with the inclusion of oil palm and the project was renamed as All India Coordinated Research Project on Palms. Seven new centres, three for coconut and four for oil palm, were added to the project. Two of the centres for

coconut, viz., Jalalgarh (Bihar) and Jagadalpur (Madhya Pradesh) are for the non-traditional coconut areas and the centre at Aliyarnagar (Tamil Nadu) is for containing coconut root (wilt) and Thanjavur/Ganoderma wilt diseases. Of the four oil palm centres, three viz., Vijayarai (Andhra Pradesh), Mulde (Maharashtra) and Gangavathy (Karnataka) started functioning in 1988 and Aduthurai Centre (Tamil Nadu) in 1989. The Razole centre was merged with Ambajipeta centre during 1988 for administrative and technical reasons. With the closure of the centres at Coimbatore (1990) and Andamans (1991), the programmes on arecanut were withdrawn from the project. Two centres for palmyrah research were started during the VIII plan, one at Killikulam in Tamil Nadu and the other at Pandirimamidi in Andhra Pradesh.

AICRP Centres

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.

Mandate

The main objectives of the All India Coordinated Research Project on Palms 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/ cropping 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

Budget

The budget for the year 2004-05 was Rs. 144.56 lakhs of which the ICAR share was Rs. 118.01 lakhs.

ON-GOING PROGRAMMES

During the year 2004-05, ten experiments on crop improvement, seven on crop management, six on disease control and four on pest management were in progress under this project.

In coconut, nine centres conducted experiment on utilization of existing germplasm and seven centres on promising varieties. The different hybrid combinations of coconut produced at Ambajipeta, Veppankulam and Kasaragod were evaluated at seven centres. New projects were initiated in seven coconut centres for collection, conservation and evaluation of local germplasm and for the production of location-specific hybrids and their evaluation. Similarly, a new project for the evaluation of new cross combinations in oil palm was initiated at all the four oilpalm centres.

Trial on assessing the nutritional requirement for Dwarf x Tall hybrid was in progress at Kahikuchi, Mondouri, Ratnagiri, Arsikere, Aliyarnagar and Veppankulam centres. Coconut based cropping system experiments were laid out at Arsikere, Ambajipeta, Kahikuchi, Mondouri, Ratnagiri and Veppankulam. Drip irrigation trial was continued at Veppankulam, Arsikere, Ratnagiri and Aliyarnagar. Integrated nutrient management trial in coconut was in progress at Ambajipeta, Aliyarnagar, Arsikere, Konark and Veppankulam centres. In addition, a new project for assessing the performance of medicinal and aromatic plants in coconut gardens was initiated at seven centres.

Studies related to etiology, epidemiology and management of Thanjavur wilt/Ganoderma wilt were in progress at Veppankulam, Arsikere and Ambajipeta centres. A new project on biocontrol of bud rot and stem bleeting disease was initiated at

Ambajipeta Centre. At Aliyarnagar, the survey was continued to monitor and contain the spread of root (wilt) disease in areas bordering Palghat tract (Kerala). While the survey for monitoring the pest problems in coconut was continued in three centres, new projects on management of eriophyid mite as well as integrated management of red palm weevil in coconut were initiated in three centres.

A trial on evaluation of oil palm crosses was in progress in the four oil palm centres. Evaluation of oil palm varieties for drought tolerance was in progress in two centres viz. Gangavathy and Mulde. Drip irrigation cum fertilizer trial on oil palm was continued at Aduthurai, Gangavathy, Mulde and Vijayarai centres.

Collection and maintenance of palmyrah germplasm was in progress at Killikulam and Pandirimamidi centres beside studies related to diseases and pests.

Group Meetings

The following discipline/crop-wise group meetings were organized during the year primarily to discuss the fine aspects of conducting the experiments as well as the Frontline Demonstrations; sources of planting materials, critical inputs for conducting the trials and their supply schedule and to resolve related administrative and management constraints.

1. Group Meeting of AICRP Palms Scientists involved in oil palm research was held at National Research Centre for Oil Palm, Pedavegi on June 15, 2004. Dr. M. Kochu Babu, Director, NRC for Oil Palm and Dr. S. Arulraj, Project Coordinator (Palms) conducted the proceedings.

2. Group Meeting of Coconut Pathologists of AICRP on Palms was held at Agricultural Research Station, Ambajipeta on June 18, 2004. Dr. Rohini Iyer, Head, Division of Crop Protection, CPCRI, Kasaragod and Dr. S. Arulraj, Project Coordinator (Palms) conducted deliberations.

3. Group Meeting of Agronomy/Horticulture Scientists of AICRP on Palms was held on June 25, 2004 at Coconut Research Station, Aliyarnagar. Dr. George V. Thomas, Head, Division of Crop Production, CPCRI, Kasaragod and Dr. S. Arulraj, Project Coordinator (Palms) conducted the meeting.

4. Group Meeting of coconut Crop Improvement Scientists of AICRP on Palms was held on December 18, 2004 at CPCRI, Kasaragod. Dr. V. Rajagopal, Director, Dr. P.M. Kumaran, Head, Division of Crop Improvement, CPCRI and Dr. S. Arulraj, Project Coordinator (Palms) conducted the meeting. Methodologies for implementing the local germplasm collection programme and also action plan for initiating the new trial on the evaluation of location specific cross combinations were finalized.

Major Achievements

COCONUT

1. Crop Improvement

Among the new germplasm types tested at Aliyarnagar, Cochin China ranked first (123.3 nuts/palm) in nut yield for the year 2003-04, followed by Ayiramkatchi (111.4) and Seychelles (108.4). At Ambajipeta Centre, Philippines Ordinary (102.35 nuts/palm/year) followed by Laccadive Ordinary (99.26 nuts) registered higher nut yields. Copra content per nut was the highest in the cultivar Philippines Ordinary (19.23 kg/palm/year) followed by Laccadive Ordinary (18.68 kg) and Andaman Ordinary (18.08 kg) compared to EC Tall (13.72 kg). Among the 10 exotic cultivars tested at Jagadalpur, the highest nut yield was recorded in Fiji Tall with 106 nuts/palm.

At Mondouri Centre in West Bengal, Jamaica Tall continued to record the highest yield in the garmplasm trial with 82 nuts/palm/annum (mean of last 16 years). The cultivar could be considered for release for commercial cultivation. Similarly, at Ratnagiri Centre, Laccadive Ordinary continued to record a very high yield (151 nuts/palm/year – mean of last 26 years) and hence could be considered for release for the commercial cultivation in the State. Among the 11 cultivars

tested at Veppankulam Centre, WCT recorded the highest annual nut yield of 115.3 nuts/palm followed by Zanzibar (112.7). Zanzibar recorded the highest cumulative mean nut yield of 98.9 nuts/palm/year followed by WCT (91.4 nuts/palm/year). San Ramon recorded the highest copra yield of 12.8 kg/palm/year followed by WCT (12.6 kg/palm) and Zanzibar (12.4 kg/palm).

A total number of 27 local germplasm types were collected by AICRP Centres during the year. Seedlings from the selected types would be planted during 2005-06 in the main field for further evaluation.

Among the different hybrid combinations tested at Aliyarnagar Centre, hybrid ECT x MYD gave the highest annual nut yield of 148.4 nuts/palm followed by WCT x GBGD (123.4 nuts/palm). Similarly, at Ratnagiri Centre, the highest average nut yield was recorded in GBGD x ECT (90 nuts/palm) followed by ECT x GBGD (87 nuts/palm).

In coastal Tamil Nadu area (Veppankulam), the hybrid COD X WCT recorded the highest annual nut yield of 117.4 nuts/palm followed by WCT X COD (112.3 nuts/palm) and WCT X MYD (106.1 nuts/palm). WCT X MYD recorded the highest cumulative mean nut yield of 106.9 nuts/palm/year followed by WCT X COD (98.5 nuts/palm/year) and COD X WCT (86.8 nuts/palm). WCT X MYD also recorded the highest copra yield of 16.4 kg/palm/year.

2. Crop Production

An analysis on the data collected from the experiment for determining the nutritional requirement of coconut hybrids at Ratnagiri Centre indicated that 1000:500:2000 of NPK (g/palm/annum) recorded the highest average yield of 117 nuts/palm during 1990-2004 (mean of 14 years). Also, it was seen that the additional doses of NPK fertilizer applied to the coconut palm have resulted in the additional profit per palm per year. The maximum additional profit per palm was recorded under treatment combination 1000:500:2000 NPK (Rs. 305) followed by 1000:0:1000 NPK (Rs.231) and 500:250:2000 (Rs. 220).

Similarly, at Veppankulam, graded doses of NPK recorded corresponding increase in the growth and yield attributes and nut yield of hybrid coconut. With respect to N, the maximum mean cumulative nut yield of 164 nuts / palm / year was recorded with N at 1000 g / palm followed by 500 g / palm (149 nuts / palm). Maximum yield (155.2 nuts / palm) was produced with P at 500 g / palm and it was closely followed by P at 250 g / palm (150.8 nuts / palm). Application of K at 2000 g / palm yielded 167.4 nuts / palm. Combined application of NPK at 1000:500:2000 g/palm/year and 1000:250:2000 g/palm/year recorded the highest yield of 171 and 170 nuts/palm/year respectively.

Among the five cropping system models tried at Arsikere in Karnataka State, the crop combination of coconut + banana could give the highest income of Rs. 74340/ha. Similarly, at Ratnagiri Centre in Maharashtra State, 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 plot (96%) followed by allspice (90%), cinnamon (71%) and nutmeg (69%).The economics worked out for different blocks indicated that maximum net returns were recorded in coconut + nutmeg block (Rs. 76495/-) followed by coconut + cinnamon block (Rs. 58840/-).

The cropping system trials at Kahikuchi gave highly encouraging results wherein the highest net return of Rs. 1,92,575/-per ha was recorded under coconut-blackpepper-turmeric cropping system followed by coconut-blackpepper-ginger intercropping, while the lowest net return of Rs. 43,487/- only was obtained from the control plot (coconut- blackpepper).

Observational trials on the performance of medicinal and aromatic plants in coconut gardens were initiated at Aliyarnagar, Ambajipeta, Kahikuchi, Bhubaneshwar, Mondouri, Ratnagiri and Veppankulam centres. At each centre, a survey on the cultivation of medicinal and aromatic plants in the region was conducted. A total number of 10-50 medicinal and aromatic plants were selected at each centre. The market potential and the status of availability of planting material were assessed

and observational plots with the selected plants were laid out.

Trials were conducted for the standardization of micro irrigation technology in coconut at Aliyarnagar Centre in Tamil Nadu State. Drip irrigation at 100% Eo and basin irrigation at IW/CPE ratio of 1.0 at 4 cm depth recorded nut yields of 153 and 152 nuts/palm/year respectively. No irrigation has recorded lowest yield of 82 nuts/palm/year. Drip irrigation from 33% to 100% Eo progressively increased the nut yield from 100 to 153 nuts/palm/year. Drip irrigation equal to 100% Eo recorded a maximum net income of Rs.65994/ha and a benefit cost ratio of 2.60 against the control with Rs.28388 and 1.97 respectively. Basin irrigation, which was on par with drip irrigation 100% Eo, recorded Rs.64694 and 2.55 respectively. Drip irrigation from 33 to 100% Eo progressively increased the net income from Rs.31470 to Rs.65994 and benefit cost ratio from 1.40 to 2.08 indicating the economic advantage of drip irrigation.

In the similar trials at Ratnagiri Centre in Maharashtra State, the mean cumulative yield data for last seven years (1997-2004) showed that palms under basin irrigation treatment has recorded (91 nuts/palm) significantly higher yield over the treatments on drip irrigation. Drip irrigation at 100% Eo recorded significantly higher yield over no irrigation treatment and at par with other treatments.

The maximum vertical and horizontal movement of water with irrigation equal to 100% Eo was 102.95 cm. and 90 cm. respectively followed by 66% Eo 99.75 cm. and 84 cm. and 33% Eo 82 cm. and 68 cm. respectively. It was further seen that the maximum water applied per palm was in basin irrigation treatment (12260 lit.) followed by drip irrigation at 100% Eo (10524 lit) and drip irrigation at 66% Eo (7009 lit.).

Among the five integrated nutrient management technologies evaluated at Ambajipeta Centre in Andhra Pradesh State, highest mean nut yield was recorded in palms receiving 50 per cent recommended dose of fertilizers (RCF) + 50 per cent composted coir pith (CCP) (154.78 nuts/palm), followed by 100 percent composted coir pith (CCP) (138.45 nuts/palm) as against control (72.56 nuts/palm). With respect to nut quality characters, the highest nut weight was registered in the treatment 50% RCF + 50% CCP (1169.87 g) followed by 100% RCF (1088.01 g) and the lowest in control (847.52 g). The husk percentage in various INM treatments ranged from 54.97% to 60.40%. The nut water content in various treatments ranged from 60.51 ml to 107.54 ml. The highest copra content was recorded in treatment receiving 50% RCF + 50% CCP (144.87 g/nut) followed by 100% CCP (136.62 g/nut).

3. Crop Protection

Correlation studies between weather factors and spread of basal stem rot disease in coconut for the period from January, 2000 to March, 2005 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.

In the sero detection studies for early detection of basal stem rot disease, the simple serological tests failed to detect basal stem rot disease infection in stem tissues of diseased coconut palm. The indirect form of ELISA was found to be more sensitive in detecting the *Ganoderma* spp in tissues from root, basal portion of stem and up to 1 m height from basal portion of stem of coconut palm.

To confirm the last year finding that the red gram plant could be used as an indicator plant for the early detection of basal stem rot disease, pigeon pea was resown again in sick soil to study the consistency of the symptoms of bark splitting at the base. Results indicated that bark splitting of red gram plant at the base was consistent in all the plants that are grown in *Ganoderma* sick soil.

Among the 11 isolates of *Ganoderma*, 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 sporophore production was also observed in the seedlings inoculated with the isolates CRS 1, CRS 4 and PV 2 at 67 days after inoculation. The results indicated that the isolate TKT 1 was a virulent one.

Scanning electron microscopy studies on mechanism of action of *Trichoderma* spp on *Ganoderma applanatum* and *G.lucidum* were conducted and the results indicated that *Trichoderma* spp coiled round the hyphae of *Ganoderma* spp both sparsely (in the initial stages) and intensely (later stages). This was followed by frequent adpressions of the *Trichoderma* hyphae on the hyphae of both the *Ganoderma* spp. Later penetration of *Trichoderma* spp into the hyphae of test pathogen followed by replacement of its protoplasmic contents was noticed. Finally, lysis of the *Ganoderma* spp mycelium was noticed by the *Trichoderma* spp, followed by protuberances of the phialospores of the bioagent from within the lysed mycelia of *Ganoderma* spp.

In the field efficacy trials on biocontrol agents at Ambajipeta Centre, *Trichoderma* spp and *P.fluorescens* on basal stem rot of coconut, 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% conc) @ 25ml at quarterly intervals.

Ten coconut genotypes 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. Among the ten coconut genotypes, ECT X BSR tolerant ECT registered a higher rate of survival (61.1 per cent) as compared to other genotypes in BSR sick soil. ECT recorded 40 per cent survival. ECT X BSR tolerant ECT had a higher content of total phenol when compared to other genotypes. Similarly, the activities of peroxidase and polyphenol oxidase were also more in the hybrid ECT X BSR tolerant ECT when compared to other genotypes in BSR sick soil, which may be responsible for tolerance. Isozyme analysis of peroxidase in BSR resistant genotype (ECT X BSR tolerant ECT) and susceptible genotype (ECT) revealed that an isoform PO2 was induced in both resistant and susceptible genotypes. But PO2 was intensified in the resistant genotype. The isoform PO1 was present only in the resistant genotype.

Survey was conducted to assess the extent of spread and intensity of root (wilt) disease of coconut in nine villages in Coimbatore district and four villages in Theni district. From the survey conducted in Cumbum block of Theni district, severe to very severe root (wilt) disease incidence was observed in Cumbum block. The disease incidence ranged from 22.2 to 30.9%. Advanced symptoms of root (wilt) disease was noticed in Gudalur and Surilipatti villages of Cumbum block. Mid-whorl yellowing was noticed in several gardens. Leaf rot disease symptom was also observed in several palms. In Pollachi-Kerala borders of Coimbatore District, root (wilt) disease incidence was not noticed in any of the 10 villages surveyed. Only two palms in Meenakshipuram area of Coimbatore District were suspected for root (wilt) disease.

An intensive periodical survey was carried out on the infestation of eriophyid mite in selected coconut gardens in 20 districts in Tamil Nadu. The eriophyid mite infestation invariably was in higher proportion in all the four districts ranging from 70% to 85% in Erode district, 75% to 90% in Salem district, 68% to 96% in Namakal district, 82% to 88% in Coimbatore district. The intensity of damage was expressed in terms of damage rating grade upto 5.00 with almost 80-90% nut damage. Similar survey in coastal districts of Andhra Pradesh indicated that the grade index of mite damage continued to be in mild condition since 2002. Size of the nut improved considerably and yields were stabilized during the year 2004. Further observations made during 2004 revealed a reduction in mite population to an extent of 49.9 per cent when compared to that of 2001. However, the percentage infestation of eriophyid mite was continued to be very high in Thane and Sindhudurg districts of Konkan region of Maharashtra State.

In the chemical control trial for the management of red weevil in coconut at Ambajipeta centre, among the three pesticides tested (through root feeding against red palm 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 80.0% recovery. Studies on pheromone catches of red palm weevil revealed that, though not

significantly, the Chem Tica lure could attract more number of weevils (28.00/trap) when compared to that of CPCRI lure (21.00/trap) in a period of 6 weeks with an average catch of 4.67 weevils/trap/week. Number of weevils trapped/week was also more in Chem Tica lure in the respective weeks when compared to that of CPCRI lure.

OIL PALM

1. Crop Improvement

Among the eleven tenera hybrids (supplied from Palode) under evaluation at Mulde Centre in Maharashtra State from 1991, hybrid combination 18 D X 32 P recorded maximum FFB yield of 121.61 kg/palm/year (17.39 t/ha) while combination 115 D X 291 P recorded maximum bunch weight i.e. 22.16 kg/bunch. Maximum number of bunches were produced by 104 D X 98 P combination.

In a similar trial laid out in Vijayarai in Andhra Pradesh State in 1992, maximum bunch weight was recorded in cross combination 18 D x 32 P (17.3 kg) and the lowest was recorded in 65 D x 111 P (13.6 kg). Maximum FFB yield was obtained in cross combination of 115 D x 291 P (113 kg/palm-13.9 t/ha) and the lowest yield was recorded in 82D x 291 P (57.9 kg/palm - 7.1 t/ha).

Nine genotypes including six Zambian(ZS) and three Tanzanian(TS) selections were under evaluation for drought tolerance at the Gangavathy Centre in Karnataka State from 1998. The results indicated that for the growth characters like height, girth and annual leaf production, the genotypic difference was not significant. For relative water content also, the drought tolerant genotypes did not differ among themselves. However, the Electrolyte leaching, other wise called the leakage expressed as the per cent of final conductivity differed significantly among genotypes. The leakage was significantly lower in case of ZS-9 (11.93%) followed by TS-4 (12.18%).

In the similar trial for screening eighteen accessions for drought tolerance at Mulde Centre, the data on yield attributes revealed that the average number of FFB produced in different genotypes showed significant difference. Maximum number of bunches were produced in genotype G.B. 25/314 i.e. 7.39 and lowest (0.17) in genotype TS-5. Though there was no significant difference in FFB yield among the genotypes, G.B. 25/314 recorded maximum yield(4.24 kg/palm). Average weight of FFB was more in genotype TS- 4 (2.44 kg/bunch).

2. Crop Production

Experiments were in progress at all the four oil palms centres to assess the irrigation and nutrient requirements for oil palm in different agro-climatic regions. At Aduthurai Centre, the palms receiving a fertilizer dose of 1200:600:2700 g NPK/palm/year (F_3) produced higher FFB yields (14.4 t/ha/year) followed by F_2-800:400:1800 g NPK/palm/year (12.1 t/ha/year) and F_1-400:200:900 g NPK/palm/year (9.7 t/ha/year) and the lowest FFB yield was in palms raised without any fertilizer (F_0) (8.4 t/ha/year). The increase in FFB yields in F_3, F_2 and F_1 were 71.4, 44.0 and 15.5 % over F_0. The interaction between irrigation methods and fertilizer levels was also found significant. A combination of basin method of irrigation (I_1) with 1200:600:2700 g NPK/palm/year registered highest FFB yield (17.6 t/ha/year).

Leaf nutrient analysis was undertaken in the trial at Gangavathy Centre in Karnataka State. The data on nutrient composition of 17th frond indicated that the differences due to irrigation treatments was significant for leaf N and leaf Ca. It was seen that no irrigation treatment recorded the highest leaf N and Ca. The different fertilizer levels did not have significant effect on any of the leaf nutrients analysed. In the case of leaf K, interaction between irrigation and fertilizer was significant. The combination of drip irrigation + 1200:600:2700 g NPK was found to record significantly higher leaf K than all other combinations except No irrigation + 400:200:900g NPK and conventional irrigation + 400:200:900g NPK.

At Mulde Centre, the study revealed that number of bunches and FFB yield increased with the increase in levels of fertilizers and it was significantly higher at 1200:600:2700g $N:P_2O_5:K_2O$/palm/year levels. 1200:600:2700g $N:P_2O_5:K_2O$/palm/year level recorded significantly more number of bunches (6.31) and highest FFB yield i.e. 137.62 kg per palm that comes to 19.68 t/ha

followed by 800:400:1800 g $N:P_2O_5:K_2O$/palm/year level. Interaction between fertilizer levels and irrigation was not significant for any of the characters under study. However, conventional irrigation (basin method)+1200:600:2700g $N:P_2O_5:K_2O$/palm/year recorded more number of bunches (6.99) and FFB yield i.e. 162.09 kg /palm /year (23.34 to t/ha) followed by drip irrigation + 1200:600:2700g $N:P_2O_5:K_2O$/palm/year i.e. 6.83 number of bunches and 159.31 kg /palm /year FFB yield (22.78 t/ha). Drip irrigation + 1200:600:2700g $N:P_2O_5:K_2O$/palm/year also recorded maximum bunch weight of 23.35 kg /bunch.

At Vijayarai Centre, the results indicated that the difference due to irrigation, fertilizer levels and their interaction was significant. It was seen that conventional irrigation + 1200:600:2700g $N:P_2O_5:K_2O$/palm/year combination gave significantly higher yield(159.6 kg/palm) than all other combinations except conventional irrigation +800:400:1800 g $N:P_2O_5:K_2O$/palm/year (143.2 kg/palm).

PALMYRAH

1. Crop Improvement

During the year 2004, a joint survey and collection of germplasm was taken up in the month of October in Tamil Nadu state. A total of 14 accessions were collected from different places of the two districts. Among the 14 accessions that had differences for the plant characters under study, accession TN-7/04 had medium sized fruits which were slightly curved inwards and these fruits mostly had single seed inside. Likewise, in accession TN-10/04, most of the fruits were two seeded in the bunch and many of these seeds have aborted endosperm.

Germplasm accessions were maintained and evaluated at Killikulam and Pandirimamidi Centres with 173 types and 176 types respectively. A few types planted in 1991 started flowering during the current year. At Pandirimamidi Centre, for the thirteen accessions planted during 1991, mean plant height was maximum in the accession-6/91[6.89 m] followed by the accession-1/91 [6.75 m]. Mean stem girth, lamina breadth and length of petiole were also found maximum with the accession-1/91 (1.77, 1.39 and 1.27 m respectively). Mean number of leaves produced ranged from 13.0 to 16.2 among the accessions.

The neera yield was recorded from the existing grown up palmyrah palms available in Killikulam Centre Farm. The palm F34 continued to yield well, recording 135.5 litres of sweet sap (Neera). This palm was found to record higher yield consistently over the years.

2. Crop Protection

In the disease status survey covering palmyrah groves in two districts of South Tamil Nadu, leaf blight was noticed in ten places, viz., Vallanadu, Vuvari, Anthoniarpuram, Servaikaranmadam, Manakarai, Athur, 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.

Among the eight treatments for the management of tuber rot disease in palmyrah, dipping seed nut with carbendazim (0.1%) was significantly better in controlling the tuber rot than all the other treatments. Carbendazim (0.1%) dip also increased the germination and tuber weight considerably in palmyrah. Soaking in *T.viride* combined with soil application of neem cake recorded a low level of 16.66 percent incidence of tuber rot disease. In the control plot, the disease incidence was 46%. Besides reducing the tuber rot incidence, this treatment also enhanced the germination and weight of tubers. It is interesting to note that the efficacy of *T.viride* was enhanced with the application of neem cake, which resulted in the reduction in tuber rot incidence.

COCONUT
1.1 Crop Improvement

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

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

The germplasm trial was initiated at nine centers to assess the performance of indigenous and exotic cultivars in different regions of the country. The planting materials for the centers other than Ambajipeta, Ratnagiri and Veppankulam, (where the trials existed prior to the starting of the All India Coordinated Research Project) were supplied by CPCRI, Kasaragod.

Aliyarnagar

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

Germplasm Set I (planted in 1988)

This set of 15 genotypes , was under evaluation for the last 16 years. The growth characters and yield of the genotypes as recorded from July,2003 to June,2004 are given in Table 1.

Among the genotypes, Arasampatti Tall continued to give the maximum number of functional leaves(37.5),female flowers(327.6) and nut yield(212.4) for the year 2003-04.

Table 1: **Growth characters and yield of germplasm – Set I-From July,2003 to June, 2004 (Aliyarnagar, 2004)**

Sl. No	Name of the cultivar	No. of leaves produced	Girth at base - at permanent mark(cm)	Height from the base (cm)	No. of bunches harvested	No. of nuts harvested
1	Zanzibar	11.2	187.2	1120.4	8.7	94.3
2	San Ramon	10.6	194.2	964.2	7.9	59.6
3	Gonthembili	11.6	182.9	1076.1	8.6	84.6
4	Java	10.4	218.3	1212.3	9.4	114.5
5	FMS	11.0	196.7	1167.9	6.2	89.1
6	BSI	11.2	181.3	1131.5	7.2	94.3
7	Kenthali	11.4	111.1	693.5	6.8	86.8
8	St. Vincent	10.0	178.7	812.2	10.3	116.6
9	ECT	11.8	168.6	943.2	9.7	122.9
10	MOD	11.6	93.0	587.4	6.4	93.4
11	MYD	11.4	92.6	650.2	7.2	89.7
12	MGD	12.0	212.8	1256.8	11.2	178.7
13	Arasampatti Tall	12.3	125.1	1224.0	10.6	212.4
14	Tiptur Tall	13.0	175.0	775.1	12.1	175.4
15	ADO	12.3	131.2	786.3	8.8	98.3

Germplasm Set II (planted in 1990)

In set II trial (Table 2), Cochin China ranked first (123.3 nuts/palm) in nut yield for the year 2003-04, followed by Ayiramkatchi (111.4) and Seychelles (108.4). The highest number of female flowers were produced by Cochin China (239.4) followed by GBD (216.3) whose nut yield was 98.4 nuts/palm. Cochin China also produced the highest number of bunches (12.2) in addition to the highest female flower production and the highest nut yield.

Germplasm Set III (planted in 1994)

Among the set III trial (Table 3), the highest nut yielder during 2003-04 was Kenya (136.4 nuts/palm) followed by ADO (127.2). Kenya also produced higher number of female flowers and the highest number of bunches. Regarding leaf production during 2003-04, ECT had the highest number (12.3) followed by Thailand, PHO and Kenya (12.2). PHO ranked second in female flower production whose nut yield was 122.6 nuts/palm. For the number of functional leaves on crown, Etamozhi Tall got the highest rank (38.2)followed by Thailand (34.6). For cumulative leaf production, Etamozhi Tall recorded the highest number (108.2) followed by PHO (109.7).

Ambajipeta

The first set of germplasm was planted in 1967 with eleven accessions. In germplasm set II, a total of 11 accessions were planted during 1970 and 1974. Planting of new germplasm was taken up during December, 2003.

Set I (planted in 1967)

The data on mean nut yield, yield attributes and nut characters are presented in Table 4. A perusal of data on yield attributes, mean nut yield / palm revealed that Laccadive Ordinary produced the highest number of spadices/palm (14.12), more number of female flowers (371.00) and higher nut yield (106.41 nuts/palm/year). However, if cumulative mean nut yields are considered, Philippines Ordinary (102.35 nuts/palm/year) followed by Laccadive Ordinary (99.26 nuts/

Table 2 : Growth characters and yield of existing germplasm – Set II(Aliyarnagar, 2004)

Sl. No	Name of the cultivar	No. of leaves produced	Girth at base(cm)	Height from the base (cm)	No. of bunches harvested	No. of nuts harvested
1	Calangute	11.3	161.2	235.8	5.2	36.7
2	Nicobar	11.3	242.0	370.2	4.7	32.3
3	Guam	12.0	144.8	356.6	6.6	51.3
4	Ceylon Tall	11.3	214.5	393.8	8.7	86.7
5	Nadora	8.9	108.9	240.8	3.0	13.8
6	Spikeless	10.1	127.3	243.8	4.2	28.8
7	A.Ranguchan	9.1	155.0	262.1	2.4	19.6
8	Jamaica	9.5	175.1	288.6	6.8	57.6
9	Seychelles	12.1	157.4	395.1	11.6	108.4
10	LCO	12.3	177.2	391.3	10.1	88.1
11	Rajapalayam Tall	12.3	170.3	358.5	8.6	94.3
12	CGD	11.3	141.8	273.2	8.4	71.0
13	Hazari	11.5	144.3	324.6	7.7	97.6
14	Ayiramkatchi	11.8	127.2	348.5	9.0	111.4
15	Andaman Giant	11.3	197.4	317.4	9.6	64.6
16	Cochin China	12.1	178.2	333.6	12.2	123.3
17	GBD	12.3	167.3	346.2	10.8	98.4

Table 3 : Growth characters and yield of existing germplasm – Set III (Aliyarnagar, 2004)

Sl. No	Name of the cultivar	No. of leaves produced	Girth at base (cm)	Height from the base (cm)	No. of bunches harvested	No. of nuts harvested
1	Sanblass	10.8	119.1	258.8	3.6	18.4
2	Nadora Tall	12.1	170.8	376.4	5.4	47.3
3	ECT	12.3	170.4	384.5	7.9	106.4
4	WCT	11.8	131.6	248.4	7.7	114.5
5	Andaman Giant	8.6	190.4	354.3	3.4	21.9
6	Etamozhi Tall	12.1	192.8	314.8	8.4	69.8
7	Fiji	11.7	186.2	347.5	7.6	112.7
8	Thailand	12.2	148.3	263.5	6.8	54.3
9	COD	11.8	121.8	269.7	5.4	45.1
10	New Guinea Tall	11.3	151.2	272.3	5.1	18.4
11	PHO	12.2	180.8	379.7	10.1	122.6
12	Kappadam	10.8	172.0	356.8	3.5	18.4
13	Siam	11.8	195.1	276.5	4.7	39.3
14	Kenya	12.2	181.9	219.3	11.3	136.4
15	ADO	11.5	167.2	359.4	8.6	127.2

Table 4 : Yield and yield attributes of germplasm accessions– Set I(Ambajipeta, 2004)

Variety	Mean nut yield/ palm/year	Whole nut wt (gm)	Husk(%)	Water content (ml)	Shell (%)	Copra (g/nut)	Oil %
Java	69.18	1211.25	37.49	182.15	16.29	196.80	61.63
Cochin China	86.45	1405.00	31.58	281.65	15.37	219.50	63.73
Philippines ordinary	94.18	1627.50	41.41	162.70	15.74	217.20	61.65
Ect	84.19	1034.56	41.48	143.25	16.62	147.30	56.81
Fiji	79.62	1233.68	47.17	120.50	16.68	164.80	59.94
Laccadive ordinary	106.41	1004.34	38.62	160.15	15.43	149.10	56.85
Laccadive micro	98.14	897.67	46.70	79.90	15.11	216.20	62.20
Andaman ordinary	82.12	1345.87	41.17	183.00	15.77	206.00	61.01
Java giant	79.00	1134.76	42.52	216.90	14.26	197.90	54.16
Ceylon tall	61.05	1009.38	31.96	214.76	14.47	191.90	57.34
Spicata	66.83	1035.54	36.43	167.15	17.75	156.24	54.68
Range	61.05-106.41	897.67-1405	31.58-47.17	79.90-281.65	14.26-17.75	147.30-219.50	54.16-63.73
Mean	82.49	1176.32	39.68	173.90	15.77	187.26	59.09

registered higher nut yields. Copra content per nut was highest in the cultivars Philippines Ordinary (19.23 kg/palm/year) followed by Laccadive Ordinary (18.68 kg) and Andaman Ordinary (18.08 kg) compared to EC Tall (13.72 kg). Highest nut weight was produced by Philippines ordinary (1627.50 g/nut) followed by Cochin China (1405.00 g). Maximum nut water content was recorded by Cochin China (281.65 ml/nut) followed by Java Giant (216.90 ml). Highest copra content was registered by Cochin China (219.50 g/nut) followed by Philippines Ordinary (217.20 g). Cochin China (63.73%) and Laccadive Micro (62.20%) recorded higher oil content.

Set II

Among the nine accessions(Table 5), maximum number of spadices were produced by WCT x COD (14.16) and COD x WCT (13.18). Sakhigopal (314.14) and COD x WCT (312.18) registered the highest number of female flowers. In respect of mean nut yield during the year, the highest was recorded by WCT x COD (88.30 nuts/palm/year) followed by COD x WCT (81.46). However, if cumulative nut yields are considered, Sakhigopal (100.49 nuts) registered highest nut yield and found promising. Copra yields were highest for WCT x COD (16.12 kg/palm/year) and Sakhigopal (14.92 kg). The whole nut weight was highest in COD x WCT (1305 g) and Sakhigopal (1233.68 g) while Borneo recorded the lowest (897.67 g). Nut water content was maximum in Ceylon Green (150.07 ml) followed by Guam (126.76 ml). If copra content is considered, WCT x COD (188.70 g/nut) and its reciprocal (173.00 g) registered highest contents and showed promise. The same crosses also recorded higher oil content viz., 63.38 and 66.70 respectively and found superior.

Arsikere

The germplasm trial (non replicated trial) consisting of 12 coconut cultivars was laid out during 1994 in typical red soil. The observations on growth parameters and yield of nuts are presented in Table 6.

Among the 12 cultivars tested, tree height was highest in Nufella, tree girth was highest in San Ramon and the functional leaves were more in

Table 5 : Yield and yield attributes of germplasm accessions –Set II (Ambajipeta, 2004)

Variety	Nut yield/ palm/year	Whole nut wt (gm)	Husk(%)	Water content (ml)	Shell (%)	Copra (g/nut)	Oil %
Ceylon Orange	56.11	1227.50	67.62	116.66	10.52	132.80	57.72
Ceylon Green	48.00	1034.56	54.76	150.07	12.93	158.90	59.78
Andaman Dwarf	50.47	1223.68	61.90	121.67	12.69	158.56	59.13
Guam	52.14	1004.04	58.78	126.76	10.28	108.40	61.01
Boreno	42.14	897.67	55.30	118.34	10.67	163.50	60.95
Sakhigopal	67.30	1345.87	53.39	128.84	12.78	160.20	57.63
B.S.Islands	41.40	1134.17	51.34	107.00	10.87	204.00	55.23
WCT x COD	88.30	1211.25	57.30	115.00	14.65	188.70	63.38
COD X WCT	81.46	1305.00	59.83	107.51	12.10	173.00	66.70
Range	41.40 - 88.30	897.67 - 1345.87	51.34 - 67.62	107.51 - 150.07	10.28 - 14.65	108.40 - 204.00	55.23 - 66.70
Mean	58.89	1154.89	57.80	128.31	11.19	160.89	60.17

Table 6 : Growth characters and yield of existing germplasm collections (Arsikere, 2004)

Sl.No.	Cultivar	Tree height (m)	Tree girth (cm)	Functional leaves (No.s)	Coconut yield (nuts/palm)	
					2003-04	Mean for 6 years
1	Zanzibar	3.73	116	21.5	31.8	21.4
2	San Ramon	3.26	118	18.5	24.9	6.0
3	Phi-Lono	3.89	104	21.6	25.1	14.3
4	Nufella	4.31	97	22.3	29.3	31.6
5	Nuguli	3.30	102	18.3	33.6	23.4
6	Nuwehung	3.41	93	24.7	30.9	24.8
7	Jawa	3.04	103	20.7	23.9	11.3
8	BSI	3.18	96	23.8	24.3	18.4
9	MYD	2.91	85	24.9	30.0	24.3
10	MOD	2.93	90	24.1	25.0	19.1
11	Kenthali	1.93	68	16.4	18.0	10.7
12	Tiptur tall	2.22	105	17.6	17.2	9.9

Malayan Yellow Dwarf (MYD). The coconut yield during 2003-04 was highest in the cultivar Nuguli (33.6 nuts/palm/year) while the mean nut yield over 6 years was highest in Nufella (31.6 nuts/palm/year).

Jagdalpur

The trial was started during June, 1988, with ten exotic cultivars. The yield-attributing characters and yields were recorded and are presented in Table 7. The data showed that, maximum number of functional leaves (32) were recorded in cultivar Fiji Tall, followed by MOD (29). However, annual leaf production rate was higher in cultivar Zanzibar (14.6) and the lowest in cultivar MYD (11.8). The number of inflorescence produced was in the range of 5.67 to 8.67, out of which the average number of barren inflorescence was maximum in Verrikobbari and FMS (0.5). The male-phase and female-phase varied in the range of 20-24 and 3.2 to 7.0 days respectively. The number of female flowers was highest in cultivar MOD (394), followed by cultivar MYD (301). However, the percentage of fruit set was maximum in Verrikobbari (63.40%), followed by Zanzibar (45.79%). The highest annual nut yield was noticed in Fiji Tall (106 nuts/palm).

Table 7 : Yield and yield attributing characters of existing germplasm collections(Jagdalpur, 2004)

Sl. No.	Cultivar	No. of functional leaves	Annual leaf production rate /year	No. of inflorescence/ palm	No. of female flowers/ palm	Setting percentage	Annual nut yield/ palm
1	BSI	28	12.0	8.00	220	33.98	55
2	MYD	22	11.8	8.00	301	15.28	18
3	Verrikobbari	26	13.6	9.17	144	63.40	50
4	MOD	29	14.0	8.50	394	38.62	40
5	FMS	26	13.8	7.50	196	35.71	55
6	Zanzibar	25	14.6	6.00	146	45.79	56
7	San Ramon	22	12.0	5.80	93	18.46	17
8	Java	24	13.6	6.50	165	30.72	36
9	Gonthembilli	26	13.8	8.80	176	41.06	54
10	Fiji Tall	32	14.0	7.60	296	41.36	106

Bhubaneshwar

The experiment was planted during December, 2003 at new site of Bhubaneshwar.The initial growth parameters of 15 cultivars are given in the Table 8.

Mondouri

The experiment was started during the year 1981. During the year, the differences between varieties was found significant for nut weight and yield(Table 9). Jamaica Tall was found to give the maximum nut weight(1667 g) followed by Zanzibar(1637 g). Jamaica Tall was also found to record highest nut yield(81.3/palm), highest cumulative mean nut yield(82.3/palm), highest copra yield/year(9.1 kg) and oil(5.9kg/palm/year).

Ratnagiri

The experiment on germplasm collection was laid out in 1956 with of 27 different cultivars and four Banawali types. During 2003-04, Pratap produced

Table 8: Mean growth parameters of existing germplasm (Bhubaneshwar, 2004)

Sl. No.	Cultivar	Height(cm)	Girth(cm)	Number of leaves on the crown	Number of new leaves produced
1	GBD	58.0	11.8	6.2	2.2
2	Sakhigopal	53.0	11.4	5.8	1.8
3	Pratap	59.6	11.2	6.8	1.2
4	COD	50.2	11.6	5.0	1.4
5	MGD	55.6	11.4	6.4	2.0
6	MYD	50.2	11.4	6.0	1.8
7	WCT	57.6	10.0	6.2	1.4
8	Tiptur Tall	63.8	11.0	6.4	1.6
9	Sanramon	55.8	11.8	6.8	2.0
10	Java	59.6	11.6	5.6	1.4
11	BSI	61.6	10.6	5.8	1.6
12	Guam	57.4	10.6	6.0	1.6
13	St.Vincent	63.0	9.8	5.4	1.4
14	Andaman Ord.	58.0	11.0	5.8	1.6
15	SSG	51.0	10.0	6.0	1.6

Table 9: Production of bunches and nut yield in different coconut varieties (Mondouri, 2004)

Varieties	Bunches/ palm	Nut weight (g)	Nut yield/ palm	Copra yield/ palm(kg)	Oil yield/ palm(kg)	Sweetness of tender nut water	Sweetness of tender meat
Borneo	7.3	1578	53.3	6.1	3.8	Average	Good
B. S. Islands	6.9	1613	52.6	4.2	2.7	Average	Good
F. M. S. Big	7.6	1559	47.3	4.9	3.1	Average	Poor
Gonthembili	6.6	1461	47.6	4.8	3.0	Poor	Average
Jamaica Tall	8.8	1667	81.3	9.1	5.9	Average	Average
Java	8.1	1481	67.6	7.5	4.7	Average	Average
San Ramon	6.3	1378	48.6	4.9	3.3	Average	Average
St. Vincent	6.6	1362	53.3	4.7	3.1	Average	Poor
Zanzibar	7.3	1637	63.6	6.2	4.0	Average	Average
Hazari	8.1	1256	78.3	8.6	5.5	Poor	Average
S.Em.	0.19	19.6	3.46	-	-		
C.D. (0.05)	N S	41.1	7.26	-	-		

the highest average yield of 161 nuts/palm followed by Laccadive Ordinary (150 nuts).As regards the average yield of last 26 years (1978 to 2004), variety "Laccadive Ordinary" recorded the highest yield of 151 nuts/palm/year followed by Pratap (143 nuts), T X D (129) and Philippines Ordinary (107). Further it was observed that the maximum percentage of increase in nut yield over WCT was recorded by "Laccadive Ordinary" (69.66%) followed by Pratap (60.68%), T X D (44.94%) and Philippines Ordinary (20.22%). T X D produced maximum copra per palm (23.45 kg) which is 4.10 t/ha, followed by Philippines Ordinary(22.95kg : 4.02 t/ ha) T X D also recorded maximum oil production per palm (16.66 kg :2.92 t/ha), followed by Philippines Ordinary (15.96 kg : 2.79 t/ha)

The yield data of cultivars are presented in Table 10. As regards the average yield of last 26 years (1978-2004), variety F.M.S. recorded the highest yield of 113 nuts/palm/year, followed by Fiji (111 nuts). Among Banawali types, Banawali Yellow Round yielded the highest yield of 120 nuts/ palm/year. The maximum copra per palm (18.40 kg.) and per ha. (3.22t.) and oil per palm (12.97kg.) and per ha. (2.27t.) were produced by Fiji variety. As regards the Banawali types, the 'Banawali Green Long' produced the maximum copra and oil per palm (20.29 kg. & 13.89kg.) and per hectare (3.55t and 2.43t) respectively .

Pratap

Among the cultivars planted in the year 1979, "Laccadive micro" recorded the highest yield of 113 nuts/palm/year (average yield of last 16 years).

Veppankulam

Germplasm Set : II (Planted in 1984)

An analysis of the reproductive characters recorded on 11 cultivars maintained in germplasm Set II, planted in 1984, revealed that among the cultivars, WCT recorded the highest number of functional leaves of 36.0 leaves/palm followed by Seychelles (34.0 leaves/palm). WCT also recorded the highest leaf production rate (13.5 leaves/palm/year), No. of female flowers (29.5/inflorescence) and nuts/ bunch (9.0/bunch). The cultivars Kenya, WCT and Zanzibar recorded the highest number of inflorescence (13.0/palm). Zanzibar recorded the highest setting percentage of 33.5% followed by WCT (30.0%).

Table 10 : Coconut yield in different cultivars planted in 1957(Ratnagiri, 2004)

Sl. No.	Name of cultivar	No. of nuts per palm	Copra		Oil	
			per palm (kg)	per ha (t)	per palm (kg)	per ha (t)
1.	F.M.S	104	13.72	2.40	9.42	1.66
2.	Fiji	132	18.40	3.22	12.97	2.27
3.	Gangabondam	110	16.69	2.92	10.39	1.83
4.	Kappadam	101	13.66	2.39	8.93	1.56
5.	New Guinea	72	14.80	2.59	10.34	1.81
Banawali types						
6.	B.Y.R.	112	16.02	2.80	11.10	1.94
7.	B.G.L.	151	20.29	3.55	13.89	2.43
8.	B.R.R.	107	15.47	2.71	10.34	1.81
9.	B.Y.L.	129	15.31	2.68	10.72	1.88

Nut characters and nut yield were recorded and presented in Table 11. Among the cultivars, San Ramon recorded the highest whole nut weight (1720 g/nut) dehusked nut weight (950.6 g/nut), kernel weight (466.2 g/nut) and copra weight (242.3 g/nut). Cochin China comes second for the above characters.

Among the cultivars, WCT recorded the highest annual nut yield of 115.3 nuts/palm followed by Zanzibar (112.7). Zanzibar recorded the highest cumulative mean nut yield of 98.9 nuts/palm/year followed by WCT (91.4 nuts/palm/year). San Ramon recorded the highest copra yield of 12.8 kg/palm/year followed by WCT (12.6 kg/palm) and Zanzibar (12.4 kg/palm).

Table 11 : Nut characters of germplasm - Set II (Veppankulam, 2004)

Sl.No.	Cultivar	Whole nut wt.(g)	Dehusked nut wt.(g)	Kernel wt.(g)	Copra wt.(g)	Annual nut yield	Copra yield/palm/year
1.	BSI	920.0	552.0	273.1	152.8	76.4	9.1
2.	Cochin China	1215.0	729.0	362.0	166.5	63.4	8.2
3.	Guam	895.2	520.3	245.4	121.8	49.4	5.4
4.	Kenya	902.5	523.2	261.9	130.9	79.3	10.2
5.	Nigerian Tall	1120.4	672.0	302.4	152.9	84.4	10.3
6.	San Ramon	1720.0	950.6	466.2	242.3	53.6	12.8
7.	Seychelles	915.4	531.7	281.3	140.3	90.0	10.2
8.	St. Vincent	709.5	358.2	189.2	105.5	89.9	7.4
9.	WCT	929.2	557.4	287.4	137.5	115.3	12.6
10.	Zanzibar	890.5	427.5	235.3	125.0	112.7	12.4
11.	ECT	950.0	520.0	298.0	144.0	100.3	12.1

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

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

Aliyarnagar

Under local germplasm collection in inland areas, the following collections were made from 10 locations(Table 12). Trees were marked and seed nuts of six types were collected during 2004 and planted in the nursery. From rest of the four types, seed nuts were collected during 2005 and planted in the nursery.

Ambajipeta

Under local germplasm collection programme, the survey was undertaken in the delta region of East Godavari district. The data on vegetative parameters, nut yield and nut characters of Pillalakodi and Jonnalarasi were recorded. Nursery will be raised in the monsoon season.

Pillalakodi - a local germplasm type in East Godavari district

Kahikuchi

The experiment started with ten accessions of coconut viz., HRSCC-01 to HRSCC-10, which were

Table 12. **Important characters of the collected germplasm and location of collections(Aliyarnagar, 2004)**

Sl. No.	Accession	Place of collection	Category	Crown shape	No. of leaves	No. of inflorescences
1	ALCO 1	Kottar	Tall	Circular	29	28
2	ALCO 2	Thamarikulam	Tall	Circular	32	31
3	ALCO 3	Udumalpet	Tall	Circular	26	26
4	ALCO 4	Pollachi	Tall	Circular	29	28
5	ALCO 5	Aliyarnagar	Tall	Circular	30	29
6	ALCO 6	Ayyampalayam	Tall	Semi Circular	32	31
7	ALCO 7	Kulasekaram	Tall	Circular	34	33
8	ALCO 8	Puthalam	Tall	Circular	28	27
9	ALCO 9	Sucindram	Tall	Circular	29	28
10	ALCO 10	Anaimalai	Tall	Semi Circular	31	30

collected from different locations of Kamrup, Nalbari, Borpeta and Darrang districts in Assam. Later two more varieties viz., 'Kamrupa' and 'West Coast Tall' were also included in the trial as control. So, in all, 12 germplasms types were planted under the trial. Four palms in each accession were taken and replicated thrice in a randomized block design. Planting of different coconut collections (about one-year-old seedlings) was done in the end of May, 2004.

Table13: **Growth characters of local germplasm of coconut (Kahikuchi, 2004)**

Sl. No.	Accession	Place of collection	Plant height (m)	Number of leaves
1	HRSCC-01	Kamrup	1.35	7.1
2	HRSCC-02	Kamrup	1.12	6.0
3	HRSCC-03	Kamrup	1.22	6.1
4	HRSCC-04	Nalbari	1.02	5.5
5	HRSCC-05	Nalbari	0.97	5.2
6	HRSCC-06	Nalbari	1.30	6.2
7	HRSCC-07	Borpeta	1.10	6.0
8	HRSCC-08	Borpeta	0.96	5.6
9	HRSCC-09	Darrang	1.56	6.8
10	HRSCC-10	Darrang	1.23	5.6
11	Kamrupa	-	1.20	6.4
12	WCT	-	1.22	6.3
C.D(P=0.05)			0.08	0.12

Observations recorded on vegetative growth characters (Table 13)showed that mean plant height and mean number of leaves of different collections ranged from 0.96-1.56 m and 5.2–7.12, respectively.

Bhubaneshwar

The experiment was planted during December-2003 at the new site in Bhubaneshwar with 10 local types viz., Tinisira, Goja, Dhila, Bana, Narangi, Surya Bana, Dhanei, Jahaji, Gol and Mamuli .The initial growth parameters are presented in the Table 14. The height of seedlings ranged from 48.1 cm to 62.9 cm.

Mondouri

Five local types of germplasm from different districts of West Bengal were identified and field survey for other local types is in progress.

Ratnagiri

The local germplasm collection work is in progress.. A total of 1952 nuts representing 16 ecotypes were collected from 31 villages of 4 districts(Sindhudurg, Ratnagiri, Raigad and Thane) of Maharashtra.

Table 14 : Growth parameters of local germplasm (Bhubaneshwar, 2004)

Sl. No.	Accession	Height (cm)	Girth (cm)	Number of leaves
1	Tinisira	62.9	11.0	5.2
2	Goja	57.7	11.8	5.2
3	Dhila	57.0	12.2	6.6
4	Bana	51.7	11.2	5.9
5	Narangi	54.1	11.3	5.7
6	Suryabana	55.9	10.9	6.2
7	Dhanei	45.1	11.2	5.9
8	Jahaji	48.1	11.3	6.0
9	Gol	51.0	11.2	6.1
10	Mamuli	49.9	11.2	6.2

Veppankulam

Under local germplasm collection programme, seednuts of selected palms were collected from the following five locations.

1. Thambikkottai
2. Adhirampattinam
3. Kallikadu
4. Ragunathapuram
5. Thamarankottai

Morphological observations and nut characters were recorded. Seedlings raised from the selected types were planted under this project in RBD with three replications.

Nut variations in local germplasm (Veppankulam, 2004)

Gen. 2 : Production and evaluation of new cross combinations

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

An hybrid evaluation trial was started at different coordinating centres to assesss the performance of the indgeneous and exotic crosses along with the local cultivars. The planting materials for the trial were produced at Central Plantation Crops Research Institute, Kasaragod as well as AICRP centres at Ambajipeta and Veppankulam and was provided to all the centres.

Aliyarnagar

A total of 12 hybrids and 3 cultivars planted in 1990 were evaluated under this programme.The growth characters and nut yield of the genotypes are given in Table 15. Among the 15 entries, hybrid ECT x MYD gave the highest annual nut yield of 148.4 nuts/palm followed by WCT x GBGD (123.4 nuts/palm). The hybrid ECT x MYD also produced the maximum number of female flowers (247.6) for the year 2003-04. The cultivar LCOT produced the second highest number of female flowers (208.5). For the number of bunches produced, COD x WCT ranked first (11.9 bunches/years) followed by LCOT x COD (11.7) and ECT x MYD (11.4). Regarding growth characters, ECT x MYD (VHC 2 hybrid) produced the maximum number of leaves (13.1) during 2003-04 followed by WCT x GBD (12.4) and MYD x ECT (12.2). For functional leaves on crown, ECT x MYD (34.4) was the top ranking entry followed by MYD x WCT (34.1) and MYD x ECT (33.8). Again the hybrid ECT x MYD produced the highest number of inflorescences per palm (13.0) followed by WCT x GBGD (12.2).

Ambajipeta

The trial was laid out in 1985 with six hybrids. The yield data recorded during the year 2004, yield attributing characters and nut characters are presented in Table 16.

The observations on yield attributes revealed that there was no significant difference among the treatments with respect to number of functional leaves and number of inflorescences produced per palm. GBGD x LCOT produced more number of female flowers (454.56) followed by ECT x GBGD (439.02). A perusal of data on yield during 2004

Table 15 : Growth characters and yield of new cross combinatios (Aliyarnagar, 2004)

Sl. No	Name of the hybrid	No. of leaves produced	No. of functional leaves on crown	Girth at base at permanent mark(cm)	Height from the base(cm)	No. of bunches harvested	No. of nuts harvested
1	PHL x GBGD	10.3	31.2	171.5	486.7	9.7	75.7
2	GBGD x ECT	11.2	32.1	145.3	426.5	8.4	69.6
3	ECT x GBGD	11.4	32.4	165.3	543.4	10.9	76.6
4	WCT x MYD	11.5	32.6	167.4	592.3	11.2	127.6
5	GBD x PHL	9.2	28.6	131.2	406.7	7.7	64.7
6	COD x WCT	11.1	29.4	131.4	532.5	11.9	120.6
7	LCOT x COD	9.8	27.4	168.2	523.4	11.7	112.6
8	MYD x WCT	11.8	34.1	158.9	556.7	10.8	106.4
9	MYD x ECT	12.2	33.8	152.8	547.6	10.4	97.8
10	ECT x MYD	13.1	34.4	186.1	617.5	11.4	148.4
11	WCT x GBGD	12.4	30.2	133.2	506.4	11.1	123.4
12	LCO x GBGD	11.9	31.0	174.2	654.3	10.8	118.6
13	ECT	11.8	29.2	183.6	595.3	10.2	93.4
14	LCOT	11.0	28.1	169.2	513.7	8.9	86.5
15	Pratap	11.8	30.9	177.3	637.6	10.3	108.7

Table 16 : Yield and quality attributes of new cross combinations (Ambajipeta, 2004)

Hybrid	Age at first flowering (months)	No. of leaves on the crown	Mean no. of iinflorescences/ palm/year	Mean no. of female flowers/ palm/year	Nut yield/ palm	Cum. yield pre cyclone period (1989-1996)	Cum. yield post cyclone period (1997-2004)
ECT X MGD (VHC-I)	65	31.67	13.58	328.64	84.08	141.12	234.10
ECT X GBGD	51	33.74	13.82	439.02	80.42	232.32	225.44
GBGD X ECT	45	32.67	12.08	403.34	66.12	231.24	193.98
GBGD X FIJI	50	31.27	13.54	358.40	85.84	224.64	261.88
GBGD X PHO	53	32.10	13.95	391.10	74.48	152.36	205.95
GBGD X LCOT	50	33.33	14.17	454.56	96.54	165.42	244.00

revealed that GBGD x LCOT recorded highest mean nut yield (96.54)) followed by GBGD x FIJI (85.84) & VHC-I (84.08). The cross combinations viz., ECT x GBGD (232.32 nuts), GBGD x FIJI (231.64) and GBGD x LCOT (224.64) were found promising in terms of cumulative nut yield during pre cyclone period. However, the highest cumulative nut yields during post cyclone period was recorded by GBGD x FIJI (261.88 nuts) followed by GBGD x LCOT (244 nuts) and thus these crosses were found to be vigorous. In terms of nut quality, maximum copra content was recorded in GBGD x PO (16.27 kg/ palm) followed by GBGD x LCOT (13.19 kg/palm)

Regarding nut quality characters, the highest nut weight was recorded in cross combination GBGD x ECT (1290.33 g/nut) followed by ECT x GBGD

(1206.74 g). The husk content was highest with the cross combination GBGD x ECT (52.44 %) while the lowest with GBGD x PHO (49.41%). Highest water content was recorded by GBGD x PHO (204.87 ml) followed by GBGD x ECT (201.68 ml). The copra content in the cross combinations ranged from 154.45 g/nut to 182.16 g and oil content from 58.41% to 66.54%. The highest copra content was recorded in GBGD x PHO (182.16 g/nut) followed by GBGD x Fiji (171 g/nut) compared to 158.64 g/nut of copra in ECT x GBGD (check).

Arsikere

This trial consisting of 9 hybrids and one local cultivar was laid out during 1987 in RBD with three replications. The observations on growth parameters and nut yield were recorded and presented in Table 17.

The tree height was significantly higher in the WCT X GBGD cross, while the tree girth was highest in CC X LCOT cross. The functional leaves were significantly more in GBD X LCOT compared to other cross combinations. The yield during 2003-04 and also the mean nut yield over 11 years was highest in GBGD X LCOT cross followed by GBGD X Fiji and GBGD X LCOT crosses.

Trial of new hybrid combinations -Set II

The 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.

The tree height and functional leaves were significantly higher in the hybrid MYD X TPT compared to other hybrids and Tiptur tall. The nut yield during 2003-04 and also the mean yield for 7 years was highest in the hybrid MYD X TPT.

Jagdalpur

Under this experiment, eight hybrids and one cultivar were planted during 1991. The other set of two hybrids and one cultivar were planted during 1993. The data on yield-attributes and yield were recorded and are presented in Table 18. The number of functional leaves per palm did not vary significantly and was in the range of 24.6 to 27.4. The annual leaf production rate was maximum in COD x WCT (14.2), followed by ECT x GBGD (14.1). The number of inflorescence was found significantly higher in ECT x GBGD (8.33) over all other hybrids and cultivar except COD x WCT (7.15) and MYD x ECT (7.13). As regards, number of inflorescence with female flowers, similar trend

Table 17 : Growth and yield of hybrids of coconut-Set I (Arsikere, 2004).

Sl.No.	Hybrid	Tree height (m)	Tree girth (cm)	No. of functional leaves	Nut yield /palm/year) 2003-04	Mean for last 11 years
1	CC X LCOT	4.28	95	20.3	44.7	19.0
2	LCOTX PHO	5.10	87	23.0	37.2	29.8
3	LCOT X CC	4.43	89	27.1	48.3	23.2
4	WCT X COD	4.62	79	22.0	51.8	31.6
5	WCT X GBGD	5.62	90	27.4	48.0	36.9
6	WCT X MYD	4.92	81	27.3	56.7	32.3
7	GBGD X Fiji	5.01	90	26.3	72.9	46.1
8	GBGD X PHO	4.55	85	28.3	66.8	41.3
9	GBGD X LCOT	4.67	83	27.0	77.0	52.7
10	Tiptur tall	4.50	86	27.4	55.8	28.8
	S. Em ±	0.40	4.8	1.7	2.7	
	CD (P=0.05)	1.19	14.1	4.9	8.1	

Table 18 : **Yield and yield attributing characters of coconut hybrids(Jagdalpur,2004).**

Sl. No.	Hybrid	No. of functional leaves/ palm	Annual leaf production/ palm	No. of inflorescence/ palm	No. of female flowers/ palm	Setting percentage	Nut yield/ palm
1.	COD x WCT	27.4	14.2	7.15	185	35	53
2.	LCOT x GBD	26.2	13.2	6.77	159	30	31
3.	PHO x COD	24.8	13.6	6.45	141	31	29
4.	LCOT x COD	26.4	13.3	6.55	152	32	42
5.	WCT x GBGD	27.0	12.8	5.26	94	41	35
6.	ECT x GBGD	26.6	14.1	8.33	280	35	81
7.	ECT x MYD	26.2	13.6	6.06	106	34	37
8.	MYD x ECT	26.8	13.8	7.13	167	36	44
9.	ECT	24.6	13.2	5.84	74	51	29
10.	MYD x WCT	26.8	12.8	6.61	189	36	36
11.	LCOT	26.2	13.6	5.83	97	32	36
12.	GBGD x ECT	26.8	13.2	6.73	133	30	28
SEm ±		0.82	—	0.51	21.96	—	10.63
CD (P=0.05)		—	—	1.52	64.41	—	NS

was observed as number of inflorescence per palm. However, maximum number of barren inflorescences were noticed in hybrids LCOT x COD and MYD x WCT. Significant variation among hybrids was also observed in case of number of female flowers per palm and highest number of female flowers was recorded in hybrid ECT x GBGD (280) which was significantly higher over all other hybrids. The minimum number of female flowers were produced by the cultivar ECT (74) which was statistically at par with cultivar LCOT (97). The highest number of nuts per palm was recorded in hybrid ECT x GBGD (98) which was comparable with MYD x WCT (69), COD x WCT (68) and was significantly superior over rest of the varieties/hybrids. The setting percentage was recorded in the range of 30% to 51%. Differences for annual nut yield was non-significant. However, maximum number of nuts was recorded in ECT x GBGD (81) followed by COD x WCT (53).

Bhubaneshwar

The seed nuts of cross combinations of this experiment were collected from CPCRI, Kasaragod and Veppankulam centre during 2004 and were sown in the nursery bed. Seedlings will be planted during 2005-06 in the field. The entire set of cross combinations as suggested in the workshop, were collected except the combination AO x GBGD. The cross combination ECT x MOD collected from Veppankulum will be planted in place of AO x GBGD. The cross combination sown in nursery bed are: LO x COD, ECT x DG, GBGD x ECT, GBGDx PH, ECT x MOD, ECT x MYD, LO x GBGD, WCT x MYD, ECT x GBGD & ECT (check).

Ratnagiri

All the hybrids and varieties started yielding from 1998-99. The yield data are presented in Table 19.

ECT x GBGD (at Ratnagiri)

Table 19 : Evaluation of promising hybrids(Ratnagiri, 2004)

Sl. No.	Name of variety/ hybrid	Nut yield per palm per year			Yield of nuts/palm (mean of last 3 years)
		2001	2002	2003	
1.	GBGD x ECT	65	90	90	82
2.	ECT x GBGD	66	83	87	79
3.	PHOT x GBGD	29	86	48	54
4.	GBGD x PHOT	39	78	57	58
5.	LCOT x COD	33	55	42	43
6.	COD x LCOT	56	104	74	78
7.	ECT x MYD	23	28	44	32
8.	MYD x ECT	45	37	54	45
9.	COD x WCT	62	77	47	62
10.	WCT x MYD	57	89	64	70
11.	LCOT x GBGD	30	70	52	51
12.	WCT x GBGD	28	74	49	50
13.	ECT	34	82	39	52
14.	LCOT	22	54	54	43
15.	Pratap	44	96	68	69

The highest average nut yield per palm during the year 2003-2004 was recorded in GBGD x ECT (90 nuts/palm) followed by ECT x GBGD (87 nuts/palm). As regards the average yield of last 3 years (2001-2004), GBGD x ECT recorded highest yield of 82 nuts followed by ECT x GBGD (79 nuts) and COD x LCOT (78 nuts).

Veppankulam

A total of 14 hybrids planted during 1986 were evaluated in this experiment. Studies on the reproductive characters of the hybrids (Table 20) revealed that the hybrid GBGD X FIJI recorded the highest number of functional leaves of 32.5/palm followed by WCT X GBGD, GBGD X ECT and ECT X DG with 32 leaves/palm. The highest leaf production rate was recorded by ECT X DG (13.4 leaves/palm) followed by LCOT X COC (13.2 leaves/palms). The hybrid ECT X COD recorded the highest number of female flowers/inflorescence (38.4) followed by GBGD X FIJI (35.0). The hybrid WCT X COD recorded the highest number of nuts/bunch (9.9 nuts) and setting percentage (41.1%) followed by COD X WCT with 9.5 nuts/bunch and setting percentage of 37.2%.

Studies on the nut characters revealed that the hybrid LCOT X PHOT recorded the highest value for whole nut weight (1093.2 g/nut), dehusked nut weight (721.3 g/nut), kernel weight (408.0 g/nut) and copra weight (195.8 g/nut).

Among the 14 hybrids, the hybrid COD X WCT recorded the highest annual nut yield of 117.4 nuts/palm followed by WCT X COD (112.3 nuts/palm) and WCT X MYD (106.1 nuts/palm). WCT X MYD recorded the highest cumulative mean nut yield 106.9 nuts/palm/year followed by WCT X COD (98.5 nuts/palm/year) and COD X WCT (86.9 nuts/palm). WCT X MYD also recorded the highest copra yield of 16.4 kg/palm/year.

WCT X MYD (at Veppankulam)

Table 20 : **Reproductive characters of hybrids(Veppankulam, 2004)**

Hybrid	No. of inflorescence/ year	Setting (%)	Whole nut wt. (g)	Dehusked nut wt. (g)	Kernel wt. (g)	Copra wt. (g)	Nut yield/ palm
COD X WCT	12.0	37.2	972.0	572.9	304.4	152.0	117.4
WCT X COD	11.3	41.1	900.0	542.0	291.3	148.4	112.3
WCT X MYD	12.0	35.0	943.6	557.1	302.6	153.3	106.1
WCT X GBGD	12.0	30.0	849.5	537.8	289.0	148.2	103.0
GBGD X LCOT	11.5	36.6	1022.3	571.9	295.0	145.4	101.6
GBGD X PHOT	11.8	29.8	853.2	511.8	265.7	138.2	105.0
GBGD X FIJI	11.0	22.2	938.5	554.7	254.8	135.0	86.1
LCOT X COC	12.0	22.0	885.5	497.9	230.5	130.2	79.8
COC X LCOT	11.0	21.3	1014.4	577.9	266.5	135.9	74.3
COC X PHOT	10.5	17.8	1020.0	601.4	364.0	178.4	56.6
LCOT X PHOT	11.2	25.0	1093.2	721.3	408.0	195.8	91.5
ECT X COD	11.0	15.6	896.3	557.6	247.0	123.5	72.8
GBGD X ECT	11.5	16.9	892.0	537.4	255.0	127.5	77.5
ECT X DG (VHC 1)	12.0	31.2	843.2	508.9	260.0	130.2	90.6

Gen. 2A : Evaluation of new coconut hybrids

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

Ambajipeta

Crossing programme was initiated during the year 2004 with best performing varieties of Gen. 1 trial. Hybridization work was started in November, 2004 with seven new cross combinations viz., ECT x PHO, ECT x CC, PHO x GBGD, GBGD x PHO, GBGD x CC, CC x GBGD, 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 highest in GBGD x ECT (49.85 %) followed by ECT x CC (48.18 %).

Aliyarnagar

The following crosses were made at Aliyarnagar during 2004-05

1. ALR (CN) 1 x MYD
2. ALR (CN) 1 x MGD
3. Tiptur Tall x MYD
4. Tiptur Tall x MGD
5. COD x ALR (CN) 1

The crossed buttons are in early maturity phase to late maturity phase (2 months to 10 months old). After attaining full maturity, the crossed nuts will be harvested and planted in the nursery.

Kahikuchi

The experiment is to be started with 5 cross combinations i.e., Assam Green tall (AGT) x Cochin China, AGT x PO, AGT x MYD, Bengal Selection x AGT and Assam Yellow Tall x PO. For this purpose, better performing types of female and male parents of the above cross combinations have been identified and crossing started. The experiment is in progress.

Bhubaneshwar

The hybridization work is in progress at Bhubaneshwar for production of required cross combinations.

Mondouri

The following cross combinations for developing hybrids in coconut for the center which has been approved will be started.

1. Philippines Ordinary x Laccadive ordinary
2. Laccadive ordinary x Philippines Ordinary
3. East Coast Tall x Laccadive ordinary
4. East Coast Tall x Jamaica Tall
5. East Coast Tall x Java

Ratnagiri

The details on the number of female flowers pollinated and nuts collected from six cross combinations selected for crossing are given in Table 21.

Table 21 : Details of hybridization for the evaluation trial (Ratnagiri , 2004)

Sl. No.	Cross	No of female flowers pollinated	No. of nuts collected
1.	BGL x COD	498	236
2.	COD x BGL	342	218
3.	Pratap x COD	422	292
4.	COD x Pratap	436	373
5.	BYR x COD	595	295
6.	COD x BYR	500	231

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

Veppankulam

The following new coconut hybrids 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 and the work is in progress.

Hand pollination of bagged emasculated bunch

Gen. 3 : Trial of promising seed materials

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

The trial was planted with 10 varieties /hybrids uniformly in all the centres along with local tall. The planting materials except 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 growth characters and nut yield of the genotypes are given in Table 22. Among the genotypes, LCM gave the maximum nut yield of 224.3 nuts/palm for the year 2003-04, followed by COD x WCT (141.4 nuts/palm/year) and WCT x COD (136.4 nuts/palm/year). In female flower production also, the above three entries occupied the top three ranks (LCM 294.3, WCT x COD 236.4 COD x WCT 228.4). For the number of bunches produced/year, COD x WCT ranked second (12.2 after LCM (13.7).

Regarding growth characters, SSG had the highest cumulative leaf production (243.7) followed by PHO (240.4). For number of leaves produced during 2003-04, WCT x COD ranked top (12.5 followed by COD x WCT (12.4) and WCT x GBGD (12.2). For the character functional leaves on crown LCOT had the highest number (35.8) followed by ECT (35.7) and WCT x COD (35.0). Maximum number of inflorescence was produced by WCT x COD (12.3) followed by COD x WCT (12.2) and WCT x GBGD (12.1).

Table 22 : Growth and yield characters of promising seed materials (Aliyarnagar, 2004)

Sl. No.	Name of the hybrid/cultivar	No. of leaves produced	Girth at base (at permanent mark) (cm)	Height from the base (cm)	No. of female flowers produced	No. of bunches harvested	No. of nuts harvested
1	WCT	11.3	160.2	1124.6	194.6	10.8	124.7
2	SSG	10.7	149.9	1130.4	217.4	11.4	134.6
3	LCO	11.3	162.1	1114.6	188.3	9.9	94.7
4	PHO	11.6	150.4	1054.8	188.4	12.0	106.8
5	ADO	11.2	160.7	1093.5	213.6	11.4	114.6
6	ECT	12.0	160.6	1108.4	216.4	10.9	125.5
7	WCT x COD	12.7	156.5	1089.8	236.4	11.9	136.4
8	WCT x GBGD	12.2	143.4	1074.7	178.6	11.4	118.6
9	COD x WCT	12.6	136.0	1085.6	228.4	12.2	141.4
10	LCM	9.3	161.7	1039.4	294.3	13.7	224.3
	Mean				215.7	11.6	132.3
	C.V.(%)				14.3	12.7	12.4
	CD(P=0.05				37.4	2.5	28.2

Ambajipeta

The planting of coconut varieties/hybrids was taken up during July, 2002.The initial observations on growth characters revealed that there was no significant difference among the hybrids/ varieties with respect to girth and height of the palm. Double Century recorded the highest number of leaves and rate of leaf production during the year (19.72 & 11.66) followed by Keraganga (18.38 and 10.50).

Arsikere

The trial was laid out with 10 varieties /hybrids during 1994 in RBD with three replications to evaluate different varieties and hybrids of coconut. 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, 2004)

Sl. No.	Hybrids/Varieties	Tree height (m)	Tree girth (cm)	Functional leaves (No.s)	Nut yield/palm/year 2003-04	Mean (6 years)
1	WCT	3.80	104	24.3	25.2	14.7
2	SSG	2.94	83	24.3	38.8	23.8
3	LCOT	3.29	97	21.1	33.0	22.2
4	LM	3.78	110	26.1	42.5	19.6
5	PHO	3.42	88	26.3	43.7	40.8
6	AO	4.54	115	24.7	40.1	33.5
7	WCT X COD	3.29	83	24.9	49.8	47.4
8	WCT X GBGD	3.31	86	26.8	37.3	30.2
9	COD X WCT	3.22	93	24.6	47.9	41.2
10	Tiptur tall	3.56	104	27.9	43.6	26.4
	S. Em ±	0.25	3.9	1.6	3.4	
	CD (P=0.05)	0.75	11.5	4.7	10.1	

The tree height and girth were significantly higher in Andaman Ordinary (AO) compared to other cultivars and hybrids. The functional leaves were significantly more in Tiptur tall followed by WCT X GBGD and Philippines ordinary (PHO). The coconut yield during 2003-04 and also the mean yield over 6 years was highest in WCT X COD followed by COD X WCT and Philippines Ordinary.

Jagdalpur

The data on yield-attributing characters were recorded and presented in Table 24. The number of functional leaves varied in the range of 25 to 29 with maximum in COD x WCT. The leaf production rate was maximum in ADO (14.4) followed by COD x WCT, WCT x COD, and SSG (14.2). The number of inflorescence/palm recorded was maximum in cultivar COD x WCT (7.92) followed by ADO (7.75). However, the variation in production of inflorescence was found to be non significant. The number female flowers was maximum in variety LCM (294) followed by ADO (264). The number of nuts/palm was found highest in COD x WCT (132), followed by ADO (105) which were significantly superior over some of the hybrids and cultivars. The setting percentage was maximum in hybrid WCT x COD (54.26), followed by COD x WCT (52.17). The annual nut yield/palm was maximum in hybrid COD x WCT (94), followed by ADO (76) which were higher over rest of the cultivars and hybrids . They were however statistically on par with each other

Mondouri

The results from the trial on promising seed materials are presented in Table 25. The differences between varieties was significant for nut weight and nut yield /palm. It was seen that S.S. Green recorded significantly higher nut weight (1845 g) than all other varieties except the variety Andaman Ordinary(1815 g). Laccadive Micro has recorded the lowest nut weight(1195 g). However Laccadive Micro was found to record the maximum nut yield /palm(103.6). As regards copra yield /palm, Philippines Ordinary was found to record the maximum(10.1 kg/palm) followed by Laccadive Ordinary(9.4 kg/palm). Philippines Ordinary was also found to be a good variety for tender nut water

Table 24 : Yield characters of promising seed materials (Jagdalpur,2004)

Sl. No.	Cultivar/hybrid	No. of functional leaves/ palm	Annual leaf production/ year	No. of inflores-cence/palm	No. of female flowers/ palm	Setting percen-tage	Nut yield/ palm
1.	WCT x COD	28	14.2	7.42	164	54.26	55
2.	WCTx GBGD	26	12.8	7.08	135	49.62	43
3.	COD x WCT	29	14.2	7.92	253	52.17	94
4.	WCT	26	12.8	6.65	155	37.41	45
5.	LCM	25	12.4	7.02	294	30.61	75
6.	ADO	28	14.4	7.75	264	39.77	76
7.	SSG	25	14.2	6.42	215	32.09	51
8.	PO	28	12.2	7.20	215	43.25	48
9.	LCO	27	12.4	7.40	220	40.45	74
	SEm ±	—	—	0.53	—	—	13.05
	CD (P=0.05)	—	—	NS	—	—	NS

Table 25 : **Nut yield of different varieties and hybrids (Mondouri, 2004)**

Varieties/ hybrids	Number of bunches/ palm	Nut weight (g)	Nut yield/ palm	Nut yield/ palm (mean of 13 years)	Copra yield/ palm/ year (kg)	Sweetness of tender nut water
Andaman Ordinary	7.6	1815	76.3	63.6	8.3	Good
Laccadive Ordinary	7.3	1396	86.3	70.7	9.4	Average
Laccadive Micro	7.6	1195	103.6	82.3	7.7	Average
Philippines Ordinary	8.8	1423	84.6	62.3	10.1	Good
S.S. Green	6.4	1845	53.3	49.9	6.8	Average
West Coast Tall	6.6	1365	63.6	61.0	7.1	Average
COD WCT	9.2	1336	88.3	74.0	9.0	Average
WCTx COD	8.6	1406	77.6	63.7	9.2	Average
MYD xWCT	7.3	1376	63.6	53.8	7.0	Good
Local Tall	7.3	1736	61.6	47.0	6.7	Average
S.Em.	0.19	26.3	2.36	-		
CD (P=0.05)	N S	55.2	4.95	-		

Bhubaneshwar

The experiment was laid out during August-2004.The seed nuts for this experiment was collected from CPCRI, Kasaragod and Veppankulum centre during 2003. The seedlings of varieties/ hybrids planted are: WCT x GBGD, COD x WCT, WCT x COD, Philippines Ordinary, Laccadive ordinary and Sakhigopal Local.

COCONUT
1.2 Crop Production

Agr. 2 : Nutritional requirement of high yielding varieties/hybrid coconut

(Arsikere, Mondouri, Ratnagiri, Veppankulam)

The experiment was laid out at different centres to assess the performance of DXT 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/Replicaion : 3

Number of palms/plot : 6

Arsikere

The observations on nut yield was recorded. The yield during 2003-04 and also the mean yield over last 11 years was the highest with the application of 1000g N, 250g P_2O_5, 2000g K_2O /palm/year.

Ratnagiri

The experiment was started during 1985. The data on annual nut yield for 2003-04 is presented in Table 26.

The results indicated that the effect of N is significant on annual as well as cumulative nut yield. Palms receiving nitrogen @ 1000 g/palm recorded significantly higher annual as well as cumulative nut yield when compared with N_0 level

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

The $N_0P_0K_0$ treatments recorded an average of 49 nuts/palm over a period of 14 years (1990-2004) whereas $N_2P_2K_2$ recorded the highest average yield of 117 nuts/palm in the same period. Also, it was seen that all the additional doses of NPK fertilizer applied to the coconut palm have resulted in the additional profit per palm per year. However, the maximum additional profit per palm was recorded under treatment combination $N_2P_2K_2$ (Rs. 305/-) followed by $N_2P_0K_1$ (Rs. 231/-) and $N_1P_1K_2$ (Rs. 220/-).

Table 26 : Effect of NPK on yield(nuts/palm) –Ratnagiri, 2004

No.	P_0	P_1	P_2	Mean	K_0	K_1	K_2
N_0	84	97	93	91	87	90	97
N_1	89	96	101	95	92	101	93
N_2	107	111	111	110	107	102	121
Mean	94	101	101		95	98	104
K_0	83	101	102				
K_1	101	103	89				
K_2	97	100	116				

S.E/ Plot 16.90 C.V. (%) 17.11 C.D. for N 11.50 Gen. Mean 98.77

Veppankulam

To confirm the results of a field experiment conducted at a farmer's field, a non replicated field experiment was laid out at Coconut Research Station, Veppankulam during 1998. The treatments were imposed as per the programme schedule ie., the combinations of three levels each N (0,0.5 and 1.0 kg / palm/year), P (0, 0.25 and 0.5 kg/palm / year) and K (0, 1.0 and 2.0 kg / palm / year) in a 3^3 factorial compounded design, non replicated with three palms / treatment.

The results indicated that graded dose of NPK recorded corresponding increase in the growth and yield attributes and nut yield of hybrid coconut. With respect to N, the growth character *viz.*,, number of functional leaves / palm, yield attributes such as number of bunches harvested, number of female flower production and number of nuts / palm were found to increase with increase of N level from 0 to 1000 g / palm / year. The maximum mean cumulative yield of 164 / palm / year was recorded with N at 1000 g / palm followed by 500 g/ palm (149 nuts / palm).

Application of P at 250 g / palm and 500 g / palm had a similar effect on leaf production, number of bunches harvested, number of female flowers

Table 27 : Effect of different levels of NPK on copra content and copra yield of hybrid coconut (Veppankulam, 2004)

Sl.No.	Treatment	Nut yield/ palm	Copra yield (kg/palm)	Cost of cultivation (Rs/ha)	Net income (Rs/ha)	B:C ratio
1	$N_0P_0K_0$	85	8.5	23212	43726	1.9
2	$N_1P_0K_0$	110	11.7	24067	62558	2.6
3	$N_2P_0K_0$	115	12.8	24922	65641	2.6
4	$N_0P_1K_0$	102	10.2	24037	56288	2.3
5	$N_1P_1K_0$	110	13.4	24892	61733	2.5
6	$N_2P_1K_0$	128	15.9	25747	75053	2.9
7	$N_0P_2K_0$	108	13.0	24862	60188	2.4
8	$N_1P_2K_0$	122	14.7	25717	70358	2.7
9	$N_2P_2K_0$	137	18.8	26572	81316	3.1
10	$N_0P_0K_1$	108	12.2	24445	60606	2.5
11	$N_1P_0K_1$	129	15.4	25300	76288	3.0
12	$N_2P_0K_1$	139	21.1	26155	83308	3.2
13	$N_0P_1K_1$	120	14.2	25270	69231	2.7
14	$N_1P_1K_1$	135	16.2	26125	80188	3.1
15	$N_2P_1K_1$	147	22.3	26980	88783	3.3
16	$N_0P_2K_1$	129	16.0	26095	75493	2.9
17	$N_1P_2K_1$	140	18.1	26950	83301	3.1
18	$N_2P_2K_1$	141	19.7	27805	83233	3.0
19	$N_0P_0K_2$	113	14.1	25677	63311	2.5
20	$N_1P_0K_2$	139	18.9	26532	82931	3.1
21	$N_2P_0K_2$	148	21.5	27387	89163	3.3
22	$N_0P_1K_2$	136	18.4	26502	80598	3.0
23	$N_1P_1K_2$	158	21.5	27357	97068	3.5
24	$\mathbf{N_2P_1K_2}$	170	25.2	28212	105663	3.7
25	$N_0P_2K_2$	144	19.9	27327	86073	3.1
26	$N_1P_2K_2$	160	22.6	28182	97818	3.5
27	$N_2P_2K_2$	171	24.5	29037	105626	3.6

produced and nut yield / palm. The mean cumulative nut yield for the six years (1998 – 2004) indicated that maximum yield (155 nuts / palm) was produced with P at 500 g / palm and it was closely followed by P at 250 g / palm (150/nuts / palm).

Regarding K, the growth characters, yield attributes and nut yield increased with increase of K level from 0 to 2000 g / palm. The maximum yield attributes and nut yield was recorded with K at 2000 g / palm. The data on the mean cumulative nut yield for the six years (1998 – 2004) indicated that application of K at 2000 g / palm yielded 167 nuts / palm.

Combined application of NPK at 1000:500:2000 g/palm/year and 1000:250:2000 g/palm/year recorded the highest yield of 171 and 170 nuts/palm/year respectively.

The details on copra content , copra yield and economics of the treatments are given in the Table 27.

The highest copra content (148.3g/nut) and copra yield (25.2kg/palm/year) was recorded by the NPK level 1000 : 250 : 2000 g/palm/year. The highest return per rupee invested(Rs.3.70) was obtained with NPK levels at 1000:250:2000 g/palm/year.

Agr. 3 : Coconut based high density multispecies cropping system

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

Arsikere

This experiment was revised and laid out with four replications and five treatments in RBD in 2001-02

Treatment details ::

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

Average yield of coconut and intercrops during 2001-04 is given in Table 28. It is seen that the coconut yield increased with intercropping and the increase was significantly more with banana compared to other intercrops. The returns were also highest with banana compared to other intercrops.

Bhubaneshwar

The experiment was laid out during December 2003 at Bhubaneshwar site. The component crops were taken during February 2004 to July2004. Banana,drum stick, moringa, pineapple,sweet potato, groundnut and colocasia were the component crops.

Table 28 : Yield of coconut and intercrops in HDMS system (Arsikere, 2001-04)

Sl. No.	Treatment	Nut yield /ha	Intercrop yield kg/ha		Gross returns (Rs/ha)
			I Intercrop	II Intercrop	
1	Coconut + Banana	**8340**	3264	-	**74340**
2	Coconut + Drumstick	7537	1147	-	49153
3	Coconut + French bean – Ladies finger (Bhendi)	7373	1022	918	56102
4	Coconut + Redgram	7450	836	-	49790
5	Coconut alone (Control)	6253	-	-	31267

Ratnagiri

The study aims at deciding the best suitable mixed crops combination for coconut, so as to obtain maximum returns per unit area. Cinnamon, nutmeg, clove, black pepper, garcinia and allspice have been planted in the separate blocks of 0.20 ha each of coconut plantation.

The yield data indicated that 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 plot (96%), followed by allspice (90%), cinnamon (71%) and nutmeg (69%).The economics worked out for different blocks are presented in Table 29. Maximum net returns were recorded in Coconut + Nutmeg block (Rs. 76495/-) followed by Coconut + Cinnamon block (Rs. 58840/-).

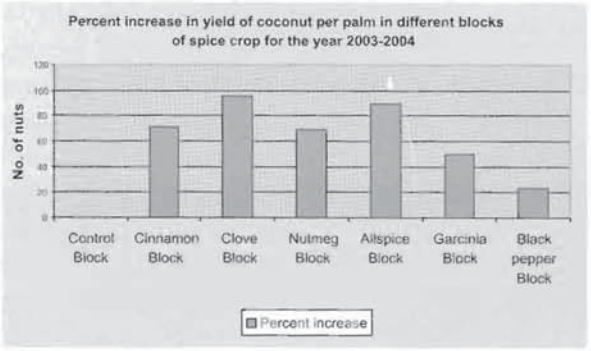


Table 29 : Economics of coconut based cropping systems (Ratnagiri, 2004)

Sr. No.	Block	Yield / ha		Cost (Rs./ ha)			Total Returns (Rs./ ha)			Total Net Profit (Rs./ha)
		Coconut	Spices	Coconut	Spices	Total	Coconut	Spices	Total	
1.	Nutmeg	15925	57695 nuts 36.3 mace	58830	30625	89455	95550	57695 12705	165950	76495
2.	Clove	19075	43.5 kg	58830	21400	80230	114450	13050	127500	47270
3.	Cinnamon	16800	212.5 kg bark 1980 kg leaves with branches	58830	30578	89408	100800	42500 4950	148250	58840
4.	Black Pepper	15925	268.75 kg	58830	25205	84035	95550	26875	122425	38390
5.	Allspice	20825	—	58830	12918	71748	124950	—	124950	53200
6.	Garcinia Cinnamon	16800	1200 kg 77.5 kg bark 860 kg leaves with branches	58830 58830	23638	82468	100800	9600 15500 2150	128050	45580
7.	Control	16100	—	58830	—	58830	96600	—	96600	37770

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

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

Kahikuchi

The experiment was started in April 2002 in a twenty eight year-old coconut plantation of Assam Tall with black pepper var. Panniyur-1(6 –years-old) with six intercrops replicated four times with a plot size of 118.5 sq. m. Each intercrop was grown in the interspaces surrounding three adult coconut palms. 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), T_6- Control.

Coconut based HDMCS at Kahikuchi

The yield of base crop (coconut) and yield data of harvested intercrops are presented in Table 30. It is evident from the table that the highest net return of Rs. 1,92,575/-per ha was recorded under coconut-blackpepper-turmeric cropping system followed by coconut-blackpepper-ginger intercropping, while the lowest net return of Rs. 43,487/- only was obtained under control plot (coconut- blackpepper).

Table 30: Yield of base crop, intercrops and their returns in coconut based cropping system (Kahikuchi, 2004)

Crop combinations	Nut yield/ palm/ year	Yield of black pepper kg/ vine	Gross return/ ha(Rs.)	Net return/ ha(Rs.)
Coconut Blackpepper Ginger(Var. Nadia)	62 186	0.30 0.9	2,13,248	1,35,028
Coconut Blackpepper Turmeric(Var. Prabha)	64 192	0.35	2,66,075	1,92,575
Coconut Blackpepper Brinjal(Var. Kuchia) *(Perennial)*	63	0.28 0.84	2,01,181	1,20,981
Coconut Blackpepper Banana(Var. Chenichampa)	52	0.25 0.75	1,81,603	1,09,203
Coconut Blackpepper Pineapple(Var. Kew)	44	0.27	1,56,118	81,618
Coconut Black pepper (Control)	46	0.26 0.78	58,987	43,487

Mondouri

The experiment was laid out during 2003 in the experimental plot of Ordinary Tall variety of coconut with following five crop models with one control .

Model I : coconut + black pepper + guava

Model II : coconut + black pepper + lime

Model III : coconut+ black pepper + lemon

Model IV : coconut + black pepper+ banana

Model V : coconut + black pepper + pineapple

Model VI : control.

The fruit plants under each model were planted in the center of each 4 palms.

Ratnagiri

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

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

Veppankulam

The second generation experiment was laid out during June, 2004 with seven models and one control (coconut mono cropping). Yields obtained from different intercrops are given in Table 31.

Turmeric in coconut garden (Ratnagiri)

Ginger in coconut garden (Ratnagiri)

Table 31 : Yield of different multiple cropping systems and net returns (Veppankulam, 2004)

Crops	Yield of inter crops (kg/ha)	Additional returns (Rs./ha)	Additional cost of cultivation (Rs./ha)	Additional net returns (Rs./ha)
Coconut + black pepper + banana	19,980	59,940	32,190	27,750
Coconut + black pepper+ banana + bhendi	4,325	36,263	23,460	12,803
Coconut + black pepper + banana + yam/greens	10,075	50,000	31,000	19,000
Coconut + black pepper + banana + turmeric/greens	8,880	1,01,970	41,190	60,780
Coconut + black pepper + banana + tapioca	5,850	30,030	21,690	8,340

Banana and turmeric in coconut gardens (Veppankulam)


Elephant Foot Yam and bhendi in coconut gardens (Veppankulam)

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

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

Aliyarnagar

A survey on the cultivation of medicinal and aromatic plants in Pollachi region was conducted. A total number of 50 medicinal and aromatic plants were selected. The market potential and availability of planting material were studied and the observational plot with the above plants was laid out and the trial is in progress

Ambajipet

Survey on cultivation of medicinal and aromatic plants in two districts of Andhra Pradesh i.e., East and West Godavari districts were conducted during 2004. Based on the survey, seven medicinal plants and eight aromatic plants were collected during the year and planted in the field for evaluation in the coconut gardens. The trial is in progress.

Kahikuchi

A survey on the cultivation of medicinal and aromatic plants in the potential areas of the region has been carried out. Based on this, 10 medicinal and aromatic plants having market potential were identified and planted as an observational trial.

Bhubaneshwar

The observational plot was laid out during September, 2004 in a farmer's field with fifteen species of medicinal and aromatic plants.

Mondouri

A 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 were selected and an observational trial was laid out with these fifteen species. The crops are performing satisfactorily

Ratnagiri

Fifteen species of medicinal plants have been identified and planted in an observational plot during June-July 2004 and harvesting of some of the crops is in progress.

Gavati Chaha (*Cymbopogum citratus*)

Ranwangi (*Solanum viarum* (Dunal))

Veppankulam

A Survey on medicinal and aromatic plants for their market potential was conducted. Based on the survey, 18 medicinal crops and 2 aromatic crops have been selected. The observation trial was initiated during June, 2004. Harvest of few medicinal crops was completed and harvest is in progress for some of the medicinal crops.

Agr. 5 : Drip irrigation cum fertilizer experiment on young palms

(Aliyarnagar, Arsikere, Ratnagiri, Veppankulam)

In all the centres, the experiment was laid out in a Split Plot design with following Main plot and Sub plot treatments. Number of replications was four.

Main plot treatments:

I1 -No irrigation (Life saving)

I2 - Drip irrigation at 33% pan evaporation (Eo)

I3 - Drip irrigation at 66% Eo

I4 - Drip irrigation at 100% Eo

I5 - Basin irrigation at IW/CPE ratio of 1.0 at 4 cm depth

Sub plot treatments:

F1 -Straight fertilizers

F2 -Application of low release NP tablet

The sub-plot treatments were discontinued from 1997 due to non-availability of NP tablet. Hence the design was reduced to a simple RBD with four replications.

Aliyarnagar

The growth and yield observations collected during 2003-04 (July-June) along with economics of drip irrigation are presented in Table 32.

It was seen that drip irrigation equal to 100% Eo and basin irrigation at IW/CPE ratio of 1.0 at 4 cm depth recorded more number of bunches and female flowers/palm/year. 'No irrigation' has recorded lowest number of bunches and female flowers. Drip irrigation at 100% Eo and basin irrigation at IW/CPE ratio of 1.0 at 4 cm depth recorded nut yields of 153 and 152 nuts/palm/year

Table 32 : Yield performance under drip irrigation(Aliyarnagar, 2004)

Treatments	Annual leaf production/ palm/year	Bunches/ palm/ year	Nut yield/ palm	Gross income/ ha(Rs)	Cost of cultivation/ ha(Rs)	Net income/ ha(Rs)	Benefit Cost ratio
No irrigation	10.1	9.5	82	57400	29012	28388	1.97
Drip irrigation at 33% Eo	10.8	10.2	100	70000	38530	31470	1.81
Drip irrigation at 66% Eo	11.8	11.1	131	91700	40286	51414	2.27
Drip irrigation at 100% Eo	12.2	12.5	153	107100	41106	65994	2.60
Basin irrigation	12.0	12.4	152	106400	41706	64694	2.55
CV %	6.6	17.4	17.5				
CD (P=0.05)	0.83	9.5	18				

respectively. No irrigation has recorded lowest yield of 82 nuts/palm/year. Drip irrigation from 33% to 100% Eo progressively increased the nut yield from 100 to 153 nuts/palm/year. Drip irrigation equal to 100% Eo recorded a maximum net income of Rs.65994/ha and a benefit cost ratio of 2.60 against the control with Rs.28388 and 1.97 respectively. Basin irrigation, which was on par with drip 100% Eo, recorded Rs.64694 and 2.55 respectively. Drip irrigation from 33 to 100% Eo progressively increased the net income from Rs.31470 to 65994 and benefit cost ratio from 1.81 to 2.60 indicating the economic advantage of drip irrigation.

Arsikere

The experiment was revised during 1999 and laid out in a 25 years old garden of local cultivar-Tiptur Tall. The experiment consists of 5 treatments and was laid out in RBD with four replications. The quantity of water given through drip system is based on the mean monthly evaporation of 10 years. The pan evaporation was 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 annual coconut yield was significantly higher in the treatment of providing drip irrigation @ 100 % Eo which was on par with drip irrigation @ IW / CPE =1. Similarly, the mean coconut yield over 5 years was also highest in the treatment of providing drip irrigation @ 100 % Eo compared to other treatments.(Table 33)

Ratnagiri

The experiment was laid out on 35 years old WCT palms grown in sandy soil during 1992. Analysis of data indicated(Table 34) that there was significant difference in the yield of coconut under different treatments during 1997-98 to 2003-04 and mean cumulative yield of seven years (1997-2004). In the year 2003-04, treatments I_2, I_4 and I_5 have recorded significantly higher yield over I_1 (no irrigation) but I_2, I_3 , I_4 and I_5 are at par with each other.

The mean cumulative yield data for last seven years (1997-2004) showed that palms under basin irrigation treatment has recorded (91 nuts/palm) significantly higher yield over treatments I_1, I_2 and I_3 and at par with I_4 (drip irrigation at 100% Eo) treatment (85 nuts/palm). Drip irrigation at 100% Eo recorded significantly higher yield over no irrigation treatment and at par with other treatments (I_2 and I_3)

The data regarding wetting zone are presented in Table 35. The maximum vertical and horizontal movement of water was with irrigation equal to 100% Eo was 102.95 cm. and 90 cm. respectively followed by 66% Eo 99.75 cm. and 84 cm. and 33% Eo 82 cm. and 68 cm. respectively. It was further seen that the maximum water applied per palm was in basin irrigation treatment (12260 lit.) followed by drip irrigation at 100% Eo (10524 lit.) and drip irrigation at 66% Eo (7009 lit.).

Table 33 : Effect of drip irrigation on coconut yield (Arsikere, 2004)

Sl. No	Treatment	Nut yield /palm/year		% increase over control	
		2003-04	Mean (5 Yrs)	2003-04	Mean(5 ears)
1	No irrigation (control)	52.4	61.2	-	-
2	Drip irrigation @ 33% Eo	79.8	84.8	52.3	38.6
3	Drip irrigation @ 66 % Eo	94.4	92.4	80.1	51.0
4	Drip irrigation @ 100% Eo	116.3	104.5	121.9	70.8
5	Basin irrigation @ IW/CPE=1	108.2	99.4	106.5	62.2
	S. Em ±	4.3			
	CD(P=0.05)	13.3			

Table 34 : Effect of drip irrigation on yield of coconut (Ratnagiri, 2004)

Sl. No.	Treatment	Nut yield/palm/year							Mean cumulative nut yield/ palm/year (1997-2004)
		1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	
1.	No irrigation (I_1)	42	68	70	54	72	57	53	57
2.	Drip irrigation at 33% Eo. (I_2)	57	73	102	69	92	79	66	79
3.	Drip irrigation at 66% Eo. (I_3)	54	83	107	68	94	74	65	80
4.	Drip irrigation at 100% Eo. (I_4)	60	101	111	87	97	70	71	85
5.	Basin irrigation at IW/CPE ratio=1 (I_5)	73	104	118	77	113	83	77	91
	SE ±	3.13	5.62	9.63	4.61	7.32	4.95	3.47	3.25
	CD(P=0.05)	9.63	17.31	29.67	14.15	22.56	15.27	12.20	10.00

Table 35 : Lateral and downward movement of irrigation water under different drip irrigation treatments(Ratnagiri, 2004).

Sl. No.	Downward movement (cm.)	Lateral movement (cm.)		
		33% E_0	66% E_0	100% E_0
1.	0 - 15	69.50	89.50	98.50
2.	15 - 30	82.00	99.75	102.75
3.	30 - 45	78.50	87.50	88.00
4.	45 - 60	40.00	63.00	66.50
5.	60 - 75	21.00	34.00	43.50
6.	68	0	30.00	33.00
7.	84	0	0	9.00
8.	90	-	-	0

The economics of the different irrigation treatments is presented in Table 36. The maximum net return was recorded in drip irrigation of 100% Eo (Rs. 30000/-) followed by drip irrigation of 66% Eo. (Rs. 24890/-).

Veppankulam

This experiment was laid out in a 21 year old ECT palms in sandy loam soil. The quantity of water given through drip system was arrived based on eight years mean evaporation data . It was observed that drip irrigation at 100% Eo could save only 7 per cent of irrigation water when compared to basin irrigation at IW/CPE=1.

Biometric observations and nut yield of coconut were periodically recorded and the highlights are presented in Table 37.

The results for the year 2003 – 04 indicated that drip irrigation at 100% Eo and basin irrigation had a similar effect on growth, yield attributes and nut yield. These two treatments registered higher number of functional leaves, bunches harvested, female flowers and nut yield and they were found to be superior to other treatments.

Palms receiving irrigation through drip system at 100% Eo produced more number of nuts (118.5 nuts/palm) when compared to palms receiving water through drip irrigation system at 66% and 33% Eo.

Table 36 : Economics of different irrigation treatments (Ratnagiri, 2004)

Sl. No.	Treatment	Nut yield/ha.	Total water applied per palm (lit.)	WUE (Nuts/ ha. -lit.)	Gross returns per ha. (Rs.)	Total cost per ha. (Rs.)	Net profit per ha. (Rs.)
1.	No irrigation	9975	-	-	59850	48756	11094
2.	Drip irrigation at 33% Eo	13825	3505	3.90	82950	58934	24016
3.	Drip irrigation at 66% Eo	14000	7009	1.98	84000	59110	24890
4.	Drip irrigation at 100% Eo	14875	10524	1.41	89250	59250	30000
5.	Basin irrigation at IW/CPE ratio =1	15925	12260	1.29	95550	75400	20150

Table 37 : Effect of basin and drip irrigation on growth and yield of coconut (Veppankulam,2004)

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 (1998 to 2004)
I_0 - Control	20.1	8.7	16.4	84.2	89.6
I_1-Drip irrigation at 33 % Eo	24.2	9.3	20.5	105.5	106.6
I_2-Drip irrigation at 66% Eo	25.5	9.1	20.1	91.5	109.0
I_3- Drip irrigation at 100% Eo	29.7	10.7	27.4	118.5	125.1
I_4- Basin irrigation	28.6	9.9	27.2	124.5	117.5
SEd	1.2	0.7	1.6	6.5	-
CD (P=0.05)	2.5	NS	3.5	14.2	-

The cumulative mean nut yield for the six years (1998-2004) showed that maximum number of nuts (125.1 nuts / palm) was recorded in drip irrigation at 100% Eo and it was followed by basin irrigation (117.5 nuts / palm).

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 nine coordinating centres in a RBD with 4 replications. The treatments consist of :

T1 - Control (No fertlisers/Farmers' practice from 1999-2000)

T2 - Recommended dose of chemical fertilizers(500:320:1200g N, P_2O_5, K_2O/palm/ year

T3 - Composted coir pith (CCP)

T4- 50% CCP + 50% chemical fertilizers (CCP+RCF)

T5- Neem cake + bone meal + ash(on equal nutrient basis) (NC+BM+Ash)

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 equal nutrient basis.

Application of 100% composted coir pith recorded a nut yield of 153 nuts/palm/year. Application of 50% CCP + 50% chemical fertilizers recorded an yield of 152 nuts/palm/year. Application of composted coir pith on 100% N basis recorded maximum net income of Rs.65140 /ha and benefit cost ratio of 2.45. Application of 50% CCP + 50% chemical fertilizers recorded a net income of Rs.62736 and a benefit cost ratio of 2.37 and this is followed by farmer's practice with Rs.59840 and 224. Application of chemical fertilizers and neem cake+bone meal + ash recorded lowest net income of Rs.57810 and Rs.42830 respectively These treatments recorded lowest BC ratio of 1.56 and 1.91 respectively.

Ambajipeta

The experiment was initiated during June-July, 1996 in the existing bulk plot of ECT with 80 palm. But the treatments were imposed during July – December 1997 due to November 1996 cyclone.

The results revealed that the differences in number of functional leaves, rate of leaf production and number of spadices were non-significant, while the number of female flowers/palm was significant. The highest number of female flowers were produced in palms receiving of 100 percent CCP (312.95) followed by palms receiving RCF (304.17). Data pertaining to nut yield and cumulative nut yield revealed that the highest mean nut yield was recorded in palms receiving 50 per cent RCF and 50 per cent CCP (154.78 nuts/palm), followed by 100 percent CCP (138.45 nuts/palm) as against control (72.56 nuts/palm). However, the highest cumulative nut yield was recorded in RCF (486.15 nuts), followed by 50percent RCF + 50percent CCP (471.93) compared to 319.87 nuts in control. Copra content was maximum in 50percent RCF+50percent CCP (15.23kg/palm).

With respect to nut quality characters, the highest nut weight was registered in the treatment 50% RCF + 50% CCP (1169.87 g) followed by 100% RCF (1088.01 g) and the lowest in control (847.52 g). The husk percentage in various INM treatments ranged from 54.97% to 60.40%. The nut water content in various treatments ranged from 60.51 ml to 107.54 ml. The highest copra content was recorded in treatment receiving 50% RCF + 50% CCP (144.87 g/nut) followed by 100% CCP (136.62 g/nut) compared to lowest in control (101.55 g/nut).

Arsikere

The experiment was started in 1996 on adult palms with five treatments laid out in RBD with four replications with the objective of evolving 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 source of nutrients.

The INM practices gave higher coconut yield compared to control and recommended dose of NPK through fertilizers. Among the INM practices, providing 100% N through composted coir pith has given highest coconut yield during 2003-04. However, the data over six years indicated that the mean yield was almost same in all the three INM practices. Considering the availability of organic sources and their cost, the INM of application of 50% N through composted coir pith + 50% NPK through fertilizers is ideal for coconut.

Bhubaneshwar

The experiment was taken up in the farmers field during June 2004 and the treatments were given during June- July 2004 after recording the initial growth and yield data.

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 chemical fertilizer registered maximum height, girth and number of leaves of 58.6 cm, 100.6 cm and 15.3 per palm respectively. Palms under control recorded lowest height (46.3 cm) and girth (75.3 cm). Maximum number of nuts/ palm /year (26.6) was recorded under recommended dose of chemical fertilizers

Ratnagiri

The experiment was laid out in 41 years old WCT palm in sandy soil, during 1998. The yield data 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 2003-04, T2 recorded significantly higher yield over treatments T_1, T_4 and T_5 but was at par with T_3.

As regards to cumulative yield (2001-02 to 2003-04), treatments T_2 and T_3 have recorded significantly higher yield over T_1, T_4 and T_5 but were were on par with each other..In all the three years, treatment of recommended NPK dose has recorded the highest nut yield.

The physical properties recorded from different treatments(Table 38) revealed that the weight of whole nut was maximum in T_1 (1050.95 g) followed by T_3 (1033.25 g) and T_2 (975.30 g) whereas weight of husk was maximum in T_2 (541.44 g) followed by T_5 (504.1 g) and T_1 (484.73 g). The maximum copra was recorded in the treatment T_1 (166.55 g) followed by T_3 (160.78 g) whereas the weight of shell was maximum in T_3 (294.48 g) followed by T_1 (275.23 g).

The quality properties recorded for different treatments are presented in Table 39. It was seen that maximum fat content was observed in T_4 (63.4%) followed by T_5 (62.7%) and T_2 (62.3%) whereas protein content was maximum in T_4 (6.84%) followed by T_2 (6.72%) and T_3 (6.41%). As regards the minerals, T_3 recorded highest minerals (1.8%) followed by T_2 (1.71%) whereas carbohydrates were maximum in T_1 (21.9%) treatment followed by T_5 (19.69%) and T_3 (19.05%)

Table 38 : Physical properties of coconut in the INM trial (Ratnagiri, 2004)

Treatment	Wt. of whole nut (g)	Wt. of husk (g)	Wt. of nut with kernel (g)	Volume of coconut water (ml)	Wt. of shell (g)	Wt. of wet copra (g)	% moisture
T_1	1050.95	484.73	556.30	124.5	275.23	281.07	40.74
T_2	975.30	541.44	427.03	75.0	212.59	214.44	42.66
T_3	1033.25	460.71	566.91	114.0	294.48	272.43	40.98
T_4	932.15	446.66	475.12	88.0	229.81	245.31	41.72
T_5	926.35	504.1	417.62	64.5	195.12	222.5	42.62

Table 39 : Chemical properties of coconut in the INM trial (Ratnagiri, 2004)

Treatments	% Moisture	% Fat	% Protein	% Fibre	% Minerals	% Carbohydrates
T_1	4.3	60.2	6.58	5.82	1.2	21.90
T_2	4.7	62.3	6.72	6.42	1.7	18.16
T_3	4.8	61.7	6.41	6.24	1.8	19.05
T_4	5.1	63.4	6.84	5.9	1.7	17.06
T_5	3.8	62.7	6.27	6.14	1.4	19.69

Veppankulam

The experiment was laid out in RBD with four replications and six palms per treatment in a garden of 29 years old ECT palms(sandy loam soil) during 1997. As per the treatment schedule, quantified amounts of manures and fertilizers were applied. The results showed that application of FYM + 100 % NPK recorded significantly higher number of bunches, number of female flowers and number of nuts/palm than other treatments. For cumulative yield also the same treatment was found to record the highest number of nuts.

Agr. 7A : Nutritional requirement of high yielding varieties/hybrids of coconut with 50% 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 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 the doses of 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 applied from 2002 onwards. Statistical analysis of the data for 2003-04 showed that there was no significant response for N, P or K for both annual leaf production and number of functional leaves. In the case of number of bunches, N_2 level was found to record significantly more number of bunches than N_0 level. In the case of number of female flowers, both N_1 and N_2 levels were found to record significantly higher value than N_0 level. In the case of nut yield (Table 40), both N_1 and N_2 levels were found to record significantly higher yield than N_0 level. Between N_1 and N_2, however, the difference was not significant.

The NPK interaction data (Table 41) revealed that application 1000:250:1000 g/ palm/year recorded maximum nut yield of 154 nuts/palm/year followed by 1000:500:2000 g with 144 nuts and 500:250:1000 with 135 nuts/palm/year. The results indicated that higher levels of P&K did not increase the yield and slight yield reductions were observed.

The net income increased to Rs.33994 /ha with 500 g of N /palm compared to Rs.7740 with N_0 level. The increase at 1000 g N was very low. The benefit

Table 40 : Effect of treatments on nut yield (nuts/palm/year) - Aliyarnagar,2004

	N_0	N_1	N_2	Mean	K_0	K_1	K_2
P_0	64	106	114	95	95	93	96
P_1	81	118	137	112	103	124	109
P_2	63	106	117	98	85	106	96
K_0	70	98	114	94			
K_1	74	122	127	108			
K_2	64	110	127	100			
Mean	70	110	123				

CV(%) 22.1 CD(P=0.05) for N 15.19

Table 41 : Three factor interaction on yield (nuts/palm/year) - Aliyarnagar,2004

NPK interaction				
		K_0	K_1	K_2
N_0	P_0	52	65	76
	P_1	89	84	72
	P_2	70	74	46
N_1	P_0	104	107	107
	P_1	94	135	124
	P_2	96	124	98
N_2	P_0	129	108	105
	P_1	125	154	133
	P_2	89	120	144

cost ratio with 500 g N was Rs.1.78 and with 1000 g N Rs.1.96. Application P @ 250 g/palm/year recorded a net income of Rs.35611 /ha and a benefit cost ratio of 1.82. The net income and benefit cost decreased with further increase in P level. Application of K @ 1000 g/palm/year recorded a net income of Rs.32608/- and a benefit cost ratio of 1.72. Further increase in K level decreased the net income and benefit cost ratio. The NPK combination 500:250:1000 g/palm/year recorded a net income of Rs.51555/- and a benefit cost ratio of Rs.1.92. The NPK combination 1000:250:1000 recorded a maximum net income of Rs. 63797 and a benefit cost ratio of Rs.2.14.

Kahikuchi

The experiment was laid out in 2003. Yield data are presented in Table 42. The highest number of functional leaves (31.0), number of leaves produced (12.0) number of inflorescence(11.8), number of female flowers/bunch(26.6) and yield were recorded in the treatment $N_1P_2K_2$. For yield, main effect of all the nutrients was found significant The nut yield increased with the increase of graded doses of nitrogen up to 500 g(N_1) and then there was a decrease whereas, for phosphorus and potash, nut yield /palm/year increased with the increase in the levels of P and K (Table 42).

A palm in INM trial at Kahikuchi with $N_1P_2K_2$ treatment

Mondouri

The number of bunches/palm showed significant variations due to different levels of nitrogen application. An increase in the dose of N, P_2O_5 and K_2O increased the bunch production. N_1K_2 combination recorded 8.6 bunches/palm followed by P_2K_2 (7.8/palm) as compared to 6.0/palm under N_0P_0 treatment.

As regards yield, though the response was not statistically significant, it was seen that there was

Table 42 : Yield of nuts/palm under different nutritional treatments(Kahikuchi, 2004)

	N_0	N_1	N_2	Mean	K_0	K_1	K_2
P_0	48.5	74.5	63.0	62.2	58.3	67.3	70.8
P_1	67.9	79.8	80.6	76.1	63.3	74.8	90.1
P_2	71.1	92.2	82.0	81.8	60.0	85.0	100.2
K_0	58.2	63.8	59.4	60.5			
K_1	66.2	93.3	85.5	81.6			
K_2	72.6	114.3	98.8	92.0			
Mean	64.0	84.6	78.2				

CV(%) :10.30 CD (P=0.05) N, P, K : 8.31

an increasing trend in yield from lower to higher levels of N,P,K. The combination, N_2K_2 recorded highest nut yield/palm (98.3/palm) followed by P_2K_2 (95.1/palm) as compared with 74.1/palm under N_0P_0 treatment (Table 43)

The copra yield showed an increasing trend on copra yield due to increasing levels of N, P_2O_5 and K_2O. Highest level of N, P_2O_5 and K_2O recorded maximum copra yield. It was seen that maximum copra yield of 12.6 kg/palm was recorded under N_2K_2 treatment combination.

Subbegoundanpudur during July 2004. A total number of 100 trees were marked for each FLD. Quantity equal to 50 % of the recommended N was supplied through composted coir pith. Remaining 50 % N and balance quantity of P and K were applied through urea, super phosphate and muriate of potash. The manures and fertilizers were applied in two splits during July and Januanry. The age of the coconut garden was more than 20 years in all the three gardens. Initial soil and leaf samples were collected from all the three fields. The harvest details are being collected at each harvest.

Table 43 : Yield of COD x WCT hybrid coconut under various nutritional treatments (Mondouri, 2004)

	P_0	P_1	P_2	Mean	K_0	K_1	K_2
N_0	74.1	86.1	89.3	83.2	74.3	81.1	85.5
N_1	79.3	87.5	91.6	86.1	77.6	89.3	90.6
N_2	81.6	92.6	94.3	92.8	80.3	92.6	98.3
Mean	78.6	85.7	89.8				
K_0	77.3	83.1	88.6	77.4			
K_1	78.3	84.5	88.7	87.6			
K_2	84.3	89.6	95.1	91.5			

S.Em : 2.6 C.D(P=0.05) : NS

Front Line Demonstrations on Integrated Nutrient Management

Aliyarnagar

Three FLDs were laid out on INM in the farmer's fields at Aliyarnagar, Puliangandi and

Ratnagiri

Three Frontline demonstrations on Integrated Nutrient Management with the use of vermicompost as the primary component have been started.

COCONUT
1.3.1 Crop Protection - Diseases

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

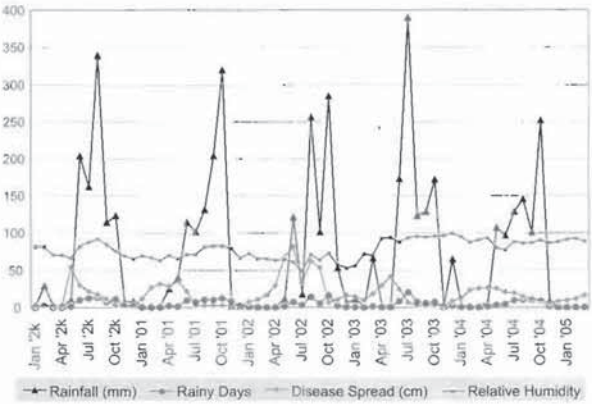
(Ambajipeta, Arsikere, Veppankulam)

Ambajipeta

a. Epidemiology of basal stem rot of coconut

Scanning electron microscopy studies on *Ganoderma applanatum* and *G.lucidum* were carried out in collaboration with Ruska labs, ANGRAU, Hyderabad and NRC for Oilpalm, Pedavegi, Andhra Pradesh. PCR for *Ganoderma applanatum* and *G.lucidum* were carried out.

Correlation studies between weather factors and spread of basal stem rot disease for the period from January, 2000 to March, 2005 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-1).



Effect of weather factors on vertical spread of basal stem rot disease on coconut

b. Early detection of basal stem rot disease

i) Sero detection studies: Polyclonal antiserum was raised against *Ganoderma applanatum*. Sero detection of *Ganoderma applanatum* (Pers.) Pat., *Ganoderma lucidum* (Leys) kant. and their infection in coconut palm was carried out by simple serological tests *i.e.*, slide agglutination test and Glass capillary tube test, the produced antiserum positively reacted (precipitation formation) with cultures of *G.applanatum* and *G.lucidum* and with sap from basal stem rot (BSR) affected coconut palm root tissues (Table 44). However, the simple serological tests failed to detect basal stem rot disease infection in stem tissues of diseased coconut palm. The indirect form of ELISA was found to be more sensitive in detecting the *Ganoderma* spp in tissues from root, basal portion of stem and up to 1 m height from basal portion of stem of coconut palm (Table 45).

During the year 2002-03, 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 results indicated that the basal stem rot disease infection in coconut seedlings could not be detected before symptom expression by simple serological tests (Table 44) as well as by Elisa (Table 45) indicating the non suitability of serological techniques in detection of *Ganoderma* infection in coconut before symptom expression.

ii) Early detection by indicator plants: During the year 2003-04 among the thirteen plant species screened against basal stem rot disease in sick soil, red gram plants showed splitting of the bark at the crown region. During the year 2004-05, pigeon pea was resown again in sick soil to study the consistency of the symptoms of bark splitting at the base. Results indicated that bark splitting of red gram plant at the base was consistent in all the plants that are grown in *Ganoderma* sick soil. Efforts to isolate the pathogen from diseased red gram plants and to prove pathogenicity to coconut palm are in progress.

Table 44 : **Simple serological tests for diagnosing *Ganoderma* wilt infection in coconut before manifestation of symptoms(Ambajipeta, 2004)**

Month after planting in sick soil	Precipitation reaction *			
	Slide agglutination test		Glass capillary tube test	
	G.applanatum	Root tissues from diseased palm	*G.applanatum*	Root tissues from diseased palm
Up to 30 months	+	—	+	—

*Data based on 9 observations each; + precipitation (+ve reaction); — no precipitation

Table 45 : **Detection of *Ganoderma* wilt infection in coconut by indirect form of Elisa before symptom expression(Ambajipeta, 2004)**

Month after planting in sick soil	Absorbance values at 405 nm * (range)		
	G.applanatum	Root tissues	
		Healthy	Diseased
Up to 30 months	0.121 – 0.170	0.141 – 0.149	0.140 – 0.149

*Dilutions used :antigen = 10^{-1}; rabbit antibody 1:500; Enzyme linked anti-rabbit fc specific antibodies produced in goat 1:1000

Arsikere

Among the four methods of inoculation, except in case of stem inoculation, the palm number 201, 203 and 204 showed bleeding symptom in about 12-15 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 infected palm (stem inoculated palm) and compared with the original culture. Hence, pathogenicity of *Ganoderma lucidum* was established in adult coconut palms (Tiptur Tall) through stem inoculation technique.

Root inoculation of coconut seedlings with four isolates of *Ganoderma lucidum* isolated from different places were inoculated to twelve coconut seedlings of 3 years old (each isolate inoculated to three seedlings) in pot culture under controlled conditions. 15-20 months after inoculation, the isolate I, II and IV infected the single seedling out of three seedlings inoculated with each isolate, whereas, the isolate III could not infect any seedling . *Ganoderma lucidum* was re-isolated from the isolate I, II and IV infected seedlings and compared with the original culture.

Veppankulam

I Pathogenicity studies

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 two 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 two years of inoculation.

iii. New experiment on pathogenicity

A new 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 re- isolated 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 is a virulent one.

II. Early detection of *Ganoderma*

An experiment was laid out for early diagnosis of *Ganoderma* in indicator plants. The basal stem rot infected (in BSR sick plot) and healthy coconut palms were selected at Coconut Research Station, Veppankulam to conduct the experiment. Four indicator plants viz., *Cajanus cajan* (seeds),*Sesbania rostrata* (seeds),*Leucana leucocephala* (seeds), *Glyricidia* (cuttings) were planted in the basins of basal stem rot infected and healthy (apparently healthy) palms separately.

The same experiment was also conducted under glasshouse conditions with artificial inoculation of *Ganoderma* isolates (TKT 1 and CRS 1). The inoculum of the isolates were multiplied on sorghum grains and inoculated at the time of sowing / planting @ 300 g / pot. Root samples from both field and pot culture experiments were collected at monthly intervals. The early diagnosis technique *viz.*, Direct Antigen Coating - Enzyme Linked Immuno Sorbant Assay (DAC -ELISA) was done for the root samples as per the method described by Viswanathan *et al.* (1998). Observations on the appearance of external symptoms in the indicator plants were also made at regular intervals. The results revealed that the sporophore of *Ganoderma* appeared at the basal stem portion of the red gram (*Cajanus cajan)* grown in the BSR infected tree basin (BSR sick soil) at four months after sowing. The results of the early diagnosis of *Ganoderma* in indicator plants revealed that there was no critical difference in the absorbance values of artificially inoculated indicator plants under glasshouse conditions except *Glyricidia*. Three fold increase in absorbance value was observed in *Glyricidia* inoculated with *Ganoderma* isolates (TKT 1 and CRS 1) than the uninoculated control plants. While under field conditions, more than three fold increase in absorbance values were observed in the indicator plants grown in BSR infected tree basins (BSR sick soil) than the apparently healthy tree basins except *L. leucocephala*

III. Epidemiology and prediction model for the incidence of BSR

BSR disease intensity and incidence were recorded along with weather data at Coconut Research Station, Veppankulam for the year 2004. The monthly mean of the variables *viz.*, temperature, relative humidity, rainfall, soil temperature at 2 30, 60 and 90 cm depths along with previous month's disease data were taken for the development of prediction model using stepwise regression (SPSS package). The correlation analysis revealed that previous month's disease incidence and relative humidity had positive correlation with the disease.

IV. Isolation of *Ganoderma*

Eighteen isolates of *Ganoderma* were isolated from different parts of Tamil Nadu and the cultures are being maintained on Potato Dextrose Agar (PDA) medium at culture collection centre of Coconut Research Station, Veppankulam. The cultures were sent to Central Plantation Crops Research Institute, Kasaragod to maintain as a national repository and for further studies.

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

(Ambajipeta, Arsikere, Veppankulam)

Ambajipeta

a. Testing varietal resistance to basal stem rot (Ganoderma) disease

During July, 2003, 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 out of 5 palms planted, 1-3 palms each in all varieties / hybrids died indicating their susceptibility to basal stem rot. During 2004, as per the Workshop decision, germplasm types(seed nuts) from Veppankulam reported to be tolerant to BSR were obtained and were planted in *Ganoderma* sick soil for further studies.

b.Integrated management of basal stem rot (*Ganoderma* wilt) disease of coconut:

Laboratory studies as well as field studies were taken up to establish the efficacy of *Pseudomonas fluorescens*, *Trichoderma spp* in combination with neem cake against the basal stem rot disease.

Scanning electron microscopy studies on mechanism of action of *Trichoderma* spp on *Ganoderma applanatum* and *G.lucidum* was conducted and the results indicated that *Trichoderma* spp coiled round the hyphae of *Ganoderma* spp both sparsely (in the initial stages) and intensely (later stages). This was followed by frequent adpressions of the *Trichoderma* hyphae on the hyphae of both the *Ganoderma* spp. Later penetration of *Trichoderma* spp into the hyphae of test pathogen followed by replacement of its protoplasmic contents was noticed. Finally, lysis of the *Ganoderma* spp mycelium was noticed by the *Trichoderma* spp, followed by protuberances of the phialospores of the bioagent from within the lysed mycelia of *Ganoderma* spp.

***In vitro* efficacy of *Pseudomonas flourescens* on *G.applanatum* and *G.lucidum*:** The fluorescent *Pseudomonas* were found to inhibit the growth of both the species of *Ganoderma*. Neem cake and farmyard manure supported the growth of *Pseudomonas flourescens*.

Field efficacy of biocontrol agents, *Trichoderma* spp and *P.fluorescens* on BSR of coconut: During the year 2004, a field experiment was conducted and the results indicated that among different treatments , 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% conc) @ 25ml at quarterly intervals (T_5). This was followed by the treatment where *T.viride* was applied to soil (50 g) along with 5 kg Neem cake, coupled with root feeding of *T.viride* culture filtrate (100% conc) @ 25 ml at 6 months intervals (T_6) and once at a time in an year (T_7) respectively. This was followed by the treatment where *T.viride* was applied to the soil (50g) along with 5 kg neem cake (T_4). However, after T_4, root feeding of the culture filtrates of *T.viride* (100% conc) @ 25 ml was also proved effective in checking the vertical spread of the disease when applied at quarterly (T_1), half yearly (T_2) and annual (T_3) intervals. On the other hand, neem cake when applied alone (T_{10}), restricted the spread of the disease satisfactorily (44.12 cm). However, soil application of *Pseudomonas fluorescens* @ 50 g and 100 g (T_8 &T_9) was not effective in controlling the spread of the disease. The combined application of *P.fluorescens* along with 5 kg neem cake to the soil (T_{11}) also did not give additional benefit over sole application of neem cake (5 g) to the soil (T_{10}), indicating the ineffectiveness of *P.fluorescens* in controlling the BSR disease spread at field level. However, control palms recorded a disease spread of 88.32cm.

Arsikere

Management of Basal stem rot (BSR) disease of coconut

A management trial was laid out in five locations in farmer's gardens including ARS, Arsikere as one of the replications during April, 2000. The treatments viz ., T1(Tridemorph 2%), T2 (T_1 + NC), T3(NC+Tv), T4(Hexaconazole 1%), T5 (T4+ NC) , T6 (T5 + Tv) , T7 (Pf) and T8 (Control) were being

imposed from April, 2000 under irrigated as well as rainfed coconut gardens. 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 viride* (@ 50g/palm/half yearly) in all the gardens.

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.

Significantly, the lower disease index recorded in the treatment T_6 was an indication that the palms responded more to this treatment compared to other treatments in irrigated as well as rainfed coconut garden. The next best treatment was found to be T_5 followed by treatment T_2. The progress of the disease was significantly less in treatment T_6 (with an increase of 15.71 disease index over initial) whereas, in the case of control, the progress in disease was significantly higher (an increase of 41.72 disease index over initial).

The combined application of Hexaconazole (1%) root feeding and soil application of neem cake (@ 5 kg/palm/year) + *Trichoderma viride* (@ 50gm/palm/half yearly) was effective in the management of basal stem rot of coconut, which recorded a lesser disease index of 37.31 compared to 62.82 in control. The results also revealed that the combined treatments gave significantly higher nut yield (87.17 nuts/palm/year during 2004 -05 and 77.95 nuts/palm as cumulative mean yield from 2000 - 2005 respectively) when compared to control (51 mean nut yield /palm during 2004-05 and cumulative mean nut yield of 55.2 nuts/palm from 2000 - 2005 respectively) and other treatments.

Veppankulam

I. Varietal screening

Ten coconut genotypes 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.

Among the ten coconut genotypes, ECT X BSR tolerant ECT registered a higher rate of survival (61.1 per cent) as compared to other genotypes 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 (35.86) as compared to ECT (46.23). The results revealed that the hybrid, ECT X BSR tolerant ECT recorded a higher mean nut yield of 74 nuts / palm during 2003– 04, which also recorded a higher cumulative mean nut yield of 125.67 nuts / palm when compared to other genotypes.

Biochemical analysis

Calorimetric analysis of total phenol, peroxidase and polyphenol oxidase activities

Total phenol content and activities of peroxidase and polyphenol oxidase in root tissues of coconut genotypes were analysed calorimetrically. Peroxidase activity was determined according to Hammerschmidt *et al.* (1982) and the polyphenol oxidase activity was determined as per Mayer *et al.* (1965). The total phenol content was estimated by the procedure of Swain and Hillis (1959). The results are presented in Table 46.

The results revealed that the hybrid, ECT X BSR tolerant ECT had a higher content of total phenol when compared to other genotypes. Similarly the activities of peroxidase and polyphenol oxidase were also more in the hybrid ECT X BSR tolerant ECT when compared to other genotypes in BSR sick soil, which may be responsible for tolerance.

Isozyme analysis of peroxidase

To study the expression pattern of different isoforms of peroxidase in different genotypes, activity gel electrophoresis was carried out.

Table 46 : Total phenol, peroxidase and polyphenol oxidase activities in coconut genotypes (Veppankulam, 2004)

Sl. No.	Genotype	Total phenol (mg g^{-1})	Peroxidase activity A_{420} nm $min^{-1}g^{-1}$	Polyphenol oxidase activity A_{495} nm $min^{-1}g^{-1}$
1	San Ramon	12.4	0.432	0.218
2	British Soloman Islands	14.3	0.508	0.292
3	Java Giant	9.1	0.392	0.199
4	Straight Settlement Green	12.8	0.451	0.263
5	WCT X COD	11.4	0.404	0.206
6	COD X WCT	12.6	0.456	0.242
7	ECT	15.1	0.478	0.311
8	ECT X BSR tolerant ECT	16.2	0.589	0.398

Isozyme analysis of peroxidase in BSR resistant genotype (ECT X BSR tolerant ECT) and susceptible genotype (ECT) revealed that an isoform PO2 was induced in both resistant and susceptible genotypes. But PO2 was intensified in the resistant genotype. The isoform PO1 was present only in the resistant genotype (Plate).

Performance of BSR tolerant materials

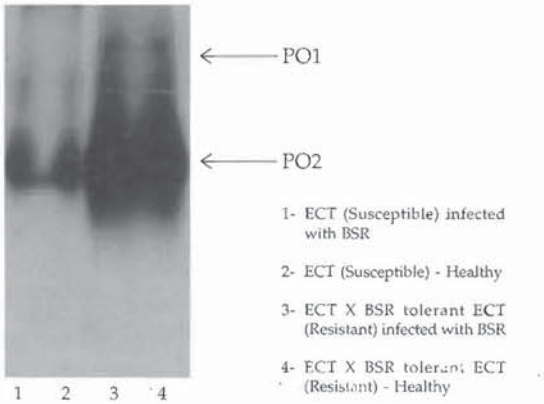
Field experiments were laid out in BSR sick soil at two different locations *viz.*, Melasambalur and Coconut Research Station, Veppankulam to test verify the performance of BSR tolerant materials as per the recommendation of the XVIth biennial workshop. Seedlings raised from the selfed seednuts of BSR tolerant mother palms were planted in BSR sick soil along with the tall varieties during August, 2004.

II. Management of basal stem rot disease of coconut

A field experiment was laid out during November, 2000 on the management of basal stem rot disease of coconut at Thambikkottai village with eight treatments. In this experiment, the following two treatments were also included during December, 2003 as per the suggestions of XVI Biennial workshop:

1. Hexaconazole 1% root feeding @ 100 ml / palm + neem cake @ 5 kg / palm + *T.harzianum @ 50 g / palm* and
2. *T.viride* + *P.fluorescens* @ 50 g each + neem cake @ 5 kg / palm

Among the ten treatments, the progress of the disease was significantly less in the treatment Hexaconazole 1% root feeding @ 100 ml / palm + neem cake @ 5 kg / palm + *T. harzianum* @ 50g / palm with an increase of 9.30 disease index over initial, which was at par with Tridemorph 2% root feeding @ 100 ml / palm + neem cake @ 5 kg / palm treatment with an increase of 10.25 disease index over initial. In case of control, the progress in disease severity was significantly high with an increase of 64.05 disease index over initial. The palms treated with *P.fluorescens* @ 50 g / palm recorded significantly higher mean nut yield of 66.3 nuts / palm, followed by Tridemorph 2% root feeding + neem cake @ 5 kg / palm (56.7 nuts / palm).



Induction of peroxidase isoforms in BSR resistant and susceptible genotypes of coconut (Veppankulam)

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

(Aliyarnagar)

Survey was conducted to assess the extent of spread and intensity of root (wilt) disease of coconut in nine villages in Coimbatore district and four villages in Theni district.

From the survey conducted in Cumbum block of Theni district, severe to very severe root (wilt) disease incidence was observed in Cumbum block. The disease incidence ranged from 22.2 to 30.9%. Advanced symptoms of root (wilt) disease was noticed in Gudalur and Surilipatti villages of Cumbum block. Mid-whorl yellowing was noticed in several gardens. Leaf rot disease symptom was also observed in several palms. In Pollachi-Kerala borders of Coimbatore District, root (wilt) disease incidence was not noticed in any of the 10 villages surveyed. Only two palms in Meenakshipuram area of Coimbatore District were suspected for root (wilt) disease. The suspected samples were subjected to serological testing.

Root (wilt) incidence in Cumbum valley in Theni district

Path. 7 : Biocontrol of budrot and stem bleeding disease of coconut

(Ambajipeta)

A. Biocontrol of budrot disease of coconut

The bud rot pathogen *Phytophthora palmivora* was isolated from diseased palm. Antagonists *viz., T.viride, T.harzianum, T.hamatum* and *P.fluorescens* were isolated from coconut gardens. *in 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 with an inhibition of 68.38% by *P.fluorescens*(Table 47). All the three *Trichoderma* spp were found to produce specific volatile and non-volatile metabolites against *P.palmivora* under *in vitro* conditions (Table 48).

Table 47 : *In vitro* antagonism of native *Trichoderma & P.fluorescens on P.palmivora* (Ambajipeta, 2004)

Biocontrol agent	*Per cent inhibition of* P.palmivora*
Trichoderma viride	82.03[a]
T.harzianum	71.87[c]
T.hamatum	75.39[b]
P.fluorescens	68.38[d]

* Values represent the means of 6 replicates. Numbers in each column followed by the same letter are not significantly different

b. Biocontrol of stem bleeding disease of coconut

The stem bleeding pathogen,*Thielaviopsis paradoxa* was isolated from diseased palm. Antagonists *viz., T.viride, T.harzianum, T.hamatum* and *P.fluorescens* were isolated from coconut gardens.

Antagonistic effect of *Trichoderma* spp and *Pseudomonas fluorescens* on *Thielaviopsis paradoxa*: *Pseudomonas fluorescens* and *Trichoderma* spp *viz., Trichoderma viride, T.harzianum* and *T.hamatum* were found to inhibit the mycelial growth of *T.paradoxa* under *in vitro* conditions with the inhibition percentage of 68.32, 69.35, 62.90 & 66.13 respectively (Table 49).

Effect of volatile and non-volatile metabolites of *Trichoderma* spp on *T.paradoxa*: In volatile metabolites, the mycelial growth of the *T.paradoxa* was suppressed when exposed to 25 day old cultures of *T.hamatum & T.harzianum* with per cent inhibition of 70.96 and 75.86 respectively, while *Trichoderma viride* could not inhibit. None of the

Table 48 : In vitro *evaluation of Trichoderma for production of volatile and non-volatile metabolites against* P.palmivora (Ambajipeta, 2004)

Biocontrol agent	Per cent inhibition *						
	Days before exposure			Conc. of culture filtrate			
	0	15	25	10	50	70	100
T.viride	16.25[b]	25.00[c]	56.15[b]	8.32[b]	23.56[b]	49.28[b]	52.00[a]
T.harzianum	16.00[b]	26.25[b]	58.00[a]	6.86[c]	20.00[c]	48.00[c]	49.00[b]
T.hamatum	18.00[a]	27.00[a]	54.00[c]	12.36[a]	35.25[a]	50.25[a]	51.00[a]

* Values represent the means of 6 replicates. Numbers in each column followed by the same letter are not significantly different.

Table 49 : Efficacy of *Trichoderma* spp and *P.fluorescens* in checking radial growth of *T.paradoxa* under in vitro conditions(Ambajipeta, 2004)

Antagonist	Test pathogen	
	Mycelial growth (mm)*	% Inhibition*
T.viride	19[b]	69.35[a]
T.harzianum	23[d]	62.90[d]
T.hamatum	21[c]	66.13[c]
P.fluorescens	18[a]	68.32[b]

* Values represent the means of 6 replicates. Numbers in each column followed by the different letter are significantly different.

Trichoderma spp were effective at 0 & 15 days of their exposure.

In non-volatile metabolites, considerable inhibition on mycelial growth of *T.paradoxa* was noticed with three spp of *Trichoderma* only at 100% concentration with maximum inhibition up to 76.67 by *T.hamatum* (Table 50).

Table 50 : Effect of volatile and non-volatile metabolites of *Trichoderma* against *T.paradoxa* (Ambajipeta, 2004)

Antagonist	% Inhibition of *Thielaviopsis paradoxa* *							
	Volatile inhibition Days before exposure			Non-volatile inhibition Concentration of culture filtrate				
	0	15	25	10	30	50	70	100
T.viride	0	0	0[b]	4.76[b]	19.05[b]	23.80[b]	33.3[b]	45.56[b]
T.harzianum	0	0	70.96[a]	3.80[b]	12.56[c]	20.00[c]	23.33[c]	46.67[b]
T.hamatum	0	0	75.86[a]	21.11[a]	31.11[a]	37.78[a]	41.11[a]	76.67a

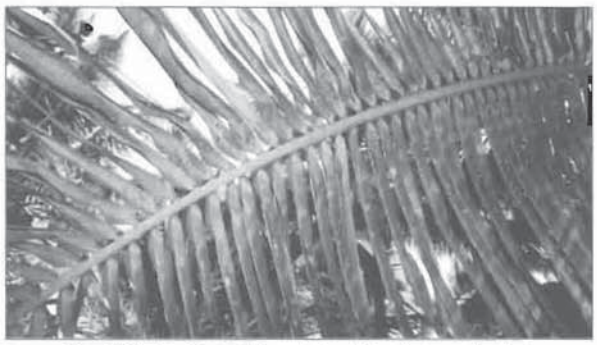
*Values represent the means of 3 replicates. Numbers in each column followed by the same letter are not significantly different.

Path. 8 : Survey and surveillance on diseases of coconut(Budrot,Stem bleeding and Ganoderma wilt)

(Aliyarnagar, Ambajipeta, Arsikere, Veppankulam)

Aliyarnagar

Survey on the occurrence of bud rot, stem bleeding, basal stem rot and leaf blight diseases was conducted in 10 villages of Coimbatore, two villages of Erode and three villages of Theni Districts of Tamilnadu. Leaf blight disease was found to be the major problem in Coimbatore District. The leaf blight disease incidence ranged from 7.7 to 28.6%. Stem bleeding disease was found to be 6% in the village Valanthayamaram, Coimbatore District. Maximum bud rot disease incidence of 4% was observed in the village Pethanaickanur of Coimbatore District.



Leaf blight affected fronds in Coimbatore district

Ambajipeta

During the year 2004, survey conducted in various coconut gardens in different mandals of East Godavari, West Godavari, Srikakulam and Visakhapatnam districts indicated that basal stem rot disease, bud rot and stem bleeding disease commonly occurred in all 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 20.7, 6.3 & 25.0 respectively in Andhra Pradesh. However, no tatipaka disease incidence was noted in the surveyed areas.

Arsikere

Survey has been undertaken in different villages of coconut gardens in Hassan and Chikkamagalur districts during July- August, 2004 and observations were recorded on the incidence of major diseases (basal stem rot, stem bleeding and bud rot) of coconut on 100 palms in each of the garden selected.

The survey revealed that the basal stem rot incidence varied from 3 to 17% in Hassan district and from 3 to 14% in Chikkamagalur district. Maximum incidence of the disease was recorded in Arsikere taluk with a mean of 11.60% followed by Channarayanapatna taluk (7.80%), Arkalgod taluk (6.60%), Belur taluk (6.0%) and Hassan taluk (3.80%) respectively. In chikkamagalur district, the maximum incidence of the disease was recorded in Kadur taluk with a mean of 8.80% followed by Tarikere taluk (8.0%) and Chikkamagalur taluk (4.40%) respectively.

The incidence of the stem bleeding disease of coconut varied from 0 to 8 % in Hassan district and it was from 1 to 16% in Chikkamagalur district. The maximum incidence of the disease was recorded in Arsikere taluk with a mean of 7.0% followed by Channarayanapatna taluk (6.0%), Arkalgod taluk (4.80%), Belur taluk (3.40%) and Hassan taluk (2.0%) respectively.Among the three taluks surveyed for the incidence of stem bleeding disease in Chikkamagalur district, the maximum incidence was recorded in Kadur taluk with a mean of 11.20% followed by Tarikere taluk (5.40%) and Chikkamagalur taluk (2.40%) respectively.

Similarly, the incidence of bud rot disease of coconut was also recorded in different coconut gardens of Hassan and Chikkamagalur districts during the survey. The incidence of the disease varied from 0 to 5% in Hassan district and it varied from 0 to 3% in Chikkamagalur district. Maximum incidence of the disease was recorded in Channarayanapatna taluk with a mean of 2.40% followed by Arkalgod taluk (1.60%), Hassan taluk (1.40%), Arsikere taluk (1.40%) and Belur taluk (0.80%) respectively.In Chikkamagalur district, the maximum incidence of the disease was recorded in Kadur taluk with a mean of 1.60% followed by

Tarikere taluk (1.0%) and Chikkamagalur taluk (0.60%) respectively.

Veppankulam

A survey was conducted during September – December, 2004 in different villages of Thanjavur, Nagapattinam and Thiruvarur districts of Tamil Nadu to assess the incidence of bud rot, stem bleeding and basal stem rot disease of coconut. A total of 14325 palms were observed in these three districts.

The survey revealed that the incidence of basal stem rot disease of coconut was maximum in Thanjavur district with a mean incidence of 4.51 per cent followed by Thiruvarur (0.73 per cent) and Nagapattinam districts (0.35). The bud rot incidence was maximum in Thiruvarur district with a mean incidence of 0.48 per cent followed by Nagapattinam (0.03 per cent) and there was no incidence of bud rot in Thanjavur district. Similarly there was no incidence of stem bleeding in any of the three districts.

Front line Demonstrations on Management of BSR disease in coconut

Six Frontline Demonstrations on the management of BSR disease in coconut were initiated at Ambajipeta, Arsikere and Veppankulam Centres. FLD 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 manuring @ 25 kg/palm
f. Basin 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.

Ambajipeta

Two front line demonstrations on coconut BSR-IDM package were conducted - one each at Gannavaram and Appanapalli villages of East Godavari district, Andhra Pradesh. The vertical and horizontal spread of the disease in FLD plots as well as in Farmers' practice were being recorded. Prepared audiovisual CD on BSR-IDM package (in Telugu) and created awareness among coconut growers on management of BSR in coconut.

Arsikere

FLD for the management of basal stem rot disease of coconut was laid out in two locations (Karagunda and Undiganalu villages) during October 2004. Different treatments were imposed and the observations were recorded on the horizontal and vertical spread of the disease.

Veppankulam

Two front line demonstrations were laid out on the management of basal stem rot disease of coconut in farmers' fields at Veerakuruchi and Kallikkadu locations.

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 2.92 in disease index over initial when compared to control (Farmer's practice) blocks with an increase of 5.66 in disease index over initial. In the FLD package treated block, 8.3 per cent of the BSR infected palms recovered from the disease. Similarly, there was no horizontal spread in the FLD treated block as against 3.33 per cent in the control block.

COCONUT
1.3.2 Crop Protection - Pests

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

(Aliyarnagar, Ambajipeta, Ratnagiri)

Aliyarnagar

An intensive periodical survey was carried out on the infestation of four major coconut pests *viz.*, rhinoceros beetle, black headed caterpillar, red palm weevil and eriophyid mite and other emerging pests in selected coconut gardens in 20 districts in Tamil Nadu. The percent incidence of four major pests and their intensities were recorded in five randomly selected blocks of each district comprising five revenue villages in each block.

a. Black headed caterpillar

In Erode district, Arachalur block has shown the highest per cent infestation of black headed caterpillar upto 88.14 with high intensity of leaf damage followed by Echikadu (75.00), Amaravathypalayam (72.00) Avalpoonthurai (68.57).Other taluks viz., Dharapuram, Kangeyam and Perundurai have shown lower level of incidence only. Similarly, in Salem district, Sithanery of Salem taluk has recorded the highest per cent infestation upto 90.00 with high intensity of leaf damage followed by Poolavari (87.00),Uthamacholapuram (78.00) and Veerapandy (56.30).Other areas in Salem district did not have the incidence of pest. In Namakkal district, Kulathur has shown 30.00 per cent infestation with heavy leaf damage followed by Olapalayam (12.00) ad Palapatty (10.00). In Coimbatore district, there was no occurrence of black headed caterpillar population in coconut palms.

b. Redpalm weevil

In Erode district, the red palm weevil infestation was found to be less than 5.00 per cent only in all the four taluks surveyed. In Salem district, the red palm weevil infestation was observed little high (7.00%) in Sithanery of Salem Taluk, followed by Attur Taluk(5.00%) and Mettur Taluk (4.00%). Other areas have shown less than 3.00 per cent only. In Namakkal distict. Mohanur block has recorded the infestation of red palm weevil upto 25.00 % followed by Panamarathapatty 15.00%, Olapalayam 14.00% and Palapatty 7.00%. In Coimbatore district, Anaimalai block has shown the per cent infestation of red palm weevil upto 7.00% followed by Pollachi South 6.00% and Udumalpet 5.00%.

c. Rhinoceros beetle

In Erode district, the maximum per cent infestation of rhinoceros beetle was observed upto 12.00% with multiple cut intensity of damage followed by Arachalur 8%, Kadumaudi 7% and Perundurai taluk. 7.00%. In Salem district, Mettur taluk has recorded the highest per cent infestation upto 11.00% followed by Pallipalayam taluk. 9.00%, Sankakiri taluk. 9.00%, Sinna Salem taluk 9.00%. In Namakal district, Panamarathapatty and Palapatty blocks recorded per cent infestation upto 5.00 % followed by other blocks. In Coimbatore district, both Pollachi-South block and Anaimalai blocks have shown 9.00 per cent each of the infestation of rhinoceros beetle. Other taluks viz., Udumalpet, Tiruppur and Coimbatore have shown less than 5.00 percent infestation only.

d. Eriophyid mite

The eriophyid mite infestation invariably was in higher proportion in all the four districts ranging from 70% to 85% in Erode district, 75% to 90% in Salem district, 68% to 96% in Namakal district, 82% to 88 % in Coimbatore district. The intensity of damage was expressed in terms of damage rating grade upto 5.00 with almost 80-90% nut damage.

Survelliance for new emerging pests

* Occurrence of coconut button borer *Cyclas*

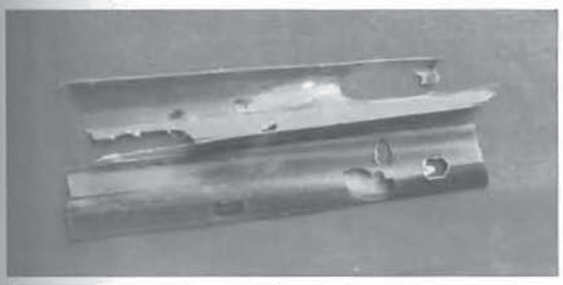
omma was recorded in Narikalpathy village of Annamalai block of Pollachi taluk.

- Coconut skipper *Gangara thyirsis* and leaf eating caterpillar *Turnaca acuta* were noticed in traces level in Namakal and Karur districts respectively.

Ambajipeta

Periodical survey for monitoring of eriophyid mite and other pests was continued in East Godavari, West Godavari, Visakhapatnam and Srikakulam districts.

A total of 64 villages in East Godavari, 20 villages in West Godavari and 5 villages in Srikakulam and 53 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 two villages in East Godavari and 11 villages in West Godavari districts and increased incidence of red palm 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. A new leaf eating caterpillar was observed feeding on coconut leaves as well as inter crop *i.e.*, banana during February month in most of the villages in East Godavari district. All the palms / plants in a garden were found to have infestation.



Damage symptoms of new leaf eating caterpillar on coconut

It was observed that, grade index of mite damage continues to be in mild condition since 2002. Size of the nut improved considerably and yields were stabilized during the year 2004. Further observations made during 2004 revealed a reduction in mite population to an extent of 53.7 per cent (Table 51) when compared to that of 2001.

Table 51 : Eriophyid mite incidence in Andhra Pradesh (Ambajipeta, 2004)

	2000	2001	2002	2003	2004
Average mite population/ 4mm^2 area	208	272	189 (30.5)	128 (52.9)	126 (53.7)
Scale of mite damage	IV	III	II	II	II

(Figures in parentheses are per cent decrease over 2001)

Ratnagiri

a. Survey of eriophyid mite in Konkan region

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 with 1-5 grade index. Also number of nuts damaged were recorded to work out per cent nut damage and the results are presented in Table 52.

To create awareness about the pest among farmers, 12 farmers' rallies, Five TV programmes (ETV, ZEETV, STV, KTV, NDTV,) one radio programme, 78 farm visits, 56 on farm demonstrations and number of telephonic advices on management of coconut eriophyid mite were undertaken.

b. Survey and monitoring of other pest problems of coconut

To record the intensity of infestation of other coconut pests 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. Intensity of incidence was recorded. Data revealed that the infestation of rhinoceros beetle was recorded in almost all the four districts of the region. The infestation of red palm weevil was more in Rajapur taluk of the Ratnagiri district. The infestation level of black headed caterpillar was highest in Thane district.

Table 52 : Infestation of eriophyid mite in Konkan region(Ratnagiri, 2004)

Sl. No.	Name of district	Percent infestation				
		April 2003	June 2003	April 2004	Sept-Oct 2004	March - April 2005
1	Thane	29.10	46.32	65.86	-	63.82
2	Raigad	3.66	18.91	1.90	0.56	2.81
3	Ratnagiri	0.009	15.37	3.33	4.36	7.49
4	Sindhudurg	4.90	-	34.09	18.42	46.34

Ent. 5 : Management of eriophyid mite in coconut gardens

(Ambajipeta, Ratnagiri)

Ambajipeta

Recommended package for the management of coconut eriophyid mite was implemented in three coconut gardens and observations were recorded as per schedule. The strategies adopted are :.

I) IPM strategies

A) Adoption of phytosanitary measures in coconut gardens.

B) Root feeding of Azadirachtin 1 % @ 10 ml + 10 ml of water

II] Palm Health Care

a) Application of 1.0 kg N, 0.5 kg P_2O_5 and 1.0 kg K_2O in three split doses i.e. June, October, February.

b) Application of neem cake 10 kg / palm in two split doses.

c) Recycling of biomass generated within the coconut system by vermicompost method.

d) Recommended level of irrigation during the summer months.

e) Soil moisture conservation by the following methods.

   i) Burial of coconut husk in the basin.

   ii) Mulching the basins with coconut leaves.

The pre treatment data indicated mild damage index in younger nuts whereas nuts which were more than 5 months old were in severe scale. Four months after the imposition of treatments, the mild scale index in the young nuts and severe scale index in the nuts of more than 5 months old was continued both in root feeding as well as spraying treatments. Similar observation was recorded, 8 months after imposition of treatments also. Whereas, in the control palms, damage index in the younger nuts increased from mild scale to medium scale. Severe scale was continued in the nuts of more than 5 months old.

Ratnagiri

A field trial with 8 treatments and 5 replications was laid out in RBD in a farmer's field to find a control measure against the pest at Ratnagiri.

Month wise percent eriophyid mite infestation data revealed that the treatment, root feeding of Ecotin 50000ppm @ 7.5 ml + 7.5 ml of water in three applications which recorded 6.73 per cent mean eriophyid mite infestation was the best treatment. The other treatments were also at par with this and were significantly better than control.

Similarly, monthwise eriophyid mite count indicated that the treatment Ecotin 50000ppm @ 7.5 ml + 7.5 ml of water in three applications recorded 8.44 mites /mm^2 area of the perianth and was the best treatment. Other treatments were also at par with this and were significantly better than control.

To validate the recommended package for the integrated management of eriophyid mite, a trial

was started with 100 palms each for treatment and control in a farmers' field at Malvan village of Sindhudurg district in 2005

Pre-treatment observations were recorded before giving root feeding treatment. The root feeding was given twice i.e. in the month of February 2005 and May 2005. Post treatment observations were also recorded. Simultaneous observations were also made on control plot .

Ent. 6 : Integrated management of red palm weevil in coconut

(Aliyarnagar, Ambajipeta, Ratnagiri)

Aliyarnagar

A. Surveillance of red palm weevil in Tamil Nadu

An intensive survey work has been undertaken on the level of infestation of redpalm weevil, in selected coconut gardens in twenty districts in Tamil Nadu. It was observed that among 20 districts surveyed, Pudukottai district has shown the highest per cent infestation of red palm weevil upto 6.76 followed by other districts viz., Thanjavur 6.05, Thiruvannamalai 5.95, Coimbatore 5.00 and Trichy 5.00. Remaining 15 districts have shown less than 4.00 per cent only.

B. Identification of hot spot areas of redpalm weevil in Tamil Nadu:

Hot spot areas of red palm weevil in 20 districts of Tamil Nadu were identified based on the percent infestation of red palm weevil on coconut palms. In most of the districts , the red palm weevil infestation was found to be less than 7 per cent only. However, in Coimbatore district, Pethanaickanur village of Anaimalai block has recorded significantly higher per cent infestation of red palm weevil upto 36 %.

In Villupuram district, Vallam block has recorded the maximum % infestation of redpalm weevil upto 40.00, followed by Melamalayanur (24.30), Gingee (12.60%).

IPM on red palm weevil

A total of three on farm trials on management of red palm weevil were laid out at Pathanaickanur, Nallur and Kaniyur.

(a) Chemical control trial for the management of red palm weevil in coconut

The following chemical treatments were imposed with 12 replications in CRD design.

T1 - Root feeding of Carbosulfan @10ml +10ml water

T2 - Root feeding of Azardiractin F5% WSC @10ml +10ml

T3 - Root feeding of Monocrotophos @10ml +10ml water as standard check

T4 - Control

Before the application of chemicals, pre treatment observations *viz*., total no of palms damaged by red weevil, no of palms dead, no of palms which need curative treatments and per cent incidence of red palm weevil were recorded in three locations (Table 53).

Table 53: Pre treatment observations in the on farm trials for red palm weevil management (Aliyarnagar, 2004)

Name of the location	Total number of palms	Total number of young palms	Number of palms damaged by pest	Number of palms dead	Number of palms needing curative treatment	% Incidence
Pethanaickanur	920	375	135	45	90	36.00
Nallur	1100	520	55	8	47	10.57
Kaniyur	980	450	75	25	50	16.67

(b) Studies on efficacy of pheromones on red palm weevil in coconut

The following two treatments of pheromone traps were installed in three locations *viz.*, Pethanaickanur, Nallur and Kaniyur.

T1 - Chemical pheromone lure (Chemtica) – Ferrolure

T2 - CPCRI Pheromone lure

No. of replications : 12 (traps).

Sugarcane molasses @2.5 litres per trap was used as food lure along with yeast 5gm + Furadon 2g. Food attractants were changed once in 15 days. Pheromone lures were tested for 6 months. Periodical observations on trapping of adult red palm weevils in each pheromone trap were recorded at regular intervals (fortnightly) (Table 54).

Table 54: Efficacy of pheromone lure for red palm weevil Management (from 1.10.04 to 31.03.05)-Aliyarnagar, 2004

Sl. No.	Location	Cumulative no.of red weevil trapped in Ferrolure	Cumulative no. of red weevil trapped in CPCRI lure
1.	Pethanaikanur	235	197
2.	Nallur	126	117
3	Kaniyur	53	34

Ambajipeta

i) Survey for hotspot areas of red weevil in coconut growing areas of the AP

Among the different villages surveyed in East Godavari, West Godavari and Visakhapatnam districts, the highest per cent of partial damage by red palm weevil was recorded in the village Pedapudi (27.8%) followed by Avidi (26.0%), where as highest incidence of dead palms was noticed in the village Mosalapalli (27.8%) followed by Avidi (11.5%) in East Godavari district.

ii) Chemical control trial for the management of red weevil in coconut

Among the three pesticides tested (through root feeding against red palm 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 80.0% recovery .

In the treatment carbosulfan@ 10 ml + 10 ml water, post treatment data revealed that, out of 9 palms, 5 palms recovered and 4 palms were found to be dead there by increasing the total number of dead palms to 13. Similarly in treatment Azadiractin 5% WSC @ 10 ml + 10 ml water also, out of 15 partially damaged palms, 11.67 palms recovered and total number of dead palms increased to 55.33 whereas in the treatment Monocrotophos @ 10 ml + 10 ml water, even though partially damaged palms increased from 85 to 90.33, there was no increase in dead palms which indicates the effectivity of the treatment in preventing the death of palms.

In control garden, an increase in both damage and death of the palms was recorded *i.e.*, of 7.67 and 13.00 palms respectively.

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

Studies on pheromone catches of red palm weevil revealed that, though not significantly, the Chem Tica lure caught more number of weevils (28.00/ trap) when compared to that of CPCRI lure (21.00/ trap) in a period of 6 weeks with an average catch of 4.67 weevils/trap/week. Number of weevils trapped/week was also more in Chem Tica lure in the respective weeks when compared to that of CPCRI lure. Maximum number of weevils were trapped in the 5th & 6th week after establishment in case of Chem Tica where as with CPCRI lure, it was

Studies on efficacy of pheromones on red weevil in coconut

in the 5th week. In case of Chem Tica, more number of female weevils were trapped (1:1.35) when compared to that of CPCRI lure.

Ratnagiri

A) Survey of red palm weevil to identify hotspots in coconut growing areas

A survey on the incidence of red palm weevil *Rhychophorrus ferrugineus* was conducted in all the four districts of the Konkan region to identify hot spot areas. The infestation of red palm weevil was graded as dead palms and newly infested palms during last five years. Benagi village of the Rajapur taluk was identified as hot spot area for conducting further trials.

B) Evaluation of different chemicals / botanicals for the control of red palm weevil of the coconut

To find out effective chemical / botanical for the control of red palm weevil, a trial with 6 treatments and 12 replications was started in a farmer's field. The root feeding of the treatments were given in the month of January 2005.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.

Re-infestation of the red palm weevil is being observed at monthly interval. The observations are in progress.

C. Evaluation of different pheromones on red palm weevil in coconut

To find an effective pheromone for red palm weevil, an experiment was started in 2004 in a farmer's field with 3 treatments and 12 replications in a RBD. Treatments were:

T_1 – Ferrolure + [Lure from Chemm Tica]

T_2 – ISCA lure [Lure from Booklands Exports]

T_3 – CPCRI lure

In each pheromone trap, food lure containing coconut logs + Yeast 25g + Furadan 2g in one litre of water was kept. Food lure was changed once in 7 days. Assessment of red palm weevil infestation in the experimental area was done before imposing the treatment. Number of red palm weevils attracted in each pheromone trap was counted to assess the efficacy of lure. The observations would be recorded upto six months.The lingering effect of the pheromone lure will be monitored during experimental period. The observations are in progress.

Front line Demonstrations

(Aliyarnagar, Ambajipeta, Ratnagiri)

Management of rhinoceros beetle

Aliyarnagar

The Frontline Demonstration Trial on the "Management of Coconut Rhinoceros Beetle" was initiated during September 2004 in coconut garden at NG Pudur village of Pollachi taluk in Coimbatore district. IPM treatments *viz.*, application of green Muscardine fungus in the manure pits, setting up of Aggregation pheromone viz., Rhinolure (5 traps/ 10 ha), release of artificially Baculovirus inoculated adult rhinoceros beetle @ 15h/ha, placement of perforated sachets containing neem seed kernel powder @ 2 sachets/per palm were imposed. Before imposing the treatments, pre treatment observations viz., total number of palm, number of palms showing leaf damage, spindle damage, spathe damage, percent infestation by rhinoceros

beetle, % of spathe and spindle damage were recorded. The experimental trial is in progress.

Ratnagiri

Demonstrations are in progress at Ratnagiri and Thane districts with all the recommended IPM package .

Management of leaf eating caterpillar

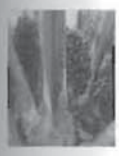
Aliyarnagar

The FLD trial on the "Management of coconut black headed caterpillar"was initiated during May – June 2004 in coconut gardens (10 ha area) at Manakadavu village of Dharapuram taluk in Erode district. The viable IPM treatments *viz.*, root feeding of monocrotophos @ 10 ml + 10 ml water to all the palms in experimental area (for only once), 28 days after chemical treatment, augmentative release of two larval parasitoids viz., *Braconid, Bracon brevicornis*, Bethylid *Goniozus nephantidis* and pupal parasitoid chalcid, *Brachymeria nosatoi* @ 20:10:1/ palm was made. Release of larval and pupal parasitoids was made for six times at monthly intervals.

Recording pre treatment and post treatment observations on total number of palms, number of palms damaged by black headed caterpillar, per cent incidence, estimated pest population / tree, (before and after treatments), reduction in pest population, population build up of parasitoids are in progress.

Ratnagiri

Demonstrations are in progress at Ratnagiri and Thane districts with the recommended IPM package.



OIL PALM
2.1 Crop Improvement

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

(Aduthurai, Gangavathy, Mulde, Vijayarai)

Aduthurai

As per the recommendations by the XVI[th] Biennial workshop on AICRIP (Palms), a new trial was initiated in a farmers' holding with 10 hybrids (promising combinations) obtained from NRC for Oil Palm Research Centre, Palode. They were sown in poly bags on 14.10.2004. Observations on growth characters were recorded. The mean growth parameters revealed that the seedling height was higher (38 . 4 cm) in 21 x 214 hybrid followed by 25 x 66 and 28 x 368 hybrids recording 37.6 cm of seedling height. Pertinent to number of leaves, it was more (6.6) in 28 x 368 followed by 25 x 66, 131 x 66 and 21 x 214 recording 6.2, 6.0 and 5.8 number of leaves. There was no mortality of seedlings and there was 100% survival among the hybrids except in two hybrids (25 x 66 and 350 x 66) where one seedling in each died.

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 contributing characters and yield are presented in Table 55. The differences between hybrids were found significant for number of bunches/palm, mean bunch weight, FFB yield (2003-04) and cumulative FFB yield (1998-99 to 2003-04).

Table 55: Yield performance of different hybrid combinations of oil palm (Gangavathy, 2004)

Hybrid combination	Bunches/palm	Mean bunch wt (kg)	FFB yield (t/ha)	Cumulative FFB yield (t/ha)1998-99 to 2003-04
18 D x 32 P	4.89	8.62	5.97	28.81
35 D x 291 P	4.97	9.34	5.88	26.87
65 D x 111 P	5.14	7.84	5.69	28.23
82 D x 266 P	4.67	7.75	5.16	34.64
14 D x 98 P	1.07	12.81	1.95	26.32
109 D x 291 P	4.78	9.28	6.23	41.27
115 D x 291 P	3.75	8.51	4.41	33.14
124 D x 266 P	4.28	7.98	4.90	28.84
128 D x 291 P	2.08	11.88	4.92	29.29
148 D x 98 P	4.74	7.80	5.06	38.50
220 D x 98 P	3.78	7.33	4.08	28.11
SE m ±	0.42	0.68	0.54	1.97
CD(P=0.05)	1.23	2.72	1.59	5.82

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 are presented in Table 56.

The data indicated that the hybrids did not show significant difference for yield attributes and yield. However, hybrid combination 18 D X 32 P recorded maximum FFB yield of 121.61 kg/palm/year (17.39 t/ha) while combination 115 D X 291 P recorded maximum bunch weight i.e. 22.16 kg/bunch. Maximum number of bunches was produced by 104 D X 98 P combination.

Vijayarai

The experiment was laid out with 11 tenera hybrids in 1992 in a RBD with three replications. The data(Table 57) indicated that maximum number of bunches was recorded in 115 D x 291 P (7.3). But, maximum bunch weight was recorded in cross combination 18 D x 32 P (17.3 kg) and the lowest was recorded in 65 D x 111 P (13.6 kg). Maximum FFB yield was obtained in cross combination of 115 D x 291 P (113 kg/palm) which comes to 13.9 t/ha, and the lowest yield was recorded in 82D x 291 P (57.9 kg/palm) which comes to 7.1 t/ha. The cumulative mean yield recorded for the past nine years from 1995-2004 revealed that the cross combination of 104 D x 98 P recorded maximum yield of 7.8 t/ha followed by 148 D X 98 P (7.6 t/ha). Lowest yield was recorded in the cross combination of 65 D x 111 P (5.2 t/ha). The cross combination 104 D x 98 P and 148 D x 98 P recorded 150 and 146% increase in yield respectively over 65Dx 11 P.

Table 56 : Yield of different tenera hybrids(Mulde, 2004)

Sl. No.	Hybrid	Bunches/ palm	Wt. of bunch (kg/bunch)	Yield of FFB (kg/palm)	Yield of FFB (t/ha)
1.	115 D x 291 P	4.84	22.16	107.58	15.38
2.	104 D x 98 P	7.05	16.60	117.80	16.85
3.	109 D x 291 P	5.38	19.77	108.15	15.47
4.	124 D x 266 P	5.83	16.95	98.03	14.02
5.	220 D x 98 P	5.25	16.57	84.64	11.85
6.	65 D x 111 P	6.04	18.30	109.43	15.65
7.	35 D x 291 P	5.29	18.51	98.57	14.10
8.	82 D x 226 P	5.58	19.21	108.04	15.45
9.	148 D x 98 P	4.63	19.42	92.98	13.30
10.	18 D x 32P	6.25	19.32	121.61	17.39
11.	128 D x 291P	6.63	16.52	108.47	15.51
	SE ±	0.67	1.80	15.20	2.17
	CD(P=0.05)	NS	NS	NS	NS

Table 57 : Yield of oil palm in different cross combinations (Vijayarai, 2004)

Sl.No	Hybrid	Number of bunches/palm	Mean bunch weight (kg)	FFB Yield (2003-04)	
				kg/palm	t/ha
1	128Dx291P	5.8	12.7	74.1	9.2
2	124Dx266P	4.7	15.0	71.1	8.8
3	18Dx32P	4.9	17.3	85.6	10.5
4	35Dx291P	6.5	14.0	90.4	11.2
5	65Dx111P	6.2	13.6	83.9	10.4
6	104Dx98P	5.0	14.9	75.8	9.3
7	82Dx266P	4.3	13.6	57.9	7.1
8	109Dx291P	5.9	14.2	83.8	10.3
9	115Dx291P	7.3	15.6	112.9	13.9
10	148Dx98P	5.5	15.2	84.1	10.4
11	220Dx98P	4.1	15.3	62.3	7.7
	CD(P=0.05)	1.4	2.3	8.3	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 at the centre. The experiment was planted during October 1998 in a RBD with three replications. The results for growth parameters, physiological parameters and yield are presented in Table 58. For growth characters like height, girth and annual leaf production, the genotypic difference was not significant. Out of the two

Table 58 : Growth, physiological parameters and yield of genotypes for drought tolerance(Gangavathi, 2004)

Genotypes	Palm height(m)	Annual leaf production	Relative water content(%)	Electrolyte leaching (% of final conductivity)	Bunches/ palm	FFB yield (t/ha)
ZS-1	5.55	30.4	94.2	12.5	2.15	0.66
ZS-3	5.80	31.6	96.0	20.0	3.14	1.04
ZS-5	5.32	29.5	95.6	13.0	3.36	1.26
ZS-8	5.27	30.3	95.2	13.2	1.98	0.58
ZS-6	5.10	28.4	92.6	14.1	3.78	1.29
ZS-9	4.38	28.3	95.3	11.9	3.53	1.10
TS-4	4.87	29.3	96.0	12.2	3.06	1.45
TS-5	4.94	29.4	92.7	17.3	2.57	0.78
TS-7	4.44	25.2	93.8	12.4	2.75	0.73
SEm±	0.31	1.32	0.96	1.2	0.60	0.17
CD(P=0.05)	NS	NS	NS	3.65	NS	0.53

physiological parameters considered, for relative water content, the drought tolerant genotypes did not differ among themselves; but the Electrolyte leaching, other wise called the leakage expressed as the per cent of final conductivity differed significantly among genotypes. The leakage was significantly lower in case of ZS-9 (11.93%) followed by TS-4 (12.18%). It was significantly higher in case of the genotype ZS-3 (20.0%). The FFB yield during 2003-04 was significantly higher in the case of TS-4 (1.45 t/ha) as compared to other genotypes and it was on par with ZS-6 (1.29 t/ha), ZS-9 (1.1 t/ha), ZS-5((1.26 t/ha) and ZS-3 (1.04 t/ha).

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. They were planted at a spacing of 9m x 9m in a RBD with three replications. Data on height, girth and number of leaves/palm did not show significant difference between genotypes. Data on inflorescences produced and yield are presented in Table 59. It is seen from the data that the production of male and productive inflorescences differed significantly among the different genotypes. Genotype G.B. 25/314 produced significantly higher productive inflorescences (4.6) than other genotypes. This genotype produced the lowest number of male inflorescences(3.8). Genotype G.B. 21/310 and TS 5 produced least number of productive inflorescences (0.1). The data regarding yield attributes revealed that the average number of FFB produced in different genotypes only showed significant differences. Maximum number of bunches were produced in genotype G.B. 25/314 i.e. 7.39 and lowest (0.17) in genotype TS-5. Though there was no significant difference in FFB yield among the genotypes, G.B. 25/314 (V_1) recorded maximum yield(4.24 kg/palm). Average weight of FFB was more in genotype TS- 4 (2.44 kg/bunch).

Table 59 : Flowering behaviour and yield of drought tolerant genotypes (Mulde, 2004)

Sl. No.	Genotypes	No. of male inflorescences	No. of productive inflorescences	No. of FFB/ palm/year	Wt. of bunch (kg)	Yield of FFB/ palm(kg)
1.	G.B. 25/314	3.8	4.6	7.39	0.54	4.24
2.	G.B. 22/311	9.0	1.2	1.89	0.57	0.98
3.	G.B. 21/310	10.8	0.1	2.11	0.31	0.99
4.	ZS -1	9.8	0.6	0.67	0.98	0.85
5.	ZS-2	7.3	1.3	2.45	0.1	2.67
6.	ZS- 3	8.0	0.8	1.50	0.86	1.46
7.	ZS- 5	8.2	0.5	1.17	1.13	1.35
8.	ZS- 6	7.8	1.3	0.83	0.93	0.94
9.	ZS- 9	7.2	0.3	1.33	1.02	1.50
10.	TS- 2	8.2	0.5	0.83	0.54	0.65
11.	ZS-8	9.5	2.1	1.05	1.29	2.30
12.	TS -4	8.9	1.1	0.90	2.44	1.00
13.	TS- 5	9.4	0.1	0.17	0.55	0.28
14.	TS-7 (Control)	8.6	1.9	1.89	0.59	2.04
15.	TS-8	8.3	0.8	0.56	1.80	0.79
16.	TS- 9	7.7	0.6	0.33	0.39	0.19
17.	TS- 10	9.7	0.8	0.55	1.75	1.17
18.	TS -11	5.7	0.6	0.61	1.45	1.15
	SE±	0.97	0.6	0.72	0.57	0.93
	CD(P=0.05)	2.8	1.8	2.06	N.S.	N.S.

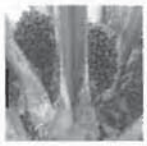
Gen. 8B : Studies on the performance of exotic and indigenous Tenera hybrids of oil palm

(Vijayarai)

The trial was conducted to study the performance of Tenera planting materials received from four sources. During the year, maximum number of bunches were recorded in IRHO (4.1) while maximum bunch weight was recorded in Costa Rica with 14.9 kg (Table 60). The FFB yield was recorded maximum in IRHO with 56.4 kg/palm (7 t/ha.). The cumulative yield of 6 years (1998 to 2004) revealed that Costa Rica recorded 6 t/ha followed by IRHO 5.8 t/ha.

Table 60 : FFB yield of oil palm in different sources of planting materials (Vijayarai, 2004)

Source of planting material	No.of bunches/ palm	Bunch weight (kg)	FFB yield kg/palm	FFB yield (t/ha)	Mean FFB yield for the last 6 years(t/ha)
Papua New Guinea	3.3	12.6	40.9	5.0	5.7
IRHO	4.1	13.7	56.4	7.0	5.8
Costa Rica	3.6	14.9	52.9	6.5	6.0
Palode	3.9	13.4	52.8	6.5	5.3



OIL PALM
2.2 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 four centres in a Strip plot design with three levels of irrigation as one set of strips and four levels of fertilisers 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. Irrigation methods were found to influence the growth parameters viz., collar girth and number of leaves/palm/year significantly. Basin irrigation (I_1) resulted in higher collar girth (2.9 m) and more number of leaves/palm/year (15.8). Palms under no irrigation (I_0) had lower collar girth (2.6 m) and lesser number of leaves/palm/year (13.8). Levels of fertilizer application had also significant effect. Increased application of fertilizer @ 1200:600:2700 g NPK/palm/year (F_3)resulted higher collar girth of 2.9 m. Palms raised without fertilizer application (F_0) registered lesser collar girth (2.6 m). Average number of leaves/palm/year was found less (14.1) at F_0 level and increased when fertilizer levels increased and was significantly higher (15.6 leaves/palm/year) at F_3 level (1200:600:2700 g NPK/palm/year).

Method of irrigation had favourable effect on the yield attributes. Basin irrigation (I_1) resulted in highest number of female inflorescences (8.3), higher number of bunches (6.6) and higher bunch weight (16.7 kg) followed by drip irrigation (I_2) with 7.0 female inflorescences, 6.0 bunches and 15.9 kg bunch weight. Palms raised without irrigation (I_0) produced least number of female inflorescences (5.8), less bunches (4.8) with least bunch weight of 10.9 kg. Basin method of irrigation resulted in lower number of male inflorescences (3.1) while no irrigation recorded higher number of male inflorescences (4.8).

Fertilizer levels imparted significant variations on number of inflorescences, number of bunches and bunch weight. There was significant gradual increase in yield attributing characters of oil palm except number of male inflorescences/palm/year for each successive increase in the levels of N, P and K application. NPK fertilizers at 1200:600:2700 (F_3) possessed the higher number of female inflorescences (8.1), number of bunches (6.7) and bunch weight (17.6 kg) compared with lower doses (F_0, F_1 and F_2). Increased levels of NPK fertilizers resulted in gradual decrease in number of male inflorescences and at F_3 (1200:600:2700 g NPK/palm/year), it was 3.5/palm/year.

The data on FFB yield (t/ha/year) presented in Table 61 revealed that both irrigation methods and fertilizer levels had significant influence. The palms irrigated by basin method (I_1) produced the highest fresh fruit bunch yield of 13.4 t/ha/year followed by the palms irrigated by drip method (I_2) with an yield of 11.3 t/ha/year. The enhancement in the FFB yields were 52.3 and 28.4 per cent over the

palms without irrigation (8.8 t/ha/year).

The palms receiving a fertilizer dose of 1200:600:2700 g NPK/palm/year (F_3) produced higher FFB yields (14.4 t/ha/year) followed by F_2-800:400:1800 g NPK/palm/year (12.1 t/ha/year) and F_1-400:200:900 g NPK/palm/year (9.7 t/ha/year) and the lowest FFB yield was in palms raised without any fertilizer (F_0) (8.4 t/ha/year). The increased FFB yields in F_3, F_2 and F_1 were 71.4, 44.0 and 15.5 % over F_0-without fertilizer (8.4 t/ha/year).

The interaction between irrigation methods and fertilizers levels was also found significant. A combination of basin method of irrigation (I_1) with 1200:600:2700 g NPK/palm/year (F_3) registered highest FFB yield (17.6 t/ha/year).

Table 61 : Influence of irrigation methods and level of fertilizers on FFB yield (t/ha/year)-Aduthurai 2004

Irrigation/ Fertilizer	F_0	F_1	F_2	F_3	I Mean
I_0	7.1	7.7	9.2	11.2	8.8
I_1	9.5	11.5	14.8	17.6	13.4
I_2	8.5	10.0	12.4	14.4	11.3
F Mean	8.4	9.7	12.1	14.4	

	SEd	CD (5%)
I	0.25	0.72
F	0.19	0.39
I at F	0.38	0.86
F at I	0.34	0.72

Gangavathy

The experiment was laid out in 1988. Data related to yield parameters and water use efficiency were recorded. Effect of irrigation was not found significant (probably due to overall irrigation water deficit in the experimental farm due to severe drought) for bunches/palm, bunch weight and water use efficiency. Effect of fertilizer was however found significant for all these parameters. F_0 was found to record significantly lower values than other fertliser levels for bunches/palm and water use efficiency. For mean bunch weight, though F_0 recorded the lowest value, it was found to be on par with F_2 level of fertilizer(800:400:1800 g N: P_2O_5 : K_2O/palm/year) . Significant interaction was not noticed for these parameters.

For FFB yield(2003-04) as well as cumulative FFB yield for the last 5 years also, it was seen that the differences due to irrigation treatments was not significant but differences due to fertliser levels was significant. Interaction between irrigation and fertiliser was not found significant for FFB yield (2003-04) but significant for cumulative FFB yield. It was seen that I_2F_3 combination recorded the highest cumulative yield of 51.44 t/ha which is significantly higher than all other combinations except I_2F_2.

Leaf nutrient analysis

The data on nutrient composition of 17th frond indicated that the differences due to irrigation treatments was significant for only leaf N and leaf Ca. It was seen that no irrigation treatment recorded the highest leaf N and Ca. The different fertilizer levels did not have significant effect on any of the leaf nutrients analysed. In the case of leaf K, the interaction between irrigation and fertilizer was significant. The combination I_2F_3 was found to record significantly higher leaf K than all other combinations except I_0F_1 and I_1F_1.

Mulde

The experiment was started in the year 1989. The data regarding number of bunches per palm, average weight of bunch (kg) and average yield of fresh fruit bunches (FFB kg/palm) for the period July 2003 to June 2004 is given in Table 62.

Irrigation had significant effect on bunch weight and yield of FFB. Basin irrigation (I_1) and drip irrigation (I_2) were significantly superior over I_0 (control) but were at par with each other. The drip irrigation (I_2) recorded maximum bunch weight (21.26 kg) and FFB yield (110.85 kg per palm per year) and yield of FFB per hectare (15.84 t/ha).

Fertilizer levels also significantly affected average number of bunches and yield of FFB. Present study revealed that number of bunches and FFB yield

Table 62 : Effect of fertilizer levels under different methods of irrigation on yield parameters and yield (Mulde, 2004)

Treatments		Number of bunches/palm	Weight of bunch (kg)	Yield of FFB (kg/ palm/year)	Yield of FFB (t/ha)
Irrigation	I_0	3.75	16.44	64.46	9.22
	I_1	4.90	20.30	101.59	14.53
	I_2	5.14	21.26	110.85	15.84
	SE ±	0.41	0.79	9.04	1.29
	CD (P=0.05)	NS	3.08	35.48	5.07
Fertilizers	F_0	3.31	16.55	56.50	8.01
	F_1	4.26	18.72	79.12	11.31
	F_2	4.51	20.51	95.96	13.70
	F_3	6.31	21.53	137.62	19.68
	SE ±	0.34	1.28	5.67	0.82
	CD (P=0.05)	1.16	NS	19.63	2.83
Interaction	I_0F_0	2.32	13.77	34.02	4.86
	I_0F_1	4.17	16.80	68.20	9.75
	I_0F_2	3.40	17.27	64.15	9.17
	I_0F_3	5.11	17.92	91.45	13.08
	I_1F_0	3.90	16.10	63.81	9.13
	I_1F_1	4.77	20.07	95.32	13.63
	I_1F_2	3.96	21.68	85.15	12.19
	I_1F_3	6.99	23.34	162.09	23.18
	I_2F_0	3.72	19.78	71.68	10.25
	I_2F_1	3.83	19.31	73.85	10.56
	I_2F_2	6.17	22.59	138.57	19.75
	I_2F_3	6.83	23.35	159.31	22.78
	SE ±	0.6	1.7	12.4	1.7
	CD (P=0.05)	NS	NS	NS	NS

increased with the increase in levels of fertilizers and it was significantly higher at F_3 levels. F_3 level recorded significantly more number of bunches (6.31) and highest FFB yield i.e. 137.62 kg per palm that comes to 19.68 t/ha followed by F_2 level.

Interaction between fertilizer levels and irrigation was not significant for any of the characters under study. However, I_1F_3 recorded more number of bunches(6.99) and FFB yield i.e. 162.09 kg /palm / year (23.34 t/ha) followed by I_2F_3 i.e. 6.83 number of bunches and 159.31 kg /palm /year FFB yield (22.78 t/ha) I_2F_3 also recorded maximum bunch weight 23.35 kg /bunch.

It is thus seen from the data that I_1F_3 and I_2F_3 exhibited better performance in respect of yield attributes.

Vijayarai

The experiment was started in 1988. The yield data of 2003-04 (Table 63) revealed that the difference due to irrigation, fertilizer levels and their interaction was significant. It was seen that I_1F_3 combination gave significantly higher yield(159.1 kg/palm) than all other combinations except I_1F_2(143.2 kg/palm). As regards the number of bunches/palm and mean bunch weight, response for fertiliser or irrigation was not found significant. There was no evidence of their interaction also.

Table 63 : Effect of irrigation and fertilizers on yield of oil palm(Vijayarai, 2004).

Treatment	Number of bunches/palm	Bunch weight(kg)	FFB yield (kg/palm)	FFB yield (t/ha)	Mean cumulative FFB yield(t/ha) 1992-93 to 2003-04
Fertilizers					
F_0	3.8	19.9	81.1	10.0	6.5
F_1	4.1	19.2	93.1	11.5	8.2
F_2	4.7	20.5	108.7	13.4	9.7
F_3	5.0	20.1	118	14.5	11.9
CD(P=0.05)	N.S	N.S	12.6	1.5	-
Irrigation					
I_0	3.7	18.9	74.7	9.2	6.2
I_1	5.1	20.7	122.4	15.1	11.1
I_2	4.5	20.2	103.6	12.8	9.9
CD(P=0.05)	N.S	N.S	13.3	1.6	-
I_0F_0	3.8	19.8	76.7	9.5	4.7
I_0F_1	3.4	18.9	74.4	9.2	5.5
I_0F_2	3.7	18.4	75.9	9.4	6.4
I_0F_3	3.8	18.5	71.6	8.8	8.3
I_1F_0	4.1	19.7	86.7	10.7	7.9
I_1F_1	4.2	19.3	100.2	12.4	9.8
I_1F_2	5.8	22.2	143.2	17.7	12.2
I_1F_3	6.2	21.7	159.6	19.7	14.6
I_2F_0	3.4	20.3	80.0	9.9	6.9
I_2F_1	4.7	19.4	104.7	12.9	9.2
I_2F_2	4.7	20.9	106.9	13.2	10.6
I_2F_3	5	20.1	122.7	15.1	12.8
CD(P=0.05)	N.S	N.S	22.9	-	-

The cumulative mean yield data of 12 years (1992-2004) indicated that there was response to both irrigation and fertilizer levels. Basin irrigation recorded maximum FFB yield (11.1 t/ha) which works out to 179% increase in yield over no irrigation treatment. The fertilizer treatments F_1, F_2 and F_3 have recorded 126%, 149% and 183% increase in yield respectively over no fertilizer level. From the interaction table, it is seen that basin irrigation (I_1) with F_3 level of fertilizer recorded highest FFB yield / year (14.6 t/ha).

Front Line Demonstrations on nutrient and irrigation management in oil palm

(Aduthurai, Mulde)

Aduthurai

Four FLD plots to demonstrate nutrient and irrigation management in oil palm were initiated representing old and new delta areas of the Cavery Delta zone. The imposition of treatments is in progress.

Mulde

Two plots have been selected for the trial. Pre treatment soil samples have been collected from both the FLD plots and required quantity of fertilizers as per the recommended dose was provided as an input.

PALMYRAH
3.1. Crop Improvement

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

(Killikulam, Pandirimamidi)

Killikulam

A total number of 173 germplasm types were collected and maintained in the germplasm bank in different blocks. A joint survey of palmyrah growing areas of Srivaikundam, Pudukottai, Rameswaram, Ramanathapuram and Tiruchendur taluks in Thoothukudi and Ramanathapuram districts was done during October 11-14, 2004.

Palmyrah groves in salt affected coastal area in Thoothukudi district

The survey was done in East coast area of Tamil Nadu which comprised of salt affected and problem soils. A total of 14 accessions were collected. Observations were recorded from the 14 accessions (Table 64). The mean weight of fruit ranged from 320 to 1810g. The accession TN10-04 collected from Kunjaravalasai of Mandapam block of Ramanathapuram district showed superiority over other accessions expressing higher weight of fruit (1810 g) and seed (372 g) and higher value for other characters recorded. The tree is also dwarf and fruits are black in colour.

Observations were also recorded on the existing 159 accessions of palmyrah. In block-I (1995), the maximum height was continuously recorded by ACC 022 (132.2) and maximum number of leaves by ACC 018 (13.4). ACC 034 recorded minimum tree height (54.25) and lowest number of leaves was recorded in ACC 033.

In block-II (1997), the accession ACC 065 and ACC 066 recorded maximum plant height 231.4, 212.4 cm respectively and 21.2 leaves each.

In block-III (1999), ACC 088 recorded maximum plant height 6.0 cm and 7.25 leaves. This accession performed well.

In block-IV (2001), ACC 099 recorded maximum plant height (129.3 cm) and ACC 104 the maximum number of leaves (10.00).

In block-V (2002), among the accessions from Nalgonda of Andhra Pradesh and Thoothukudi districts of Tamil Nadu, ACC 136 recorded 65.0 cm plant height and ACC 121 recorded 7.2 leaves.

Promising accession from Tamil Nadu

Table 64: Fruit characters(average of five fruits) of palmyrah(Killikulam, 2004)

Accession No.	Fruit weight (g)	Flesh weight (g)	Single seed weight (g)	No. of seeds per fruit	Weight of perianth lobe (g)
TN 01	918	126.3	224.50	3	118.0
TN 02	1112	88.3	272.50	3	207.0
TN 03	640	135.0	166.00	2	173.0
TN 04	608	55.3	129.30	3	165.1
TN 05	1220	182.0	210.60	4	195.6
TN 06	576	128.7	176.20	2	94.9
TN 07	1958	605.0	398.30	3	158.1
TN 08	1176	292.2	318.80	2	246.2
TN 09	690	186.5	207.50	2	88.5
TN 10	1610	368.2	369.10	3	134.5
TN 11	320	32.0	59.33	3	110.0
TN 12	540	48.6	113.33	3	151.4
TN 13	404	62.0	129.00	2	84.0
TN 14	368	148.0	134.00	1	86.0

In block-VI (2003), among the accessions collected from West Godavari district of Andhra Pradesh, ACC 152 recorded maximum plant height of 35 cm and ACC 150 recorded 2.8 leaves.

The neera yield was recorded from the existing grown up palmyrah palms available in Killikulam Centre Farm. The palm F34 continued to yield well, recording 135.5 litres of sweet sap (Neera). This palm was found to record higher yield consistently over the years (Table 65).

Palmyrah leaf products

Pandirimamidi

A total of 176 accessions have been collected and maintained since the inception of the project. The accessions were planted at 3x3 m spacing in single rows using 12 stones per accession. The accessions are being evaluated regularly for the parameters such as plant height, stem girth, number of leaves, lamina length, lamina breadth and petiole length.

Data presented in Table 66 showed that, in the germplasm planted during 1991, mean plant height

Table 65 : Neera yield from existing Palmyrah trees (Killikulam, 2004)

Sl. No.	Tree No.	Tapping duration (days)	Neera yield (litres)
1.	E1	9	4.5
2.	E6	43	67.0
3.	F1	17	14.5
4.	F4	50	32.0
5.	F6	17	17.0
6.	F16	63	70.5
7.	F23	40	77.5
8.	F34	45	135.5
9.	F36	71	126.0

Table 66 : Performance of the accessions planted during 1991 (Pandirimamidi, 2004)

Acc No	Plant height (m)	Stem girth (m)	No. of leaves	Lamina length (m)	Lamina breadth (m)	Petiole length (m)
Acc-1/91	6.75	1.77	14.6	0.94	1.39	1.27
Acc-2/91	5.98	1.53	13.6	0.84	1.25	1.11
Acc-3/91	6.00	1.50	14.4	0.87	1.2	1.10
Acc-4/91	6.54	1.82	15.0	0.94	1.33	1.11
Acc-5/91	5.31	1.53	13.8	0.89	1.26	1.09
Acc-6/91	6.89	1.73	14.6	0.94	1.35	1.25
Acc-7/91	5.62	1.52	15.8	0.97	1.36	1.19
Acc-8/91	6.10	1.60	14.0	0.96	1.27	1.25
Acc-9/91	6.23	1.62	13.0	0.92	1.06	1.11
Acc-10/91	4.99	1.58	14.6	0.78	1.06	1.09
Acc-11/91	4.39	1.36	14.0	0.84	1.19	1.10
Acc-12/91	6.03	1.66	16.2	0.94	1.31	1.01
Acc-13/91	5.06	1.64	14.6	0.88	1.17	1.09

was maximum in the accession-6/91[6.89 m] followed by the accession-1/91 [6.75 m]. Mean stem girth, lamina breadth and length of petiole were also found maximum with the accession-1/91 (1.77, 1.39 and 1.27 m respectively). Mean number of leaves produced ranged from 13.0 to 16.2 among the accessions. During the year, flowering (for the first time) was observed in the germplasm block of 1991. Particulars on the inflorescence production have been recorded. Tapping was initiated on the palms, but as it was the first year of flowering, neera out flow was very poor and negligible.

During the year 2004, a joint survey and collection of germplasm was taken up in the month of October in Tamil Nadu state. A total of 14 accessions were collected from different places of the two districts. Among the 14 accessions that had differences for the plant characters under study, accession TN-7/04 had medium sized fruits which were slightly curved inwards and these fruits mostly had single seed inside. Likewise in accession TN-10/04, most of the fruits were two seeded in the bunch and many of these seeds have aborted endosperm.

Fruit of accession TN-7/04

Fruit of TN-10/04 accession

PALMYRAH
3.2.1 Crop Protection - Diseases

Path. 6 Survey and control of diseases in palmyrah

(Killikulam, Pandirimamidi)

Killikulam

The disease survey covered the palmyrah groves in Thoothukudi and Tirunelveli districts. Survey on leaf spot, leaf blight and bud rot was carried out. Disease severity was recorded in the scale of 1-9 for leaf spot and leaf blight diseases. For bud rot disease, percent disease incidence was calculated. During the period of report, leaf blight was noticed in ten places, viz., Vallanadu, Vuvari, Anthoniarpuram, Servaikaranmadam, Manakarai, Athur, 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 67).

Lesions of leaf blight were 2.0 to 3.5 cm in length, 1.0 cm in width, with brown margins and pale centers. The causal agent was *Pestalotia palmarum*, an imperfect fungi produced five celled conidia at all isolates. The central three cells are dark while the end cells are hyaline with the terminal cell bearing appendages.

Leaf spot disease was recorded at four places with PDI ranging from 6.00 to 25.00. The disease severity on seedlings was the highest at Kalanthapanai. 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 which are brown, slightly curved with 7-10 septa.

An experiment was laid out on the eco- friendly management of nursery diseases of palmyrah with the following treatments.

1. Soaking of palmyrah seed in *Trichoderma viride* –cf
2. Soaking of palmyrah seed in *Pseudomonas fluorescens*
3. Soaking of palmyrah seed in *Bacillus subtilis*

Table 67 : Disease status in palmyrah palms(Killikulam, 2004)

Place	Soil type	Grove/ Bunds	Age	Leaf blight *	Leaf spot *	Budrot **
Vallanadu	Loam	Bunds	10-50	18.0	12.0	2.0
Vuvari	Loam	Bunds	10-40	9.0	-	-
Anthoniarpuram	Sandy loam	Bunds	10-60	18.0	-	9.0
Servaikaranmadam	Loam	Grove	10-45	32.0	6.0	-
Manakarai	Loam	Bunds	15-40	15.0	-	8.0
Athur	Sandy	Grove	10-60	21.0	-	-
Srivaikundam	Sandy loam	Bunds	10-70	3.0	-	-
Kalanthapanai	Sandy loam	Bunds	40-60	4.5	25.0	-
Nanguneri	Sandy loam	Grove	10-50	12.0	-	-
Tharuvai	Loam	Grove	4-70	32.0	8.0	3.0

* Per cent Disease Index(PDI) ** Per cent Disease Incidence

4. Soil application of *Trichoderma viride* –10g/ bed
5. Soil application of *Pseudomonas fluorescens* -10g/bed
6. Soil application of *Bacillus subtilis* -10g/bed
7. Soil application of neem cake-20g
8. Soaking of palmyrah seed in carbendazim-0.1%
9. Control

Results indicated that soaking seed nut with carbendazim (0.1%) was significantly better in controlling the tuber rot than all the other treatments (Table 68).

Carbendazim (0.1%) soaking also increased the germination and tuber weight considerably and also enhanced seed nut germination in palmyrah. However, the use of chemical fungicide is being discouraged because the tuber is edible. The treatment on soaking in *T.viride* recorded 16.66 percent of tuber rot disease. In the control plots, the disease incidence was 46.66. Besides reducing the tuber rot incidence, this treatment also enhanced the germination and weight of tubers.

Table 68 : Management of tuber rot disease in palmyrah(Killikulam, 2004)

Sl. No.	Treatment	Germination %	Tuber rot (%)	Tuber weight(g)
1.	Soaking in *Trichoderma viride*(1%talc)	79	30.00	94
2.	Soaking in *Pseudomonas fluorescens*(1%talc)	77	33.33	89
3.	Soaking in *Bacillus subtilis*(1%talc)	75	33.33	90
4.	Soil application of *Trichoderma viride*	83	16.66	102
5.	Soil application of *Pseudomonas fluorescens*	81	20.00	96
6.	Soil application of *Bacillus subtilis*	75	23.33	94
7.	Soaking in *Trichoderma viride*(1%talc) with soil application of neem cake	76	16.66	99
8.	Soaking in carbendazim (0.1%)	84	13.33	106
9.	Control	62	46.66	88
	CD(P=0.05)	3.7	5.4	4.2

PALMYRAH
3.2.2 Crop Protection - Pests

Ent. 4 : Monitoring the pests of palmyrah

(Killikulam, Pandirimamidi)

Killikulam

Infestation of *Oryctes rhinoceros* and *Opisina arenosella* was noticed in the palmyrah groves surveyed. Infestation of *Oryctes rhinoceros* was observed in four groves surveyed with a maximum of 12.00% at Nanguneri. The incidence ranged from 3.00 to 12.00 per cent. Occurrence of leaf feeding caterpillar ranged from 3.00 to 9.00 per cent. Maximum incidence of leaf feeding caterpillar was observed at Manakarai and Srivaigundam where the incidence was 9.00 percent.

Pandirimamidi

Among various pests attacking the palmyrah palm, red palm weevil was found more damaging followed by rhinoceros.During the year 2003, severe incidence of red palm weevil was noticed. The percentage of palms attacked was 39 % of which 8 % of palms were completely damaged. The pest was found severe between January and April which normally coincides with the tapping periods.

During the year 2004, incidence of rhinoceros was observed on the germplasm blocks of 1991, 1993,1994,1995,1998 and 1999. More incidence of the pest was observed in 1991 block followed by 1993 and 1998 blocks. The percentage of incidence varied from 5 to 15%. Root feeding with monocrotophos at 10ml : 10ml could control the pest effectively.

History, Objectives and Growth of the Project

History

The All India Co-ordinated Coconut and Arecanut Improvement Project was sanctioned in the year 1970 by the Indian Council of Agricultural Research and the project started functioning in 1972. The time line of the Project over the years is presented here under:

Scenario analysis

Coconut, oil palm and palmyrah occupy a predominant place in the rural economy. Further they play an important role in the sustainability of the fragile eco system in island and coastal regions. More than 20 million people in rural areas are engaged in the production, processing and

1970	All India Coordinated Coconut and Arecanut Improvement Project was sanctioned by the ICAR
1972	The Project started functioning
1975	Five more centres added
1977	Konark Centre (OUAT) added
1980	Experiments in Konark shifted to Patha Farm
1980	Mondouri (BCKV) Centre in West Bengal added
1982	Kahikuchi Centre (AAU) in Assam sanctioned under VI Plan
1985	Kahikuchi centre started functioning
1987	Jalalgarh Centre in Bihar was recommended for closure in the VII Biennial Workshop.
1988	Razole centre merged with Ambajipeta centre
1990	Four oil palm centres at Vijayarai (Andhra Pradesh), Mulde (Maharashtra), Gangavathy (Karnataka) and Aduthurai (Tamil Nadu) added
1990	Pilicode, Mahuva and Dapoli centres were closed during VII Plan. Coimbatore - coconut programmes shifted to Aliyarnagar
1990	Arecanut centre at Coimbatore closed
1990	Two centres on coconut, one each for Bihar and Madhya Pradesh were sanctioned
1990	The project was renamed as All India Coordinated Research Project on Palms
1991	Arecanut centre at Andamans closed
1991	Two centres for Palmyrah research sanctioned during VIII Plan – Pandirimamidi in Andhra Pradesh and Killikulam in Tamil Nadu started.
1992	Research work on arecanut phased out
2000	Programmes of Konark centre shifted to Bhubaneshwar due to super cyclone

marketing of these three crops. The long term nature of research on these crops, the prospects of higher returns from research investment and the likely distribution of research benefits to the small holders, makes it all the more imperative to develop a long term perspective.

The average coconut productivity in India is still at a low level (6776 nuts/ha/year) as compared to the production potential of 27300 nuts/ha/year. On the other hand, the coconut yield in states like Andhra Pradesh and Tamil nadu is more than 9,000 nuts/ha/year. This indicates the scope for increasing the productivity by bridging the yield gap through the use of quality planting materials and adoption of better management practices. The States of Tamil Nadu, Andhra Pradesh, Orissa and Pondicherry in the East Coast and Assam, Tripura and West Bengal in the North East have made rapid strides in coconut cultivation during the last two decades. These regions have substantially increased their share in the total nut production in the country. There is a need to develop location specific agro-techniques for sustaining and improving the yield levels.

Oil palm is one of the highest oil yielding crops that could help the country to minimize the edible oil imports with the cultivation of location-specific oil palm hybrids along with the required management practices. The farmers would be able to realize more than 25 tonnes of FFB/ha yielding about 5 tonnes edible oil/ha.

Palmyrah palm, adorns their dry landscape of the semi arid regions of Tamil Nadu, Andhra Pradesh, Orissa, West Bengal, Bihar, Karnataka and Maharashtra. India has nearly 102 million palms and half of the trees are in Tamil Nadu. Out of 51.9 million trees in Tamil Nadu, more than 50% of palms are concentrated in the southern districts of Thoothukudi, Tirunelveli, Virudhunagar and Ramnad, while Thoothukudi district alone has a major share of 10 million trees. The palm offers vast scope for increasing the employment potential and thus the standard of living among the poor rural community.

Opportunities in the Sector

Coconut offers wide scope in terms of improvement in coconut productivity and also vast employment potential through the adoption of appropriate coconut based farming systems. Large scale adoption of value addition technologies in the coconut sector is still a less exploited field in India as compared to other countries.

Palmyrah palm ranks first in yielding sugar as well as other edible and non-edible products. Many value added products can be prepared from the fruit and other parts of the palm. The Palmyrah palms also serve as a wind break and arrests sand dunes. Palmyrah palm could be grown in soil with sub optimal levels of physio-chemical characteristics. Tamil Nadu is a potential centre for the growth and development of Palm Products Industry to a greater extent so as to attract foreign exchange by way of export of Palm Products.

Mandate

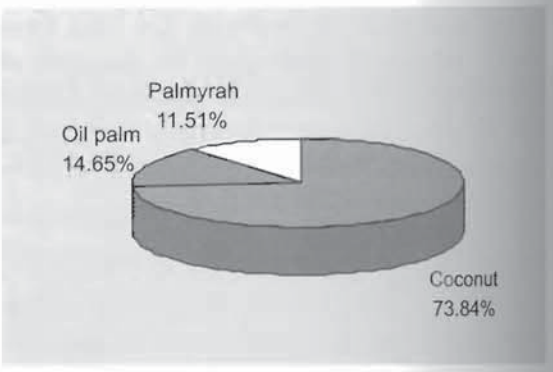
1. Collection, conservation, cataloguing and evaluation of germplasm, new hybrids and high yielding varieties in coconut
2. Standardization of agro-techniques for various agro-climatic regions including development of appropriate farming/ cropping systems compatible with the main crop and the edaphic 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

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 11.51% (Table 69).

Table 69 : Budget allotment to different crops during X Plan

Crop	Budget allotted (Rs. in lakhs)	Percent
Coconut	498.42	73.84
Oil palm	98.88	14.65
Palmyrah	77.70	11.51
Total	675.00	100.00



Budget allotment to different crops during X Plan

Profile of the AICRP on Palms

State	AICRP-Palms Centre	University	Area 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, Ramapachodaram PO 533 288, East Godavari District	Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad 500 030.	Palmyrah Crop Improvement, 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
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, Krishi Nagar, Dharawad 580 005	Oil Palm Crop Improvement and Agronomy

Kerala	Central Plantation Crops Research Institute, Kasaragod 671 124	Indian Council of Agricultural Research	CoconutCrop 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 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

Achievements of AICRP on Palms at a glance

- In coconut, four cultivars and ten hybrids have been released based on their performance at different locations for commercial cultivation in the respective states.
- In addition to the released cultivars and hybrids, a few types are in the final stages of evaluation at different locations. In the East Coast of Tamil Nadu, the WCT and Andaman Ordinary are performing well. In the Maharashtra coast at Ratnagiri, Laccadive Ordinary, Pratap and Kerasankara have shown stable performance as suitable varieties of the tract. At Ambajipeta, Philippines Ordinary is performing well.
- In West Bengal, Jamaican Tall and Assam, Assam Green Tall (Kamrupa) are suggested for commercial cultivation.
- The hybrids showing promise in different

centres include WCT x GBGD, COD x WCT and WCT x COD.

- Three arecanut cultivars were released for cultivation based on multilocation trials.
- Nutrient management techniques for littoral sandy soils of West Coast region have been standardized.
- Nutritional requirements for D x T hybrids for each agro-climatic zone have been worked out.
- Recommendation on biomass recycling within the system/use of low cost technologies on lignin degrading fungi/use of epigeic earthworms was offered for commercial exploitation.
- Irrigation schedule based on evaporation demand (Eo) has been standardized for interior and coastal regions of Tamil Nadu and Konkan coast of Maharashtra.
- Successful and economically viable coconut based cropping systems have been identified for different states. In general, nut yield increased in mixed farming compared with monocrop of coconut. The net profit under mixed farming was reported between Rs.50,000 to Rs.65,000 per hectare.
- Plant protection packages for the management of basal stem rot, leaf eating caterpillar, red palm weevil and rhinoceros beetle have been developed.
- Fertilizer and irrigation requirements for oil palm in major states have been worked out.
- Promising germplasm types in palmyrah available in Andhra Pradesh and Tamil Nadu were collected and a genebank with 176 accessionshas been established.

Expenditure statement 2004-05 (Fund released from ICAR)

(Rupees in lakhs)

Sl. No.	Name of the Centre	Pay	TA	RC	NRC	TARFF	Total
1	Aliyarnagar	10.36	0.45	2.40	0.60	0.23	14.04
2	Ambajipeta	11.93	0.53	3.00	2.51	0.23	18.20
3	Arsikere	5.29	0.30	1.66	0.45	0.17	7.87
4	Jagadalpur *	---	---	---	---	---	---
5	Kahikuchi	5.10	0.26	1.25	10.00	---	16.61
6	Bhubaneshwar	3.98	0.23	1.34	0.45	---	6.00
7	Mondouri	4.80	0.26	1.34	0.45	---	6.85
8	Ratnagiri *	---	---	---	---	---	---
9	Veppankulam	12.76	0.38	3.65	0.52	0.15	17.46
10	Killikulam	7.21	0.23	1.20	0.10	---	8.74
11	Pandirimamidi	6.45	0.19	1.13	1.13	---	8.90
12	Aduthurai	3.38	0.26	0.52	---	0.19	4.35
13	Gangavathy	3.55	0.15	0.56	---	---	4.26
14	Mulde	3.53	0.15	0.90	---	0.15	4.73
15	Vijayarai *	---	---	---	---	---	---
16	CPCRI, Kasaragod	---	---	---	---	---	---
	Total	78.34	3.39	18.95	16.21	1.12	118.01

* Sufficient funds available at the centre

Staff Position

HEADQUARTERS

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Scientist (Economic Botany)	:	Mr. C. Jayabose (Study Leave)
Personal Assistant	:	Mrs. K. Narayani
Assistant	:	Mr. K.S. Ramakrishna

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Principal Scientist (Pathology)	:	Dr. B.Srinivasulu
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Senior Scientist (Entomology)	:	Dr. A.Sujatha
Scientist (Plant Pathology)	:	Mr. K.Vijay Krishna Kumar
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		2. Vacant

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Field Assistant	:	Mr. Syed Jamaluddin

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Research Officer	:	Mr.. V. S. Sawant
Jr. Entomologist	:	Mr. V. S. Desai
Sr. Clerk	:	Mr. P. V. Sawant
Junior Agricultural Assistants	:	1. Mr. P. A. Shinde 2. Mr. G. B. Bharankar

Agricultural Research Station, Mulde, Kudal Taluk, Sindhudurg Dist. PIN 416520
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Field Assistant	:	Mr. N. R. Parab

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Assistant Professor (Plant Pathology)	:	Dr.G.Karthikeyan
Assistant Professor (Crop Physiology)	:	Dr. T. Sivakumar(from 06-12-2004)
Agricultural Assistant	:	Mr. .N.Vinayagamoorthy
Technical Assistant		Mr.. R.Sekar
Junior Assistant (Administration)	:	Mr..M. Muthumani

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Associate Professor (Plant Pathology)	:	Dr. E.G. Ebenezar
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Technical Assistant	:	Mr. A. K. De

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Central Plantation Crops Research Institute, Kasaragod 671 124
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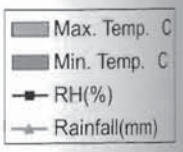
Weather data of Co-ordinating Centres - 2004

COCONUT CENTRES



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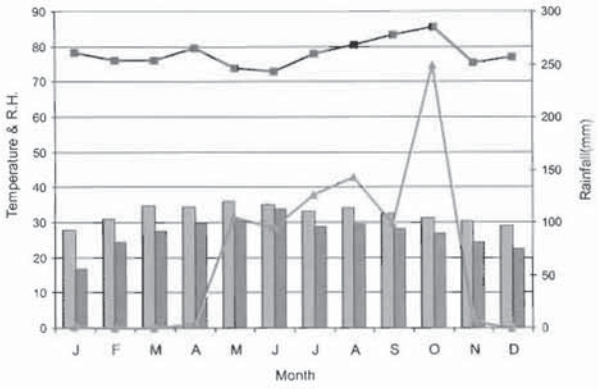

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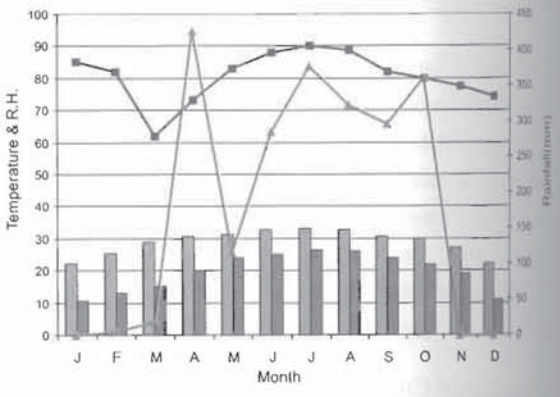

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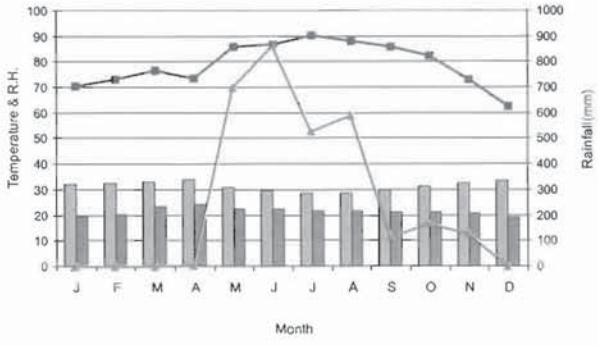

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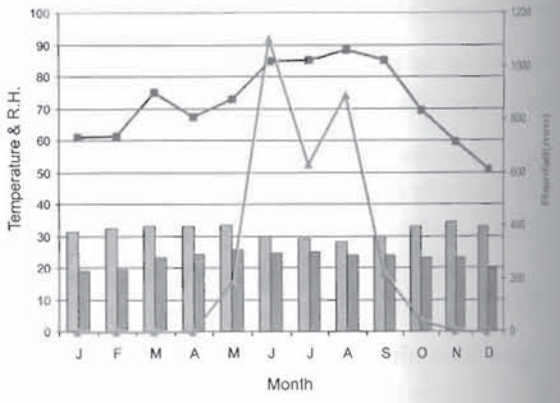

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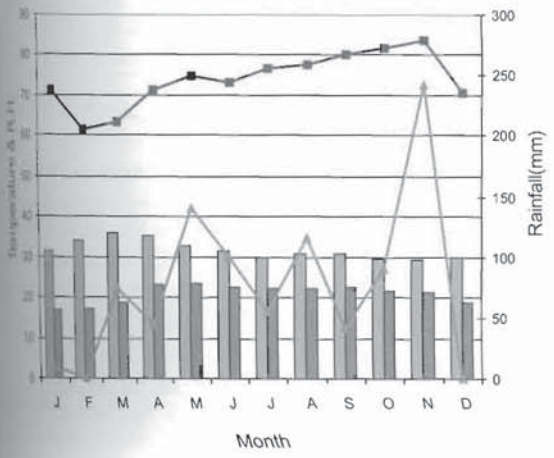

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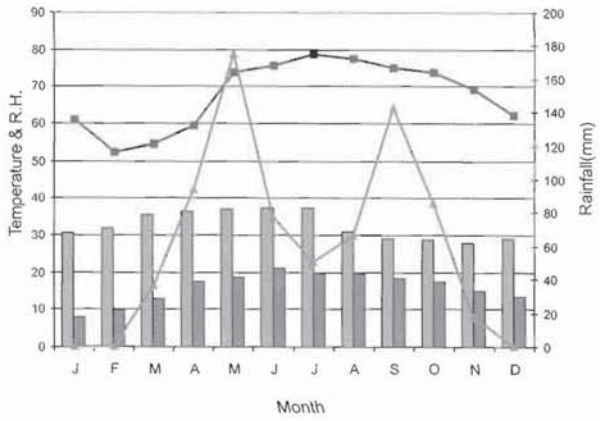

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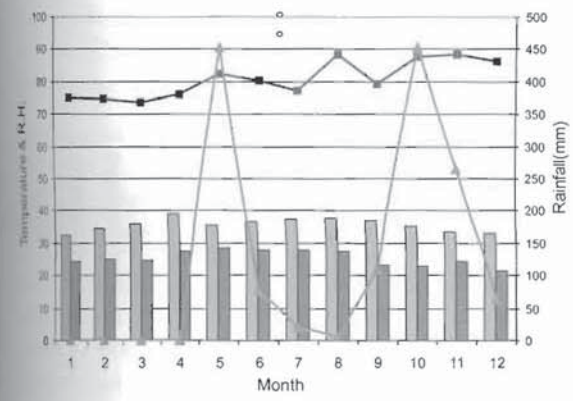

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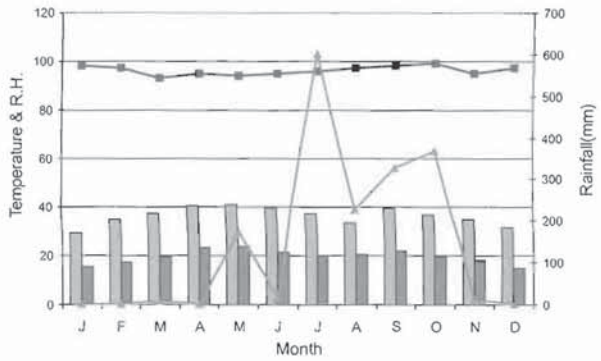

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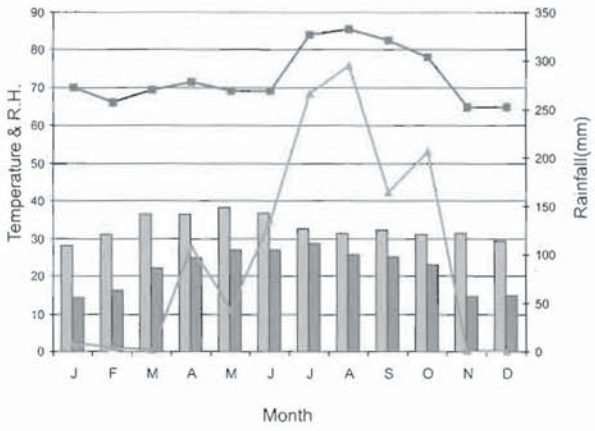
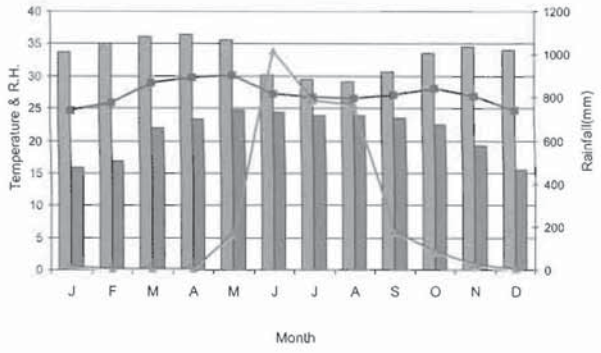
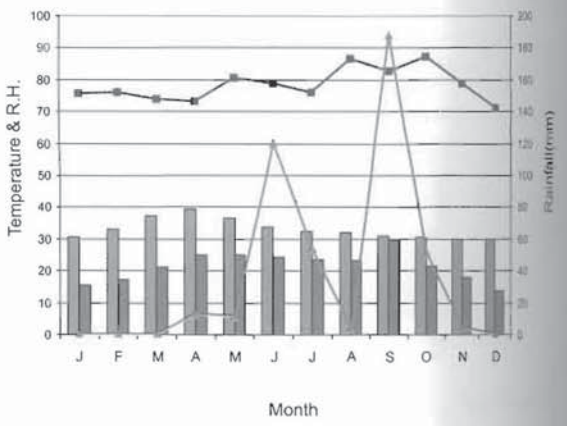


OIL PALM CENTRES

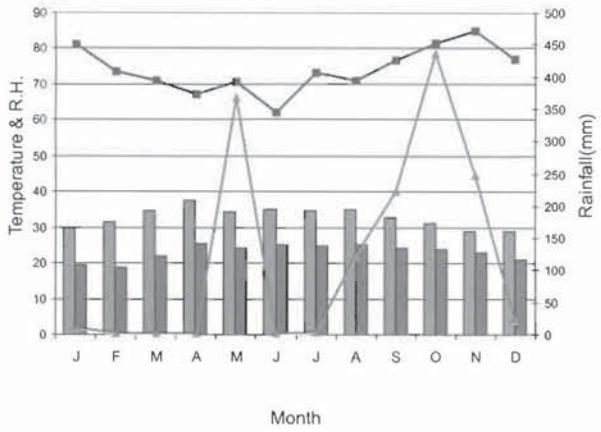
Mulde



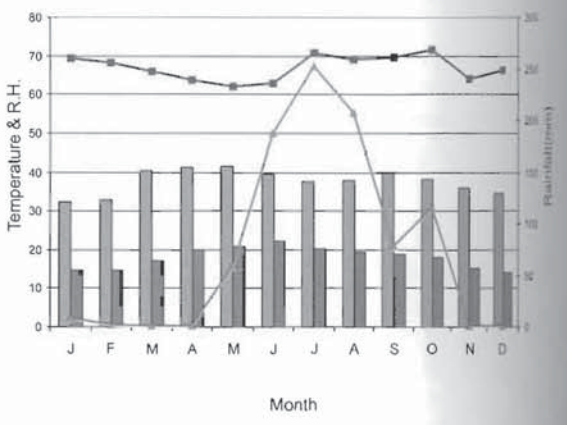
Gangavathy



Aduthurai

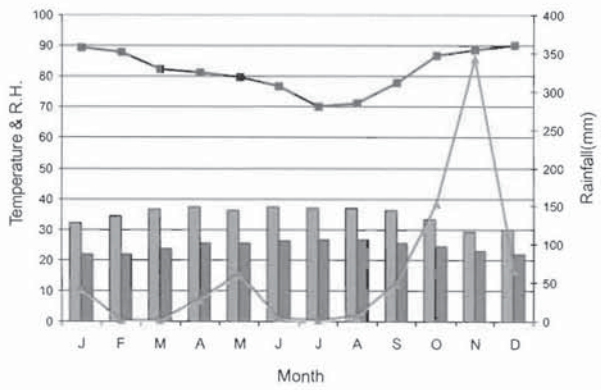


Vijayarai

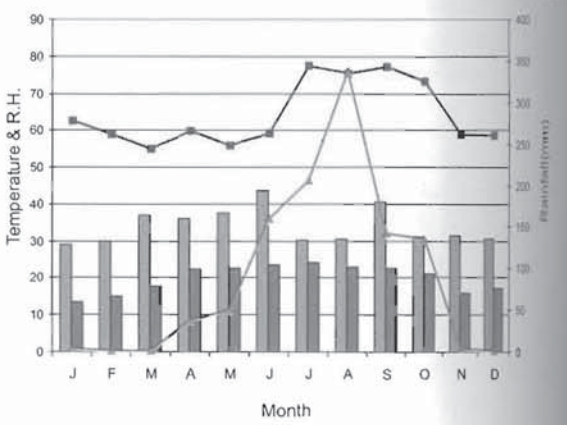


PALMYRAH CENTRES

Killikulam



Pandirimamidi



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