



वार्षिक प्रतिवेदन
ANNUAL REPORT
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राष्ट्रीय तेल ताड़ अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद)

पेदवेगी-534 450, प. गोदावरी जिला, आ.प्र.

National Research Centre for Oil Palm

(Indian Council of Agricultural Research)

Pedavegi-534 450, West Godavari Dt., A.P.

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Preface

Oil Palm, by virtue of its tremendous potentiality to meet the demand of edible oil in the country, needs no special mention. The contribution made by the National Research Centre for Oil Palm under the ICAR system for the last more than one decade in terms of conducting training programmes, providing the needed technical support, supply of indigenous hybrid sprouts and other multi-faceted service to all those involved in Oil Palm development, has given enough encouragement towards the crop besides creating self-confidence among the farming community about the merits of Oil Palm cultivation and the yeomen service they get from the NRC-OP.



At this juncture, this National Research Centre dedicates itself for providing the needed support and service required for an overall development of the crop.

It is really heartening to say that in order to give further impetus and support to the efforts being made by this centre, the Government of India has constituted a Working Group under the chairmanship of Dr. K.L. Chadha, the eminent Horticulturist mainly to assess a fresh potential areas for of Oil Palm cultivation in India, and also to critically assess the experience of Oil Palm cultivation in India, to review the Oil Palm technologies, identify the need and sources for supply of planting material, assess the processing facilities available and suggest ways and means of financing Oil Palm. I am glad to inform that with the active support and concerted efforts made by the Centre as well as all those involved in Oil Palm development in the Oil Palm growing states, a comprehensive report could be brought out and was submitted to Government of India in July 2006 for implementation of the recommendations made by the Working Group.

During the period under report, there was encouraging environment for this crop from the Government of India and the concerned State by way of continuing subsidies and needed support, as the crop has proved to be the best substitute in bridging the gap between the demand and supply and also to save valuable foreign exchange to the exchequer involved in import of planting material. Efforts are continued to achieve self-sufficiency in production of the planting material by strengthening the indigenous seed gardens and also develop production technologies for the crop to make them available to the farming community.

Now, it is time for all of us to formulate a clear-cut strategy to make the country self-sufficient in vegetable oil production, of which oil palm will play a very vital role with its high yield at low production cost. With the coordinated and concerted effort of each and every one of us, we can confidently achieve our dream of 'yellow revolution' in edible oil production. Let us hope and wish that India in the very near future will emerge as the third largest Palm Oil producing country in the world.

M . Kochu Babu
Director

कार्यकारी सारांश

जननिक सुधार

- ◆ छोटा अण्डमान से 9 संग्रहों और आई. आर. एच. ओ. श्रोत के किसान के खेत से एक संग्रह के साथ जर्म-प्लाज्म संग्रह पुष्ट किया गया।
- ◆ आकृतिक, पैदावर, गुच्छ-गुणता, शरीर क्रियात्मक जीव-रसायनिक, गुणात्मक एवं मोलेक्युलर स्तरों के लिए अफ्रिकन जनन द्रव्यों का चरित्र-चित्रण प्रगति में है।
- ◆ अल्प फल समुच्चयन, पतली-मिसोकार्प, छोटे फल, लंबे और पतले पर्णक के साथ-साथ मादा पुष्पक्रम उत्पादन वाले भारतीय बौना ताड़-2 का चरित्र-चित्रण किया गया।
- ◆ किसान के खेत में टेनेरा फल के रूप में मेन्टेल्ड फल वाला ताड़ देखा गया।
- ◆ पेदवेगि के क्षेत्रीय जीन-बैंक में एक ताड़ के पर्णवृन्त में काटें नहीं है; यह इडोलेट्रिका के ड्यूरा फ़लाकृति से संबंध रखते हैं।

अफ्रिकन जर्म-प्लाज्म का मूल्यांकन

- ◆ पेदवेगि में गुनिया विसु(जी. बी) प्रविष्टियों में अत्यधिक वृद्धि और उच्चतम निर्दिष्ट पत्तों का भार दर्ज किया गया।
- ◆ जांबियन और तानजेनियन प्रविष्टियां अत्यधिक उपजवाले पाये गये जबकि जी. बी. प्रविष्टियों में गुच्छों की संख्या एवं अधिक लिंग अनुपात दर्ज किये गये।
- ◆ जर्म-प्लाज्म प्रविष्टियों में स्टोमा से संबंधित शरीर क्रियात्मक विशेषक, रंधी चालकता, वाष्पोत्सर्जन, पत्ते का तापमान, प्रकाश संश्लेषण दर, प्रकाश संश्लेषक जल प्रयोग दक्षता और पर्ण जल संभाव्यता के लिए चरित्र-चित्रण किये गये।
- ◆ सिंचित और तनाव वातावरणों के पत्तों में प्रोलीन, विलेय प्रोटीन, कुल कार्बोहाइड्रेट तथा फ़िनोल की मात्रा में अन्तर नहीं पाया गया।
- ◆ आर.ए.पी.डी. विश्लेषण से कोस्टा रिका ताड़ों में अधिक समरूपता देखी गयी।
- ◆ ड्यूरा में सुधार उच्च उत्पादकता वाले टेनेरा संकर, फ़लों के रंग और आकार आदि में सुधार के लिए संकरण कार्यक्रम आयोजित किया गया।
- ◆ नेल्लूर में जी.बी. प्रविष्टियों में अत्यधिक ऊंचाई एवम वक्ष परिधि दर्ज किये गये। जांबियन प्रविष्टियों में विशिष्ट पर्ण वजन, अधिक दर्ज किया गया।
- ◆ आदिलाबाद में जांबियन प्रविष्टियों में तुलनात्मक ऊंचाई कम पायी गयी।
- ◆ पालोड में तानजेनियन प्रविष्टियों में सबसे अधिक एफ़. एफ़.बी. वजन दर्ज किया गया। गुनिया विसु प्रविष्टियों में गुच्छों की संख्या सर्वाधिक दर्ज की गयी। पालोड में तानजेनियन संग्रह में एक नया पिसिफ़ेरा ताड़ अभिप्रमाणित किया गया।
- ◆ अधिरापल्ली में गुनिया विसु प्रविष्टियों में अधिक लिंग अनुपात दर्ज किया गया।
- ◆ पेदवेगि में अंतरजातीय संकरों में अधिक उपजवाले दो ताड़ पाये गये। इन ताड़ों में गुच्छों का आकार मध्यम तथा गुच्छ सूचि भी परिमिति था। स्टेरिलिटी की प्रतिशत, बीज का आकार, मेसोकार्प मात्रा लिंग अनुपात, द्विलिंगी पुष्पक्रम का उत्पादन की आकृति आदि में अन्तर दर्ज किया गया।
- ◆ पालोड में टी X टी आबादी में एक ड्यूरा ताड़ बौना पाया। बौना टेनेरा ताड़ की संतति में बौनापन के सात ताड़ पाये गये।
- ◆ ड्यूरा बीजों के संग्रहण पर अध्ययन शुरू किया गया।

- ◆ जनन-सक्षम तथा अर्ध-जनन सक्षम पिसिफ़ेरा के लिए बीज निष्कर्षण पद्धति को मानकीकृत किया गया।
- ◆ असामान्य अंकुरों का गणन और वर्गीकरण पूरा किया गया।
- ◆ पेदवेगि में 26 पिसिफ़ेरा ताड अभिप्रमाणित किये गये।
- ◆ विभिन्न संकरों में बीज की आकृति, अंकुरण तथा संबंधित लक्षणों में स्पष्ट सह संबंध पाया गया।
- ◆ तारका बाग में उपज निष्पादन के आधार पर 25 और ड्यूरा मातृ ताडों का चयन किया गया।
- ◆ लक्ष्मीपुरम बीज बाग में अंकुरण आचरण के लिए 16 डीXपी संकरों का मूल्यांकन किया गया। 34 पिसिफ़ेरा ताडों पर गुच्छों का विश्लेषण भी किया गया।
- ◆ लक्ष्मीपुरम में डी X पी पालोड संकरों के मूल्यांकन में, दूसरे परीक्षण में सार्थक एफ़. एफ़. बी. वजन दर्ज किया गया जबकि तीसरे परीक्षण में सार्थक औसत गुच्छ-वजन दर्ज किया गया।
- ◆ पेदवेगि में विभिन्न श्रोतों के संकरों में पर्ण संख्या एवम औसत गुच्छा वजन में सार्थक अंतर पाया गया।
- ◆ ए.एस.डी डेली X लेम तथा पी 65 डी X 111 के बाद आई सी जी सी 1001 में अधिकतम गुच्छा-सूचकांक देखा गया।
- ◆ लंबाई, चौड़ाई, छिलके की मोटाई, छिलके का भार एवं दानों के भार, आदि बीज लक्षणों के लिए संकरों में सार्थक भिन्नता दर्ज की गयी।
- ◆ पेदवेगि और पालोड स्थानों पर ए. एस. डी. कोस्टा रिका एवं एक पालोड संकर में मुख्य उपज गुणों में सार्थक भिन्नता नहीं थी। कोस्टा रिका संकरों में 11 ड्यूरा ताड अभी तक अभिप्रमाणित किये गये।
- ◆ बीज-अंकुरण में वृद्धि के लिए गड्ढा पद्धति उपयुक्त पायी गयी।
- ◆ प्रसुप्ति कणन के अम्ल छेदन पद्धति में, अंकुरण सल्फ़्यूरिक अम्ल के साथ बीज का उपचार अनुपयुक्त पाया गया।

फ़सल उत्पादन

- ◆ वयस्क तेल ताड को नाइट्रोजन और पोटेशियम की आवश्यकता के मूल्यांकन के दौरान उपचारों में गुच्छों की संख्या और एफ़. एफ़. बी. के उपज में सार्थक नहीं थी।
- ◆ पूर्व-फलन स्थिति में फ़र्टीलाइजर खुराकों की प्रमाणीकरण पर किये गये परीक्षण उपचार (1200-600-1200) में, सभी वृद्धि के लक्षण अधिकतम दर्ज किये गये, एफ़. एफ़. बी उपज के लिए अन्तर सार्थक नहीं थे।
- ◆ पश्चिम गोदावरी जिले में 34 तेल ताड बागानों (1-19 वर्षों की उम्र) में प्रकाश अतः स्पन्दन पर सर्वेक्षण किया गया। तेल ताड के नीचे औसत विकिरण 13.7 प्रतिशत था।
- ◆ पालोड में कोको, दालचीनी, कालीमिर्च और एनथूरियम का निष्पादन आशाजनक पाया गया और कचोलम का निष्पादन कम पाया गया।
- ◆ तेल ताड आधारित फ़सल पद्धति में मृदा एवं पोषक पदार्थों के अप्रवाह हानियां परिमाणित और अनुमानित किये गये।
- ◆ वर्ष 2005-06 के दौरान कुल 538 पर्ण नमूनें और 1138 मृदा नमूनें विश्लेषित किये गये।
- ◆ ड्रिप सिंचाई प्रणाली में तेल ताड की ऊंचाई अधिकतम दर्ज की गई जो जेट सिंचाई से समान है। ड्रिप सिंचाई पद्धति में अत्यधिक उपज दर्ज की गयी।
- ◆ मिश्रित कृषि पर परीक्षणों में तेल ताड के पौधों के बीच में केला, लौकी, मक्का, ड्रम स्टिक, पपीता, सुब्बी-पत्ते, सक्करकन्द, बैंगन, मूली, काशीफल, सेम, टमाटर, जैसे फ़सल और फ़ूल जैसे डेली को सफलतापूर्वक उगाया गया।

- ◆ नवंबर- दिसम्बर के दौरान मशरूमों का भारी उत्पादन और मई-अप्रैल में कम उत्पादन देखा गया।
- ◆ विभिन्न अवमल पदार्थों को चारा सामाग्री के रूप में उपयोग करके भेड जैसे पशुओं का पालन किया गया।
- ◆ डेली X घाना, डेली X नाइजीरिया और पालोड की तुलना में मलेशियन संकर गुथ्री में राइनोसिरस भृंग का असर अधिक देखा गया।
- ◆ ताड़-तेल कारखाना अवमल के द्वारा बायोगैस का उत्पादन किया गया।
- ◆ वयस्क तेल ताड़ पौधों में रस स्राव के दैनिक उतार-चढ़ाव पर किये गये अध्ययन से पता चला कि पौधे में दारू रस का प्रवाह और पूरे पौधे के वाष्पारपत्सर्जन में घना संयोग है।
- ◆ गुच्छे और फ़ल के विभिन्न भागों से तेल के वसा अम्ल संघटन और तेल की मात्रा का अध्ययन किया गया।

फ़सल संरक्षण

- ◆ सर्वे किये गये क्षेत्रों में राइनोसिरस भृंग का प्रभाव कम देखा गया।
- ◆ आन्ध्र प्रदेश के पूर्वी गोदावरी जिले में वयस्क बागानों में पत्ती खाने वाली इल्ली का बहुत असर देखा गया।
- ◆ केरल के कुटानाड में चूहों का बहुत असर देखा गया। इससे लगभग 40% तक मृत्यु दर देखी गयी।
- ◆ कृष्णा में कौए और मेना, पूर्वी एवं पश्चिमी गोदावरी में कौए और तोता एवं विजयनगरम जिलों में मेना का काफ़ी नुकसान देखा गया।
- ◆ उग रहे भ्रूणों पर काले स्लज का काफ़ी प्रभाव देखा गया। इसे नमक के द्वारा नियंत्रित किया गया।
- ◆ तेल ताड़ के पौधों पर ज्वार तना छेदन कीड़े का असर दर्ज किया गया।
- ◆ पत्ती खाने वाली इल्ली और राइनोसिरस भृंग के नियन्त्रण में *ब्यूवेरिया बेसियाना* नामक सूक्ष्मजीवी एजेंट्स काफ़ी असरदार पाया गया।
- ◆ पक्षियों का गुच्छों पर नुकसान पुष्पक्रम के परागण के 130 दिनों के बाद से कटाई तक होना पाया गया।
- ◆ हरी एवं बैंगनी रंगों की फ़िश- नेट जो कि नायलोन की बनी हो, को चिडियों के नियन्त्रण में फ़ली अच्छा पाया गया। एक हेक्टर में 5 जालियां चिडियों के नियन्त्रण में उपयुक्त पायी गयी।
- ◆ *ब्यूवेरिया बेसियाना* का उष्मीय मरण समय 30 से. तापमान पर 21 घण्टे पाया गया।
- ◆ गोबर खाद के खड्डों में *मेटाराईजियम कल्चर* के उपयोग से राइनोसिरस भृंग का असर 5.29 से 0.57 तक कम किया जा सका।
- ◆ *मेटाराईजियम एनिसोपीली*, *ब्यूवेरिया बेसियाना* तथा *ट्राइकोडर्मा विरिडि* को वर्मी-कंपोस्ट के खड्डों में डालने से केचुओं पर विपरीत असर नहीं देखा गया।
- ◆ *मेटाराईजियम एनिसोपीली* की वृद्धि पर सभी प्रकार के फ़्रफ़ून्नाशकों का विपरीत प्रभाव पाया गया; उर्वरकों का प्रभाव फ़्रफ़ून्नाशकों एवं कीटनाशकों की अपेक्षा कम दर्ज किया गया।
- ◆ *मेटाराईजियम एनिसोपीली* एवं *ट्राइकोडर्मा विरिडी* युक्त 300 किग्रा व्यवसायिक प्रतिपादन किसानों को वितरित किया गया।
- ◆ पेदवेगी में कली-सडज़, तना-गीला सडज़ और नारंगी चितकों का प्रभाव कम पाया गया।
- ◆ गुच्छा अन्त सडन का प्रभाव मई-जून में 1.56-11.48% दर्ज किया गया। बेसल तना सडन 0.003-2.08% तक दर्ज की गयी।
- ◆ नारंगी चितका बीमारी में पत्तियों की संख्या, ताड़ की ऊंचाई, पत्तियों की लम्बाई तथा पर्णकों की संख्या में कमी दर्ज की गयी।



- ◆ इलेक्ट्रान सूक्ष्मदर्शी अध्ययन में नारंगी चित्तका-ग्रस्त सुई पत्ती के उत्तकों में टी.एम.वी. वाइरस की तरह के छड़-आकार के कणों के बारे में पता चला।
- ◆ गानोडर्मा के सभी 18 आइसोलेटों ने नारियल उत्तकों की अपेक्षा तेल ताड़ के उत्तकों को अधिक अवक्रमित किया। आर.ए.पी.डी. विश्लेषण में 13 आइसोलेटों के तीन ग्रूप बने जबकि 5 आइसोलेट अलग-अलग ही रहे।
- ◆ ट्राइकोडर्मा विरिडी एवं ट्राइकोडर्मा हरजियानम ने गानोडर्मा की वृद्धि में सार्थक कमी उपचार के सातवें दिन दर्ज की गयी।
- ◆ ट्राइकोडर्मा के 11 आइसोलेटों ने गानोडर्मा की वृद्धि में कमी 5.88-35.29% तक दर्ज की गयी।
- ◆ गानोडर्मा की वृद्धि में कमी लाने के लिए 13 वानस्पतिक उपचारों का इन विट्रो वृद्धि पर असर के मूल्यांकन में एसिटोन के मुकाबले एल्कोहाल उद्धरण का काफ़ी असरदार पाया गया।

कटाई उपरान्त प्रबन्धन

- ◆ एक पाम तेल का छोटा कारखाना लगाया गया जिसकी क्षमता एक टन ताजा फ़ल गुच्छों प्रति घण्टा संशोधित करने की है। इसकी कुल कीमत तीस लाख रुपये तक है।
- ◆ 10 मेट्रिक टन/घण्टा क्षमता वाले तेल कारखाने में 14.39% तक तेल निष्कर्षण अनुपात दर्ज किया गया।
- ◆ तेल ताड़ नटों के सुखने के गुणों का अध्ययन किया गया और वक्रता को स्थापित किया गया।
- ◆ व्यवसायिक स्तर पर उपलब्ध ट्रेक्टर चलित तेल ताड़ की पत्तियों को काटने वाली मशीनों का मूल्यांकन किया गया। इसमें मशीन की काटने वाली ब्लेडों की धार को बार-बार तेज करने की समस्या के बारे में पता चला।
- ◆ ताड़ के रेशों को निकालने वाले उपक्रम को प्रदर्शन के लिये लगाया गया।
- ◆ ताड़-तेल-कारखाना के अवमलों का भौतिक-रसायन एवं जैविक गुणों के लिए अध्ययन किया गया।
- ◆ पोम में मुख्य रूप से पाये जाने वाले बेक्टीरिया को अलग किया गया एवं उनकी पहचान की गयी।
- ◆ पोम-डीकेण्टर स्लज आधारित जानवरों जैसे मछली, भेड़, सुअर एवं भैंसों के बछड़ों के रवाने के लिए जांचें की गयीं।
- ◆ पोम के सेटलिंग तालाबों से ली गयी स्लज से जैव-गैस का उत्पादन किया गया। इसे गोबर से बनी गैस की गुणवत्ता की अपेक्षा ज्यादा अच्छा पाया गया।

प्रौद्योगिकी हस्तान्तरण

- ◆ 748 तेल ताड़ लगाने वाले किसानों में किये गये वितरण प्रभाव के अध्ययन में असमान वितरण पाया गया।
- ◆ किसानों से इकट्ठे किये गये प्रश्नावली एवं ज्ञान-अन्तर से प्रशिक्षण के लिए आवश्यकताओं का अध्ययन किया गया।
- ◆ किसान के खेतों पर उर्वरकों की अनुशंसित मात्रा और राइनोसिरस भृंग के नियन्त्रण पर ली जा रही जांचों को पूरा किया गया।
- ◆ गोवा में 8-12 साल तक के तेल बागानों (85%) में 9 टन/हैक्टर तक ताजा फ़ल गुच्छों की उपज दर्ज की गयी।
- ◆ प्रौद्योगिकी हस्तान्तरण एवं भारत में तेल ताड़ के क्षेत्र में फ़ैलाव पर बहु-विद्या तरीका अपनाया जा रहा है।
- ◆ तेल ताड़ उत्पादन प्रौद्योगिकी, तेल ताड़ में पौध-संरक्षण, तेल ताड़ नर्सरी प्रबन्धन इत्यादि पर आयोजित प्रशिक्षण में 85 अधिकारियों ने भाग लिया।
- ◆ तेल ताड़ खेती, तेल ताड़ में सिंचाई और पोषक तत्वों का प्रबन्धन एवं तेल ताड़ में ताजा फ़ल के गुच्छों की कटाई पर संस्थान में एवं किसानों के खेतों पर प्रशिक्षण शिविरों का आयोजन किया गया।

EXECUTIVE SUMMARY

GENETIC ENHANCEMENT

- ◆ Germplasm collection was enriched with nine collections made from Little Andaman and one from the farmer's field having IRHO source.
- ◆ Characterization of African Germplasm for morphological, yield, bunch quality, physiological, biochemical, qualitative and molecular level is in progress.
- ◆ Indian Dwarf Oil Palm II was characterized by poor fruit setting, thin mesocarp, small fruit, long & thin leaflets, long rachis, producing pre-dominantly female inflorescences.
- ◆ A palm with mantled fruit having tenera fruit form was identified in the farmer's field.
- ◆ A palm in field gene bank at Pedavegi did not have spines on leaf petiole and was referred as *Idolatraca* with dura fruit form.

EVALUATION OF AFRICAN GERmplasm

- ◆ At Pedavegi, Guinea Bissau (GB) accessions recorded maximum growth and highest specific leaf weight (SLW).
- ◆ Zambian and Tanzanian accessions were found high yielders while number of bunches and sex ratio were recorded more in GB accessions. Average bunch weight was highest in Tanzanian accessions.
- ◆ Two palms each from ZS 5, ZS 8 and TS 9 were found yield promising under water stress conditions.
- ◆ RAPD analysis showed more uniformity among the Costa Rican palms.
- ◆ Crossing programme has been taken up on the improvement in dura populations, development of promising tenera hybrids, genetics of fruit colour and sizes etc.
- ◆ At Nellore, maximum height and girth were recorded by GB accessions.
- ◆ At Adilabad, Zambian accessions were found comparatively dwarf, variation for SLW was more among Cameroon accessions.
- ◆ At Palode Tanzanian accessions recorded highest FFB weight. One new pisifera palm was identified in Tanzanian collection.
- ◆ At Athirappally the sex ratio was highest in Guinea Bissau accessions.
- ◆ At Pedavegi two palms in Inter specific hybrid progenies have been identified with high yield.
- ◆ At Palode, one palm in TxT population was identified as dura dwarf.
- ◆ In progeny of dwarf NIFOR tenera palm, seven palms with some dwarfness have been tagged.
- ◆ Bulk storage studies on dura seeds have been initiated.
- ◆ Seed extraction method for fertile and semi fertile pisifera was standardized.
- ◆ Cataloguing and classification of abnormal sprouts and seedlings have been completed.
- ◆ At Pedavegi 26 suspected pisifera palms have been identified.
- ◆ At Taraka seed garden 25 more dura mother palms were selected based on yield performance. A total of 1.65 lakh sprouts were supplied at commercial level.
- ◆ In evaluation of DxP Palode hybrids at Lakshmipuram, FFB weight was significant in the second trial while the average bunch weight was significant in the third trial.




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- ◆ Hybrids from different sources at Pedavegi differed significantly for number of leaves, average bunch weight. Seed characters like length, width, shell thickness, shell mass and kernel mass.
 - ◆ Maximum bunch index was observed in IC 9C X 1001 followed by ASD Deli X Lame and 65 D X 111.
 - ◆ At Pedavegi and Palode locations ASD Costa Rica hybrids did not differ significantly for major yield attributes; 22 dura palms have so far been identified in Costa Rica hybrids.
 - ◆ Pit method was found to enhance germination and seedling growth.
 - ◆ Rhinoceros beetle infestation was higher in the Malaysian cross namely Guthrie compared to Deli X Ghana, Deli X Nigeria and Palode.

OIL PALM MANAGEMENT

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- ◆ Light infiltration studies in the 34 oil palm gardens (9-19 years age) in West Godavari District indicated that the average radiation below the oil palm canopy was 13.8% of that of the above canopy.
 - ◆ The performance of cocoa, cinnamon, pepper and anthurium in the adult oil palm plantation in Palode was found promising; performance of kacholam was observed poor.
 - ◆ Run-off losses of soil and nutrients in the oil palm based cropping systems were quantified and estimated.
 - ◆ A total of 538 leaf and 1138 soil samples were analyzed during 2005-06
 - ◆ Palm height was maximum in palms irrigated with drips and was on par with palms irrigated with jets. Palm girth decreased with decreasing level of irrigation. Maximum yield and number of bunches were recorded in palms irrigated with drips. Among irrigation levels, palms irrigated with a IW/CPE=1 recorded maximum yield.
 - ◆ In experiment on mixed farming, crops like banana, bottle gourd, maize, drum stick, papaya, curry leaves, sweet potato, brinjal, radish, pumpkin, beans, tomato, and flowers like Heliconia were raised in the interspaces of oil palm plants.
 - ◆ Vermi-compost (3.75t) was generated using the dung and leftover material of intercrops in three beds of 50m length.
 - ◆ Animals like lambs were maintained to obtain subsidiary income using the different sludge as the constituents of the feed material.
 - ◆ Biogas was produced using palm oil sludge of the processing factory.
 - ◆ Diurnal variations in sap flow in adult oil palm plantations indicated that the flux in xylem sap was found closely associated with whole plant evapo-transpiration & vapour pressure deficit.
 - ◆ Oil content and fatty acid composition from different parts of bunch and fruit was studied.

OIL PALM PEST AND DISEASE MANAGEMENT

- ◆ Incidence of rhinoceros beetle was observed at low levels in the surveyed areas.
- ◆ Incidence of leaf eating caterpillar was heavy in aged gardens of E. G. district in A.P.
- ◆ Incidence of rats was severe in Kuttanad (Kerala) causing more than 40% mortality.
- ◆ House crow and mynah in Krishna, crows and parakeets in West and East Godavari and mynah in Vizianagaram districts were the predominant avian pests causing moderate to heavy damage.

- ◆ Incidence of black slug (*Laevicaulus alte*) was observed on emerged sprouts causing severe damage to the plumule and was effectively controlled by salt pellets.
- ◆ Incidence of sorghum shoot borer (*Sesamia inferens*) on seedlings was observed. Incidence of hairy caterpillar, *Dasychira mendosa* was observed moderate in Kerala.
- ◆ Control of leaf eating caterpillar and rhinoceros beetle using microbial agent. *Beauveria bassiana* was effective.
- ◆ Incidence of birds was observed from 130 days after the pollination of female flower and continued till harvest.
- ◆ Nylon nets were found to be long lasting compared to plastic ones as the latter was ineffective after one use. Green and violet colour fishnets were effective in the control of birds. Five nets per acre were found optimum to make the plantation free from birds. Nets having mesh size of 5 sq cm were found to trap birds.
- ◆ The thermal death time for *Beauveria bassiana* spores was found to be 21 hours at 30°C.
- ◆ Application of *Metarhizium* culture in FYMpits reduced rhinoceros incidence from 5.29 to 0.57.
- ◆ Application of *Metarhizium anisopliae*, *Beauveria bassiana* and *Trichoderma viride* did not cause any adverse effect to earthworms when applied into the vermi-compost pits.
- ◆ All fungicides were found toxic to the growth of *M. anisopliae*; monocrotophos exhibited less inhibition. Fertilizers were found less toxic compared to fungicides and insecticides.
- ◆ Commercial formulation of the product (300 kg) having both *Metarhizium anisopliae* and *Trichoderma viride* was distributed to the farmers.
- ◆ At Pedavegi incidence of bud rot, stem wet rot and orange spotting was low.
- ◆ At Pedavegi, the Bunch End Rot incidence was more during May-June ranging from 1.56 to 11.48%. The incidence of Basal Stem Rot ranged from 0.003 to 2.08%.
- ◆ Reduction in the number of leaves, stem height, length of leaves and number of leaflets were observed in orange spotting effected palms indicating the debilitating nature of the disease.
- ◆ Electron microscopic studies of spear leaf tissues of orange spotting affected palms indicated rod-shaped virus particles resembling TMV.
- ◆ All the isolates of *Ganoderma* in general degraded more oil palm tissues than that of coconut tissues. RAPD showed three major group of 13 isolates, whereas remaining 5 isolates did not form any cluster.
- ◆ Studies on antagonistic activity indicated more than 60% inhibition of *Ganoderma* fungus in most of the isolates of *Trichoderma* under study.
- ◆ *T. viride* and *T. harzianum* inhibited the growth of *Ganoderma* isolates most effectively at 7 days of inoculation.
- ◆ Eleven *Trichoderma* isolates were evaluated against *Ganoderma sp.* and the per cent inhibition ranged from 5.88-35.29.
- ◆ Evaluation of 13 botanicals against *Ganoderma sp.* under *in vitro* conditions indicated that alcohol extracts showed more inhibition followed by Acetone extracts.



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OIL PALM POST HARVEST TECHNOLOGY

- ◆ A mini palm oil mill with a capacity to process one MT of FFB per hour is assembled. The total cost of the mill has estimated to be Rs.30 lakhs.
- ◆ One time observation of Oil Extraction Ratio revealed 14.39% in 10MT/hr capacity mill under study and 15.7% in the 1MT/hr capacity mill in the two mills of Karnataka.
- ◆ A study on understanding drying characteristics of Oil Palm nuts was taken up and drying curves have been established.
- ◆ Evaluation of various commercially available models of tractor mounted oil palm frond shredders was conducted. The major problem encountered was poor sharpness of blades resulting in frequent dismantling and sharpening of the blades.
- ◆ A pilot plant on Palm Fibre Extraction was established for demonstrating the technology.
- ◆ Physicochemical and Biological characterization of Palm Oil Mill Effluent was carried out.
- ◆ The predominant bacteria from POME were isolated and identified.
- ◆ POME decanter sludge based animal feed trials were undertaken on fish, ram lambs, weaned piglets and buffalo calves.
- ◆ Biogas yield of sludge collected from POME settling ponds was found superior to cow dung.

SOCIAL SCIENCES

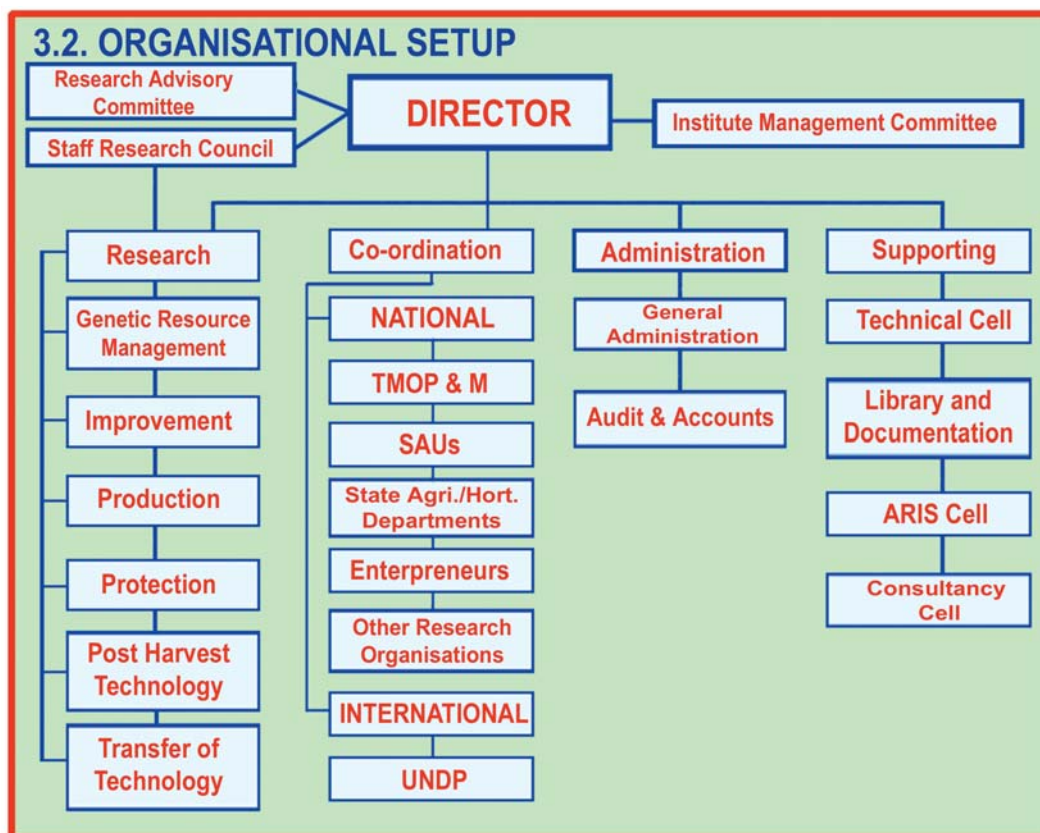
- ◆ Diffusion effect studied with a sample of 748 oil palm growers indicated an unequal distribution.
- ◆ The training needs were assessed through knowledge gaps as well as farmers requirement through open ended questionnaire.
- ◆ Field trials on adoption of recommended dose of fertilizers and control of Rhinoceros beetle in Oil Palm were completed.
- ◆ Grower-wise information collected from Goa indicated that majority of the farmers (85%) having oil palm plantations of (8-12 years) obtained FFB yield upto 9 MT/ha.
- ◆ Multidisciplinary approaches for transfer of technology and area expansion in relation to oil palm development in India is being followed.
- ◆ A total of 85 officers participated in training programmes on Oil Palm Production Technology, Plant Protection in Oil Palm, Nursery Management in Oil Palm and Oil Palm Cultivation.
- ◆ Nineteen one-day On-Campus and 14 one-day On-Farm training programmes on "Oil Palm Cultivation", 4 one-day On-Campus and 6 On-Farm training programmes on "Irrigation and nutrient management in oil palm" and eleven one day training programmes on "Harvesting of Fresh Fruit Bunches" at farmers' plantations were organised for 2418 farmers.
- ◆ At NRCOP-RS, Palode six one-day training programmes were organised for students in which 338 students from different colleges/ schools participated.

3. INTRODUCTION

The National Research Centre for Oil Palm is a pioneer institute established under the aegis of Indian Council of Agricultural Research (ICAR) at Pedavegi, West Godavari District of Andhra Pradesh on 19th February' 1995. The Centre is 13 Km away from Eluru, which is the district headquarter of West Godavari. The then CPCRI (Regional Centre), Palode was merged with NRCOP in April, 1999 with a view to unifying oil palm research. The Regional Station Palode is 35 Km away from Thiruvananthapuram, Kerala on Thiruvananthapuram - Schenottah route. NRCOP serves as a Centre of Excellence for conducting and coordinating research on Oil Palm in the fields of germplasm collection and conservation; genetic improvement, production, protection, post-harvest aspects and dissemination of knowledge through transfer of technology.

3.1. MANDATE

- To conduct mission oriented research on all aspects of Oil Palm with an objective to improve the productivity and quality
- To serve as national repository for Oil Palm germplasm and clearing house for all research information on Oil Palm and coordinate national research project
- To act as center for training in research methodology and technology of Oil Palm
- To generate nucleus planting material
- To collaborate with national and international agencies in achieving the above



3.3. Financial Outlay (2005-06)

HEAD	PLAN			NON-PLAN	
	BE 2005-06	RE 2005-06	Expenditure	RE 2005-06	Expenditure
Establishment	8.00	0.20	0.20	120.00	112.99
TA	5.00	3.50	3.50	3.60	3.58
Equipment	125.00	17.70	94.30	106.00	99.84
Works	69.00	69.00	53.46	19.90	27.54
Others	3.00	1.60	1.54	1.50	-
Total	210.00	192.00	153.00	251.00	243.95

3.4. Externally Funded Schemes (2005-06)

S. No.	Name of the Scheme Project	Opening Balance as on 01.04.2005	Funds Received during 05-06	Expenditure during 2005-06	Closing Balance as on 31.03.2006
ISOPOM funded schemes					
1.	G x E scheme	65,229	11,52,000	6,83,146	5,34,083
2.	Strengthening of Training on Oil Palm	4,22,471	5,76,000	3,00,501	6,97,970
3.	Establishment of Leaf Analysis Lab	2,09,147	2,88,000	1,39,617	3,57,530
4.	Strengthening of Oil Palm seed gardens	0	3,94,000	3,11,943	82,057
AP Cess fund Schemes					
5.	Utilization and recycling of Palm Oil Mill Effluent (POME)	6,26,564	4,19,760	7,00,986	3,45,338
6.	Acceleration of Germination of Hybrid seeds	5,07,935	4,60,000	6,18,591	3,49,344
7.	Wilt of Crops with special reference to cultural, morphological and molecular characterization and pathogenic variability of isolates in India	1,77,054	0	2,19,360	(-)42,306
8.	Oil Palm Information System	1,26,899	-	-	1,26,899
9.	NATP-IVLP (upto December' 2005)	4,85,739	31,341	45,558	-
R Deposit Schemes					
10.	Oil Palm Seed Garden, Rajahmundry (A.P.)	2,16,733	3,51,800	1,88,166	3,80,367
11.	Oil Palm Seed Garden, Taraka (Karnataka)	1,12,481	2,11,800	1,73,459	1,50,822
12.	Research-cum-development project on oil palm in Karnataka	4,45,027	14,57,000	14,04,775	4,97,252
13.	OPDP, Karnataka Consultancy Fund	-	1,85,867	1,62,653	23,214
14.	OPDP, Goa	-	9,260	-	9,260
15.	RF Scheme on Indigenous hybrid seed production in oil palm	-	60,81,568	38,40,723	1,50,45,114

3.5. STAFF POSITION :

The Centre is having more vacancies in the scientific cadre. The filling up of the scientific positions is essential to tackle the research priorities of oil palm, which is a newly introduced crop.

Grade	Sanctioned	Filled	Vacant
RMP	1	1	-
Scientific	22	12	10
Technical	18	17	1
Administration	13	13	-
Supporting	30	28	2
Total	84	71	13



4. Research Achievements

तेल ताड जननिक संसाधन

Oil Palm Genetic
Resources

OIL PALM GENETIC RESOURCES

Collection of germplasm: Six accessions were collected in Nigerian plantation planted during 1975-76 at Hut Bay in Little Andaman. In these four were teneras, one was dura and one pisifera. The pisifera palm had virescence fruit colour. Two selections were made in IRHO plantation planted during 1982 based on yield, mesocarp and shell thickness. One dura collection was made from Baratang (North Andaman) from palms near the creek shore. Seed was collected from the farmer's field in Mandya (Mysore) which had planting material from IRHO source producing mostly female inflorescences.

Identification of palm with mantled fruit: A palm with mantled fruit having tenera fruit form was identified in the farmer's field at Makkinavarigudem village (Mandal-T.Narsapuram, West Godavari district in A.P. The palm was yielding only female inflorescences. The bunches were taken up for characterization and regeneration.

Characterization of African Germplasm: The germplasm accessions collected from African countries like Cameroon, Tanzania, Guinea Bissau and Zambia are being characterized for various morphological, yield, bunch quality, physiological, biochemical and qualitative characteristics. Variations for mesocarp content, fruit size, fruit testa colour, size of bunch and other characters have been recorded. The Indian Dwarf Oil Palm Germplasm II is being characterized; interestingly this palm is producing two inflorescences per leaf axis.

Characterization of Indian Dwarf Oil Palm II: The dwarf palm identified in Guinea Bissau accession (GB-21/310) is being characterized and evaluated for biometrical characters. The palm is characterized by poor fruit setting (2.42 – 40.68%), thin mesocarp, small fruit, long & thin leaflets, long rachis, producing predominantly female inflorescences. The seeds of the palm did not germinate and get desiccated even under lab condition during incubation.

Identification of thornless palm: This was identified from the field gene bank at Pedavegi. This palm is having intermediate character of fused leaves, large frond base and short and less thorns referred as **Idolatrixa I** with dura fruit form. The fruits are of big size with large kernel; the fruit set was recorded low (1.3 - 2.7%). Open pollinated seeds were successfully regenerated through de-operculation method and seedlings are maintained in the primary nursery.

EVALUATION


Evaluation of Pune and Little Andamans accessions: The germplasm accessions of Pune and Little Andaman are being monitored in field; the observations on precocity, leaf production and height have been recorded. The ablation (process of removal of inflorescences) is being followed.

Performance of African Germplasm Accessions: The African accessions are being screened for water stress conditions at six locations viz., Pedavegi, Nellore and Adilabad (Andhra Pradesh), Mohitnagar (West Bengal), and Palode and PCKL (Kerala).

Performance at NRCOP, Pedavegi: The evaluation at this centre is being done in two trials- replicated and observational. In replicated trial, the screening is being done at two moisture regimes; irrigated (IW/CPE ratio=1.0) and stress (IW/ CPE ratio=0.5) environments.

Morphological and yield characters: Under water stress conditions Guinea Bissau (GB) accessions recorded maximum growth with an average stem height of 2.17m; the girth at collar was recorded at par in all the sources. Differences in number of leaves and sex ratio were also non significant. The specific leaf weight (SLW) was highest in Zambian accessions like the previous year reflecting its high water use efficiency. Zambian and Tanzanian accessions were highest yielders while number of bunches were more in GB accessions. Under irrigated conditions stem





height was, in general, more (2.36m) in GB accessions and lowest (1.51m) in Zambian material. Maximum sex ratio (0.57) was recorded by GB. The highest total bunch weight (68.2kg) was recorded in Tanzanian accessions followed by Zambian ones (60.9Kg). The average bunch weight was highest in Tanzanian accessions (10.1Kg). The highest FFB yield was recorded in TS 9 (86.5kg) followed by ZS 3 (76.7Kg). Two palms each from ZS 5, ZS 8 & TS 9 have been identified as the highest yielders under water stress conditions. Bunch analysis is in progress.

Physiological characters: In irrigated palms, highest stomatal frequency was observed in ZS-3 followed by ZS-2, ZS-8 and ZS-5 which didn't significantly among them. The highest epidermal frequency was observed in ZS-3 and ZS-5, significantly differed from that of other germplasm. Stomatal Index ranged from 43.42 to 67.14. The maximum stomatal Index was observed in ZS-8 followed by ZS-2, ZS-5, GB-22 and ZS-3 which didn't significantly differ among them. Maximum number of stomatal plastids were observed in GB-2, which differed significantly from that of other germplasm. Maximum guard cell length was observed in ZS-1, GB-25 and ZS-5 which were not significant among them. Stomatal pore area ranged from 4.59 to 16.52. Maximum pore area was observed in ZS-3 which was significantly different from other germplasm. Maximum transpiration rate was observed in ZS-8 and ZS-2 which were significantly different from other germplasm. Highest leaf temperature was observed in ZS-5, ZS-2 and TS-9, which were not significant. Maximum stomatal conductance was observed in ZS-5 followed by ZS-2. Stomatal conductance showed less variability (0.01 to 0.15). Maximum photosynthetic rate was observed in TS-9 followed by ZS-5, which didn't significantly differ with each other but significantly differed from that of the other germplasm. The photosynthetic water use efficiency was more in ZS-5 and ZS-1 followed by TS-9. Significant variation in leaf water potential was observed and it ranged from -6.40 to -2.07 Mpa. Maximum Leaf water potential was observed in GB-21

followed by ZS-3 and ZS-1, which didn't differ significantly among them.

In the stressed palms, the highest stomatal frequency was observed in TS-11. Epidermal frequency ranged from 197.10 to 318.84. The maximum epidermal frequency was observed in TS-11 followed by TS-9, ZS-3 and ZS-5. Highest stomatal Index was observed in GB-22 and ZS-2 followed by GB-22, ZS-5. More plastids were observed in ZS-8, which significantly differed from that of the other germplasm. The guard cell length was maximum in TS-9 followed by ZS-8 and ZS-2 which didn't differ significantly among them. Maximum stomatal pore area was observed in ZS-3, TS-9 and by ZS-8. The maximum transpiration rate was observed in TS-11 followed by ZS-5, GB-21, ZS-2 and ZS-8 which didn't differ significantly among them. The maximum leaf temperature was observed in GB-22 followed by GB-21 and TS-9. Maximum stomatal conductance was observed in ZS-2 and ZS-8, which didn't significantly differ with each other. Highest photosynthetic rate was observed in ZS-1, which was significantly different from that of other germplasm. ZS-1 recorded the maximum water use efficiency, which differed significantly from that of other germplasm. The highest leaf water potential was observed in ZS-8 followed by ZS-1 and ZS-5.

Biochemical characters : Proline, soluble protein, total carbohydrate and phenol content in the leaves did not show any difference between stressed and fully irrigated palms in any of the genotypes. However, the variation was observed between the genotypes. In case of soluble carbohydrate and peroxidase activity, the differences between stressed and fully irrigated palms were observed in a few genotypes (Fig 1-2).

Fruit and seed descriptor analysis: The african *dura* accessions were characterised for length of seed, width of seed, thickness of shell, shell mass, kernel mass and kernel oil (Table 1). Seeds of Cameroon accessions were smallest in size.

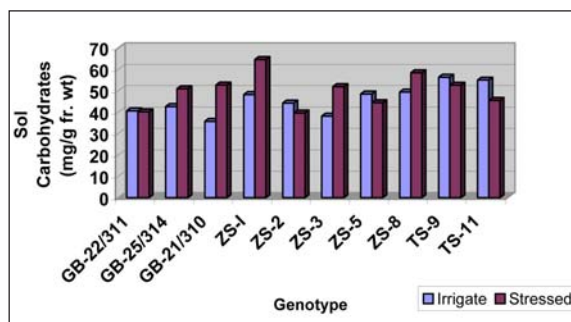


Fig. 1. Effect of Water Stress on Soluble Carbohydrate

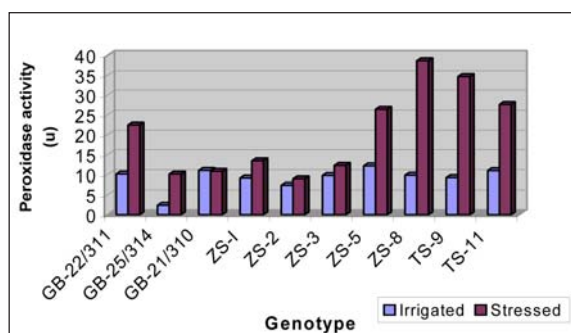


Fig.2. Effect of Water Stress on Peroxidase activity

Molecular studies: RAPD analysis of first set of germplasm (GB-22/311 - ZS 8 - TZ 9 - CA 13 - 240D x 281D - and 98C x 254 D) was completed. The preliminary analysis showed that the each genotype formed a separate cluster. Uniformity among the Costa Rican palms was more (Fig 3).

Molecular characterization including biochemical analysis, isozyme analysis and DNA fingerprinting of second set of germplasm is in progress.

Biochemical parameters were on par in the Palode and Costa Rican materials, when they were compared with African genotypes. Soluble and total carbohydrates were highest in these two genotypes (Fig 4-5). RAPD analysis showed separate cluster for each genotypes. Genetic diver-

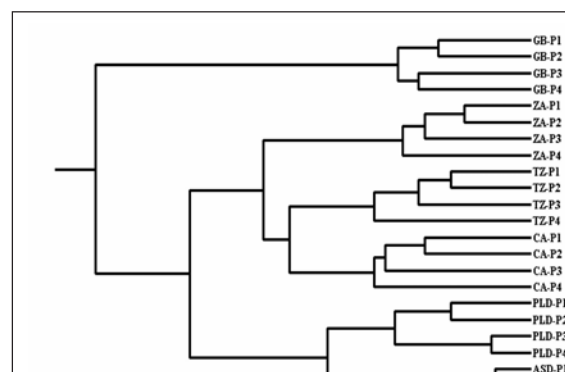


Fig. 3. Dendrogram showing cluster analysis result with 6 accessions of oil palm (1st set) from different countries

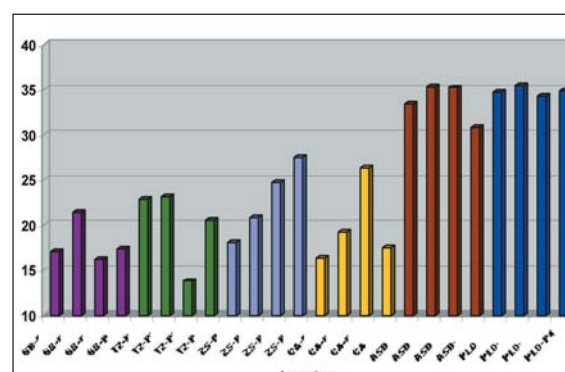


Fig. 4. Soluble carbohydrate in the leaf of oil palm from different accessions

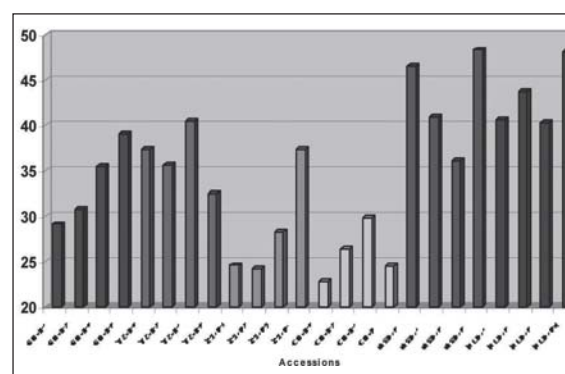


Fig. 5. Total carbohydrate in the leaf of oil palm from different accessions

Table I. Seed descriptor analysis for different African dura genotypes

Source	Seed length (cm)	Seed width (cm)	Thickness of the shell (cm)	Shell weight /seed (g)	Single Kernel weight per seed (g)
Guinea Bissau	3.05	5.11	0.57	1.72	0.90
Zambia	3.31	5.57	0.61	2.61	1.02
Tanzania	3.19	5.39	1.26	2.15	0.97
Cameroon	2.91	4.66	0.65	1.76	0.77



sity study using STMS marker has been initiated.

Hybridization: With a view to improve dura populations, develop promising tenera hybrids and to study on genetics of fruit colour and sizes etc., crossing programme has been initiated.

Observational Trial : African accessions are being evaluated under water stress conditions (IW/CPE ratio=0.5). Mean height of Cameroon accessions was lowest while the Zambian accessions were of medium height. The average FFB weight of Tanzanian accessions was highest (79.3kg/palm/year) with high standard deviation suggesting availability of variation in this material.

Evaluation at Nellore (A.P.): The accessions are being evaluated under water stress conditions. Significant variation was observed for

all the characters studied. Maximum height (1.04m) and girth at collar (2.26m) were recorded by GB accessions which also had small leaves (mean Rachis length = 2.65m) when compared with others. Zambian accessions recorded lowest sex ratio but had large variations among the accessions were observed for this trait. The highest sex ratio was recorded in ZS 9 accession. The specific leaf weight was maximum in Zambian accessions implying their tolerance towards water stress. ZS 7 had the highest SLW (1.75kg) followed by ZS 2 (1.25kg).

Evaluation at Adilabad (A.P.): Zambian accessions were found comparatively dwarf as reported last year. The highest SLW was recorded in ZS 6 (1.98Kg) followed by TS 5 (1.59Kg). In the observational trial involving Cameroon

Table 2. Top yielding palms (cumulative yield over past four years) under irrigated and stress environments at Pedavegi, A.P.

Acces.	En.	P.No.	2002-03		2003-04		2004-05		2005-06		Cumulative	
			BN	BW	BN	BW	BN	BW	BN	BW	BN	BW
ZS 2	I	257	1.0	5.0	4.0	24.0	13.0	145.0	12.0	186.1	30.0	360.1
ZS 8	S	60	20.0	78.0	6.0	30.0	15.0	142.0	9.0	108.6	50.0	358.6
ZS 5	I	37	8.0	25.0	9.0	43.0	20.0	165.0	11.0	114.7	48.0	347.7
ZS 2	I	209	10.0	30.0	13.0	68.5	20.0	169.0	8.0	79.0	51.0	346.5
TS 9	I	260	8.0	33.0	10.0	58.5	12.0	80.0	18.0	163.3	48.0	334.8
ZS 1	I	44	12.0	39.0	9.0	41.5	24.0	166.0	10.0	84.9	55.0	331.4
ZS 2	I	85	14.0	38.0	11.0	58.0	21.0	153.0	7.0	76.4	53.0	325.4
TS 9	I	258	13.0	27.0	10.0	57.5	15.0	110.0	15.0	128.0	53.0	322.5
ZS 1	I	45	7.0	21.0	17.0	83.0	25.0	146.0	8.0	69.4	57.0	319.4
ZS 3	I	100	5.0	14.0	11.0	88.0	16.0	121.0	11.0	91.7	43.0	314.7
ZS 5	I	35	6.0	25.0	10.0	64.5	19.0	121.0	9.0	103.1	44.0	313.6
ZS 3	I	206	14.0	57.0	7.0	43.0	10.0	101.0	11.0	110.8	42.0	311.8
ZS 2	I	208	13.0	40.0	8.0	46.0	17.0	129.0	9.0	96.4	47.0	311.4
ZS 8	S	61	7.0	24.0	4.0	22.0	15.0	133.0	13.0	125.1	39.0	304.1
ZS 3	I	99	2.0	10.0	11.0	36.0	17.0	157.0	10.0	101.0	40.0	304.0
ZS 3	I	204	9.0	44.0	9.0	61.0	15.0	123.0	8.0	71.0	41.0	299.0
TS 9	S	276	14.0	51.0	10.0	28.5	17.0	150.0	10.0	69.0	51.0	298.5
ZS 5	S	66	6.0	19.0	5.0	18.0	22.0	182.0	9.0	78.8	42.0	297.8
ZS 5	S	230	5.0	17.0	4.0	25.0	10.0	78.0	16.0	174.0	35.0	294.0
TS 9	S	275	4.0	15.0	9.0	51.5	8.0	72.5	13.0	154.0	34.0	293.0

En= Environment; I= Irrigated; S= Stress; BN= No. of bunches; BW= Bunch Weight (Kg)

Table 3. Evaluation of African accessions for water stress tolerance in Observational trial at Pedavegi, A.P.

Accession		Stem height (m)	Stem girth (m)	No. of leaves	Sex ratio	No. of bunches	Bunch yield (kg)	Specific leaf weight (kg)
Cameroon (5)	M	1.63	2.95	25.3	0.27	4.9	36.2	0.67
	CD(±)	0.44	0.56	2.71	0.65	3.8	30.5	0.34
Guinea Bissau (13)	M	2.55	2.92	24.6	0.44	9.5	49.4	0.48
	CD(±)	0.52	0.19	1.63	0.45	3.7	19.2	0.08
Tanzania (7)	M	2.11	2.95	24.7	0.39	7.9	79.3	0.53
	CD(±)	0.20	0.27	1.73	0.58	1.1	18.4	0.23
Zambia (6)	M	1.67	2.75	24.7	0.38	8.0	66.7	0.50
	CD(±)	0.34	0.22	1.91	0.46	2.5	29.5	0.27
Bulk Palms (32)	M	1.35	2.78	23.8	0.42	6.2	39.5	0.62
	CD(±)	0.15	0.15	1.02	0.49	1.8	12.7	0.10

Table 4. Evaluation of germplasm at ITDA Farm, Jambuga, Adilabad, A.P.

S . No.	Accessions	No. of leaves	Sex ratio	Palm height (m)	Height increment (m/palm/y)	SLW
1	GB-2/298	14.3	0.19	0.71	0.26	1.12
2	GB-10/306	15.5	0.19	0.96	0.26	1.21
3	GB-21/310	14.6	0.21	0.96	0.29	1.33
4	GB-5/310	14.8	0.21	0.92	0.31	1.34
	Mean	14.8	0.20	0.89	0.28	1.25
5	ZS-3	15.1	0.14	0.81	0.31	1.19
6	ZS 6	15.3	0.27	0.79	0.29	0.96
7	ZS6	14.8	0.26	0.82	0.32	1.61
	Mean	15.1	0.22	0.81	0.31	1.25
8	TS 5	15.0	0.12	0.92	0.31	1.59
9	TS 8	15.3	0.16	0.88	0.28	1.13
	Mean	15.2	0.14	0.90	0.30	1.36
	SD (+)	0.36	0.05	0.08	0.02	0.19

accessions, it was observed that there was more production of female inflorescences in CA 3, CA 6, CA 7, CA 11, CA 10 & CA 16; the individual palms could be selected in these accessions for future utilization in breeding programmes. The variation for SLW ranged from 0.91 (CA 1) to 0.43 (CA 7) with standard deviation of 0.13, indicating variability available in these accessions for this trait.

Evaluation at Palode (Kerala): The evaluation is under rainfed conditions. Tanzanian accessions recorded highest FFB weight (65.1kg) when

compared with other accessions. The highest number of bunches were produced by Guinea Bissau accessions followed by Tanzanian accessions.

Evaluation at Athirappaly (Kerala): The evaluation is under rainfed conditions. Maximum number of male and female inflorescences (11.34) was produced by Zambian accessions and minimum by Tanzanian accessions. The sex ration was the highest in Guinea Bissau (0.645) accessions followed by Zambian accessions (0.478).

Table 5. Evaluation of stress tolerant germplasm under rainfed conditions at Palode and Athirappaly (Kerala)

S. No.	Source	Palode		Athirappaly	
		No. of Bunches	FFB weight (kg)	Leaves	Sex Ratio
1.	Guinea Bissau	13.8	54.7	28.6	0.65
2.	Cameroon	10.6	43.1	28.6	0.39
3.	Tanzania	11.1	65.1	28.0	0.37
4.	Zambia	9.8	43.4	28.2	0.48



4. Research Achievements

तेल ताड प्रजनन

Oil Palm Breeding

OIL PALM BREEDING

EVALUATION OF INTER-SPECIFIC HYBRIDS: Inter-specific hybrid (*E. guineensis* x *E. oleifera*) progenies are being evaluated for vegetative and yield traits at Pedavegi and Palode.

At Pedavegi : In I1 one palm was found high yielder (157kg) with good number of bunches (8.0) and medium bunch weight (19.36kg). The bunch index was 0.38. In I2 also one palm was found high yielder (123.7kg), with medium bunch size (17.7kg) and BI (0.24). Two palms in I2 cross were having moderate height increment (0.42-0.45 m/Year) and yield about 90-100kg per year, which needs be confirmed in the coming years so that back crossing programme could be planned. Bunch analysis was carried out on individual palms. There was significant variation among palms within a IS cross for % sterility, seed size, % mesocarp content, Sex ratio, frequency of production of hermaphrodite inflorescences etc.

At Palode : In a single bunch of an interspecific hybrid two types of fruits were observed, one was round, big and dura type and the other was elongated without seeds. The fatty acid composition of 13 interspecific hybrid palms from Palode was analysed by Gas liquid chromatography. Average oleic acid content (also TUSA content) was higher in the progenies of 261D X *E.o*-11 crosses than that of 260 D X *E.o*-13. Open (*E.o* -10) progeny was found superior among the interspecific hybrids studied so far. Palm No. *E.o* - 11 was found better in terms of FAC than that of *E.o*-13, proving

heritability of the oil quality, however entire progeny needs to be analysed. Bunch analysis of the 23 mother *oleifera* palms at Palode has been started.

IDENTIFICATION OF NEW SOURCE FOR DWARFNESS: One palm in T x T population at Palode (Palm number 151) was identified dwarf. The fruit was having thick shell and was categorized as dura. The palm is yield promising (Table 6) and short stature (almost three times lesser than other surrounding palms). This palm could be more crucial as a source gene for dwarfness.

PERFORMANCE OF PROGENY OF DWARF TENERA PALM: The progeny of dwarf tenera palm identified in the NIFOR collection at Palode was evaluated for height in field. Seven palms with comparatively dwarfness have been tagged which would be further be monitored for dwarfness.

OIL PALM SEED GARDENS (OPSG)

Standardization of Seed Extraction and Germination Technique in Pisifera : Seed extraction method for fertile and semi fertile pisifera was standardized. Fresh fruits were collected and mesocarp was removed manually and soaked in water for two days. There after seeds were thoroughly cleaned and treated with 0.1 % bavistin for 5 minutes and surface dried. Operculum was removed with the help of sterilized blade and again treated with fungicide.

Table 6. Morphological characters Dwarf palm (151) and its adjacent palms

Palm No.	Stem height (m)	Stem girth (m)	Rachis length (m)	No. of leaflets	Leaflet length (cm)	Leaflet width (cm)	Petiole length (m)	Petiole width (cm)	Petiole depth (cm)
150 (Pisifera)	4.09	2.25	7.80	320	90.6	5.7	1.80	8.0	11.0
151 (dura)	1.56	2.27	6.89	324	89.0	4.8	1.36	10.2	15.0
152 (Pisifera)	4.70	2.20	7.50	348	160.0	5.8	1.20	9.0	15.0
138 (Pisifera)	4.57	3.55	7.40	364	110.0	6.0	1.00	10.5	18.0
139 (Tenera)	3.50	2.94	7.44	312	1.6	5.4	1.20	8.0	15.0



The seeds were then kept at 22°C in airtight polythene bags for germination. Seed extraction from fruits was also standardized using Sulphuric Acid (40%). Hand Removal of mesocarp and soaking the seeds with adhering mesocarp in the distilled water for one week gave high recovery of seeds without any injury.

CLASSIFICATION OF ABNORMAL SPROUTS : The oil palm seed abnormalities was broadly classified into three groups namely, Root, shoot and shoot and root abnormalities.

Root abnormalities

R1-roots crossing each other in a doubleton sprout.

R2-stunted root, no main root, with only adventitious roots

R3-bulged root, curved upward

R4 - Retarded root growth after radicle and plumule differentiation

R5-Stunted root growth

Shoot abnormalities

S1 - Twisted and curved shoot

S2 - Pale colour of plumule

S3 - Shoot Base become bulged and growth stunted

S4 -Twisted hooked and bent towards the seed. Pale coloured plumule develops into grassy leaf like form.

S5-Plumule splitted, curved, stunted growth, no root formation

S6-Only root development and plumule totally absent .

Root and shoot abnormalities

RS1 - Plumule splitted into two and curved

RS2 - Roots growing upwards instead of downwards and plumule become stunted, twisted and hooked.

RS3 -Weak plumule and root curved upwards

RS4 - Bented and thick root, stout and stunted shoot

RS5 - Root curved upward, bented shoot

RS6- Plumule divided into two and inverted 'T' shaped growth

RS7- Stunted shoot, root thick and grows upward

RS- Both plumule and radicle stunted

RS9- Bulged shoot base and no main root only adventitious roots

REGENERATION OF SELECTED MOTHER PALMS:

Two palms having good bunches and FFB yield were selfed and sprouts are in the primary nursery. Twelve *pisifera* palms from Lakshmipuram and 20 from Pedavegi seed gardens were regenerated and raised in Pedavegi nursery.

OPSG, NRCOP-RS, PALODE:

Fruit typing : The segregation ratio of Dura (36):Tenera (75):Pisifera (26) was confirmed so far in TxT crosses. Wide variation was observed in the progeny for fruit characters and morphology. Palm No. 134 is a tenera with very thin shell. Interestingly Palm No.151 has been identified as dwarf dura palm.

Selection of Dura Mother palms: Five-year yield data were tabulated for the selection of more mother palms for strengthening hybrid seed production.

Pisifera Identification from African Germplasm: One new pisifera palm was identified from the Tanzanian collection. (Palm No.65) which was found to be sterile.

Pollen germination studies: Pollen germination studies were initiated among *E. guineensis*, *E. oleifera* and Interspecific hybrids for standardizing pollen storage technique without affecting germination.

OPSG, NRCOP, PEDAVEGI:

Evaluation of dura populations: Data on morphological, phenological & yield related characters were recorded on three Palode Dura crosses. Palms with high FFB have been selected and are being utilised in crossing programme.

Evaluation of TxT population: Data on morphological, phenological & yield related



characters were recorded. Fruit typing was done; A segregating ratio of dura (28): pisifera: tenera was recorded till date. Selection of pisifera palms was conducted utilizing bunch, fruit and seed set characters. A total number of 26 suspected *pisifera* palms are recorded. Based on seed and kernel characters Palm No 44 has been confirmed as fertile Pisifera. The variation in kernel in the *pisifera* is presented in the Fig.6&7.

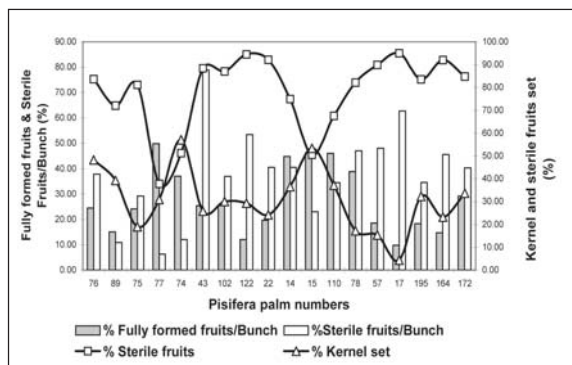


Fig. 6. Cross section of fertile Pisifera at OPSG, Pedavegi

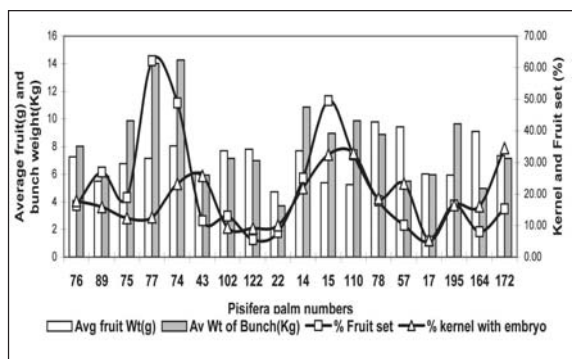


Fig. 7. Seed and kernel of Cross section of fertile Pisifera at OPSG, Pedavegi

OPSG, RAJAHMUNDRY :

DXP seed germination behaviour: Influence of seed size on germination and initial seedling growth within and among hybrid combinations was investigated. Twenty two Dura x Pisifera hybrids had significant differences for shell thickness (Table 9). Seed size was positively correlated with germination and related parameters. Big seeds of the majority of the combinations tested put forth early germination and produced more vigorous seedlings (high leaf production, fresh and dry mass). Among 22 hybrids tested, hybrid 1140 x 2277 showed maximum difference between big and small for length and circumference. Minimum length was observed in 519 x 2326 for small seeds. Same trend were observed for circumference. Maximum difference for shell thickness between both sizes was noticed in 512 x 2277. Other hybrids which showed higher values for shell thickness were 1022 x 2277, 111 x 2326, 1022x 2277. Contrary to general belief, small seeds of 1085 x 2310 have recorded maximum shell thickness. Seedling from small seeds produced low shoot and root length and dry weights among all the hybrids. Large seeds from majority of the hybrids produced two leaves after two months where as small size seeds could produce only less than two leaves in majority of the combination with some exceptions (Table 10).

Bunch analysis of suspected pisifera palms:

The suspected pisiferas of 38 palms were analyzed for fertility, fruit, seed and other characters. The

Table 9. Shell thickness and germination behaviour of big and small seeds recorded in 22 hybrids at OPSG. Rajahmundry

Parameters	Seed Sizes	Shell Thickness (mm)	Days to Initiate germination	Germination (%)	Abnormality (%)
Big size	Minimum	0.42	7.70	15.83	5.60
	Maximum	0.93	20.30	78.57	23.10
Small size	Minimum	0.35	8.00	9.03	3.47
	Maximum	1.01	18.00	68.67	28.07
CD()	Size (S)	0.00	0.4	0.46	0.56
	Hybrid (H)	0.01	1.2	1.52	1.86
	S X H	0.02	1.6	2.15	2.63



variation for characteristics namely, fully formed fruits, sterile fruit/bunch, % seed set, fruits with kernel, % seed with embryo and single fruit weight for the selected Pisifera were recorded which formed the basis for their selection (Table 11).

OPSG, TARAKA :

The seed production was initiated last year and was found satisfactory. Twenty five more dura

mother palms were selected based on yield performance. The FFB yield of the first year (1999) had positive and significant association with current year yield (2005). However, no definite conclusion could be drawn as yields of all years have to be taken into consideration.

During 2004-05 a total of about 1.65 lakh sprouts were supplied at commercial level. In all

Table 10. Initial growth, fresh and dry weight of seedlings from big and small seeds in hybrids at OPSG, Rajahmundry.

Parameters	Seed Size	Seedling growth			Fresh and dry weight of seedlings			
		Root length (cm)	Shoot length (cm)	No of leaves	Fresh wt. of Shoot (g)	Fresh wt. of Root (g)	Shoot dry wt. (g)	Root Dry wt. (g)
Big size	Min	11.66	12.21	1.72	0.43	0.17	0.10	0.07
	Max	19.51	19.40	2.15	0.93	0.30	1.14	0.95
	Mean	15.34	16.03	1.94	0.70	0.24	0.19	0.14
	SD	1.90	1.90	0.12	0.15	0.04	0.21	0.18
Small size	Min	9.80	9.68	1.33	0.30	0.13	0.10	0.04
	Max	16.46	18.68	2.00	0.82	0.31	0.22	0.14
	Mean	13.96	14.10	1.79	0.53	0.22	0.12	0.07
	SD	1.97	2.44	0.21	0.12	0.05	0.02	0.02

Table 11. Characterization of pisifera palms at OPSG, Rajahmundry (A.P.)

Characters	1821	1988	2016	2037	2038	2252	2277	2326	2299	2310	2504	2528
Fully formed fruits/Bunch	23.2	31.8	36.4	46.8	19.9	17.6	32.0	24.9	5.6	2.4	3.2	2.8
Sterile fruits/Bunch	9.5	18.9	4.8	6.5	21.0	17.5	15.1	10.6	1.8	22.0	2.6	12.3
Fully formed Fruit set %	30.8	62.7	69.4	65.0	25.4	24.2	40.5	49.8	68.7	3.5	19.5	45.8
Sterile fruit set %	55.2	37.3	30.6	42.0	74.6	78.1	59.5	50.2	31.3	96.5	80.5	54.2
Seed (kernel) set %	7.2	0.0	32.3	46.2	0.0	0.0	0.7	0.0	18.6	1.7	12.9	25.8
Seed (kernel)/Bunch	4.3	0.0	29.1	32.4	0.0	0.0	0.5	0.0	3.0	1.0	2.5	2.0
% Seed with embryo	1.3	0.0	3.6	5.5	0.0	0.0	0.1	0.0	0.0	0.2	1.4	0.0
Wt of bunch (kg)	11.7	14.0	11.3	9.3	12.0	14.3	5.6	11.0	12.0	5.0	8.0	8.0
Avg. wt of fruit (g.)	3.9	5.0	2.8	4.4	3.3	2.4	5.2	4.1	3.5	1.9	3.3	2.7

77 dura and 9 pisifera palms were being utilized in the seed production. In addition, 25 dura and two pisifera palms have been selected for seed production. DXP progenies are performing well in nursery as maintained at Shimoga.

OPSG, LAKSHMIPURAM :

DXP germination behaviour: Evaluation of 16DXP combinations for germination behaviour indicated significant differences in % germination (Table 12). Mean germination was 73.3%. The hybrid 141Dx 90P took six days to initiate germination while 223D x 484P took 18 days; the former cross achieved 99.5 % germination while 83 x 132 recorded lowest (40%) germination.

Bunch analysis: To confirm the selection of sterile pisifera bunches from 34 pisifera palms were analysed for seed set and % seed with embryo and other characters per cent seed with embryo was high in Palms number 141, 94, 32, 46, 57,169,446 and 149 has high per cent seed with embryo (73.20). Seed set was high in Palm numbers viz., 48, 209, 189, 362, 183, 273, 446, 155,197, 201and 218.

Germination behaviour of pisifera : Ten pisifera palms viz., 141(294x323) 53(294x323) 57(294x323) 169 (648x65) 368(763x323) 133(294x323) 102(294x323) 390(763x323) 218(648x65)and 103(294x323) were subjected for observations on germination behaviour. The results revealed that palm numbers 310 and 141 showed maximum germination (Fig. 8).

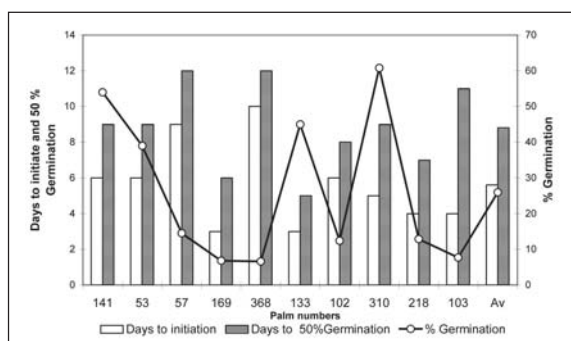


Fig. 8. Germination behaviour of pisifera palms at OPSG, Lakshmipuram

EVALUATION OF DXP PROGENIES

DxP Progenies of Palode origin at Lakshmipuram:

DxP progenies of Palode are being evaluated at Lakshmipuram in three separate trials each with 14 DxP progenies. Data on biometrical, phenological and yield were recorded; FFB weight/ palm was significant in the second trial only while the average bunch weight was significant in third trial.

DxP Progenies of Lakshmipuram at Pedavegi:

The trial consists of 16 DxP progenies of Lakshmipuram. The crop is three years old and observations on leaf production and number of inflorescences are being recorded; progenies with early flowering (precocity) have been tagged.

DxP Hybrids from different sources at Pedavegi:

Eleven hybrids (four each from ASD Costa Rica and Palode, two from Ivory Coast and one from Papua New Guinea) are being evaluated for differences in yield, morphological and physiological characters.

Morphological parameters:

Hybrids differed significantly for number of leaves and average bunch weight (ABW). Variation for ABW ranged from 16.2Kg (Deli x Lame) to 22.8Kg (12Dx313P). Maximum number of leaves were recorded in Ivory Coast IC 9x1001 (20.0). Seed length was maximum (3.63cm) in 9C x 1001 genotype. Width of seed, shell mass and kernel mass were maximum in large sized seeds of Deli x Lame combination. Highest oil/ kernel (0.36g) was recorded in large sized seeds of 12 x 31323 Palode combination which have kernel mass on par with Deli x Lame. Lowest oil/ kernel were recorded in 9C x 1001 PNG and IM-0069 D x P Ivory Coast.

Physiological parameters: Maximum leaf area was observed in ASD Deli X Ekona which was significantly different from that of other hybrids.

The leaf dry weight was more in P12 X 266 followed by ASD Deli X Avros and PNG I M - 0069. Maximum bunch index was observed in IC 9C X 1001 followed by ASD Deli X Lame and P65 D X I I I which were on par with each other.



The lowest bunch index was observed in 18 C X 2501 which was significantly different from others.

Highest stomatal frequency was observed in ASD Deli X Avros followed by ASD Deli X Ekona and ASD Deli X lame which were on par with each other (Table 2). Stomatal index was more in IC 18 C X 2501 followed by ASD Deli X Ghana and IC 9C X1001 while lower stomatal indices were observed in P12 X 313 and P12 X 266. More stomatal plastids were observed in ASD Deli X Avros followed by P12 X 313, ASD Deli X Ekona and IC 9C X 1001 which were on par with each other. Lower stomatal plastid number were observed in P 65 D X 111 followed by P 128 X 31323, ASD Deli X Lame and PNG - 1M 0069. Highest guard cell length was in ASD Deli X Ghana followed by IC 9C X 1001 and PNG 1M - 0069.

Maximum transpiration rate was recorded in ASD Deli X Ekona followed by P128 X 31323 which significantly differed from that of other hybrids. Minimum transpiration rate was

observed in ASD Deli X lame followed by P12 X 266 which didn't significantly differ with each other. Lowest leaf temperature was observed in ASD Deli X Ekona and 65Dx111 which didn't differ significantly with each other but significantly differed from that of other hybrids. Highest photosynthetic rate was recorded in P12 X 313 followed by IC 9C X 1001. Maximum photosynthetic water use efficiency was observed in ASD Deli X Lame which was significantly different from that of other hybrids. Minimum water use efficiency was observed in ASD Deli X Ekona followed by PNG 1 M -0069, P128 X 31323 and ASD Deli X Avros which didn't differ significantly among them.

SEED CHARACTERIZATION: The hybrids were characterized for seed length, seed width, nutshell thickness, shell mass and kernel mass. All the characters except seed width were found to be significantly different among the hybrids. Size of the seeds was also significantly different among hybrids. Seed length was maximum (3.63cm) in 9C x 1001. Seed width, shell mass and kernel mass were more in large sized seeds

Table 12. Germination behaviour of 16 DxP hybrids at OPSG, Lakshmipuram

Code No.	Crosses	Batch 1	Batch 2	Batch 3	Batch 4	% germination	Initiation(d)
G1	141 X 90	99	100	100	99	99.50	6.00
G2	141 X 46	45	46	46	45	45.50	14.00
G3	69 X 90	78	80	88	82	82.00	15.00
G4	58 X 90	90	92	94	87	90.75	11.00
G5	403 X 58	81	81	84	89	83.75	13.00
G6	403 X 90	42	45	36	42	41.25	13.00
G7	223 X 484	41	48	45	40	43.50	15.00
G8	223 X 58	94	98	92	94	94.50	18.00
G9	122 X 484	53	68	62	66	62.25	14.00
G10	449 X 132	86	88	83	87	86.00	11.00
G11	83 X 132	40	38	42	40	40.00	14.00
G12	175 X 90	48	48	47	44	46.75	14.00
G13	212 X 58	94	89	91	90	91.00	9.00
G14	212 X 46	84	88	93	85	87.50	10.00
G15	212 X 90	96	95	94	98	95.75	11.00
G16	119 X 214	96	91	86	92	91.25	10.00
CD 0.05	4.67	SEd	2.32	CV 4.5%	Grand Mean	73.83	12.38

of Deli x Lame and shell mass was more in Deli x Ekona.

PERFORMANCE OF EXOTIC DXP HYBRIDS IN FARMERS' FIELD :

The survey for relative performance of indigenous (Palode) & exotic hybrids were conducted in three factory zones, in Andhra Pradesh namely M/s Sical, M/s Simhapuri Agro-Products Ltd., Nellore and Food, Fats and Fertilizers Ltd. The survey revealed superiority/ at par performance of Palode hybrids over other sources. Representative plantations of Palode and ASD hybrids revealed that Palode hybrids showed superior performance consecutively (Fig. 10).

Performance of Costa Rican hybrids under varied environments: With the objective of identifying suitable hybrids for different locations, the experiment was carried out at two locations - NRC for Oil Palm, Pedavegi (A.P.) and NRCOP-Regional Station, Palode (Kerala) using Costa Rican tenera hybrids with Palode hybrid as check.

At NRCOP, Pedavegi : The experiment consisted of 23 ASD Costa Rica and one Palode

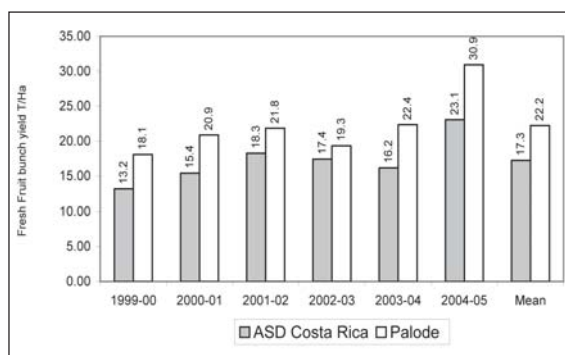


Fig. 10. Performance of ASD and Palode material in Andhra Pradesh during 1999-00 to 2004-05

hybrid. Variation in hybrids for all characters excepting palm height was non significant indicating lack of variability in the hybrids. Palm height was maximum in C 11136 (4.61m) while it was lowest in C 11123 (3.09m). The mean FFB weight and FFB numbers over the years revealed no significant differences among the hybrids indicating uniformity in productivity. The bunch analysis was also carried on 54 palms pertaining to different crosses.

Identification of dura palms in Costa Rica hybrids : 22 dura palms have been identified in

Table 14. Performance of different sources of oil palm hybrids at Pedavegi, A.P.

Genotypes	Stem height (m)	Girth at collar (m)	No. of Leaves/ Palm/Year	Sex ratio	No. of Bunches/ Palm/ Year	FFB Weight (Kg)	ABW (Kg)
Deli x Avros	4.50	2.83	19.7	0.46	4.5	82.1	19.0
Deli xEkona	4.55	3.04	19.3	0.48	3.3	72.4	21.8
Deli x Ghana	4.38	3.22	19.3	0.51	5.6	104.9	18.7
Deli x Lame	4.06	3.33	20.0	0.41	4.2	68.7	16.2
Mean (Costa Rica)	4.37	3.10	19.6	0.47	4.4	82.0	18.9
65D x111	4.11	2.87	19.1	0.56	3.7	65.4	17.9
12 x 313	4.20	2.73	18.3	0.56	3.0	67.6	22.8
12 x 266	4.24	2.90	19.6	0.53	4.3	88.4	20.8
128 x 31323	4.03	2.82	19.5	0.53	4.2	70.5	17.0
Mean (Palode)	4.14	2.83	19.1	0.54	3.8	73.0	19.6
18 C x 2501	3.20	5.27	19.7	0.42	4.3	83.9	19.5
9C x 1001	3.32	3.24	20.1	0.48	4.5	77.5	17.1
Mean (Ivory Coast)	3.26	4.26	19.9	0.45	4.4	80.7	18.3
IM - 0069 D x P (Papua New Guinea)	4.49	2.89	19.2	0.49	4.5	91.8	20.1
CD	NS	NS	0.45	NS	NS	NS	1.96

Costa Rican hybrids which are being utilized in crop improvement programme.

At NRCOP- RS, Palode: The experiment was initiated during 1994 with 19 hybrids under rainfed conditions. No significant differences were

observed among the hybrids in terms of growth and yield characters. Similar observations were made during previous years also. The pooled analysis also revealed lack of variability by yield and other biometric characters.

Table 2 : Variations in physiological characters in different sources of oil palm hybrids

Source	SI	TL	GS	PWUE	Leaf area (sqm)	Bunch Index
PI2 X 313	37.17 d	46.11 def	0.02 a	3.85 ab	106.26 f	0.38 bc
PI2 X 266	37.96 d	46.57 bcde	0.03 a	3.75 bcd	134.77 de	0.36 c
PI28 X 31323	46.74 abc	47.29 abcde	0.02 a	1.70 de	107.45 f	0.37 bc
P65D X III	43.70 c	45.18 ef	0.01 a	3.50 bc	150.83 cde	0.40 abc
ASD DELI X LAME	44.09 c	46.22 cdef	0.01 a	2.44 bcde	151.58 cde	0.41 ab
ASD DELI X EKONA	43.87 c	44.25 f	0.03 a	1.19 e	200.97 a	0.38 bc
ASD DELI X AVROS	46.02 bc	49.12 ab	0.02 a	1.86 de	154.00 cd	0.37 bc
ASD DELI X GHANA	48.53 ab	48.92 abc	0.02 a	2.60 bcde	176.90 d	0.36 c
IC 9C X 100I	46.80 abc	47.33 abcde	0.02 a	2.63 bcde	155.31 c	0.31 d
IC 18C X 250I	49.44 a	49.58 a	0.01 a	2.84 bcd	133.73 e	0.43 a
PNG IM – 0069	43.89 c	48.62 abcd	0.01 a	1.57 de	154.52 c	0.36 c
LSD (p=0.05)	3.34	2.72	NS	1.66	19.08	0.05

SI (Stomatal Index); TL (Leaf temperature °C); GS (Stomatal Conductance, mol.m⁻².s⁻¹); PWUE (Photosynthetic water use efficiency);

Table 15. Seed descriptor analysis for different tenera planting materials

Tenera variety	Seed length (cm)	Seed width (cm)	Thickness of the shell (cm)	Shell weight per seed (g)	Single Kernel weight per seed (g)
12 X 266	3.02	4.63	0.82	2.15	1.48
128 x 31323	2.76	4.93	0.85	1.34	1.01
12 X 313	2.44	4.63	0.85	1.58	1.12
65 D x III	2.86	4.72	0.96	1.30	0.98
Deli X Ekora	2.68	4.61	0.96	0.92	0.73
Deli x Avros	3.01	4.61	0.97	1.02	0.84
Dei x Ghana	2.88	4.60	0.92	1.46	1.10
Deli x Lame	2.93	5.14	0.93	1.77	1.18
Im-0069D x P	2.16	4.35	0.80	1.17	1.02
18 C x 250I	2.39	4.62	0.81	1.12	1.04
9 c x 100I	2.36	4.18	0.83	0.95	0.81
SED	0.216	0.274	0.034	0.234	0.114
CD(0.05%)	0.437	0.553	0.069	0.473	0.230

OIL PALM CROP IMPROVEMENT



Change of fruit colour of virescences types towards maturity



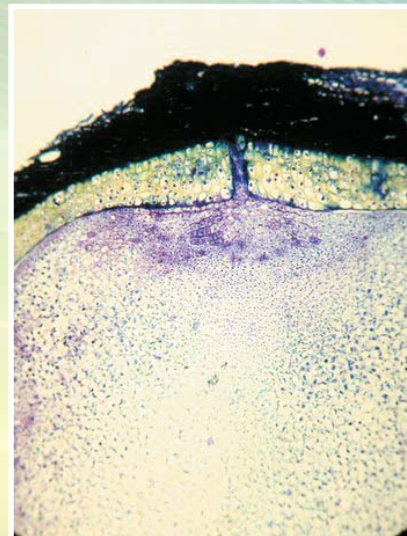
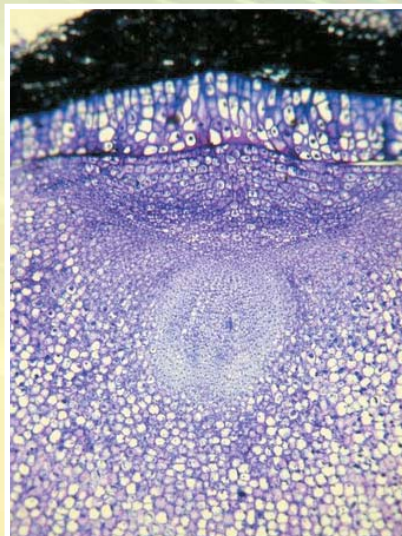
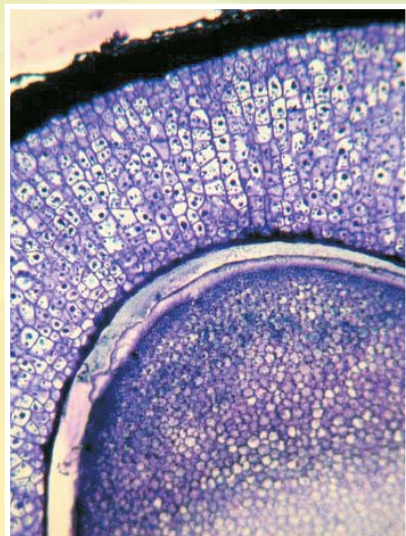
Collection of germplasm accessions in Little Andamans



Dwarf dura palm identified at NRCOP-RS, Palode



Germinated pisifera seeds



Histological studies of seed germination



4. Research Achievements

तेल ताड प्रबन्धन

Oil Palm Management

OIL PALM MANAGEMENT

NUTRIENT MANAGEMENT

Studies on nitrogen and potassium management in adult Oil Palm (on farm trial):

With a view to assess the nitrogen and potassium requirement of an adult oil palm, the field experiment was started during 2003-2004 in a farmer's field. The treatments consisted of three levels of nitrogen (600, 900, 1200 g N per palm per year) and three levels of potassium (1200, 1800, 2400 g K per palm per year), laid out in a factorial randomized block design with three replications in a plot of five palms each. The yield data from the on-farm trial were collected and statistically analysed. Number of bunches varied between 1.08 and 3.38 per palm per year among different treatments. The FFB yield varied between 36.6 and 116.8 kg per palm per year among different treatments. Both these parameters were not affected by the treatments. It is also observed that most of the palms had more than one un-opened leaves (spindles), which indicated that the palms experienced stress.

Nutrient Management (Fertilizer requirement of Oil Palm during pre-bearing stage):

The experiment on standardization of fertilizer doses during pre-bearing stage was continued to assess the early yield performance of young palms. The fertilizers were applied in two equal split

doses coinciding with the monsoon seasons. The growth observations on height, girth, number of leaves produced, leaf area of 9th leaf, number of male, female and hermaphrodite inflorescences were recorded. For all the growth characters, the T₄ treatment (1200-600-1200) recorded the maximum value (Table 20). For height, all the treatments were on par except control. Girth was on par for T₄, T₃ and T₂. For annual leaf production, all the treatments except T₂ were on par. T₄ recorded the maximum leaf area and was significantly superior to all other treatments. There were no significant differences among the treatments for FFB yield. Maximum number of bunches was produced in T₃ followed by T₄ treatment. The highest FFB yield was recorded by T₄ followed by T₆.

The soil samples collected during the year before fertilizer application were analyzed for available nutrient status and the leaf samples for foliar nutrient levels. The foliar nutrient levels were in the optimum range except nitrogen, which was slightly less than the optimum in T₁ and T₂.

Studies on the nutrient and water management studies in oil palm

The experiment was laid in split-split plot design in three replications with 3 main plot treatments (drip, micro-jet and basin methods of irrigation), 3 sub-plot treatments of irrigation levels [(IW/CPE = 1.0 (I-1), 0.8 (I-2) and 0.6 (I-3)] and 3 sub-

Table 20. Growth parameters and FFB yield of palms after four years of planting

Treatments (N-P ₂ O ₅ -K ₂ O)	Height (m)	Girth (m)	Annual leaf production	Leaf area (m ²)	FFB yield (Kg/palm)
T ₁ (0-0-0)	4.52	1.59	25.44	2.71	7.07
T ₂ (600-300-600)	5.03	1.69	20.29	3.01	9.53
T ₃ (900-450-900)	4.95	1.71	24.29	3.05	11.66
T ₄ (1200-600-1200)	5.06	1.97	27.39	3.74	17.62
T ₅ (1500-750-1500)	4.89	1.61	23.30	2.85	10.43
T ₆ (1800-900-1800)	5.02	1.68	24.82	3.06	13.98
CD (+)	0.42	0.27	4.73	0.61	NS



sub plot treatments of fertilizer levels [900N: 450P₂O₅: 900K (F-1); 1800N: 900P₂O₅: 1800K (F-2), 2700N: 1350P₂O₅: 2700K (F-3)]. Irrigation was scheduled based on evaporation rate and canopy area.

Palms irrigated with drips recorded maximum height of 147.48 cm and was on par with palms irrigated with jets (137.72 cm). Both these were significantly superior to palms irrigated with basin (65.71 cm). Girth of oil palm was higher in drip and jet irrigated palms as compared to basin irrigated palms and in each of the methods, girth decreased with decreasing level of irrigation, however, the magnitude of decrease differed with each method. Palms irrigated with jets produced maximum no. of leaves followed by palms irrigated with drip and basin. Irrespective of irrigation method unopened spear leaves were more than one (2.74, 2.76 and 4.40 in palms irrigated with drip, jet and basin irrigation respectively). Similarly leaf dry weight, and total leaf area were more in palms irrigated with drip and jet irrigations as compared to palms irrigated with basin irrigation treatment. Both these parameters showed a decreasing trend with decrease in the amount of water applied. Regarding yield parameters, palms irrigated with drips recorded maximum yield of 41.88 kg/palm followed by palms irrigated with jet and basin (33.99 kg/palm & 4.91 kg/palm). Among irrigation levels I-1 recorded maximum yield of 32.26 kg/palm followed by I-2 & I-3 27.10 & 21.4 kg/palm. Relating to bunch production palms irrigated with drips recorded maximum number of bunches

(6.71) followed by jet and basin irrigated palms (5.58 & 1.07). In irrigation levels I-1 recorded maximum no of bunches (5.10) followed by I-2 and I-3 (4.45 and 3.81). Because of non-availability of sufficient irrigation water the irrigation levels could not be maintained. This has reflected in a number of unopened leaves even in palms irrigated drip and jets.

Analysis of Leaf samples: The leaf and soil samples from farmers' fields and research centres are being analysed for nutrients. During 2005-06 a total of 538 leaf and 1138 soil samples from farmer's fields and experimental plots were analyzed for different nutrients.

Oil Palm based Cropping System

Intercropping in oil palm- Survey on Light infiltration:

A total of 34 oil palm gardens in West Godavari District were surveyed. The age of oil palm gardens varied between 9 and 19 years. Age of Cocoa varied from 1-5 years and Dry Cocoa bean yield between 0-1 kg per tree. The range of light above the canopy varied between 1384-1849 $\mu\text{mol}/\text{sq.m/s}$ (Table 21). The maximum light measured below the oil palm canopy was 591.77 $\mu\text{mol}/\text{sq.m/s}$ which was 37% of the above canopy radiation; the lowest radiation below the canopy was 41.29 $\mu\text{mol}/\text{sq.m/s}$ (2.98). However, the average radiation above and below the oil palm canopy and the percentage available below the oil palm canopy were 1647.76 and 227.29 $\mu\text{mol}/\text{sq.m/s}$ which works out to be 13.79 percent. The low yield levels of Cocoa could be attributed to

Table 21. Radiation interception in oil palm gardens inter cropped with cocoa and other crops

Age Years	Intercrops grown	Radiation interception (Intercrops) - PAR		
		Open sky $\mu\text{mol}/\text{sq.m/s}$	Above $\mu\text{mol}/\text{sq.m/s}$	Below $\mu\text{mol}/\text{sq.m/s}$
9	Oil Palm + Arecanut + Vanilla	1200	188.4	92.4
9	Oil Palm + Arecanut	1100	95.8	50.3
9	Oil Palm + Cocoa	1165	145.1	36.5
11	Oil Palm + Cocoa	1279	40	5.5
20	Coconut + Cocoa	1320	531	40

low availability of light under oil palm plantations as the saturation of Cocoa leaf takes place around 800 $\mu\text{mol}/\text{sq.m/s}$.

Agro-techniques and land use systems for soil, water and nutrient conservation in oil palm plantations of hill slopes

The field experiment was started during 2000 with eight sets of treatments involving different crop combinations and various soil and water conservation measures. All the inter crops viz., cocoa, cinnamon; pepper, guinea grass, anthurium and kacholam were in the yielding stage. Cocoa yielded an average of 2 kg dry beans per ha whereas cinnamon yielded 87.4 kg of quills and quillings. Pepper when trailed on palms yielded 15 kg of dry pepper and on *Glyricidea* planted in the inter spaces, yielded 28 kg. The performance of kacholam was poor (yielding only 10 kg of rhizomes). Anthurium produced 7500 flowers during the period and guinea grass yield ranged from 32-47 tonnes per ha.

The soil and leaf samples collected were analyzed for available nutrient status and foliar nutrient levels, respectively. The run-off samples collected after every event of rain were processed in the lab and the quantity of soil and water loss at monthly intervals was calculated. The nutrient content of run-off samples was analysed and the nutrient loss from a hectare of plantation in different treatments were worked out. In general, the loss was less from the plantation. The water loss ranged from 7962 to 63618 litres and the soil loss ranged from 3.7 to 34.7 kg. Nutrients losses to the tune of 0.5-6.0 kg N, 0.3-4.9 kg P and 10.1-65.1 kg K were recorded in one year.

MIXED FARMING SYSTEM IN THE IRRIGATED OIL PALM PLANTATIONS

Crops like banana, bottle gourd, maize, drum stick, papaya, curry leaves, sweet potato, brinjal, radish, pumpkin, beans, tomato, and flowers like *Heliconia* were raised during the reported period in the interspaces of the oil palm plants. Yield data of all the plants was collected. Heavy yields

of drumstick were obtained with average yield of 371 fruits per plant.

A total of 52.5kg of mushrooms were cultivated on the oil palm mesocarp waste. Heavy production of mushrooms was observed during November followed by December. Low production was observed during the months of May and April as the high temperatures were existed causing detrimental effect on the growth. 3.75 tonnes of vermi-compost was generated using the dung and leftover material of intercrops in three beds of 50m length during the period.

Animals like lambs were maintained to obtain subsidiary income using the different sludge as the constituents of the feed material. These lambs were also fed with guinea grass raised in the interspaces of oil palm plants.

Rhinoceros beetle infestation was observed higher in Malaysian cross namely Guthrie compared to other crosses viz. Deli X Ghana, Deli X Nigeria and Palode.

No adverse effects were observed on the main crop i.e. oil palm with the raising of drumstick as intercrop even though they were adjacent. Regular pruning of drumstick after harvesting of fruits was found better way to stop the lanky ness of the oil palm as getting more sunlight benefited the latter.

Both pumpkin and bottle gourd yielded very well with 128 and 158 numbers of fruits respectively when raised in the basins of banana in half an acre area. Since these did not require any extra water the yields are extra benefits from unit area by providing income during the year round.

With the extraction of biogas using the palm oil sludge of the processing factory, no extra money was spent for mushroom production in way of boiling the water for sterilization of the bed material.

Effect of microorganisms on the population of earthworms in the vermi-compost pits was



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studied using microbial agents namely *Metarhizium anisopliae*, *Beauveria bassiana* and *Trichoderma viride*. No mortality was observed on the earthworm population.

Curry leaf plants were found to be the best intercrop during the second and third year of plantations as they grew very well because of partial shade and yielded nearly 180kg from 0.20acres.

No major pest problem was observed that was migrating from main to intercrop and vice versa during the reported period. However heavy incidence of scales was observed on curry leaves.

PHYSIOLOGICAL & BIOCHEMICAL STUDIES ON GROWTH AND YIELD

Diurnal variations in sap flow in adult oil palm plantations

Measurement of xylem flux is one of the ways in monitoring the plant stress responses to the changes in the environmental conditions. The sap flux was monitored by sap flow analyser (Delta-T, UK). A perusal of the xylem sap flow data taken from 15-18th January 2006 revealed that the sap flux (Fig. 11) closely changed with potential evaporation (PE). As PE is mostly zero during nights, the xylem flux also followed the same trend. The xylem flux then increased till noon and sharply decreased. Similar trend followed for the next consecutive three days

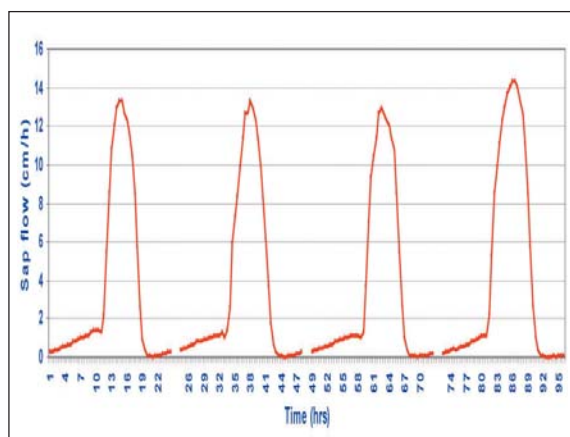


Fig. 11. Diurnal variations in sap flow in oil palm (15-18th January 2006)

during January 2006. Attempts will be made in future to study the sap flux in the fronds and also study the seasonal influence of sap flux in oil palm.

Studies on oil content and FAC of oil from different parts of bunch and fruit

To study the qualitative and quantitative differences of oil in the different part of FFB, samples were collected for a period of one year. Each month five fully ripen bunches were collected randomly from *tenera* palms (source ASD Costa Rica) and each bunch was divided into five parts. Replicated fruit samples were collected from each part. Oil content and FAC in the five different portions of FFB and three different part of individual fruits have been carried out for two more months' (July and August) sample.

It was observed that portion I during had lesser amount of oleic (C18:1), linoleic (C18:2) and linolenic (C18:3) acids (unsaturated fatty acids) and in the same portion, the palmitic (C16:0) and stearic (C18:0) acid (saturated fatty acids) content was found highest.

Among the different parts of the fruits, the whitish part of the fruit, i.e., Part A has lesser amount of the three unsaturated fatty acids (C18:1, C18:2 and C18:3) and higher amount of major saturated fatty acids (C16:0 and C18:0).

SEED TECHNOLOGICAL STUDIES:

Pilot Studies on Breaking of Seed Dormancy :

Effect of seed pre-heating and its duration on germination in African germplasm:

Freshly harvested seeds of four African germplasm accessions were subjected to pre-heating for a period ranging from 10-90 days. Wide variation in the germination pattern was observed among the accessions and it was maximum (93.3, 96 & 36) with 60 days of heating for Cameroon, Tanzania and Guinea Bissau; for Zambia 80 days of heating gave maximum germination (80%).

Electron microscopic studies: Seed tissues showing morphological changes in the operculum and adjoining areas were subjected to scanning through Electron microscopy (6kv RUSKA - SEM X50 500i) to confirm breaking of dormancy due to pre-heat treatments. The control seeds (with out heating & soaking) did not show any change in the operculum centre point whereas seeds subjected to pre-heating (10-70 days and soaking (5 d) showed slight expansion initially and cracking of seed coat during subsequent durations.

Histological studies: Pre heated seeds were subjected to histological studies using microtome. The embryo, adjoining endosperm below operculum were sectioned and investigated for changes due to pre-heating before germination. Ring of minute cells above the embryo, which gets split during germination. The point at which splitting took place was found out, which was very clear from the seed subjected for 50-70 d of heating. Pre-heated seeds above 40 d duration were found to have enlarged endosperm ring. Seeds which received 50-60 d heating were found to have enlarged embryo with radicle and plumule and two bands of haustorium.

Pit method for enhancement of germination: Seeds were subjected to modified pit method adopted from method developed for teak seeds (seeds mixed with dried oil palm leaf biomass and put in nylon bags and kept in 1 cum sized pits during peak summer) along with control

(dry heat treatment). 88% germination was recorded on 40th day. Total germination was high when seeds were kept in pits for 40 & 50 days. Control took 71 days to complete 68% germination whereas maximum of 88% germination attained when seeds were kept for 40 days in pits. Evaluation of seedlings evaluation for growth parameters revealed that maximum shoots and root weight and total dry matter production was in seeds exposed for 40 days in pits (Table 19).


Acid scarification: Different Oil palm genotypes were subjected to acid scarification with sulphuric acid to know its effect on germination. Seeds were treated with 3%, 5% and 10 % concentrations of acid for different durations starting from 0 hrs to 19 hrs. Five African dura genotypes and two inter specific hybrid seeds were used for the purpose. Total germination was very poor in all the seeds exposed to acid scarification. In most cases all the treatments seeds took 42 days to initiate germination. Increased concentration and duration of exposure was found affecting viability of seeds.

Microbial treatments: The effect of non-pathogenic lignin degrading microbial organisms on germination enhancement in oil palm was started during the reported period. Lignin degrading microbial cultures were procured from National Chemical laboratory, Pune and

Table 19. Germination of seeds in modified pit method

Treatment	Germination % on specific days	Final germination	Total duration of germination(Days)
20 days in pit	0	61.3	71
30 days in pit	33.3	52.0	45
40 days in pit	88.0	88.0	40
50 days in pit	88.0	88.0	51
60 days in pit	82.6	86.6	80
70 days in pit	76.6	86.6	80
Control (Dry heat)	0	68.0	71
CD	9.68	15.08	





IMPTECH, Chandigarh for utilizing them for oil palm dormancy studies. The different hybrid combinations obtained from seed garden, Rajahmundry were mixed with sterilized oil palm degraded biomass and cultured with the above microbes.



Different growth media for evaluation of sprouts of cross combinations: An experiment was conducted to see the influence of different growth media for oil palm sprouts germination and growth to find out correct media for seed testing. The media used was sand, red

soil, peat moss, germination paper and control also maintained without any media. The freshly sprouted seeds were used for the purpose. The sprouts were maintained in the respective media for three months. Every month sample seedlings were taken and evaluated for growth parameters as well as dry matter production. It was found that overall growth parameters were better in red soil media and which was on par with germination paper. The total dry matter was high in germination paper. But number of leaves was found more in sand media.

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4. Research Achievements

**तेल ताड नाशी-कीड़ा एवं
बीमारी प्रबन्धन**

**Oil Palm Pest and Disease
Management**

OIL PALM PEST AND DISEASE MANAGEMENT

Studies on insect, avian and mammalian pests of Oil Palm and their management

Survey for pest incidence and infestation was carried out in Oil Palm gardens of Krishna, West Godavari, Visakhapatnam, Vizianagaram, East Godavari, Srikakulam and Nellore districts of Andhra Pradesh; Belgaum district of Karnataka, North and south Goa districts of Goa, Kolasib, Lungpui districts of Mizoram, West Tripura and South Tripura districts of Tripura, Guwahati of Assam, Darjeeling and Jalpaiguri districts of West Bengal, Tiruvananthapuram, Bharatipuram, Kulathpuzha, Kuttanad and Thodupuzha areas of Kerala and Rayagada district of Orissa.

Incidence of rhinoceros beetle was observed at low levels in all the areas surveyed which could be due to heavy rains. Incidence of leaf eating caterpillar was heavy in the aged gardens of East Godavari district of Andhra Pradesh. Incidence of rats was severe, feeding from both under ground as well as from top of the young plants in Kuttanad area of Kerala causing more than 40% mortality. In North Eastern states, rhinoceros was only observed as the major pest. In Baspadua area of Tripura, made of rats and wild boar were observed.

House crow and mynah among birds in Krishna district, crows and parakeets in West and East Godavari district, mynah in Vizianagaram district were the predominant avian pests causing moderate to heavy damage.

Incidence of black slug, *Laevicaulus alte* belongs to Class Gastropoda, Sub class Pulmonata, Order Stylommatophora and Family Vaginulida was observed feeding on the just emerged sprouts causing severe damage to the plumule region.

Incidence of sorghum shoot borer *Sesamia inferens* on both primary and secondary seedlings in Andhra Pradesh and Karnataka was observed causing severe losses in the nursery. The

caterpillar was observed boring into the spindle leaf and occasionally killing the plants. The growth of the plant was hampered drastically. Incidence of hairy caterpillar, *Dasychira mendosa* was moderate in Kerala area causing defoliation at low levels.

Incidence of birds was observed from 130 days after pollination of the female flower and continued till harvest. During lean periods of oil palm FFB production and summer months, incidence was observed even on 100 day old FFB, due to non availability of the food material.

Management of Pests


These were effectively controlled using indigenous methods like keeping common salt pellets.

Investigations carried out on the leaf eating caterpillar incidence on Oil palm indicated that the pest was effectively controlled with microbial agent *Beauveria bassiana* on par with quinalphos.

Beauveria bassiana that caused white muscardine disease was found effective in controlling the pest after 7 days of the treatment. The infection was profuse even at 10^{-3} concentration. The spore count of *Beauveria bassiana* in different growth media indicated that the Rice powder broth was found to harbour more number of spores (3.32×10^6) followed by Rice powder sugar broth (2.84×10^6) compared to PDA broth (0.93×10^6). Maximum number of spores of *Beauveria bassiana* (0.98×10^6) were observed at pH 6 followed by pH 7 (0.89×10^6) and pH 5 (0.80×10^6) at 10^{-1} dilution. No spore population was observed at 3 & 10 pH. Studies on effect of salt concentration on the growth of *Beauveria bassiana* indicated that the fungus can sustain up to 0.5% salt level. As the concentration was increased to 30% & above the intensity came down and there was no growth.



DEVELOPMENT OF INTEGRATED MANAGEMENT PRACTICES FOR AVIAN AND MAMMALIAN PESTS OF OIL PALM USING THE LATEST DEVICES



Nylon nets were found to be long lasting compared to plastic ones as the latter was found to be ineffective after one use. Green and violet coloured fishnets were found to trap more number of birds because of poor visibility as compared to white and other colours. Five nets per acre were found optimum to make the plantation free from bird infestation.

The per cent infestation has come down to 0 from 40 within one week after tying the nets. However maintenance of nets at every trapping was required to keep them fit to receive the birds. Nets having the mesh size of 5 sq cm was found to trap all the avian pests compared to 10 sq.cm. Experiments conducted on the effectiveness of fishnets in trapping the birds in different aged gardens revealed no difference among different gardens and was found on par with each other.

COMMERCIAL PRODUCTION OF GREEN MUSCARDINE FUNGUS METARHIZIUM ANISOPLIAE FOR THE CONTROL OF INSECT PESTS

The sustainability of the *Beauveria bassiana* spores to different temperatures carried out for different time periods indicated that the thermal death time was at 21 hours at 30°C temperature and beyond where the fungus did not survival. Similarly the effect of UV radiation on growth of *Beauveria bassiana* was carried out by exposing them to different periods indicated poor growth when the exposure was beyond 4 minutes.

Application of *Metarhizium* culture in FYM pits reduced the rhinoceros incidence from 5.29 to 0.57 (average number of grubs in 1 square area). Spraying of talc formulated culture on dead logs of coconut and crown region of oil palm showed very less incidence and infestation. In dead coconut logs the incidence was reduced from 6.07 to 0.67 (average number of grubs in 30 logs). Application of *Metarhizium* on palms caused

infestation (1.57%) compared to the unsprayed palms (6.74%).

Commercial formulation of the product was prepared and supplied to different Oil palm growers for further multiplication and spread into the plantations. A total of 300 kgs of the product having both *Metarhizium anisopliae* and *Trichoderma viride* was distributed to the farmers for further multiplication.

Compatibility studies

Application of microbial agents viz. *Metarhizium anisopliae*, *Beauveria bassiana* and *Trichoderma viride* did not cause any harm to the earthworms when applied into the vermin compost pits.

Commercial product of *Metarhizium anisopliae* mixed with talc powder caused mortality to the worms where as the bioagent cultured in broth medium did not show any mortality indicating that the spores were not harmful but the filler talc material was harmful.

Rhinoceros beetle population was not found in any vermicomposting pits that were treated with *Metarhizium anisopliae* where as it was observed in control as well as *Trichoderma* treated pits.

More number of spore colonies were found in the commercial product that was having the mixture of both *Metarhizium anisopliae* and *Trichoderma viride* when compared to individual organisms indicating the compatibility of both the fungi. All fungicides were found toxic to the growth of *M. anisopliae* but in PD broth having copper oxy-chloride exhibited fungal growth with low sporulation. In case of insecticides, monocrotophos exhibited the less inhibition and other insecticides show moderate inhibition. All the fertilizers were found less toxic compared to fungicides and insecticides.

Studies on Pollinating Weevil

The total duration of the presence of pollinating weevils was 27 days on male spikes

during normal periods. High temperatures of more than 37°C and low humidity of less than 40% in the oil palm orchards during summer months of April to June had observed weevils populations resulting in bunch failure.

SURVEY ON OIL PALM DISEASES :

Disease incidence in the plantations of NRCOP, Pedavegi and Palode was monitored. At Palode, five spear rot disease and four basal stem rot affected palms were identified in the germplasm and dura blocks. At Pedavegi disease incidence of bud rot, stem wet rot and orange spotting were recorded very low. Survey was carried in few plantations of West Godavari and Visakhapatnam districts. Out of 16,835 palms, 64 palms were affected by orange spotting, one by stem wet rot and 97 by bud rot. Treatments were given to 97 bud rot disease affected palms and out of that 90 got recovered.

At NRCOP, Pedavegi, the Bunch End Rot (BER) incidence was observed on 34 palms. The incidence was more in Varietal trial plot (5%) followed by GXE field (3.6%) and Inter specific hybrid plot (2.2%). The percent incidence of Bunch End Rot (BER) during the months of May and June ranged from 1.56 to 11.48%.

Morphological observations of the Orange Spotting affected palms were compared with healthy palms revealed that there is a reduction in the number of leaves (27.6%), Height of the palm (34.3%), length of leaves (34.7%) and number of leaflets (24.5) indicating the debilitating nature of the disease. The inflorescence emergence was drastically reduced. However the extent of reduction in morphological parameters needs confirmation by recording the data on more orange spotting palms in comparison with the healthy palms using statistical analysis.

Wilt of crops with special reference to cultural, morphological, molecular characterization and pathogenic variability of isolates in India

Oil Palm plantations of East and West Godavari districts of Andhra Pradesh located in

Rajahmundry, Makinavarigudem, Jagannathapuram, Duppalapudi, Namavaram, Peddapuram and Pedavegi, Palode in Thiruvananthapuram district of Kerala and Mohitnagar areas of Jalpaiguri district of West Bengal were surveyed for Basal Stem Rot incidence. The incidence ranged from 0.003 to 2.08% (Fig. 12). Disease incidence was observed in the Oil Palm gardens that were raised in the vicinity of Coconut, Palmyra and cashew nut having incidence of Basal Stem Rot. In Rajahmundry and Makinavarigudem, the disease spread was observed from infected palms to the surrounding palms, mainly to the adjacent palms. This indicated that root to root contact of palms plays an important role in the disease spread.

Collection & isolation of isolates : Thirty two suspected *Ganoderma* isolates were isolated from infected root bits/ stem tissues/ brackets. The native antagonists isolated from rhizosphere of roots of infected palms were 6 isolates of *Trichoderma* sp.

Transmission studies: Electron microscopy of spear leaf tissues of orange spotting affected palms revealed rod-shaped virus particles resembling TMV (Fig.13).

PCR studies of phytoplasma associated with Spear Rot Disease: Spear leaf samples from 11 suspected spear rot affected palms were collected from Palode and DNA isolated from them. Out of 11 suspected spear rot disease-affected palms, four were found positive by PCR

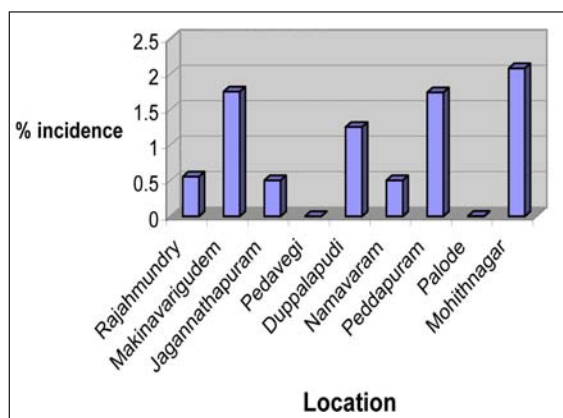


Fig. 12 : Percentage incidence of BSR disease in different locations



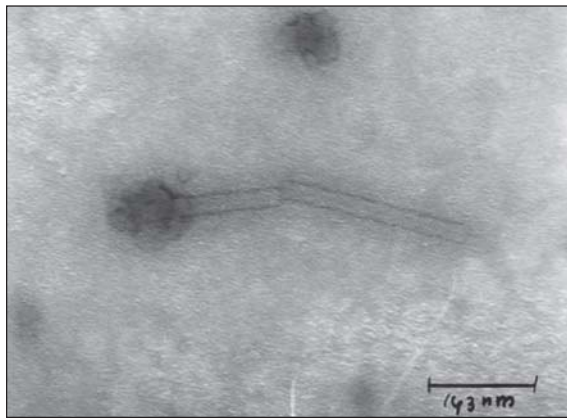


Fig. 13. Rod-shaped virus particles observed under electron microscopy of spear leaf tissues of orange spotting affected palms

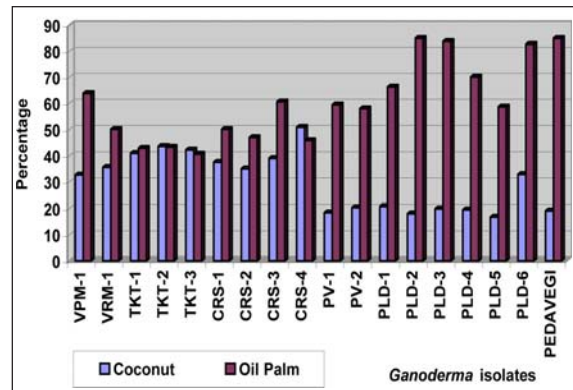


Fig. 15. In vitro biomass degradation of coconut and oil palm stem tissue by different Ganoderma isolates

analysis (Fig. 14). However, it needs confirmation with more samples and primers.

Comparative analysis of isolates of Ganoderma in Oil Palm and Coconut:

Comparative analysis of 7 isolates from oil palm garden and 11 isolates from coconut garden were carried out for both biomass degradation studies as well as for DNA fingerprinting. Results showed that all the isolates degraded more oil palm tissues than that of coconut tissues except CRS-4 isolate collected from CRS, Veppankulam and G6 isolate collected from Palode oil palm garden which degraded more of coconut root. (Fig. 15 & 16). Two isolates from Peravurani, Thanjavur, Tamil Nadu (PV-1 and PV-2) were different from the other isolates collected from the coconut garden and it seemed those two isolates were more similar to oil palm isolates. DNA fingerprinting analysis by RAPD showed that 3 major groups were formed by the 13 isolates, where as remaining 5 isolates (3 from coconut garden, and two from oil palm garden) did not form any cluster (Fig. 17). A representative photograph is of RAPD of the 18 isolates is presented in

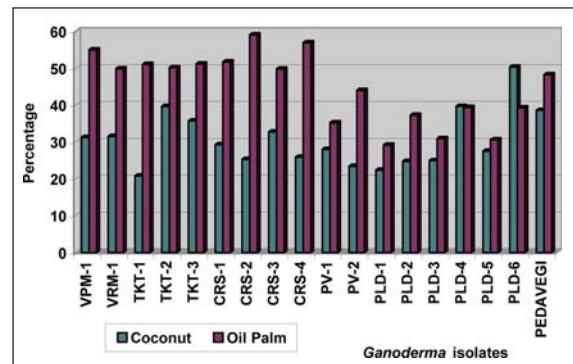


Fig. 16. In vitro biomass degradation of coconut and oil palm root tissue by different Ganoderma isolates

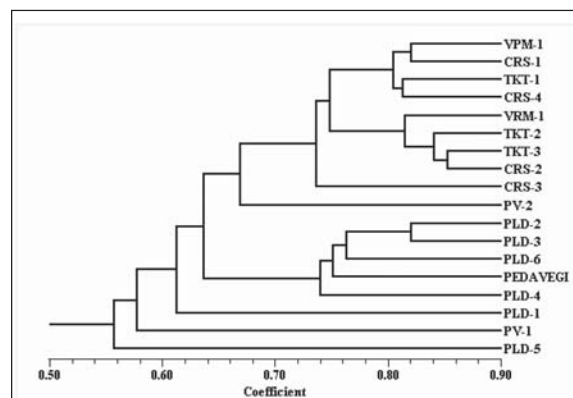


Fig. 17. Dendrogram showing cluster analysis result of 18 Ganoderma isolates

Fig. 14. PCR detection of suspected Spear Rot affected palms



Fig. 18. These clusters were similar to isolates collected from oil palm garden, though they did not form any cluster, and a similar trend was observed by biomass degradation study also.

Studies on Antagonistic activity by Dual culture technique: *Trichoderma viride*, *T. harzianum*, *T. hamatum* and *Trichoderma* cultures isolated from Makinavarigudem, Rajahmundry, Peddapuram, Namavaram and Jagannathapuram were used for testing their efficacy against *Ganoderma* isolates of Makinavarigudem, Rajahmundry and Peddapuram by dual culture technique.

It was observed that more than 60% inhibition of *Ganoderma* fungus was recorded in most of the isolates of *Trichoderma* under study (Fig. 19). *T. harzianum* was found more effective than that of the other *Trichoderma* isolates.

Effect of volatile compounds on growth of *Ganoderma*: Influence of volatile compounds produced by *Trichoderma viride*, *T. harzianum* and *T. hamatum* was studied. It was observed that *T. viride* and *T. harzianum* inhibited the growth of *Ganoderma* isolates most effectively at 7 days of inoculation (Fig. 20).

Effect of non-volatile compounds (culture filtrates) on growth of *Ganoderma*: Eleven *Trichoderma* isolates (isolated from different Oil Palm gardens) were evaluated against *Ganoderma* sp. (Makinavarigudem) through their culture filtrates at 10% concentration, under *in vitro*

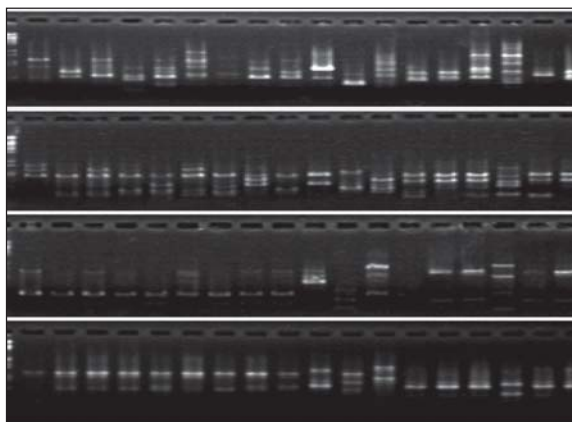


Fig. 18. RAPD of the 18 *Ganoderma* isolates

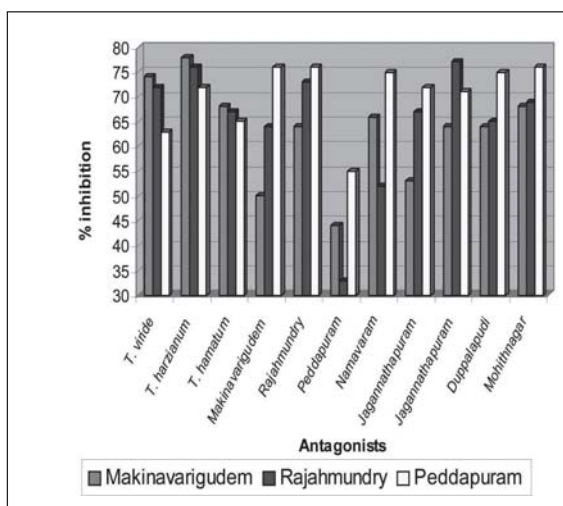


Fig. 19: Percent inhibition of *Trichoderma* isolates on growth of *Ganoderma* isolates of Oil Palm

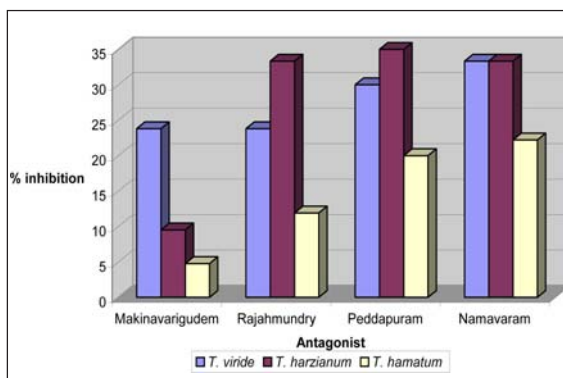


Fig. 20 : Effect of volatile compounds of *Trichoderma* sp. on radial growth (% inhibition) of *Ganoderma* isolates of Oil Palm

conditions by poisoned-food technique. Percentage inhibition ranged from 5.88 to 35.29 and Mohitnagar culture exhibited the highest inhibition.

Pathogenicity studies: One hundred tenera sprouts were raised in poly bags for taking up the pathogenicity studies using *Ganoderma* isolates. Thirty-three oil palm seedlings, of 10 months age were inoculated using 11 isolates of *Ganoderma* multiplied on oil palm root bits. No symptoms were observed on inoculated seedlings so far even after 7 months.

In vitro biomass reduction study: Healthy oil palm root bits were inoculated with different *Ganoderma* isolates and the biomass reduction



was estimated 9 weeks after inoculation. The biomass reduction was more in Rajahmundry isolate followed by Makinavarigudem, Peddapuram and Namavaram isolates.

Molecular characterization: DNA was isolated, purified and quantified from 38 suspected *Ganoderma* cultures collected from oil palm gardens of Rajahmundry, Makinavarigudem, Jagannathapuram, Nagannagudem, Peddapuram, Duppalapudi, Nagannagudem, Mohitnagar and Palode. One pair of *Ganoderma* specific primers namely *Gan1* & *Gan2* was used for diagnosis of the 38 suspected isolates and only 14 were found *Ganoderma* positive. The positive isolates were from Makinavarigudem Palm No. 2, Palm No. 4, Rajahmundry Palm No. 621, Rajahmundry Palm No. 866, Peddapuram, Namavaram (cashew), Pedavegi, Jagannathapuram Palm No.2, Jagannathapuram Palm No.3, Nagannagudem (Coconut isolate) and Palode. Remaining three of the fourteen isolates were from 2 Palmyra palms and one wild date palm inside the Rajahmundry oil palm plantation. A 167 bp band was observed in the PCR product in case of positive isolates.

The result was confirmed using another pair of *Ganoderma* specific primers namely *Gan ET* and *ITS*. The result conformed the previous PCR based result with an approximate 500 bp band in the case of the fourteen isolates mentioned earlier. A representative photograph with *Gan1*-*Gan2* primers and *Gan ET*-*ITS* are presented in Fig. 21 & 22 respectively. To confirm the result further, the annealing temperature (standard used

was 52°C) was varied from 50 - 55°C and no change was observed (Fig. 23).

To design a PCR base diagnosis kit with adoptable cost, an attempt was made to optimize and economize the technique. Enzyme concentration was reduced from 2U per reaction to 0.5U per reaction and no change in amplification was observed (Fig. 24). Similarly the concentration of the primers from 15ng (each primer) to 7.5ng did not show any change (Fig. 25). Further, the reaction volume was reduced from 25µl to 12.5µl successfully.

DNA concentration from 20ng to 5ng for 12.5µl reaction volume did not show any difference (Fig. 26).

Effect of plant leaf extracts on the growth of *Ganoderma* sp.: Thirteen botanicals were evaluated against *Ganoderma* sp. (Makinavarigudem isolate) through their aqueous, acetone and alcohol extracts at 10% concentration, under *in vitro* conditions by poisoned-food technique. All were extracted from fresh leaves. Alcohol extracts showed more inhibition followed by Acetone extracts (Fig. 27). Alcoholic and acetone extracts of *Vinca rosea*, *Aloevera* sp., *Parthenium hysterophorus*, *Phyllanthus niruri* and *Tridax procumbens* showed 100% inhibition. Alcohol extracts of *Cassia auriculata*, *Cassia occidentalis*, *Acyranthus aspera* and *Ocimum sanctum* also showed 100% inhibition. Aqueous extracts of *Acyranthus aspera* plant product exhibited 75% inhibition followed by 70% inhibition with *Parthenium hysterophorus* plant extract.



Fig. 21. Detection of *Ganoderma* sp. with *Gan 1* and *Gan 2*



Fig. 22. Detection of *Ganoderma* sp. with *Gan ET* and *Gan ITS*

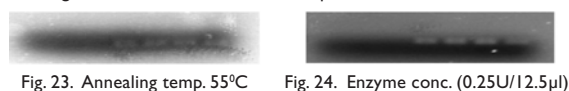


Fig. 23. Annealing temp. 55°C

Fig. 24. Enzyme conc. (0.25U/12.5µl)



Fig. 25. Different Primer concentration



Fig. 26. Different DNA concentration

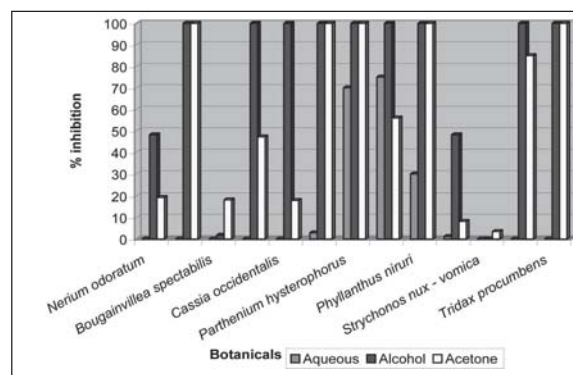


Fig. 27. Antifungal activity of botanicals against *Ganoderma* sp

OIL PALM CROP PROTECTION



Protection from wild boars in Tripura



Bunch failure observed at Baspadua (Tripura) due to lack of pollinating weevils



Symptoms of Mynah and crow damage on oil palm FFB



Damage of black slug on one day old seedlings



Incidence of shoot borer in oil palm seedlings





4. Research Achievements
तेल ताड कटाई-उपरान्त
प्रौद्योगिकी
Oil Palm Post Harvest
Technology

OIL PALM POST HARVEST TECHNOLOGY

A. PROCESSING

Construction of Mini Palm Oil Mill: A mini palm oil mill with a capacity to process 1 MT of Fresh Fruit Bunches (FFB) per hour is developed. The total cost of the mill including infrastructure is estimated less than 20 lakhs where as the estimated cost for a 1MT/hr capacity palm oil mill in the widely followed state of art technology in the country is 100 lakhs. The mill consists of a small industrial type boiler, an inclined sterilizer, decagonal stripper, a digester cum screw press, rectangular clarifier, mini palm oil centrifuge, weighing systems, mini nut cracker and a hand cum motor operated nut fibre separator to carry out various unit operations in palm oil extraction. The mill is devised in such a way that it is easily maintainable and can be repaired locally. Manual power is taken into advantage for material handling to reduce the initial investment and to create employment opportunities for rural youth. The mill operation is simple that this can be managed by woman labour also.

It is envisaged to utilize such mills to meet the processing need of isolated pockets in which oil palm is grown and also to act as demonstration units to give confidence to farmers in new areas identified for oil palm cultivation where entrepreneurs are reluctant to install big capacity mills with huge investment in the beginning of plantation establishment. Being low in cost, this mill can be established by farmers also so as to avoid middlemen in adding value to their produce. This mill makes on farm processing of the highly perishable oil palm fruits possible, which obviously improves the oil quality by reducing delay between harvest and processing.

It is also envisaged to use this mill to conduct studies on estimation of oil content in small FFB samples of size as low as 100 kg.

Estimation of Oil Extraction Ratio (OER) in Palm Oil Mills: Oil extraction ratio is the

quantity of crude palm oil extracted from unit weight of fresh fruit bunches (FFBs) expressed in percentage. A study was conducted to estimate the OER in the palm oil mills of Karnataka as requested by Department of Horticulture, Karnataka. It was observed that the OER in the 10MT/hr capacity mill under study was 14.39% and that in the 1MT/hr capacity mill was 15.70%. These OER figures were less compared to the average range (17-18%) reported by the mills due to high percentage of rotten and immature bunches in the sample.

Drying Characteristics of Oil Palm Nuts:

Oil palm nuts contain kernels which is good source of palm kernel oil. Hence a study was conducted to understand the drying characteristics of oil palm nuts. Thin layer and deep bed drying of palm nuts were performed and drying curves were established. In both the cases, drying was done at heated air temperatures of 45 °C, 65 °C and 85 °C. Thin layer drying was done in a tray drier by spreading the nuts in a single layer in the trays arranged in a hot air chamber. Deep bed drying was done by passing hot air through a column of nuts having a height of 25 cm. The drying curves are given in Fig. 28 and 29.

B. FARM MECHANIZATION

Performance evaluation of Tractor Mounted Frond shredders:

Large number of fronds has to be cut during oil palm harvesting and hence disposal of fronds often creates problem to the farmers. Fronds heaped in plantations often hinder the movement of transportation devices, tillage machinery etc. and act as host for insects and reptiles. It is, therefore, recommended to shred the fronds with frond shredders and use it for vermi composting or mulching. Fronds are also suitable for gasification, which require cutting and size reduction. Mobile shredders would be suitable as it makes in-field disposal possible and avoids the transportation



Fig.28. Thin Layer Drying of Oil Palm Nuts- Drying Curves

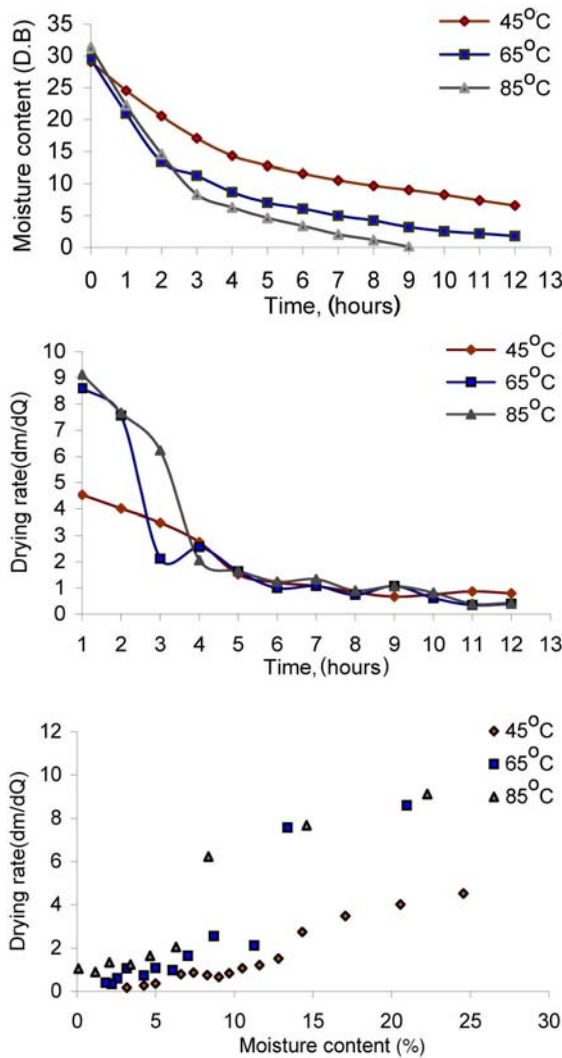
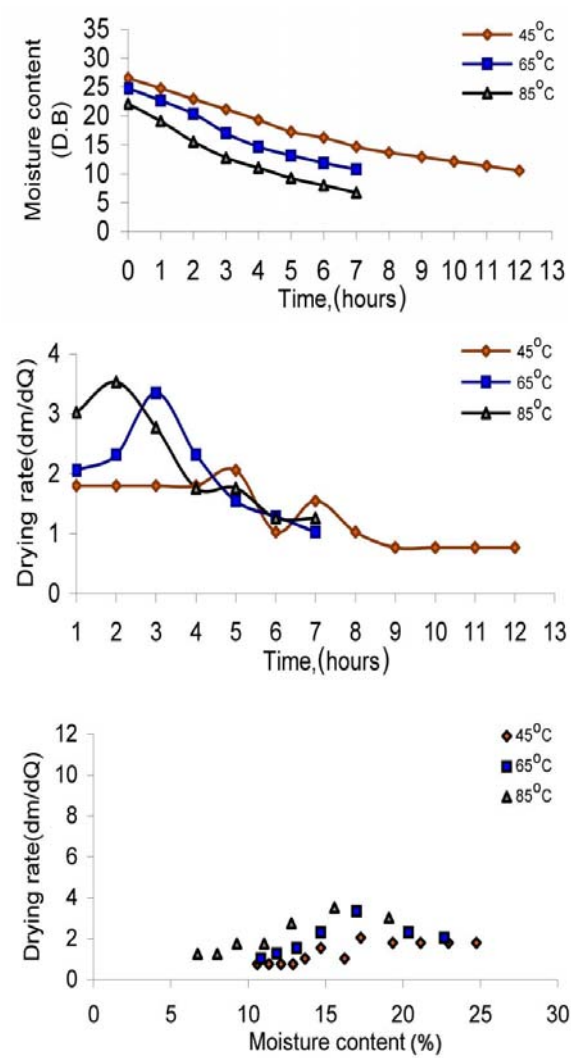


Fig. 29. Deep bed drying of Oil Palm Nuts- Drying Curves



of fronds and shredded mass. As the oil palm fronds are hard to cut, sturdy machinery with good quality blades are required for the purpose.

There are some models of tractor operated oil palm frond shredders recently introduced in the oil palm growing area in the country. As there is opinion from the farmers that all these models give troubles while operation, a study was conducted to evaluate the performance of various commercial models of tractor mounted oil palm frond shredders by monitoring their performance continuously for 8 hours each. It is observed that poor sharpness of blades is the major drawback of all these machines. As a result,

blades need to be dismantled and sharpened frequently. The frequency of sharpening varied from 'after 1 hour of operation' to 'after 7-8 hours of operation'. As the blades get exhausted in terms of sharpness, chocking of the machine and high power consumption was observed. It was also observed that shifting these machine from one place to other was a difficult and time consuming job since each time the machine need to be dismantled from the prime mover. It is concluded from the study that these models need modification that a good quality material need to be identified for the blades and a machine-prime mover linkage system has to be developed

for making these machines trouble free and user-friendly.

C.WASTE UTILIZATION

Establishment of a Pilot Plant for Palm Fibre Extraction: The Empty Fruit Bunches (EFB) of oil palm, a left over of fruit stripping operation in palm oil mills is an abundant source of natural fibre with 25.08 per cent lignin, 59.86 per cent cellulose and 2.17 per cent hemicellulose content. It is mostly wasted except the use of a meager quantity for mulching. The conventional method of burning these residues often creates severe air pollution. On an average 0.25 MT of EFB is produced per tone of FFB processed. EFB fibres are clean, biodegradable and compatible than many other fibres from other wood species and are suitable for the manufacture of mattress, car seat, insulation, composite panels, medium-density fibre boards, thermal insulating materials, packaging materials, rubberized mattresses, coir geo-textiles etc. Effective utilization of this potential natural fibre not only adds profit for the processors, but also helps in environmental friendly disposal of EFB.

Manual methods of fibre extraction are tedious, time consuming and uneconomical. Hence National Research Centre for Oil Palm developed an EFB fibre extractor similar to coconut fibre extracting machine, which can extract and grade EFB fibre continuously and the technology has been commercialized. A pilot plant was established in the campus for demonstrating the technology to farmers and entrepreneurs with facility for drying the EFB, mechanized fibre extraction, grading and storing the extracted fibres and EFB.

Utilization and Recycling of Palm Oil Mill Effluent (POME)

Physicochemical and Biological characterization of (POME): Samples of fresh POME were collected from different collection points of four different Palm Oil Mills in Andhra Pradesh having different processing capacity and tested for their Physicochemical and biological

parameters. The estimated parameters are tabulated in tables 1-4.

Identification of predominant bacteria isolated from POME: The predominant bacteria from POME were isolated by streak plate technique and identified by analyzing colony morphology, spore structures, physiological and biochemical characterization. results are provided in Table 5.

Fish feed trial on POME based feeds: Growth trial on Fresh water fish *Rohu (Labeo rohita)* has been carried out using the decanter sludge as a chief ingredient of the fish feed, which has been selected based on its high crude protein value comparing to other POME derivative. The decanter sludge with 18% protein content was selected for fish feed formulation rather than the POS with 11% protein content. Fish feed with different concentrations of dried decanter sludge was formulated along with the conventional substrates. The growth record of the fish feeding on different feeds formulated with different concentrations of decanter sludge have reported significant variation in their growth and it was observed that Fish feed with 60% inclusion of decanter sludge proved good by increasing body weights.

Animal feed trials using POME based feed:

A. Ram lambs: Different treatments with feed comprising different concentrations of decanter sludge were prepared and growth trial was conducted on Ram lambs. Variation in body weights of experimental ram lambs is provided in Fig.30. Feed mixture CM II was found as the best increasing body weights of ram lambs.

B. Weaned piglets: Different concentrate mixtures were prepared by using decanter sludge as partial replacement of rice bran to reduce the cost of feed for piglets. Usage of dehydrated POME (collected from decanter sludge) in the diets of growing weaned piglets by replacing the de-oiled rice bran at various levels to make the POME incorporated diets more economical for rearing of piglets. Variation in body weights of experimental piglets is provided in Fig.32. Though



Table 22. Physicochemical and biological parameters of POME in Mill I

Collection point	Temperature	pH	Conductivity	BOD	COD
Raw POME	80	4.02	13.24	32000	87000
Sludge pit (mixing point of sterilizer condensate and Centrifuge mix)	64	4.30	13.00	29500	69500
Acidification pond (LIME)	54.2	4.36	11.00	21000	60000
Anaerobic pond (6months)	36.1	4.65	5.35	16570	31600
Aerobic pond (aerators)	33.9	4.86	6.42	9750	12500
Facultative pond (Final)	54.2	4.36	4.25	3000	950

Table 23. Physicochemical and biological parameters of POME in Mill II

Collection point	Temperature	pH	Conductivity (mS)	BOD	COD
Raw POME	28	4.07	9.71	35500	80500
Mixing pond	28	3.93	12.60	36000	87000
Anaerobic pond I	28	4.53	13.00	25300	66750
Anaerobic pond II	28	7.40	6.54	19400	43000
Facultative pond I	28	7.20	6.43	17000	15000
Facultative pond II	28	7.56	5.87	15350	13500

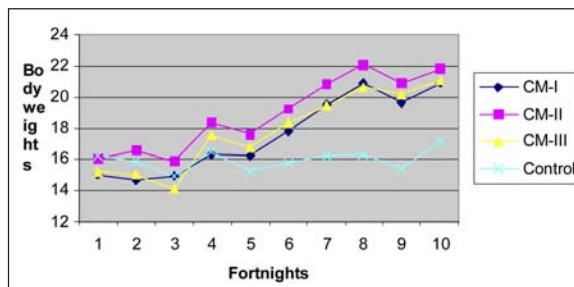
Table 24. Physicochemical and biological parameters of POME in Mill III

Collection point	Temperature	pH	Conductivity (mS)	BOD	COD
Fresh POME	63.5	4.60	13.20	34500	90000
Facultative (1 st) pond	50.5	5.10	12.00	28000	69500
Aerobic	42.5	5.20	7.23	19500	33400
Anaerobic pond	43.5	5.35	7.00	16000	15000
Final pond	39.5	7.23	6.42	4500	1200

Table 25. Physicochemical and biological parameters of POME in Mill IV

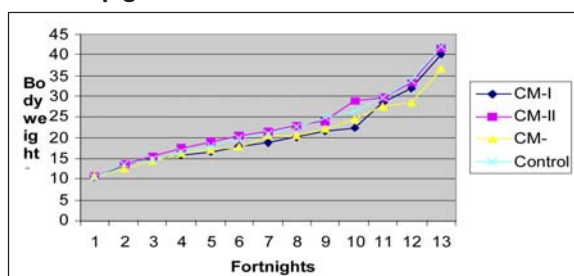
	Temperature	pH	Conductivity (mS)	BOD	COD
Raw POME [Collection pit]	82	4.32	13.00	35000	82000
Recovery tank	65	4.62	12.87	30050	75500
Recovery tank II	45	5.05	12.53	22500	67970
Recovery tank III	42	5.67	9.00	20000	62800
Holding pond	42	5.52	6.52	17550	41500
Equalization pond	40.5	6.02	6.43	11650	32000
Clarification tank	39	6.15	5.07	8500	24500
Anaerobic pond	37.5	6.9	5.03	8200	12000
Aerobic pond	35	7.20	3.02	4000	5300
Clarifiers	35	7.23	3.15	3300	3000
Polishing pond [Final]	32	7.65	3.00	2500	900

Fig.30. Variation of bodyweights in experimental ram lambs



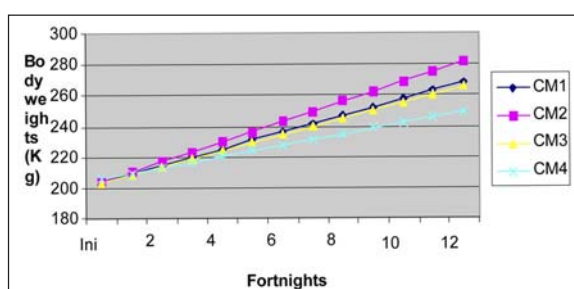
CM I: 40% dehydrated POME in feed mixture, CM II: 50% dehydrated POME in feed mixture, CM III: 60% dehydrated POME in feed mixture

Fig.31. Variation of bodyweights in experimental weaned piglets



CM I: 15% dehydrated POME in feed mixture, CM II: 20% dehydrated POME in feed mixture, CM III: 25% dehydrated POME in feed mixture

Fig.32. Variation of bodyweights in experimental buffalo calves



CM I: 30% decanter sludge in feed mixture, CM II: 40% dehydrated POME in feed mixture, CM III: 50% dehydrated POME in feed mixture

growth rate was better in CM II it was on par with control. When taking the cost of feed into the consideration CM II could be the better choice rather than the conventional (control) feed.

C. Buffalo calves: Different treatments with feed comprising different concentrations of decanter sludge were prepared and growth trial has been conducted on buffalo calves. Bodyweight of calves was recorded fortnightly. Variation in body weights of experimental piglets is provided in Fig.32. Feed mixture CM- II with 40% decanter sludge showed significant growth rate.

Biogas production from POME: Batch digestion study was conducted to find out the biogas yield potential of POME. The experimental set up consisted of 2.5 litre amber coloured bottles with a sealed lid and glass bend tubes as outlet, and rubber tube extension closed by pinch clips as outlet. Biogas yield and methane content in the biogas produced from POME of different concentrations was measured daily by water displacement method keeping cow dung as control. The methane content was measured.

The volume of biogas-collected daily was added up for seven days and designated as weekly biogas production and expressed in milli litres. The weekly biogas production for eight weeks was added up and designated as total biogas production. Ratio of total biogas production to retention time is designated as average biogas production. The day with which the maximum biogas production reached was designated as maximum biogas production. Weekly average percent methane production was arrived by taking average of 7-day methane content. The measurement was done for 20 weeks and the results are presented in figures 33-36.

Table 26. Predominant bacteria isolated from POME

S. No.	Strain designation	Source of the sample	Identity
1	Anaerobic pond	Mill- II	<i>Streptomyces sp.</i>
3	Facultative pond	Mill- III	<i>Rhodococcus</i>
4	Neutralization pond	Mill- II	<i>Staphylococcus haemolyticus</i>
5	Anaerobic pond	Mill- I	<i>Arthrobacter sp.</i>



The biogas yield of sludge collected from POME settling ponds was found better than that of cow dung, which is the most common substrate for biogas production. The generation

of biogas in terms of methane content was also better for Palm Oil sludge, where as the biogas yield of fresh POME at different concentrations was found poor.

Fig 33. Weekly biogas production

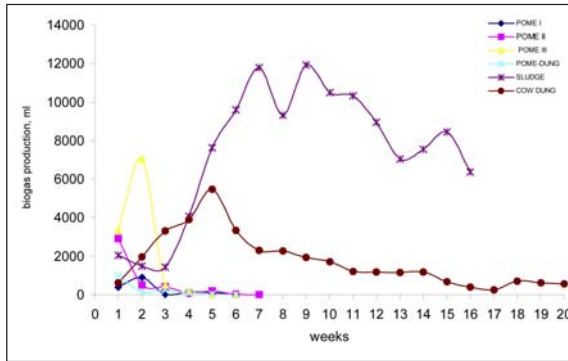


Fig.34. Weekly average methane content

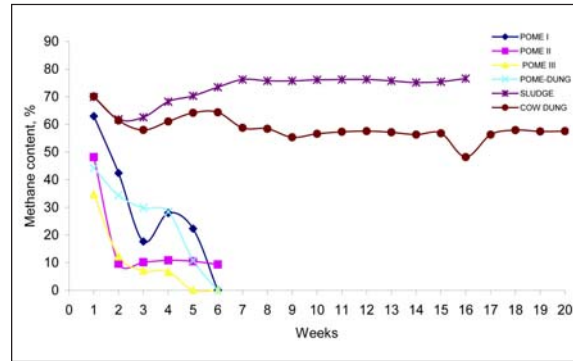


Fig.35. Total biogas production during the period under study

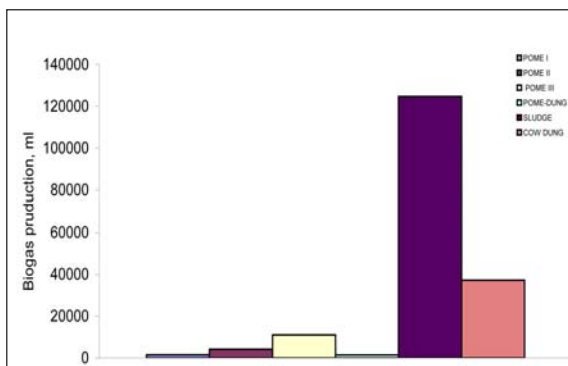
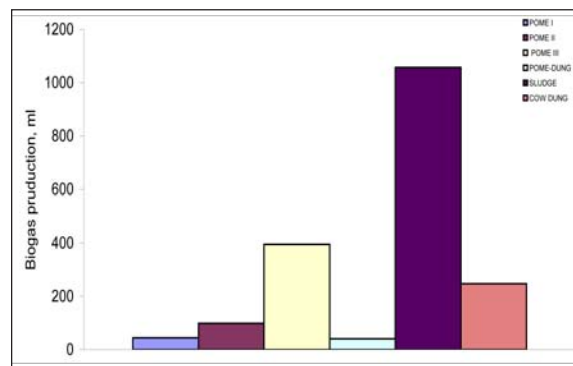


Fig.36. Daily average biogas production



**POME I-2.5% solid content POME II-5.5% solid content POME III-10.5% solid content
POME-DUNG- 1:1 mixture with 7.1% solid content SLUDGE-13.1% solid content
COW DUNG-10.3% solid content (control)**

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OIL PALM POST HARVEST MANAGEMENT



Pilot plant for extraction of oil palm fibres



Evaluation of tractor mounted frond shredder



Mini palm oil mill



Screw Press



Lambs feeding on POME based feed



Weaned piglets feeding on POME based feed



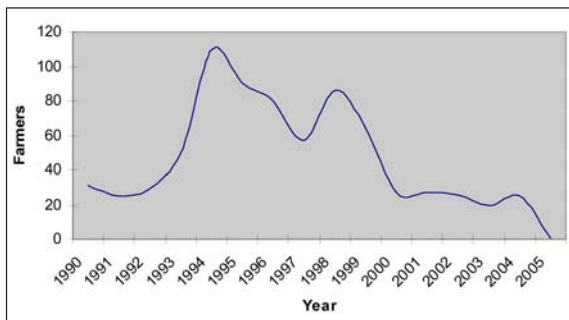
4. Research Achievements

सामाजिक विज्ञान
Social Sciences

SOCIAL SCIENCES

CRITICAL ANALYSIS OF TRAINING OF TRAINERS PROGRAMME IN RELATION TO OIL PALM GROWERS KNOWLEDGE AND ADOPTION PATTERN

Diffusion Effect (cumulatively increasing degree of influence upon an individual to adopt or reject a technology resulting from the activation of peer network about a technology in a social system) studied with a sample of 748 oil palm growers indicated an unequal distribution.



The training needs were assessed through knowledge gaps as well as farmers requirement through open ended questionnaire. No farmer indicated the training need on integrated farming system.

INSTITUTE VILLAGE LINKAGE PROGRAMME FOR TECHNOLOGY ASSESSMENT AND REFINEMENT IN COASTAL AGRO-ECOSYSTEM IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH

This programme was initiated during 1990-2000 and was completed during 2005. The major objectives were to identify and prioritize the farmers needs and list the technologies available; to assess and refine the available technologies in the existing micro farming situations; and to assess the impact of refined technology for adoption in similar production systems in the coastal agro-ecosystem. The study was taken up in Pedakadimi village of Pedavegi Mandal, West Godavari district of Andhra Pradesh.

The two possible farming systems namely lowland and upland were identified in the chosen village. A total of 23 interventions were identified 19 interventions were implemented for assessment and refinement. The interventions were implemented in the form of “on farm trials (OFT) and verification trials”.

Salient findings:

The introduction of high yielding varieties of paddy in place of traditional varieties not only gave high yields but also reduced the cost of cultivation. It also created a tremendous impact on the local farming community paving the way for seed village concept. Application of Carbofuran @ 25 kg/ha during early transplanting controlled the attack of Gall midge in paddy. Formation of alleys of 20 cms at 2 m interval along with application of chloropyriphos @ 2 ml/l at tillering stage controlled the brown plant hopper incidence in paddy. Application of Propiconazole and Validomycin controlled the sheath blight of paddy. The use of balanced dose of fertilizers along with Blue green algae and Zinc sulfate reduced the excess use of Nitrogenous fertilizers and enhanced the yields of paddy. The specific use of Endosulfon @ 1.6 ml/l and Nuclear Poly hedrosis virus controlled the tobacco caterpillar attack and increased the yields by 20 per cent. Application of Ridomil and Calixin reduced the incidence of Black shank and Fusarium wilt respectively in Tobacco.

Adoption of recommended dose of fertilizers in Oil Palm increased the FFB yields by 17-24 per cent and reduced the nutrient deficiencies due the impact caused by nutrient imbalances. Application of Phorate granules @ 20 g/palm in the spindles along with castor cake baiting and treating the breeding sites with green muscardine fungus reduced the incidence of Rhinoceros beetle in Oil Palm. The use of 0.2 % Carbendzim in the crown region effectively controlled the bud rot in Oil Palm. Maize shoot borer was effectively controlled by using



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Endosulfon and enhanced the yields by 7-14 per cent. Application of Chloropyriphos @ 2.5 ml/l twice and adopting sanitary measures controlled the leaf eating caterpillar in green gram. Spraying of Dithane M 45 @ 3 g/l at 30-35 days and 50-55 days after sowing along with field sanitation reduced the powdery mildew incidence in maize.

Introduction of de-worming in cattle effectively reduced the incidence of ecto and endo-parasites and improved the health of animals. Effective use of nutrient supplements in cattle improved the health of the animals in the village. De-worming in sheep also resulted in the improving the health and productivity of the animals. Implementation of fresh water technology of Catla, Rohu and Mrigal in the ration of 2:7:1 in the community pond has increased the net returns and in turn improved their livelihood tremendously. Lastly it is worth mentioning that all the above successful implementations got wide publicity and appreciation from the village and it also spread to the adjoining villages.

OIL PALM DATA BASE MANAGEMENT SYSTEM: Data were collected from oil palm growers on area planted and FFB production from oil palm growing states in the country. Grower-wise Information during 2004-05 was collected from Goa. Majority of the farmers (85%) were having oil palm plantations of 8-12 years age and were obtaining FFB yield upto 9 tonnes/ha followed by 9-18 t/ha. A very few farmers (2%) with plantation of 10-12 years age were obtaining high yield levels of 18-27 tonnes/ha.

DESIGN AND DEVELOPMENT OF NRCOP WEBSITE

Incorporated the data on institute activities on the web site in a uniform format as that of all ICAR institutes and necessary improvements were made and incorporated. Updating of website was done from time to time.

MULTIDISCIPLINARY APPROACHES FOR TRANSFER OF TECHNOLOGY AND AREA EXPANSION IN RELATION

TO OIL PALM DEVELOPMENT IN INDIA:

Director and scientists had attended the Project management Committees and price Fixation Committees in different states as and when required. The scientists also participated in National Level Monitoring Team on ISOPOM which reviewed the progress made in the implementation of ISOPOM Programmes by different states during 2005.

The scientists also participated in identification of suitable areas for oil palm cultivation in Chhatisgarh, Andhra Pradesh, West Bengal and North eastern states.

Under this programme a Consultancy project on Oil Palm Development in Karnataka is going on where Project Assistant have been posted in different district for facilitating the oil palm development programme in target area. They are also entrusted to look into the problems being faced by the growers in oil palm cultivation, analyzed the problem and suggest the remedial measures.

Supply of commercial formulations of microbial cultures: Commercial formulations of microbial organisms namely *Metarhizium anisopliae* and *Trichoderma viride* were supplied to various Oil palm growers for the control of Rhinoceros beetle and bud rot.

OTHER TRANSFER OF TECHNOLOGY ACTIVITIES ORGANIZED

Exhibitions organised/participated/ provided exhibits at NRCOP, Pedavegi.

- Provided exhibition material i.e. specimens, blowups and charts to display at Exhibition organised at Mysore during awards ceremony on 16.4.2005.
- Participated in the Exhibition during Rytusadassu organised at Buffalo Research Station, Venkataramannagudem (A.P.) on 28-29 May 2005.
- Participated in the "Pride of India-Science Expo" organised on the occasion of 93rd Indian Science Congress at Acharya NG



Ranga Agricultural University (ANGRAU), Hyderabad, held during 3-7 January 2006.

- Participated in the Exhibition organised on the occasion of Southern Regional Agricultural Fair - National Level Kisan Mela at Indian Institute of Horticultural Research, Bangalore during 3-4 March 2006.

Participation in Exhibition/ Kisan Mela etc at NRCOP-RS, Palode:

- Participated in the exhibition 'Kathir-2005' held at Vithura, Trivandrum during 1st week of May, 2005
- Participated in the exhibition stall of CPCRI from 17.12.05 to 01.01.2006 in connection with 'Karshika Mela' at Thodupuzha organized by the Gandhi Study Centre.
- Participated in the 'Karshika Mela' held at Palode from 7th to 13th February, 2006 and bagged 1st prize in the Govt. Category.
- Participated in 'The Mushroom Fair' conducted by TBGRI held from 14th to 16th February 2006.
- Participated in 'Rastriya Bagwani Kisan Mela-Cum-Exhibition' from 3rd to 4th March 2006 conducted by the Indian Institute of Horticultural Research, Bangalore.

Providing publicity materials: Provided publicity material / Exhibits to the department of Horticulture for participating in the Exhibition organised at Mysore and participated in southern regional agricultural fair at Bangalore. The literature was also provided on "Oil Palm cultivation" to department of Horticulture, Karnataka.

Oil Palm in All India Radio Programme:

The scientists of the centre are participating in Phone in programmes on oil palm being recorded and broadcasted live on AIR – Vijayawada between 6.25pm to 7.45pm.

Queries on oil palm: Queries of oil palm growers regarding cultivation practices received

through letters and phone calls are being regularly attended and replied. Entrepreneur/ developmental department letter queries are also answered from time to time.

Field visits: Based on the request received from farmers/ entrepreneurs/ state department of agriculture/ horticulture, visits to oil palm plantations for diagnosing the problems faced by the growers and suggesting suitable remedial measures is regularly followed. Oil Palm plantations located in Andhra Pradesh, Karnataka and Goa were visited and problems faced by the oil palm growers regarding pests, diseases and nutritional disorders were diagnosed and necessary remedial measures were suggested.

Exposure of students visiting during study tour to the institute to oil palm:

At Pedavegi, exposure visits (6) to the students of Acharya N. G. Ranga Agricultural University, Acharya Nagarjuna University and Andhra University were organised. A total of 418 students visited the NRCOP. In all the above visits they were taught about the research programmes of the centre, shown the laboratories and they were shown video film on Oil Palm cultivation.

At NRCOP-RS, Palode six one-day training programmes were organised for students in which 338 students from different colleges/ schools participated.

Table 3 I. Interface meets organised at NRC for Oil Palm, Pedavegi

Sl. No	Date	Topic	No. of Participants
1	18-19 th May 2005	Oil Palm Research and Development	66
2	19 Feb 2006	Strategies for research and development for sustainable oil palm	102
Total			168





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4. Research Achievements

प्रशिक्षण और शिक्षा
Training & Education

TRAINING & EDUCATION

TRAINING PROGRAMMES ORGANISED

The following training programmes for officers and farmers were conducted during 2005-2006, details are as follows.

Training programmes for Officers: Training programmes on Oil Palm Production Technology, Plant Protection in Oil Palm, Nursery Management in Oil Palm and Oil Palm Cultivation were organised to officers belonging to Department of Agriculture, Horticulture, State Agricultural University, ICAR institutions and Oil Palm entrepreneurs. A total of 85 officers from Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Orissa, Tripura, Tamil Nadu and Mizoram participated (Table I). In training programmes, series of lectures were delivered on different aspects of Oil Palm. Field visits were arranged to demonstrate method of planting, control of pests and diseases, correction of nutritional disorders etc. Literature viz. Compendium of lectures on

Oil Palm Production Technology, Pest, Disease and Disorders Management in oil palm and nursery management in oil palm, leaf nutrient analysis in oil palm were distributed to the officers.

Training programmes organised to farmers : Nineteen one day On Campus and 14 one day On Farm training programmes on “Oil Palm Cultivation”, 4 one day On Campus and 6 On Farm training programmes on “Irrigation and nutrient management in oil palm” and eleven one day training programmes on “Harvesting of Fresh Fruit Bunches” at farmers’ plantations were organised for 2418 farmers of Andhra Pradesh, Karnataka, Goa, Gujarat, Orissa and Tamil Nadu. In all the above programmes, lectures were delivered on respective subjects of Oil Palm. Field visits were arranged to demonstrate method of planting, control of pests and diseases, correction of nutritional disorders.

Table 27. Training programmes organised for Officers

Sl. No.	Date	Training programme	Venue	Place from trainees came.	Number of participants
1.	04.06.2005	Oil Palm Cultivation	NRCOP, Pedavegi, A .P	Andhra Pradesh Orissa	9
2.	21 st to 25 th 06.2005	Oil Palm Production Technology	NRCOP, Pedavegi, A. P	Andhra Pradesh Orissa	5
3.	15 th to 21 st 09.2005	Oil Palm Production Technology	NRCOP, Pedavegi, A. P	Andhra Pradesh Karnataka Gujarat Mizoram Tripura	19
4.	21 st to 26 th 11.2005	Oil Palm Production Technology	NRCOP, Pedavegi, A. P	Mizoram	11
5.	13 th to 15 th 12.2005	Nursery Management in Oil Palm	NRCOP, Pedavegi, A. P	Orissa Kerala	5
6.	27-28 January 2006	Oil Palm Production Technology	Farmers Training centre, Old Goa, Goa	Goa	28
7.	7-9 February 2006	Plant Protection in Oil Palm	NRCOP, Pedavegi, A. P	Andhra Pradesh Orissa, Kerala, Tamil Nadu.	8



Importance of FFB harvesting indices were explained and demonstrated FFB harvesting technique. Farmers were shown video film on Oil Palm cultivation and they were taken to Oil Palm gardens. Farmers were also taken to processing units to know about the harvesting

standards, time of harvesting, quality aspects of FFB in processing and demonstrations were arranged on FFB harvesting from tall palms. Literature viz. Oil Palm Cultivation Know how-do how, Oil Palm Sagu and Oil palm Cultivation were distributed to the farmers.

Table 28. On Farm training programmes on “Oil Palm Cultivation”

Sl. No	Date	Place at which the Training Programme organised	Place & state of farmers represented	No. of Participants
1.	28.07.2005	Lebagiri, Koppal Taluk	Koppal, Karnataka	70
2	29.07.2005	Nagarahalli, Mundargi Taluk	Gadag, Karnataka	48
3	08.08.2005	Ramachandrapuram, Gara mandal, Srikakulam	Srikakulam, A. P.	51
4	09.08.2005	Jodumamillavalasa, Salur mandal, Vizianagaram	Vizianagaram, A. P.	60
5	10.08.2005	Narasipatnam, Visakhapatnam	Visakhapatnam, A. P.	52
6	27.08.2005	Sarvepalli, Nellore	Nellore, A. P.	42
7	09.09.2005	Aswaraopet	Khammam, A. P.	60
8	29.09.2005	Palvoncha	Khammam, A. P.	40
9	06.12.2005	Kambara, Veeraghattam mandal, Srikakulam dist	Srikakulam, A.P.	51
10	07.12.2005	Karada, Bobbili mandal, Vizianagaram dist	Vizianagaram, A. P.	50
11	08.12.2005	Vammavaram, S. Rayavaram mandal, Visakhapatnam dist	Visakhapatnam, A.P.	45
12	24.1.2006	Quepem, Goa	Goa	60
13	25.1.2006	Valpoi, Sattari, Goa	Goa	32
14	30.1.2006	Belgaum, Karnataka	Karnataka	92
	TOTAL			753

Table 29. Training programmes for Farmers on “Irrigation and Nutrient Management in Oil Palm” conducted at NRC for Oil Palm

Sl. No	Date	Place & state of farmers represented	No. of Participants
1.	10.10.2005	East Godavari, A. P	47
2.	11.10.2005	West Godavari, A. P	53
3.	14.10.2005	West Godavari, A. P	49
4.	27.12.2005	East Godavari, A. P	34
	Total		183

TRAINING AND EDUCATION



Trainees (officers) visit to oil palm nursery



Demonstration of Oil Palm planting



Explaining Stem wet rot symptoms to officers



Demonstrating harvesting of Oil Palm FFB in tall palms



On farm training on Oil Palm cultivation at Goa



Interaction of Mizoram farmers during a field visit in A.P.

Table 30. On Farm training programmes on “Irrigation and Nutrient Management in Oil Palm”

Sl. No	Date	Place at which the Training Programme organised	No. of Participants
1	20.10.2005	Kukunoor, Khammam Dt., A. P.	45
2.	3.1.2006	Dammamet, Khammam Dt., A. P.	52
3.	24.2.2006	Chatrai, Krishna Dt., A.P.	65
4.	4.3.2006	Ketepalli, Krishna Dt., A.P.	50
5.	4.3.2006	Polasanipalli, Krishna Dt., A.P.	50
6.	24.3.2006	Koyyuru, Krishna Dt., A.P.	25
	Total		287

Table 31. On Farm training programmes on “Oil Palm Fresh Fruit Bunches Harvesting”

Sl. No	Date	Place at which the Training Programme organised	Place & state of farmers represented	No. of Participants
1.	01.04.2005	Kuruwada, Shimoga district, Kerebilichi, Chennagiri Taluk, Davenegeri district and Hosakundawada, Davenegeri district.	Shimoga and Davenegeri district of Karnataka	20
2.	02.04.2005	Munduvada, Mundargi, Gadag district.	Koppal, Gadag, Hospet, Ballary and Raichur districts of Karnataka	37
3.	04.04.2005	Sanguem, Goa.	Sanguem, Quepe taluks of Goa	49
4.	05.04.2005	M/s. Godrej Agro Vet Oil palm plantations, Volpai, Goa.	Sattari, Madgoa, Old Goa, Ponda and Bicholi of Goa	30
5.	09.08.2005	Jodumamillavalasa, Salur mandal, Vizianagaram	Vizianagaram, A. P.	60
6.	10.08.2005	Madugual, Visakhapatnam	Visakhapatnam, A. P.	45
7.	27.08.2005	Sarvepalii, Nellore	Nellore, A. P.	42
8.	05.09.2005	Kalavalapalii, Chagallu mandal	West Godavari, A. P.	50
9.	05.09.2005	Makkinavarigudem, T. Narasapuram	West Godavari, A. P.	70
10.	06.09.2005	Veleru, Bapulapadu mandal	Krishna, A. P.	70
11.	09.09.2005	Naravarigudem, Aswaraopet	Khammam, A. P.	40
	TOTAL			513



EDUCATION

Er. Shinoj, S. organised the following training programmes

- One year Graduate apprenticeship training programme in Chemical engineering
- One year Diploma apprentice training programme in electronics and instrumentation.

PROJECT WORKS OF STUDENTS CARRIED OUT AT THE INSTITUTE:

The following students carried out their project works for partial fulfillment of the degrees during 2005-06:

Name of the student	Discipline & college	Period of project work	Title of project work	Guide
M. BALA TRIPURA SUNDARI	M. Sc Biochemistry Sir C.R.R. College for Women, Eluru	April-June 2005	Extraction of DNA from different palms without using detergent	Dr. P. K. Mandal
S. SREE LAKSHMI	M. Sc Biochemistry Sir C.R.R. College for Women, Eluru	April-June 2005	Analysis of genetic diversity of American oil palm (<i>Elaeis oleifera</i>) using randomly amplified polymorphic DNA	Dr. P. K. Mandal
K.VENKATA VAMSY	M. Sc Biotechnology Bharathidasan University, Tiruchirapalli	April-June 2005	Analysis of fatty acid composition in the oil extracted from different portions of oil palm (<i>Elaeis guineensis</i> Jacq.) Bunches and different parts of fruits	Dr. P. K. Mandal
CHANDRA SEKHAR G.V.V.N	M. Sc Biotechnology Bharathidasan University, Tiruchirapalli	April-June 2005	Use of functional micro-satellite markers to detect the genetic variability in oil palm (<i>Elaeis guineensis</i> Jacq.)	Dr. P. K. Mandal
D.Annie Ruth Helena	M. Sc(Biotechnology) Nagarjuna university, Guntur	May-July 2005	Comparative protein estimation studies in different microorganisms	Dr. P. Kalidas
A. Jyothsna	M. Sc(Biotechnology) Nagarjuna university, Guntur	May-July 2005	Studies on effect of culture filtrates on growth of micro organisms	Dr. P. Kalidas
M. Lakshmi	M. Sc(Biotechnology) Nagarjuna university, Guntur	May-July 2005	Studies on longevity of <i>M. anisopliae</i> and <i>B. bassiana</i> , <i>T. Viridae</i> spores in commercial formulation	Dr. P. Kalidas
K.R. Madhavi	M. Sc(Biotechnology) Nagarjuna university, Guntur	May-July 2005	Studies on effect of agro chemicals on growth of micro- bial agent <i>T. viridae</i>	Dr. P. Kalidas

Imrahullah khan	M. Sc(Biotechnology) Nagarjuna university, Guntur	May-July 2005	Studies on effect of growth of <i>B. bassiana</i> on psychids of oil palm in different media, pH, salt concentration and its efficacy on psychids of oil palm	Dr. P. Kalidas
S. Balaji	M. Sc Microbiology KGRL College, Bhimavaram	May-July 2005	Studies on bunch end rot disease of oil palm	Dr. M. Kochu Babu
D. Rebecca	M. Sc Microbiology KGRL College, Bhimavaram	May-July 2005	Studies on growth pattern of <i>T. viride</i> on different growth media, pH, thermal death time and ultraviolet radiation	Dr. P. Kalidas
M. Padmaja	M. Sc Microbiology Andhra University, Visakhapatnam	May-July 2005	Studies on effect of agro chemicals on growth of microbial agent <i>B. bassiana</i>	Dr. P. Kalidas
Ch. Satyavathi	M. Sc Microbiology Andhra University, Visakhapatnam	May-July 2005	Investigations on orange spotting of oil palm	Dr. M. Kochu Babu
P. Sirisha	M. Sc Microbiology Visakha women's Govt. college, Visakhapatnam	May-July 2005	Studies on effect of agrochemicals on the growth of microbial agent <i>Metarhizium anisopliae</i>	Dr. P. Kalidas
M. Rajesh	B.Tech (Biotech) Madanapalle college of Science & Technology, Madanapalle	Nov'05-Jan'06	Studies on Electrophoresis pattern of Isozymes and protections indifferent levels of pisifera variety of oil palm	Dr. P. K. Mandal
T. C. Venkateswarlu	B.Tech (Biotech) Madanapalle college of Science & Technology, Madanapalle	Nov'05-Jan'06	Studies on Electrophoresis pattern of Isozymes and proteins in different leaves of dura variety of oil palm.	Dr. P. K. Mandal
V. Gopi satya Prasad	M.Sc (Microbiology) College of arts & science, Pudukottai	Jan-March 2006	Studies on effect of abiotic factors on the virulence of <i>Metarhizium anisopliae</i>	Dr. P. Kalidas
K. Srinivas	M.Sc (Microbiology) College of arts & science, Pudukottai	Jan-March 2006	Studies on effect of <i>Metarhizium anisopliae</i> on the growth of bruchids	Dr. P. Kalidas
M. Murali Mohan	M.Sc (Microbiology) College of arts & science, Pudukottai	Jan-March 2006	Studies on the impact of the bio control organism on the growth of the earth warms	Dr. P. Kalidas
K. Chiranjeevi	M.Sc (Microbiology) PR Colege, Thanjavur	Jan-March 2006	Bio efficacy studies of <i>Metarhizium anisopliae</i> on rhinoceros beetle	Dr. P. Kalidas



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6. AWARDS AND RECOGNITIONS

Dr. P. Kalidas received the first prize for Oral presentation in the National seminar on "Tel Tad Anusandhan evam Vikas- Chunauthiya aur Sambhavanaye" held at NRCOP, Pedavegi during October, 2005.



Dr. M V Prasad received the best Poster presentation award in Rashtriya sanghasti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on "Oil Palm Research and Development-Challenges and opportunities") held on 26.10.2005 at NRC for Oil Palm, Pedavegi for his poster on the article entitled "Thad tel - Ek uttam Vikalp (Palm oil an excellent choice)" authored jointly as Rayapa Raju D G S and Prasad M V.



Dr. P. Murugesan, Senior Scientist received the second best Poster award for the paper entitled "Evaluation of Tenera x tenera progenies for hybrid seed production" in National seminar on Oil palm research and challenges during 26, Oct 2005 organised by National Research Centre for Oil Palm, Pedavegi-534 450, West Godavari District (A.P).



Dr. P. Murugesan received the best poster award for the paper entitled "Oil Palm selection and hybrid seed production in India" in National Seed Seminar on "Prosperity through quality seeds" held at AG Ranga Agricultural University, Hyderabad during 24-26th February, 2006.

Special Assignments

Er. Shinoj Subramannian was Chairman of the committee constituted by Department of Horticulture, Govt. of Karnataka to assess the OER in palm oil mills of Karnataka during August 2005.



7. LINKAGES AND COLLABORATIONS

The National Research Centre for Oil Palm is maintaining linkages with the following National and International Institutes / Agencies:

A. National

- Technology Mission on Oil Seeds Pulses and Maize (TMOP&M)
- National Agricultural Technology Project (NATP)
- State Departments of Agriculture/ Horticulture, Govt. of Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Goa, Gujarat, Orissa, Mizoram and Tripura
- State Agricultural Universities of oil palm growing states
- Entrepreneurs involved in oil palm development
- Agricultural Finance Corporation
- Oil Palm India Ltd (OPIL), Kottayam, Kerala
- CIRCOT, Mumbai

B. International

- Malaysian Palm Oil Board, Malaysia
- ASD Costa Rica
- IDEFOR, Ivory Coast
- DAMI, Papua New Guinea
- United Nations Development Programme (UNDP)
- CIRAD-CP, Montpellier, France
- BUROTROP - Paris, France
- UNIVANICH, Thailand

This centre has been providing technical advice to TMOP&M, and State Agriculture/ Horticulture Departments on all aspects of oil palm cultivation. The TMOP&M funds are being utilized for strengthening the training programme in which the lower level field staff involved in oil palm development are trained. A leaf nutrient analysis laboratory meant for analyzing the leaf samples for effective scheduling of fertilizers is also being funded by TMOP&M.

8. AICRP/CO-ORDINATION UNIT/NATIONAL CENTRES

The activities of oil palm under All India Coordinated Research project on Palms (AICRP, Palms) are being monitored by the Project Coordinator (Palms) at Central Plantation Crops Research Institute (CPCRI, Kasaragod).

9. LIST OF PUBLICATIONS

RESEARCH ARTICLES/ BOOK CHAPTERS/ REVIEW ARTICLES ETC

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- Prasad M.V., Mary Rani K. L. and Rayapa Raju D.G.S. 2005. Role of private entrepreneurship in oil palm development. *International Journal of Oil Palm*. **5(1&2)**: 39-42.
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- Mathur, R.K.; and Murugesan, P. 2005. TEL TAD KE UCHCHA GUNHVATTA VALE ANKURON AUR PODHON KA UTPADAN (Production of superior quality oil palm sprouts and seedlings). In National Seminar on "Tel Tad Anusandhan evam Vikas-Chunotiyani aur Sambhavanayan (Oil Palm Research and Development- challenges and Opportunities) held at National Research Centre for Oil Palm, Pedavegi, A.P. during 26th October' 2005. **Pp- 12-13.**
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 - Murugesan, P.; Mathur, R.K.; Nagmangla, U.; and Padma, P. 2005. TENERA X TENERA SAMUDAYA ME PISIFERA TADON KA CHAYAN (Selection of pisifera palms in tenera x tenera population). In National Seminar on "Tel Tad Anusandhan evam Vikas-Chunotiyani aur Sambhavanayan (Oil Palm Research and Development- challenges and Opportunities) held at National Research
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 - Pillai, R.S.N., Hegde, M.V. and Krishna Kumar, T. 2005. Oil Palm Hybrid seed production in India - Present status and future strategies. Paper presented at "Rashtriya Sangoshti, tel tad anusandhan evam vikas - chunotiyani oor sambhavanayee" held at NRC for Oil Palm, Pedavegi, on 26th October, 2005.
 - Prasad, M.V. and Rayapa Raju, D.G.S. 2005. Tel thad ki kheti me samasya kisan ka dristikon. (Constraints in oil palm cultivation- Farmers' perception). Smarika evam vistrut saramsh. Rashtriya sanghosti tel thad anusandhan evam vikas chunautiya aur sambhavanayem (souvenir and extended summaries brought out on the occasion of National seminar in Hindi on "Oil Palm Research and Development-Challenges and opportunities") held on 26.10.2005, at NRC for Oil Palm, Pedavegi. **Pp: 50-52.**
 - Prasad MV and Rayapa Raju D G S 2005. Tel tad praudyogik prasar kisanom ki seva me ek dashak (Dissemination of oil palm technology- A decade service to farmers). Smarika evam vistrut saramsh. Rashtriya sanghosti tel thad anusandhan evam vikas chunautiya aur sambhavanayem (souvenir and extended summaries brought out on the occasion of





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- Rajasekhar, P. and Kalidas, P. 2005. Studies on the effect of agrochemicals on the growth of *Trichoderma viride* a biocontrol agent. A paper presented in the seminar on Microbiotech 2005 held at Osmania university, Hyderabad during 8-10, December, 2005.
 - Rayapa Raju, D.G.S. and Prasad, M.V. 2005. Thad tel – Ek uttam Vikalp (Palm oil an excellent choice) Smarika evam vistrut saramsh. Rashtriya sanghosti tel thad anusandhan evam vikas chunautiya aur sambhavanayem (souvenir and extended summaries brought out on the occasion of National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005, at NRC for Oil Palm, Pedavegi. **Pp-**65-66.
 - Satyavani, V. and Kalidas, P. 2005. Effect of antagonists on the pest management in Oil palm. A paper presented in the National Seminar on Research and development of Oil palm in India, 19-20th Feb., 2005 held at NRC for Oil palm, Pedavegi. **Pp-**174.
 - Sunitha. S. 2005. Integrated nutrient management in Oil Palm. Sunitha. S. 2005. Integrated nutrient management in Oil Palm. Paper presented at “Rashtriya Sangoshti, tel tad anusandhan evam vikas– chunothiya oor sambhavanayee” held at NRC for Oil Palm, Pedavegi on 26th October 2005. **Pp-**
 - Suresh, K. and Nagamani, Ch. 2005. Photosynthesis in relation to stomatal characteristics in Oil Palm. Paper presented in National Seminar on Plant Physiology at NAU, Navsari during Nov. 23-25, 2005. **Pp-**

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10. VISITS AND PARTICIPATION IN CONFERENCES, SEMINARS, SYMPOSIA ETC

Dr. M. Kochu Babu

- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.
- Participated in the International Palm Oil Congress (PIPOC-2005) held in Malaysia during 25-29 September, 2005.

Dr. R. S. N. Pillai

- Participated in the International Palm Oil Congress (PIPOC-2005) held in Malaysia during 25-29 September, 2005.
- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.
- Visited Oil Palm Seed garden, Taraka (Karnataka) during 29-31st July’ 2005 for monitoring Oil Palm Seed Garden, Taraka (Karnataka), Palm Tech Nursery, Kabini and Farmers’ village in Mandya (Mysore).
- Visited Kotoonar area of Kerala during 12.03.2006 to 17.03.2006 for monitoring TxT block at Palode, identification of dura and pisifera palms at OPIL seed garden, Thodupuzha and monitoring pest menace at Kotoonar area of Kerala.

Dr. P.T.Varghese

- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.

Dr.V.M. Reddy

- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.

Dr. P. Kalidas

- Attended National Interface meet on Oil palm Research and Development. 18th May, 2005 at the institute.
- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.
- Visited NRCOP-RS, Palode and Kuttanad area of Kerala during 12.03.2006 to 17.03.2006 for monitoring pest menace at Palode, OPIL Bharatpura, Thodupuzha and Kuttanad area of Kerala.





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- Attended “Review Meeting on Oil Palm Hybrid Seed Production” conducted on 28th December at the National Research Centre for Oil Palm, Pedavegi (A.P).
 - Participated in Indian National Science Congress on 5th January, 2006 at Hyderabad (A.P)
 - Attended Seminar on Palm Oil - The golden crop. 25th November, 2005, Hyderabad
 - Attended National Conference on Applied Entomology: Current status, Challenges and Opportunities, 26-28th September, 2005, Udaipur.
 - Attended Group meeting on Awareness and action plan for pesticides residues in plantation crops, 20-21st September, 2005. Kasaragod (Kerala).
 - Visited Chhatishgarh state for identifying suitable areas for Oil Palm cultivation during 06-10.06.2005.
 - Visited Mohitnagar and other areas of West Bengal during 05-11.04.2005.
 - Visited Chhatishgarh state for identifying suitable areas for Oil Palm cultivation during 06-10.06.2005.
 - Visited Oil Palm Seed Garden, Rajahmundry on 02.07.2005 and 20.09.2005.
 - Visited Oil Palm Seed garden, Taraka (Karnataka) during 29-31st July’ 2005 and 03-08th February’ 2006 for monitoring Oil Palm Seed Garden, Taraka (Karnataka), Palm Tech Nursery, Kabini and Farmers’ village in Mandya (Mysore).
 - Visited Oil Palm Seed garden, Lakshmipuram on 09.08.2005.
 - Visited NRCOP-RS, Palode and Kutanad area of Kerala during 12.03.2006 to 17.03.2006 for monitoring OPSG, Palode and OPIL seed garden, Thodupuzha and monitoring pest menace at Kutanad area of Kerala.

Dr. R.K. Mathur

- Attended National Interface meet on Oil palm Research and Development. 18th May, 2005 at the institute.
- Organised RASHTRIYA SANGHOSTI on “TEL TAAD ANUSANDHAN AUR VIKAS-CHUNOTIYAN EVAM SAMBHAVNAYEN” (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) in Hindi during 26th October’ 2005.
- Attended Functional Workshop on Rajbhasha at the Taj Residency, Bangalore during 30.11.2005 to 04.12.2005.
- Attended National Interface Meet organised by the institute during May 18’ 2005.
- Attended “Review Meeting on Oil Palm Hybrid Seed Production” conducted on 28th December at the National Research Centre for Oil Palm, Pedavegi (A.P).
- Visited Bangalore and reviewed the work done reports of Project Assistants during 30.11.2005 to 04.12.2005.

Dr. MV Prasad

- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.
- Attended A. P.state oil palm **farmers** welfare association governing body meeting on 28.4.2005 at IADP hall, Eluru, West Godavari District.

- Attended Oil palm **growers** meeting organised at Gudigunta village, West Godavari Dist, A. P. on 17.9.2005, by SICAL Oil Palm Ltd. Explained the irrigation & nutrient management practices in adult oil palm, importance of harvesting indices and precautions to be taken while harvesting oil palm FFB.
- Attended Transfer of appropriate technology for sustainable oil palm production in the training programme on “oil palm production technology” organised for **officers**.
- Attended Internal Quality Assurance Cell of CH. S. D. St. Theresas College for women, Eluru on 7.2.2006.

Dr. S. Sunitha

- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.
- Dr. S. Sunitha, Senior Scientist attended the brain storming session on ‘Relevance of Organic Resistance in Indian Contest’ held at IIHR, Bangalore on 20.12.06

Dr. P.K. Mandal

- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.
- Attended National Seminar on “Strategies for Improved Farming and Ecological Security of Coastal Region” organised by ISCAR during 21-24 December, 2005 at Central Tuber

Crops Research Institute, Sreekariyam, Thiruvananthapuram, Kerala.

- Attended National Symposium on molecular breeding in crop plants at Indian institute of vegetable Research, Varanasi – 221 305., U.P. during March 20-21., 2006.
- Attended a training programme on ‘MDP on Intellectual Property Rights in Agriculture’ from 26th to 30th July 2005 at National Academy of Agricultural Research Management, Hyderabad.
- Attended a orientation course on “Biosafety Considerations for evaluation of transgenic crops” from 7th to 14th November 2005 at National Research Centre on DNA Fingerprinting (NBPGR), New Delhi
- Attended National interface meet at NRCOP, Pedavegi – 534 450, Andhra Pradesh. May 18th, 2005.

Dr. P. Murugesan

- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.

Dr. K. Suresh

- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on “Oil Palm Research and Development-Challenges and opportunities”) held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.
- Attended National seminar on plant physiology (Crop productivity and quality improvement through physiological interventions held at Gujarat Agricultural



University, Navsari during 23-25th Nov, 2005.

- Visited Chhatishgarh state for identifying suitable areas for Oil Palm cultivation during 06-10.06.2005.

Er. Shinoj Subrmannian

- Participated in Rashtriya sanghosti - tel thad anusandhan evam vikas chunautiya aur sambhavanayem (National seminar in Hindi on "Oil Palm Research and Development-

Challenges and opportunities") held on 26.10.2005 at NRC for Oil Palm, Pedavegi and presented three poster papers and oral presentation.

- Attended workshop on *Technology Development Utilization and Transfer* organized by Dept. of Scientific and Industrial Research, Ministry of Science and Technology, Govt. of India on 13th February, 2006 at Panampilly Nagar, Cochin.

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I I. LIST OF ONGOING PROJECTS

Name of Project		Name of PI /Co-PI (S)
OIL PALM GENETIC RESOURCES		
GEN I.	Collection, conservation, cataloguing and evaluation of oil palm germplasm	R.S.N. Pillai, R.K. Mathur & P. Murugesan
GEN V.	Evaluation of stress tolerant germplasm	R.K. Mathur, R.S.N. Pillai, P. Murugesan, P. K. Mandal & K.Suresh
OIL PALM BREEDING		
GEN II.	Production, evaluation and improvement of oil palm hybrids	R.K. Mathur, R.S.N. Pillai, P. Murugesan & P.K. Mandal
GEN IV.	Breeding for compact palm and oil quality	R.K. Mathur, R.S.N. Pillai & P. K. Mandal
GEN VI.	Studies on performance of different oil palm planting materials	R.K. Mathur, P. Murugesan & K. Suresh
PHY I.	Studies on the photosynthetic efficiency, dry matter production and partitioning in different oil palm hybrid cross combinations	K. Suresh
BIO II.	Bio-chemical characterisation of oil palm germplasm	P.K. Mandal, R.S.N. Pillai & R.K. Mathur
SST I.	Acceleration of germination of oil palm Hybrid seeds (A.P. Cess fund Scheme)	P. Murugesan, R.S.N. Pillai & R.K. Mathur
GEN III.	Research-cum-demonstration of oil palm genotypes under varied environment (TMOP&M funded scheme)	M. Kochu Babu, R.S.N. Pillai R.K. Mathur & P. Murugesan
	Indigenous production of oil palm hybrid seeds (Revolving Fund Scheme)	R.S.N. Pillai
	Strengthening of seed gardens for indigenous seed production	P. Murugesan, R.S.N. Pillai & R. K. Mathur
	Oil Palm Hybrid Seed Production at Taraka	R.K. Mathur & R.S.N. Pillai
	Oil Palm Hybrid Seed Production at Rajahmundry	R.K. Mathur & P. Murugesan
OIL PALM MANAGEMENT		
AGR.II.	Fertilizer requirement of oil palm during pre-bearing stage	S.Sunitha, P.T.Varghese & K.Suresh
AGR IV.	Studies on water and nutrient management in oil palm	K. Suresh & V.M. Reddy
AGRV.	Nutrient recycling of oil palm wastes in oil palm plantations	P.T.Varghese & S.Sunitha
AGRVI.	Studies on mixed farming in the irrigated oil palm plantations of Andhra Pradesh	M. Kochu Babu & P. Kalidas
AGRVII.	Agro-techniques and land use systems for soil, water and nutrient conservation in oil palm plantations of hill slopes	P.T.Varghese & S.Sunitha
AGR VIII.	Intercropping of Cocoa in oil palm	V.M. Reddy & K. Suresh
BIO III.	Bio-chemical basis for growth and yield in oil palm	P.K. Mandal
PHY II.	Physiological basis for growth and yield in oil palm	K. Suresh



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Name of Project		Name of PI /Co-PI (S)
	Establishment of leaf analysis laboratory- Studies on nitrogen and potassium management in adult oil palm- on farm trial (TMOP&M funded scheme)	V.M. Reddy & K. Suresh
OIL PALM PEST & DISEASE MANAGEMENT		
PATH II.	Studies on diseases of oil palm and their management	M.Kochu Babu & P.K. Mandal
ENT I.	Studies on insect, avian and mammalian pests of oil palm and their management	P. Kalidas
ENT IV.	Commercial production of green muscardine fungus <i>Metarhizium anisopliae</i> for the control of insect pests	P. Kalidas
	Wilt of crops with special reference to cultural, morphological, molecular characterization and pathogenic variability of isolates in India (Net Work Project)	M. Kochu Babu & P.K. Mandal
OIL PALM POST - HARVEST TECHNOLOGY		
PHT V.	Mechanization of oil palm plantations and farm level processing	S. Shinoj
PHT VI.	Utilization of oil palm plantation and industry wastes	S. Shinoj
PHT VII.	Development of Grading system for Oil Palm FFB and estimation of factory level OER	S. Shinoj
	Utilization and recycling of oil palm mill effluent (ICAR Cess Fund)	M. Kochu Babu & S. Shinoj
SOCIAL SCIENCES		
CA I.	Oil palm data base management system	K.L. Mary Rani & M.V. Prasad
CA III.	Design and development of NRCOP website	K.L. Mary Rani & M.V. Prasad
EXT II.	Training of extension, research workers and farmers involved in oil palm production under Strengthening of Training on oil palm Production (TMOP&M funded)	M.V. Prasad & R.S.N. Pillai
EXT III.	Critical analysis of training of trainers programme in relation to Oil Palm growers knowledge and adoption pattern	M.V. Prasad
EXT IV.	Multi disciplinary approach for Transfer of Technology and area expansion in relation to Oil Palm Development in India	M. Kochu Babu, P.T.Varghese, R.S.N. Pillai, V.M.Reddy, P. Kalidas, R.K. Mathur, M.V.Prasad, P.K. Mandal, P. Murugesan, K.Suresh & S. Shinoj
	Institute Village Linkage Programme for Technology Assessment and Refinement in coastal agro-ecosystem in West Godavari district of Andhra Pradesh (NATP funded)	M.V. Prasad, V.M. Reddy, P. Kalidas, K. Suresh & K.L. Mary Rani
	Research - cum - Development project on oil palm in Karnataka (OPDP funded through govt. of Karnataka)	M. Kochu Babu, P. Kalidas, R.K. Mathur & M.V. Prasad

12. CONSULTANCY, PATENTS AND COMMERCIALIZATION OF TECHNOLOGY

The Consultancy Processing Cell of NRC for Oil Palm gives broad guidelines for consultancy work, brings out consultancy information system, prepares and processes the Training / Consultancy / Contract Research/ Contract Service proposals, identifies the team for assignments, coordinates the work related to consultancy assignment and monitors the progress of work assigned. The following facilities offered by the Consultancy Processing Cell at NRC for Oil palm are as under.

1. Training Programmes (National and International)

Training programmes are organised in the following areas in oil palm to the officers involved in oil palm development.

- Oil palm nursery management
- Oil palm production and processing technology
- Harvesting of oil palm FFB
- Oil palm seed production
- Plant protection in oil palm

2. Consultancy services

- Hybrid Seed Production in Oil Palm
- Feasibility reports on oil palm cultivation
- Project reports
- Techno - advisory services
- Setting up of oil palm nurseries and their management
- Plant health centre for Pest & Disease management
- Project evaluation and management
- Feasibility study reports on selection of appropriate technology for disposal of oil palm plantation and mill wastes.
- Study reports on improving Oil Extraction Ratio (OER) in Palm Oil Mills.

3. Contract Research

- Testing of Agro-chemicals, Fertilizers, Bio-fertilizers, Bio-pesticides, and Growth regulators suitable for oil palm.
- Projects on all aspects of water, nutrient, Pest and Disease Management in oil palm /oil palm based cropping system.

4. Contract services

- Analysis of water and soil to test the suitability for oil palm
- Leaf nutrient analysis





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- Lab and field evaluation of fertilizers, herbicides, agro-chemicals/plant protection against fungi, bacteria and insect pests of oil palm
 - Diagnosis of damages caused by insect pests and diseases in oil palm plantations and suggest control measures
 - Oil analysis
 - Bunch analysis
 - Design and installation of mini palm oil mills
 - Design and installation of pilot plants for palm fibre extraction.
 - Estimation of Oil Extraction Ratio (OER) in Palm oil mills

COMMERCIALIZATION OF TECHNOLOGIES

- Oil Palm Empty Fruit Bunch Fibre Extractor
- Construction of Mini Palm Oil Mill
- Design of Power Tiller Operated Mobile oil palm waste shredding unit
- Development of Value added products from oil palm fibres
- Technology of making window shades from oil palm rachis

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13. MAJOR DECISIONS OF RAC, SRC, IMC AND IJSC

Staff Research Council Meeting

The Eighth staff research council meeting of the National Research Centre for Oil Palm was held during 4-6th May 2005 at its regional station, Palode. Dr. M. Kochu Babu, Director and Chairman of the staff research council welcomed all the experts and scientists for the meeting. There were five sessions namely crop improvement, crop production, crop protection, post harvest technology and transfer of technology/Computer applications. Twenty five institute and six externally funded projects were presented in the five technical sessions. Eight new projects were proposed in the meeting. The technical programme for the year 2005-06 was discussed and finalized. The decisions taken and technical programme of the individual projects have been documented in this document



Composition of Research Advisory Committee

Dr.K.L.Chadha , Former DDG(Hort.)ICAR,New Delhi	Chairman
Dr.A.K.Vashishta , Director General and Advisor, Bharat Institute of Technology, Meerut U.P	Member
Dr.D.R.Sharma , Professor & Head, Dept.of Bio technology ,Nauni,Solan H.P	Member
Dr.A.N.Mukhopadhyay , Ex -Vice Chancellor,A.A.U. Jorhat, Lucknow U.P	Member
Dr.Vikraman Nair , (Retd.Dean,Agril.College,Vellayani,Trivandrum	Member
Dr.S.N.Pandey , Asst.Director General (PCH),ICAR , New Delhi.	Member
Dr.M.Kochu Babu , Director, NRC Oil Palm,Pedavegi	Member
Dr.P.Thomas Verghese , Principal Scientist ,NRC OP RS, Palode - Pacha Trivandrum	Member Secretary



Composition of Institute Management Committee

Dr. M. Kochu Babu , Director, NRCOP, Pedavegi	Chairman
Mr. S. Gopala Reddy , Nellore	Non official Member
Mr. V.S. Subramanian , F& AO, NAARM, Hyderabad	Member
Dr. B. Rosaiah , Director of Research, ANGRAU, Anakapalli	Member
Mr. Ikram Ullah Mahmood , Addl. Dir. of Hort., Govt. of Karnataka, Bangalore	Member
Dr. R.K. Mathur , Senior Scientist, NRCOP, Pedavegi	Member
Dr. P. Gopala Sundaram , Pr. Scientist, S.B.I. Coimbatore	Member
Dr. V. Krishna Murthy , Head, Div. of Crop Chemistry & Soil Science, CTRI, Rajahmundry	Member
Dr. K.V. Ramana , Asst. Director General (PC), ICAR, New Delhi	Member
D. S. Chander Rao , Sr. Scientist, DOR, Hyderabad	Member
Mr. Vinaka Rao Patil , Babul Kadambvan Sarpur, Nasik, Maharashtra	Non official Member
Mr. Jagdeshwar Reddy , Addl. Dir. of Hort.(Oil Palm) Govt.A.P., Hyderabad	State Representative
Mr. B. Satish , AAO, NRCOP, Pedavegi	Member Secretary
Mr. T.D.S. Prakash , AFA&O, NRCOP, Pedavegi	Co-opted Member



Composition of Institute Joint Staff Committee

	Dr. M. Kochu Babu, Director	Chairman
Official Side	Dr. P.T.Varghese	Member
	Dr. R.S.N. Pillai	Member
	Dr. M.V. Prasad	Member
	Dr. P.K. Mandal	Member
	Dr. R.K. Mathur	Secretary
A.A.O A.F.A. & O	Mr. B. Satish	Member
	Mr. T.D.S. Prakash	Member
Staff Side	Mr. A. Lakshmana Rao	Member
	Mr. K.V. Rao	Member
	Mr. M. Ananda Rao	Member
	Mr. S. Sudhakaran Nair	Member
	Mr. G. Raju	Member
	Mr. K. Ravindran	Secretary

INFRASTRUCTURE DEVELOPMENT



Mini conference hall at NRCOP-RS, Palode



Shed for bunch analysis at NRCOP-RS, Palode



Renovation of guest house at NRCOP-RS, Palode

14. WORKSHOPS, SEMINARS, SUMMER INSTITUTES, FARMERS' DAY AND OTHER MEETINGS ORGANISED

SEED MEET

Seed meet on production and supply of indigenous oil palm sprouts was organised at National Research Centre for Oil Palm, Pedavegi on 28th December 2005. Dr. K.D.Singh, Director, CTRI, Rajahmundry, was the chief guest. Dr.A.N. Maurya, Professor, Banaras Hindu University, Shri.C. P. Gupta, Assistant Director (Oil Palm) TMOP&M, New Delhi and Dr. N. Satyanarayana, Deputy Director (Plant Pathology), Regional Plant Quarantine Station, Chennai were the other dignitaries. Officials associated with seed production, entrepreneurs and scientists attended the meeting. Seed demand and supply schedule for the year 2006-07 was discussed and finalized.



National Oil Palm Seed Meet- 2005 organised on



Price fixation committee meeting

OIL PALM FFB PRICE FIXATION COMMITTEE MEET

A committee to review Oil palm FFB price was constituted by the State Department of Horticulture, Andhra Pradesh under the chairmanship of Dr. M. Kochu Babu, Director, NRCOP. Officers of state department of horticulture, representatives of processors and farmers from A. P. are the other members. The committee met on 29.10.2005 at NRCOP, Pedavegi for considering the revision of existing Price Fixation formula for Oil palm FFB in A.P. It was decided that the price of oil palm FFB/t shall be 12% of the net CPO price realized by AP Oil Fed until a suitable scientific formula is evolved.

NATIONAL INTERFACE MEET ON OIL PALM ORGANISED

National Interface meet on Oil Palm was organised on 18.5.2005 at NRC for Oil Palm, Pedavegi. Sri. H. Rammawi, Hon. Minister for Agriculture, Mizoram inaugurated the interface meet. Dr. K.V. Ramana, Assistant Director General (Plantation Crops), ICAR; Smt. Ranjana Dev Sharma, Deputy Secretary, TMOP&M; Sri. R.S. Vijan, President All India Palm Oil Processors Association and Sri. P. Subbarao, President, A. P. Oil Palm Growers association graced the occasion. Various issues relating to oil palm were discussed.



Organised National Interface Meet on 18.05.2005.

15. OFFICIAL LANGUAGE IMPLEMENTATION ACTIVITIES

राजभाषा अधिनियम 1963 धारा 3(3) एवं राजभाषा नियम 1976 के अनुपालन पर राजभाषा विभाग, गृह मंत्रालय एवं भारतीय कृषि अनुसंधान परिषद की ओर से जारी किये नये दिशा-निर्देश एवं वार्षिक कार्यक्रमों के कार्यान्वयन हेतु इस केन्द्र की राजभाषा क्रियान्वयन समिति का गठन इस प्रकार है-

1.	डा. एम. कोच्चु बाबु, निदेशक	अध्यक्ष
2.	डा. रवि कुमार माथुर वरिष्ठ वैज्ञानिक	सदस्य एवं सम्पर्क अधिकारी (राजभाषा)
3.	श्री के.वी.वी. सत्यनारायण निजी सचिव	सदस्य
4.	श्री खासिम सैदा एस.एस.ग्रेड-1	सदस्य
5.	श्री बी. सतीश सहायक प्रशासनिक अधिकारी	सदस्य-सचिव

प्रतिवेदित वर्ष 2005-06 की अवधि में निदेशक महोदय की अध्यक्षता में केन्द्र की राजभाषा कार्यान्वयन समिति की त्रै मासिक बैठकें नियमित रूप से बुलाई गईं। बैठकों में राजभाषा के अनुपालन की अनिवार्यता पर विशेष बल दिया गया और सरकारी काम काज में अधिकाधिक हिन्दी का प्रयोग करने के लिए भी जोर दिया गया। इसके अतिरिक्त राजभाषा नीति के कार्यान्वयन के संबन्ध में कार्यालय द्वारा किये गये प्रयासों की समीक्षा की गयी।

भारत संचार निगम लिमिटेड, एलूरू द्वारा गठित की गयी नगर राजभाषा कार्यान्वयन समिति की बैठकों में भी केन्द्र के कर्मचारियों ने भाग लिया।

राजभाषा विभाग के वार्षिक कार्यक्रम हिन्दी चेतना मास के अवसर पर राजभाषा संबन्धित प्रतियोगितायें जैसे अंग्रेजी से हिन्दी में अनुवाद, प्रश्नोत्तरी, निबंध लेखन, हिन्दी कविता एवं गीत आदि आयोजित किये गये। एवं प्रतियोगिताओं के विजेताओं को पुरस्कार वितरित किये गये। आज का हिन्दी शब्द कार्यक्रम का अनुपालन भी समयनिष्ठा से किया जा रहा है।

वर्ष 2005 में तेल ताड़ अनुसंधान एवं विकास नामक शीर्षक पर एक राष्ट्रीय संगोष्ठी का आयोजन किया गया।

हिन्दी में राष्ट्रीय संगोष्ठी का आयोजन

26 अक्टूबर 2005 को इस संस्थान में हिन्दी माध्यम में "तेल ताड़ अनुसंधान एवं विकास - चुनौतियाँ और सम्भावनाएँ" नामक शीर्षक पर एक राष्ट्रीय संगोष्ठी का आयोजन किया गया। संगोष्ठी में कुल चार तकनीकी सत्र आयोजित किये गये जिनमें 30 शोध पत्रों को प्रस्तुत किया गया। संगोष्ठी का उदघाटन राष्ट्रीय कृषि अनुसंधान प्रबन्ध अकादमी, हैदराबाद के निदेशक डा सत्य प्रकाश तिवारी ने किया। संगोष्ठी में 80 तेल ताड़ से जुड़े वैज्ञानिकों, अधिकारियों, किसानों इत्यादि ने भाग लिया।

इस अवसर पर मौखिक प्रस्तुति वर्ग में शोधपत्र - भारत में तेल ताड़ पर लगने वाले हानिकारक कीड़े (पी. कालिदास) को प्रथम और तेल ताड़ और नारियल में बेसल तना सडन का नियन्त्रण - एक संगठित प्रयत्न (बि. श्रीनिवासुलु) को द्वितीय पुरस्कार दिया गया। पोस्टर प्रस्तुति वर्ग में शोध पत्र - तेल ताड़ - एक उत्तम विकल्प (डी.जी.एस. रायपा राजु) को प्रथम एवं टेनेरा X टेनेरा समुदाय में पिसिफेरा ताड़ों का चयन (पी. मुरुगेशन, आर.के.माथुर, नागमंगला और पी. पदमा) को द्वितीय सर्वोत्तम पोस्टर पुरस्कार प्रदान किया गया।



HINDI SEMINAR



Address by chief guest



Releasing of publications



Best oral presentation



Poster presentation



Poster presentation



Poster presentation



A view of gathering

16. LIST OF DISTINGUISHED VISITORS

- 18.05.2005 : Shri H. Rammawi, Hon'ble Minister for Agriculture, Mizoram.
Dr. K.V. Ramana, Asst. Director General (PC), ICAR, New Delhi.
Smt. Ranjana Dev Sharma, Deputy Secretary, TMOP&M, New Delhi.
Shri R.S.Vijan, President, All India Palm Oil Processors Association
Shri Parvathaneni Subba Rao, President, A.P. Oil Palm Growers Association.
- 01.07.2005 : Dr(Mrs) Vandana Tyagi, Senior Scientist, NBPGR, New Delhi.
- 02.09.2005 : Dr. P. Kumaraiah, Head, CIFA, Regional Station, Penamaluru, Vijayawada.
- 03.09.2005 : Shri P.T. Natarajan, General Manager, M/s. Foods, Fats and Fertilizers Ltd., Hyderabad.
- 05.09.2005 : Shri R. Sundara Rama Raju, Progressive Coconut Grower, Tadepalligudem.
- 26.10.2005 : Dr. S.P.Tiwari, Director, NAARM, Hyderabad
Dr. Harveer Singh, Principal Scientist, DOR, Hyderabad
Dr. B. Srinivasulu, Associate Professor, Coconut Research Station of ANG-RAU, Ambajipet.
- 28.12.2005 : Dr. Kapil Deo Singh, Director, CTRI, Rajahmundry.
Dr.A.N. Maurya, Retd. Professor, Banaras Hindu University, Varanasi.
Shri C.P. Gupta, Asst. Director (Oil Palm), TMOP&M, New Delhi.
Dr. N. Satyanarayana, Deputy Director (Pl. Pathology), Regional Plant Quarantine Station, Chennai.



17. Personnel

RMP

1. Dr. M. Kochu Babu Director

STAFF POSITION AT HEAD QUARTER - PEDAVEGI

Scientific Staff

- | | |
|----------------------------|---|
| 2. Dr.V.M. Reddy | Pr. Scientist (Agronomy) |
| 3. Dr. P. Kalidas | Sr. Scientist (Ag. Entomology) |
| 4. Dr. R.K. Mathur | Sr. Scientist (Plant Breeding) |
| 5. Dr. M.V. Prasad | Sr. Scientist (Ag. Extension) |
| 6. Dr. P.K. Mandal | Sr. Scientist (Bio-Chemistry) |
| 7. Dr. P. Murugesan | Sr. Scientist (Seed Technology) |
| 7. Dr. K. Suresh | Scientist, Sr. Scale (Plant Physiology) |
| 8. Mrs. K.L. Mary Rani | Scientist Sr. Scale (Computer Applications) |
| 9. Er. Shinoj Subramannian | Scientist (AS&PE) |

Administrative Staff

- | | |
|---------------------------|--------------------------------------|
| 10. Sri T.Ashok Kumar | Assistant Administrative Officer |
| 11. Sri B. Satish | Assistant Administrative Officer |
| 13. Sri T.D.S. Prakash | Assistant Finance & Accounts Officer |
| 14. Sri K.V.V.S. Narayana | Private Secretary |
| 15. Sri K.S.N.D. Mathur | Assistant |
| 16. Sri P. Gowrishankar | Assistant |
| 17. Mr.T.V. Rama Krishna | Personal Assistant |
| 18. Mr. K. Ravindran | Upper Division Clerk |
| 19. Mr.A. Lakshmana Rao | Lower Division Clerk |
| 20. Mr. Dharma Raju | Lower Division Clerk |

Technical Staff

- | | |
|------------------------|----------------------|
| 21. Mr.V.G. Sasidharan | T-4 |
| 22. Mrs.A. Bhanusree | T-4 |
| 23. Mr. K.V. Rao | T-4 |
| 24. Mr. J. Mohan Rao | T-1-3 |
| 25. Mr. M.Ananda Rao | T-2 |
| 26. Mr.V.V.S.K. Murthy | T-2 |
| 27. Mr. Ch. Subba Raju | T-2 (Driver) |
| 28. Mr. P.R.L. Rao | T-2 (Driver) |
| 29. Mr. E. Perayya | T-2 (Driver) |
| 30. Mr.A. Papa Rao | T-1 (Tractor Driver) |
| 31. Mr. M. Rambabu | T-1 |

Supporting Staff

- | | |
|----------------------|----------|
| 32. Mr. K.Ananda Rao | SS Gr.II |
| 33. Mr. G. Raju | SS Gr.II |
| 34. Mr. I.V. Sundar | SS Gr.II |

35.	Mr. G.Venkateswara Rao	SS Gr.II
36.	Mr.A. Dhana Raju	SS Gr.II
37.	Mr.A. Joji Showri	SS Gr.II
38.	Mr. U. Rama Rao	SS Gr.II
39.	Mr.A. Ganga Raju	SS Gr.II
40.	Mr. S. John	SS Gr.II
41.	Ms.Y. Chaitanya	SS Gr.I
42.	Mr. S.K. Saida	SS Gr.I
43.	Mr.A. Nagarjuna Rao	SS Gr.I
44.	Mr. G.S.N. Babu	SS Gr.I
45.	Ms. N.V.V. Sathya Lakshmi	SS Gr.I
46.	Mr. M. Satyanarayana	SS Gr.I
47.	Mr. Ch.Venkata Durga Rao	SS Gr.I

STAFF POSITION AT NRCOP, REGIONAL STATION, PALODE

Scientific Staff

1.	Dr P.T.Varghese	Pr. Scientist (Agronomy) & Scientist I/C
2.	Dr R.S.N. Pillai	Pr. Scientist (Plant Breeding)
3.	Dr. (Mrs.) S. Sunitha	Sr. Scientist (Agronomy)

Administrative staff

4.	Mrs. E.J. Mary	Assistant
5.	Mrs.V. Satyabhama	Upper Divisional Clerk
6.	Sri P. Prasad	Personal Assistant

Technical Staff

7.	Mrs. N. Sujatha Kumari	T-5
8.	Mrs. I.C. Rajamma	T-4
9.	Mr. C.K. Devadathan	T-4
10.	Mr.V. Sunil Duth	T-2
12.	Mr. K. Soman	T-3
13.	Mr. B. Muralidharan Pillai	T-1

Supporting Staff

14.	Mr. G. Rajappan	SS Gr. II
15.	Mrs. N. Indira	SS Gr. II
16.	Mrs.A. Radha	SS Gr. II
17.	Mrs. M. Rebecca	SS Gr. II
18.	Mrs.A. Raceena	SS Gr. II
19.	Mr. H. Dasan	SS Gr. II
20.	Mr. P.K. Rethnakaran	SS Gr. II
21.	Mr. S. Sudhakaran Nair	SS Gr. II
22.	Mr. P.Anil Kumar	SS Gr. II
23.	Mrs. C. Shantha	SS Gr. II (Retired on 31.12.2005)
24.	Mrs. P. Rema	SS Gr. II
25.	Mr. C. Ravi	SS Gr. II



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18. METEOROLOGICAL DATA

Weather Data during 2005-06 at NRCOP, Pedavegi

Month (2005-06)	Temperature (0C)		Relative humidity (%)		Sun shine hours
	Min	Max	Min	Max	
April-05	24.67	35.27	32.77	86.03	2.40
May	26.16	36.84	31.97	84.55	13.20
June	25.10	34.26	32.58	84.19	23.40
July	24.55	30.61	54.71	82.32	43.39
August	24.45	31.77	51.23	82.42	5.40
September	24.71	32.43	51.14	84.43	26.40
October	NA	NA	NA	NA	NA
November	NA	NA	NA	NA	NA
December	17.25	27.75	34.50	81.44	3.80
January-06	16.94	28.84	44.13	86.58	0.00
February	17.79	30.64	56.21	88.25	0.00
March	22.81	34.55	39.52	93.94	0.00

NA = Not Available

Weather Data during 2005-06 at NRCOP, RS, Palode

S N	Parameters	Months											
		April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan*	Feb*	Mar*
1	No of rainy days	13	12	14	19	8	9	9	6	7	4	2	21
2	Total rainfall (mm)	373.0	317.5	289.5	464.4	50	205.5	369	16.5	322	0.65	1.06	6.27
3	Highest max. Temp. (°C)	36.5	34.5	34	32.5	32.5	34.0	34.0	34.5	34.5	24.31	25.92	26.51
4	Lowest max. Temp. (°C)	31.5	27	25	27	27	26	26	27	30.5			
5	Highest min. Temp. (°C)	26	26	25	25	25	25	24	24	24.0			
6	Lowest min. Temp. (°C)	21	22	22	22	22	21	18	21	16			
7	Average max. Temp. (°C)	34.4	31.2	34.6	33.7	34.5	31.5	34.2	32	32.5			
8	Average min. Temp. (°C)	23.6	23.6	23.3	23.3	22	19.7	20	22.2	20			
9	Average Pan evaporation (mm)	3.6	3.0	3.1	2.0	3.1	3.2	2.8	2.5	3.4			
10	Average Relative Humidity (%)	80.0	85	83.7	81.6	78.6	83.4	84.5	85.2	80.6	77	68.64	82.19

*Recorded from AWS

GENERAL ACTIVITIES



Independence day celebrations



Republic day celebrations



Celebration of sadbhavan divas



New Year day celebrations



Visit by DG, ICAR to NRCOP stall at Hyderabad



Cultural programme organised by Recreation club

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