भाकृअनुप
ICAR

वार्षिक प्रतिवेदन
ANNUAL REPORT
2006-07

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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Cover Page

Front : Fully matured oil palm fruits
Back : Immature oil palm bunch of *virescens* fruit type

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Preface

India has taken the challenge of cultivating oil palm on a large scale under irrigated conditions and hit success. Since irrigated Oil Palm is a new venture, it is necessary to develop high yielding hybrids, quality planting materials, appropriate agro-techniques, pests and disease management techniques, post harvest management techniques, etc. The excellent infrastructure facilities developed at the center coupled with the concerted efforts being made by the scientists for the last eleven years paved way for development of suitable technologies and also their transfer to the farmers for further reducing the cost of production and increasing productivity.

In the recent years, palm oil produced globally is being diverted for biodiesel production leading to its huge demand. This demand coupled with the increase in internal demand for edible oil in the and import duty structure made the palm oil prices soar in India. Owing to the increase in palm oil price, the price of FFB is also at its increase during the year and hence oil palm crop has become synonymous to profitable agriculture among the farming community in India. Many farmers are coming forward for taking up oil palm, which is a very positive sign for oil palm development in the country. Though an area of 8 lakh ha was identified as potential for oil palm cultivation in the country during 1988 only 63000 ha are existing under oil palm till March 2006. In order to give a new impetus for oil palm cultivation in the country, the activity of reassessing the potential areas for oil palm cultivation in the country was taken up by the committee constituted by Govt. of India under the chairmanship of Dr. K. L. Chadha, Former DDG (Horticulture), ICAR and submitted a report during July 2006.

The committee reassessed the potential area available for oil palm cultivation in the country as 10.36 lakh ha in nine states. Area expansion targets of 23,975 ha during 2006-07, 2.24 lakh ha during XI Plan and 3.01 lakh ha during XII Plan periods have been proposed. The committee also assessed that from the existing 63,000 ha area under oil palm, the present FFB production is about 2 lakh MT / year, in well managed gardens the productivity levels have reached as high as 40 MT/FFB/ha, six seed gardens with a production potential of 2.2 million sprouts per year and eighteen palm oil mills with a processing capacity of 115MT/hr were established in the country till now.

During the reporting period, X Five year plan was completed and the plan fund could be utilized effectively in the center. With scientific staff strength of 15 we are able to operate 44 research projects including externally funded projects. Present scenario gives us confidence of sustainability of oil palm in India especially under irrigated conditions. I thank all my staff members for their untiring efforts in the success of oil palm in this country.

M . Kochu Babu
Director

कार्यकारी सारांश

राष्ट्रीय तेल ताड अनुसंधान केन्द्र पिछले ग्यारह वर्षों से तेल ताड के फसल को बढाने और उसकी अनुसंधान सम्बन्धी जरूरतों को पूरा करने की दिशा में सुनियोजित ढंग से प्रयत्न कर रहा है। उच्च स्तर की प्रयोगशालाएँ, उपयुक्त संसाधन और 15 वैज्ञानिकों के साथ यह केन्द्र सुसज्जित है। यह केन्द्र तेल ताड के विकास, उत्पादन, सुरक्षा, उत्पादनोत्तर तकनीकी और तकनीकी विस्तरण के क्षेत्रों में अनुसंधान कर रहा है। विवरण वर्ष 2006-07 में यहाँ कुल 44 परियोजनाएँ चलीं जिन में 31 परियोजनाएँ केन्द्र की ओर से संचालित की गई और बाकी 13 को बाहरी वित्तीय सहायता मिली। इस संस्था के कार्यकलापों का संक्षिप्त विवरण आगे दिया गया है -

फसल सुधार

इस वर्ष भी जनन द्रव्यों का मूल्यांकन और इस के लक्षणों का अध्ययन जारी रखा गया। व्यापक जनन आधार का विकास करने के लिए सिंचित एवं असिंचित वातावरणों में अच्छी उपज देने वाले ड्योरा ताडों का चयन किया गया है।

तेल ताड से DNA को निकालने की नयी प्रक्रिया अपनायी गई। परंपरागत प्रक्रिया में एक चरण, क्लोरोफ़ार्म का उपचार को हटा दिया गया है।

तेल ताड जनन द्रव्य के आण्विक लक्षणों का अध्ययन करने से पता चला कि GB सामग्री का संकरण जन्यु वैविध्य को दृष्टि में रखकर पालोड के साथ किया जा सकता है। लेकिन ज़ांबिया की प्रजातियाँ उच्च स्तर की होने के कारण PLD P1, PLD P2 & ZS P3, ZS P4 का संकरण बेहतर होगा। आफ्रीकी, कोस्टारिका और पालोड के जननद्रव्यों में किये गये आण्विक और जीव रसायनिक विश्लेषण में व्यापक विविधता पायी गयी। RAPD विश्लेषण में विभिन्न जननद्रव्य अलग-अलग समूहों में पाये गये।

पालोड के 23 ओलिफेरा और दो जिनंनसिस ताडों पर RAPD विश्लेषण किया गया। EO-16 नामक ताड बाकी ताडों से भिन्न था और वह कोई विशेष समूह में नही था। जन्यु वैविध्य विश्लेषण के लिए SSR मार्कर का उपयोग किया गया और शुरुआती जोडों के लिये PCR प्रोटोकॉल का मानकीकरण किया गया।

राजमंड्री के बीज-बगीचे से D x P संततियों की परीक्षण जाँच में खेत में रोपण किया गया और तेल ताड के संकरण का मूल्यांकन किया गया।

बौने, ससंबद्ध और उच्च कोटि तेल ताड प्रजनन के लिए फलों के गुच्छों और तेल उत्पादन की निष्पत्ति को दृष्टि में रखकर उच्च स्तर के ताडों का चयन किया गया। पालोड स्थित सभी ओलिफेरा ताडों में गुच्छों का विश्लेषण किया गया। उच्च स्तर के ताडों के गुच्छों के विश्लेषण और तेल की मात्रा के आधार पर अंतर विशेष संकरण के लिए चयन किया गया। लेकिन यह पाया गया है कि E.o में मध्यफल भित्ति (mesocarp) और अनिषेक कलत (Parthenocarpic) गुच्छे निम्न कोटि के हैं।

अंतर संगम और स्वसंगम (Selfing) की प्रक्रिया के माध्यम से चार ताडों को सफलता पूर्वक पुनरुज्जीवित किया गया। 14 ड्यूरा ताडों से पराग इकट्ठा कर अंतर संगम के लिए सुरक्षित रखा गया। इस से नये बीज-बगीचों को बनाया जा सकता है।

तेल ताड के अंकुरण बढाने पर किये गये अध्ययन से यह पता चला कि मशीन द्वारा छिलके को आधा या एक मिनट के लिये निकालने से पहले एवं बीजो को दस दिन के लिये गरम करने में अंकुरण की गति संतोषजनक पायी गयी।

फसल उत्पादन

पेदवेगी में सिंचाई और खाद पर किये जा रहे प्रयोग में पता चला कि खाद के तीन उपचारें (900-450-900, 1800-900-1800 and 2700-1350-2700 g N-P-K) में ज्यादा अंतर नही पाया गया। जेट और ड्रिप सिंचाई पद्धति के ताडों में गैस विनिमय और FV/FM निष्पत्ति थला पद्धति की तुलना में अधिक है। 2003-04 में किसान के खेत में किये गये प्रयोग से पता चला कि खाद में विभिन्न स्तरों का कोई महत्वपूर्ण अंतर दिखाई नहीं पडा।

पालोड में खाद उपचार - (1200-600-1200 NPK) में FFB उत्पादन अत्यधिक दर्ज किया गया।

वर्ष 2000 में विभिन्न फसलों और जल एवं मृदा संरक्षण के उपायों पर शुरु किये गये प्रयोग में यह पाया गया कि तेल ताड़ के साथ किसी भी तरह की फसल लेने से तेल ताड़ की उपज पर कोई भी विपरीत असर नहीं देखा गया। कोको, एन्थुरियम, दाल्चीनी और कालीमिर्च अंतर फसलों की पद्धति में अन्यउपचारो कि अपेक्षा सर्वाधिक लाभ मिला।

मिश्र खेती पर NRCOP में किये गये प्रयोगों से पता चला कि केले की अंतर फसल तरुण अवस्था में सब से ज्यादा लाभदायक है। बाकी फूल और सब्जियों की अपेक्षा हेलिकोनिया सब से ज्यादा लाभदायक पायी गई।

वयस्क तेल ताड़ (10-14 वर्ष) के बगीचे जिसमें कोको (1-9 वर्ष) को अन्तर फसल पद्धति में लिया गया हो, में रोशनी के प्रवेश पर जो अध्ययन किया गया उस से पता चला कि ताड के Canopy के ऊपर और नीचे 1240.64 और 137.26 micro moles/Sq./Sec तरंगे मिल सकती है। रोशनी का इतना कम होना ही कोको की फसल के उत्पादन में कमी का कारण माना गया क्योंकि कोको के लिये 800 micro moles/Sq.m/Sec रोशनी की जरूरत होती है।

तेल ताड़ की वृद्धि एवं उपज पर किये गये मौलिक अध्ययन में यह ज्ञात हुआ कि जिन डूयूरा ताड़ों में रंध्री आवृत्ति, रंध्री सूचिका, गार्ड कोशिका की लम्बाई, रंध्री छिद्रों का क्षेत्रफल, प्रस्वेदन दर एवं पत्ती का तापमान कम हो एवं प्रकाश संश्लेषण दर, प्रकाश संश्लेषित जल उपयोग सक्षमता, पर्ण जल क्षमता एवं प्लास्टिड संख्या अधिक हो, को निम्न क्रम में रखा गया, उन्हें सूखा-सहनशील डूयूरा ताड़ कहा गया। ZS-1 ड्यूरा क्रम में सबसे नीचे एवं TS-9 क्रम में सबसे ऊपर पाये गये।

ताड़ में रस का प्रवाह सुबह 9 बजे से धीरे-धीरे बढने लगा कि जो कि दिन में 1-2 बजे के बीच अधिकतम स्तर पर था, उसके बाद फ़िर से घटने लगा। तेल ताड़ में रस प्रवाह का वातावरणीय कारक जैसे - वाष्पीप्रस्वेदन और वाष्प-चाप कमी के साथ सकारात्मक संबंध है। मई-जून में रस प्रवाह में कमी देखी गयी जो कि पर्ण-रंध्रों का दोपहर में बन्द हो जाने के कारण हो सकता है, क्योंकि उस समय वाष्प चाप में कमी बढ जाती है।

ताजा फलों के गुच्छे और फल के विभिन्न भागों में तेल में गुणात्मक और मात्रत्मक अध्ययन को जारी रखा गया है। जुलाई से सितम्बर महीनों में गुच्छे के दूसरे भाग में मध्यभित्ति में तेल सर्वाधिक पाया गया। फल के गुच्छे

में दूसरे एवं तीसरे भाग में औसत कुल असंतृप्त वसीय अम्लों की मात्रा दुसरे भागों से अधिक दर्ज की गयी, उसका मुख्य कारण इन भागों में ऑलिक अम्ल की अधिक मात्रा थी। फलों के मध्य भाग में तेल की मात्रा सार्थक रूप से अधिक पायी गयी। फ़ल के प्रथम भाग (जो कि डंटल के नजदीक था) में पाल्मिटिक अम्ल की मात्रा अधिक पायी गयी।

तेल ताड़ के ग्यारह संकरों में प्रकाश संश्लेषण क्षमता एवं शुष्क तत्वों का उत्पादन का अध्ययन किया गया। पापुगा-न्यू-गुवाना के संकर में पत्ती का शुष्क भार एवं गुच्छे का शुष्क भार; ए.एस.डी. डेली x इकोना एवं डेली x एवरोज में तने का शुष्क भार; P65D x 111 में पर्ण क्षेत्र सूचिका; और P12 x 266 में गुच्छा सूचिका एवं गुच्छे का शुष्क भार सर्वाधिक दर्ज किये गये।

फसल सुरक्षा

चिडियों की समस्या से फसल को बचाने के लिए डरावनी ध्वनियों का प्रयोग किया गया, जिस से पक्षियों को तेल ताड के गुच्छो को खाने से सफलता पूर्वक रोका गया। जामूनी और हरे रंग के जाल को लटकाने से भी चिडियों की समस्या से फसल को बचाया जा सका। तेल ताड के ही पत्तों से गुच्छों को ढंकने की जो पारंपरिक पद्धति भी यह रंगीन जाल वाली पद्धति ज्यादा सफल पायी गयी।

पत्ते खाने वाली सुँडी नामक कीड़े के नियन्त्रण में जैव-कीटनाशक - ब्यवेरिया बेस्सियाना, रसायनिक कीटनाशक - क्विनॉल फोस और लेम्डा सायलोप्रिन के बराबर असरदायक पाया गया।

पत्ती में जाली बना देने वाले कीड़े पर किये गये जैव अनुसंधान में यह ज्ञात हुआ कि कीट नियन्त्रण में दाने ज्यादा असरदार नहीं है। जड़ द्वारा दिये जाने वाले उपचारों में फॅासफोमिडोन की तुलना में मोनोक्रोटोफास अधिक प्रभावशील पाया गया।

तेल ताड़ में हानिकारक कीडों के नियंत्रण में काम में ली जा रही सूक्ष्मजीवों की विभिन्न नस्लों पर किये गये अण्विक अध्ययन में यह ज्ञात हुआ कि *ट्राइकोडर्मा विरिडि* एवं *ब्यूवेरिया बेसियाना* की नस्लें जो कि पी.डी.बी.सी., हैदराबाद से प्राप्त की गयी थी, का कीडों को नियंत्रण में एन.आर.सी.ओ.पी. एवं डी.ओ.आर. से प्राप्त नस्लों की अपेक्षा अधिक प्रभावशाली पायी गयी।

तेल ताड स्पियर रॉट-रोग कारक कीटाणु के लक्षणों का अध्ययन करने के लिए 8 जोडे फाइटो प्लासमा के लिए विशिष्ट प्राइमरों को चुनकर DNA के नमूनों का अध्ययन किया गया। इस अध्ययन के जो नतीजे मिले उन में एकरूपता नहीं पायी गयी। इन नमूनों को इकट्ठा करने में भी समस्या की संभावना है क्योकि तेल ताड के रेशों से लिये गये पदार्थ में कीटाणुओं के DNA के साथ साथ तेल ताड के DNA भी अधिक मात्रा में होते हैं। फाइटोप्लासमा का DNA बहुत कम मात्रा में पाया गया - अध्ययन जारी है।

कटाई उपरान्त प्रौद्योगिकी

एक मेट्रिक टन/घण्टा की क्षमता वाले लघु तेल ताड़ कारखाने में सारी प्रक्रिया का मानकीकरण किया गया। ग्यारह वर्ष की आयु के तेल ताड़ों से इकट्ठा किये गये गुच्छों में तेल निष्कर्षण दर 17.1% दर्ज की गयी। खाली फलों के गुच्छों के रेशों से तेल निकालने के लिये हवारहित वातावरण में सूक्ष्मजीव आधारित उपचार की तकनीक की प्रयोगशाला स्तर पर जाँच की गयी। इसमें तेल की मात्रा 5% से 0.4% तक कम की जा सकी।

तेल ताड़ के रेशों से कागज़ और कागज़ संबधित दूसरी उत्पत्तियाँ - जैसे कागज़ की थैलियाँ, कोरियर की थैलियाँ, कलमदान, कार्यालयी फाइलें, फाइल बोर्ड आदि की तैय्यारी की गयी। तेल ताड के पत्तों की धारियों को यंत्र से काट कर खिडकियों के चिक बनाये गये। लकडी को काटने और रन्द्र करने वाले यंत्र में थोडा परिवर्तन कर इस यंत्र को बनाया गया।

तेल ताड में FFA की मात्रा पर अध्ययन करने से पता चला कि incubation के 7 दिनों में FFA की मात्रा स्थिर रही, अतः incubation के बाद वाली अवधि में FFA की मात्रा के बढने की संभावना है। इस अध्ययन से पता चला कि 10°C के तापमान पर FFA की मात्रा अधिक थी। Incubation के २४ घण्टे बाद आयोडिन की मात्रा में सभी वातावरणों में कमी होती दर्ज की गयी।

समाज विज्ञान

वर्ष 2006-07 में 31 शिक्षण प्राप्त अधिकारियों से जो जानकारी मिली उस से पता चला कि अधिकारियों के लिये प्रशिक्षण बहुत उपयोगी सिद्ध हुआ। अधिकांश लोगों ने कहा कि शिक्षण के दौरान जो विषय सिखाये गये वे उन लोगों के काम से संबध रहे। विभिन्न व्यक्तियों या समूहों से बात करते या तेल ताड की खेती के सुझाव देने में उनका यह प्रशिक्षण बहुत काम आया। 79 किसान जिन्होंने प्रशिक्षण प्राप्त किया उन लोगों ने कहा कि तेल ताड की और यह प्रशिक्षण उन लोगों के लिये उपयोगी सिद्ध हुआ। एक प्रश्नावली के माध्यम से प्रशिक्षण और जानकारी में जो कमियाँ है उन का अध्ययन किया गया।

तेल ताड़ की खेती पर आधारित कुछ मुद्धों को इन्टर्व्यू की अनुसूचि बनाने के लिए मानकीकरण किया गया जिनसे किसानों की सोच पर आधारित तेल ताड़ की अनुसंधान सम्बन्धी आवश्यकताओं को प्राथमिकीकरण किया जायेगा।

तेल ताड की खेती के संबन्धित विभिन्न विषयों पर 79 अधिकारियों को प्रशिक्षित किया गया। प्रशिक्षण में मुख्य विषय रहे - तेल ताड के संकर बीजों का उत्पादन, तेल ताड उत्पादन तकनीकी, तेल ताड की सुरक्षा, तेल ताड के नर्सरी का प्रबंधन, तेल ताड के पत्तों के पोषक पदार्थों का विश्लेषण इत्यादी। आन्ध्र प्रदेश, मिज़ोरम, तमिल नाडु, कर्नाटक, उडीसा, गोवा आदि राज्यों से अफसरों ने इन प्रशिक्षणों में भाग लिया। तेल ताड के अनुसंधान केन्द्र के परिसर में एक दिवसीय प्रशिक्षण 19 बार चले और क्षेत्र में प्रशिक्षण - तेल ताड खेती पर चलाये गये। तेल ताड में सिंचाई और पोषक पदार्थों का प्रबंधन विषय पर 5 एक दिवसीय प्रशिक्षण कार्यक्रमों को चलाया गया। तेल ताड-पौधों की सुरक्षा विषय पर किसानों के खेतों पर 2081 किसानों को प्रशिक्षण दिया गया इस में आन्ध्र प्रदेश, कर्नाटक, गोवा, गुजरात, उड़ीसा और तमिल नाडु के किसानों ने भाग लिया।

EXECUTIVE SUMMARY

National Research Centre for Oil Palm is making systematic efforts for the last eleven years to cater to the needs of the Oil Palm community and to increase the production and productivity of the crop. The centre has now excellent infrastructure with well equipped laboratories and a strength of 15 scientists. The center is conducting and coordinating research on all aspects of Oil Palm conservation, improvement, production, protection, post harvest technology and transfer of technology. Thirty one institute projects and 13 externally funded projects were under operation at the institute during the year 2006-07 and the salient research achievements are summarized below:

CROP IMPROVEMENT

During the reporting year, evaluation and characterization of germplasm were continued. Yield promising *dura* palms have been identified under irrigated and stress environments which could be utilized for developing Pre-breeding populations with wide genetic base.

The novel method of DNA extraction for oil palm was still modified by deleting a step of chloroform treatment and found successful. Studies conducted for molecular characterization of oil palm germplasm revealed that GB materials can be crossed with Palode considering the genetic diversity. However, since the Zambian accessions were superior performers, a cross combination with PLD-P1 , PLD-P2 and ZS – P3, ZS-P4 would be better. Molecular and biochemical analysis of another set of palms from African countries, Costa Rica and Palode revealed wide variability in biochemical parameters among the palms between different accessions and also within the accessions. RAPD analysis showed separate cluster for separate accessions.

RAPD analysis conducted on *oleifera* palms (23 palms) from Palode along with 2 *guineensis* palms revealed that the two *guineensis* palms are completely genetically divergent and form another cluster. Palm No. *Eo*-16 was distinctly different from the other palms and did not form any cluster. Use of SSR marker for genetic diversity analysis initiated and PCR protocol for each pair of primers was standardized.

DxP Progeny of Rajahmundry seed garden was planted in testing trials for evaluation and improvement of oil palm hybrid combinations.

Superior palms based on oil/bunch ratio and oil yield/palm/year have been selected under the trial “Breeding for compact palm and oil quality”.

Four palms were successfully regenerated through *inter-se*-mating or selfing for raising new seed garden. Pollen from 14 *dura* palms was collected and stored after isolation which could be used for selfing or *inter-se*-mating.

All the available *oleifera* palms from Palode were subjected to bunch analysis and the superior palms on the basis of bunch analysis as well as oil quality (fatty acids combinations) were selected for interspecific hybridization. It is observed that mesocarp of parthenocarpic fruits was inferior in terms of quality and quantity of oil than that of the seeded fruits of *E. oleifera* bunches.

Studies conducted for acceleration of germination in oil palm revealed that subjecting dura seeds to physical scarification with depericarping machine for half to one minute and pre-heating seeds for 10 days accelerated germination to a satisfactory level.

CROP PRODUCTION

In the irrigation cum fertilizer trial at Pedavegi, there was no significant difference in yield among the three fertilizer levels (900-450-900, 1800-900-1800 and 2700-1350-2700 g N-P-K). Palms irrigated with jets and drips recorded higher gas exchange rates and Fv/Fm ratios than that of basin irrigated palms. The lower Fv/Fm ratios and gas exchange parameters clearly indicated that oil palm might require more water during summer months irrespective of the method of irrigation used. From a field experiment started during 2003 - 04 in the adult oil palm plantation of a farmer, no significant difference in yield among the three different levels of N (600, 900, 1200 g) and K (1200, 1800, 2400 g) was observed. However water was a constraint to realize the actual response to different fertilizer levels.

Highest FFB yield was recorded by the fertilizer treatment 1200-600-1200 g NPK (T-4), in the field experiment taken up at Palode to standardize suitable fertilizer doses during pre-bearing stage.

From the field experiment started during 2000 with eight treatments involving different crop combinations and various soil and water conservation measures, it was observed that the yield of palms was not adversely affected by growing any of the inter crops in Oil palm plantations and a combination of oil palm, cocoa, cinnamon, pepper and anthurium gave maximum returns compared to other combinations.

From the mixed farming experiment laid out at NRCOP, it was observed that Banana was found to be the highest income fetching inter crop in juvenile stage of oil palm. *Heliconia* was observed as the most economically competent intercrop compared to other flower crops as well as the vegetables.

Light infiltration studies conducted in adult oil palm plantations(10-14 years) intercropped with cocoa(1-9 years) in the farmers' fields indicated the average radiation above and below the oil palm canopy to be 1240.64 and 137.26 micro moles per sq. m per second. The over all low availability of light is probably the reason for low cocoa yield under oil palm plantations as the light saturation of cocoa leaf takes place at around 800 micro moles per sq. m per second.

Under the 'basic studies on oil palm growth and yield' programme, physiological studies revealed that d*ura* palms having lower stomatal frequency, stomatal index, guard cell length, stomatal pore area, transpiration rate, leaf temperature and higher plastid number, photosynthetic rate, photosynthetic water use efficiency, leaf water potential was ranked lower i.e., superior drought tolerant *dura*s". ZS-1 recorded the lowest rank compared to that of other *dura*s. Highest rank was recorded by TS-9.

Diurnal variations in the sap flux indicated that the sap flux increased gradually from 9.00 AM onwards reaching a peak during 1.00 to 2.00 P.M and then decreased thereafter as the day progressed. It was observed that the sap fluxes in oil palm plantations are closely associated with environmental variables like evapotranspiration and vapor pressure deficit.

A decrease in sap flux during the dry months of May and June was also observed which could be due to the closure of stomata after mid day as the atmospheric vapor pressure deficit increased.

Studies on qualitative and quantitative differences of oil in the different part of FFB and different parts of individual fruits are continuing. The result of the reporting period revealed that mesocarp oil content is highest in the second portion of the bunches during July to September (three months). Total unsaturated fatty acids content in portion 2 and 3 combined average was higher than that of other portion of the bunches mainly due to higher oleic acid content in these two portions. Middle part of the fruits had significantly higher amount of oil content. Palmitic acid content was always highest in the first part (near peduncle) of the fruits.

Eleven Oil Palm hybrids i.e. four each from ASD Costa Rica and Palode, two from Ivory Coast and one from Papua New Guinea were evaluated for photosynthetic efficiency and dry matter production. Maximum leaf dry weight and bunch dry weight were recorded in PNG hybrid, trunk dry weight in ASD Deli X Avros and Deli X Ekona, leaf area index in P65D X 111, bunch index as well as bunch dry weight in P12 X 266.

CROP PROTECTION

Trials carried out against the bird menace using scarring sounds were observed effective in repelling the birds from feeding on oil palm FFB. Coloured net (violet and green) hanging was found effective in controlling the bird menace compared to other conventional methods of covering the FFB with oil palm leaves.

Bio-pesticide, *Beauveria bassiana* was found on par with conventional quinalphos and Lambda cyhalothrin in managing the leaf eating caterpillar problem. Bioefficacy studies on leaf webworms, *Acria* sp. indicated that the granules are not effective in controlling the pest population and among the root feeding treatments, monocrotophos was found effective compared to phosphamidon.

Molecular studies (SDS PAGE) of the different strains of organisms that are used for the management of pests of oil palm indicated that both *Trichoderma viride* and *Beauveria bassiana* obtained from PDBC were effective in causing infection within shorter period compared to the other strains of NRC and DOR.

For the characterization of causal organism of spear rot disease, eight pairs of phytoplasma specific primers sequences were collected and procured and attempts were made to amplify the DNA samples extracted from spear rot affected tissues of oil palm. But the results were not consistent. There might be problem in collection of samples having more inoculum. Since the DNA extracted from the tissue also contains large amount of plant DNA, the concentration of phytoplasma DNA was very low. The work is in progress.

POST HARVEST TECHNOLOGY

The unit operations in the mini palm oil mill of 1MT/hr capacity have been standardized. An oil extraction ratio of 17.1 was observed when the FFBs from a 11 year old plantation

were processed. In order to remove the residual oil from EFB fibres, an anaerobic microbial treatment technique was tested in lab-scale and found that the oil content came down to 0.4% from an initial value of 5%.

Paper boards and different value added paper board products like textile kits, courier covers, pen stands, office files, file boards etc. were made from oil palm fibres.

A mechanized process was developed for making stripes from oil palm fronds and window shades were made from the stripes. The mechanization was achieved by employing a wood planer cum cutter with modifications.

Studies conducted to see the effect of low temperature on FFA content in the oil after harvesting the FFB indicated that increase in FFA during incubation for 7 days period was steady and hence, further increase in FFA was expected beyond seven days. However, the increase was minimum at ambient temperature and maximum at 10^{O}C. Increase in FFA content was higher in the fallen fruits in all the conditions. There was decrease in iodine value in all the conditions after 24 hours of incubation.

SOCIAL SCIENCES

Data collected from 31 trained officers revealed that cent percent of the trainees perceived that training is beneficial. Majority of them felt that subject matter taught is relevant and trainees are diffusing the technology either through individual or group contacts or using both. Similarly, data collected from 79 trained farmers indicated that farmers were not much aware about oil palm before training and felt that training was beneficial. The training needs were assessed through knowledge and skill gaps as well as farmers requirement through open ended questionnaire.

For prioritization of research needs in oil palm based on farmers perception, items were developed on “oil palm cultivation” for standardizing the interview schedule for pilot testing.

A total of 79 officers were trained on various aspects of oil palm cultivation. Training was imparted on aspects like Oil Palm Hybrid Seed Production, Oil Palm Production Technology, Plant Protection in Oil Palm, Nursery Management in Oil Palm, Leaf Nutrient Analysis in Oil Palm. Officers from Andhra Pradesh, Mizoram, T.N., Karnataka, Orissa, Goa participated in the training progarmmes.

Nineteen one day on campus and 13 one day on farm training programmes on “Oil Palm Cultivation”, 5 one day on farm training programmes on” Irrigation and Nutrient Management in Oil Palm” and four one day on farm training programmes on “Plant Protection in Oil Palm” at farmers plantations were organized to 2081 farmers of Andhra Pradesh, Karnataka, Goa, Gujarat, Orissa and Tamil Nadu

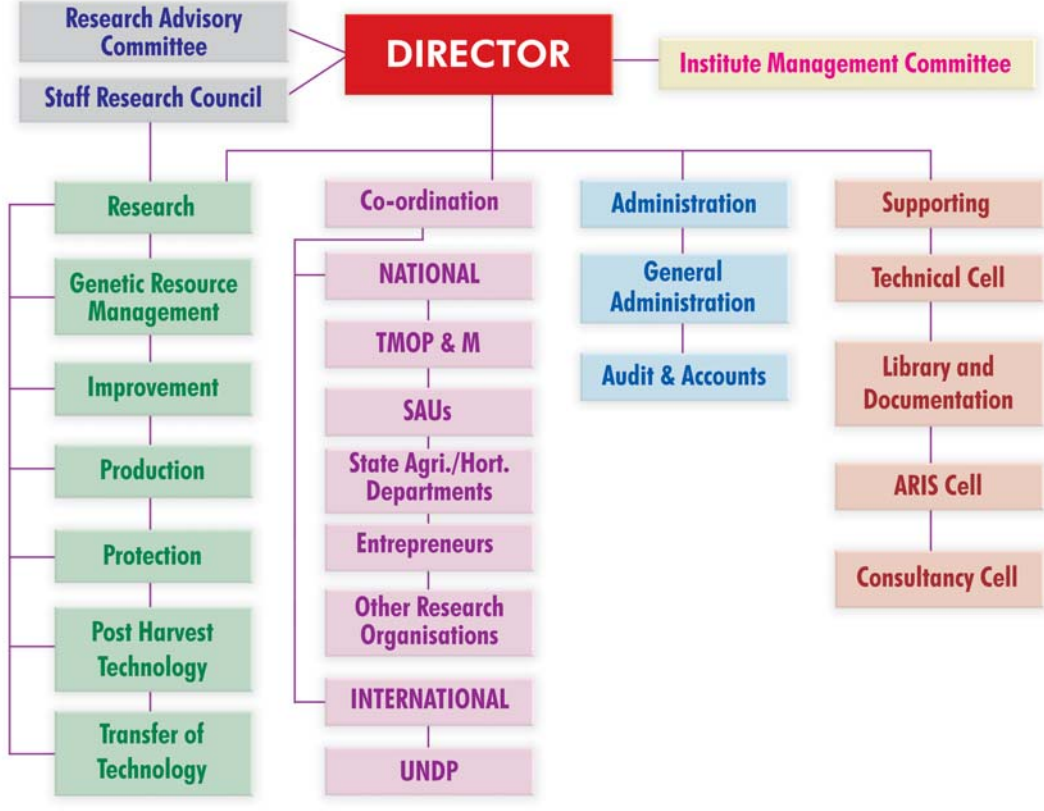
3. INTRODUCTION

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 headquarters 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

3.2. ORGANISATIONAL SETUP



3.3 Financial outlay (Rs)

HEAD	PLAN		NON PLAN	
	Allocation RE	Expenditure	Allocation RE	Expenditure
Establishment	948000	455666	12500000	12069810
OTA	0	0	10000	10000
TA	549000	523114	300000	292920
Other charges			9490000	9869212
Equipment	2251000	2237266		
Library	457000	444500		
Furniture	535000	531017		
R&M office buildings			300000	51690
R&M residential buildings			200000	166500
Works	921000	919468	100000	0
HRD	652000	79900		
Total	**6313000**	**5190931**	**22900000**	**22460132**

3.4 Externally funded projects (Rs)

S. No.	Name of the Scheme Project	Opening Balance as on 01.04.2006	Funds Received during 06-07	Expenditure during 2006 - 07	Closing Balance as on 31.03.2007
	ISOPOM funded schemes				
1.	G x E scheme	534083		753244	-219161
2.	Strengthening of Training on Oil Palm	697970		328231	369739
3.	Establishment of Leaf Analysis Lab	357530		462097	-104567
4.	Strengthening of Oil Palm seed gardens	82057		301323	-219266
5	Oil palm cultivation	8646		0	8646
6	Chadha committee report	0	160200	159520	680
	Other deposits				
	DST	1092	0	0	1092
	DST- Development of molecular markers for variety identification in oil palm	0	410000	67355	342645
	Oil Palm Seed Garden, Rajahmundry (A.P.)	380367	192045	286574	285838
	Oil Palm Seed Garden,Taraka (Karnataka)	150822	300000	312462	138360
	OPDP Karnataka	497252	1000000	1387840	109412
	EMD	55152	4000	6000	53152
	SD	105606	0	0	105606
	Miscellaneous	3538	0	0	3538
	OPDP, Karnataka Consultancy Fund	23214	0	0	23214
	Training fee, Goa	9260	0	0	9260
	Hindi seminar	0	15201	0	15201

(Contd.)

S. No.	Name of the Scheme Project	Opening Balance as on 01.04.2006	Funds Received during 06-07	Expenditure during 2006 - 07	Closing Balance as on 31.03.2007
	R-deposit Training	0	0	33750	-33750
	Plan scheme-Seed production in Agril. Crops and fisheries	0	2089000	2244330	-155330
	AP Cess fund schemes				
	Utilization and recycling of Palm Oil Mill Effluent (POME)	345338	223740	363090	205988
	Acceleration of Germination of Hybrid seeds	349344	242880	268248	323976
	Wilt of Crops with special reference to cultural .... in India	-42306	312500	218542	51652
	Drip irrigation	18440	0	0	18440
	Disaster Management	-1688	0	-1688	0
	Determining the vectorial	-164824	0	0	-164824
	Nutrient recycling	70510	0	0	70510
	Studies for developing	5343	0	0	5343
	Evaluation of pollinating	219888	0	0	219888
	Oil Palm Information System	-20770	0	0	-20770

3.5 Resource generation

Publicity / exhibition material i.e blow ups, charts, CD & literature on oil palm cultivation, oil palm cultivation, oil palm sagu, Talabilakrishi (Kannada version of Oil Palm cultivation) worth of Rs. 1,00,000/- was supplied to various developmental agencies (viz., Entrepreneurs of oil palm, SAUs, TMO&P and ICAR) involved in oil palm development in the states of Karnataka, A. P, Kerala, Gujarat, Mizoram, Tamil Nadu, Orissa and Goa. Sold nearly 1000 books of oil palm sagu, 1000 books of oil palm cultivation and 3000 books of Talabilakrishi (Oil Palm cultivation). Through other means the resource generations during the year is to a tune of Rs. 20.14 lakhs.

3.6 Staff position

Grade	Sanctioned	Filled	Vacant
RMP	1	1	0
Scientific	22	15	7
Technical	18	18	0
Administration	12	12	0
Supporting	30	30	0
Total	**83**	**76**	**7**

3.7 Library

The institute has a fully furnished library and subscribes 16 foreign and 26 Indian journals, with 7 ICAR journals and 7 back volume journals. The total back volume journals in the

library are about 1000. Four newspapers are also subscribed for the benefit of staff members. Software namely Newgenlib has been purchased for automation of the library. During 2006-07 an amount of Rs.4.66 lakh has been utilized for procuring books, journals, software and other essential items. The library has internet, Photo copy and binding facilities

3.8 ARIS cell

ARIS cell of NRCOP is furnished with two HP Xeon servers and eight PCs (node). Fully furnished ARIS cell is backed up with UPS and all essential softwares. This cell provides internet facility to all the scientists, laboratories and sections through Local area network. The statistical software and databases are provided in the server for use at the client systems. The servers and most of the PCs are of Pentium IV or above. Internet facility is at present provided through ISDN connection as well as VSAT connection from Ernet. VSAT connection is available round the clock.

ARIS cell also takes the responsibility to circulate all the circulars through Local area networking. Web-page of the institute is hosted by National Informatics Centre. Presently web-site is under the process of upgradation. Important notices like advertisements and tender notices are made available in the website of the institute.

http://nrcop.ap.nic.in is the website maintained by the institute.

3.9 PME cell

Project Monitoring and Evaluation cell is functional in the institute. PME cell extended its help in carrying out the background work for the Research Advisory Committee meeting, Staff Research Council meeting, QRT meeting and other meetings attended by the Director. PME cell also attended routine work such as preparation of monthly reports, quarterly reports, half yearly reports and attending various correspondence from the Council and other institutes. PME cell played active role in compilation of Vision 2025, Information bank and the Chadha committee report " Progress and Potential of Oil palm in India" submitted by Dr. K. L. Chadha to Dept. of Agril. and Cooperation, New Delhi in July 2006.

3.10 Museum

A Museum is established at NRCOP to create awareness about oil palm among farmers, entrepreneurs, officials of development agencies and general public who visit NRCOP. It is also aimed to provide technical know how of oil palm cultivation and disseminate technologies generated by NRCOP. Oil palm cultivation practices from nursery to harvesting are sequentially depicted for the benefit of visitors. Research attainments of NRCOP, specimens, exhibits, models, charts showing technologies are also on display for the benefit of the visitors. Audio facility highlighting the cultivation practices of oil palm and research attainments of NRCOP are provided. Touch screen facility to get first hand information on facilities available at NRCOP is provided.

3.11 Right to information Act

In pursuance of the instruction from ICAR, under the Right to Information Act 2005, Dr. K. Suresh, Sr. Scientist is nominated as Public Information Officer and Dr. K. Ramachandrudu Scientist(SS), as Asst. Public Information Officer.

4. Research Achievements

तेल ताड जननिक संसाधन

Oil Palm Genetic Resources

Fully matured bunch of E.oleifera palm

OIL PALM GENETIC RESOURCES

Collection of germplasm: Collection of germplasm was taken up in oil palm plantations of Little Andaman. A total of 22 accessions (3 from Ivory Coast, 8 from Nigeria, 4 from PNG, 5 from Zaire and 2 of unknown sources) were collected; most of them (13) were *dura*. Two were from unknown source planted at Baratang (North Andaman) from palms near the creek shore. The seeds are being processed for germination.

Evaluation of Germplasm

Evaluation in nursery : Progeny of thorn less palm known as '*Idolatrica*' identified from African accessions has been planted in nursery. Open pollinated seeds were successfully regenerated through de-operculation method and seedlings are maintained in the primary nursery. Ten number of germplasm collected from Little Andaman are raised in primary nursery.

Evaluation of Pune and Little Andaman accessions : Observations on precocity, leaf production and height have been recorded. Palms with high initial yields based on number of bunches, bunch size and sex ratio have been identified for further monitoring.

Performance of African Germplasm accessions : African accessions are being screened for water stress tolerence conditions at six different locations namely, Pedavegi, Nellore and Adilabad (all in Andhra Pradesh), Mohitnagar (W.B.), Palode and PCKL (both in Kerala).

In the present experiment, oil palm germplasm materials collected from four African countries (Cameroon, Guinea Bissau, Tanzania and Zambia), are being screened for drought tolerance and/ or high water use efficiency at different locations in India. The very objective of the experiment is to identify germplasm suitable for a particular location in order to develop location specific varieties. The accessions were planted at locations like Pedavegi, Nellore, & Adilabad (in Andhra Pradesh) and Palode & PCKL (Kerala). At all the locations the crop is maintained well and standard practices of cultivation are being followed. The crop is being grown as rainfed at Palode and PCKL locations whereas at other locations it is being grown under water stress conditions (IW/CPE ratio = 0.5).

Quarterly observations were recorded on production of leaves, inflorescences (male/ female). The biometric observations on 17th leaf, height, girth at collar were recorded once in a year. The Fresh Fruit Bunch weights (FFB yield) were recorded on each harvest basis.

Variability in Germplasm: Significant variability has been recorded within and between the accessions for many characters like long stalked male inflorescence, dwarfness, position of leaflets, better exposure to sun light for better photosynthetic activity, palms with only female inflorescence, narrow petiole, short rachis length and virescens fruit types with good yield.

High yielding tenera palm with mantled fruit character was identified from farmers, garden (not from germplasm accessions) Makkenavarigudem, West Godavari District, Andhra Pradesh. During the reporting period virescens pisifera known as *'Hracilinue'* from Tanzanian germplasm accession was identified.

Evaluation and Characterization of African Germplasm (NRCOP, Pedavegi): African accessions (from Cameroon, Tanzania, Guinea Bissau and Zambia) are continued for characterization for 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. Six palms have been selected which are performing well under water stress conditions.

The germplasm accessions at this location were planted in 1998 in replicated and observational designs. The replicated trial was laid in RCBD with three replications keeping plot size of 4 palms. The screening is being done at two moisture levels, irrigated (IW/CPE ratio=1.0) and stress (IW/ CPE ratio=0.5), being maintained through drip irrigation system by arranging water drippers. The experiment is being maintained as per the standard package of practices followed for oil palm. Till the reported period, the crop is in good health.

Replicated trial: Quarterly observations were recorded on leaf and inflorescence production. Number of bunches and FFB weights were recorded as and when the harvesting was done and were expressed on annual basis. Annual biometric observations on palm height, girth of stem, standard leaf (17th) measurements like rachis length, petiole width, depth, number, length, width of leaflets were recorded to calculate leaf area, leaf dry matter, trunk dry matter production etc.

Under stress conditions (Table 1) Guinea Bissau germplasm recorded maximum growth with an average stem height of 360.1cm; the girth at collar was recorded at par in all the sources. For number of leaves and sex ratio, the differences were non significant. The SLW was recorded highest in Zambian accessions (0.76) under irrigated conditions like previous year reflecting the high water use efficiency trait in these materials. The FFB yield per palm was recorded highest in Zambian accessions (126.6kg under irrigated and 101.5kg under stress) followed by Tanzanian accessions. Similar was the trend recorded for Average bunch weight also. Under irrigated conditions sex ratio was highest in Zambian accessions followed by Tanzanian accessions.

Under irrigated conditions, the highest yield was recorded in Zambian accession ZS-2 (163.5kg) followed by ZS-8 (134.1kg) and ZS-5 (133.3kg). Under water stress conditions ZS-1 recorded the highest yield (113.9kg) followed by ZS-5 (103.9kg).

These accessions are showing lot of variations than other palms for many characters like palms are very strong, robust, compact canopy, having long stalked male inflorescence, dwarfness, position of leaf lets, to have maximum exposure to sun light for better photosynthetic efficiency, some palms are producing only female inflorescence, without male flowers, narrow petiole, having short rachis length, and virescence fruit forms, are very much seen with good yields.

Observational Trial: A number of accessions from all the four African countries are being evaluated for water stress conditions (IW/CPE ratio = 0.5). In observational trial at Pedavegi the Zambian and Tanzanian accessions recorded maximum FFB weight per palm/ year (Table 2). The variation was more for FFB yielding capacity of palms in GB and Zambian accessions. The average bunch weight was almost equal in Cameroon, Zambian and Tanzanian accessions (10.1-11.21 kg); it was the least in GB accessions (5.4kg) indicating production of small bunches. Cameroon and

Table 1. Performance of germplasm accessions (morphological and yield characters) under irrigated and stress environments at NRCOP, Pedavegi, A.P. (Replicated trial)

Accessions	Stem height (cm)	Girth at collar (cm)	No. of Leaves/ P/Y	Sex ratio	Specific Leaf Weight (Kg)	No. of bunches /P/Y	FFB Weight (Kg/palm /year)	Average Bunch Weight (Kg)
IRRIGATED ENVIRONMENT								
GB22/311	355.9	302.2	28.4	0.49	0.62	14.1	81.4	5.8
GB25/314	396.2	298.3	27.2	0.29	0.55	12.3	64.0	5.2
GB21/310	328.2	283.1	26.0	0.65	0.66	15.7	96.8	6.0
Mean (Guinea Bissau)	**360.1**	**294.5**	**27.2**	**0.48**	**0.61**	**14.0**	**80.7**	**5.7**
ZS1	242.7	291.0	30.4	0.52	0.67	8.4	105.1	13.8
ZS2	242.9	264.0	30.8	0.44	0.85	12.9	163.5	13.4
ZS3	258.4	297.2	27.2	0.41	0.79	7.9	97.0	12.6
ZS5	246.8	309.4	28.8	0.54	0.67	10.0	133.3	12.8
ZS8	260.6	284.8	26.8	0.57	0.82	10.6	134.1	12.9
Mean (Zambia)	**250.3**	**289.3**	**28.8**	**0.50**	**0.76**	**10.0**	**126.6**	**13.1**
TS9	329.4	297.2	27.2	0.58	0.72	9.8	113.8	12.4
TS11	297.6	293.2	26.8	0.37	0.68	9.7	112.7	11.5
Mean (Tanzania)	**313.5**	**295.2**	**27.2**	**0.47**	**0.70**	**9.7**	**113.2**	**12.0**
STRESS ENVIRONMENT								
GB22/311	330.4	304.2	28.0	0.56	0.59	15.3	81.9	5.4
GB25/314	398.2	278.9	27.2	0.53	0.58	10.8	49.6	4.5
GB21/310	296.2	271.5	25.6	0.77	0.78	12.1	77.0	6.6
Mean (Guinea Bissau)	**341.6**	**284.9**	**26.8**	**0.62**	**0.7**	**12.7**	**69.5**	**5.5**
ZS1	223.6	270.2	28.4	0.53	0.66	10.4	113.9	11.2
ZS2	216.4	268.0	31.2	0.56	0.71	9.0	98.8	11.1
ZS3	257.1	299.8	26.8	0.56	0.80	9.3	99.8	11.0
ZS5	212.8	295.5	29.2	0.61	0.73	8.6	103.9	13.5
ZS8	237.2	265.9	26.4	0.57	0.80	7.7	90.9	12.5
Mean (Zambia)	**229.4**	**279.9**	**28.4**	**0.57**	**0.7**	**9.0**	**101.5**	**11.9**
TS9	282.2	294.3	28.8	0.56	0.76	8.3	96.7	12.1
TS11	256.4	289.6	27.6	0.57	0.72	8.0	87.9	11.0
Mean (Tanzania)	**269.3**	**291.9**	**28.0**	**0.56**	**0.7**	**8.1**	**92.3**	**11.6**

GB accessions recorded highest sex ratio (0.74), however, variation for this trait was more in Cameroon accessions (SD = 0.74), which was least in GB accessions (0.24).

Bunch Analysis for different components of FFB: Bunch analysis was done to study different components directly or indirectly related with oil yield per unit area.

The bunch analysis was carried out (Table 3) and wide variation has been observed for F/B, M/F, K/F and S/F ratios. The activity is in progress. The percent sterile fruits ranged from 5.28 to 44.53%. The percent oil/ bunch ratio ranged between 2.50% to 19.48% suggesting a wide range of variation for this character.

Hybridization: Hybridization programme was initiated to exploit the variation available in the materials for various characters like no empty spike lets, less number of sterile/ infertile/parthenocarpic fruits etc. The hybridization programme is mainly aimed at development of high yielding *dura* palms, high yielding *tenera* hybrids, study on genetics of fruit colour and sizes *etc*. Till the reported period three D x D and one D x P progenies are in primary nursery; some more crosses are being harvested.

Physiological characterization: Stomatal and physiological parameters were recorded in the African *dura* germplasm collected from Guinea Bissau, Tanzania and Zambia. Based on stomatal and physiological observations,

Table 2. Evaluation of diverse germplasm accessions for water stress tolerance in observational trial at NRCOP, Pedavegi, A.P.

Accession		Stem height (cm)	Stem girth (cm)	No. of leaves	Sex ratio	Rachis length (cm)	No. of bunches	FFB yield (kg)	Average bunch weight (Kg)	Specific leaf weight (kg)
Cameroon (5)	M	314.3	269.2	27.08	0.74	451.1	9.78	108.7	11.21	0.60
	SD(±)	33.6	19.3	0.53	0.74	21.3	2.16	32.10	2.71	0.09
Guinea	M	303.0	369.0	30.4	0.74	372.8	9.9	52.4	5.4	0.6
Bissau (13)	SD(±)	22.78	65.46	1.15	0.24	38.10	4.7	34.0	1.9	0.09
Tanzania (7)	M	299.3	318.4	32.78	0.30	438.4	9.9	111.0	11.4	0.67
	SD(±)	17.4	33.8	0.86	0.28	24.0	3.4	39.3	3.1	0.04
Zambia (6)	M	314.0	259.2	31.52	0.51	436.0	9.8	110.0	10.1	0.64
	SD(±)	82.6	29.4	0.65	0.32	33.1	4.0	52.1	3.1	0.04

Table 3. Bunch parameters on some palms in different accessions at NRCOP, Pedavegi, Andhra Pradesh

Parameters	General Mean	Standard deviation (±)	Maximum value	Minimum value
Per cent sterile fruit	18.22	7.42	44.53	5.28
Bunch weight (Kg)	10.88	3.98	20.02	2.90
Percent oil/ bunch ratio	12.12	3.50	19.48	2.50

Table 4. Ranking of *dura*s based on physiological and stomatal characters grown under stress

	SF	SI	Pno	GCL	SPA	E	Tleaf	Pn	PWUE	LWP	Total	Rank
GB-22	7	10	5	10	1	1	8	5	3	4	54	3
GB-25	6	8	2	6	3	2	5	3	2	5	42	2
GB-21	2	1	9	3	4	8	9	6	8	10	60	7
ZS-1	3	3	4	5	8	4	7	1	1	1	37	1
ZS-2	4	5	10	1	2	10	3	9	10	7	61	9
ZS-3	5	2	8	4	9	3	10	4	4	9	58	5
ZS-5	9	7	6	2	5	6	4	7	6	6	58	5
ZS-8	8	9	1	9	10	7	2	2	5	3	56	4
TS-9	1	4	7	8	6	5	6	10	9	8	64	10
TS-11	10	6	3	7	7	9	1	8	7	2	60	7

Table 5. Ranking of *dura*s based on physiological and stomatal characters grown under irrigated conditions

	SF	SI	Pno	GCL	SPA	E	Tleaf	Pn	PWUE	LWP	Total	Rank
GB-22	4	10	6	10	1	8	6	9	9	7	70	9
GB-25	3	6	9	6	3	3	4	8	7	3	52	5
GB-21	5	7	2	3	4	6	7	5	5	5	49	4
ZS-1	1	3	7	5	8	1	8	2	1	4	40	1
ZS-2	7	8	1	1	2	10	3	10	10	9	61	8
ZS-3	10	9	3	4	9	7	10	7	8	8	75	10
ZS-5	9	4	5	2	5	9	9	1	2	6	52	5
ZS-8	8	5	10	9	10	5	2	4	4	1	58	7
TS-9	2	2	4	8	6	2	5	3	3	10	45	2
TS-11	6	1	8	7	7	4	1	6	6	2	48	3

rankings were given to different *dura*s grown under stress and irrigated conditions.

*Dura*s having lower stomatal frequency, stomatal index, guard cell length, stomatal pore area, transpiration rate, leaf temperature and higher plastid number, photosynthetic rate, photosynthetic water use efficiency, leaf water potential was ranked lower i.e., superior drought tolerant *dura*s. The ranking of *dura*s grown under stress (Table 4) indicated that ZS-1 recorded the lowest rank compared to that of other *dura*s. Highest rank was recorded by TS-9. Among the Guinea Bissau *dura*s, GB-25 recorded the lowest rank and GB-21 recorded the highest rank. In Zambian *dura*s, ZS-1 recorded the lowest rank than that of other *dura*s. Highest rank was noted by ZS-2. Ranking was given to *dura*s grown under irrigated conditions also (Table 5). ZS-3 and GB-22 recorded the highest ranking compared to that of the other *dura*s. Lowest rank was recorded by ZS-1 and TS-9. Among the different Guinea Bissau *dura*s, GB-21 recorded the lowest rank and GB-22 recorded the highest rank. ZS-1 and ZS-3 recorded lowest and highest rank in Zambia *dura*s. Among the two Tanzanian *dura*s, TS-9 recorded the lowest ranks compared to that of TS-11.

Biochemical characterization: From the data analysed during the reporting period, it was observed that Total sugar content was less in most of the accessions from Cameroon (though one of the Cameroon accessions showed highest total sugar content) and high in some of the Guinea Bissau accessions. No country wise trend was observed in case of soluble sugar, soluble protein, chlorophyll and carotenoids. Hence, accession wise and more precisely palm wise data is more useful for evaluation and selection of palms for further improvement.

Evaluation of African Germplasm (Nellore, A.P.): The experiment was planted in 1998 with 14 accessions, planted in a Randomized Block Design with three replications. The plantation is under severe water stress and is being maintained as per standard package of practices. Irrigation is given as per the IW/CPE ratio of 0.5. Quarterly observations were recorded on leaf and inflorescence production. Annual biometric morphological observations on plant height, girth, and 17th leaf measurements like rachis length, depth, and width were recorded to calculate leaf area and dry matter production.

Palms with high yield have been tagged. Significant variation was recorded among the genotypes for all the characters studied. Six palms (two in Guinea Bissau and four in Tanzanian accessions) identified during the previous year have been found producing female inflorescences this year also.

GB accessions were in general tall growing (122.95cm) with thin leaflets (Table 6); Zambian & Tanzanian accessions were of medium height. Maximum height and girth at collar were recorded by Guinea Bissau accessions like in the previous year. These accessions had small leaves (mean Rachis length = 2.76m) when compared with other accessions from different sources. The specific leaf weight was recorded maximum in Tanzanian accessions followed by Zambian accessions. Rachis length (leaflet bearing length) was maximum in Zambian accessions (338.5cm); these accessions also had highest number of leaflets (243.8).

Evaluation of African Germplasm (Adilabad, A.P.): The experiment was laid out in Randomized Block Design with three replications, from three sources like Tanzania, Zambia, and Guinea Bissau. Annual biometrical observations like plant

Table 6. Evaluation of germplasm at Simhapuri Agro-products Pvt. Ltd., Nellore, A.P.

Genotype	Palm height (cm)	Stem girth (cm)	No. of leaflets	Rachis length (cm)	Leaf area (sq m)	Leaf dry weight (kg)	Specific Leaf Weight (Kg)
TS-7	111.75	245.08	246.00	322.92	3.06	2.59	0.85
TS-12	97.94	227.39	211.33	330.22	3.10	1.95	0.64
TS-9	88.25	245.92	240.25	297.83	3.29	2.47	0.78
TS-10	100.33	225.17	222.50	293.42	2.62	1.76	0.69
Mean (Tanzania)	**99.57**	**235.89**	**230.02**	**311.10**	**3.02**	**2.19**	**0.74**
SD (Tanzania)	**9.66**	**11.14**	**15.98**	**18.20**	**0.28**	**0.40**	**0.09**
GB27/316	124.67	239.58	221.28	262.83	2.57	1.13	0.49
GB8/314	121.83	261.08	213.22	256.42	2.07	1.31	0.62
GB5/320	110.44	221.97	180.39	250.28	2.32	1.18	0.50
GB3/290	101.33	256.25	224.67	278.33	2.25	1.33	0.57
GB30/319	152.44	252.83	204.83	312.86	2.77	1.66	0.61
GB24/313	126.96	266.08	216.08	299.42	2.28	1.28	0.62
Mean (Guinea Bissau)	**122.95**	**249.63**	**210.08**	**276.69**	**2.38**	**1.31**	**0.57**
SD (Guinea Bissau)	**17.40**	**16.26**	**16.08**	**25.01**	**0.25**	**0.18**	**0.06**
ZS-3	75.75	221.50	242.17	337.33	3.19	2.37	0.75
ZS-2	80.03	210.92	247.67	339.39	2.95	2.12	0.75
ZS-7	113.33	226.86	255.50	352.22	4.28	2.72	0.69
ZS-9	111.00	246.17	229.67	324.92	2.74	1.59	0.58
Mean (Zambia)	**95.03**	**226.36**	**243.75**	**338.47**	**3.29**	**2.20**	**0.69**
SD (Zambia)	**19.89**	**14.77**	**10.87**	**11.18**	**0.69**	**0.48**	**0.08**

height, girth, standard leaf (17th) measurements *etc*., were recorded.

Variation for rachis length, petiole width, number of leaflets, leaflet length and leaflet width were non significant (Table 7a). Like in previous year, TS 8 had the highest leaf area (2.1sqm) but had the least SLW (0.44). The highest SLW was recorded in GB 10/306. In Cameroon accessions CA 12 (0.85) & CA 8 (0.84) were having high SLW. Zambian accessions were found comparatively dwarf like previous year. The highest SLW was recorded in Zambian accessions followed by Tanzanian ones. In observational trial (Table 7b) involving Cameroon accessions, there was 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 was significant, implying variability available in this material for this trait.

Evaluation of African Germplasm (Palode, Kerala): The experiment was planted in 1998 in Randomized Complete Block Design with two replications under rainfed conditions. Potential palm having long stalk identified from Guinea Bissau accessions. Phenotypic variation in seed, nut and bunch characters evaluated in African accessions. One ideal *Pisifera* identified from Tanzanian accession.

The average bunch weight of Guinea Bissau accessions (Table 8) was in general small (3.6Kg); the Tanzanian accessions in general produced big sized bunches (7.6kg). Guinea Bissau accessions were characterized by small seed size (single seed weight= 1.8g as against big sized (2.6g) Tanzanian accessions.

Table 7a. Evaluation of germplasm at ITDA Farm, Jambuga, Adilabad, A.P.

S. No.	Germplasm accession ID	Rachis length cm	Petiole width cm	Petiole depth cm	No. of leaflets	Leaflet length cm	Leaflet width cm	Leaf area Sq m	Leaf dry weight Kg	SLW Kg
1	GB-2/298	232.0	3.41	2.37	207.9	49.7	2.90	1.70	1.05	0.62
2	GB-10/306	202.7	3.54	2.47	185.1	48.7	2.96	1.52	1.17	0.85
3	GB-21/310	200.6	3.42	2.55	191.5	46.7	2.90	1.49	1.13	0.76
4	GB-5/310	215.2	3.57	2.58	208.7	48.2	2.94	1.70	1.16	0.73
5	ZS-3	204.5	3.35	2.36	190.8	50.1	2.87	1.56	1.04	0.68
6	ZS 6	214.6	3.24	2.19	195.8	47.6	2.81	1.51	0.96	0.67
7	ZS6	192.6	3.36	2.41	186.7	48.9	2.88	1.53	1.06	0.72
8	TS 5	211.7	3.78	2.69	197.5	53.1	2.98	1.78	1.25	0.72
9	TS 8	230.5	3.22	2.09	215.0	58.0	2.93	2.11	0.92	0.44
	Mean	211.6	3.43	2.41	197.66	50.1	2.91	1.66	1.08	0.69
	SD (±)	13.3	0.18	0.19	10.571	3.47	0.05	0.201	0.11	0.113

Data were recorded on individual palm basis in Guinea Bissau accessions (Table 9), Tanzanian palms (Table 10) and Zambian accessions (Table 11). Variation in different bunch components, fruit and seed components were recorded to characterize the palms. The variation has been measured in terms of average, standard deviation, maximum and minimum parameter value.

Variation for bunch weight among the palms ranged from 0.84 – 10.29 kg in GB accessions, 0.92 – 17.29 kg in Tanzanian accessions and 4.23kg - 14.94 kg in Zambian accessions. Tanzanian accessions in general had long bunches (bunch length= 35cm), more number of spikelets/ bunch (88 nos.). Numbers of spikelets were least in Guinea Bissau accessions, which eventually also had small bunch size (bunch length= 24.76cm).

Evaluation of African Germplasm (PCKL, Athirapally, Kerala): The experiment was planted in 1998 along with other locations. The palms are grown as rain fed.

Phenotypic variation in seed, nut and bunch characters evaluated in African accessions. Preponderance of male and

Table 7b. Evaluation of germplasm at ITDA Farm, Jambuga, Adilabad, A.P.

S. No.	Germplasm accession ID	Rachis length cm	Petiole width cm	Petiole depth cm	No. of leaflets	Leaflet length cm	Leaflet width cm	Leaf area Sq m	Leaf dry weight Kg	SLW Kg
1	CA-1	274.8	3.9	3.0	220.8	60.9	3.1	2.42	1.42	0.61
2	CA3	246.8	3.6	2.8	203.5	57.1	3.0	2.043	1.26	0.65
3	CA4	224.0	3.5	2.7	204.0	55.8	2.9	1.908	1.2	0.65
4	CA6	242.8	3.5	2.5	237.0	61.2	3.0	2.466	1.12	0.46
5	CA7	233.5	3.2	2.1	223.0	59.9	3.0	2.27	0.87	0.39
6	CA8	196.3	3.3	2.3	125.2	50.1	2.9	1.343	0.97	0.84
7	CA15	259.0	4.1	3.5	179.2	62.1	3.0	2.406	1.67	0.73
8	CA11	231.5	3.3	2.4	149.6	57.0	2.9	1.807	1.02	0.58
9	CA12	222.5	3.5	2.7	177.5	56.7	2.4	1.378	1.17	0.85
10	CA13	228.5	3.3	2.3	174.0	59.0	2.8	1.642	0.98	0.60
11	CA10	208.5	3.4	2.2	178.5	56.5	2.9	1.683	0.98	0.65
12	CA16	232.0	3.3	2.2	208.4	61.5	2.8	2.023	0.96	0.51
13	CA 18	175.5	3.1	2.1	146.5	60.1	3.0	1.511	0.87	0.58
	Mean	228.9	3.46	2.52	186.71	58.30	2.90	1.92	1.11	0.62
	SD (±)	25.8	0.28	0.41	33.18	3.27	0.17	0.40	0.23	0.13

Table 8. Family performance of African germplasm accessions at NRCOP-RS, Palode

African germplasm	Bunch Wt. (Kg)	Bunch Length (cm)	Bunch breadth (cm)	Total No. of spikelet	Spikelet weight (Kg)	Spikelet length (cm)	Spikelet breadth (cm)	Peduncle length (cm)	Peduncle Breadth (cm)	Stalk length (cm)	Stalk breadth (cm)	Single seed Wt (g).	Single fruit wt.(g)	Fruit / Bunch ratio
Guinea Bissau	3.57	24.76	55.05	70.89	0.40	6.47	10.48	13.43	18.25	10.43	14.88	1.77	4.70	46.19
Tanzania	7.57	35.00	53.77	88.75	1.02	7.38	12.95	15.85	24.15	11.30	20.10	2.55	8.16	72.21
Zambia	6.72	29.51	48.22	82.09	0.85	6.47	10.68	14.89	21.19	9.83	17.68	2.22	7.02	54.58
Grand Mean	5.95	29.76	52.34	80.58	0.75	6.77	11.37	14.72	21.20	10.52	17.56	2.18	6.63	57.66

Table 10. Bunch characteristics of Tanzanian accessions (individual palms) at NRCOP-RS Palode, Kerala

Palm No.	Bunch Wt. (Kg)	Bunch Length (cm)	Bunch breadth (cm)	Total No. of spikelet	Spikelet weight (Kg)	Spikelet length (cm)	Spikelet breadth (cm)	Peduncle length (cm)	Peduncle Breadth (cm)	Stalk length (cm)	Stalk breadth (cm)	Single seed Wt (g).	Single fruit wt.(g)	Fruit / Bunch
47	9.99	37	45.5	116	1.7	7.50	13.33	16.5	31	15	30	3.063	9.16	54.25
49	1.41	20.5	49	60.5	0.12	6.00	10.00	12	14.5	8	12	1.206	8.98	36.52
51	1.36	20	46.5	50	0.11	4.83	9.50	10	14	8	12.5	1.757	2.53	31.62
56	7.14	32.5	78.5	104	0.62	7.67	13.50	13	21	14.5	20.5	4.871	11.41	59.10
61	12.01	38	90	96	1.385	9.00	14.33	13.5	28	14.5	29	4.027	12.16	67.86
73	0.92	16.5	44.5	49	0.11	5.67	9.83	9.5	13	7	12	2.197	2.95	298.91
76	7.05	32.5	84	110	1.24	7.67	17.00	15.5	24.5	17	27	4.089	10.21	53.62
78	1.66	22.5	48	77	0.13	5.00	10.17	13	16	7.5	12	2.299	2.91	37.35
84	17.29	45	50.575	104	2.25	9.67	17.00	26.5	39.5	10	23	5.489	10.72	21.40
85	16.85	85.5	1.1	121	2.52	10.83	14.83	29	40	11.5	23	5.596	10.57	61.48
Mean	7.57	35.00	53.77	88.75	1.02	7.38	12.95	15.85	24.15	11.30	20.10	2.55	8.16	72.21
A. Dev.	5.17	13.10	18.24	23.70	0.80	1.61	2.46	4.89	8.45	3.20	6.38	1.36	3.22	45.34
SD (±)	6.34	20.03	25.57	27.43	0.93	2.03	2.92	6.65	10.25	3.70	7.43	1.58	3.82	81.03
Max	17.29	85.50	90.00	121.00	2.52	10.83	17.00	29.00	40.00	17.00	30.00	5.60	12.16	298.91
Min	0.92	16.50	1.10	49.00	0.11	4.83	9.50	9.50	13.00	7.00	12.00	1.21	2.53	21.40

Table 9. Bunch characteristics of Guinea Bissau accessions (individual palms) at NRCOP-RS Palode, Kerala

Palm No.	Bunch Wt. (Kg)	Bunch Length (cm)	Bunch breadth (cm)	Total No. of spikelet	Spikelet weight (Kg)	Spikelet length (cm)	Spikelet breadth (cm)	Peduncle length (cm)	Peduncle Breadth (cm)	Stalk length (cm)	Stalk breadth (cm)	Single seed Wt (g).	Single fruit wt.(g)	Fruit / Bunch ratio
2	3.04	44.5	43.5	66.0	0.32	8.17	12.5	14.0	19.0	8.5	13.5	2.25	4.46	52.96
9	5.06	0.3	46.0	112.0	0.58	6.22	12.7	17.0	27.0	27.0	27.0	2.20	3.02	51.78
13	8.41	0.6	76.0	61.0	0.86	7.33	11.7	20.0	23.5	12.0	20.0	2.72	9.64	49.23
15	8.26	0.9	77.0	83.0	0.79	7.33	14.2	18.0	23.0	11.5	13.5	2.21	11.48	8.60
17	2.65	0.8	57.0	81.0	0.75	6.50	11.7	15.0	19.0	7.0	15.0	1.39	2.31	56.60
20	1.06	19.0	57.0	49.0	0.12	5.33	8.5	12.5	12.0	7.5	10.0	1.64	3.04	24.53
21	1.63	0.1	50.0	65.5	0.20	5.33	9.5	12.0	17.0	9.5	12.5	1.48	2.41	63.19
22	1.76	0.2	50.0	60.0	0.28	6.67	11.0	13.5	17.5	9.5	15.0	2.15	2.45	30.68
25	1.30	0.3	46.5	61.5	0.15	6.00	7.2	11.0	17.5	9.0	12.5	1.53	3.14	29.23
26	1.61	0.2	48.5	50.0	0.16	6.00	9.5	12.5	15.5	8.0	11.5	2.50	2.62	17.39
27	0.90	0.2	55.0	45.5	0.17	7.83	7.8	12.0	15.0	10.5	11.0	2.09	2.88	40.00
28	2.57	0.2	59.0	91.0	0.24	7.00	10.7	14.5	18.0	9.5	12.0	1.50	3.00	47.47
29	0.84	0.2	43.5	30.0	0.15	5.67	7.7	11.5	16.0	9.0	12.5	1.83	3.56	59.52
30	2.37	0.2	59.0	75.0	0.30	6.00	11.0	13.0	19.5	10.5	14.5	1.62	2.50	79.44
31	2.49	0.3	78.0	75.0	0.23	6.33	11.3	13.5	19.0	7.0	14.0	1.33	2.74	46.59
33	2.67	0.2	58.5	93.5	0.25	6.83	10.7	16.5	17.5	9.5	13.0	1.50	2.34	49.81
34	2.43	24.0	58.0	61.5	0.38	6.67	10.5	16.0	20.0	14.0	15.0	2.17	3.27	48.97
35	2.47	0.4	58.5	95.0	0.40	6.67	9.2	15.5	21.0	6.5	14.0	1.69	3.06	40.08
37	1.22	0.4	49.0	68.5	0.17	5.67	9.3	13.0	15.5	8.5	11.5	1.61	2.07	45.08
38	10.29	0.2	61.5	68.0	0.70	6.75	13.5	15.0	22.5	11.5	16.0	1.91	12.13	39.18
39	5.31	0.7	77.5	137.0	0.47	8.50	11.3	16.0	22.0	12.5	21.0	1.24	1.84	45.57
40	2.57	0.5	41.0	87.5	0.23	7.67	11.0	13.5	17.5	7.5	14.5	1.67	2.76	43.39
42	2.34	0.2	62.5	48.0	0.25	7.83	13.5	15.0	17.0	9.5	14.0	1.49	4.63	46.58
43	3.24	47.0	66.5	55.0	0.37	7.67	12.2	15.0	20.0	10.0	16.5	1.99	3.22	61.42
44	2.51	0.4	47.0	60.0	0.19	7.00	12.7	11.0	15.5	11.0	13.0	2.45	3.90	35.06
45	2.40	0.2	58.5	72.0	0.27	6.50	11.5	14.0	19.0	11.5	13.5	2.42	3.70	47.71
46	2.48	0.3	58.5	82.5	0.29	7.67	12.0	14.0	19.0	9.0	15.5	1.78	3.21	39.72
50	1.22	0.3	46.5	57.0	0.14	5.83	8.3	12.5	17.5	9.5	12.0	1.12	5.85	21.31
Mean	3.55	0.1	57.6	73.3	0.39	6.79	11.0	14.0	19.1	10.5	15.4	2.25	4.71	46.92
A. Dev.	1.60	0.4	8.2	16.5	0.16	0.70	1.5	1.7	2.3	2.1	2.2	0.36	1.74	11.01
SD (±)	2.36	0.2	10.7	22.0	0.21	0.87	1.9	2.1	3.1	3.7	3.4	0.42	2.67	14.90
Max	10.29	0.2	78.0	137.0	0.86	8.50	14.2	20.0	27.0	27.0	27.0	2.72	12.13	79.44
Min	0.84	0.9	41.0	30.0	0.12	5.33	7.2	11.0	12.0	6.5	10.0	1.12	1.84	8.60

Table 11. Bunch characteristics of Zambian accessions (individual palms) at NRCOP-RS Palode, Kerala

Palm No.	Bunch Wt. (Kg)	Bunch Length (cm)	Bunch breadth (cm)	Total No. of spikelet	Spikelet weight (Kg)	Spikelet length (cm)	Spikelet breadth (cm)	Peduncle length (cm)	Peduncle Breadth (cm)	Stalk length (cm)	Stalk breadth (cm)	Single seed Wt (g).	Single fruit wt.(g)	Fruit / Bunch ratio
52	10.41	37.00	44.50	182.50	1.32	9.00	10.83	27.00	30.00	6.00	24.50	6.21	12.04	51.59
60	4.23	33.5	72.5	66	0.26	7.67	11.00	14	18	10.5	14	2.463	4.10	62.41
63	8.51	34	93.5	114	1.42	7.50	10.50	20	34.5	15	29	5.458	5.05	56.64
70	6.16	29	77	142.5	0.71	7.83	9.67	20	26	6	23	5.373	10.81	53.25
71	10.04	39	86	109	1.475	7.00	13.17	15.5	29	16	27	6.141	7.58	59.56
72	14.94	35	1.05	105	1.44	11.00	19.00	23	35	11	30	7.378	15.16	27.58
77	13.13	35	45.58	121	1.62	7.33	13.33	26	32.5	8.5	26.5	7.817	11.16	83.47
Mean	6.07	31.38	57.28	89.90	0.74	7.38	12.09	16.26	22.93	10.46	18.71	2.25	6.57	51.59
A.Dev.	2.86	2.42	25.41	24.57	0.40	1.03	2.29	3.90	4.24	3.08	3.73	1.20	3.29	10.47
SD (±)	3.73	3.41	32.06	35.85	0.50	1.39	3.17	4.93	5.90	3.98	5.36	1.74	3.99	16.55
Max	14.94	39.00	93.50	182.50	1.62	11.00	19.00	27.00	35.00	16.00	30.00	7.82	15.16	83.47
Min	4.23	29.00	1.05	66.00	0.26	7.00	9.67	14.00	18.00	6.00	14.00	2.46	4.10	27.58

Table 12. Preponderance Female inflorescence in African germplasm at PCKL, Athirapalli, Kerala

Accession	Peduncle Length(Cm)	Peduncle Width(Cm)	Inflr. Length (Cm)	Inflr. Width (Cm)
G8B	13.5	18.2	34.5	79
G6B	12.3	16.9	28.5	70
G1B6	18.3	22.5	39	55
G2B8	13.2	20.3	36.5	20.3
2GB9	10.1	17.8	40.8	79.7
3G0B	17.2	21.5	36.5	79.3
G3B1	12.3	19.5	33.5	80.2
3GB5	12.8	18.6	35.05	81.8
3GB6	12.2	21.3	34.5	80.7
GB90	19	17.5	26.5	17.5
G6B4	11.8	16.6	35.5	69.2
22GB0	13.5	16.8	31.5	16.8
3G4B0	16.23	16	37	78
33GB8	13.6	20.2	40.5	87.3
33GB6	11.2	19.3	33.5	19.3
D ´ P, PLD12	11.8	21.8	38.5	89
Z5S7	17.8	18.3	43	102.3
1T7S6	23.3	18.8	32	65.5
32TS8	17.4	19.6	36.3	75.8
35CA4	17.8	17.6	32.5	72.5
AVERAGE	14.77	18.96	35.28	65.96
AVEDEV	2.89	1.54	3.08	20.14
STDEV	3.39	1.87	4.05	26.13
MAX	23.3	22.5	43	102.3
MIN	10.1	16	26.5	16.8
MEDIAN	13.5	18.7	35.275	76.9
VAR	11.49	3.50	16.42	682.81

female inflorescences assessed in all the accessions of African germplasm at this centre. The observations on individual palms on different characters are being recorded (Table 12). The evaluation activity is continuing.

Molecular Characterization of oil palm germplasm

RAPD analysis of oil palm germplasm from Africa, Costa Rica and Palode : The RAPD analysis was carried out with one set of palms (GB-22/311 - palm No: 90,118,120,161; ZS 8 – palm No: 38, 39, 61, 62; TZ 9 – palm No: 297, 298, 300, 301; CA 13 - palm No:: 297, 298, 300, 301; Palode 240D x 281D - palm No: 27, 28, 29, 68; and ASD Costa Rica 98C x 254 D - palm No: 489, 546, 566, 567) and data were further analysed to estimate the Marker Index as well as Resolving power of the primers. Considering both the parameters, the markers were grouped into three categories, Most useful, Medium useful and Least useful. This categorization needs to be considered only for the identification purpose. The list of three categories of the primers are presented in the Table 13.

RAPD analysis of another set of germplasm (GB-22/311 - palm No: 154, 156, 160, 162;

Table 13: Categorization of the Primers based on their usefulness for palm identification

Primer		MI	Rp	Primer		MI	Rp
	OPM - 08	0.00	0.00		OPO - 15	8.09	4.17
	OPM - 15	0.00	0.00		OPM- 20	8.45	6.58
Least	OPN - 11	0.00	0.00	Most	OPN - 10	8.66	5.92
useful	OPN - 16	0.00	0.00	useful	OPO - 19	9.43	4.33
	OPN - 19	0.00	0.00		OPO - 18	9.97	5.42
	OPO - 14	0.00	0.00				
	OPP - 01	0.00	0.00				
Primer		**MI**	**Rp**	**Primer**		**MI**	**Rp**
	OPM - 12	0.31	0.33		OPM - 04	2.28	2.33
	OPN - 08	0.31	0.33		OPO - 10	2.42	1.67
	OPM - 16	0.39	0.42		OPP - 16	3.19	1.83
	OPP - 19	0.56	0.67		OPO - 11	3.33	2.17
	OPO - 16	0.94	0.50		OPM - 05	3.33	2.25
Medium	OPO - 13	0.97	0.33	Medium	OPP - 08	3.34	2.08
useful	OPM - 07	1.28	0.67	useful	OPP - 12	3.87	1.42
	OPM - 10	1.66	1.92		OPO - 09	4.53	2.17
	OPP - 14	1.94	0.67		OPM - 02	5.91	3.17
	OPO - 08	2.05	0.50		OPM - 17	6.38	3.17
	OPN - 12	2.10	1.25		OPO - 20	7.47	4.83
	OPP - 17	2.14	1.67		OPP - 10	9.65	2.50

ZS 8 – palm No: 150, 163, 164, 166; TZ 9 – palm No: 198, 226, 227, 228; CA 13 - palm No: 129, 132, 133, 134; 240Dx281D - palm No: 35, 54, 82, 93 and 98C x 254 D - palm No: 337, 342, 413, 505) was completed. Cluster analysis (by UPGMA method) showed six different groups, each consisting of palms from same accession, although no two palms from any accession were completely similar. The similarity among the four palms under Guinea Bissau ranged from 0.926 – 0.957. Cameroon and ASD Costa Rica accessions were found closer to each other. Palode accession was closer to these two group and Tanzanian palms were closer to the said three groups than that of others (Fig.1)

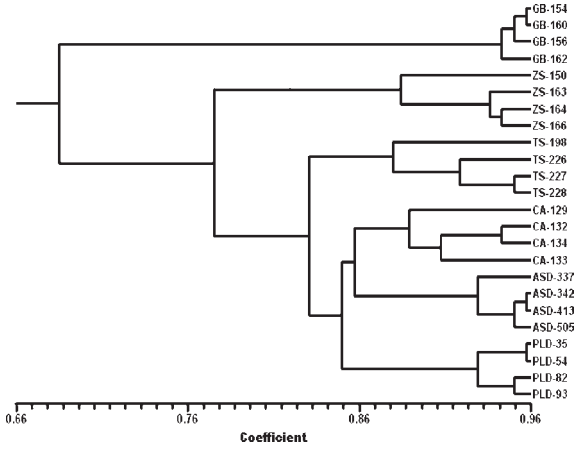


Fig. 1: Dendrogram showing diversity among 24 palms from 6 different accessions.

RAPD analysis of oleifera palms : All the *oleifera* palms (23 palms) from Palode were subjected to DNA isolation and RAPD analysis using total of 44 primers. Total No. of band obtained were 200 and 70% of that (140) were polymorphic. Analysis with more number of primers is in progress. The work is still continuing with more number of primers. Along with 23 *oleifera* palms, 2 *guineensis* palms were also analysed. The data so far recorded were analysed and it reveals that the two *guineensis* palms are completely genetically divergent and form another cluster. Palm No. *Eo*-16 was distinctly different from the other palms and did not form any cluster (Fig. 2). However, the maximum divergence with Palm No. *Eo*-16 was observed with *Eo*-01, *Eo*-10, *Eo*-13 (Similarity index 0.690) followed by *Eo*-08 (Similarity index 0.695) and *Eo*-02 (Similarity index 0.700). *Eo*-05 and *Eo*-16 showed maximum divergence with *E.guineensis* palms in comparison to other *Eo* palms**.**

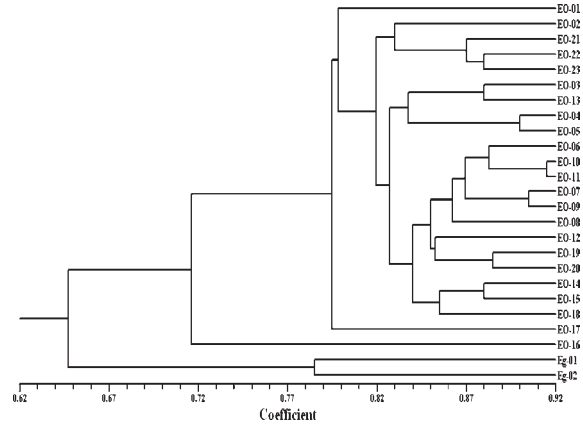


Fig. 2: Dendrogram derived from cluster analysis of 23 *oleifera* and two *guineensis* palms using UPGMA method

Use of microsatellite primers for genetic diversity study of oil palm : Several oil palm genomic sequences, suspected to be microsatellite sequences are available in the public domain. 250 such sequences were downloaded for designing primers using software 'OLIGOS' Version 6.2. While designing primers, several combinations (pairs) of primers were derived for each microsatellite, from which only one pair was selected. So far 160 such primers pairs were designed. 118 primer pairs were procured through custom-oligo synthesis service. During the reporting period, 80 primers were tested for their functionality for oil palm and 74 primer pairs were found to be functional.

Studies on DNA isolation without detergent from other palms : Attempts have been made to extract DNA using the novel method developed at NRCOP from the other palms (Palmyra, Coconut, Arecanut, Date) as well some fruit trees like guava, sapota and citrus. DNA extraction from other palms using the Novel-method without detergent was confirmed, however, it was not possible for the other tree species under study. Since CTAB interacts with polysaccharides and help in precipitation, and facilitate cleaner DNA isolation, total and soluble carbohydrate content in the leaves of these palms and other tree species were studied. No significant difference in total as well as soluble carbohydrates was found among the palms and other trees (Chart 1). Total carbohydrates were significantly lower in

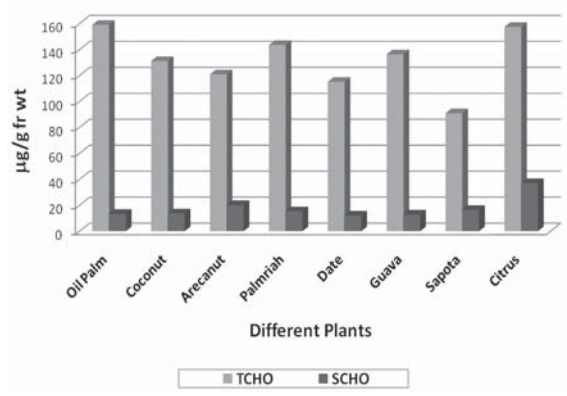


Chart 1: Soluble and total carbohydrates in the leaves of different plants

Sapota and all other plants were on par. Similarly soluble carbohydrate was significantly lower in citrus than that of other plants which were on par.

4. Research Achievements

तेल ताड प्रजनन

Oil Palm Breeding

Female flowers of oil palm

OIL PALM BREEDING

Evaluation of inter-specific hybrids: The inter-specific hybrids are being evaluated for morphological, dry matter and biochemical characters. The observations on leaf and inflorescence production on quarterly basis, other biometrical observations on annual basis and FFB production on every harvest basis were recorded. Comparative height increment of IS 2 was less. Mean FFB weight & ABW of 361Dx11Eo was more than 360D x 13Eo and also have high variation. Frequency of production of Hermaphrodites is more in many palms. Variation for BI was more. The variations for bunch quality parameters, production of hermaphrodite inflorescences, growth parameters and FFB yield have been recorded. Bunch analysis was carried out on individual palms. There was significant variation among palms within a cross for % sterility, seed size, % mesocarp content, Sex ratio, frequency of production of hermaphrodite inflorescences etc. The percent sterility ranged between 8.7 & 76.5. Oil/ Bunch ratio varied between 5.5% & 25.04%.

Parameters	GM	SD (±)	Max	Min
Percent Sterility	22.00	13.90	76.49	8.7
Bunch weight (Kg)	15.47	6.10	29.55	5.3
Fruit/ Bunch ratio	0.28	0.04	0.35	0.1
Percent Mesocarp /fruit	62.57	9.82	89.40	39.2
Percent Kernel/ fruit	9.85	2.80	17.15	0.0
Percent Shell /fruit	19.98	9.02	39.60	8.4
Percent moisture content of nuts	21.05	5.49	34.63	9.5
Oil/Dry mesocarp	0.74	0.05	0.84	0.6
Oil/wet mesocarp	0.45	0.06	0.56	0.3
Oil/ bunch ratio	15.77	4.47	25.04	5.5

Analysis of Fatty acids composition of the oils from selected progeny palms

The fatty acids composition (FAC) of 58 fruit samples from 20 interspecific hybrid palms from Palode was analysed. These palms were derived from 9 crosses including one Eg x Eg progeny and another Eo open.

The average unsaturated fatty acids content ranged from 61.51 to 49.51%. Many of the bunches from different interspecific hybrid palms were having considerable amount of parthenocarpic fruits, and hence parthenocarpic and seeded fruits were analyzed separately for FAC. Average unsaturated fatty acids content in the parthenocarpic fruits were ranging from 49.62 to 58.92% , where as in the seeded fruits it was ranging from 61.51 48.70 % in a particular hybrid cross. However, palm wise content of total unsaturated fatty acids were ranging from 61.51 to 40.08 %

Bunch analysis of *oleifera* palms

Bunch analysis of the 23 mother *oleifera* palms at Palode has been completed. Three bunches per palm were analyzed for this purpose. Out of the 23 *oleifera* palms, one palm was very poor yielder and during the two years period only one bunch could be obtained. Hence, the data from remaining 22 bunches were analyzed. From the bunch analysis data superior palms were identified on the basis of oil/bunch ratio and oil yield/ palm/year. Among the 22 palms analysed oil/ bunch ratio ranged from 24.69 to 3.05%, where as oil yield per palm per year ranged from 36.42kg to 2.50 kg.

While conducting bunch analysis of the *oleifera* palms, it was observed that the parthenocarpic fruits have lesser oil content. Hence an experiment was taken up to check the moisture content, oil content and fatty acids composition in the mesocarp of parthenocarpic and seed fruits from the same bunches of *oleifera* palms. Thirty such bunches were analysed and subsequently the data were analysed statistically to record the differences.

The results of the experiment on parthenocarpic and seeded fruits revealed that the the mesocarp of parthenocarpic fruits were inferior in terms of quality and quantity of oil content than that of the seeded fruits of *E. oleifera* bunch (Chart 2 and Chart 3).

Total saturated fatty acids (TSFA) content was significantly higher in the oil of parthenocarpic fruits, which was due to significantly high amount of palmitic acid (C16:0), and lower amount of total

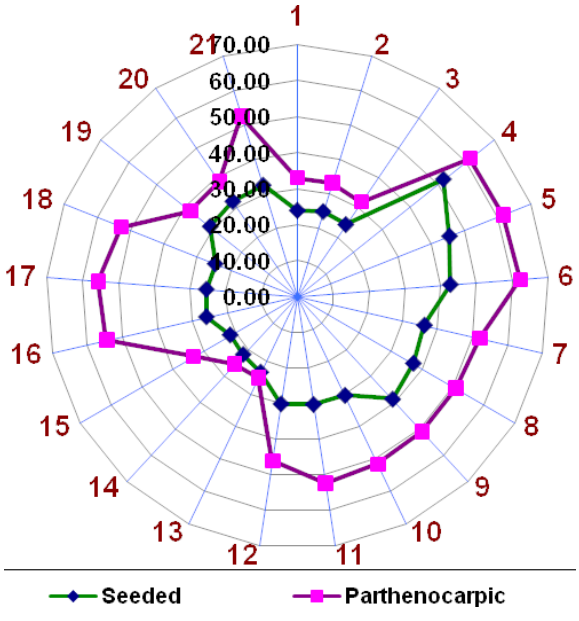


Chart 2 : Moisture percentage in the mesocarp of parthenocarpic and seeded fruits of E.oleifera palms

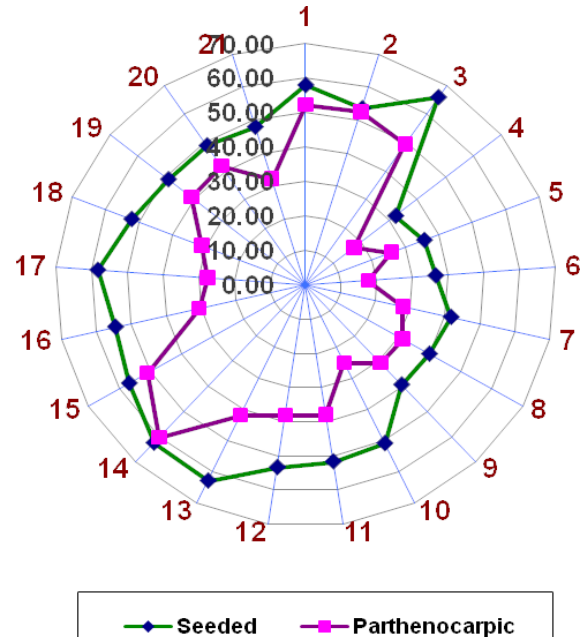


Chart 3 : Oil percentage in the mesocarp of parthenocarpic and seeded fruits of E.oleifera palms

unsaturated fatty acids content due to significantly lower amount of linoleic acid (C18:2) and linolenic acid (C18:3) - both of them were poly unsaturated fatty acids (PUFA). The results revealed that the parthenocarpic fruits were inferior in terms of quality and quantity of oil content than that of the seeded fruits of *E. oleifera* bunch.

Bunch analysis of open pollinated and crossed bunch of oleifera palms at Chithera revealed that crossed bunch recorded reduced weight of (15 Kg) in comparison to open pollinated bunches (26 Kg). Chithara *oleifera* was crossed with Tanzanian *pisifera* pollen (Palm No.66) from Palode and progeny raised in nursery. Bunches crossed with Palode pisifera were processed for progeny evaluation and regeneration.

Biometric observation of *oleifera* palms

Morphological characters were recorded for *oleifera* palms from Palode , which are presented in the Table 14.

Table 14. Morphological characters of *oleifera* palms from Palode

Oleifera Palm No.	Height (m)	Girth (1/2m) above soil level	Leaflet No.	17th leaf length (m)	Petiole length (m)	Petiole Width (cm)	Petiole depth (cm)	Fresh weight of 17th leaf(Kg)	Dry weight of the leaf (Kg)	Middle Leaflet length(m)	Middle leaflet Width (cm)	B. Leaflet length (m)	B. Leaflet Width (cm)	A. Leaflet Length (m)	A. Leaflet width (cm)
1	1.6	3	164	6.61	1.77	116	176	14.28	6.56	1.1	81	1.13	79	1.12	76
2	3.2	2.9	162	6.85	1.9	102	164	11.36	4.76	1.4	60	1.32	56	1.39	55
3	1.8	2.65	156	6.73	0.8	90	139	9.5	3.38	1.2	60	1.14	64	1.15	61
4	3	3.2	148	6.7	1.5	94	169	13.72	5.38	1.3	72	1.26	70	1.32	68
5	2.3	3.1	148	6.15	1.47	116	177	13.48	5.08	1.5	65	1.5	67	1.46	66
6	2.3	3.4	146	5.34	1.62	110	171	14.94	5.34	1.3	65	1.24	57	1.26	54
7	3	3.25	160	6.74	1.1	92	165	12.84	4.94	1.3	64	1.27	66	1.3	62
8	3	2.95	140	5.6	1.27	83	140	7.96	3.12	1.2	50	1.15	56	1.13	54
9	2.3	3.15	160	7.27	1.5	110	184	13.26	4.94	1.3	68	1.3	72	1.31	69
10	2.9	2.95	176	6.73	1.6	100	165	14.12	6.12	1.1	70	1.15	70	1.15	74
11	2.3	3.32	142	5.93	1.6	101	172	12.02	4.52	1.12	68	1.21	61	1.18	65
12	1.76	3.2	164	7.44	1.4	104	182	13.38	5.46	1.2	83	1.15	78	1.19	76
13	1.58	3	172	6.86	1.6	85	145	11.24	4.04	1.1	76	1.5	64	1.70	71
14	3.5	3.4	144	6.96	1.8	122	197	15.42	7.46	1.4	66	1.43	64	1.43	65
15	2.3	2.2	152	7.55	1.3	110	185	15.82	5.14	1.4	73	1.37	69	1.38	70
16	1.9	3.4	164	6.95	1.4	104	179	12.52	4.86	1.2	65	1.26	62	1.21	61
17	3.4	3.5	154	6.95	1.1	99	170	12.56	5.26	1.6	60	1.57	61	1.56	65
18	2.8	3.3	154	7.1	1.9	95	168	14.58	6.44	1.2	70	1.16	75	1.18	72
19	1.6	3.4	120	6.55	1.4	92	145	11.36	4.18	1.2	83	1.22	79	1.24	80
20	1.3	3.4	98	5.85	1.64	131	205	15.96	5.68	1.4	71	1.23	80	1.26	65
21	2	3.2	158	6.9	1.5	93	150	12.54	3.98	1.3	75	1.29	75	1.25	73
22	1.3	3.5	160	5.65	1.3	134	195	14	5.4	1.3	70	1.32	74	1.33	71
23	1.55	3.5	150	7.2	1.6	110	170	13.25	5.3	1.4	60	1.42	61	1.49	59
Average	2.29	3.17	151.83	6.64	1.48	104.04	170.13	13.05	5.10	1.28	68.48	1.29	67.83	1.30	66.61
STDEV	0.69	0.31	16.62	0.60	0.26	13.53	17.73	1.92	1.00	0.13	8.02	0.13	7.66	0.15	7.21
AVEDEV	0.57	0.23	11.34	0.47	0.20	10.66	13.18	1.44	0.72	0.11	6.15	0.10	6.51	0.12	5.85
Minimum	1.3	2.2	98	5.34	0.8	83	139	7.96	3.12	1.1	50	1.13	56	1.12	54
Maximum	3.5	3.5	176	7.55	1.9	134	205	15.96	7.46	1.6	83	1.57	80	1.70	80

Identification of new source for dwarfness : New palms with low height increments have been identified in Zambian and Tanzanian accessions. These palms are being assessed for their productivity so as to include them in breeding programme.

Performance of progeny of dwarf *tenera* palm : The progeny of dwarf *Tenera* palm identified in the NIFOR collection at Palode is evaluated for height character in field. The suspected dwarf palms are being monitored for height increment.

Oil Palm Seed Gardens

Oil palm seed garden (NRCOP, Pedavegi): Evaluation of Dura populations: Data on morphological, phenological & yield related characters were recorded on three Palode *dura* crosses. Palms with high FFB weights have been recorded. A total of 23 high yielding *dura* palms (FFB weight >150 kg/ year) in Palode source and nine in Costa Rican source have been identified as high yielders based on two years data.

Five palms from dura I were selfed and three are ready for nursery planting. Pollen from seven palms were collected and kept for selfing.

Evaluation of TxT population: Data on morphological, phenological & yield related characters were recorded. Fruit typing was done; A segregation ratio of *dura* (27): *tenera* (97): *pisifera* (28) has so far been recorded. High fruit set (62.22%) was recorded in one of the *pisifera* palms (Palm no 77) followed by palm numbers (15, 74 and 110) with fruit set of 49.3, 49 and 32.4 % respectively. Based on sterility characteristics the palm number 17 was identified as sterile ideal for crossing and progeny testing. The *pisifera* palm numbers 43 and 44 had comparatively high kernel weight. The fruit typing, however, is in progress. Selection of *pisifera* palms was conducted utilizing bunch, fruit and seed set characters.

Crosses have been made between fertile *pisifera* palms which were also selfed for generating population for research purpose.

Oil Palm Seed garden (NRCOP, RS, Palode) : Evaluation and segregation pattern of TXT : Yield evaluation revealed that 137 x 137T and 65 x 323 performed well based on the yielding pattern during 2006-07. Thirty eight Dura 80 Tenera & 24 Pisifera were confirmed in the T×T block of Palode.

Oil palm seed garden (Rajahmundry, A.P.): The seed production at this centre is going on with earlier selected mother palms and *pisifera* palms. The progeny testing materials developed from this seed garden has been planted in field in three trials. In first trial 48 DxP progenies (four *pisifera* X 12 *dura* palms each) were planted in RCBD with two replications in a plot size of 12 palms. In second trial 35 DxP progenies (5 *pisifera* X 7 *dura* palms each) were planted in RCBD with two replications in a plot size of 12 palms. In third trial 32 DxP crosses of Rajahmundry source were planted as observational trial in 12-palm plot size. Arrangements are being made for planting of fourth trial as per the land availability.

Oil palm seed garden (Taraka, Karnataka): Evaluation of Dura and TxT progeny: The seed production at this seed garden has picked up and is observed satisfactory. Performance of *dura* Population No. 4 is found good as the average productivity of this population was highest and most of the mother palms are from this population. Eleven more *dura* mother palms were selected based on yield performance, fruit and seed characters. In all 97 *dura* and 9 *pisifera* palms

are being utilized in seed production. DxP progenies are reported to be performing better in different nurseries.

Against an average stem height of 4.45m, palm no. 681 (2.68m), palm no. 705 (2.82m) and palm no. 1017(2.84m) recorded significantly low height, thus, could be good source for dwarfness. There was no interrelation found between palm height and girth at collar (-0.04ns). The average bunch weight ranged between 10.2kg and 45.0kg (mean=24.3kg) in the selected mother palms.

Evaluation of DxP Progenies

Evaluation of DxP Progenies of Palode origin at Lakshmipuram : DxP progenies of Palode seed garden are being evaluated at Lakshmipuram in three separate trials each with 14 DxP progenies in RCBD with three replications. Data on biometrical, phenological and yield were recorded. The plantation is 16 years old now. Pooled analysis of variance over years revealed that age had significant role on performance of the hybrids. Variation among hybrids was found significant. Hybrid x Year interaction effects were non significant. Variation among hybrids for FFB yield was recorded high.

Evaluation of DxP Progenies of Lakshmipuram at Pedavegi: The trial consists of 16 D x P progenies of Lakshmipuram seed garden planted in RCBD with three replications. The crop is three years old and observations on leaf production and no. of inflorescence are being recorded. Early high yielding palms/ progenies have been identified which shall be monitored for their productivity.

Evaluation of DxP Hybrids from different sources at Pedavegi: Eleven Oil Palm hybrids (four each from ASD Costa Rica and Palode, two from Ivory Coast and one from Papua New Guinea) are being evaluated for differences for yield, morphological and physiological characters.

The hybrid means significantly differed for number of leaves per palm per year and average bunch weight. For other characters like FFB yield, number of bunches, sex ratio, stem height and girth at collar, the differences among the hybrids were non significant. Thus, the performance of hybrids from different sources was recorded at par.

The variation for average bunch weight (ABW) ranged from 16.6Kg (9C x 1001) to 22.8Kg (Deli x AVROS & Deli x EKONA). Maximum number of leaves were recorded in Deli x Lame (27.8) while it was recorded minimum in Palode cross 65D x 111P (23.4). The highest yield was recorded in Palode crosses (184.7Kg) while the Costa Rican hybrids recorded the lowest average FFB yield of 125.8kg/ palm. Same was the trend for number of bunches produced. Ivory Coast hybrids recorded the lowest palm height (327.1cm) (Table 15). Bunch analysis has been carried out on individual palm basis to ascertain the oil yielding capability of *Tenera* hybrids. The bunch observations on oil/ bunch ratio, shell/ fruit, kernel/ fruit, mesocarp/ fruit etc are being recorded. The activity is in progress.

Evaluation of Costa Rican hybrids under varied environments

With the objective of identifying suitable hybrids for different locations, the experiment is being 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 cross as check variety.

Evaluation of Costa Rican hybrids at NRCOP, Pedavegi, A.P.: The experiment at

this location consisted of 24 crosses (23 from ASD Costa Rica and one from Palode) and was laid in 1996 in RCBD with three replications in a plot of six palms. To maintain good condition of palms, the palms were regularly monitored and all the cultural practices like irrigation, fertilizer application, weeding *etc*. were followed at regular intervals. Harvesting of fresh fruit bunch was done periodically. Biometric observations like palm height, stem girth, number of leaves, inflorescence production and yield particulars were recorded; data was statistically analyzed and results are presented in Table 16a & 16b.

The variation in *tenera* hybrids for all characters excepting palm height was non-significant indicating lack of variability in the hybrids for these characters. Palm height (measured from ground level to base of the 41st leaf) was recorded 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 the productivity of *Tenera* hybrids. Four Costa Rican hybrids recorded height on par with Palode hybrid (4.43m); the remaining hybrids had significantly low height than that of Palode hybrid.

All the Costa Rican hybrids recorded less number of bunches except C11097

Table 15. Performance of different sources of oil palm planting materials at Pedavegi, A.P.

Genotypes	Stem height (cm)	Girth at collar (cm)	No. of Leaves/ Palm/Year	No. of Bunches/ Palm/ Year	FFB Weight (Kg)	ABW (Kg)
Deli x AVROS	470.5	291.3	24.7	5.7	114.6	22.8
Deli x EKONA	479.4	310.1	23.7	7.1	149.5	22.8
Deli x GHANA	465.5	326.2	23.9	6.9	125.6	19.0
Deli x LAME	408.7	341.4	27.8	6.0	113.4	18.4
Mean (Costa Rica)	**456.0**	**317.3**	**25.0**	**6.44**	**125.8**	**20.8**
65D x111	453.8	295.3	23.4	9.9	186.7	18.8
12 x 313	444.8	275.8	24.2	9.9	182.7	19.0
12 x 266	478.9	296.1	23.8	10.3	202.6	19.1
128 x 31323	415.8	289.1	23.6	8.9	166.8	18.9
Mean (Palode)	**448.3**	**289.1**	**23.8**	**9.74**	**184.7**	**18.9**
18 C x 2501	327.0	344.7	25.8	7.0	131.9	19.3
9C x 1001	327.2	338.9	27.3	8.3	138.2	16.6
Mean (Ivory Coast)	**327.1**	**341.8**	**26.5**	**7.63**	**135.0**	**17.9**
1M - 0069 D x P	459.9	295.5	24.0	7.3	145.8	20.6
(Papua New Guinea)						
SD (±)	**NS**	**NS**	**0.51**	**NS**	**NS**	**1.85**

Table 16a. Final growth and yield performance of different Oil palm cross combinations from ASD Costa Rica at NRCOP, Pedavegi (A.P.)

S. No.	Cross ID	Palm* Height (cm)	Stem* Girth(m)	No. of* Leaves	Sex* Ratio	No. of** bunches	FFB** Yield (Kg)	Av. Bunch Weight**(Kg)
1	91C002	381	285	20.1	0.53	9.7	155.0	15.92
2	C11022	451	280	20.5	0.41	7.8	123.4	15.76
3	C11085	454	296	21.2	0.36	8.8	142.9	16.18
4	C11086	363	288	20.0	0.40	9.4	116.6	12.42
5	C11097	361	298	20.6	0.44	10.2	139.2	13.64
6	C11123	309	265	20.9	0.47	8.7	143.2	16.42
7	C11142	324	285	20.6	0.49	6.7	98.1	14.59
8	C11143	379	265	21.1	0.47	9.1	119.2	13.08
9	C11152	379	259	20.1	0.50	8.9	128.9	14.45
10	C11162	374	290	21.0	0.41	7.7	131.0	16.96
11	C11163	370	279	21.3	0.45	7.5	97.3	12.99
12	C11166	364	275	21.1	0.40	9.9	147.4	14.90
13	C11168	334	291	20.4	0.37	7.1	114.3	16.08
14	C11198	376	281	20.8	0.42	8.8	122.7	13.98
15	C11214	378	273	20.8	0.37	6.9	102.6	14.78
16	C11220	349	282	20.2	0.41	6.1	83.9	13.74
17	C11238	387	286	21.3	0.46	7.4	103.7	13.93
18	C11248	417	291	20.7	0.39	8.9	123.6	13.85
19	C11259	393	280	21.3	0.42	7.9	136.7	17.20
20	C65635	346	269	20.2	0.38	9.8	152.1	15.56
21	C65571	427	273	20.7	0.38	7.4	116.3	15.62
22	C66536	398	283	21.1	0.35	6.7	96.8	14.40
23	C11136	461	273	20.4	0.42	8.1	120.5	14.96
24	Palode	443	286	21.4	0.43	9.1	132.8	14.66
CD at 0.5 (±)		24	NS	NS	NS	0.65	10.80	NS

* Recorded during 2005-06, ** Recorded during 2006-07

Table16b. Performance of Costa Rican hybrids over years at the NRCOP, Pedavegi (A.P.)

S. No.	Cross ID	2003-04			2004-05			2005-06			2006-07			Average		
		BN	TBW	ABW	BN	TBW	ABW	BN	TBW	ABW	BN	TBW	ABW	BN	TBW	ABW
1	91C002	3.8	45.7	12.0	6.94	89.9	13.0	4.9	87.1	17.8	9.7	155	16.0	25.3	377.7	14.9
2	C11022	3.5	32.2	9.2	5.61	87.6	15.6	3.6	62	17.2	7.8	123.4	15.8	20.5	305.2	14.9
3	C11085	8	91.6	11.5	5.98	91.4	15.3	3.8	70.1	18.4	8.8	142.9	16.2	26.6	396.0	14.9
4	C11086	7.3	85.6	11.7	9.5	132.6	14.0	4.5	76.7	17.0	9.4	116.6	12.4	30.7	411.5	13.4
5	C11097	8.3	144	17.3	8.33	116.4	14.0	4.9	81.3	16.6	10.2	139.2	13.6	31.7	480.9	15.2
6	C11123	6.6	84	12.7	8.53	128.6	15.1	4.4	85	19.3	8.7	143.2	16.5	28.2	440.8	15.6
7	C11142	6.8	85.3	12.5	4.28	66.6	15.6	4.6	84.5	18.4	6.7	98.1	14.6	22.4	334.5	14.9
8	C11143	5.6	66.1	11.8	7.15	87.1	12.2	4.3	75.9	17.7	9.1	119.2	13.1	26.2	348.3	13.3
9	C11152	7.1	76	10.7	6.5	94.1	14.5	4.2	76.2	18.1	8.9	128.9	14.5	26.7	375.2	14.1
10	C11162	6.9	71.4	10.3	6.6	107.0	16.2	5.1	93.9	18.4	7.7	131	17.0	26.3	403.3	15.3
11	C11163	5.1	66.8	13.1	6.33	90.7	14.3	4.6	83.8	18.2	7.5	97.3	13.0	23.5	338.6	14.4
12	C11166	8.3	99.7	12.0	8.33	109.4	13.1	4.4	69	15.7	9.9	147.4	14.9	30.9	425.5	13.8
13	C11168	8.7	107.9	12.4	7.83	121.2	15.5	5.3	95	17.9	7.1	114.3	16.1	28.9	438.4	15.2
14	C11198	7.7	81.8	10.6	7.56	118.2	15.6	4.3	64.1	14.9	8.8	122.7	13.9	28.4	386.8	13.6
15	C11214	7.3	85.5	11.7	8.58	134.0	15.6	3.9	71.5	18.3	6.9	102.6	14.9	26.7	393.6	14.8
16	C11220	6	73	12.2	7.01	103.8	14.8	5.3	88.8	16.8	6.1	83.9	13.8	24.4	349.5	14.3
17	C11238	4.7	54.3	11.6	6.61	92.7	14.0	4.8	86.9	18.1	7.4	103.7	14.0	23.5	337.6	14.4
18	C11248	4.7	48.3	10.3	8.56	126.1	14.7	4.7	78.1	16.6	8.9	123.6	13.9	26.9	376.1	14.0
19	C11259	5.3	54.1	10.2	8.67	131.1	15.1	4.4	78.6	17.9	7.9	136.7	17.3	26.3	400.5	15.2
20	C65635	3.2	44.6	13.9	6.61	96.7	14.6	4.1	75.9	18.5	9.8	152.1	15.5	23.7	369.3	15.6
21	C65711	5.2	74	14.2	6.78	101.2	14.9	5.3	93.8	17.7	7.4	116.3	15.7	24.7	385.3	15.6
22	C66536	7.7	95.2	12.4	5.9	89.7	15.2	5.3	84.5	15.9	6.7	96.8	14.4	25.6	366.2	14.3
23	C11136	5.1	69.9	13.7	7.78	117.2	15.1	4.7	86.4	18.4	8.1	120.5	14.9	25.7	394.0	15.3
24	Palode	6.6	83.1	12.6	5.83	84.5	14.5	4.3	77	17.9	9.1	132.8	14.6	25.8	377.4	14.6
Mean		6.23	75.84	12.09	7.16	104.90	14.69	4.57	80.25	17.58	8.28	122.84	14.86	26.2	383.84	14.6
CD at 0.05(±)		0.90	13.46	0.96	0.70	10.39	0.54	0.27	5.07	0.59	0.65	10.80	0.73	1.52	22.12	0.39

BN = Bunch Number; TBW = Total Bunch Weight (kg); ABW = Average Bunch Weight (kg)

which recorded significantly higher number of bunches per palm (10.2). The FFB yield in Costa Rican hybrids was either at par or significantly lower than that of Palode (132.8kg/palm) excepting the cross C11176 which recorded the highest FFB yield (147.4kg/ palm). The bunch size of Palode hybrid was of medium size (ABW=14.6kg) on par with that of Costa Rican hybrids. Out of 23 Costa Rican hybrids six hybrids recorded cumulative FFB yield over four years significantly lower than that of Palode hybrid; seven other hybrids out-yielded the Palode hybrid.

Identification of *Dura* Palms in Costa Rica Tenera : A total number of 22 *dura* palms have so far been identified in *tenera* hybrids of Costa Rica origin. This could be due to some error in pollination process while producing hybrid seeds. These palms are being utilized in Oil palm improvement programme.

Hybridization: Hybridization activity has been initiated to utilize high yielding and other elite palms in oil palm improvement programme. The crossing programme formulated is being executed in order to

Table 17a. Growth and yield performance in different Oil palm cross combinations from ASD Costa Rica at NRCOP-Regional Station, Palode (Kerala)

S. No.	Cross ID	Number of			Bunch	
		Leaves	Male infl.	Female infl.	No.	Weight (kg)
1	C65711	25.2	6.7	5.2	6.7	54.7
2	C11067	22.3	9.2	5.2	8.2	56.4
3	C11239	36.4	9.6	4.6	5.3	57.3
4	C11225	24.0	9.8	8.2	9.9	81.4
5	C11143	24.7	6.7	8.6	8.2	76.3
6	C11146	23.2	7.8	6.2	6.8	76.4
7	C65635	24.6	7.1	8.1	10.2	92.1
8	C11044	25.9	7.9	7.3	14.3	134.6
9	C11076	25.6	10.2	7.8	7.3	49.0
10	C11053	24.9	10.5	5.9	5.7	41.3
11	C65893	25.7	5.2	5.8	11.2	74.4
12	C11142	24.8	10.2	4.3	7.4	73.6
13	C65758	24.3	5.6	5.7	5.5	45.1
14	C11169	25.1	8.8	6.3	5.3	40.7
15	C11163	24.7	11.2	3.4	7.3	70.4
16	C11189	24.9	6.5	10.1	11.9	140.4
17	C11092	23.3	8.1	4.6	8.8	79.8
18	C11075	24.6	7.8	5.4	8.8	78.7
19	Palode	24.9	10.4	4.4	3.3	29.7
CD at 0.05 (±)		**NS**	**NS**	**NS**	**NS**	**NS**

produce the progenies with desired characters.

Bunch Analysis: Bunch analysis has been carried out on individual palm basis to ascertain the oil yielding capability of *Tenera* hybrids. Bunch analysis was carried out on 54 palms pertaining to different crosses and observations on oil/ bunch ratio, shell/ fruit, kernel/ fruit, mesocarp/ fruit etc are being recorded. The activity is in progress.

Evaluation of Costa Rican hybrids at NRC for Oil Palm Regional Station, Palode, Kerala: The experiment was initiated during 1994 at NRCOP-Regional Station, Palode (Kerala) in Randomized Block Design with 19 *Tenera* combinations in two replications. The crosses were evaluated under rain fed conditions. The general condition of the experimental palms was good. The palm wise observations on the height, girth and number of leaves, number of male & female inflorescences, number of bunch and weight of bunch were recorded regularly. Details of the biometric observations are presented in Table 17a. No significant differences were observed among the *tenera* hybrids for growth and yield characters like trunk height, girth, number of leaves, inflorescence production and FFB yield.

Pool analysis over years: The average bunch weight of hybrids (8.29kg) at Palode location (Table 17b) was in general observed to be lower than that recorded at Pedavegi (14.6kg). Similar was the observations on cumulative number of bunches produced per palm and cumulative FFB yield/ palm. Based on the cumulative FFB yield, C11189 recorded the highest yield (344.3kg/palm), which was significantly highest from all other hybrids. Most of the Costa Rican hybrids (12 numbers) recorded higher yields than that of Palode cross.

Development of molecular markers for varietal identification in oil palm

Seed garden at Palode was selected for the study. Leaf samples were collected from 60 identified palms for DNA extraction. DNA was extracted by the modified protocol and good amount of DNA was obtained by using the modified method without using the detergent. The DNA was quantified for future use.

Simple Sequence Repeats or micro satellites was used for the first time in oil palm in India and hence optimization of the reagents was necessary before using them routinely. The quantity of Primers, Taq Polymerase and dNTPs were reduced gradually from a standard reaction protocol reported from CIRAD, France and NRC for DNA Fingerprinting, New Delhi and the quantity required for the PCR amplification was optimized. The Primers concentration was reduced successfully from 0.2µM to 50nM, Taq polymerase from 1U to 0.25U and dNTP (each) from 0.5µM to 0.25µM in a reaction volume of 25µL. The reaction volume was reduced from 25µl to 10µl. The cost of the reactions was considerably reduced and hence accordingly for 1000 reactions, the cost was reduced from Rs 8200/- to Rs.920/-. The standardized protocol is routinely being used in our laboratory. Using this optimized procedure 80 microsatellite primers were screened for their functionality and 74 primers gave amplification.

Development of tissue culture protocol for oil palm

Infrastructure development has been carriedout for tissue culture laboratory.

Seed Science Research

Germinated seed with split plumule was successfully germinated and is being maintained in the nursery which could be used for ornamental purpose.

Aseptic Operculum Germination technique (OAGI) was standardised. In this method radicle protuberance commenced within one day and recorded 50% in two days. Germination percent of pisifera palms recorded 0 to 75 % by this method.

Influence of seed size on germination and initial stage of seedling growth was recorded.

Table 17b. Performance of Costa Rican hybrids over years at NRCOP-Regional Station, Palode (Kerala)

S. No.	Cross ID	2003-2004			2004-2005			2005-2006			Cumulative		
		BN	TBW	ABW	BN	TBW	ABW	BN	TBW	ABW	BN	TBW	ABW
1	C65711	4.8	27.8	5.9	7.4	55.8	5.9	6.7	54.7	8.2	18.9	138.3	7.3
2	C11067	7.4	38.5	5.2	11.5	62.6	5.2	8.2	56.4	6.9	27.1	157.5	5.8
3	C11239	2.9	20.6	7.2	8.3	61.1	7.2	5.3	57.3	10.8	16.5	139.0	8.4
4	C11225	7.2	60.1	8.4	16.0	97.4	8.4	9.9	81.4	8.2	33.1	238.9	7.2
5	C11143	6.6	56.2	8.5	12.1	74.1	8.5	8.2	76.3	9.3	26.9	206.6	7.7
6	C11146	4.8	69.8	14.4	5.1	62.0	14.4	6.8	76.4	11.2	16.7	208.2	12.5
7	C65635	8.8	81.0	9.2	7.2	66.0	9.2	10.2	92.1	9.0	26.2	239.1	9.1
8	C11044	10.9	88.4	8.1	8.9	71.9	8.1	14.3	134.6	9.4	34.1	294.9	8.6
9	C11076	6.4	40.1	6.3	7.3	52.5	6.3	7.3	49.0	6.7	21.0	141.6	6.7
10	C11053	3.5	28.7	8.1	5.5	44.1	8.1	5.7	41.3	7.2	14.7	114.1	7.8
11	C65893	14.3	85.5	6.0	8.9	62.4	6.0	11.2	74.4	6.6	34.4	222.3	6.5
12	C11142	4.4	36.9	8.4	6.5	52.4	8.4	7.4	73.6	9.9	18.3	162.9	8.9
13	C65758	7.8	50.0	6.5	9.6	84.0	6.5	5.5	45.1	8.2	22.9	179.1	7.8
14	C11169	5.1	34.5	6.7	11.5	95.1	6.7	5.3	40.7	7.7	21.9	170.3	7.8
15	C11163	3.4	31.1	9.2	9.8	87.6	9.2	7.3	70.4	9.6	20.5	189.1	9.2
16	C11189	7.6	103.5	13.6	10.0	100.4	13.6	11.9	140.4	11.8	29.5	344.3	11.7
17	C11092	6.1	50.6	8.3	8.0	63.9	8.3	8.8	79.8	9.1	22.9	194.3	8.5
18	C11075	8.0	59.9	7.5	8.3	41.5	7.5	8.8	78.7	8.9	25.1	180.1	7.2
19	Palode	4.8	42.3	8.7	7.3	63.8	8.7	3.3	29.7	9.0	15.4	135.8	8.8
Mean		6.57	52.92	8.22	8.91	68.35	8.22	8.01	71.17	8.83	23.48	192.44	8.29
CD (±) at 0.05		1.57	13.27	1.33	1.46	9.82	1.33	1.51	16.31	0.83	3.53	32.63	0.92

BN = Bunch Number; TBW = Total Bunch Weight (kg); ABW = Average Bunch Weight (kg)

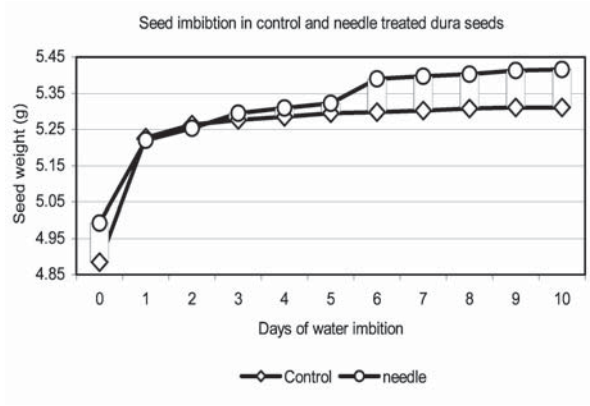
Big seeds exhibited early germination and produced more vigorous seedlings that had high leaf production and fresh and dry mass.

However, seeds of big and small sizes exhibited different germination behaviour among hybrid combinations. From the tested hybrids, big size seeds of 1504 x 2326, 1110 x 2326, 778x 2310, 1762x 2326 and 1504 x 2310 have showed > 60 % germination. However some hybrids namely 1100x 2277 and 1178 x 2310 have recorded poor germination even from big size seeds. Predictably, small size seed lot showed poor germination in the majority (72.72 %) of the hybrids.

To improve the visual quality of the seeds, seed colouring was attempted with polycote and henna mixture etc for making commercial application for 'Palode seed' identity and germination improvement.

Acceleration of germination in Oil Palm hybrid seeds : Some dormancy breaking techniques were attempted for oil palm seeds. Salient findings were reported here

Needle Method : Dormancy of Oil Palm is due to the presence of operculum and fibre plug above the embryo. Hence physical method was attempted to remove these barriers using calibrated needle without making any damage to the embryo. For calibrating the depth of needle portion to be inserted, thickness of the fibre plug to seed coat kernel was measured. The approximate distance noticed was 2.4mm. As a first step of this study, identification features of germ pore having embryo was investigated. The prominent features of the germ pore having embryo are given below



a) The size of germ pore under which embryo is located is larger compared to other two.

b) The tuft of hairs of germ pore is many compared to other two.

c) The germ pore under which embryo located is prominent than the other two.

d) If two-germ pore is prominent there will be two embryo in two kernels

Preliminary results indicated that Needle Treatment showed prominent results in accelerating germination in oil palm seed. The results from all the treatments are awaited.

Dormancy breaking by mechanical scarification using depericarper: The endosperm and seed coat tissues in the freshly harvested seeds were compactly arranged which prevents instant seed germination. To get early initiation of germination, fresh DXP seeds were subjected to mechanical scarification using de-pericarper for 0.5 and one minutes followed by water soaking and pre-heating at different intervals of 10-50 days. Initial results indicated that half-minute de-pericarping followed by 10 days pre-heating initiated germination. Results from other treatments are awaited

Chemical pre-treatment: a. GA3 treatment: Fresh seeds were subjected to GA3 concentrations of 100, 150, 200, 250, 500, 750 and 1000 ppm followed by different combinations of heat treatment. None of the treatment showed germination initiation so far. However the treatments were monitored for germination and other parameters.

b. Sodium Chloride treatment: Different concentrations of Sodium Chloride viz., 0.5%, 1%, 1.25% and 1.5% were treated with fresh as well as heat-treated seeds and these experiments are under progress.

Histological studies of endosperm and embryo: Pre heated seed samples with different heating period were subjected to histological studies. Kernel with embryo and endosperm tissues was removed from treated seeds as 3mm cubes taken at operculum regions. The materials were fixed in the fixative for 18 h and then stored in ethanol until dehydration process was started. Before fixing dry mature seeds of different stages were put to imbibition in water for 12 h to soften the testa and allow easy penetration of fixatives. After dehydration, infiltration and embedding sectioning was done using leica rotary microtome machine. The sections were stained with safranin and photographs of all the sections were taken with 40 x magnifications. The sections were mounted with DPX mountant and observed under light microscope. The embryo, adjoining endosperm below operculum were sectioned and investigated for changes due to pre-heating before germination. It reveals that ring of minute cells above the embryo gets split during germination. The point at which splitting taking 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, found to have enlarged embryo with radicle and plumule and two bands of haustorium. Further investigation is continuing.

Histological Studies of seed coat structures – SEM

Samples of 5 seeds were randomly selected from each of nine treatments (0-80 days of pre-heat treatments and water soaking for five days). They were dried in a desiccator before mounting on aluminum stubs. Each seed was sputter coated with gold for 6 min before being viewed in a RUSKA – SEM x150 100m scanning electron microscope at an accelerating potential of 6 Kv. Ultra structural changes in the seed coat structures around operculum were recorded for each seed. Representative seed samples were photographed for each treatment. Morphological changes in the operculum and adjoining areas were subjected to scanning electron microscopic studies to confirm dormancy breaking due to pre-treatments. The control seeds (without heating & soaking) have not shown any change in the operculum centre point whereas seeds subjected to 10 days heating shown slight expansion. Scanning electron micrographs illustrated, extensive changes in the seed coat due to the pre-heat treatments compared to the control. The seeds subjected to heat treatments of 30-50 days showed operculum enlargement, hairline cracks in the seed coat and progressive enlargement of cracking in the subsequent period.

4. Research Achievements

फसल उत्पादन

Crop Production

Heliconia as intercrop in oil palm

CROP PRODUCTION

Fertilizer requirement of Oil Palm during pre-bearing stage

The field experiment to standardize suitable fertilizer doses during pre-bearing stage was continued to assess the early yield performance of young palms with the following treatments: T_1:0-0-0, T_2: 600-300-600, T_3: 900-450-900, T_4: 1200-600-1200, T_5: 1500-750-1500 and T_6: 1800-900-1800 of N, P_2O_5 and K_2O per palm per year. The fertilizers were applied in two equal splits coinciding with the monsoon seasons. The growth observations viz., height, girth, no.of leaves produced during the year, leaf area of 9th leaf, no. of male, female and hermaphrodite flowers were recorded. Among the growth characters analysed, height only expressed significant difference among treatments. The yield data of various treatments indicated that the maximum no. of bunches were produced by T_3 followed by T_4. But the highest FFB yield was recorded by T_4.The soil samples collected during the year before fertilizer application were analysed for organic carbon and available nutrient status and the leaf samples collected were analysed for foliar nutrient levels (Table 18).

Table 18. Yield of young palms during 2005-06

Treat.	No. of bunches/palm	FFB yield (kg/palm)
T1	3.35	6.82
T2	5.30	11.48
T3	5.55	10.24
T4	5.38	16.51
T5	4.60	11.42
T6	4.58	10.62
SE	NS	4.20

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

The field experiment was started during 2000 with eight treatments involving different crop combinations and various soil and water conservation measures. The inter crops were harvested and yield recorded. The soil and leaf samples collected were analysed for nutrient status. The yield performance of palms over five years was ananlysed statistically and found that there is no significant difference between the treatments. It can be inferred that the yield of palms was not adversely affected by growing any of the inter crops. When the economics of the various cropping systems was worked out, a combination of oil palm, cocoa, cinnamon, pepper and anthurium gave the maximum return compared to other combinations (Table 19).

Table 19. Average yield performance of palms in different treatments

Treat	No.of bunches Per palm	FFB yield (kg/palm)
T1	5.72	116.6
T2	5.10	90.20
T3	5.86	121.2
T4	5.76	128.2
T5	6.04	125.4
T6	5.22	118.0
T7	5.98	127.2
T8	5.52	117.6
SE	0.99	20.97
CD	NS	NS

Studies on replanting techniques in Oil palm

A suitable field is identified in OPIL for conducting the trial. OPIL has asked for the financial estimate towards this project from their side and accordingly a proposal is given.

Intercropping in bearing oil palm gardens

There is a scope to grow shade loving and shade tolerant crops in grown up oil palm gardens under irrigated conditions. So, work has been initiated to evaluate the performance of intercrops in oil palm gardens. Crops identified for the study are cocoa, banana, pine apple, pepper, vanilla, betel vine, anthurium, orchids, jasmine, ginger lily, heliconia, ginger, turmeric, pachouli, cut foliage etc. So far, cocoa, banana, heliconia, ginger lily, bush pepper and jasmine were planted in 11year old oil palm garden and observations are in progress.

Intercropping of cocoa in oil palm

A total of 20 oil palm gardens in Krishna district were surveyed. The age of oil palm gardens varied between 10 and 14 years. Age of cocoa varied from 1 to 9 years and yield between 0 to 0.4 kg per tree. Maximum light above the canopy ranged from 856 to 1800 $\mu mol.m^{-2}.s^{-1}$. The maximum light measured below the oil palm canopy was 346 $\mu mol.m^{-2}.s^{-1}$ which was 21.56 per cent of the above canopy radiation. The lowest radiation obtained below the canopy was 39.67 $\mu mol.m^{-2}.s^{-1}$and the percentage of full sun light obtained below the oil palm canopy was 2.57. However, the average radiation above and below the oil palm canopy and the percentage available below the oil palm canopy were 1240.64 and 137.26 $\mu mol.m^{-2}.s^{-1}$ which works out to be 13.79 percent.

Experiments in mixed farming systems

Honey bee, *Apis indica* was found to have more resistance to wax moth and found to be fit for the area as the soldiers were found to kill many moths that entered the hive. The survival of the bees during summer months reveals that these are resistant to all odd conditions.

Goat rearing using the grass from oil palm plantations along with the food material prepared with the oil palm sludge recorded 19% more weight compared to untreated ones.

Heliconia was observed as the most economically competent intercrop compared to other flower crops as well as the vegetables. However these were next to fruit crop banana, which was recorded as the highest income fetching intercrop in juvenile stage of oil palm. Heavy rainfall during the flowering season was found detrimental to drumstick in causing flower dropping and thereby yield losses.

Effect of different organic manures on growth and vigour of oil palm seedlings.

Five types of organic manures (1:1 ratio) and their mixtures along with soil (50% soil+50% manure 25% each) were used for the study. Treatments were: soil, termite mound soil, soil+fym, soil+goat manure, soil+pig manure, soil+vermi compost, soil+poultry manure, soil+poultry manure +goat manure, soil+fym+poultry manure, soil+vermi compost+poultry manure and soil+vermi compost + goat manure. Observations on growth of seedlings are in progress.

Basic Studies on Growth and Yield of Oil Palm

Biochemical basis for growth and yield in oil palm : Studies on oil content and FAC of oil from different parts of bunch : To study the qualitative and quantitative differences of oil in different parts 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. During the reporting period oil content and FAC in the five different portions of FFB and three different parts of individual fruits have been carried out for three more months' (September, October and November) sample. Total of 450 samples (225 for different portion of bunch and 225 for different parts of fruits) were analyzed during this period. From the study conducted in the sample of three months duration (September, October and November) it was observed that mesocarp oil content is highest in the second portion of the bunches in all three months (Chart 4). Total unsaturated fatty acids content in portion 2 and 3 combined average was higher than that of other portion of the bunches mainly due to higher oleic acids content in these two portions (Chart 5) .

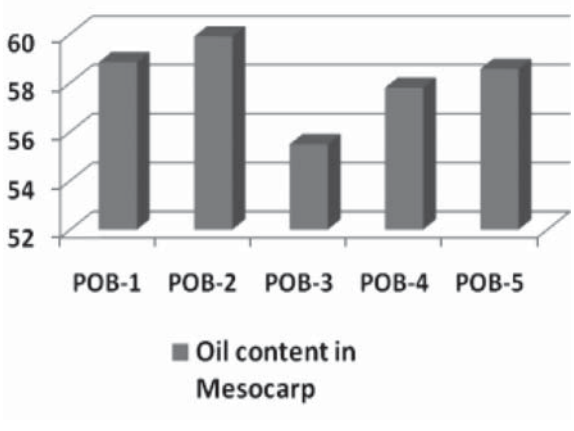


Chart 4 : Oil content in the different parts of bunch during the months of September - November

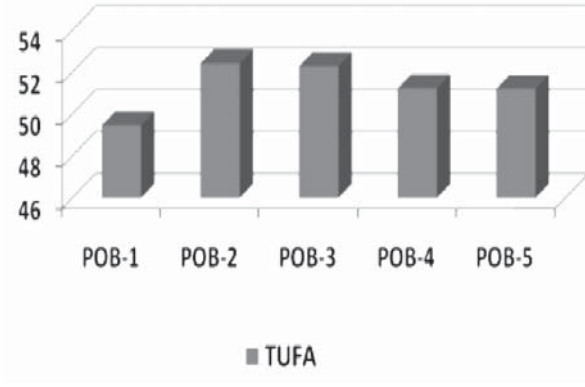


Chart 5 : TUFA in the different parts of bunch during the months of September-November

Among the different parts of the fruits, middle part of the fruits have significantly higher amount of oil content (Chart 6). Palmitic acid content was always highest in the first part (near peduncle) of the fruits (Chart 7).

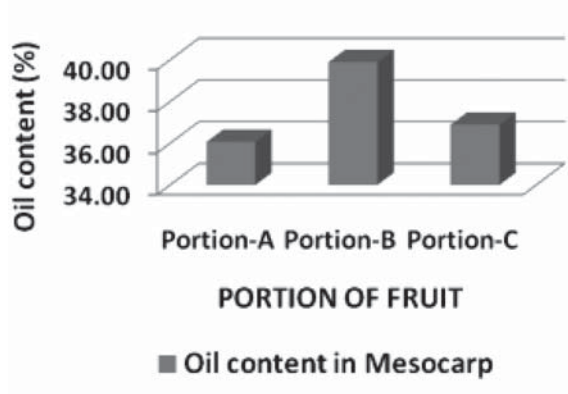


Chart 6 : Oil content in different portion of fruits during the months of September-November

***P*hysiological basis for growth and yield in oil palm : Diurnal variations in sap flow in adult oil palm plantations :** Measurements of sap flux were tried by inserting the probes into the palm trunk. The diurnal variations in the sap flux indicated that

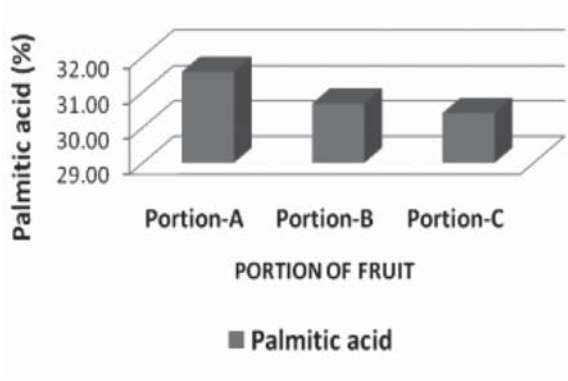


Chart 7 : Palmitic acid content in different portion of fruits during the months of September-November

the sap flux increased gradually from 9.00 AM onwards reaching a peak during 1.00 to 2.00 A.M and then decreased thereafter as the day progressed. The evapotranspiration calculated based on the Penman-monteith equation also showed the same type of trend as that of the sap flux, both tending to become zero during nights. The sap flux in mature oil palm plantations also followed the same trend as that of vapor pressure deficit. This shows that the sap fluxes in oil palm plantations are closely associated with environmental variables like evapotranspiration and vapor pressure deficit. Seasonal variations in the sap flux were also noticed from January to June also with the increased sap flux being recorded in the months of February and March. The decrease in sap flux during the dry months of May and June could be due to the closure of stomata after mid day as the atmospheric vapor pressure deficit increased.

Effect of different levels of fruiting activity on growth and yield in oil palm : One of the possible ways of understanding the source sink relationship in oil palm is studied by removing the inflorescences and understanding its influence on growth and yield. The experiment was started during the period under review with following treatments - No disbudding, 50 % disbudding, 75% disbudding and 100% disbudding. Before the treatments were imposed pre experimental data like number of leaves, plant height, girth and number of bunches were recorded. The number of leaves in the palms ranged from 32 to 60, while the plant height ranged from 142 to 292 cms. The plant girth ranged from 67-96 cm. The number of bunches per palm ranged from 1-9. Treatments will be imposed during the monsoon of 2007-08.

Studies on the photosynthetic efficiency, dry matter production and partitioning in relation to growth and yield in Oil Palm hybrids: Eleven Oil Palm hybrids i.e. four each from ASD Costa Rica and Palode, two from Ivory Coast and one from Papua New Guinea were evaluated for photosynthetic efficiency and dry matter production. Maximum leaf dry weight per palm was recorded in Papua New Guinea hybrid which differed significantly from that of the other hybrids. Trunk dry weight was higher in ASD Deli X Avros and Deli X Ekona which didn't significantly differ with each other but significantly differed from that of the other hybrids. Among the hybrids, P65D X 111 recorded the highest leaf area index when compared to that of the other hybrids. Lower leaf area indices were observed in ASD Deli X Lame and IC 9C X 1001. Higher bunch dry weights were recorded in P12 X 266 and PNG hybrid compared to that of the other hybrids. Among the hybrids, the bunch index was highest in P12 X 266 which differed significantly with that of the other hybrids.

Nutrient and water management in oil palm

Palms irrigated with Jets recorded the maximum Fv/Fm ratio at I1F2 level followed by I2F3 level. Among the irrigation methods, palms irrigated with jets recorded the maximum Fv/Fm ratio than that of other methods. Highest Fo/Fm ratio was observed

in palms irrigated with drips at I1F3 level. Among the different methods, palms irrigated with basins recorded the highest Fo/Fm ratio than that of others. Palms irrigated with drips recorded the maximum ETR at I1F1 level which was closely followed by I3F2 level. Minimum ETR was observed at palms irrigated at I3F2 level through jets. Among the different methods, maximum ETR was recorded by palms irrigated by drips. Lowest leaf temperature was observed at palms irrigated through jets at I3F2 level and highest was recorded at I2F2 level irrigated through drips. Among the different methods, palms irrigated through jets recorded the lowest leaf temperature followed by drip and basin. Highest stomatal conductance was recorded at I1F1 level irrigated through drips. Lowest was observed at I2 F1 level irrigated through basins. Palms irrigated through drips recorded the highest conductance followed by jets and basins. Maximum transpiration rate was observed in palms irrigated through drips at I1F3 level which was closely followed by I1F1 level. Minimum was observed at I3F2 level in palms irrigated through basins. Among the different methods, palms irrigated through drips recorded the maximum transpiration rate compared to that of others. Maximum leaf water potential was observed in palms irrigated through drips at I1F2 level and minimum was observed in palms irrigated through basins at I2F3 level. Among the different methods, palms irrigated through drips recorded the higher leaf water potential compared to that of other methods. Chlorophyll index was observed highest in palms irrigated through jets at I1F2 level which was closely followed by I2 F3 level. The lowest was observed at I1F1 level in palms irrigated through basins. Among the different methods, palms irrigated through jets recorded the highest chlorophyll index than that of other methods.

[I1 = 1.0 IW/CPE ; I2 = 0.8 IW/CPE ; I3 = 0.6 IW/CPE ; F1 = 900-450-900 (NPK) ; F2 = 1800-900-1800 (NPK); F3 = 2700-1800-2700 (NPK)]

Survey and analysis of soils from oil palm growing areas

Initial survey was conducted in West Godavari district. Information on operational area of different oil palm processing industries was collected. Details of mandals under each oil palm processing industries were collected from different factory managers. Major oil palm growing mandals under each factory jurisdiction were identified. Five stages of survey in different factory area were planned for collection of soil and leaf sample. *In situ* morphological characteristics of these oil palm gardens were studied. The status and management of oil palm gardens of these mandals was also recorded in the form of schedule. Soil and leaf samples were collected, processed, numbered and stored in plastic containers. Development of laboratory facility for analysis of soil for various properties is being done. Procurement of soil sampling tools and instruments is in progress. Basic infrastructure for appropriate processing and storage facilities for soil and leaf samples is being established.

Studies on nitrogen and potassium management in adult Oil palm- on farm trial under the scheme establishment of leaf analysis laboratory

To analyse the leaf samples from the oil palm plantations and to give fertilizer recommendations, 259 leaf and 433 soil samples from farmer's fields were analyzed for different nutrients. Validation of analytical data is in progress.

A field experiment was started during 2003-204 in a farmer's field with an objective to assess the nitrogen and potassium requirement of an adult oil palm. The treatments included consisted of 3 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 5 palms in each plot and replicated three times. The yield data from the on-farm trial were collected and statistically analyzed. Number of bunches varied between 3.93 and 6.40 bunches per palm per year among different treatments. The bunch weight varied between 62.3 and 94.33 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 two un opened spindles, which indicates the palms are under stress. On an average there were more than broken leaves per palm which is also an indication of water stress.

Improvement to the existing laboratory facilities and infrastructure for soil and leaf analysis is in progress.

Seed Production in Ag. Crops & Fisheries – DSR- Seed Mega Project Pedavegi centre : Three thousand oil palm sprouts of hybrids 68 x 435 and 183 x 66 brought from our Regional Station, Palode were planted on 17th February 2007 and seedlings are in secondary nursery stage.

Palode Centre : During April 2006 to March 2007 a total of 3,36,450 germinated oil palm seeds were supplied as per the details given in Table 20 :

Analysis of Palode seed production data was carried out. It is revealed that this centre is producing an average of 2146 seeds per bunch with an average germination of 73 per cent. We got as high as 97.88 per cent germination in some D X Ps.

Table 20: Germinated oil Palm seed Production and Income generation (2006-07)

Name of agency	Apr-Jun 06	Jul-Sep 06	Oct-Dec 06	Jan-March0 7	Total
M/S Cauvery palm oil ltd, Trichy	5500	0	18700	66400	90600
M/S Badravathi Balaji oil palm Ltd	15500	0	47000	0	62500
M/S Simhapuri Agrotech.	26000	27500	0	0	53500
M/S Agro Cooperative Corporation	0	0	0	11000	11000
M/S Lakshmi Balaji Oils Pvt. Parvathipuram	0	22000	0	0	22000
M/S Srinivasa palm oil mill	0	0	14850	0	14850
M/S SICIAL oil palm	27000	22000	0	0	49000
M/S Godrej Agrovet Ltd	0	33000	0	0	33000
Total	74000	104500	80550	77400	336450
Minus 10 % extra supplied					33945
Net quantity					302505
Income generated through sale of seeds @ Rs.10 seed					3025050

4. Research Achievements

फसल संरक्षण

Oil Palm Crop Protection

Ganoderma causing basal stem rot disease in oil palm

CROP PROTECTION

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

Survey was carried out in West and East Godavari, Krishna, Khammam, Nellore, Vizianagaram and Visakhapatnam districts of Andhra Pradesh, Mysore, Mandya, Chamarajanagar, Coorg, Chikmagalur, Hasan and Shimoga districts of Karnataka, Trichy and Tanjore districts of Tamil Nadu, Trivandrum, Kulathpuzha and Thrissur districts of Kerala and Little Andamans and North Andaman areas of Andaman and Nicobar islands to find the pest incidence. Rhinoceros beetle was observed in all the areas surveyed with low to very low incidence. Psychids and leaf webworms were observed moderate to heavy in Andhra Pradesh. In the nursery shoot borer incidence was observed in Karnataka and Andhra Pradesh. In Andaman and Nicobar islands incidence of crows and psychids were observed at moderate levels. In East and West Godavari districts heavy incidence of leaf webworm was observed. In the nursery, incidence of shoot borer was recorded.

On cocoa, which is grown as intercrop in oil palm, hairy caterpillars and mealy bugs were observed as major pests. The leaf webber that was observed feeding on both oil palm and cocoa was identified as *Acria* sp., which belongs to order Lepidoptera, family Oecophoridae.

Incidence of avian pests particularly the crows and mynahs were observed at moderate to heavy levels in Karnataka and isolated gardens of Andhra Pradesh.

Stem borer incidence on nursery plants that was observed at moderate to severe levels intially, came down to nil. All the infested plants recovered from the incidence. However the growth of these plants was found stunted compared to uninfested ones.

Bioefficacy studies on leaf eating caterpillars: Bioefficacy studies on leaf eating caterpillars were carried out using conventional and biopesticides. Of the conventional ones quinalphos and Lambda cyhalothrin were found to be very effective where as biopesticides, *Beauveria bassiana* was found on par with them in managing the pest problem.

Molecular studies of the different strains of organisms that are used for the management of pests of oil palm were carried out using SDS PAGE. It was found that both *Trichoderma viride* and *Beauveria bassiana* obtained from PDBC were effective in causing infection within shorter period compared to the other strains of NRCOP and DOR. Re-inoculation studies carried out using the same organisms confirmed the results.

Bioefficacy studies on leaf webworms, *Acria* sp. were carried out using both commonly available chemicals and biopesticides. All the treatments were found on par in controlling the pest population during the first fortnight but later the second generation was observed in profuse in the root feeding and granular applied treatments. This indicates that the granules are not effective in controlling the pest population. In the root feeding treatments,

monocrotophos was found effective compared to phosphamidon.

Management of avian and mammalian pests on oil palm : Use of coloured nets against avian pests indicated that both green and violet nets attracted more number of parakeets and crows where as white coloured ones repelled the birds from getting trapped. Coloured net hanging was found effective in controlling the bird menace compared to other conventional methods of covering the FFB with oil palm leaves. Scaring sounds of crows, mynah and parakeets that were reproduced in the oil palm gardens to scare away the birds yielded very good results with the attraction of all the birds which hovered over the trial garden and flew away sensing the trouble. Continuous use may cause some effect on the bird movement. Studies need to be carried out further.

Studies on diseases of Oil Palm and their management

Studies on oil quality and quantity in the bunch end rot disease affected fruits: Conducted survey for inflorescence diseases of Oil palm namely Bunch rot, Bunch end rot and Bunch failure in Oil Palm plantations of NRCOP, Pedavegi. Out of 954 bunches surveyed 326 bunches were found affected by Bunch failure; 108 by Bunch Rot and 27 by Bunch end rot. Bunch end rot affected fruits were categorized into three types namely Infected-healthy, Half rotten and Completely rotten. Oil content, free fatty acid composition and free fatty acids content in the different categories of BER affected and Healthy fruit samples were analysed. Oil content decreased from healthy to completely rotten fruits. Healthy fruits having 80.85% followed by infected-healthy 80%, half rotten 63.55%and completely rotten fruits 51.68%. Free fatty acid percentage was less in healthy fruits (0.29%) followed by infected-healthy (0.90%), half rotten fruits (4.48) and completely rotten fruits (19.77) (Chart 8).

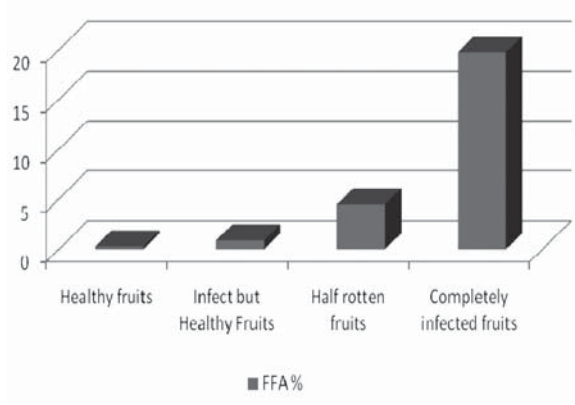


Chart 8 : %FFA in the fruits affected by bunch end rot disease

Characterization of phytoplasma associated with Spear Rot Disease of oil palm : Several spear rot disease affected palms were identified at NRCOP, Palode. Spear rot affected samples from Palode as well as OPIL, Chithara estates were collected and DNA isolated from each sample. Eight pairs of phytoplasma specific primer sequences were collected from Scientist working on phytoplasma (Table 21). The primers were procured and attempted to amplify the DNA samples extracted from spear rot affected tissues of oil palm. While amplifying the DNA samples extracted from spear rot affected tissues of oil palm using differnt phytoplasma specific primers, results were not consistent. There might be problems in collection of samples where the inoculum was more. Since the DNA extracted from the SRD affected tissue also contains large amount of plant DNA, the concentration of phytoplasma DNA was very low. The work is in progress.

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

Survey & Collection of isolates: Oil Palm plantations located in Lakshmipuram Borrum Palem and Rajahmundry of Andhra Pradesh, Jalpaiguri district of west Bengal were surveyed for BSR incidence. Details are given in Table 22. Brackets and tissues of roots and stem from affected palms were plated and microorganisms were isolated. *Ganoderma* cultures from different oil palm gardens were inoculated on PDA.

Table 21 : List of primers to be used for the characterization of phytoplasma causing SRD of oil palm.

Primer	Sequence (5'-3')	Reference
A&Sf	ACG AAA GCG TGG GGA GCA AA	Ahrens & Seemuller (1992)
A&Sr	GAA GTC GAG TTG CAG ACT TC	Ahrens & Seemuller (1992)
P1	AAG AGT TTG ATC CTG GCT CAG GAT T	Deng & Hiruki (1991)
P4	GAA GTC TGC AAC TCG ACT TC	Kirkpatrick *et al.,* (1994)
P6	TAG GGA TAC CTT GTT ACG ACT TA	Deng & Hiruki (1991)
P7	CGT CCT TCA TCG GCT CTT	Smart *et al.,* (1996)
fU5	CGG CAA TGG AGG AAA CT	Lorenz *et al.,* (1995)
rU3	TTC AGC TAC TCT TTG TAA CA	Lorenz *et al.,* (1995)
Rohde-f	GAG TAC TAA GTG TCG GGG CAA	Rohde *et al.,* (1993)
Rohde-r	AAA AAC TCG CGT TTC AGC TAC	Rohde *et al.,* (1993)
R16F2	ACG ACT GCT GCT AAG ACT GG	Lee *et al.,* (1993)
R16R2	TGA CGG GCG GTG TGT ACA AAC CCC G	Lee *et al.,* (1993)
R16mF2	CAT GCA AGT CGA ACG GA	Gundersen & Lee (1996)
R16mR1	CTT AAC CCC AAT CAT CGA C	Gundersen & Lee (1996)

Table 22 : Incidence of BSR on Oil Palm

Location / Planting material	Frequency of survey	Disease incidence			
		Age of palms (years)	Total No. of palms	No. of BSR infected palms	% Incidence
Andhrapradesh:					
Rajahmundry - *Dura*	Monthly	16	2000	12	0.6
Lakshmipuram– *Dura*	Monthly	17	476	12	2.5
Lakshmipuram – *Tenera*	Monthly	17	1000	7	0.7
Borrum palem – *Dura*	Monthly	15	700	2	0.29
Borrum palem – *Dura*	Monthly	15	800	4	0.50
West Bengal:					
Mohithnagar	Monthly	17	144	3	2.08

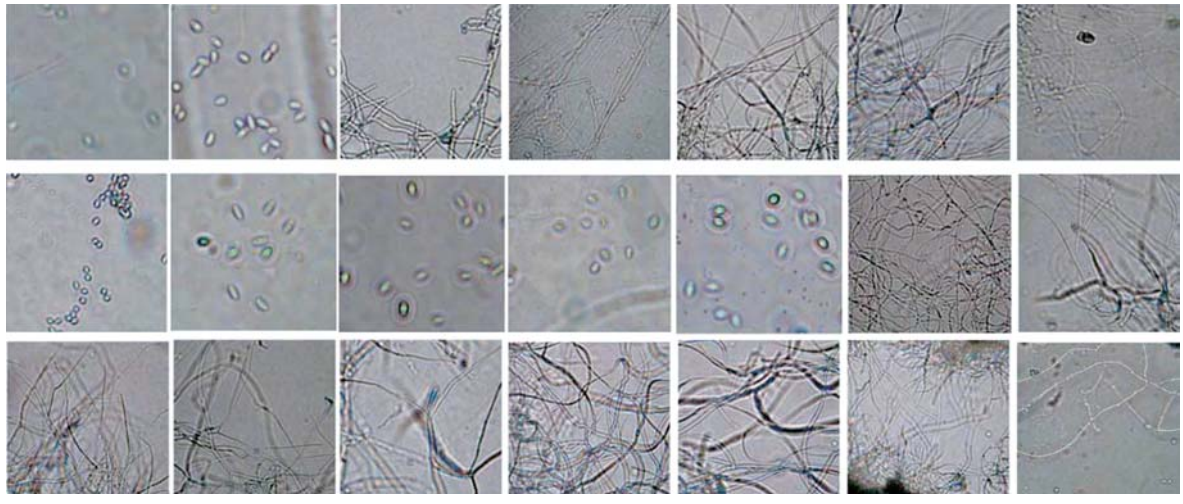
Cultural and Morphological variability: Twenty-one cultures were grown on commercially available Potato Dextrose Agar (PDA) medium for testing the cultural variability. Growth rates and colony morphology were recorded at every one-week interval (Table: 23 and Fig: 3). Cultural characteristics of all the 21 isolates were studied. Out of twenty-one cultures seven were spore forming isolates (Table : 23 & Fig: 4).

Fig: 3. Colonies of Ganoderma isolates three weeks after inoculation

Table 23 : Growth rates of Ganoderma isolates on Potato Dextrose Agar medium

S. No	Location	Growth rate (mm)			Spores
		1st week	2nd week	3rd week	
1	Makinavarigudem	77	Full	Full	+
2	Makinavarigudem	42	Full	Full	+
3	Namavaram	46	Full	Full	-
4	Rajahmundry	74	Full	Full	-
5	Peddapuram	31	90	Full	-
6	Rajahmundry	58	Full	Full	-
7	Rajahmundry	39	83	Full	-
8	Rajahmundry	31	72	84	+
9	Rajahmundry	41	87	Full	+
10	Rajahmundry	22	40	60	+
11	Rajahmundry	26	44	75	+
12	Rajahmundry	50	Full	Full	+
13	Jagannathapuram	54	Full	Full	-
14	Jagannathapuram	64	Full	Full	-
15	Mohitnagar	47	Full	Full	-
16	Mohitnagar	51	Full	Full	-
17	Mohitnagar	56	Full	Full	-
18	Palode	Full	Full	Full	-
19	Palode	Full	Full	Full	-
20	Palode	34	64	86	-
21	Nagannagudem	77	Full	Full	-

Fig: 4. Mycelial growth and sporulation of Ganoderma isolates



Pathogenicity studies : Seedlings inoculated with *Ganoderma* isolates did not show any symptom so far. So for testing the pathogenic variability of the isolates, *in vitro* biomass reduction study was conducted. Healthy oil palm root bits and stem tissues were inoculated with 21 *Ganoderma* isolates and the biomass reduction was estimated 9 weeks after inoculation (Chart 9). Biomass reduction was observed more in stem tissues than in root tissues. *Gan*O-21 isolate showed the highest biomass reduction of root tissue. Incase of stem tissue maximum reduction was observed with *Gan*O-5 isolate.

For testing the extra cellular laccase activity, 21 *Ganoderma* isolates were grown on Potato Broth medium containing 2gms of Oil Palm stem and root tissues. Culture filtrate was used as a enzyme source.Twenty one *Ganoderma* isolates were inoculated and estimated the change of O.D. per minute (Chart 10). Enzyme activity was more in *Gan*O-5 isolate grown on Potato dextrose broth containing root tissue powder. *Gan*O-15 isolate exhibited the highest enzyme activity in case of stem tissues.

Molecular characterization: Molecular characterization of the 21 isolates, which were identified through PCR using *Gan* 1-*Gan* 2 and *Gan* ET-*Gan* ITS, is in progress.

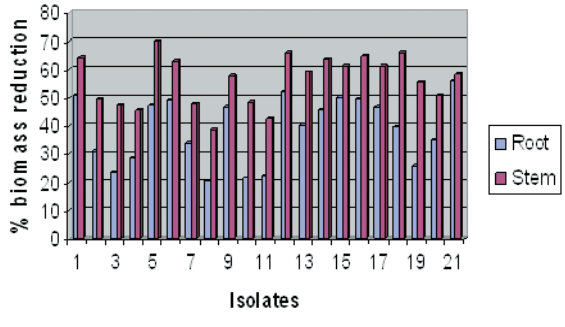


Chart 9: Biomass degradation (of oil palm root and stem tissue) by different Ganoderma isolates

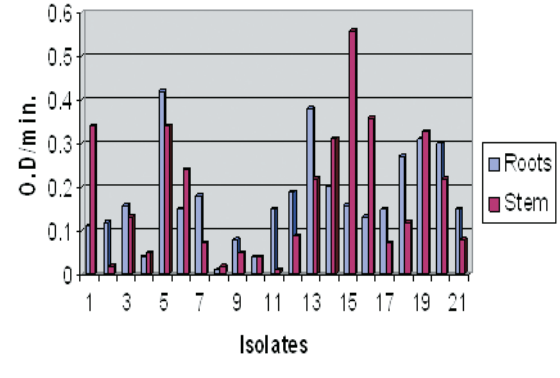


Chart 10 : Laccase activity (of oil palm root and stem tissue) by different Ganoderma isolates

4. Research Achievements

तेल ताड कटाई-उपरान्त प्रौद्योगिकी

Oil Palm Post Harvest Technology

Curios from oil palm trunk

POST HARVEST TECHNOLOGY

Processing

The unit operations in the mini palm oil mill of 1MT/hr capacity have been standardized. An Oil Extraction Ratio of 17.1 was observed when the FFBs from a 11 year old plantation were processed. The standardized unit operations in the mini palm oil mill are follows:

Sterilization	:	1hr, 3kg/cm^2
Stripping time	:	7 minutes for 1 batch (500kg)
Residence time in digester	:	10 minutes
Pressing	:	1MT/hr
Clarification	:	2hrs

The efficiency of the stripper was evaluated as a ratio of the weight of stripped fruits in the sterilized bunch to the weight of total fruits in the sterilized bunch and it is found that the stripper gave 97 percent efficiency at an rpm of 38. As the present digester is having a capacity of only 350 kg/hr, in order to match with the capacity of the screw press (1250 kg/hr), a higher capacity digester (1000 kg/hr) was designed and developed. A storage tank of 8MT/hr capacity is designed for storing the extracted oil.

Post harvest studies on palm oil

Biochemical changes of oil for storing FFB at lower temperature for different time intervals after harvesting : To study the effect of low temperature on FFA content in the oil after harvesting the FFB, fully mature FFB (five bunches) were harvested and spikelets were separated. Spikelets from the middle of the bunches containing uniform sized fruits were incubated at 10^{o}C, 20^{o}C natural condition for a period up to seven days. Replicated samples (spikelets) were collected and sterilized for one hour and oil was extracted from each sample with the help of a mini hand press. Change in FFA content Iodine value and Peroxide value were estimated from each sample. This experiment was conducted during the previous year also but since the result was quite unexpected and different, the experiment was completely repeated.

The increase in FFA during incubation for 7 days period was steady. However the increase was minimum at ambient temperature and maximum at 10^{O}C (Chart 11). Along with the spikelets, fallen fruits were also incubated separately and It was observed that increase in FFA content was higher in the fallen fruits in all the conditions. Though the fruits were only incubated for 7 days, the increase in FFA was steady even on the seventh day and hence, further increase in FFA was expected beyond seven days.

There was decrease in iodine value in all the conditions after 24 hours of incubation (Chart 12). However, variation in peroxide value was insignificant.

Waste Utilization

The residual oil present in the fibres extracted from the empty fruit bunches makes it unsuitable for using in rubberized mattress, cushions etc. In order to remove this residual oil, an anaerobic microbial treatment technique was tested in lab-scale and found that the oil content came down to 0.4% from an initial value of 5%.

Chart 11: Increase in FFA content during store of FFB/Fruits at different temperature for 7 days

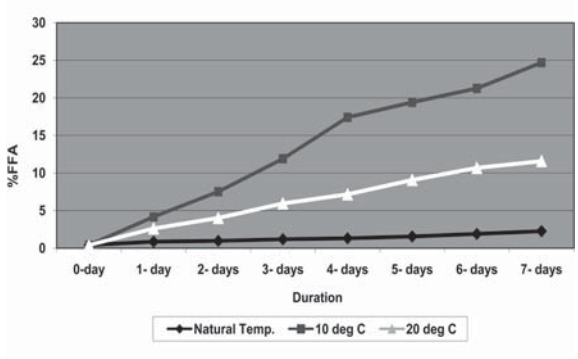
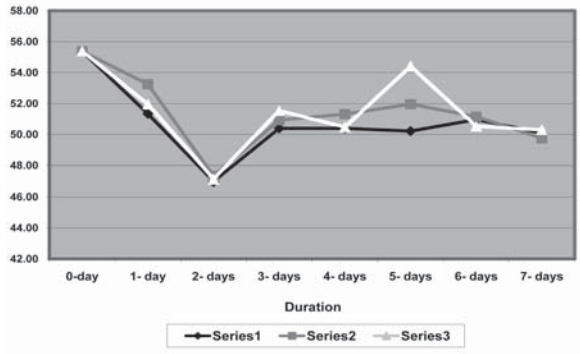


Chart 12: Iodine Value of palm oil extracted from fruits stored at different temperature for different duration



Paper boards and different value added paper board products like textile kits, courier covers, pen stands, office files, file boards etc. were made from oil palm fibres.

A mechanized process was developed for making stripes from oil palm fronds and window shades were made from the stripes. The mechanization was achieved by employing a wood planer cum cutter with modifications.

Utilization and Recycling of Palm Oil Mill Effluent (POME)

Studies on microbial properties of POME: In order to know the ability of the indigenous microbial flora that have been isolated from oil palm factory wastes to biodegrade POME, four different species of fungi were tested for the activity of the extra and intra cellular enzymes. *Arachnitus dankalensis* exhibited substantial laccase activity.

Samples of POME and organisms under culture in POME tank were analyzed for their fatty acids, amino acids and mineral content. Nutritional value of the single cell algae grown in POME tanks was not encouraging. *In vitro* studies conducted on '*Azolla'* and '*Eichornia'* to assess their growth on POME medium was also not encouraging.

The effect of effective micro-organisms on POME treatment was studied in lab scale and found that the application of EM is promising. Scaled up trials are planned.

The study using POME as the medium source to grow the industrially important microorganisms *Sacharomyces* and *Streptomyces* is in progress.

Studies on land application of fresh and digested POME as organic manure : The soil samples collected from the *Bhendi* (*Okra*) grown as an intercrop in plantation of Oil Palm and applied with POME were plated for viable counts. The soil samples collected from the oil palm nursery seedlings under POME application were plated for total viable counts.

Observations on plant height, girth, number of bunches, bunch weight, total leaves and leaflets, width of the petiole and number of spindles were recorded in oil palm nursery which is maintained at the NRCOP campus, Pedavegi.

Growth trials on fish and animals using Palm Oil Sludge (POS) based feeds : Proximate analysis of animal and fish feed was carried out. Growth trials of fish on

sludge based feed has been carried out in '*Rohu*' fish variety and it was observed that there were increased amounts of NPK in the fish tissue fed with 60% inclusion of POS and the increase in their levels followed the increase in body weights of the fish. In *'Catla catla'* fish variety also observations were recorded and found encouraging so far with significant growth rate in 40% inclusion of POS. POS can be included in the diets of ornamental fish (*Coi-carp*) up to 60% levels with out any adverse effect on growth and color of the fish, there by reducing the cost of feed. Whereas growth efficiency of different species of fresh water fish species under POME based feeds is not encouraging.

Animal growth trials on buffalo calves and goats have been completed. Encouraging results were observed when inclusion of sludge in the diet is 40% and 50% for calves and goats respectively. Economics of production was worked out for comparing the growth rate with feed cost among different treatments.

Growth of fresh water fish in POME tanks: The Physico- chemical and biological characters of the POME that had been collected and analyzed from different oxidation ponds and treatment points revealed very high BOD and COD levels in which fish cannot survive. Studies on toxic effects of POME on fish cultured in the effluent revealed that POME exerts its toxicity on fresh water fish even up to 20% dilution and it is not suitable for the growth of the fresh water fish.

Biogas production from POME: It is observed that sludge collected from POME settling ponds in palm oil mills yielded maximum biogas compared to other substrates as well as cow dung, which is a popular substrate for domestic biogas production. The quality of biogas in terms of methane content was also superior for POME sludge. The biogas yield of cow dung (control) was quantified in the pilot plant. Pilot plant level experiments on POME sludge are to be initiated.

4. Research Achievements

सामाजिक विज्ञान

Social Sciences

Demonstration on oil palm cultivation

SOCIAL SCIENCES

Critical analysis of Training of Trainers programme in relation to oil palm growers knowledge and adoption pattern

Collected data from 31 trained officers. Results revealed that cent percent of the trainees perceived that training is beneficial. Majority of them felt that subject matter taught is relevant; they are in medium to high knowledge category. Trainees are diffusing the technology either through individual or group contacts or using both. Trainers are organizing farmers' group meetings, trainings, awareness campaigns, study tours and distributing literature/publicity material to the farmers. Trainers perceived that they need refresher courses once or twice in a year for a duration of three days to one month. They opined that training venue can be either NRC for Oil Palm or convenient place to them. Suggested topics for future training are oil palm production technology in detail, irrigation & nutrient management, intercropping, harvesting of oil palm Fresh Fruit Bunches, leaf nutrient analysis, pest and disease management etc.

Data collected from 79 trained farmers indicated that farmers were not much aware about oil palm before training and training on oil palm cultivation is beneficial. They opined that extension officials are visiting their farms at monthly or fortnightly interval; they are in high knowledge category and in medium adoption category; getting low yields (<11.25 t/ha). Majority of trained farmers are not willing to go for area expansion due to lack of sufficient irrigation facilities and power problems. They perceived that irrigation, power supply and harvesting are the major problems in oil palm cultivation. Perceived that beneficial topics in the training are production technology, harvesting, irrigation &nutrient management, pest management and intercropping. They wanted to have refresher course in harvesting of oil palm FFB in tall plantations, intercropping, irrigation and nutrient management etc. Farmers felt duration of the training is sufficient. They indicated to have training at NRC for Oil Palm/oil palm garden/factory site/in their village during January/February. Diffusion effect was studied, which revealed unequal distribution. The training needs were assessed through knowledge and skill gaps as well as farmers requirement through open ended questionnaire. No body indicated the training need on integrated farming system.

Data collected from 31 oil palm growers on skill gap revealed that (Table 24), Skill gap is existing in the practices viz., management of soils, pit making, selection of seedlings, planting, fertilizer application, irrigation management, basin management, mulching, weed control, plant protection measures, harvesting tools, ablation, pruning of leaves, waste utilization, leaf sampling and soil sampling.

Prioritization of research needs in oil palm based on farmers perception

Developed items on "oil palm cultivation" for standardizing the interview schedule for pilot testing.

Oil Palm Data Base Management System

Data collected from oil palm growers of Karnataka, revealed (Table 25.) that 43% of

Table 24: Distribution of respondents based on their skill gap.

Sl. No.	*Practice*	Skill gap						
		Low		Medium		High		NR
		F	%	F	%	F	%	F
	Land preparation:							
1	Site selection.	20	62.5	7	21.8	3	9.3	2
2	Proper lay out, while leaving the space for roads, roadsides and electrification.	20	62.5	8	25.0	1	3.0	2
3	Management of sandy and black cotton soils.	7	21.9	7	21.8	10	31.2	8
	Pit making:							
4	Digging the pit by 2x2x2 feet exactly.	7	21.9	10	31.2	10	31.2	5
	Selection of seedling for planting:							
5	Identification of pest and disease free and healthy seedling.	6	18.7	7	21.8	14	43.7	5
6	Number of functional leaves and judging the age of seedlings.	7	21.9	9	28.0	14	43.7	2
	Planting of seedling:							
7	Mixing the dug out soil with 250 g DAP/400 g SSP, 50 g Phorate and one basket full of FYM, half the quantity of the above soil should be filled in the pit, place the seedling straight at the center of the pit and fill the pit with remaining quantity of soil layer by layer and form the basin.	1	3.1	8	25.0	18	56.2	5
8	Planting to a required depth.	7	21.9	5	15.6	13	40.6	7
	Fertilizer Management:							
9	Application of fertilizers in the recommended ratio of 1200: 600:1200 g NPK /ha. incase of adult palms. Two third and one third of the above fertilizers for one and two years old plantations, respectively.	6	18.7	14	43.7	10	31.2	2
10	Uniform application of fertilizers around the basin by leaving a gap of 50 cm from the trunk and within 3 m. of basin.	13	40.6	11	34.3	8	25.0	0
11	Application of Boron and Magnesium fertilizers alone and by leaving a gap of one week, if NPK fertilizers applied.	13	40.6	7	21.8	10	31.2	2
12	Identification of nutrient deficiency, disorders and their symptoms.	6	18.7	4	12.5	19	59.3	3
	Irrigation Management:							
13	Selection of suitable method of irrigation based on soil type and water availability.	19	59.0	5	15.6	7	21.8	1
14	Identification of palms with water stress symptoms for proper scheduling of irrigation.	10	31.2	8	25.0	13	40.6	1

F = Frequency

Sl. No.	Practice	Skill gap						
		Low		Medium		High		NR
		F	%	F	%	F	%	F
15	Application of required quantity of water to palms based on climatic change.	16	50	5	15.6	7	21.8	4
16	Placing the drippers/sprinklers in right position.	9	28.0	3	9.3	1	3.0	19
17	Cleaning of drippers/sprinklers, maintenance of irrigation/drainage channels.	7	21.9	3	9.3	4	12.5	18
	Basin management							
18	Forming the basin around the palm, with 1, 2, 3m distance from trunk in first, second and from third year onwards respectively.	8	25	10	31.2	8	25.0	6
	Mulching:							
19	Proper mulching in the basin (placement).	6	18.7	6	18.7	16	50	4
	Weed management:							
20	Preparation of weedicide, Glyphosate(750 ml/ha) for spraying on the weeds in the initial stages.	3	9.3	4	12.5	17	53.0	8
21	Correct application of weedicide.	3	9.3	4	12.5	16	50.0	9
	Plant protection measures:							
22	Identification of pests and their symptoms	1	3.0	12	37.5	10	31.2	9
23	Identification of diseases and their symptoms	1	3.0	11	34.3	11	34.3	9
24	Following right method of chemical control measures and mixing the pesticide or fungicide solution well, before application to palm	1	3.0	7	21.8	12	37.5	12
	Harvesting of Fresh Fruit Bunches:							
25	Identification of matured bunches based on the colour changes of fruit.	30	93.7	0	0	0	0	2
26	Judging the suitable time of harvesting.	29	90.6	1	3.0	0	0	2
27	Using of harvesting tools for efficient harvesting.	24	75.0	1	3.0	4	12.5	3
28	Maintaining the length of stalk below 5 cm. while harvesting.	24	75.0	4	12.5	0	0	4
	Ablation:							
29	Following the right time of ablation.	2	6.2	3	9.3	18	56.0	9
30	Pruning of leaves.	4	12.5	7	21.8	15	46.8	6
31	Utilization of oil palm wastes in a suitable proportions and methods.	3	9.3	4	12.5	17	53.1	8
32	Collection of leaf samples by identifying 17 th leaf, for leaf nutrient analysis.	2	6.2	3	9.3	23	71.8	4
33	Collection of soil samples from a specified depth, by using suitable method.	0	0	4	12.5	25	78.0	3
34	Selection of suitable intercrops for juvenile stage palms.	26	81.2	1	3.0	2	6.2	3

N R : Not Responded ; F = Frequency

the farmers are in < 2.5 acres category, 31% of the farmers are in 2.6-5.0 acres category and 26% of the farmers are in > 5.0 acres category.

Majority (Table 26.) of the farmers (52.6%) of 13-17 years age oil palm plantations are getting 12.5-25 tons FFB/ha. Majority of the farmers (46%) of 8-12 years age oil palm plantations are getting <12.5 tons/ha, rest of them are getting >12.5 tons/ha. Majority of the farmers (83%) of 3-7 years age oil palm plantations are getting <12.5 tons/ha.

Table 25. Distribution of respondents based on land holding.

N= 101

Sl. No.	Farm Size (Acres)	Frequency	
		Number	Percentage
1.	< 1.0	2	2
2.	1.0-2.5	42	41
3.	2.6-5.0	32	31
4.	5.1-10.0	17	16
5.	> 10.0	9	8
6.	Not Responded	2	2
	Total	101	100

Table 26. Distribution of Farmers based on Fresh Fruit Bunch yield.

N= 82

Sl.No.	Year of Planting	Yield(tha^{-1})	Frequency	Percentage
1.	1989-1993	<12.5	5	26.3
2.		12.5-25.0	10	52.6
3.		25.0-37.5	4	21.1
4.		37.5-50.0		
5.		50.0-62.5		
6.		>62.5		
		Total	**19**	**100**
1.	1994-1998	<12.5	26	46
2.		12.5-25.0	25	45
3.		25.0-37.5	4	7.3
4.		37.5-50.0	1	1.7
5.		50.0-62.5		
6.		>62.5		
		Total	**56**	**100**
1.	1999-2003	<12.5	6	83
2.		12.5-25.0	1	17
3.		25.0-37.5		
4.		37.5-50.0		
5.		50.0-62.5		
6.		>62.5		
		Total	**7**	**100**

Activities under Social Sciences

Training on "Nursery Management in Oil Palm"
Visit to oil palm nursery

Training on "Oil Palm Production Technology
Demonstrating method of fertilizer application

Training on "Plant Protection in Oil Palm"
Demonstrating Pest management techniques

Training on "Leaf Nutrient Analysis in Oil Palm"
Demonstrating Magnesium deficiency symptoms

On-farm training programmes to farmers on
"Oil Palm Cultivation"

Training on "Oil Palm Hybrid Seed Production"
Showing germinated sprouts of oil palm

प्रशिक्षण और शिक्षा

Training & Education

Training on oil palm production technology

TRANSFER OF TECHNOLOGY AND EDUCATION

Multidisciplinary approaches for Transfer of Technology and area expansion in relation to oil palm development in India.

Andhra Pradesh : Based on the request received from the state department of Horticulture, Andhra Pradesh committees were constituted to identify the potentiality for oil palm cultivation in non-identified mandals of a few districts on scientific basis. The committees surveyed the areas and interviewed the enthusiastic farmers to get first-hand information on the socio-economic conditions and awareness regarding Oil Palm cultivation.

Dr. V. M. Reddy, Dr. M. V. Prasad and ADH (Khammam dt) surveyed the mandals of Khammam district and report was submitted

Dr. P. Kalidas, Dr. G. C. Satisha and ADH (Krishna dt.) surveyed the Pedaparupudi mandal in Krishna district and report was submitted

Dr. P. Kalidas acted as Chairman of the team which has visited Borrampalem and Kommugudem of West Godavari district to observe and pass remedial measures for the problems in oil palm plantations.

Dr. P. Kalidas acted as resource person for the Oil palm awareness campaigns and training programmes conducted to the officers of the state department of Agriculture, in different districts of Andhra Pradesh

Tamil Nadu

Mr. Shinoj Subramannian acted as a member of the expert team constituted to identify reasons for low OER in Tamil Nadu

Kerala

S. Sunitha visited Kari lands of Kottayam to study the feasibility of growing oil palm and submitted report.

Training of Extension, research workers and farmers involved in oil palm production.

The following officers and farmers training programmes were conducted.

Training to officers : Training programmes on Oil Palm Production Technology, Plant Protection in Oil Palm, Nursery Management in Oil Palm, and Leaf Nutrient Analysis were organized to officers belonging to Department of Agriculture, Horticulture, State Agricultural Universities, ICAR institutions and Oil Palm entrepreneurs. A total of 79 officers belonging to Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Orissa, Tamil Nadu and Mizoram have participated in these training programmes (Table 27). In the 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. The subject matter scientists clarified trainees' doubts during the field visits. Literature viz. Compendium of lectures on Oil Palm production technology; Pest, disease and disorders management in oil palm; Nursery management in oil palm; Leaf nutrient analysis in oil palm were distributed to the officers. Pre and post evaluations were conducted. Certificates were awarded to the trainees at the end of each training programme.

Table 27. Training programmes organised for officers

Sl. No	Date	Programme	Venue	Trainees represented from	No.of Participants
1	21-23.06.2006	Oil Palm Hybrid Seed Production	NRCOP, R. S., Palode	Andhra Pradesh, T.N., Karnataka	7
2	4-7. 07. 2006	Oil Palm Production Technology	NRCOP, Pedavegi, A.P.	Karnataka	14
3	3-9.08. 2006	Oil Palm Production Technology	NRCOP, Pedavegi, A.P.	Andhra Pradesh, Mizoram, T.N., Karnataka	12
4	17-19.10.2006	Plant Protection in Oil Palm	NRCOP, Pedavegi, A.P.	A.P. , Mizoram, Orissa, Goa, T.N.	12
5	22-24.11.2006	Nursery Management in Oil Palm	NRCOP, Pedavegi, A.P.	A. P. , Orissa,	4
6	23-24.01.2007	Leaf Nutrient Analysis in Oil Palm	NRCOP, Pedavegi, A.P.	A. P., Goa, T.N.	5
7	1-3.02.2007	Oil Palm Production Technology	NRCOP, Pedavegi, A.P.	Andhra Pradesh, Mizoram	25
				Total	**79**

Table 28a. Training programmes organised to farmers by NRC for Oil Palm.

Sl. No	Training programme	No of programmes organized	No of farmers participated
1	**Oil Palm cultivation**		
	Organized at NRC for oil palm, Pedavegi	13	420
	Organized at Farmers plantations	19	1056
2	**Irrigation and Nutrient Management in Oil Palm**		
	Organized at Farmers plantations	5	310
3	**Plant Protection in Oil Palm**		
	Organized at Farmers plantations	4	295
	Total	**41**	**2081**

Table 28b: Farmers training programmes on "Oil Palm Cultivation" organised at NRCOP, Pedavegi.

Sl. No	Date	Place at which the Training Programme organised	Place & state of farmers represented	No. of Participants
1	13.04.2006	NRCOP, Pedavegi, A.P.	Havery, Karnataka	25
2	17.04.2006	NRCOP, Pedavegi, A.P.	Bellary	37
3	21.06.2006	NRCOP, Pedavegi, A.P.	Srikakulam district, A.P.	26
4	25.07.2006	NRCOP, Pedavegi, A.P.	Mundargi, Karnataka.	43
5	31.08.2006	NRCOP, Pedavegi, A.P.	Mundargi, Karnataka.	50
6	26.09.2006	NRCOP, Pedavegi, A.P.	Mysore, Karnataka.	31
7	30.10.2006	NRCOP, Pedavegi, A.P.	Tanjavur,tiruvur, Nagipattinam,	40
8	09.11.2006	NRCOP, Pedavegi, A.P.	Trichy, Perambalur	35
9	28.11.2006	NRCOP, Pedavegi, A.P.	Ganjam, Orisia	33
10	13-14.03.2007	NRCOP, Pedavegi, A.P.	34 Bhilad, Gujarat	
12	16-17.03.2007	NRCOP, Pedavegi, A.P.	36 Surat, Gujarat	
13	26.03.2007	NRCOP, Pedavegi, A. P.	Anand, Gujarat	30
			Total	420

Table 28d : Farmers training programmes on "Irrigation and Nutrient Management in Oil Palm" conducted at farmers plantations.

Sl. No	Date	Place at which the Training Programme organised	Place & state of farmers represented	No. of Participants
1	24.03.2006	Koyyuru, Krishna District	A. P.	25
2	05.01.2007	Jaggampeta mandal	East Godavari	50
3	20.02.2007	Seetharampuram, Nuziveedu	Krishna Dist.	70
4	12.03.2007	Tadavai, Jangareddygudem.	W. G. Dist, A.P	100
5	12.03.2007	Veerisettygudem, Kamavarapukota Mandal.	W. G. Dist, A.P	65
			Total	**310**

Table 28e : Farmers training programmes on "Plant Protection in Oil Palm" conducted at farmers plantations.

Sl. No	Date	Place at which the Training Programme organised	Place & state of farmers represented	No. of Participants
1	06.02.2007	Parvatipuram	Vizianagaram	100
2	13.02.2007	Rajanagaram,	Rajahmundry, E. G.	70
3	03.03.2007	Gangannagudem	West Godavari	60
4	03.03.2007	Pedavegi	West Godavari	65
			Total	**295**

Table 28c : Farmers training programmes on "Oil Palm Cultivation" conducted at farmers plantations.

Sl. No	Date	Place at which the Training Programme organised	Place & state of farmers represented	No. of Participants
1	13.09.2006	Narasannapeta, Pedarajulamadaga, Mandal.	Srikakulam Dist.	105
2	14.09.2006	Gangannadora valasa, Salur Mandal.	Vizianagaram	50
3	15.09.2006	Devarapalli Mandal	Visakhapatnam	30
4	05.10.2006	Peda Gullalagudem, Aswaraopet Mandal.	Khammam	52
5	11.10.2006	Valer Padu, Gullalagedem, Aswaraopet Mandal.	Khammam	50
6	07.11.2006	Koyyuru, Bapalpadu Mandal	Khammam	50
7	08.11.2006	Palwancha.	Khammam	75
8	23.12.2006	Narayanapuram,	Khammam	50
9	29.01.2007	Peddapuram village	East Godavari	80
10	29.01.2007	Singampalli village	East Godavari	60
12	05.02.2007	Timmapuram vill, Addategala	East Godavari	50
13	05.02.2007	Punyaksetram, Rajahmundry	East Godavari	41
14	06.02.2007	Bendapudi village, Annavaram	East Godavari	60
15	26.02.2007	Pallermudi, Nuziveedu	Krishna	50
16	27.02.2007	Akkireddygudem, Musunuru	Krishna	50
17	28.02.2007	Atkuru, Unguturu mandal	Krishna	50
18	08.03.2007	Dwaraka Tirumala	West Godavari	83
19	08.03.2007	Nallajerla	West Godavari	70
			Total	**1056**

NRCOP, RS, Palode

Farmers training programme at NRCOP (RS),Palode was conducted as given beow:

Sl. No	Date	Place at which the Training Programme organised	Place & state of farmers represented	No. of Participants
1	13.02.2007	NRCOP, RS, Palode	Krishi Bhavan, Kudappanakunnu, Trivandrum	65

Specilised training Programme at RS, Palode

Organised exposure training programme to Research Officer of OPIL on 'Hybrid seed production, seed and seedling quality' during March 2007

Training to farmers

Nineteen one day on campus and 13 one day on farm training programmes on "Oil Palm Cultivation", 5 one day on farm training programmes on" Irrigation and Nutrient Management in Oil Palm" and four one day on farm training programmes on "Plant Protection in Oil Palm" at farmers plantations were organized to 2081farmers of Andhra Pradesh, Karnataka, Goa, Gujarat, Orissa and Tamil Nadu (Table 28a, 28b, 28c, 28d 28e). In all the above programmes, lectures were delivered on respective subjects of Oil Palm. Field visits were arranged to demonstrate method of planting, identification of pest, disease and disorder symptoms and control of pests and diseases, correction of nutritional disorders etc. Farmers were shown video film on Oil palm cultivation and they were taken to Oil palm gardens of progressive farmers. The scientists clarified farmers' doubts during the field visits. Farmers were also taken to processing units to know about the harvesting standards, time of harvesting, and quality aspects of FFB in processing. Literature viz. Oil palm Cultivation Know how-do how, Oil Palm Sagu and Oil palm Cultivation were distributed to the farmers.

Consultancy Project on "Research-Cum-Development Project on Oil Palm in Karnataka"

This is a Consultancy Project with the Govt. of Karnataka on Oil Palm Development. The project is successfully running and helped in bringing more area under oil palm cultivation. Besides this, it has also helped in boosting the productivity of oil palm plantations by identifying the constraints faced by the growers and suggesting critical solution. The major activities under the project were as under :

- Attended Project Management Committee Meeting of Oil Palm Development Programme of Karnataka
- Visited the Farmers' fields in Mysore & Mandya districts of Karnataka.
- Oil palm growers and officers involved in Oil Palm Development Programme visited NRCOP fields and labs and during their visits the activities about Oil Palm research and development were explained
- Interviews were conducted and Project Assistants and drivers were recruited under the project
- Organised training to 14 Project Assistants involved in Oil Palm Development Project in Karnataka.
- Organised 5 training programmes on "oil palm cultivation" and trained 186 farmers.
- Brought out the book on oil palm cultivation in Kannada (Talabilakrishi).
- Extended appropriate support to Senior Assistant Director of Horticulture, Shimoga with regard to soil and leaf analysis, establishment and operational mode of leaf analysis laboratory at Shimoga to provide advisory service in fertilizer management to oil palm growers in Karnataka.

Field days organized

Dr. P. Kalidas organized Field day on "cocoa in oil palm" at Nellore on 26th August, 2006 and at Parvatipuram of Vizianagaram district on 29th August, 2006. Directorate of Cashew and Cocoa Board, Cochin sponsored the programmes.

All India Radio Programmes

Dr. V. M. Reddy

- Gave an interview on " Oil palm saagu" in the All India Radio, Vijayawada on 1-10-06

Dr. P. Kalidas

- Participated in the Live Phone in Programme on "Integrated Pest management in oil palm" in All India Radio, Vijayawada on 13 April, 2006 to answer the doubts on pest problems of Oil palm.
- Participated in interview on 'Integrated Pest Management practices in Oil Palm' for the benefit of oil palm growers by All India Radio, Vijayawada on 5 September, 2006.
- Participated in the Live Phone in Programme on 'Integrated Pest Management in Oil Palm' in All India Radio, Vijayawada on 25th January, 2007 to answer the problems of oil palm farmers.

Dr. M. V. Prasad

- Gave a live Phone in programme (question and answer mode) on "Oil Palm" at AIR, Vijayawada on 3.8.2006. Explained the package of practices on oil palm. Answered the questions (asked by the growers over phone) pertaining to oil palm cultivation.
- Gave a radio talk (interview mode) on "Oil Palm cultivation" for F. M. Radio (AIR) on 8.11.2006, at Palwancha.
- Gave a talk (interview mode) on "Government efforts for oil palm cultivation, training on oil palm cultivation on recent technology" at AIR, Vijayawada on 1.12.2006.

Television programmes

Dr. P. Kalidas

- Acted as a resource person for ETV on "Research in oil palm" held in a farmer's garden at Tadikalapudi on 6 September 2006.

Dr. M. V. Prasad

- Gave an interview to E TV – Annadata on "Oil Palm leaf nutrient deficiency symptoms, their management and fertilizer management in oil palm" at Salur, Vizianagaram.
- Coordinated Video shooting on "oil palm", at NRCOP, Pedavegi by Doordarshan Kendra, Vijayawada on 30 November 2006.

Exhibitions

Pedavegi

- Provided exhibits to the students of Horticulture and Agriculture – RAWEP to organize exhibitions at Kondalaraopalem and Gopannapalem.
- Participated in Horticultural Fair organised at Indoor Stadium, Eluru

during 19-23 February, 2007

Palode

- Participated in an exhibition conducted at Neyyar Dam, Trivandrum during 4-7 September, 2006
- Organized and participated in an exhibition at The Institute of Animal Health & Biologicals, Palode during 18-19 December, 2006.
- Participated in the 'Agri- Fair Exhibition' held at Palode, during 7-13 February, 2007.
- Participated in 'Vejaranmood Exhibition', held at Venjaranmood, Trivandrum during 10-16 February, 2007.
- Organized and participated in 'Nedumangad Expo- 2007 Exhibition' held at Nedmangad, Trivandrum during 5-15 March, 2007

Digital video film on Oil Palm

- Digital video film on Oil Palm Production Technology useful for the farmers and officers for gaining basic information on oil palm cultivation was taken up and it is in the process of shooting.
- Initiated shooting/production of Digital video film on oil palm cultivation in 5 languages viz. English, Telugu, Tamil, Kannada and Hindi.
- Video CD covering all aspects of Oil Palm hybridization, seed processing, sprouts development is being prepared for the benefit of seed production personnel and others.

Students exposure visits organized at NRC for Oil Palm

Sl.No.	Date	Name and Location of Institute	
1	21. 04 2006	Sir C.R. Reddy College, Eluru, West Godavari, A.P.	20
2	26.06.2006	Kasthuribha junior College, Eluru, West Godavari, A.P.	60
3	29.07.2006	Dept. of Biotechnology, Acharya Nagarjuna University, Nuzivid, West Godavari, A.P.	25
4	19.08.2006	A. N. R. College, Gudivada, West Godavari, A.P.	25
5	24.08.2006	D. N. R. College, Bhimavaram, West Godavari, A.P.	26
6	06.09.2006	Jawahar Navodaya Vidyalay, Pedavegi, West Godavari, A.P.	40
7	16.09.2006	St. Theresa Jr. College, Eluru, West Godavari, A.P.	15
8	13.11.2006	Nalanda Degree College, Vijayawada, Krishna, A. P.	36
9	29.11.2006	Agricultural College, Bapatla, A. P.	25
10	21.12.2006	Government Junior College for Women, Guntur, A. P.	40
11	22.12.2006	Sir C. R. Reddy College, Eluru, West Godavari, A.P.	44
		Total	356

Queries Answered

- Queries of oil palm growers regarding cultivation practices received through letters and phone calls were attended and replies were given for successful cultivation of oil palm. Entrepreneur/ developmental department letter queries were also answered from time to time.

Field visits

Dr. P. Kalidas

Visited the oil palm and cocoa orchards of East Godavari and Visakhapatnam districts, oil palm gardens of Krishna and West Godavari, Vizianagaram and Nellore districts in Andhra pradesh, Oil palm plantations of Palode and OPIL, Kerala, Oil palm orchards in Mysore, Chamrajnagar, Mandya, Coorg, Chikmagalur, Hasan and Shimoga districts in Karnataka, Oil palm plantations of Tanjore district of Tamil Nadu.

Dr. M. V. Prasad

Based on the request received from farmers/ entrepreneurs/state department of agriculture/horticulture, visited thirty four oil palm plantations for diagnosing the problems faced by the growers and suggested suitable remedial measures. 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.

Dr. G. C. Satisha

Visited farmers' fields at Krishna and Khammam districts of A.P and Mysore, Coorg, Hassan, Shimoga and Chickmagalur districts of Karnataka, identified the field problems and appropriate management practices were advised.

Students Visit to NRCOP, Pedavegi

Organised students visits to NRCOP, Pedavegi. Students (356) belonging to Andhra University, Acharya Nagarjuna University, Acharya N. G. Ranga Agricultural University visited this centre. Explained about the research activities undertaken at this centre on oil palm and showed the video film on oil palm cultivation. Lab visits were arranged; respective scientists explained the research achievements.

Sl.No.	Date	Name and Location of Institute	
1	07.10.2006	BSc (Ag) students from Annamalai University, Tamil Nadu	89
2	11.10.2006	BSc (Ag) students from Annamalai University, Tamil Nadu	44
3	30.10.2006	BSc (Ag) students from Padannakkad, Kasaragod, Kerala Agricultural University	23
4	01.12.2006	Indian Central School Peroor Kilimanoor, Trivandrum	61
6	02.03.2007	Parent Teachers Association ST. Joseph's U.P. School Perayam Meenmutty, Trivandrum	46
		TOTAL	**263**

PROJECT WORKS CARRIED OUT BY STUDENTS AT THE INSTITUTE:

Name of the student	College & Discipline	Period of Completion	Title of project work	Guide
P. Rajesh	Bharathidasan University, Trichy M.Sc (Biotechnology)	Dec 06 to Feb 07	A modified method of DNA extraction from oil palm, coconut and arecanut	Dr. M. Jayanthi
P. Rajasekhar	Nagarjuna University, Guntur M Phil (Biotechnology)	July 2006	Studies on the growth pattern of *Beauveria bassiana* and its efficacy on the pests of oil palm	Dr. P. Kalidas
M. Aparna	Andhra University Visakhapatnam M. Sc (Microbiology)	May-July 06	Studies on comparative protein variations in bioagent *Metarhizium anisopliae* isolates using SDS-PAGE	Dr. P. Kalidas
K. Satya nagalakshmi	Nagarjuna University, Guntur M. Sc (Biotechnology)	May-July 06	Studies on comparative protein variations in bioagent *Trichoderma viride* isolates using SDS-PAGE	Dr. P. Kalidas
Ch. Anjani Devi	Nagarjuna University, Guntur M. Sc (Biotechnology)	May-July 06	Studies on comparative protein variations in bioagent *Beauveria bassiana* isolates using SDS-PAGE	Dr. P. Kalidas
V. Jyothsna	Nagarjuna University, Guntur M. Sc (Biotechnology)	May-July 06	Studies on impact of biocontrol organisms on growth of earth worms	Dr. P. Kalidas
Krishna Prasad G	Acharya Nagarjuna University Post Graduate Centre, Nuzvid M. Sc (Biochemistry)	May,	Changes In Palm Oil Quality During Storage Of Fresh Fruit Bunches At Low Temperature	Dr. P. K. Mandal
M. Rajesh	Madanapalle Institute of Technology & Science, Madanapalle under JNTU, Hyderabad B. Tech (Biotechnology)	April, 2006	Studies On Electrophoresis Pattern Of Isozymes And Proteins In Different Leaves Of *Pisifera* Variety Of Oil Palm (*Elaeis guineensis* Jacq.)".	Dr. P. K. Mandal
T.C. Venkateswarlu	Madanapalle Institute of Technology & Science, Madanapalle under JNTU, Hyderabad B. Tech (Biotechnology)	April, 2006	Studies On Electrophoresis Pattern Of Isozymes And Proteins In Different Leaves Of *Dura* Variety Of Oil Palm (*Elaeis guineensis* Jacq.)	Dr. P. K. Mandal
N.Murali Mohan	Gitam College, Visakhapatnam M. Sc (Biotechnology)	August, 2006	Analysis of fatty acid composition in the oil extracted from different portions of oil palm (*Elaeis guineensis jacq.)* Bunches and different parts of fruits during different months	Dr. P. K. Mandal
K.N.S.S. Ganesh Boppe	Ponnaiyah Ramajayam College, Thanjavur M.Sc (Biotechnology)	February, 2007	A modified method of DNA extraction from three palms namely *Borassus flabellifer* L., *Phoenix dactylifera* L., and *Livistona rotundifolia.*	Dr. P. K. Mandal
G. Sujatha	Nagarjuna University, Guntur Continuing PhD in Biotechnology	Cont..		Dr. P. K. Mandal

Dr. P. K. Mandal

1. Delivered lectures for the P.G. Students of Department of Biochemistry, P.G.Centre, Acharya Nagarjuna University, Nuzivid on: BIOCHEMICAL AND BIO-TECHNOLOGICAL RESEARCH APPROACHES, AT NRCOP.

2. Delivered lectures for the P.G. Biochemistry students and teachers of Sir C.R.Reddy Women's College, Eluru on "RESEARCH APPROACHES AT NRCOP USING BIOCHEMICAL AND BIOTECHNOLOGICAL TOOLS".

3. Delivered lectures for the U.G. Biotechnology students from ANR College Gudivada and DNR College Bhimavaram on : BIO-TECHNOLOGICAL APPROACHES FOR OIL PALM AT NRCOP.

4. Taken guest lectures at Nalanda Degree College on Molecular Biology for the B.Sc. Biotechnology courses and demonstrated laboratory techniques during their visit to NRCOP on 13-11-2006.

Students Visit to NRCOP (RS), Palode

Five one –day training programs were conducted on Oil Palm Cultivation to 263 students.

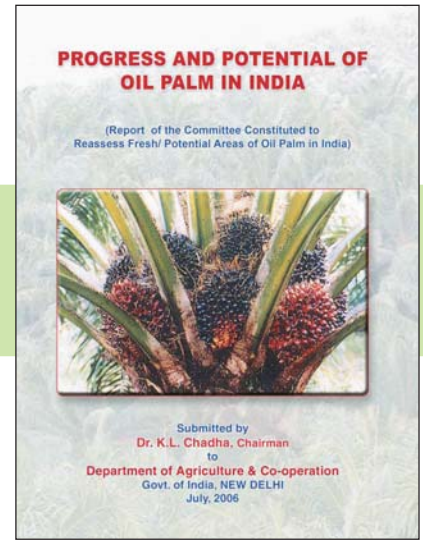
6. AWARDS AND RECOGNITIONS

- Dr. P. Kalidas acted as co-opted member of the high level committee to fix the Oil palm FFB price formula held at NRCOP, Pedavegi during February, 2007
- Dr. M. V. Prasad is a member, Internal Quality Assurance Cell and Academic council of CH. S. D. St. Theresas college for women, Eluru.
- Dr. P. Murugesan, nominated as a Member, Special Purpose Vehicle - Tamil Nadu Agriculture Department "Precision Farming in Oil Palm cultivation" Joint scheme operated by Department of Agriculture, Tamil Nadu Agricultural University and Cauvery Palm Oil Limited.

SPECIAL ASSIGNMENTS

Chadha committee report-2006

A committee has been constituted under the chairmanship of Dr. K. L. Chadha, Retd. DDG (Hort.), ICAR by Department of Agriculture and Cooperation, Govt. of India, New Delhi to reassess the fresh /potential areas of Oil palm cultivation in India. The working group visited various states and held meetings with the entrepreneurs and representatives of the farmer/grower associations besides policy makers and officials dealing with Oil Palm. An area of 10.36 lakh ha has been identified as potential for oil palm cultivation in nine states of India. A report " Progress and potential of oil palm in India" was submitted during July, 2006. Dr. M. Kochu Babu, Director, NRC for Oil palm was a member of the working group of the Committee and the scientific staff of NRCOP had contributed a great deal in bringing out the publication.



7. LINKAGES AND COLLABORATIONS

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
- Dept. of Agriculture and Co-operation, Govt. of India

B. International

- Malaysian Palm Oil Board, Malaysia
- ASD Costa Rica
- IDEFOR, Ivory Coast
- DAMI, Papua New Guinea
- 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 and oil palm farmers 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. Another TMOP&M funded project entitled “Strengthening of seed gardens” is also under operation which is aimed at improving the indigenous hybrid seed production.

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 papers:

- Kalidas, P., Venkateswara Rao, Ch., Nasim Ali and Kochu Babu, M. 2006. New pest incidence on Oil palm seedlings in India- A study of black slug (*Laevicaulus alte*). The Planter, Kuala Lumpur 82(960):181-186
- Kalidas, P. 2006. Avian pest menace in oil palm and the impact of novel technologies on its management. *J. Plant. Crops.* **34**(3). 172-178.
- Mandal, P.K. and Susmita D. 2006. Characterisation of oil palm *Elaeis guineensis* germplasm using biochemical and molecular parameters. *J. Plant. Crops*, **34**(3), pp529-533.
- Murugesan, P, Pillai, R.S.N., Mathur, R.K.,.Ravi Kumar, M., Shivanand Kapashi and Kochu Babu, M. 2006. Oil Palm selection and hybrid seed production in India. *The Planter* 82(961): 227-244
- Nagamani, Ch and K. Suresh 2006. Dry matter production and Photosynthetic efficiency of oil palm hybrids grown under irrigated conditions. *J. Plant. Crops* **34** (3): 601-605
- Prasad, M. V. 2006. Perception of farmers about training on oil palm cultivation. *J. Plant. Crops.* **34**(3). : 681-682.
- Sunitha, S and Krishna Kumar,T. 2006. Biomass production and potential nutrient contribution from Oil palm at felling. *J. Plant. Crops.* **34**(3) : 309-311
- Suresh, K., Nagamani, Ch and V.M. Reddy 2006. Photosynthesis and chlorophyll fluorescence in oil palm grown under different levels and methods of irrigation. *J. Plant. Crops* **34** (3):621-624.

Popular articles:

- Kochu Babu M, Prasad M V and Sampath Kumar P .2006. Oil Palm thotallo movvukullu samasya nivarana-Telugu (bud rot disease problem and it's control in oil palm), P 57, *Annadata,* a telugu monthly news magazine.
- Kochu Babu M, Prasad M V and Sampath Kumar P .2007. Control of bud rot in Oil Palm, *The Hindu*, March 22, 2007.
- Shinoj Subramannian.2006. Oil Palm-A Kalpa Vriksha, *Plant Hortitech* Vol.6 (6), pp:19-20.
- Shinoj Subramannian and M.Kochu Babu.2006. Status of Oil Palm Processing in India, *Kisan World*, April 2006

Technical bulletins/books

- Prasad M V, Madhav Reddy V, Kalids P, Suresh K and Rayapa Raju D G S. 2006. Talebila Krishi (in Kannada) (English-Oil palm cultivation), NRC for Oil Palm, Pedavegi.
- Prasad M V and Rayaparagu D G S. 2006. "Compendium of lectures on Oil Palm Production Technology", NRC for Oil Palm, Pedavegi.

Book Chapters

- Kochu Babu, M. 2007. Scope for Oil Palm-A potential source of vegetable oil in India.. Hegde, D.M. (Ed.).2007 Changing global vegetable oils scenario: Issues and challenges before India.

Indian Society of Oilseeds Research, Hyderabad (A.P.).pp - 391-418

- Kochu Babu, M. 2006 Bharatha desam lo oil palm saagu- oka visleshana (Telugu) in Nuneginjala rangam o sarikotha oravadi (Telugu) by M/s. Andhra Pradesh cooperative oilseeds growers federation Ltd., Hyderabad. Pp
- Kochu Babu, M., Kalidas, P., Satyavani, V. 2006. Palm oil mokkala naasinche vividha purugulu, pakshulu, yelukalu, adavi janthuvulu, thegullu mariyu vaati nivarana (Telugu) in Nuneginjala rangam o sarikotha oravadi (Telugu) by M/s. Andhra Pradesh cooperative oilseeds growers federation Ltd., Hyderabad. Pp 31
- Reddy, V. M. Prasad M. V. and Sampath Kumar P. 2006. Oil Palm sagulo patinchavalasina melakuvalu – Telugu (Techniques to be followed in oil palm cultivation) in Nuneginjala rangam o sarikotha oravadi (Telugu) by M/s. Andhra Pradesh cooperative oilseeds growers federation Ltd., Hyderabad. Pp
- Vanangamudi, K., K.Natarajan and Murugesan, P. 2006. Water Management for quality seed production In: Advances in seed Science and Technology Vol I Recent trends in seed technology and management Published by Agrobios (India) Jodhpur P 435-442
- Vanangamudi, K., A. Bharathi and Murugesan, P. 2006. Quality parameters for different categories of seeds and their maintenance In: Advances in seed Science and Technology Vol I Recent trends in seed technology and management (Eds: K.Vanangamudi et al) Published by Agrobios (India) Jodhpur. P 516-522
- Vanangamudi, K., A. Bharathi and P. Murugesan, P 2006. Seed hardening for drought resistance In: Advances in seed Science and Technology Vol I Recent trends in seed technology and management (Eds: K.Vanangamudi et al) Published by Agrobios (India) Jodhpur. P 196-200
- Murugesan, P. 2006. *Elaeis guineensis* In: Advances in Seed Science and Technology Vol IV, Forest Tree Seed Production (Eds: K.Vanangamudi *et al.,*) Published by Agrobios (India) Jodhpur. P 179 – 216

Presentations in seminars/symposia/ conference and other fora

- Kalidas, P., Rajasekhar, P., Satyavani, V and Kochu Babu, M. 2006. Oil palm cultivation for ecofriendly environment. Paper presented in the National seminar on Environment and Development held at Acharya Nagarjuna University, Guntur on 30 June 2006. Abstracts pp.8-9.
- Kalidas, P., Satyavani, V., Rajasekhar, P and Kochu Babu, M. 2006. Studies on growth parameters of different biocontrol organisms for the successful transformation as biopesticides . Paper presented in the Regional seminar on Environmental pollution with special reference to pesticide pollution held during 27-28 July 2006 at Vijayawada.
- Kalidas, P and Satyavani, V. 2006. Impact of biopesticides, *Metarhizium anisopliae* and *Trichoderma viride* on earthworms in vermicompost units. Paper presented in the National seminar on organic crop protection for export oriented agri horticulture held at Chennai during 21-22 November 2006
- Kalidas, P. 2007. Role of biopesticides, *Beauveria bassiana* on the management of defoliators of oil palm. In the extended summaries of National Seminar on “Changing global vegetable oil scenario

: Issues and challenges before India", conducted during January 29-31, 2007 at Directorate of Oilseeds Research, Hyderabad (A.P.). pp. 168-169.

- Kalidas, P and Satyavani, V. 2007. Impact of different growth media and abiotic factors on the commercial multiplication of green muscardine fungus, *Metarhizium anisopliae.* Paper presented in the National conference on Organic waste utilization and ecofriendly technologies for crop protection held at Hyderabad during 15-17 March, 2007
- Kalidas, P and Rajasekhar, P. 2007. Studies on the growth patterns of microbial agent, *Beauveria bassiana* and its efficacy on the Lepidopteron pests of Oil palm. National conference on Organic waste utilization and ecofriendly technologies for crop protection held at Hyderabad during 15 - 17 March, 2007.
- Kochu Babu, M., Kalidas, P and. Mathur, R. K .2006. Integrated management of pests and diseases of Oil palm (*Elaeis guineensis* Jacq.) Paper presented in the winter school on resistance breeding for oil palm held at CPCRI, Kasargod during November, 2006
- Kochu Babu, M and Shinoj Subramannian.2006. Waste Management in Oil Palm Industry, In: Proceedings of the National Seminar on Solid Waste Management in Chemical and Allied Industries, RVR&JC College of Engineering, Guntur, AP. August 18-19, 2006.
- Mandal, P.K.. Satyavani V, Kochu Babu M. and Jayanthi M. 2006. An economic method for diagnosis of diseases in oil palm using PCR In: The abstract of the National Symposium on recent trends in diagnosis and management of chronic and emerging plant diseases, Central Institute for Cotton Research, Nagpur. November 23-24, 2006. pp. 32
- Mandal, P.K. 2006. Characterisation of oil palm *Elaeis guineensis* germplasm using biochemical and molecular parameters. Poster presented in PLACROSYM XVIII held during 5-8 December 2006 at Kochi
- Mandal, P.K. Participated and presented the work done report during a mid-term review meeting of the wilt network project which was held at IIVR, Varanasi during 23rd July 2006.
- Mandal, P.K. Participated and presented the work done report during the review meeting of the wilt network project held at TNAU, Coimbatore during 16th-18th October 2006.
- Mandal, P.K. Participated and presented the progress of research work on wilt project during the second annual review meeting held at NBPGR, New Delhi during 24th November 2006.
- Mathur, R.K., Murugesan, P. and Ravi Kumar, M. 2007. Relationship between oil yield and bunch quality parameters in Oil Palm. In the extended summaries of National Seminar on "Changing global vegetable oil scenario : Issues and challenges before India", conducted during January 29-31, 2007 at Directorate of Oilseeds Research, Hyderabad (A.P.). pp. 396-398.
- Murugesan, P., Mathur, R.K., Padma, P., Nagmangla, U., Bijimol, G. and Krishnakumar, T. 2007. Characterization of *pisifera* parents (*Elaeis guineensis* var. *pisifera*) and its seed germination behaviour. *In* Abstracts of poster sessions of 8th Agricultural Science Congress on "Science for Food, Livelihood security and rural prosperity" organised by National Academy of

Agricultural Sciences and TNAU, Coimbatore during 15-17th February' 2007. pp.13-14.

- Murugesan, P. 2006. Quality standards in Oil Palm planting material. Special paper presented in the Seed meet on production and supply of indigenous oil palm hybrid seeds for the year 2007-08 organised on December 21, 2006 at NRCOP, RS, Palode.
- Murugesan, P. 2007. Recent Advances in Oil Palm cultivation. Lead talk in a seminar on Oil Palm cultivation – through precision farming at Tamil Nadu Rice Research Institute, Aduthurai on 04.01.2007
- Nagamani, Ch and Suresh, K. 2006. Dry matter production and Photosynthetic efficiency of oil palm hybrids grown under irrigated conditions. Paper presented in the PLACROSYM XVIII held at Kochi during 5-8, December, 2006.
- Prasad M. V. 2006. Perception of farmers about training on oil palm cultivation. Paper presented in PLACROSYM XVIII held during 5-8 December 2006 at Kochi.
- Shinoj Subramannian., Kochu Babu, M and Pillai, R.S.N.2007. Mini Palm Oil Mills for Oil Palm Development in India. In: Proc. of 8th Agricultural Science Congress: *Science for food, livelihood security and rural prosperity;* (Eds.), Samiyappan, *et al*, National Agricultural Science Congress, 15-17, Feb., 2007, Tamil Nadu Agric. Univ., Coimbatore, India Pp266
- Sunitha, S and Krishna Kumar, T. 2006. Biomass production and potential nutrient contribution from oil palm at felling. Paper presented in PLACROSYM XVIII held during 5-8 December 2006 at Kochi
- Suresh, K., Nagamani, Ch and V. M. Reddy 2006. Photosynthesis and chlorophyll fluorescence in oil palm grown under different levels and methods of irrigation. Paper presented in the PLACROSYM XVIII held at Kochi during 5-8, December, 2006.
- Suresh,K., Nagamani,Ch. and V.M. Reddy, 2007. Measurement of transpiration using sap flux probes in Oil Palm grown under irrigated conditions. In the extended summaries of National Seminar on "Changing global vegetable oil scenario : Issues and challenges before India", conducted during January 29-31, 2007 at Directorate of Oilseeds Research, Hyderabad (A.P.). pp.398-400.

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

Trainings attended

Dr. M. V. Prasad

- "Participatory methodologies for agricultural extension management" at MANAGE, Hyderabad during 21-25 August 2006.
- "Direct Trainers skills" at Institute of Secretariat Training and Management (ISTM), New Delhi during 13-17 November 2006.

Dr. M. V. Prasad and Dr. K. Ramachandrudu

- "Advances in Cocoa production technology" at CPCRI, RS, Vittal, Karnataka during 12-14 December 2006.

Dr. P. Murugesan

- "Intellectual Property Rights and World Trade Organisation related issues" during December 11–15, 2006 (Sponsored by the Department of Science and Technology, Govt of India) at Administrative Staff College of India, Hyderabad- 500 082

Dr. G. C. Satisha

- "Developing Winning Research Proposals in Agricultural Research" during 9-13 October, 2006 at National Academy of Agricultural Research Management, Hyderabad.

Dr. G. C. Satisha, Dr. M. Jayanthi and Dr. K. Ramachandrudu

- "Oil Palm Production Technology" at NRCOP, Pedavegi during 03- 09 August 2006.

Dr. Ananta Sarkar

- Foundation Course for Agricultural Research Service (FOCARS) training at National Academy of Agricultural Research Management (NAARM), Hyderabad from 8 January to 7 May, 2007

Visits

- **Dr. P. Kalidas, Dr. R. K. Mathur, Dr. P. Murugesan and Dr. K. Suresh** visited CARI, Portblair, HutBay, Little Andamans, Baratang, North Andamans during 20-27 April 2006 to study the "Impact of tsunami" on plant genetic resources, growth of oil palm and pest and disease incidence.

Dr. R. K. Mathur

- Visited Oil Palm Seed garden, Taraka during 19-23rd July' 2006 to monitor seed production activity and selection of a few more mother palms.
- Visited PCKL, Athirapally.
- Visited Drought experiment at Nellore during 09.05.2006.

Dr. S. Sunitha and Dr. P. Murugesan

- Attended the expert committee meeting at OPIL on 19.06.2006 constituted for suggesting recommendation for improvement of productivity of oil palm at OPIL.

Dr. S. Sunitha

- Visited OPIL estates where they are planning to undertake replanting and given suggestions, and submitted a report justifying the purchase of a JCB for the estates.

Dr. P. Murugesan

- Visited Karinilam Oil Palm scheme, Kallara and Oil Palm seed garden, Thodupuzha as expert Member during October 2006 and reviewed current status and recommended action plan in the form of Technical Report as requested by MD, OPIL

CONFERENCES, SEMINARS, SYMPOSIA, MEETINGS ETC ATTENDED

Dr. M. Kochu Babu, Director; **Dr. P. Kalidas, Dr. M. V. Prasad, Dr. S. Sunitha, Dr. P. K. Mandal, Dr. G. C. Satisha, Dr. K. Suresh** Senior Scientists

- PLACROSYM XVII during 5-8 December 2006 at Kochi

Dr. M. Kochu Babu and Mr. Shinoj Subramannian

- National Seminar on Solid Waste Management in Chemical and Allied Industries during 18-19August, 2006 RVR&JC College of Engineering, Guntur, AP.

Dr. M. Kochu Babu, Dr. P. Kalidas, Dr. R.K. Mathur and Dr. K. Suresh

- National seminar on "Changing Global Vegetable oil Scenario: Issues and Challenges before India held during 29-31 January, 2007 at DOR, Hyderabad.

Dr. M. Kochu Babu, Director

- Meeting with the Chairman of the Working Group constituted by Govt. of India for identification of additional potential areas for Oil Palm cultivation in India

4 April, 2006 at Panjim, Goa

5 April 2006 at Bangalore

21 April, at Aizawl, Mizoram

31 May 2006 at Ahmedabad

20 July 2006 at New Delhi

15th PMC meeting of Oil palm Development Programme of Andhra Pradesh on 27 January 2007 at Hyderabad.

Dr. P. Kalidas

- Brain storming session on "Role of agriculturally important microorganisms in sustainable food and agriculture production" held under the chairmanship of Director General, ICAR on 17 April, 2006 at NBAIM, Mau, Uttar Pradesh
- Invited to give the lead talk in the "National seminar on Environment and development" held at Acharya Nagarjuna University, Guntur on 30 June, 2006
- Regional seminar on "Environmental pollution with special reference to pesticide pollution" held during 27-28 July, 2006 at Vijayawada.
- National seminar on "Organic crop protection for export oriented agri horticulture" held at Chennai during 21-22 November, 2006
- Review meeting on "Oil palm development in Tamil Nadu and suggestions for speedy development of Oil palm in the state" with Director of Agriculture, T.N. in Chennai on 23 January, 2007
- National conference on "Organic waste utilization and ecofriendly technologies for crop protection" held at Hyderabad during 15th to 17th March, 2007.
- Farmers' conference held during March, 2007 in Khammam organized by State

government of Andhra Pradesh

Dr. R. K. Mathur

- First International Conference on "Indigenous Vegetables and Legumes" held at ICRISAT, Hyderabad during 12-15 December 2006.
- Meeting of the Mega Seed Project entitled "Seed Production in Crops and Fisheries" at NAAS, New Delhi during 27-28 June' 2006 and 01-02 March 2007.

Dr. M. V. Prasad

- Seminar on "oil palm" organised by Department of Horticulture, Govt. of A. P. on 10.1.2006 at NRCOP

Dr. P. K. Mandal

- Mid-term review meeting of the wilt network project at IIVR, Varanasi during 23rd July 2006.
- Review meeting of the wilt network project held at TNAU, Coimbatore during 16th-18th October 2006.
- National Symposium on Recent trends in diagnosis and management of chronic and emerging plant diseases at Central Institute for Cotton Research, Nagpur during November 23-24, 2006.
- Second annual review meeting of the wilt network project held at NBPGR, New Delhi during 24th November 2006.
- Workshop on "Data analysis and data mining" on 26th February, 2007 at NAARM, Hyderabad

Dr. P. Murugesan

- Seminar on "Oil Palm cultivation – through precision farming" on 4 January 2007 at Tamil Nadu Rice Research Institute, Aduthurai
- Eighth Agriculture Science Congress held during February 15-17,2007 at Tamil Nadu Agriculture University, Coimbatore

Dr. K. Suresh

- Satellite workshop of NAIP on 22 September 2006 at CPCRI, Kasaragod.

Dr. K. Ramachandrudu

- National Symposium on Ornamental Bulbous Crops held in Meerut during 5-6 December 2006 organized by SVBPUA&T and Indian Society of Ornamental Horticulture.

Dr. Ananta Sarkar

- International Conference on Statistics and Informatics in Agricultural Research (ICSI) of the Indian Society of Agricultural Statistics (ISAS) from 27-30th December, 2006 at Indian Agricultural Statistics Research Institute (IASRI), New Delhi

11. LIST OF ONGOING PROJECTS

Name of Project		Name of PI /Co-PI (S)
IMPROVEMENT		Name of PI and Co-PI(s)
GEN I	Collection, conservation, cataloguing and evaluation of oil palm germplasm	RSN Pillai, RK Mathur, P Murugesan
GEN II	Production, Evaluation and improvement of oil palm hybrids	RK Mathur, RSN Pillai, P Murugesan
GEN IV	Breeding for compact palm and oil quality	RSN Pillai, RK Mathur, PK Mandal P Murugesan
GEN V	Breeding for high yield and drought tolerant oil palm	RK Mathur, RSN Pillai, P Murugesan PK Mandal, K Suresh
GEN VI	Studies on Performance of different oil palm planting materials	RK Mathur
BIO II	Molecular characterization of Oil Palm Germplasm	PK Mandal, RSN Pillai, RK Mathur, P Murugesan, M Jayanthi
RF Scheme	Indigenous production of oil palm hybrid seeds	RSN Pillai
TMOP	Strengthening of seed gardens for indigenous seed production	RK Mathur, P Murugesan, RSN Pillai
AP Cess fund	Acceleration of germination in oil palm	P Murugesan, RSN Pillai, RK Mathur
OPDP Kar	Oil Palm hybrid seed production at Taraka	P Murugesan, RSN Pillai, RK Mathur
OPDP-AP	Oil Palm hybrid seed production at Rajahmundry	RK Mathur, P Murugesan
ICAR network	Seed production of agricultural crops and fisheries	M Kochu Babu, P Murugesan, K Ramachandrudu
DST FT	Development of molecular markers for variety identification in Oil palm	M Jayanthi
New project	Development of tissue culture protocol for oil palm	M Jayanthi, PK Mandal, K Suresh
	CROP PRODUCTION	
AGR II	Fertilizer requirement of Oil Palm during pre-bearing stage	S Sunitha, K Suresh, PT Varghese
AGR IV	Studies on water and nutrient management in Oil palm	K Suresh, VM Reddy
AGR VI	Studies on the mixed farming in the irrigated oil palm plantations of A.P	M Kochu Babu, P Kalidas
AGR VII	Agro-techniques and land use systems for soil, water and nutrient conservation in oil palm plantations of hill slopes	PT Varghese, S Sunitha
AGR VIII	Intercropping of cocoa in oil palm	VM Reddy, K Suresh
BIO III	Biochemical basis for growth and yield in Oil palm	PK Mandal, M Jayanthi
PHY I	Studies on the photosynthetic efficiency, dry matter production and partitioning in different oil palm cross combinations	K Suresh
PHY II	Physiological basis for growth and yield in Oil palm	K Suresh

	Name of Project	Name of PI /Co-PI (S)
AGR IX	Studies on Replanting techniques in Oil Palm	S Sunitha
AGR XII	Fertigation in Oil Palm plantations	VM Reddy, PT Varghese, GC Satisha
New Proj.	Intercropping in bearing oil palm gardens	K. Ramachandrudu
New Proj.	Assessment of fertility status of Oil palm growing areas in India: Nutrient deficiencies and nutrient indexing	GC Satisha, MV Prasad
New Proj.	Recycling of oil palm processing industry wastes into value added organic fertilizer	GC Satisha
TMOP	Studies on nitrogen and potassium management in adult Oil palm- LAL	VM Reddy, K Suresh
	CROP PROTECTION	
PATH II	Studies on diseases of oil palm and their management	M Kochu Babu, PK Mandal
ENT I	Studies on insect pests of Oil palm and their management	P Kalidas
ENT III	Studies on avian and mammalian pests of Oil palm and their mgmt	P Kalidas
ENT IV	Commercial production of green muscardine fungus *Metarhizium anisopliae* for the control of insect pests	P Kalidas
Net work	Wilt of crops with special reference to cultural, morphological, molecular characterization & pathogenic variability of isolates in India	M Kochu Babu, PK Mandal
	POST HARVEST TECNONOLGY	
PHT V	Mechanization in Oil Palm Plantations and farm level processing	Shinoj Subramannian
PHT VI	Utilization of Oil Palm Plantation and industry wastes	Shinoj Subramannian
PHT VII	Development of a grading system for Oil Palm FFB and estimation of factory level OER	Shinoj Subramannian
PHT VIII	Post harvest studies on palm oil	PK Mandal
Cess fund	Utilization and recycling of palm oil mill effluent	M Kochu Babu, Shinoj Subramannian
	TRANSFER OF TECHNOLOGY & COMPUTER APPLICATIONS	
EXT III	Critical analysis of Training of Trainers programme in relation to oil palm growers knowledge and adoption pattern	MV Prasad
EXT IV	Multidisciplinary approaches for TOT and area expansion in relation to oil palm development in India	Director and all scientists
EXT V	Prioritization of research needs in oil palm based on farmers perception	MV Prasad
EXT II-TMOP	Training of Extension, research workers and farmers involved in oil palm production	MV Prasad, PT Varghese
OPDP-Kar	Research cum development project on oil palm in karnataka	M Kochu Babu, PT Varghese, P Kalidas, RK Mathur, MV Prasad
CA I	Oil palm database management system	KL Mary Rani, MV Prasad

Projects sanctioned (with external funding)

Sl. No.	Title of the project	Amount (Lakhs)	Funding source	Remarks
1.	Farmers' awareness campaign on pest problems of cocoa in A.P.	0.50	Directorate of Cashew nut and Cocoa Board, Cochin	Sanctioned to Dr. P. Kalidas

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 facilities offered by NRC for Oil palm are as under:

1. Training Programmes (National and International)

Training programmes in the following areas 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
- Techno - advisory services
- Setting up of oil palm nurseries and their management
- Plant health centre for Pest & Disease management
- Project evaluation and management

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
- Lab and field evaluation of fertilizers, herbicides, agro-chemicals/plant protection chemicals 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

5. Consultancy in Oil palm processing

National Research Centre for Oil Palm provides consultancy on design and installation of mini palm oil mills, feasibility study reports on installation of palm oil mills of any capacity, pilot plants for extraction of fibres from oil palm empty fruit bunches, pilot plants for making value added products from natural fibres extracted from oil palm EFB, mobile plantation waste shredding units, estimation of Oil Extraction Ratio (OER) in Palm oil mills, study reports on improving OER in Palm Oil Mills, feasibility study reports on appropriate technology for disposal of oil palm plantation and mill wastes

6. Consultancy services taken up:

Consultancy training programme was organized on “Oil palm Production Technology” to 25 officers belonging to M/s AP Oil Fed, Andhra Pradesh, M/s Godrej Agrovet Ltd., Mizoram and M/s Foods, fats and Fertilizers Ltd., Mizoram during February 2007.

Entered into the agreement for advisory consultancy services with M/s. Bala Balaji oil farms (is in processing stage).

13. Major Decisions of RAC, SRC, IMC and IJSC

Quinquennial Review team (QRT)

Quinquennial Review Team (QRT) to review the work done by the National Research Centre for Oil Palm, Pedavegi during the period from 1.4.2001 to 31.3.2006 was constituted during 2006.

Composition of QRT

Dr. K. V. Peter, — Chairman
Former Vice-Chancellor,
KAU, Thrissur, Kerala

Dr. Srikant Kulkarni, — Member
Professor & Head, Dept. of Plant Pathology,
UAS, Dharwad,

Dr. Alapati Satyanarayana, — Member
Former Dir. of Extn.,
ANGRAU, Hyderabad

Dr. H.Hameed Khan — Member
Former Project Coordinator (Palms)
Coimbatore

Dr. K. John Thomas, — Member
Former Dean,
KAU, Thrissur

Dr. P.Kalidas , — Member Secretary
Sr. Scientist, NRCOP

First review meeting of the QRT (2001-06) was organized at NRCOP Pedavegi during 26-28 October, 2006. Second review meeting was organized at Palode during 21 - 23 December 2006. Third review meeting was organized during 22-23 January 2007 at Trichy, Tanjore and Chennai.

Research Advisory Committee

Composition of Research Advisory Committee

Dr.K.L.Chadha, — Chairman
Former DDG(Hort.)
ICAR,New Delhi

Dr.A.K.Vashishta, — Member
Director General and Advisor,
Bharat Institute of Technology, Meerut U.P Member

Dr.D.R.Sharma, — Member
Professor & Head,
Dept.of Bio technology ,Nauni,Solan H.P

Dr.A.N.Mukhopadhyay, — Member
Ex - Vice Chancellor, A.A.U. Jorhat, Lucknow U.P

Dr.Vikraman Nair, Member
Dean, (Retd.)
Agril.College, Vellayani, Trivandrum

Asst.Director General (PC), Member
ICAR , New Delhi.

Director,
NRC Oil Palm,Pedavegi , A.P Member

Dr.P.Thomas Verghese, Member Secretary
Principal Scientist ,
NRC OP RS, Palode Trivandrum

The seventh Research Advisory Committee meeting was held on 3rd May, 2006 at NRCOP, Pedavegi. Dr. K. L. Chadha, Chairman of RAC, Dr. R. Vikraman Nair, Dr. D.R. Sharma, Dr. K. V. Ramana, Dr. M. Kochu Babu, Dr. P. Thomas Varghese are the other members who attended the meeting. Dr. K. L. Chadha in his inaugural address appreciated the overall progress made at the center. He advised the scientists to make long term planning of their requirements in terms of infrastructure, equipment etc during the XI five year plan period to enable the committee review and recommend the same. He urged the scientists to continue the work with the same tempo for achieving the fixed targets envisaged in the mandate of the center. Other observations/ recommendations made by the chairman and members of the committee have been summarized discipline wise for implementation by the respective team leaders.

STAFF RESEARCH COUNCIL MEETING

The Ninth Staff Research Council meeting was held from 4-6th May, 2006 at Pedavegi. The inaugural session was chaired by Dr. K. V. Ramana, ADG (PC) and the plenary session was chaired by Dr. K. L. Chadha. Dr. D. R. Sharma, Dr. R. Vikraman Nair, Dr. S. Sitaramaiah, Principal Scientist (Retd.), CTRI, Dr. V. G. K. Rao, Professor (Retd.) EEI, Hyderabad, Dr. R. Viswanathan, TNAU, Coimbatore chaired the Crop Improvement, Crop production, Crop protection, Transfer of Technology and Post harvest technology sessions respectively.

INSTITUTE MANAGEMENT COMMITTEE

Composition

Dr. M. Kochu Babu, Chairman
Director, NRCOP, Pedavegi

Mr. S. Gopala Reddy, Non official Member
Nellore, A.P

Mr. Vinaka Rao Patil, Non official Member
Nasik, Maharashtra

Mr. V.S. Subramanian, Member
F& AO, NAARM, Hyderabad

Dr. B. Rosaiah, Member
Director of Research,
ANGRAU, Anakapalli

Mr. Ikram Ullah Mahmood, Member
Addl. Dir. of Hort.,
Govt. of Karnataka, Bangalore

Dr. P. Gopala Sundaram, Member
Pr. Scientist, S.B.I. Coimbatore

Dr. V. Krishna Murthy, Member
Director, CTRI, Rajahmundry

Dr. K.V. Ramana, Member
Asst. Director General (PC),
ICAR, New Delhi

D. S. Chander Rao, Member
Sr. Scientist, DOR, Hyderabad

Mr. Jagdeshwar Reddy, State Representative
Addl. Dir. of Hort.(Oil Palm)
Govt. A.P., Hyderabad

Dr. R.K. Mathur, Member
Senior Scientist, NRCOP, Pedavegi

Mr. B. Satish, Member Secretary
AAO, NRCOP, Pedavegi

Mr. T.D.S. Prakash, Co-opted Member
AFA&O, NRCOP, Pedavegi

INSTITUTE JOINT STAFF COMMITTEE

Composition

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	Member
A.F.A.O	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

The first meeting of the newly constituted IJSC was held on 20th April, 2006.

14. Workshops, Seminars, Summer Institutes, Farmers' Day and other meetings organised

SEED MEET 2006

Interface meeting on production and supply of indigenous oil palm hybrid seeds for the year 2007-08 was organised on December 21, 2006 at NRCOP, Regional station, Palode. All the seed garden officials, entrepreneurs, scientists and other officials attended the meeting.

FOUNDATION DAY CELEBRATION

Twelfth foundation day of the institute was celebrated on 19th February. Dr. P. Rethinam, Founder Director of the institute was the chief guest.

15. Official Language Implementation Cell 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 2006 - 07 की अवधि में निदेशक महोदय की अध्यक्षता में केन्द्र की राजभाषा कार्यान्वयन समिति की त्रै मासिक बैठकें नियमित रूप से बुलाई गई। 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 आयाजित 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।

16. LIST OF DISTINGUISHED VISITORS

May 03, 2006	Dr. K.L. Chadha, Former DDG(Hort.), ICAR and Chairman of the RAC.
	Dr. R. Vikraman Nair, Retd. Director of Research, Kerala Agricultural University, Vellanikkara.
	Dr. D.R. Sharma, Professor and Head, Department of Biotechnology, YS Parmar University of Horticulture and Forestry, Solan.
	Dr. K.V. Ramana, Asst. Director General (PC), ICAR, Krishi Anusandhan Bhawan-II, New Delhi-12.
May 06, 2006	Dr. S. Sitaramaiah, Retd. Principal Scientist, CTRI, Rajahmundry.
	Dr. V.G.K. Rao, Retd. Professor, Extension Education Institute, Hyderabad.
	Dr. R. Viswanathan, Professor, Tamil Nadu Agricultural University, Coimbatore.
26-28 Oct. 2006	Dr. K.V. Peter, Former Vice Chancellor, Kerala Agricultural University, Vellanikkara.
	Dr. Srikant Kulkarni, Professor and Head, Department of Plant Pathology, University of Agricultural Sciences, Dharwad.
	Dr. Alapati Satyanarayana, Retd. Director of Extension, ANG-RAU, Hyderabad.
	Dr. Hameed Khan, Retd. Project Coordinator (Palms), CPCRI, Kasaragod.
	Dr. John Thomas, Retd. Dean, Kelappaji College of Agricultural Engineering, Kerala Agricultural University, Vellanikkara.
January 25, 2007	Sri Sanjay Kumar, I.F.S., Chief Conservator of Forests, Ministry of Environment and Forests, Govt. of India, New Delhi.

17. Personnel

RMP

Dr. M. Kochu Babu Director

STAFF POSITION AT HEAD QUARTERS - PEDAVEGI

Scientific Staff

Dr. P. Thomos Varghese Pr. Scientist (Agronomy) (till 18 July, 2006)
Dr. V.M. Reddy Pr. Scientist (Agronomy)
Dr. P. Kalidas Sr. Scientist (Ag. Entomology)
Dr. R.K. Mathur Sr. Scientist (Plant Breeding)
Dr. M.V. Prasad Sr. Scientist (Ag. Extension)
Dr. P.K. Mandal Sr. Scientist (Bio-Chemistry)
Dr. P. Murugesan Sr. Scientist (Seed Technology) (till 24 June, 2006)
Dr. K. Suresh Sr. Scientist (Plant Physiology)
Dr. G. C. Satisha Sr. Scientist (Soil Science) (from 14 July, 2006)
Dr. M. Jayanthi Sr. Scientist (Biotechnology) (from 1 August, 2006)
Dr. K. Ramachandrudu, Scientist Sr. Scale (Horticulture) (from 19 April, 2006)
Mrs. K.L. Mary Rani Scientist Sr. Scale (Computer Applications) on study leave
Er. Shinoj Subramannian Scientist (AS&PE)
Dr. Ananta Sarkar Scientist (Agril. Statistics) (from 25 September, 2006)

Administrative Staff

Sri B. Satish Assistant Administrative Officer
Sri T.D.S. Prakash Assistant Finance & Accounts Officer
Sri K.V.V.S. Narayana Private Secretary
Sri K.S.N.D. Mathur Assistant
Sri P. Gowrishankar Assistant
Mr. T.V. Rama Krishna Personal Assistant
Mr. K. Ravindran Upper Division Clerk
Mr. A. Lakshmana Rao Lower Division Clerk
Mr. Dharma Raju Lower Division Clerk

Technical Staff

Mr. B. Parthasaradhi T-5
Mr. V. G. Sasidharan T-5
Mrs. A. Bhanusree T-4
Mr. K. V. Rao T-4
Mr. J. Mohan Rao T-II-3
Mr. M. Ananda Rao T-2
Mr. V.V.S.K. Murthy T-2
Mr. Ch. Subba Raju T-2 (Driver)
Mr. P.R.L. Rao T-2 (Driver)
Mr. E. Perayya T-2 (Driver)
Mr. A. Papa Rao T-1 (Tractor Driver)
Mr. M. Rambabu T-1

Supporting Staff

Mr. K. Ananda Rao SS Gr.II

Mr. G. Raju SS Gr.II
Mr. I.V. Sundar SS Gr.II
Mr. G. Venkateswara Rao SS Gr.II
Mr. A. Dhana Raju SS Gr.II
Mr. A. Joji Showri SS Gr.II
Mr. U. Rama Rao SS Gr.II
Mr. A. Ganga Raju SS Gr.II
Mr. S. John SS Gr.II
Ms. Y. Chaitanya SS Gr.I
Mr. S.K. Saida SS Gr.I
Mr. A. Nagarjuna Rao SS Gr.I
Mr. G.S.N. Babu SS Gr.I
Ms. N.V.V. Sathya Lakshmi SS Gr.I
Mr. K. Satyanarayana SS Gr.I
Mr. Ch. Venkata Durga Rao SS Gr.I
Mr. M. Appa Rao SS Gr.I (from 18 August, 2006)
Mr. B. Gopala Krishna SS Gr.I (from 22 December, 2006)

STAFF POSITION AT NRCOP, REGIONAL STATION, PALODE

Scientific Staff

Dr. R.S.N. Pillai Pr. Scientist (Plant Breeding) (till June 2006)
Dr. (Mrs.) S. Sunitha Sr. Scientist (Agronomy)
Dr. P. Murugesan Sr. Scientist (Seed Technology) (from 25 June, 2006)

Administrative staff

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

Technical Staff

Mrs. N. Sujatha Kumari T-6
Mrs. I.C. Rajamma T-5
Mr. C.K. Devadathan T-5
Mr. V. Sunil Duth T-2
Mr. K. Soman T-3
Mr. B. Muralidharan Pillai T-1

Supporting Staff

Mr. G. Rajappan SS Gr. II
Mrs. N. Indira SS Gr. II
Mrs. A. Radha SS Gr. II
Mrs. M. Rebecca SS Gr. II
Mrs. A. Raceena SS Gr. II
Mr. H. Dasan SS Gr. II
Mr. P.K. Rethnakaran SS Gr. II
Mr. S. Sudhakaran Nair SS Gr. II
Mr. P. Anil Kumar SS Gr. II
Mrs. P. Rema SS Gr. II
Mr. C. Ravi SS Gr. II

18. METEOROLOGICAL DATA

Meteorological Data of R. S. Palode (2006-2007)

	Max. temp (0 C)	Min. temp (0 C)	Total rainfall (mm)	No. of rainy days	Pan evaporation (mm)	Relative humidity (%)
Apr-06	28.09	25.21	156.4	17	1.94	85.5
May	28.27	23.18	408.8	21	1.55	88.87
June	27.25	24.33	188.6	19	1.76	86.73
July	26.41	21.42	306.4	28	1.33	90.42
Au	26.20	23.51	203.4	22	1.57	89.68
Se	26.73	23.10	399.4	28	1.41	90.97
Oct	25.99	23.37	666.4	29	1.2	92.13
Nov	26.02	23.49	299.2	27	1.32	91.2
Dec	26.55	22.84	14.60	19	2.2	77.42
Jan-07	27.40	23.01	5.80	16	2.54	72.35
Feb	27.16	23.72	41.60	8	2.635	74.11
March	28.22	25.11	207.6	15	2.64	78.13

General Activities

Independence Day Celebration

Republic Day Celebration

Dr. P.K. Mandal won Silver Medal in long jump in the ICAR Zonal sports 2006-07

Sports contingent