# वार्षिक प्रतिवेतन ICAR-AICRP on Palms ANNUAL REPORT 2023



RCOP

भा.कृ.अनु.प. - अखिल भारतीय समन्वित ताड़ अनुसंधान परियोजना भा.कृ.अनु.प. - केंद्रीय रोपण फसल अनुसंधान संस्थान कासरगोड़, केरल, भारत - 671 124 ICAR- ALL INDIA COORDINATED RESEARCH PROJECT ON PALMS ICAR-Central Plantation Crops Research Institute KASARAGOD, KERALA, INDIA - 671 124



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# I. PREFACE

Plantation crop sector play a vital role in providing livelihood, national economy and contributes significantly to the foreign exchequer owing to its domestic and global importance. A plantation is the large-scale estate meant for farming that specializes in cash crops. The term plantation crop refers to those crops which are cultivated on an extensive scale in contiguous area, owned and managed by an individual or a company. These are high value commercial crops of greater economic importance and play a vital role in improving economy, especially in view of their export potential, employment generation and poverty alleviation in rural sector. More than 25 million people in rural areas are engaged in the production, processing and marketing the products of these crops.

The All India Coordinated Research Project on Palms started functioning from 1972 with the objective of conducting location-specific research in the mandate crops. Presently, the project has coconut, oil palm, arecanut, palmyrah and cocoa as mandate crops. It is implemented in 28 centres across the contry. The notable achievements made during 2023 are given in this annual report.

Among five Tall x Tall coconut cross combinations planted during 2011 at Aliyarnagar centre, the hybrid, BGR x ADOT recorded the highest yield (78 nuts/palm/year), which was on par with WCT x TPT (61 nuts / palm / year). In the evaluation trial of five coconut Dwarf x Dwarf cross combinations planted during 2011 at Veppankulam centre, the nut yield varied from 55.60 to 97.00 nuts in COD and GBGD x MOD respectively. The tender nut volume was higher in GBGD x MOD (603.83 ml /nut). Assuming 175 palms per hectare, the tender nut yield was higher in GBGD x MOD (10,250 litres) when compared to COD (3,175.97 litres). Two cocoa varieties recommended for released viz., VTLCH 1 for Kerala, Tamil Nadu and Karnataka & VTLCH 2 for Kerala, Andhra Pradesh, Karnataka and Gujarat. Integration of coconut with pasture crops (*Cumbu Napier hybrid* + *Desmanthus*), fodder trees (*Sesbania grandiflora* + *Leucaena leucocephala* + *Glyricidia*) and Tellicherry breed of goats recorded net income of Rs. 2,54,206/- per ha with BC ratio of 3.16 as compared to Rs. 1,51,312/- per ha with BC ratio of 2.25 in the monocrop of coconut at Aliyarnagar centre.

The XXXII Annual Group Meeting of All India Coordinated Research Project on Palms was organized at HRS, Kahikuchi, AAU Jorhat, during 13-15<sup>th</sup>, September 2023 to review the work carried out during 2022-23. During the year, different centres involved in ToT activities such as on-farm, off-farm trainings, kisan melas, exhibitions, diagnostic field visits and coverage through press and media. The Scheduled Caste Sub Plan (SCSP) was implemented to benefit and improve their livelihood security in targeted states. The budget for the year 2023 (January -December) was Rs. 735.57 lakhs.

I consider it a privilege to express my sincere gratitude to Dr. Himanshu Pathak, Secretary, DARE and Director General, ICAR for his constant support for the project. I would like to record my sincere gratitude to Dr. S. K. Singh, DDG (Hort. Sci.) and Dr. V.B. Patel ADG (F & PC), ICAR, New Delhi for their support and guidance. I record my gratefulness to Dr. K.B. Hebbar, Director, ICAR - CPCRI, Kasaragod, Dr. K. Suresh, Director, ICAR-IIOPR, Pedavegi for their constant support. The efforts made by all the nodal officers from ICAR -CPCRI, scientific and other staff of the coordinating centres in execution of various activities is well appreciated. The support and coordination of Dr. Sumitha S (Scientist), Smt. K. Narayani (Private Secretary) of AICRPP Cell for bringing out this report is highly appreciated.

1 20/03/224

**Dr. B. Augustine Jerard** Project Coordinator (Palms)

Date : 30-03-2024 Place : Kasaragod





# Varieties recommended for the release at XXXII AGM from AICRP trials







# II. कार्य सारांश

भारत में अखिल भारतीय समन्वित ताड़ अनुसंध ाान परियोजना का कार्य 1972 से षुरू हुआ, जिसका मुख्य उद्देष्य स्थान विषिश्ट अनुसंधान करना है। वर्तमान में, इस परियोजना में नारियल, तेल ताड (ऑइल पाम), सुपारी, पॉमेरा और कोको को इसके अधिदिश्ट फसल के रूप में षामिल किया गया है जिसे 28 केंद्रों पर क्रियान्वित किया जा रहा है। अखिल भारतीय समन्वित् ताड़ अनुसंध ाान परियोजना अंतर्गत नारियल के पंद्रह, तेल ताड़ के छह, सुपारी के चार, पॉमेरा के चार और कोको के सात अनुसंधान केंद्र संचालित हैं जिनका मुख्यालय भाकृ अनुप– केंद्रीय रोपण फसल अनुसंधान संस्थान, कासरगोड में स्थित है। इसके समन्वित केंद्र 14 राज्यों और एक केंद्र षासित प्रदेष में स्थित हैं, जिसमें 13 राज्य कृ शि/उद्यानिकी विष्वविद्यालय, एक केंद्रीय कृशि विष्वविद्यालय और चार भाकृअनुप संस्थान षामिल हैं। वर्श 2023 (जनवरी से दिसंबर) के लिए अनुसंधान हेत् वित्तीय प्रावधान 681 लाख रुपये था। इस योजना को संबंधित राज्य कृशि/उद्यानिकी विष्वविद्यालयों के माध यम से 75:25 के अनुपात पर क्रियान्वित किया जाता है, जिसमें 75 प्रतिषत हिस्सा भाकृअनुप का तथा 25 प्रतिषत हिस्सा राज्य कृशि / उद्यानिकी विष्वविद्यालयों का होता है। केंद्रीय कृशि विष्वविद्यालयों और भाकृअनूप संस्थानों के केंद्रों को 100 प्रतिषत वित्तीय प्रावधान भारतीय कृशि अनुसंधान परिशद से प्राप्त होता है।

# अनुसंधान उपलब्धियां

## फसल सुधार

- वर्श 2011 में अम्बाजीपेट केंद्र द्वारा लगाए गए ड्वार्फ × ड्वार्फ संयोजन में सीओडी × एम्जीडी का प्रति पेड़ प्रति वर्श 84.29 नारियल तथा प्रति नारियल 447 मि.ली. डाब पानी के साथ 7000 लीटर / हेक्टेयर डाब पानी की उच्चतम मात्रा दर्ज की गई।
- रत्नागिरी केंद्र से वर्श 2022–23 में 13 वर्शों की आयु में सीओडी × एम व्हाई डी के संयोजन से 91.
   58 नारियल प्रति पेड़ प्रति वर्श की उच्चतम औसत वार्शिक कोमल नारियल उपज तथा 458.13 मि. ली. प्रति नारियल डाब पानी के साथ 7340.14 लीटर / हेक्टेयर कोमल डाब पानी की उच्चतम मात्रा दर्ज की गई।

वेप्पनकुलम केंद्र से 13 वर्शों की आयु में जीबीजीडी × एमओडी हाइब्रिड ने 98 नारियल प्रति पेड़ प्रति वर्श की उच्चतम औसत उपज दर्ज की, जो सीओडी नामक प्रचलित किस्म की तुलना में 50.82 प्रतिषत अधिक थी। इसमें प्रति हेक्टेयर 9746 लीटर कोमल डाब पानी की अधिकतम मात्रा भी दर्ज की गई ।

- भुवनेष्वर केंद्र द्वारा स्थान विषिश्ट संकरण में एस के एल × जीबीजीडी हाइब्रिड ने प्रति पेड़ प्रति वर्श 137 नारियल की अधिक उपज तथा प्रति नारियल 455 मि.ली. कोमल डाब पानी के साथ कुल 5.28 घुलनषील ठोस पदार्थ की मात्रा दर्ज कराई। इस हाइब्रिड में प्रति नारियल 192.35 ग्राम कोपरा और 66.28 प्रतिषत तेल की मात्रा पायी गई। यह प्रचलित किस्म सखिगोपाल लोकल की तुलना में 24.75 प्रतिषत अधिक उपज और 34.63 प्रतिषत अधिक कोपरा की मात्रा प्रदान करता है।
- वेप्पनकुलम केंद्र द्वारा तीन संरक्षित नारियल किस्म में गुलाबी हस्क की एक नई विषेशता देखी गई। चयन प्रक्रिया के माध्यम से इनकी प्रोजेनी उत्पन्न की गई एवं भाकृअनुप – राश्ट्रीय पादप आनुवंषिक संसाधन ब्यूरो के माध्यम से अलग आई सी नंबर प्राप्त किए गए।

## फसल उत्पादन

- नारियल–आधारित कृशि प्रणालियों के विकास हेतु तीन केंद्रों में दो प्रयोग किए गए, जिनमें नारियल के साथ पषु घटक एकीकरण के प्रभाव का मूल्यांकन किया गया। अलियारनगर एवं वेप्पनकुलम केंद्रों में नारियल के साथ बकरियों को जोड़ा गया जबकि रत्नागिरी केंद्र में नारियल के साथ मुर्गी पालन का समन्वय किया गया। केंद्रों के परिणामों से यह ज्ञात हुआ कि पषु घटक को नारियल के साथ जोड़ने से नारियल उत्पादन, षुद्ध लाभ और लाभ–लागत अनुपात में सकारात्मक प्रभाव पड़ता है। एकीकृत कृ शि प्रणाली में मृदा उर्वरता और ऊर्जा लाभप्रदता अधिक थी, जबकि कीट और रोग की घटनाएं कम थीं। प्रयोग में ग्रीनहाउस गैस उत्सर्जन का नकारात्मक प्रभाव पाया गया, जिससे यह पारिस्थितिक रूप से सुरक्षित साबित हुआ।
- तटीय रेतीली मिट्टी में नारियल–आधारित बहु–प्रजाति फसल प्रणाली का मूल्यांकन किया गया। इस प्रयोग में नारियल + गार्सिनिया इंडिका + अनानास

फसल प्रणाली में अनुषंसित पोशक तत्व अनुप्रयोग के साथ अधिकतम नारियल उत्पादन दर्ज किया गया। भुवनेष्वर केंद्र में नारियल + गार्सिनिया इंडिका + अनानास फसल प्रणाली के लिए अधि कितम षुद्ध लाभ <sup>1</sup> 4,63,857 / हेक्टेयर प्राप्त हुआ, जो हरित खाद, जैव उर्वरक, जैविक पुनर्चक्रण और मृदा परीक्षण आधारित पोशक तत्व अनुप्रयोग (रासायनिक उर्वरक) उपचार के साथ किया गया था। दूसरी ओर नारियल के एकल फसल प्रणाली (मोनोक्रॉप) के लिए केवल <sup>1</sup> 60,250 का लाभ दर्ज किया गया। C<sub>S2N3</sub> प्रणाली अपनाने पर सबसे उच्च लाभ-लागत अनुपात (2.38) प्राप्त हुआ।

 चार केंद्रों पर नारियल की जैविक खेती पर प्रयोग किया गया। जिसमें T4 उपचार (स्थानीय जैव पदार्थ पुनर्चक्रण + पी जी पी आर समूह + स्थानीय हरी खाद + 25 किग्रा गोबर + हस्क ब्यूरिअल + 50 प्रतिषत अनुषंसित मात्रा के रूप में सल्फेट ऑफ पोटाष) का उपयोग करते हुए सबसे अधिक प्रणाली उत्पादकता और लाभप्रदता प्राप्त की गई।

#### फसल संरक्षण

 फसल संरक्षण एवं कीट नियंत्रण के लिए कुल 1726600 Bracon hebetor, 846476 G nephantidis, 44000 Encarsia guadeloupe, 34000 Pimbrues, 242 Tricho card और 346500 P astur के अंडे तमिलनाडु, आंध्र प्रदेष, कर्नाटक और रत्नागिरी के किसानों को वितरित किए गए। प्रभावित क्षेत्रों से नारियल के पत्ते या टहनी एकत्र की गई, जिसमें परजीवी पुपरिया मौजूद थे और उन्हें नए संक्रमण क्षेत्रों में छोडा गया।

#### तेल ताड़

- मूल्यांकन किए गए 10 संकरों में से विजयराय केंद्र
  में NRCOP 37 (पेडावेगी 1) हाइब्रिड ने 19.9
  किग्रा / गुच्छे का वजन और प्रति पेड़ प्रति वर्श 10.
  7 गुच्छे के साथ प्रति हेक्टेयर 29.69 टन ताजे फलों का गुच्छा प्राप्त किया ।
- पट्टुक्कोट्टई केंद्र में NRCOP 9 (पेडावेगी 2) हाइब्रिड ने 20.20 किग्रा / गुच्छे का वजन और प्रति पेड़ प्रति वर्श 10.60 गुच्छे के साथ 30.62 टन / हेक्टेयर ताजे फलों के गुच्छे की उपज दर्ज की, जिसमें 21. 50 उच्च तेल की मात्रा पाई गई।

#### कोको

 अखिल भारतीय समन्वित् ताड़ अनुसंधान परियोजना के अंतर्गत कोको जीनोटाइप्स का मूल्यांकन 7 केंद्रों

# Annual Report 2023

में किया जा रहा है, जो पष्टिमी तट, पूर्वी तट और उत्तर—पूर्वी क्षेत्रों को कवर करते हैं। इनमें सुपारी, नारियल और तेल ताड़ के बागों के विभिन्न फसल प्रणालियां षामिल हैं। 12—वर्शीय परीक्षण के अनुसार कासरगोड (केरल), अंबाजिपेटा (आंध्र प्रदेष) और वेप्पनकुलम (तमिलनाडु) केंद्रों में VTLCH—2 और VTLCH—1 को क्रमषः नारियल की छाया में सर्वश्रेश्ठ प्रदर्षन करने वाले जीनोटाइप्स के रूप में पहचाना गया है। अलियारनगर (तमिलनाडु), रत्नागिरी (महाराश्ट्र) और काहिकुची (असम) में 8—वर्शीय परीक्षण द्वारा VTLCP—16, VTLC—17, और VTLC—20 को क्रमषः सर्वश्रेश्ठ प्रदर्षन करते हुए पाया गया। जबकि विजयराय (आंध्र प्रदेष) में तेल ताड़ की छाया में VTLC-57 को उच्चतम उपज देने वाला जीनोटाइप पाया गया।

### पॉमेरा

- ताजे नीरा को 10 प्रतिषत या अधिक माल्टोडेक्सट्रिन के साथ फ्रीज ड्राइंग करने पर एक ऐसा सैप पाउडर प्राप्त होता है, जो कमरे के तापमान पर स्थिरता बनाए रखता है और उत्कृश्ट घुलनषीलता प्रदान करता है। पानी मिलाकर इसे आसानी से पुनः हाइड्रेट किया जा सकता है, जिससे यह अपनी मूल विषेशताओं में वापस आ जाता है। यह पाउडर फलों और सब्जी उत्पादों के लिए वर्तमान कानूनी मानकों को पूरा करता है, जिसमें नमी का मान 5.
   0 प्रतिषत से कम है।
- पॉमेरा नीरा कंसंट्रेट (PNC) अथवा पॉमेरा सिरप को 90 प्रतिषत सापेक्षिक आर्द्रता और 40°C पर त्वरित भंडारण के दौरान 90 दिनों तक बिना भौतिक और रासायनिक गुणों पर प्रभाव डाले, ग्लास बोतल में संग्रहीत किया जा सकता है।
- पॉमेरा कंद स्टार्च का सस्ता और समष्द्व स्रोत है। प्राकृतिक स्टार्च को संषोधित करके विषेश गुणों वाले उत्पाद तैयार किए गए हैं, जिनका उपयोग इंस्टेंट सूप को गाढ़ा करने वाले एजेंट के रूप में किया जा सकता है।
- पॉमेरा फल के गूदे से निश्कर्शित किये गए पेक्टिन की उपज और विषेशताएं अन्य स्रोतों से निकाले गए पेक्टिन के बराबर पायी गयी जिसमें पेक्टिन की मात्रा 5.8 प्रतिषत से 20.4 प्रतिषत तक प्राप्त की गई।

## आयोजित बैठकें

अखिल भारतीय समन्वित् ताड़ अनुसंधान परियोजना की 32वीं वार्शिक समूह बैठक 13 सितंबर



2023 को असम कृशि विष्वविद्यालय, जोरहाट के तहत काहिकूची में उद्यानिकी अनुसंधान स्टेषन में आयोजित की गई। इस बैठक का उद्घाटन डॉ. वी. बी. पटेल (सहायक महानिदेषक, फल और बागवानी फसलें, आईसीएआर, नई दिल्ली) की अध्यक्षता में हआ। इस कार्यक्रम के मुख्य अतिथि डॉ. एन. के. मोहन, (माननीय सदस्य, कृशि आयोग, असम सरकार) थे। उद्घाटन सत्र में निम्नलिखित गणमान्य व्यक्तियों ने भाग लिया – डॉ. के. बी. हेब्बार, निदेषक, भाकुअनुप – केंद्रीय रोपण फसल अनुसंधान संस्थान, कासरगोड ; डॉ. के. सुरेष, निदेषक, आईआईओपीआर, पेडावेगी; डॉ. आर. के. माथूर, निदेषक, भाकृअनुप– आई आई ओ आर, हैदराबाद; डॉ. वी. वेंकटसुब्रमण्यम, निदेषक, भाकृअनुप– अटारी, बेंगलुरु; डॉ. जी. काथिरवेल, निदेषक, भांकृअनुप– अटारी, गुवाहाटी; डॉ. डी. प्रसाथ, परियोजना समन्वयक (मसाले), भाकृ अनूप– आई आई एस आर, कोरीकोड। इसके अतिरिक्त, डॉ. के. यू. के. नामबूथिरी और डॉ. पी. चौडप्पा (पूर्व निदेषक, भाकृअनुप – केंद्रीय रोपण फसल अनुसंधान संस्थान) ने आमंत्रित विषेशज्ञों के रूप में भाग लिया। डॉ. एम. सैकिया, अनुसंधान निदेषक, असम कृशि विष्वविद्यालय, जोरहाट ने सभी गणमान्य व्यक्तियों का स्वागत किया।

डॉ. बी. ऑगस्टीन जेरार्ड (परियोजना समन्वयक, पाम्स, भाकृअनुप– केंद्रीय रोपण फसल अनुसंधान संस्थान, कासरगोड) ने अपनी रिपोर्ट में 1972 से की गयी इस परियोजना के स्थापना से लेकर 15 राज्यों के 28 केंद्रों के साथ साथ केंद्र षासित प्रदेषों में फैले हुए पांच अधि ादिश्ट फसलों (नारियल, तेल ताड़, पॉमेरा, सुपारी और कोको), के मिषन का विवरण प्रस्तुत किया। 16–18 सितंबर 2022 के दौरान 31वीं वार्शिक बैठक में नारियल की तीन बेहतर किस्मों (द्वीप सोना, द्वीप हरिता और कल्प वज्र) को केंद्रीय उप–समिति द्वारा अधिसूचित करने के लिए सिफारिष की गई थी। इन प्रस्तावों को संबंधित केंद्रों ने केंद्रीय उप-समिति में जमा किया है और ये विभिन्न स्तरों पर विचाराधीन हैं। बैठक में तीन प्रमुख तकनीकों पर चर्चा की गईः बौने नारियल की खेती के लिए समग्र पोशक तत्व प्रबंधनय नारियल में पत्ते के झुलसा रोग का प्रबंधन एवं नारियल बागों में सुपारी का अंतरफसल विकल्प। वित्तीय वर्श 2022–23 के दौरान कुल बजट व्यय <sup>1</sup>681 लाख था। तकनीकी कार्यक्रम और उप-केंद्रों में बजट उपयोग की निगरानी के लिए नोडल केंद्र द्वारा समय समय पर समीक्षा बैठकें आयोजित की गईं ।

नारियल की टाल × टाल और ड्वार्फ × ड्वार्फ हाइब्रिड्स का विकास एवं मूल्यांकन, नारियल–आधारित बहु–प्रजाति फसल प्रणालियाँ, स्थान–विषिश्ट एकीकृत कृशि प्रणाली मॉडल, नारियल में ब्लैक हेडेड कैटरपिलर

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के नियंत्रण के लिए जैविक एजेंट का प्रयोग, सुपारी में क्राउन चोक रोग का प्रबंधन एवं नारियल बागों में अंतर फसल के लिए सर्वश्रेश्ठ प्रदर्षन करने वाले कोको क्लोन (VTLCH–1 और VTLCH–2) की पहचान इस परियोजना की प्रमुख उपलब्धियों में था जिसने क्षेत्रीय अनुसंधान और उन्नति में महत्वपूर्ण भूमिका निभाई है। प्रयोगषाला से भूमि तक कार्यक्रम के प्रभावी हस्तांतरण और राज्य–स्तरीय क्षेत्रों की यात्रा इस कार्यक्रम की प्रमुख ताकत रही है।

डॉ. वी. बी. पटेल के अध्यक्षीय संबोधन में उन्होंने अखिल भारतीय समन्वित् ताड़ अनुसंधान परियोजना के अंतर्गत कार्य कर रहे वैज्ञानिकों को उनके उत्कृश्ट कार्य के लिए बधाई दी। उन्होंने भारत सरकार की दृष्टि पर जोर दिया, जिसमें आयात को कम करना और बागवानी फसलों तथा उत्पादों के निर्यात को अधिकतम करना षामिल है। साथ ही साथ उन्होंने पॉमेरा से निकाले गए नीरा को संरक्षित करने के लिए तकनीकों पर ध्यान केंद्रित करने की आवष्यकता को रेखांकित किया। अखिल भारतीय समन्वित् ताड़ अनुसंधान परियोजना के 50 वर्शों के अनुसंधान को चिह्नित करने के लिए ''तकनीकों का संग्रह'' और ''प्रभावी प्रौद्योगिकियों की सफलता की कहानियां" प्रकाषित करने का सुझाव दिया। उन्होंने वैज्ञानिकों से 2047 तक भारत को विकसित राश्ट्र बनाने में पाम सेक्टर के माध्यम से योगदान देने का आग्रह किया।

मुख्य अतिथि डॉ. एन. के. मोहन के विषेश संबोध ान में उन्होंने उत्तर—पूर्व क्षेत्र में बागवानी क्षेत्र की समष्द्व जैव विविधता और भारत में ब्रिटिष षासन द्वारा पहले चाय बागान की स्थापना का उल्लेख किया। उन्होंने अहोम राजाओं के 12वीं—18वीं सदी के दौरान दक्षिण—पूर्व एषिया से नारियल और सुपारी को भारत में लाने के योगदान को भी रेखांकित किया। उन्होंने बताया के किस प्रकार स्वतंत्रता के बाद नारियल और सुपारी की बढ़ती जरूरतों के मद्देनजर ब्रह्मपुत्र के दक्षिणी किनारे और हरवाई (असम) में अनुसंधान केंद्रों की स्थापना का मार्ग प्रषस्त हुआ है । साथ हे साथ उन्होंने इन अनुसंधान केंद्रों को बागवानी क्षेत्र की चुनौतियों से निपटने और मल्टी—टियर फसल प्रणाली जैसी तकनीकों के माध्यम से छोटे और सीमांत किसानों की आजीविका में सुधार करने के लिए सराहा।

अलियारनगर केंद्र, तमिलनाडु एग्रीकल्चरल यूनिवर्सिटी , तमिलनाडु को वर्श 2022–23 के लिए सर्वश्रेश्ठ अखिल भारतीय समन्वित् ताड़ अनुसंधान परियोजना केंद्र के रूप में चुना गया। इस केंद्र के वैज्ञानिकों को प्रमाणपत्र और स्मर्षते चिह्न प्रदान किए गए। उद्घाटन सत्र के बाद तकनीकी सत्र आयोजित



हुए, जिनमें किस्म विमोचन, आनुवंषिक संसाधन, फसल सुधार, फसल उत्पादन, फसल संरक्षण, ताड़ में फसलोत्तर प्रौद्योगिकी एवं प्रौद्योगिकी हस्तांतरण के प्रयासों पर चर्चा की गई तथा 13–15 सितंबर 2023 के दौरान समापन सत्र आयोजित किया गया।

# 32वीं वार्शिक बैठक में किसान समुदाय के लिए अनुषंसित प्रौद्योगिकियाँ

## VPM 6 – वेप्पनकुलम केंद्र द्वारा प्रस्तावित नारियल किस्म

- VPM 6 (IC 599264) में 166.25 नारियल प्रति वर्श एवं औसत 107 नारियल प्रति पेड़ प्रति वर्श दर्ज की गयी । इसमें 137.40 ग्राम कोपरा की मात्रा प्रति नारियल, 18 किलोग्राम कोपरा प्रति पेड़ प्रति वर्श, 67.94 प्रतिषत तेल की मात्रा तथा 2.67 टन प्रति हेक्टेयर तेल उत्पादन क्षमता पायी गयी। यह किस्म तमिलनाडु के पूर्वीय तटीय क्षेत्र के लिए अनुकूल है तथा विभिन्न तनावपूर्ण स्थितियों (अधि ाक रोपण, सूखा, चक्रवात) के बावजूद तेजी से पुनः स्तापना क्षमता के कारण बेहतर प्रदर्षन करती है।
- तमिलनाडु के लिए अनुषंसित

# VTLCH 1 – कोको हाइब्रिड भाकृअनुप– केंद्रीय रोपण फसल अनुसंधान संस्थान द्वारा प्रस्तावित

- VTLCH 1 सीडलिंग तथा क्लोन के रूप में नारियल एवं सुपारी के मध्य, षीघ्र फलन, उच्च उपज क्षमता एवं मध्यम आकार की छाया वाली पायी गयी है जिसे उच्च घनत्व रोपण में लगाया जा सकता है। इसके 3.5–4 मीटर ऊंचाई, 16–18 वर्ग मीटर कैनोपी वाले वक्ष में 50 फली प्रति वर्श दर्ज की गयी है जिसमें 350 से 400 ग्राम वजन की फली में 35–44 बीज प्रति फली प्राप्त होती है। इसके एकल सुखे बीज का वजन 1-1.10 ग्राम होता है जिसे 3 स्थानों में औसत 1.5 किलोग्राम दर्ज किया गया और 750 किलोग्राम प्रति हेक्टेयर की औसत उपज (500 वृक्ष) प्राप्त की गयी। इसके बीन्स अंतरराश्ट्रीय मानक के अनुरूप हैं जिनका आकार 1 ग्राम से अधिक है, जो चॉकलेट उद्योग के लिए उपयुक्त हैं तथा इसमें 13% षेलिंग प्रतिषत , 87 प्रतिषत की निब रिकवरी, 50 प्रतिषत से अधिक वसा और 1 प्रतिषत मुक्त फैटी एसिड दर्ज की गयी है।
  - केरल, तमिलनाडु और कर्नाटक के लिए अनुषंसित

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# VTLCH 2 – कोको हाइब्रिड भाकृअनुप– केंद्रीय रोपण फसल अनुसंधान संस्थान द्वारा प्रस्तावित

- VTLCH 2 सीडलिंग तथा क्लोन के रूप में नारियल एवं सुपारी के मध्य, षीघ्र फलन, उच्च उपज क्षमता एवं मध्यम आकार की छाया वाली पायी गयी है जिसे उच्च घनत्व रोपण में लगाया जा सकता है। 6 वर्शीय हाइब्रिड से 1.5–2 किलोग्राम सूखे बीन्स प्रति वृक्ष प्रति वर्श की औसत उपज एवं 5 किलोग्राम प्रति 20 वर्ग मीटर दर्ज कराई गयी है। 3.5–4 मीटर ऊंचाई एवं 15–20 वर्ग मीटर कैनोपी वाले वृक्ष से औसतन 50 फली प्रति वृक्ष प्रति वर्श प्राप्त की जा सकती है। इसकी फलियाँ 350–400 ग्राम वजन की होती हैं जिसमें प्रति फली 35-42 फलियाँ होती हैं। 1 से 1.20 ग्राम की सुखी फलियों के वजन के साथ, इस किस्म की औसत उपज 1. 5 किलोग्राम दर्ज की गई है। इसके बीन्स अंतरराश्टीय मानक स्तर के हैं जिनका आकार 1 ग्राम से अधिक है, जो चॉकलेट उद्योग के लिए उपयुक्त हैं तथा इसमें 13% षेलिंग प्रतिषत , 87 प्रतिषत की निब रिकवरी, 50 प्रतिषत से अधिक वसा और 1 प्रतिषत मुक्त फैटी एसिड दर्ज की गयी है। यह वैरायटी ब्लैक पॉड रॉट, टी मॉसक्विटो बग एवं नमी तनाव के प्रति सहनषील है ।
- केरल, आंध्र प्रदेष, कर्नाटक और गुजरात के लिए अनुषंसित

## पत्ते के झुलसा रोग का प्रबंधन

 अलियारनगर केंद्र में प्रोपिकोनाजोल के 5 मि.ली. प्रति 100 मि.ली. पानी के साथ तीन महीने के अंतराल पर (जनवरी, अप्रैल, जुलाई, अक्टूबर) जड़ पोशण उपचार करने से 36 महीनों में रोग की 27 प्रतिषत कमी पायी गयी है। इससे उपचारित पेड़ों में 138 नारियल प्रति वध्क्ष प्रति वर्श की उच्चतम उपज और 3.7 का लाभ–लागत अनुपात (अलाभित पेड़ों में 97 नारियल प्रति वध्क्ष प्रति वर्श) दर्ज किया गया ।

# गैंडा भष्ंग (राइनोसेरस बीटल) प्रबंधन के लिए नायलॉन जाल

 अलियारनगर, रत्नागिरी, अंबाजिपेटा और अर्सीकेरे केंद्रों में मछली जाल (3.2 × 3.4 मि मी जाली) से नारियल के युवा स्पीयर पत्तों को लपेटने पर गैंडा भषंग के संक्रमण से प्रभावी सुरक्षा प्रदान की गई।



# **EXECUTIVE SUMMARY**

The All India Coordinated Research Project on Palms started functioning from 1972 with an objective of conducting location-specific research in the mandate crops. At present the project has coconut, oil palm, arecanut, palmyrah and cocoa as mandate crops and is implemented in 28 centres. The AICRP on Palms has 15 centers conducting research on coconut, six on oil palm, four on arecanut, four on palmyrah and seven on cocoa with Headquarters at ICAR-CPCRI, Kasaragod. The coordinating centres are located in 14 states and one union territory functioning under 13 SAUs/ SHUs, one CAU and four ICAR institutes. The budget for the year 2023 (January -December) was Rs. 735.57 lakhs and the scheme is implemented through the respective state Agricultural/ Horticultural Universities on 75:25 basis, with 75% share from ICAR and 25% share from State Agricultural/Horticultural Universities. The centers under Central Agricultural University and ICAR Institutes have 100% funding from ICAR.

## RESEARCHACHIVEMENTS

- Among the Dwarf x Dwarf coconut hybrid combinations planted during 2011, COD x MGD at Ambajipeta centre recorded as better considering its higher yield (84.29 fruits/palm/ year) and tender nut water content (447 ml/ fruit) and also estimated tender nut water yield of 7000 liters/ha. At Ratnagiri Centre, 13 years of palms of COD x MYD recorded the highest mean annual tender nut yield of 91.58 fruits/ palm/year (2022-23), higher quantity of tender nut water content (458.13 ml/fruit) and estimated tender nut water yield (7340.14 liters/ha).
  - At 13 years of age, the GBGD x MOD hybrid recorded the highest mean yield of 98 fruits / palm / year (2022-23) with an increased yield

of 50.82% over the ruling variety COD at Veppankulam location. It also recorded an estimated tender nut water yield of 9746 liters /ha.

- Among the location specific crosses evaluated at Bhubaneswar, the hybrid SKL x GBGD recorded higher yield (137 fruits/palm/year) and high tender nut water content (455 ml/nut) with Total Soluble Solids 5.28° Brix. The hybrid recorded copra content of 192.35 g/nut with an oil content 66.28% with an increased nut yield of 24.75 % and higher copra content (34.63%) over the local variety Sakhigopal Local.
- With the aim to develop of coconut-based farming systems with enhanced profitability, the two experiments conducted over three locations, wherein the impact of integration of animal component with coconut on productivity and profitability of the system were evaluated. In Aliyarnagar and Veppankulam locations coconut was integrated with goatery and with poultry in Ratnagiri, poultry was the animal component. Irrespective of the locations, the integration of animal component in coconut plantation has shown positive impact on coconut yield, net returns and favourable Benefit Cost Ratio. Soil fertility and energy profitability were higher and pest & disease incidence was lower in Integrated Farming Systems. Green House Gas emissions were negative and were ecologically safe.
  - Evaluation of Coconut based multispecies cropping systems under coastal littoral sandy soil indicated higher nut yield in Coconut + *Garcinia indica* + Pineapple cropping system with recommended nutrient application. At Bhubaneshwar location, maximum net returns

(Rs. 4,63,857/ha) was obtained in Coconut + Garcinia indica + Pineapple cropping system with Green manuring + biofertilizers + organic recycling + Soil test-based nutrient (chemical fertilizers) application treatment. However, less profit (Rs.60,250) was obtained in sole cropping system of Monocrop of coconut+ Green manuring+ biofertilizers + organic recycling +FYM (as per Package of Practice). The highest B: C ratio (2.38) was obtained in  $C^{S2N3}$  is adopted.

- Under organic cultivation of coconut at four locations, highest system productivity and profitability was realized in  $T_4$ -*In situ* organic matter recycling + PGPR consortia + insitu green manuring + 25 kg cow dung + husk burial + 50 % rec. dose as Sulphate of Potash.
- To strengthan the pest and disease management in coconut plantation, a total of 17,26,600 numbers of *Bracon hebetor*; 8,46,476 numbers of *G. nephantidis*; 44,000 numbers *Encarsia guadeloupe*, 34,000 numbers of *P. imbrues*; 242 Tricho cards and 3,46,500 number s of *P. astur* eggs were supplied to the farmers from the centres in Tamil Nadu, Andhra Pradesh, Karnataka and Maharashtra.
- Among the 10 hybrids evaluated at Vijayarai for growth and yield parameters, the hybrid NRCOP 37 recorded a mean bunch weight of 19.9 kg along with moderate number of bunches (10.7 per palm) per annum resulting in a good FFB yield of 29.69 tonnes per ha.
- At Pattukkotai, NRCOP 9 recorded a mean bunch weight of 20.20 kg along with moderate number of bunches (10.60 per palm) per annum resulting in FFB yield of 30.62 tonnes per ha with high oil content of 21.50%.
- Cocoa genotypes are being evaluated in 7 AICRP (Palms) centres covering west coast, east coast and NE regions under different

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cropping systems including arecanut, coconut and oil palm plantations. From the 12-yearold trial at Kasaragod (Kerala), Ambajipeta (Andhra Pradesh) and Veppankulam (Tamil Nadu), VTLCH-2 and VTLCH-1 were identified as best performers respectively in the regions under coconut. From the initial years of evaluation, it was observed that among 8year-old trees of Aliyarnagar (Tamil Nadu), Ratnagiri (Maharashtra) and Kahikuchi (Assam), VTLCP-16, VTLC-17 and VTLC-20 were best performing respectively, whereas VTLC-57 was high yielding at Vijayarai (Andhra Pradesh) under oil palm.

- Freeze drying of fresh neera with maltodextrin with 10 % or more resulted in a sap powder with good stability at room temperature and excellent solubility. Sap powder shows an easy rehydration by water addition to its original characteristic of the process. The sap powder obtained meets the current legislation standards for fruits and vegetable products, with moisture value of less than 5.0. %.
- Technology standardized for storage of Palmyrah Neera Concentrate (PNC) or palmyrah syrup up to 90 days with glass bottle without affecting physicochemical properties at accelerated storage conditions (90 % RH and  $40^{\circ}$ C).
- A thickener for instant soup preparation developed using palmyrah tuber as it is considered a cheap and rich source of starch. Modifications of native starches are carried out to provide palmyrah starch based products with specific desirable properties.
- The yields and characteristics of pectin extracted from palmyrah fruit pulp was comparable to pectin extracts from other sources. The pectin yield from palmyrah fruit pulp ranged from 5.8 - 20.4%.



#### **MEETINGS HELD**

The 32<sup>nd</sup> Annual Group Meeting of ICAR -All India Coordinated Research Project on Palms was held at AICRPP Centre, Horticultural Research Station, Kahikuchi under Assam Agricultural University, Jorhat during September 13-15, 2023. Dr. V. B. Patel, Assistant Director of General (Fruits and Plantation Crops), Horticulture Science Division, ICAR, New Delhi presided over the inaugural function wherein, Dr. N. K. Mohan, Hon'ble Member, Agricultural Commission, Govt. of Assam was the Chief Guest. Dr. K. B. Hebbar, Director ICAR- CPCRI, Kasaragod, Dr. K. Suresh, Director, ICAR-IIOPR, Pedavegi, Dr. R. K. Mathur, Director, ICAR-IIOR, Hyderabad, Dr. V. Venkatasubramanian, Director, ICAR-ATARI, Bangalore, Dr. G. Kathirvel, Director, ICAR-ATARI, Guwahati, Dr. D. Prasath, Project coordinator (Spices), ICAR-IISR, Kozhikode were present for the inauguration. Dr. KUK. Namboothiri, and Dr. P. Chowdappa, Former Directors of ICAR-CPCRI have participated in the AGM as invited experts. Dr. M. Saikia, Director of Research, Assam Agricultural University, Jorhat welcomed the dignitaries.

Dr. B. Augustine Jerard, Project Coordinator (Palms), ICAR-AICRP on Palms, ICAR-CPCRI, Kasaragod in his report, presented the mission of the Project Directorate since its genesis in 1972, on five mandate crops - coconut, oil palm, palmyrah, arecanut and cocoa in 28 centres distributed across fifteen States/UTs through thirteen State Agricultural/ Horticultural Universities, four ICAR institutes and one Central Agricultural University. During the 31st Annual Group Meet of AICRP on Palms held during 16-18 September 2022, three release proposals on improved coconut varieties with desirable traits viz., Dweep Sona, Dweep Haritha and Kalpa Vajra were recommended for submission to Central Subcommittee on Seed standards and release of varieties of horticultural crops towards notification in gazette. The proposals on these varieties have

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subsequently been submitted by the respective centres to Central sub-committee and are in various levels of consideration. Three technologies viz., Integrated Nutrient Management for cultivation of dwarf coconut, Leaf blight management in coconut and Arecanut Intercropping options in coconut gardens have emanated from different projects. The total budget outflow during financial year 2022-23 was 681 lakhs. Review meetings were scrupulously conducted by the Nodal centres to monitor the technical programme and budget utilization across the sub centres.

Development and evaluation of Tall x Tall and Dwarf x Dwarf coconut hybrids, coconut based multispecies cropping systems, location specific Integrated Farming System models, Bioagents for the control of black headed caterpillar in coconut, crown choke disease in arecanut, and identification of best performing cocoa clones *viz.*, VTLCH -1, VTLCH-2 for intercropping in coconut gardens are the noteworthy contributions made and identified for further studies/promotion. Effective Transfer of Technology from lab to land through diverse extension tools & modes and need-based diagnostic field visits across the states continued to remain the major strength of this programme.

Dr. V. B. Patel, Assistant Director General (F&PC) in his Presidential Address, congratulated the group of Palm Scientists for doing exemplary work in the sector. He also enumerated the vision of Government of India to minimize imports and to maximize the export potential of plantation crops and products. He desired to focus work on technologies to preserve Neera tapped from palmyrah. He urged the Palm Scientists to take concerted efforts to transform India into a developed nation by 2047, marking India's 100<sup>th</sup> year of Independence through palm sector in all possible ways.

The Chief guest, Dr. N. K. Mohan in his Special Address, underlined the rich biodiversity of

horticultural sector in the Northeastern Region. He narrated the historical importance of how the Ahom Kings contributed to the introduction of coconut and arecanut during their regime of  $12^{th} - 18^{th}$  century from SE Asian regions. He applauded these research hubs for scraping the maladies from plantation sector like crown choke disorder, for introduction and promotion of varieties like Kamrupa and for the array of technologies like muti-tier cropping system with black pepper to improve the standard of living of small and marginal farmers of the state amidst climatic vagaries. He appreciated the efforts of palm scientists over the years and indicated the need to address the future challenges in increasing profitability.

Aliyarnagar Centre, TNAU, Tamil Nadu was adjudged as the Best AICRP (Palms) Centre for the year 2022-23. The AGM consisted of technical sessions on Variety Release, Genetic Resources and Crop Improvement, Crop Production, Crop Protection, Post Harvest Technology of palmyrah and Transfer of Technology efforts followed by plenary session.

# Technologies recommended to farming community at 32<sup>nd</sup> AGM

# VPM 6 - Coconut variety proposed by Veppankulam centre was recommended

- VPM 6 (IC 599264) recorded a higher yield of 166.25 nuts per year (in one year) with a Mean yield 107 nuts/palm/annum - Copra content (g/nut) 137.40 - Copra/palm/year (kg) 18.00 - Oil content (%) 67.94 and Oil yield per ha (t) 2.67. The variety is adapted in the East Coast region of Tamil Nadu and performed better in terms of nut and oil content even under several forms of stress (under planting, drought, cyclone) conditions due to its quick recovering habit.
- · Recommended for Tamil Nadu

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# VTLCH 1 – Cocoa hybrid proposed by ICAR-CPCRI was recommended.

- The VTLCH 1 variety has early bearing, high yielding potential with medium canopy both under arecanut and coconut shades and as seedlings and clones. It has shown suitability under high density planting. The trees with a height of 3.5-4 m and an optimum canopy (16-18 m<sup>2</sup>) - yielded an average of 50 pods/tree/ year. Pods are 350-400 g weight with 35-44 beans/pod. With a single dry bean weight of 1 to 1.10 g this variety recorded an average yield of 1.5 kg in 3 locations and the yield/ha is 750 kg (500 trees). Beans are of international standard with >1 g bean size, suitable for chocolate industry with a shelling percentage of 13%, nib recovery of 87%, >50% fat and 1% free fatty acids.
- Recommended for Kerala, Tamil Nadu and Karnataka

# VTLCH 2 - Cocoa hybrid proposed by ICAR-CPCRI was recommended

This variety is having early bearing, high yielding potential with medium canopy both under arecanut and coconut shades and as seedlings and clones, showed suitability under high density planting. Average yield (dry beans/tree/year) 1.5-2.0 kg/tree/year in 6-year-old hybrid tree. Potential yield 5 kg per 20 m<sup>2</sup> canopy. The trees with a height of 3.5-4 m and an optimum canopy (15-20 m<sup>2</sup>) yielded an average of 50 pods/tree/year. Pods are 350-400 g weight with 35-42 beans/pod. With a single dry bean weight of 1 to 1.20 g, this variety recorded an average yield of 1.5 kg. Beans are of international standard with >1 g bean size, suitable for chocolate industry with a shelling percentage of 13%, nib recovery of 87%, >50% fat and 1% free fatty acids. This variety is tolerant to black pod rot, tea mosquito bug, low moisture stress.

• Recommended for Kerala, Andhra Pradesh, Karnataka and Gujarat

#### Management of coconut leaf blight disease

 At Aliyarnagar centre, root feeding with propiconazole @ 5 ml in 100 ml of water at three months intervals during January, April, July and October reduced the leaf blight incidence by 27.0 per cent after 36 months of treatment. This treatment also resulted in highest yield of 138 nuts/ palm/year and the B:C ratio of 3.7 as against 97 nuts/ palm/year in the untreated control.

# Nylon net for the management of rhinoceros beetle in coconut palms

 Wrapping spear leaf with nylon fish net (3.2 x 3.4 mm mesh) was found effective to safeguard the juvenile coconut palms from infestation by rhinoceros beetle at Aliyarnagar, Ratnagiri, Ambajipeta and Arsikere.



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VPM 6 coconut bunch



Cocoa VTLCH-2 fruits



Delegates at 32<sup>nd</sup> AGM of AICRP on Palms at Kahikuchi





# III. PROFILE OF AICRP ON PALMS

Among the plantation crops, coconut (*Cocos nucifera* L.), arecanut (*Areca catechu* L.), oil palm (*Elaeis guineensis* Jacq.), palmyrah (*Borassus flabellifer* L.) and cocoa (*Theobroma cacao* L.) play a significant role in the sustainable livelihood of millions of small and marginal farmers in the country. The All India Coordinated Research Project on Palms came into existence in the year 1972 to carry out the location specific research on mandate crops (coconut, arecanut, oil palm, palmyrah and cocoa) with the following objectives:

- Identification, conservation and utilization of elite genetic resources for useful traits in palms and cocoa from different agro-climatic regions.
- Evaluation of varieties/hybrids under different locations and to facilitate release of varieties/ hybrids of palms and cocoa through multilocation testing (MLT).
- To improve input use efficiency and develop location-specific palm based integrated farming

systems to enhance the productivity per unit area.

- Evolving cost effective integrated insect-pest and disease management practices besides survey and surveillance of pests and diseases for forewarning.
- Development of post-harvest technologies in palmyrah.

# **List of Centres**

The project is implemented in twenty - eight centers with its headquarters at ICAR-CPCRI, Kasaragod and at present15 centres are working on coconut, six on oil palm, four each on arecanut & palmyrah and seven on cocoa. These coordinating centers are located in thirteen State Agricultural / Horticultural Universities, one Central Agricultural University and four ICAR institutes in fourteen states and one union territory.

| State             | Center/Location  | Area of Research   | University/Institution   |
|-------------------|--|--|--|
| Andhra<br>Pradesh | Ambajipeta: Horticultural Research<br>Station, Ambajipeta, East Godavari<br>Dt 533 214<br>Phone: 08856-244436/243711                                       | Coconut: Crop<br>Improvement, Crop<br>Production & Crop<br>Protection          | Dr. Y.S.R Horticultural<br>University, West<br>Godavari Dt., Andhra<br>Pradesh - 534 101 |
|                   | Pandirimamidi: Horticultural<br>Research Station, Pandirimamidi,<br>Ramapachodaram, East Godavari<br>Dt 533 288<br>Phone : 08864-246577                    | Palmyrah: Crop<br>Improvement, Crop<br>Production & Post<br>Harvest Technology |  |
|                   | Vijayarai: Horticulture Research<br>Station, Vijayarai, West Godavari<br>Dt 534 475<br>Phone : 08812-225431  | Oil palm: Crop<br>Improvement & Crop<br>Production<br>Cocoa:Crop Improvement   |  |
|                   | Pedavegi: Indian Institute of Oil<br>Palm Research, Near Jawahar<br>Navodaya Vidyalaya, Pedavegi,<br>West Godavari Dt534 450<br>Phone :08812-259409/259532 | Oil palm: Crop<br>Improvement & Crop<br>Production                             | Indian Council of<br>Agricultural Research   |

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| Andaman and<br>Nicobar | <b>Port Blair</b> : Central Island<br>Agricultural Research Institute,<br>Port Blair - 744 101<br>Phone : 03192-250436                       | Coconut and Arecanut:<br>Crop Improvement &<br>Crop Production  | Indian Council of<br>Agricultural Research  |
|------------------------|--|---|---|
| Arunachal<br>Pradesh   | Pasighat: College of Horticulture<br>& Forestry, Pasighat - 791 102<br>Phone : 0368-2224887  | Oil palm: Crop<br>Improvement & Crop<br>Production  | Central Agricultural<br>University, P.O. Box 23,<br>Imphal, Manipur - 795<br>004        |
| Assam                  | Kahikuchi: Horticultural Research<br>Station, Kahikuchi, Guwahati<br>Kamrup Dt 781 017<br>Phone : 0361-2840232                               | Coconut: Crop<br>Improvement & Crop<br>Production<br>Cocoa: Crop<br>Improvement                                 | Assam Agricultural<br>University, Jorhat,<br>Assam - 785 013                            |
| Bihar                  | Sabour: Bihar Agricultural College,<br>Sabour, Bhagalpur Dt 813 210<br>Phone : 0641-2451001  | Coconut: Crop<br>Improvement & Crop<br>Production<br>Palmyrah: Crop<br>Improvement & Post<br>Harvest Technology | Bihar Agricultural<br>University, Sabour,<br>Bhagalpur, Bihar - 813<br>210              |
| Chhattisgarh           | Jagdalpur: Shaheed Gundadhur<br>College of Agriculture & Research<br>Station, Kumhrawand Farm,<br>Jagdalpur - 494 005Phone :<br>07782-229360 | Coconut: Crop<br>Improvement & Crop<br>Production   | Indira Gandhi Krishi<br>Vishwavidyalaya,<br>Raipur, Chhattisgarh -<br>492 012           |
| Goa                    | <b>Goa:</b> Central Coastal Agricultural<br>Research Institute, Ela, Old Goa<br>Dt 403 402<br>Phone : 0832-2285448                           | Coconut and Arecanut:<br>Crop Improvement &<br>Crop Production  | Indian Council of<br>Agricultural Research  |
| Gujarat                | Navsari: ASPEE College of<br>Horticulture & Forestry, Navsari<br>Agricultural University, Navsari -<br>396 450<br>Phone : 02637-282144       | Coconut: Crop<br>Improvement &<br>Production<br>Cocoa: Crop<br>Improvement                                      | Navsari Agricultural<br>University, Navsari,<br>Gujarat - 396 450                       |
| Karnataka              | Arsikere: Horticultural Research<br>and Extension Station, Arsikere,<br>Hassan Dt573 103<br>Phone: 08174-291565/291711                       | Coconut: Crop<br>Improvement, Crop<br>Production & Crop<br>Protection   | University of<br>Horticultural Sciences,<br>Navanagar, Bagalkot,<br>Karnataka - 587 102 |
|                        | Sirsi: Horticulture Research and<br>Extension Centre, Sirsi, Uttara<br>Kannada Dt 581 401<br>Phone: 08384-226797/247787                      | Cocoa: Crop<br>Improvement  |   |

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|             | <b>Bavikere</b> : Agricultural and<br>Horticultural Research Station,<br>Bavikere, Chikkamagaluru – 577<br>144<br>Phone :08261 255122 | Oil palm: Crop<br>Production  | Keladi Shivappa<br>Nayaka University of<br>Agricultural &<br>Horticultural Sciences<br>(KSNUAHS), Navile, |  |  |
|-------------|---|---|---|--|--|
|             | Shivamogga: Arecanut Research<br>Centre, College of Agriculture,<br>Navile, Shivamogga Dt. – 577 225<br>Phone : 08181-267011          | Arecanut: Crop<br>Improvement, Crop<br>Production & Crop<br>Protection                              | - 577 225   |  |  |
| Kerala      | Kasaragod: Central Plantation<br>Crops Research Institute,<br>Kasaragod - 671 124<br>Phone : 04994-232733                             | Coconut:Crop<br>Production  | Indian Council of<br>Agricultural Research  |  |  |
|             | <b>Pilicode</b> : Regional Agricultural<br>Research Station, Pilicode P.O.,<br>Kasaragod - 670 353<br>Phone:0467-2260450              | Coconut: Crop<br>Improvement  | Kerala Agricultural<br>University, KAU,<br>Vellanikkara, Thrissur,<br>Kerala - 680 656                    |  |  |
|             | Thrissur: Cocoa Research<br>Centre, Kerala Agricultural<br>University, Vellanikkara, Thrissur<br>Dt. – 680 656<br>Phone: 0487-2438457 | Cocoa: Crop<br>Improvement  |   |  |  |
| Maharashtra | Mulde: College of Horticulture,<br>Mulde, Kudal Taluk, Sindhudurg<br>Dt 416 520<br>Phone: 02362-244231/244232                         | Oil palm: Crop<br>Improvement & Crop<br>Production  | Dr. Balasaheb Sawant<br>Konkan Krishi<br>Vidyapeeth, Dapoli,<br>Ratnagiri Dt.,<br>Maharashtra - 415 712   |  |  |
|             | Ratnagiri: Regional Coconut<br>Research Station, Bhatye,<br>Ratnagiri Dt 421 612<br>Phone : 02352-255077                              | Coconut: Crop<br>Improvement, Crop<br>Production & Crop<br>Protection<br>Cocoa: Crop<br>Improvement |   |  |  |
|             | Wakawali: Central Experimental<br>Station, Asond block, Wakavali,<br>Daopli Taluk.Phone : 02358-<br>282417                            | Arecanut: Crop<br>Improvement & Crop<br>Production  |   |  |  |
| Odisha      | <b>Bhubaneswar</b> : Department of<br>Horticulture, (OUAT),<br>Bhubaneswar - 751 003<br>Phone : 0674-2397463                          | Coconut:<br>Crop Improvement &<br>Crop Production<br>Cocoa:<br>Crop Improvement                     | Odisha University of<br>Agriculture and<br>Technology,<br>Bhubaneswar, Odisha -<br>751 003                |  |  |

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| Tamil Nadu  | Aliyarnagar: Coconut Research<br>Station, Aliyarnagar, Coimbatore<br>Dt 642 101<br>Phone: 04253-288722/288662                   | Coconut:<br>Crop Improvement,<br>Crop Production &<br>Crop Protection<br>Cocoa:<br>Crop Improvement | Tamil Nadu Agricultural<br>University, Coimbatore,<br>Tamil Nadu - 641 003  |
|-------------|---|---|---|
|             | Killikulam: Agricultural College &<br>Research Institute, Killikulam,<br>Vallanad, Tuticorin Dt 628 252<br>Phone : 04630-261226 | Palmyrah:<br>Crop Improvement &<br>Crop Production  |   |
|             | Pattukkottai: Agricultural<br>Research Station, Pattukkottai,<br>Thanjvur Dt614 602<br>Phone : 04373-235832                     | Oil palm:<br>Crop Improvement &<br>Crop Production  |   |
|             | Veppankulam: Coconut Research<br>Station, Veppankulam, Thanjavur<br>Dt 614 906<br>Phone: 04373-260205/202534                    | Coconut:<br>Crop Improvement,<br>Crop Production &<br>Crop Protection                               |   |
| Telangana   | Konda Mallepally: Horticultural<br>Research Station, Konda<br>Mallepally Mandal, Nalgonda Dt<br>508 243                         | Palmyrah:<br>Crop Improvement &<br>Post Harvest Technology  | Sri Konda Laxman<br>Telangana State<br>Horticultural University,<br>Rajendranagar,<br>Hyderabad, Telangana –<br>500 030 |
| West Bengal | Mondouri: Directorate of<br>Research, P. O. Kalyani, Nadia<br>Dt 741 235<br>Phone :033-25827574                                 | Coconut:<br>Crop Improvement &<br>Crop Production   | Bidhan Chandra Krishi<br>Viswavidyalaya,<br>Mohanpur, Nadia, West<br>Bengal - 741 252                                   |

# Budget

The budget for the year 2023 was Rs 735.57 lakhs (ICAR Share)

|         |                    | (Rs. in lakhs) |
|---------|--------------------|----------------|
| Sl. No. | Head               | Expenditure    |
| 1.      | Pay and allowances | 572.62         |
| 2.      | T.A.               | 12.5           |
| 3.      | RC                 | 110.45         |
| 4.      | HRD                | 0.00           |
| 5       | NRC                | 5.00           |
| 6.      | NEH                | 10.00          |
| 7.      | TSP                | 10.00          |
| 5.      | SCSP               | 15.00          |
|         | Total              | 735.57         |

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# Centre wise budget for 2023 (ICAR share Rs. in Lakhs)

| Centre                 | Pay    | TA    | RC     | HRD  | Eqpt. | Works | NEH   | TSP   | SCSP  | Total  |
|------------------------|--------|-------|--------|------|-------|-------|-------|-------|-------|--------|
| Aliyarnagar            | 68.00  | 0.95  | 7.30   | 0.00 | 1.50  | 0.00  | 0.00  | 1.66  | 1.49  | 80.90  |
| Ambajipeta             | 47.00  | 0.85  | 6.70   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 1.78  | 56.33  |
| Arsikere               | 51.00  | 0.90  | 6.85   | 0.00 | 0.00  | 0.00  | 0.00  | 1.59  | 1.88  | 62.22  |
| Jagdalpur              | 20.00  | 0.30  | 5.15   | 0.00 | 0.00  | 0.00  | 0.00  | 1.61  | 0.00  | 27.06  |
| Kahikuchi (NEH)        | 47.70  | 0.40  | 0.00   | 0.00 | 0.00  | 0.00  | 8.00  | 0.00  | 1.48  | 57.34  |
| Bhubaneswar            | 20.50  | 0.20  | 5.85   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 1.08  | 27.63  |
| Mondouri               | 20.33  | 0.20  | 3.05   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 23.58  |
| Ratnagiri              | 86.16  | 0.85  | 6.95   | 0.00 | 0.00  | 0.00  | 0.00  | 1.26  | 1.02  | 96.24  |
| Veppankulam            | 56.60  | 0.60  | 6.65   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 1.41  | 65.26  |
| Killikulam             | 20.00  | 0.20  | 3.20   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.69  | 24.09  |
| Pandirimamidi          | 28.00  | 0.30  | 4.65   | 0.00 | 0.00  | 0.00  | 0.00  | 1.60  | 0.00  | 34.55  |
| Pattukotai             | 21.44  | 0.20  | 4.60   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 26.24  |
| Mulde                  | 22.30  | 0.20  | 5.50   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 28.00  |
| Vijayarai              | 22.00  | 0.20  | 3.75   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 1.45  | 27.40  |
| Navasari               | 14.00  | 0.20  | 4.55   | 0.00 | 0.00  | 0.00  | 0.00  | 1.60  | 0.00  | 20.35  |
| Sabour                 | 15.89  | 0.30  | 2.25   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.68  | 19.12  |
| Shivamogga             | 11.70  | 0.15  | 3.35   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 15.20  |
| Wakawali               | 0.00   | 0.10  | 1.50   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 1.60   |
| Pilicode               | 0.00   | 0.10  | 3.30   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 3.40   |
| Bavikere               | 0.00   | 0.10  | 2.50   | 0.00 | 3.50  | 0.00  | 0.00  | 0.00  | 0.00  | 7.00   |
| K Mallapally           | 0.00   | 0.10  | 1.55   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 1.02  | 2.67   |
| Sirsi                  | 0.00   | 0.25  | 2.15   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 2.40   |
| Thrissur               | 0.00   | 0.10  | 1.65   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 1.75   |
| Pasighat (NEH)         | 0.00   | 0.30  | 0.00   | 0.00 | 0.00  | 0.00  | 2.00  | 0.00  | 0.00  | 2.30   |
| Port Blair (ICAR)      | 0.00   | 0.00  | 3.90   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 3.90   |
| Goa (ICAR)             | 0.00   | 0.00  | 3.70   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 3.70   |
| IIOPR, Pedavegi (ICAR) | 0.00   | 0.00  | 3.80   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 3.80   |
| Kasaragod (ICAR)       | 0.00   | 0.00  | 0.00   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| PC cell (ICAR)         | 0.00   | 4.00  | 6.05   | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 10.05  |
| Total                  | 572.62 | 12.05 | 110.45 | 0.00 | 5.00  | 0.00  | 10.00 | 10.00 | 15.00 | 735.57 |



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# Mode of implementation

The project is implemented through the respective State Agricultural/Horticultural Universities on 75:25 basis of which 75% is ICAR share and 25% share is from State Agricultural Universities.

# Staff strength

| Category   | Present strength |
|------------|------------------|
| Scientific | 35               |
| Technical  | 20               |
| Supporting | 17               |
| Total      | 72               |







# IV. GENETIC RESOURCES AND CROP IMPROVEMENT

#### 4.1 Coconut

# Conservation and evaluation of coconut genetic resources in different agro climatic regions

Expt. 1: Evaluation of conserved germplasms

Centers: Bhubaneswar, Navsari and Sabour.

This trial was laid out for multi-location evaluation of coconut germplasm for performance on growth traits, yield, biotic and abiotic stress related traits. The experiments were planted as un-replicated observational experiment with fourteen palms per genotype at Sabour and five palms per genotype at Bhubaneswar and Navsari centres.

| Centre      | Genotypes/germplasam to be evaluated   |
|-------------|--|
| Bhubaneswar | COD, MYD, MGD, Gangabondam, Sakhigopal, St. Vincent, SSG, Guam Type I, BSI,          |
|             | Andaman Ordinary, Zanzibar Tall, San Ramon, Benaulim Tall, WCT, Tiptur Tall and Java |
|             | Tall   |
| Navsari     | COD, CGD, MYD, Gangabondam, Benaulim, PHOT, Kappadam, Seychelles, Borneo,            |
|             | FMS, LCT, ADOT, San Ramon, Guam, New Guinea Tall, WCT Spicata, BRR, BGL and          |
|             | BYL  |
| Sabour      | COD, MOD, MYD, GBGD, LCD, PHOT, ADOT, Tiptur Tall, Arasampatti Tall, ECT,            |
|             | Gonthembilli Tall, Zanzibar Tall, Hazari Tall, Assam Green Tall and Benaulim.        |

#### Bhubaneswar

At Bhubaneswar centre, the experiment was started with sixteen germplasm from 2004 comprising of twelve tall and four dwarf accessions. Among the tall accessions, shortest height (5.24 m) was recorded in Java Tall followed by San Ramon Tall (5.50 m) and maximum girth (115.10 cm) at 1 m height was observed in Andaman Ordinary Tall. Highest number of functional leaves/palm (38.60) was observed in Zanzibar Tall. However, maximum number of annual leaf production (12.50) recorded in the germplasm Sakhigopal Local Tall (IND 041), Java Tall & Andaman Ordinary Tall. Highest number of inflorescence (12), female flowers/palm (297.40) and nuts/palm/year (100.54) were recorded in the Tiptur Tall. Among the dwarf cultivars, shortest height (4.13 m) was recorded in Gangabondam Green Dwarf (GBGD) followed by Chowghat Orange Dwarf (COD) (4.27 m). However, among the dwarf accession, GBGD performed better by producing maximum numbers of inflorescence (12.40), number of female flowers (286.50 per palm/year), number of fruits (98.50/palm/year) and fruit set % (37.30%). It was observed that the performance of the palms of all germplasm in the trial have been improved during the year which were earlier affected severely by cyclonic storm "FANI" during 3<sup>rd</sup>May 2019.

#### Navsari

This experiment includes four dwarf and fifteen tall accessions which were planted during August 2014. The result revealed, maximum (5.40 m) and minimum (0.92 m) stem/trunk height of palm in Kappadam Tall and Malayan Yellow Dwarf (MYD), respectively. Moreover, BRR recorded maximum stem girth i.e., 125 cm. Kappadam Tall was observed with the highest annual leaf production (11.25), numbers of leaves on the crown (33.00), number of inflorescences per palm per year (11.00), fruit yield/palm/year (70.00) with minimum incidence (3.18 %) of Rugose Spiraling Whitefly (RSW) infestation. The highest leaf length (561.67 cm) and petiole length (190.00 cm) were recorded in Philippines Ordinary Tall (PHOT) while, Chowghat

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has been found as the highest yielding (64 nuts per palm per year) accession under Sabour conditions followed by Chandra Sankara (60) and Kera Chandra (44). Number of female flowers and initial fruit set was also highest in Sakhi Gopal Tall. No incidence of rhinoceros beetle and RSW damage was recorded in any of the accessions under the trial. Similarly, the highest fruit weight (1105g) was recorded in KGD followed by Sakhi Gopal Tall (1089g) and Chandra Sankara (1047g). Chandra Kalpa and Zanzibar Tall recorded lower fruit weight.

## Arsikere

Eleven (MYD, MOD, PHOT, LCOT, San Raman, NuWehung, Nu Fella, ADOT, FMS, Philippines Laguna and Kenya Tall) accessions were multiplied from the earlier conservation block at the location were multiplied and planted during 2011 at the present location of the centre as observational trial due to the shifting of the earlier experimental plot area to the then newly formed University.

# Expt. 2: Collection, conservation and evaluation of location specific germplasms

**Centers**: Aliyarnagar, Ambajipeta, Arsikere, Bhubaneswar, Jagdalpur, Kahikuchi, Mondouri, Navsari, Pilicode, Ratnagiri, Sabour and Veppankulam.

SI.No. Name of Centres | IC No. 1 Aliyarnagar 610371, 610372, 610373, 610374, 610375, 610379 2 Ambajipeta 610311, 610309, 610306, 610307, 610310 Arsikere 3 610343, 610342, 610341, 610339, 610333 4 Bhubaneswar 612457, 612458, 612459, 612460, 612461, 612462, 612463, 612464, 612465, 612466, 612467 Jagdalpur 610323, 610324, 610325, 610326, 610327, 610328 5 Kahikuchi 610353, 610354, 610355, 610356, 610357, 610358, 610359, 610360, 6 610361, 610362 7 Mondouri 612447, 612448, 612449, 612450, 612451 8 Navasari 610319, 610320, 610321, 610322 9 Pilicode RARS-DC-1-7 599111, 599112, 599113, 599114, 599115, 599116 10 Ratnagiri 11 SBRC-1-6, Sabour 12 Veppankulam 599263, 599264, 599265, 599266, 599267

Green Dwarf (CGD) flowered earlier at the age of 41.33 months. Regarding to reaction of biotic stresses, 2.00-2.68% palms of all accessions are infested by rhinoceros beetle.

#### Sabour

A total of fourteen germplasm accessions were planted during 2013 at Sabour centre and seedlings are still under establishment juvenile phase. Under this experiment, twelve accessions were evaluated during 2022-23 as non-replicated trial with 5-10 palms per variety. Effect of low winter temperature was recorded during this year and compared to observations made during 2021-22. Varietal differences for frost tolerance was also recorded. The highest plant height was recorded in Sakhi Gopal Tall followed by and Kulasekharam Green Dwarf (KGD) and Chandra Sankara with plant height of 5.74 m, 4.64 m and 4.58 m, respectively. The lowest plant height was recorded in Tiptur Tall followed by Arasampatti Tall respectively. The highest number of leaves on the crown was noted in Sakhi Gopal Tall (31.5) followed by KGD and Assam Green Tall with 28 and 21.5 leaves. The lowest leaf number was observed in Tiptur Tall. Annual leaf production was also high in variety Sakhi Gopal Tall followed by KGD and Assam Green Tall. Shakhi Gopal Tall



This trial was initiated with a view to collect, conserve and evaluate the local germplasm of coconut for yield and response to biotic and abiotic stresses. The evaluation materials comprise of 10 to 15 local germplasm accessions (with IC No.) collected and conserved in each centre. Among them, some are under evaluation in replicated field experiments and some are in un-replicated observational field trials.

#### Aliyarnagar

Eleven germplasm accessions were collected during 2008 in which five accessions (IC610370, IC 610375, IC610376, IC610377 and IC610378) were planted as a replicated trial and the remaining six (IC610371, IC610372, IC610373, IC610374, IC610375 and IC610379) have been planted as observational trial.

Among the five accessions, IC610377 recorded the lowest stem height (3.90 m) indicating the dwarf stature. The accession IC610370 registered the highest stem girth (116.2 cm), number of leaf scars in 1 m length of stem (15.9), annual leaf production (11.8/palm/year), number of functional leaves (33.9), number of inflorescence production (11.4/palm/ year), number of spikelets per inflorescence (30.4), number of buttons per inflorescence (26.5) and annual nut yield (121.3/palm/year). The highest total leaf length (555.6 cm) and petiole length (148.3 cm) were recorded in IC610376. The germplasm accession IC610378 recorded the highest fruit weight (1794.6 g), husked fruit weight (684.5g), kernel weight (333.5 g) and copra weight (162.4g/ nut) and tender nut water content (314.8 ml/fruit). Whereas the accession IC610370 recorded the highest estimated copra yield per palm (18.1 kg) and copra yield per hectare (3.2 t).

#### Ambajipeta

Thirteen local germplasm accessions were collected from traditional coconut growing districts *viz.*, Srikakulam, East and West Godavari districts of Andhra Pradesh. The experiment was laid out during February 2013.Out of thirteen accessions, five accessions *viz.*, ECT green (IC610311), Jonnalarasi

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Brown (IC610309), Pillalakodi Green (IC610306), Pillalakodi Brown (IC610307) and Gangabondam Green Dwarf (IC610310) were planted in RBD with four replications and 4 palms per replication and remaining eight accessions *viz.*, Jonnalarasi Green, ECT Brown, Itikulagunta ECT Big, Itikulagunta ECT Small, Saradapuram ECT, Srikakulam ECT, Vemulapalli ECT Big, Vemulapalli ECT Small were planted as an observational trial at six palms per accession and they are in vegetative /initial bearing stage.

The growth attributing characters for the year 2023 were recorded and significant differences were noticed among different accessions. The highest stem height (4.56 m), Number of leaves on crown (30.85), Total leaf length (583.50 cm) and petiole length (151.75 cm) were recorded in IC610311, while the highest stem girth at 1 m height (107 cm) was recorded in IC610306 and IC610311. Lowest stem height was recorded in IC610310 with 2.51 m. Earliest flowering (37 months after planting) was recorded in IC610306 (51 months).

Yield attributing characters for the year 2022-23 showed significant variation among the evaluated accessions. The highest number of inflorescences (11.61/palm/year), average number of buttons (403.25/palm/year) and number of fruits (144.01 palm/year) were recorded in IC610306. This accession was showed to be statistically on par for fruit yield with IC610307 (138.77 fruits/palm/year) and IC610309 (131.34 fruit/palm/year).

#### Arsikere

Five accessions *viz.*, TKB-1(IC610333), GNA-1(IC610339), HSH-2 (IC610341), KDK-1 (IC 610342) and KRN-1(IC610343) along with local check TPT are collected during 2011 and maintained as a replicated trial. Among the five different germplasm accessions, the IC610339 has recorded highest yield parameters like number of inflorescence (8.88 per palm per year), number of fruits (84.40 per palm per year). Tender and mature nut



IC610323 (7.9%). The RSW incidence and intensity were higher in accession IC610327 (37.7 and 25.4 % respectively) followed by accession IC610323 (25.7 and 17.6 % respectively)

#### Kahikuchi

The experiment was initiated during 2005 with ten local accessions CRP 701 (IC61035) to CRP 710 (IC610362) along with two check *viz.*, Kamrupa Tall and WCT in RBD with three replications. The experiment was laid out. Additionally, five accessions, IC610363, IC610364, IC610365, IC610366 and IC610367 were collected from Nowgaon and Marigaon districts and were planted during 2009 in a non-replicated (single row planting with six palms per genotype) observational trial.

Under the replicated trial, the data pertaining to the year 2023 showed that highest trunk height (6.4 m), trunk girth (193.5 cm), annual leaf production (11.9) and total number of leaves (34.9) and number of leaf scar (15.6) in 1 m length were recorded in IC610357. About reproductive characters, the highest number of inflorescence (11.9), female flowers/inflorescence (25.7) and fruit setting (30.4%) were also recorded in IC610357 followed by Kamrupa and the lowest values for number of inflorescence were obtained in IC610358. Among the accessions, significantly the highest nut yield of 95.2 nuts/palm/year was observed in IC610357 while the lowest (72.5 nuts/palm/year) was found in IC610355.

About nut characteristics, the IC610354 recorded the highest husked fruit weight, weight of husk, percentage of husk, kernel thickness, kernel weight and copra content/nut. Copra yield was recorded highest (17.0 kg/palm) in IC610357 which was at par with Kamrupa (16.3 kg/palm). With respect to pest incidence, the minimum incidence of rhinoceros beetle infestation (2.8%) was recorded in Kamrupa closely followed by IC610357 while, highest of 8.0% was found in IC610361. No incidence of eriophyid mite and RSW was noticed.

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characters of IC610339 were superior like volume of tender coconut water (393 ml) taste of water and endosperm was also good. The copra content of mature nut in IC610339 is 165.7 g higher among the five accessions under evaluation.

#### Bhubaneswar

The field trial was initiated during December 2003 with eleven locally collected germplasm accessions as an un-replicated observational trial with ten palms per accession. During the period of study, it was observed that the IC612457 performed better as compared to others by producing maximum number of inflorescences (12.00/palm/year) and no. of fruits (91 /palm/year); whereas maximum number of female flowers (263.40/palm/year) was observed in the IC612467. IC612467 also registered shortest stem height (5.76 m). Maximum number of functional leaves (37.40/palm) observed in the germplasm IC612457 and thickest girth (104.10 cm) at 1 m height were recorded in the IC612460. After cyclone "FANI" hit on third, May 2019, all palms were damaged severely. However, palms have been reviving from then and now, the yield is observed in increasing trend over the years.

### Jagdalpur

Six accessions were planted in July 2011 in RBD with four replications @ 4 palms per replication and their growth observations were recorded. The accession IC610323 (270.8 cm) recorded the highest plant height followed by accession IC610324 (244.3 cm). IC610324 (353.7 cm) also recorded the highest leaf length in comparison to the other accessions. The characters viz., annual leaf production and functional leaves had non-significant difference among themselves whereas, the Stem girth (141.6m) and the petiole length (133.8m) were higher in accession IC610325. Among the accessions, IC610328 recorded the highest rhinoceros beetle incidence (2.8%) whereas the red palm weevil incidence was the highest in accession IC610325 (9.2%) followed by accession



#### Mondouri

A total of ten local accessions were collected from different districts of West Bengal. Out of these local accessions, five (IC612447, IC612448, IC612449, IC612450 and IC612451) were planted in replicated trial during 2007 and remaining five local germplasms (IC612452, IC612453, IC612454, IC612455 and IC612456) were planted in observational trial during 2009.

Among the accessions evaluated under replicated trial, significant variations were recorded in different vegetative characters. IC612451 recorded maximum trunk height of 6.48 m followed by IC612448 (6.29m) and IC612449 (6.25m) when IC612450 recorded a minimum trunk height of 5.11m. In case of stem girth, IC612449 recorded maximum girth of 1.79 m followed by IC612447 (5.35m) whereas IC612451 recorded minimum basal girth of 1.56m only. Number of functional leaves per palm was recorded maximum of 10.62 in IC612449. Total leaves per palm were recorded maximum of 31.67 numbers in IC612451. The accession. IC612450 recorded maximum number of inflorescences (10 per palm per year) whereas IC 612447 recorded minimum (9 per palm per year). Maximum 219.67 numbers of female buds per palm per year was recorded in IC612447 and minimum of 208.33 numbers were recorded in IC612451. Fruits per palm were recorded maximum of 95.15 in IC612447 followed by IC612450 (92.46) and minimum of 84.21 per palm was recorded in the accession no IC612451. Maximum leaf length of 3.86 m was recorded in IC612449 and minimum of 3.29 in IC612451. Maximum petiole length of 1.75 m was recorded in IC612448 and IC612449 whereas minimum of 1.50 m was recorded in IC612450.

#### Navsari

The maximum stem/trunk height (5.10 m), stem girth (120.60 cm), numbers of annual leaf production/ palm (11.20 numbers), total number of leaves on crown (32.40 numbers), length of leaf (502.80 cm),

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petiole length (140.00 cm), inflorescence production per annum (11.00 numbers), number of female flowers (280.40) with nut yield per palm per year (74.80 nuts) was recorded in IC610319. Whereas minimum age at first flowering (45.33 months) was observed in IC610320. In case of fruit and copra characters, IC610322 recorded maximum fruit weight (1073.80 g), husked fruit weight (452.20 g), weight of husk (621.60 g), kernel weight (262.80 g), kernel thickness (1.23 cm), copra content (186.40 g/nut), copra yield (10.97 kg/palm) and tender nut water (309.80 ml/nut). Regarding to reaction of biotic stresses, IC610319 observed minimum per cent of incidence with respect to insectpest.

#### Ratnagiri

At Ratnagiri centre, a total of six local accessions collected from Konkan region were planted in replicated trial (CRP 757 to CRP 762) (IC599111 to IC599116) and remaining six were planted in observational trial (IC599994 to IC599999) during 2007 and 2010, respectively for evaluation. One more accession (sweet kernel coconut-Mohacha naral) IC599123 (CRP763 to CRP776 and one embryo cultured plantlets) which was collected from Guhagar Tahsil of Ratnagiri district, the fourteen seedling types and one set of embryo culture plantlets were planted in the field during 2007 for evaluation. Among the accessions evaluated under replicated trial, significant variations were recorded in different vegetative characters. The data on growth and flowering characters revealed that the maximum Stem height (479.7 cm) was recorded in IC599115. IC599115 recorded maximum Stem girth (110.3cm), IC599113 recorded maximum annual leaf production (12.3 nos.), IC599115 recorded maximum number functional leaves (28.1 nos.), IC599113 recorded highest leaf length (425 cm) and IC599112 recorded maximum petiole length (160.6 cm) among all genotypes under evaluation. Flowering was observed in all the genotypes. IC599113 recorded maximum no. of inflorescence



(11.3 nos.) and IC599116 recorded maximum no. of buttons (164.7 nos.). The accession IC599112 recorded maximum nuts yield (64.9 nuts), maximum whole nut weight (1412.5 g), maximum de-husked fruit weight (954.8 g) and maximum copra weight (188.1g). The Rhinoceros beetle incidence was highest in CRP 757 (4.73 %) whereas lowest in IC 599116 (0.68 %), the highest eriophyid mite incidence was in IC599112 (33.33 %) and highest RSW incidence was in IC599113 (4.0%) among all accessions under evaluation.

#### Sabour

Out of six germplasm accessions collected, four have been field planted during 2014 and other two during 2019. All the accessions are in vegetative growth stage till now.

## Veppankulam

At Veppankulam centre, five germplasm accessions (IC599263 to IC599267) have been collected and planted during 2005 as under planting along with two check varieties (Kera Keralam and ALRCN1). The old plants in this experiment were removed during 2012 and the experimental palms are now in bearing phase with real expressivity. Due to the damage caused by 'Gaja' cyclone during November 2018, twelve palms were lost and bunches in all the palms with different maturity were fallen. The trees

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are recovering gradually over the years with adequate irrigation and application of recommended dose of fertilizers, incorporation of vermincompost, neem cake and bio-fertilizers. The trunk height was higher in IC599266 (9.23m) and lower in IC599624 (8.52m) while the mean was 8.21m in the experiment. The girth was lower in VPM 4 (92.83cm) and higher in IC599263 (118.67cm) at 1m height and the average girth was 111.14 cm. The annual leaf production, total leaf production and breath of leaf were observed to be non-significant. The number of inflorescences per year per palm varied from 12.40 (IC599264) to 14.00 (IC599261), with an average of 13.10. The setting per cent was above 30% in four genotypes and the highest was recorded in IC599264 (36.66%).

#### **Evaluation of elite germplasm**

Multi Locational Trial (MLT) on elite coconut germplasm was initiated during 2015–16 at six AICRP centres *viz.*, Aliyarnagar, Arsikere, Ambajipeta, Bhubaneswar, Ratnagiri and Veppankulam. In all the centres, six elite accessions provided by ICAR-CPCRI along with a local check at respective centres were planted in Randomized Block Design (RBD) with three replications (Table 1). The objective is to test the performance for yield and their response to biotic and abiotic stresses under different agro climatic condition.

| Aliyarnagar    | Arsikere       | Ambajipeta     | Bhubaneswar          | Ratnagiri      | Veppankulam    |
|----------------|----------------|----------------|----------------------|----------------|----------------|
| YOP: 2015      | 2015           | 2016           | 2015                 | 2015           | 2016           |
| Verrikkobari   | Verrikkobari   | Verrikkobari   | Verrikkobari         | Verrikkobari   | Verrikkobari   |
| Nigerian Green | Nigerian Green | Nigerian Green | Nigerian Green       | Nigerian Green | Nigerian Green |
| Guam III       | Guam-II        | Guam- III      | Guam- III            | Guam- III      | Guam III       |
| Markham        | Markham        | Zanzibar       | Kenya                | Zanzibar       | Markham        |
| Straits        | Straits        | Straits        |                      | Straits        |                |
| Settlement     | Settlement     | Settlement     | Laguna               | Settlement     | Laguna         |
| Green          | Green          | Green          |                      | Green          |                |
| Palawan        | St. Vincent    | St. Vincent    | Palawan              | St. Vincent    | Palawan        |
| WCT (C)        | KPT(C)         | Pratap (C)     | Sakhigopal local (C) | Pratap (C)     | ECT (C)        |

Table 1. List of tall elite genotypes in different AICRP centres



#### Aliyarnagar

The observations on growth attributes revealed significant variation among different exotic collections for all traits except for functional leaves. The lowest stem height (378.3 cm) and the highest stem girth (116.6 cm) were recorded by the exotic genotype SSGT. The genotypes Verrikkobari Tall recorded with high rate of annual leaf production (12.1), a greater number of functional leaves (34.6) and maximum leaf length (584.5 cm) and petiole length (183.8 cm) and the minimum time taken for inflorescence emergence (42 months) was also observed in Verrikkobari Tall. Regarding the floral and yield parameters, maximum number of inflorescence production per annum (11.6), average number of spikelets (36.4), average number of buttons (23.4), fruit set (26.4 %) and nut yield (80.4/ palm/year) were recorded in Verrikkobari Tall. The incidence of rhinoceros beetle (3.9 %), RSW incidence (4.2%), intensity of RSW (3.6%) and eriophyid mite incidence (8.3 %) were recorded least in Markham Tall.

#### Arsikere

Among the germplasm accessions evaluated under replicated trial, significant variation was recorded for most vegetative growth characters. Straits Settlement Green Tall (SSGT) was observed to be more vigourous which recorded significantly higher palm height (7.66m), stem girth (139.13 cm), total leaf length (306.85cm), petiole length (132.85 cm), annual leaf production per palm (11.58). Early flowering (41.2 months), higher number of bunches (7.8 per year), button (88 per year) and spikelet (25.0 per inflorescence) were recorded in SSGT.

## Ambajipeta

Shorter palms (2.67 m) were observed in Guam-II Tall while taller stature was observed in St. Vincent Tall (3.90 m). Stem girth was recorded maximum in Zanzibar Tall (1.12 m), SSGT recorded 0.83 m least stem girth. Verrikobbari Tall (42 months) recorded earliest for flower initiation followed by SSGT (46 months). Male phase was recorded a greater number

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of days in St. Vincent Tall (21.67) and Straits Settlements Green (20.75). Female phase was recorded maximum in maximum in East Coast Tall (4.68) which was on par with Zanzibar Tall (4.23) and Verrikkobari Tall (4.11). Verrikkobari Tall and Straits Settlements Green recorded more nut yield 36.33 and 29.40 nuts/palm/year respectively.

No disease incidence was observed. However, the incidence of pests particularly RSW, rhinoceros beetle and red palm weevil was noticed. Per cent leaf damage by rhinoceros beetle was maximum (5.95) in Straits Settlements Green and minimum in Verrikkobari Tall (3.25). However, the incidence of Eriophyid mite was moderate in the all the accessions. The intensity of RSW was found medium in all the accessions.

#### Bhubaneswar

There was significant variation observed among the different accessions on yield contributing characters like numbers of inflorescences and female flowers/ palm and fruits/palm/year. Maximum numbers of bunches (10.37/palm/year), female flowers (122.42/ palm/year) and yield (30.42 fruits/palm/year) were recorded in Nigerian Tall followed by the Verikkobari Tall. Whereas, among the growth parameters, plant height, girth and petiole length were found statistically non-significant to each other.

#### Ratnagiri

Analyses on growth parameters revealed significant variation among different elite exotic collections. The minimum palm height (175.25 cm) recorded in St. Vincent Tall, maximum palm girth (120.42 cm) and annual leaf production was recorded in Guam-III Tall, functional leaves on crown (28.83 nos.) recorded maximum in Straits Settlement Green Tall, highest leaf length (351.67 cm) recorded in Guam-III Tall and petiole length (159.17 cm) recorded maximum in SSGT. The highest yield was recorded in Verikkobari Tall (42.33 nuts) followed by St. Vincent Tall (30.47 nuts). In respect of pest incidence, the percentage of Rhinoceros beetle incidence was lowest in Guam- III Tall (8.0%)

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whereas the highest incidence was observed in Nigerian Green Tall (12.8%). The RSW incidence was lowest in St. Vincent Tall (5.8%) while lowest intensity was in Guam- III Tall (3.28%).

# Veppankulam

Among the six elite types under evaluation Markham tall showed the dwarf stature (1.49m) and Nigerian Green Tall expressed slender stem girth (84.10 cm). Earliness in flowering was observed in Verrikkobari Tall (40 months after planting) followed by Nigerian Green (48 months after planting). All the palms started to yield, and the setting per cent ranged between 21 and 29. The genotype Verikkobari Tall registered higher number of fruits *i.e.*, thirty-nine nuts per year with 23% setting per cent. The Rhinoceros beetle incidence ranged between 3% and 4% and RSW incidence were medium in intensity. There was no red palm weevil incidence observed during 2022-23.

# Evaluation of location specific coconut hybrids.

The objective of the experiment is to assess the performance of location specific hybrid combinations in terms of yield and reaction to biotic stresses. This experiment was laid out at eight centers in RBD with four replications.

# Ratnagiri

Seven location specific Tall x Tall hybrids (PHOT x BENT, BENT x PHOT, PHOT x CRP 513, CRP 513 x PHOT, CRP 514 x PHOT, PHOT x CRP514, LCT x BENT) along with a check (Pratap) were planted during 2009. The growth characters in these specific coconut exihibited significant differences. The hybrid, COD x Pratap recorded the shortest palm height (499.75 cm) whereas the tallest palm height (622.92 cm) was in CRP-513 x Pratap. The cross, Pratap x COD recorded the highest palm girth (105.79 cm) whereas the lowest palm girth (78.32 cm) was in COD x Pratap. The highest annual leaf production (11.96 nos.) was recorded in COD x CRP-514. The highest number of functional leaves (31.67 nos.) observed

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in CRP-513 x COD. The highest leaf length (353.25 cm) was in hybrid, COD x CRP-514 and lowest petiole length (150.0 cm) was recorded in CRP-514 x COD. The hybrid COD x CRP-513 recorded maximum no. of inflorescence (12.64 nos.) whereas lowest (10.92 nos.) were in CRP-513 x COD. The hybrid COD x CRP-513 recorded maximum female flowers (227.5 nos.) whereas the lowest (196.6 nos.) was in CRP-513 x COD. The highest nut yield (102.5 nuts) was recorded in hybrid COD x CRP-513 followed by COD x Pratap (100.14 nuts) whereas the lowest (71.6 nuts) was in CRP-513 x COD. The maximum fruit weight (1296.5 g) was recorded in hybrid, COD x Pratap and maximum copra content (175.63 g) was in COD x Pratap. The Rhinoceros beetle incidence was lowest (10.6 %) in COD x CRP-513 and CRP-514 x COD whereas highest incidence was observed in COD x Pratap (13.4%). The RSW incidence and intensity was lowest in Pratap x COD (2.8 %) and (5.0 %), respectively. The lowest eriophyid mite incidence was recorded in COD x CRP-513 (11.3 %).

# Veppankulam

Six location specific cross combinations *viz.*, West Coast Tall x Kenthali Dwarf, West Coast Tall x Malayan Orange Dwarf, Malayan Orange Dwarf x West Coast Tall, Andaman Ordinary Tall x Chowghat Orange Dwarf, West Coast Tall x Malayan Green Dwarf and VHC 2 (Check) were planted in the main field during 2008 in RBD with four replications.

Earliness in flowering was observed in Verikkobari Tall (40 Months) followed by Nigerian Green (48 months).

Analysis of data revealed that the cross WCT x KD recorded dwarf palms (6.02m) with slender palms (81.38 cm) at 1m height. The number of leaf scars in 1m of stem was highest in VHC 2 15.50 and total leaves on crown in MOD x WCT (30.50). The annual leaf production was almost twelve in all the hybrids under study, and it was observed to be nonsignificant. The leaf and petiole length were higher in WCT x MOD (359.25 cm) and WCT x MGD



(122.25cm) respectively. The number of female flowers per inflorescence (34.60 Nos) and number of spathe (12.63) per palm per year was higher in MOD x WCT. The nut shape was oval in all the cross combinations. Except MOD x WCT, all the other combinations had the nut positioned at the centre. The nut length and breadth were higher in the cross-MOD x WCT (20.04cm and 14.32cm respectively) which was like the check VHC 2 (19.43cm and 15.02 cm respectively)

#### Bhubaneswar

At Bhubaneswar centre, the trial was conducted with five specific cross combinations since February 2008. The experiment was laid out in RBD with four replications. The parameter like plant height, girth, leaf production, number of bunches and number of nuts harvested were found significant, whereas leaf length found statistically non-significant. Among the different cross combinations, the shortest plant height (4.72 m) was recorded in the cross GBGD x Guam followed by the cross combination SKL x COD (5.10 m). Whereas, maximum number of annual leaves (13.00 numbers/palm/year), total leaf (37.60/ palm) and girth at 1 m height (131.20 cm)were observed in the cross combination SKL x COD. Whereas highest number of bunches (13.00 numbers/palm/year), maximum female flowers (412.60 numbers/palm/year) and nuts harvested (85.25 numbers/palm/year) were recorded in the cross combination SKL x GBGD. All the palms in the trial were severely affected by cyclonic storm "FANI" held on 3rd May 2019. However, palms are recovering gradually with time.

#### Arsikere

In Arsikere centre, six location specific hybrids were planted during 2012. Observation on growth parameters showed significant differences among hybrids. Among the tested hybrid combinations, TPT x MOD has recorded significantly higher annual leaf production per palm (11.95), functional leaves (23.25) inflorescence production per annum (10.40) and female flower production per palm (190.50) compared to other cross combinations. Among the six-hybrid combinations, the hybrid, TPT x MOD was observed to be earliest to start flowering 60 months. Higher yield (98.25 fruits/palm/year), tender nut water content (450.53ml/fruit) and copra content (145.3 per fruit) were recorded in the cross TPT x MOD.

#### Kahikuchi

The highest trunk height (4.4 m), girth (128.0 cm) were recorded in Assam Yellow Tall (AYT) x PHOT whereas, maximum leaf production per year (12.0), total number of leaves/palm (36.3), no. of inflorescence/palm (12.3), no. of female flowers/ inflorescence (27.2) and fruit setting (28.9%) were observed in AGT x PHOT. Significantly the highest fruit yield (97.6 nuts/palm/year) was recorded in AGT x PHOT followed by AGT x MYD (86.0 nuts/ palm/year) whereas, the lowest yield (75.6 nuts/ palm/year) among the cross combinations was found in Bengal Hazari x AGT. About nut characteristics, significantly the highest husked fruit weight, weight of husk, kernel weight, copra content and copra yield (17.5 kg/palm) were observed in AGT x PHOT. Pest incidence in different cross combination revealed that the lowest incidence of rhinoceros beetle (2.8%) was observed in check variety (AGT) followed by AGT x PHOT (3.6%) whereas, the highest (8.1%) was recorded in AYT x PHOT. No incidence of eriophyid mite and RSW was noticed.

#### Ambajipeta

The hybrid combinations *viz.*, ECT x Cochin China, GBGD x Cochin China, ECT x PHOT, GBGD x PHOT, PHOT x GBGD and ECT x GBGD were planted in June 2011 in randomized block design with four replications. Due to Helen and Philin cyclones during October & November 2013, some of the accessions were badly affected. Gap filling has been done during the month of February 2014 and the experiment is in bearing stage. Growth characters for 2023-24 of these coconut hybrids revealed that the cross, ECT x Cochin China recorded significantly higher plant height (6.23 m)



and was on par with ECT x PHOT (5.99 m), whereas, plant girth (1.14 m) was recorded as the highest in ECT x PHOT and was on par with ECT x Cochin China (1.08 m). ECT x GBGD noted a greater number of leaf scars in 1m (18.13). GBGD x PHOT recorded maximum total leaf length (6.00 m) which was on par with all cross combinations under evaluation except for GBGD x Cochin China (5.64) and ECT x GBGD (5.66 m). PHOT x GBGD recorded shorter duration for first flowering, i.e., 45 months after planting followed by GBGD x Cochin china (46 months). The cross combination, ECT x Cochin China has recorded the highest yield (114.15 fruits/palm/year), and was on par with ECT x GBGD (105.53 fruits/palm/year) and ECT x PHOT (105.75 fruits/palm/year). Lowest yield was recorded in GBGD x Cochin China (75.09 fruits/palm/year). Husked fruit weight was recorded the highest in GBGD x Cochin China (689.25 g), which was on par with GBGD x PHOT (600.96 g), Copra weight was noted higher in GBGD x Cochin China (151.92 g/nut) which was on par with ECT x Cochin China

(143.79 g). Maximum copra yield was recorded in ECT x Cochin China (15.21 kg/palm), which was on par with all cross combinations under evaluation except for ECT x GBGD. Oil content was recorded the highest in PHOT x GBGD with 60.41 %.

## Aliyarnagar

Among the hybrids in Set I the cross, COD x WCT proved its dwarf stature by registering minimum palm height (466.8 cm) and the maximum was recorded in ALR x MGD (542.8cm). Maximum trunk girth (113.5 cm) was noticed in local check variety Kalpatharu. Among the five hybrid combinations, the combination MGD x ALR was observed to be the earliest to start flowering (34 months). Maximum number of leaf scars (18.4/m), annual leaf production (11.8), number of functional leaves (36.8/palm), higher petiole length (175.7 cm), number of bunches (11.5/palm/year), number of spikelets (38.2/spathe) and number of buttons (19.6/spathe) were registered by COD x ALR hybrid. The maximum yield was

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also recorded in the hybrid COD x ALR (150.3 fruits/palm/year) followed by ALR x MGD (140.9 fruits/palm/year) and MGD x ALR (128.2 fruits/ palm/year). The analyses of nut component traits showed significant difference among the genotypes. The cross, COD x WCT recorded higher fruit length (27.6 cm), fruit breadth (16.2 cm), whole nut weight (1711.4 g), de-husked nut weight (670.3 g), kernel weight (389.3g) and copra content per nut (160.4 g). The maximum copra yield (20.3 kg/palm), copra out turn (3.6 t/ha) and more tender nut water content (470.3 ml/fruit) were observed in COD x ALR. The appraisal of hybrid combinations against pest incidence exposed that, Kalpatharu recorded the least incidence of rhinoceros beetle (3.2%), RSW incidence (5.3%) and intensity (4.3%) and KTD x ALR registered minimum incidence of eriophyid mite (7.2%). The infestation of red palm weevil, black headed caterpillar and bud rot disease were not observed in the experiment during the reporting period.

# **Evaluation of location specific Tall x Tall** hybrids.

Multi location trial was initiated at Ambajipeta (2011), Ratnagiri (2009) and Veppankulam (2009) with an objective to evaluate Tall x Tall (T x T) hybrids for yield and reaction to biotic stress. The experiment was laid out with seven hybrids under Randomized Block Design with four replications.

## Ambajipeta

Growth parameters recorded in the year 2023 showed non-significant differences for growth parameters except for total leaf length. The highest palm height was recorded in cross combination Java Tall x ECT (5.44 m) and highest girth at 1m height was recorded in cross combination PHOT x ECT & Cochin China x ECT (1.08 m). Highest total leaf length was recorded in Cochin China x ECT with 6.25 m which was on par with PHOT x ECT (5.81 m) and Fiji Tall x ECT (5.83 m).

Further, yield parameters recorded significant differences for number of female flowers in LCT x



ECT with 210.87, which was significantly on par with all other cross combinations under evaluation except for Fiji Tall x ECT (151.95). The highest fruit yield was recorded in LCT x ECT (94.44 fruits/ palm/year), which was on par with Cochin China x ECT (90.39 fruits/ palm/year), ECT x Fiji Tall (83.43 fruits/palm/year) and ECT (85.39 fruits/palm/year). The matured nut characters recorded significant difference for Husked fruit weight, weight of the Husk, Kernel weight and copra content. Significantly higher husked fruit weight was recorded in Cochin China x ECT with (568.67 g) which was on par with PHOT x ECT (554.00 g) and ECT x PHOT (502.67 g). Kernel weight was recorded significantly higher in PHOT x ECT (273.61 g/nut) which was on par with Cochin China x ECT with (250.74 g/ nut) and ECT x PHOT (245.14 g/nut). Copra content was significantly higher in PHOT x ECT (172.43 g/nut) which was on par with Cochin China x ECT with (157.01 g/nut) and ECT x PHOT (157.05 g/nut).

# Ratnagiri

The local check Pratap recorded lowest palm height (4.41 m). The hybrid PHOT x BYR recorded maximum palm girth (114.1 cm) whereas the lowest palm girth (97.5 cm) was in local check. The highest number of functional leaves (29.3 per palm) was observed in hybrid, BGL x PHOT. The highest leaf length (385.0 cm) was in PHOT x BGR and highest petiole length (155.0 cm) was recorded in hybrid BGL x PHOT. Hybrid, BGR x PHOT recorded the highest number of inflorescence (12.4/palm/year) and female flowers (222.7 per palm per year). The highest yield (97.7 fruits/palm/year) recorded in BGR x PHOT followed by BYR x PHOT (85.5 fruits) among all the location specific Tall x Tall coconut hybrids. The highest fruit weight (1448.3 g) was recorded in BGL x PHOT. The copra content (180.3 g) was the highest in hybrid BGR x PHOT. In respect of pest incidence, the Rhinoceros beetle incidence was lowest in LCOT x BGR (8.07%) whereas highest incidence was observed in BGL x

PHOT (11.01%). The RSW incidence and intensity were lowest in BYR x PHOT (1.22% and 2.25% respectively) and the lowest eriophyid mite incidence was also recorded in PHOT x BGL (6.45%).

#### Veppankulam

The palm height and girth varied between 4.95 m to 5.25m and 95.75 to 119.25 cm, respectively. The annual leaf production was above 11 in the entire cross combinations and the total number of leaves on crown was above 25. The total number of female flowers were above 260 per inflorescence and mean inflorescence production was 11.50. The fruit dimensions were high in the check and in ECT x PHOT. The setting percent was highest in ECT x PHOT i.e., 38.89 per cent. The number of nuts was above 90 nuts in all the cross combinations and the highest nuts per palm per year was recorded in ECT x JG (114.40 nuts) and ECT x PHOT (112.00 nuts). The copra yield was higher in ECT x PHOT (178g/ nut) which was higher than the check VHC 3. The per cent Rhinoceros beetle incidence was least in the cross WCT x PHOT i.e., 3.02%. There was no incidence of red palm weevil observed in any of the crosses. The eriophyid mite incidence was almost moderate in all the crosses under the study. RSW intensity was medium in all the crosses except ECT x JG and VHC 3 which were observed to be high.

#### **Evaluation of Tall x Tall coconut hybrids**

This experiment was started with the objective to assess five Tall x Tall hybrids, viz., LCT x ADOT, ADOT x ECT, BENT x ADOT, ECT x LCT and WCT x TPT at various agro-climatic regions. The hybrids were produced at CPCRI, Kasaragod and supplied to eight AICRP (Palms) centres *viz.*, Aliyarnagar, Ambajipeta, Arsikere, Bhubaneshwar, Kahikuchi, Navsari, Ratnagiri and Veppankulam for evaluation in RBD with three replications and six palms per genotype per replication

#### Aliyarnagar

WCT X TPT was significantly observed as short statured one with minimum palm height (5.34 m).



The maximum plant girth (116.8 cm), leaf scars in 1 m length (16.0), high rate of annual leaf production (12.0), higher number of functional leaves on the crown (34.9), total leaf length (589.6 cm), petiole length (162.7 cm), number of bunches (12.0/palm/ year), number of spikelets (34.1/inflorescence) and nut yield (139.4/palm/year) were recorded by with BENT x ADOT. Regarding the nut component traits concerned, the cross BENT x ADOT recorded maximum fruit length (26.1 cm), fruit breadth (16.5 cm), fruit weight (1756.2 g), de-husked fruit weight (678.1 g), kernel weight (368.4 g), kernel thickness (1.5 cm), copra content (168.7 g/nut), copra yield per palm (23.5 kg/palm), copra out turn per hectare (4.2 t/ha) and tender nut water content (468.0 ml) among the Tall x Tall hybrid combinations. The assessment of hybrid combinations for reaction to pest incidence revealed that, BENT x ADOT cross recorded the least incidence of rhinoceros beetle (4.2%), RSW incidence (3.9%) with intensity (3.1 %) and eriophyid mite incidence (5.6 %)

#### Ambajipeta

The cross combination ADOT x ECT recorded maximum palm girth (1.20 m). However, the remaining growth parameters *viz.*, palm height, annual leaf production, total leaf length, petiole length and number of leaf scars were found to be non-significant. However, LCT x ADOT recorded highest number of female flowers/palm/year (305.14) and number of fruits/palm/annum (119.46). With respect to matured nut characters, the maximum husked fruit weight (543.23 g), less per cent of husk weight (47.82 %), kernel weight (289.44 g/nut), copra content (159.50 g/nut) and copra yield (16.32 kg/palm) was recorded in BENT x ADOT

#### Arsikere

Among the different hybrid combinations, LCT X ADOT has recorded significantly higher annual leaf production per palm (10.68), total number of leaves on the crown (23.79), number of inflorescence per palm per year (11.25), number of nut per palm (82.36), female flower per palm per annum (182), setting (47.86 %) and copra content (14.50 kg/ palm/year) compared to other cross combinations.

#### Bhubaneswar

Maximum number of female flowers (307.78/palm/ year) and fruit yield (113.65 fruits/ palm/ year) was recorded in WCT x TPT. However, other growth parameters like plant height, girth, no. of functional leaf, leaf length and petiole length were found to be statistically non-significant.

#### Kahikuchi

The highest palm height (3.50 m), girth (121.0 cm), annual leaf production (11.8) and no. of total leaves (33.7) were observed in LCT x ADOT. The cross combination BENT x ADOT recorded the lowest trunk height (2.7 m) with maximum number of scars in 1 m length of trunk (15.8), highest number of inflorescence (10.7), no. of female flowers/ inflorescence (25.1), fruit setting (28.8%) and yield (71.0 fruits/palm/year).

#### Ratnagiri

Local check (Pratap) recorded the highest plant height (549.58 cm), plant girth (115.92 cm), no. of functional leaves (30.8 nos.) and leaf length (404.6 cm). The hybrid WCT x TPT recorded maximum no. of inflorescence (12.11 nos) and female flowers (217.92 nos.) with the highest yield (92.92 fruits/ palm/year). The highest fruit weight (1310.25 g) was in ECT x LCOT and the highest copra content (179.0g) were in WCT x TPT. In respect of pest incidence, the percentage of rhinoceros beetle incidence was lowest in LCOT x ADOT (8.3 %) whereas, the percent of RSW incidence and intensity were lowest in ECT x LCOT (2.59 %) and (2.59 %) respectively. The lowest eriophyid mite incidence was recorded in BENT x ADOT (7.31 %).

#### Veppankulam

Among the five crosses and local check (VHC3), the performance of LCT x ADOT expressed the



dwarf stature (5.91 m), and all the crosses recorded higher number of fruit bunches (more than twelve bunches per palm) and annual nut yield of 158.60 nuts/palm/year was observed in BENT x ADOT. The setting per cent was above 30% in all the crosses except ECT x LCT, WCT x TPT and VHC 3 under study. The copra content was highest in BENT x ADOT (22.49 kg per palm per year).

#### Navsari

Minimum stem/trunk height (3.85 m) with maximum stem girth (101.00 cm), annual leaf production (11.50 numbers), total numbers of leaves on the crown (32.50 numbers), leaf scars in 1 m length of trunk Annual Report 2023

(14.40 numbers), inflorescence production per annum (10.75 numbers), number of female flowers per palm (248.00), fruit setting (30.83 %) and nut yield per palms per year (76.25 nuts) with minimum age at first flowering (39 months) was noted in treatment BENT x ADOT whereas, maximum fruit weight (1114.75 g), husked fruit weight (555.50 g), kernel weight (267.00 g), copra content (140.50 g/ nut), copra yield (10.72 kg/palm) and tender nut water (422.75 ml) with minimum per cent husk weight (49.65 %) were also recorded in treatment BENT x ADOT.

| Centres/year of planning | Best performing hybrid | Nuts/palm/year |
|--------------------------|------------------------|----------------|
| Aliyarnagar (2011)       | BENT x ADOT            | 118.9          |
| Ambajipeta (2011)        | LCT x ADOT             | 119.4          |
| Arsikere (2012)          | ADOT x ECT             | 94.2           |
| Bhubaneswar (2013)       | WCT x TPT              | 113.6          |
| Kahikuchi (2013)         | BENT x ADOT            | 71.0           |
| Navsari (2013)           | BENT x ADOT            | 76.2           |
| Ratnagiri (2011)         | WCT x TPT              | 99.9           |
| Veppankulam (2011)       | BENT x ADOT            | 158.6          |

#### Summary of yield data of best performing TxT hybrids under different centres

# Evaluation of Dwarf x Dwarf coconut hybrids in different agro climatic conditions

**Centres**: Ambajipeta, Mondouri, Pilicode, Ratnagiri and Veppankulam

This experiment was laid out to develop dwarf statured hybrids for tender nut yield and quality and to screen for pest and disease incidence. The experiment comprising five Dwarf x Dwarf hybrids *viz.*, COD x MYD, COD x MGD, MGD x CGD, GBGD x MOD and CGD x MGD supplied by ICAR-CPCRI, Kasaragod along with a local check was planted in RBD with four replications and six palms per genotype per replication. In Mondouri and Pilicode centres, the performance of the hybrids were very poor with very high incidence of pest and diseases which resulted in loss of many palms.

#### Ambajipeta

This experiment was initiated at Ambajipeta during 2011. Due to Helen and Philin cyclones in 2013, some of the hybrids were severely affected. Gap filling was done with planting material received from CPCRI, Kasaragod in March 2014. However, initiated production of COD x MYD seed nuts in 2015 and seed nuts were harvested in 2016. These seedlings were raised in poly bags during 2017, and the selected seedlings were planted in experimental plot in 2018. These seedlings were established in the field and are in vegetative stage. Further, the other



cross combinations of the experiment are in bearing stage. Data pertaining to growth attributes and nut yields showed that the mean lowest plant height was recorded in GBGD (3.29 m), and maximum was recorded in MYD x CGD (5.05 m) while, the maximum stem girth was recorded in MYD x CGD (109.69 cm), lowest in GBGD (78.15 cm). Highest number of inflorescences per palm was recorded maximum in COD x MGD (12.12 nos.) which was on par with MYD x CGD (10.53 nos.). Total number of buttons per palm was recorded more in COD x MGD with 255.90, on par with MYD x CGD (228.93) and CGD x CGD (231.02). The highest fruit yield (98.69/palm/annum) was recorded in COD x MGD which was on par with MYD x CGD (80.13 fruits/palm/annum) and CGD x MGD (77.38 fruits/palm/annum). Whereas minimum nut vield was recorded in GBGD (64.53 nuts/palm/ annum). Tender nut water content was recorded maximum in COD x MGD (418.33 ml/nut). GBGD x MOD and GBGD had low (3.34 %) and high (8.92 %) per cent leaf damage due to rhinoceros beetle respectively, while the per cent spindle damage was 4.16 %, 2.41 % and 3.34 % respectively in GBGD x MOD, CGD x MGD and GBGD. Eriophyid mite damage was lesser in GBGD and the exihibited had moderate mite intensity.

#### Ratnagiri

At Ratnagiri centre, the trial was initiated during 2011 with five D x D hybrids and one check variety (COD). The growth characters showed significant difference among the D x D hybrids. Data revealed that COD recorded lowest palm height (276.3 cm) whereas highest palm height (419.4 cm) was observed in MYD x CGD. Hybrid CGD x MGD recorded maximum plant girth (85.1 cm) and maximum annual leaf production (11.24 nos.) was in the hybrid COD x MYD. The maximum no. of functional leaves (28.91 nos.) was recorded in COD x MYD. Hybrid GBGD x MOD showed early

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flowering after planting (27.83 months) followed by COD x MGD (28.79 months). The hybrid COD x MYD recorded maximum annual number of inflorescences (11.8 per palm per year) and female flowers (177.5 nos.). The hybrid COD x MYD recorded highest annual tender nut yield (91.58 fruits) followed by the hybrid GBGD x MOD (85.55 fruits). The hybrid COD x MYD recorded maximum volume of tender nut water (604.6 ml/nut). As per Total soluble solids (TSS) of water, the maximum score was recorded in the hybrid GBGD x MOD (6.0 °Brix) followed by COD x MYD (5.4 °Brix). Rhinoceros beetle incidence was lowest in local check COD (6.5%) whereas highest incidence was observed in MYD x CGD (8.9%). RSW incidence and intensity was lower in COD x MGD (2.71 %) and (2.58%), respectively and the lowest eriophyid mite incidence was recorded in COD x MYD (8.66 %).

# Veppankulam

This trial was started during 2011 at Veppankulam centre. Among five cross, MYD x CGD palms commenced flowering at 22<sup>nd</sup> month after planting, indicating its promising nature for the earliness. Based on morphological characters recorded, it is revealed that, MYD x CGD expressed the dwarf stature (4.03 m) with less stem girth (78.56 cm) and regarding the tender nut quality parameters, GBGD x MOD recorded maximum volume of tender nut water (605.30 ml/nut). Regarding the Total Soluble Solids, all the crosses exhibited around 6.01 °Brix. GBGD x MOD was recorded higher average yield of tender nuts (91.56 fruits per palm per year). Regarding the pests, Rhinoceros beetle was observed on all the cross combinations as like RSW and eriophyid mite. There was no incidence of RPW and BHC in the entire set of cross combinations.





# Summary of yield data of best performing DxD hybrids under different centres

| Centres     | Tender nut<br>vield  | Cumulative<br>tender nut yield | Estimated<br>tender nut water | TSS<br>( <sup>0</sup> Brix) | Total<br>Sugars | Sodium<br>content | Potassium content |
|-------------|----------------------|--------------------------------|-------------------------------|-----------------------------|-----------------|-------------------|-------------------|
|             | (nuts/<br>palm/year) | (nut/palm) (last<br>7 years)   | (lit./palm/yr)                |                             | (g/100ml)       | (ppm)             | (ppm)             |
| Ambajipeta  | COD x                | COD x MGD                      | COD x MGD                     | MYD x                       | GBGD x          | CGD x             | GBGD x            |
|             | MGD                  | (590.06)                       | (41.28)                       | CGD                         | MOD             | MGD               | MOD               |
|             | (98.69)              | GBGD x MOD                     | MYD x CGD                     | (7.63)                      | (4.25)          | (26.55)           | (2750.67)         |
|             |                      | (445.14)                       | (32.30)                       |                             |                 |                   |                   |
| Ratnagiri   | COD x                | COD x MYD                      | COD x MYD                     | GBGD                        | COD x           | GBGDx             | COD x             |
| _           | MYD                  | (538.58)                       | (41.96)                       | x MOD                       | MYD             | MOD               | MYD               |
|             | (91.58)              | GBGD x MOD                     | GBGD x MOD                    | (6.0)                       | (4.29)          | (26.0)            | (3300.0)          |
|             |                      | (504.45)                       | (34.71)                       |                             |                 |                   |                   |
| Veppankulam | GBGDx                | GBGD x MOD                     | GBGD x MOD                    | COD x                       | MYD x           | COD x             | GBGD x            |
|             | MOD                  | (585.89)                       | (71.96)                       | MGD                         | CGD             | MGD               | MOD               |
|             | (118.89)             | CGD x MGD                      | MYD x CGD                     | (6.27)                      | (4.1)           | (29.65)           | (2290.34)         |
|             |                      | (515.59)                       | (57.87)                       |                             |                 |                   |                   |



GBCD x MOD palm at Veppankulam Centre


## 4.2. Oil Palm

## Evaluation of new cross combination in oil palm

#### **Pasighat**

The growth of the palms with respect to stem height and stem girth was found to be non-significant and statistically at par in all the cross combinations. Maximum number of leaves (22.66) was produced by the cross combination NRCOP-22 which was significantly higher than any other treatment. Minimum number of leaves (19.30) was produced by NRCOP-30 which was at par with NRCOP-29, NRCOP-25, NRCOP-24 and NRCOP-23. Maximum number of male flowers (7.43, 8.36 and 8.50) were produced by the cross combination NRCOP-30, NRCOP-29 and NRCOP-28, respectively. The minimum number of male flowers were recorded in the cross combination NRCOP-22(5.73) which was significantly less than other crosses except NRCOP-27, NRCOP-26 and NRCOP-24. Maximum number of female flowers (11.20) were produced by the cross NRCOP-22 which was significantly higher than the female flowers produced by other cross combinations and at par with NRCOP-26 (10.30). Minimum number of female flowers (9.03) were produced by the cross NRCOP-23. The sex ratio was recorded highest (0.65) in NRCOP-22. Sex ratio was recorded least (0.51) in NRCOP-30. Maximum number of Fresh Fruit Bunches (9.30) was produced by NRCOP-22 whereas the NRCOP-30 produced the least number of FFB (6.53) per palm. The average bunch weight was recorded maximum (12.56 Kg) in NRCOP-26 which was at par with NRCOP-22 (12.53 Kg). The bunch weight was least in NRCOP-23 (9.16 Kg). Highest FFB yield was recorded in NRCOP-22 (16.63 t/ha) which was significantly higher than any other cross combinations except NRCOP-26 (15.33 t/ha).

## Pattukottai

Nine hybrids viz., NRCOP 31, 32, 33, 34, 35, 36, 37, 38 and 39 were planted on 26.02.2013 in ARS, Pattukkottai. Among nine hybrids received, only five hybrids (NRCOP 31, 32, 33, 38 and 39) are in replicated trial and the other four hybrids viz., NRCOP 34, 35, 36 and 37 are in non-replicated observational trial. The palm height ranged from 4.80 to 5.35 m amoung the hybrids under replication. The hybrid NRCOP -32 recorded significantly higher palm height of 5.35 m. The lowest palm height (4.80 m) was recorded in the hybrid NRCOP 39. The palm girth was ranged between 3.10 m (NRCOP 31) and 3.68 m (NRCOP 38). Leaf production per palm per year was the highest in NRCOP 39 (24.90) and the highest number of male inflorescence (7.90) was recorded in NRCOP 39 which was closely followed by NRCOP 33 (7.72). The lowest number of male inflorescence (6.59) was recorded in NRCOP 32. The number of female inflorescences was ranged between 11.58 and 12.55. The number of female inflorescence (12.55) was the highest in NRCOP 38, whereas the percentage of female flowers was high in NRCOP 32 (65.00%). Data on yield attributes revealed that the number of

fresh fruit bunches per palm are more in the hybrid NRCOP 31 (9.50) followed by NRCOP 32 (9.45). Average weight of the fresh fruit bunches ranges from 15.50 kg to 19.00 kg and highest bunch weight was observed in the hybrid NRCOP 38 (19.00 kg). The highest FFB yield per palm of 178.60 kg and FFB yield per hectare of 25.54 tonnes was registered in the hybrid NRCOP 38 followed by NRCOP 32 (23.11 t/ha) during the reporting period.

## Vijayarai

The trial was laid out during July 2011. Ten progeny cross combinations of oil palm (NRCOP-31 to NRCOP-40) were planted in triangular system at spacing of  $9 \times 9 \times 9$  m in RBD with 3 replications



and 6 palms per treatment. There were no significant differences observed among the cross combinations for number of leaves per palm per year, rachis length, bunch production and FFB yield. Significantly lowest palm height recorded in the cross NRCOP-36 (3.73 m) and highest palm height was recorded in the cross NRCOP-40 (5.39 m) Annual height increment recorded lowest in the crosses NRCOP-37, 38 & 39 showing 3.4, 3.5 & 3.4 cm respectively. Girth of the palm was recorded higher in the crosses NRCOP-36, 38 & 39 showing 3.04, 3.17, 3.11m respectively. Sex ratio recorded significantly highest in the cross NRCOP-39 (0.61), Average bunch weight recorded significantly higher in the cross NRCOP-33 (24.6 kg), FFB yield recorded was 171 kg/palm/year in NRCOP-38 which is yielding FFB of 24.5 t/ha/year. In bunch analysis parameters, Bunch weight, Total number of fruits/bunch, Fruit/ bunch ratio, % Mesocarp/fruit, % Kernal/fruit, % Oil/bunch, % Kernal oil/fruit, % Kernal oil/bunch and Kernal oil yield parameters were also not differed significantly among the ten new progeny crosses. Significantly highest shell per fruit was recorded in the cross NRCOP-31 (30.80) and lowest recorded in the cross NRCOP-40 (10). Significantly highest oil yield of 6.05 t/ha was recorded in the cross NRCOP-38, followed by NRCOP-37 (5 t/ha).

## Mulde

Growth parameters exhibited non -significant variation, however the highest plant height recorded in NRCOP 33(6.25 m), while minimum height increment 0.14 m recorded in NRCOP 35. The yield parameters differed significantly. The highest number of female inflorescences was recorded in NRCOP 39 (8.71). The highest sex ratio recorded in NRCOP 39 (8.71). The highest sex ratio recorded in NRCOP 31 & NRCOP 39 (0.66). The highest number of FFB was recorded in NRCOP-31(6.39). The highest weight of FFB (21.42kg/bunch) along with highest yield was recorded in NRCOP-31 (137.25 kg/palm/year) and (19.62 t/ha.). The highest % of mesocarp recorded as 67.15% in

NRCOP 40, whereas per cent kernel per fruit was maximum in NRCOP 39 (13.24%). Percent oil per Bunch recorded maximum in NRCOP 36 (34.57%), whereas higher oil yield was recorded in NRCOP 31 (5.79 t/ha) with highest kernel oil yield (0.18 t/ ha)

## **Pasighat**

Non-significant difference was observed among the hybrids with respect to stem height, stem girth and number of leaves. The maximum stem girth (113.83 cm), stem height (188.96 cm) and number of leaves (18.9) was recorded in NRCOP-37, NRCOP-36 and NRCOP-37, respectively. Least number of male flowers (6.5) was produced by NRCOP- 32 and maximum (9.3) by NRCOP- 39. Maximum female flowers (6.7) were recorded in NRCOP-37 which was statically at par with all other cross combinations. Sex ratio was the highest (0.49) in NRCOP-37 and lowest (0.35) in NRCOP-39. The number of FFB/ palm was recorded maximum (6.86) in NRCOP-37 while least (4.70) was in NRCOP-40. The average bunch weight was recorded maximum (7.66 kg) in NRCOP-37. The minimum bunch weight (6.16 kg) was noted in NRCOP-39. The mean yield/palm and yield t/ha was maximum (52.68 kg/palm and 7.53 t/ha) in NRCOP-37 which was better than any other cross combination. The yield was recorded least (4.33 t/ ha) in NRCOP-39.

## Evaluation of D X P hybrids for dwarfness and yield in oil palm

## Vijayarai

Twelve entries of oil palm including eleven  $D \times P$ (NRCOP-41 to NRCOP-51) along with one control (646) were planted in triangular system at spacing of  $9 \times 9 \times 9$  m in RBD with 3 replications and 9 plants per treatment during 2013. There were no significant differences among the entries for palm height (m), annual height increment, number of leaves per palm per year and number of bunches per palm



per year, FFB yield (kg/palm/year) and FFB yield (t/ha/year).

However, the hybrids differed significantly for palm girth where NRCOP-43 recorded significantly highest girth of 3.06 m which was on par with the crosses NRCOP-41,45 & 46. Rachis length was highest in NRCOP-43 (525.12cm) which was on par with all crosses except NRCOP-46, 47 & 48. Sex ratio recorded was significantly highest in the cross NRCOP-42 (0.72) and on par with the crosses, NRCOP-41, 43, 44, 45, 51 & 52. Average bunch weight was the highest in NRCOP-44 (19.50kg) followed by NRCOP-42 (19.05 kg). Highest FFB yield of 215.24 kg/palm was recorded in the palm NRCOP-44 accounting to 30.77 t/ha/ year.



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NRCOP-26 at Pasighat Centre



Oil Palm Plantation in Arunachal Pradesh





## 4.3. Palmyrah

## Survey and collection of high yielding dwarf palmyrah germplasm and evaluation (*Borassus flabellifer* L.)

## Killikulam

Survey and collection of palmyrah germplasm was done to identify dwarf and superior palmyrah genotypes for high neera and nungu yield. So far, 265 number of Palmyrah germplasm accessions were collected and are being maintained as year wise germplasm blocks. The germplasm accessions are being evaluated for various biometric, yield and yield related characters.

Trees belong to different accessions planted in the year 1995, 1997 and 2001 started flowering. In 1995 planted accessions, the highest bunch weight (5.8 kg), average number of fruits per bunch (6) was recorded with Acc. No. 02/95 followed by Acc. No.22/95 after 25 years of planting. Among the 10 accessions of 1997 planted germplasm, Acc.

No. 1/97 has recorded the highest bunch weight (9.2 kg) where as maximum number of fruits per palm was recorded in Acc. No.25/97. In 2001 planted germplasm accessions, flowering was observed only in few palms in which the highest bunch weight (8kg) and fruit weight (560g) was recorded in Acc. No. 72/01. This accession is identified as a unique producing biggest sized fruits among the all germplasm accessions that have come to flower sofar.

#### Pandirimamidi

Survey and collection of palmyrah germplasm had been undertaken to identify dwarf and highly yielding palmyrah genotypes. Till date, 272 Palmyrah germplasm accessions were collected and are being maintained as year wise germplasm blocks. The accessions are being evaluated for biometric, yield and yield related characters. The data on biometrical observations, flowering and fruiting characters and tender fruit traits were recorded in year wise blocks.



Flowering in Acc 72/01



Palmyrah gene bank at Killikulam Centre





Flowering in Acc 2009/05



Palmyrah gene bank at Pandirimamdi Centre

## Palmyrah Fruit data: Performance of palmyrah collections 1991:

| Acc. No. | Number of bunches/palm | Bunch wt. (kg) | No. of fruits per<br>bunch | Fruit wt. (g) | Fruit yield/palm<br>(kg) |
|----------|------------------------|----------------|----------------------------|---------------|--------------------------|
| 1991/1   | 7                      | 9              | 9                          | 948           | 60                       |
| 1991/2   | 7                      | 7              | 6                          | 1020          | 49                       |
| 1991/3   | 3                      | 8              | 8                          | 923           | 22                       |
| 1991/4   | 7                      | 10             | 10                         | 1050          | 71                       |
| 1991/5   | 5                      | 7              | 7                          | 945           | 33                       |
| 1991/6   | 4                      | 7              | 6                          | 994           | 23                       |
| 1991/7   | 5                      | 11             | 10                         | 1077          | 54                       |
| 1991/8   | 5                      | 9              | 8                          | 736           | 29                       |
| 1991/9   | 5                      | 10             | 13                         | 776           | 50                       |
| 1991/10  | 7                      | 7              | 8                          | 929           | 52                       |
| 1991/11  | 8                      | 11             | 7                          | 1253          | 70                       |
| 1991/12  | 8                      | 9              | 10                         | 915           | 73                       |
| 1991/13  | 6                      | 11             | 16                         | 755           | 72                       |

In 1991 planted germplasm accessions the highest fruit yield per palm recorded in (73kg) Acc. No.

12/91 followed by Acc. No.1/91(72kg) and 1991/ 4 (71 kg).

## Performance of palmyrah collections 1993

| Acc. No. | Number of     | Bunch wt. (kg) | No. of fruits per | Fruit wt. (g) | Fruit yield/palm |
|----------|---------------|----------------|-------------------|---------------|------------------|
|          | buildies/pain |                | Dunch             |               | (Kg)             |
| 1993/2   | 6             | 11             | 12                | 930           | 67               |
| 1993/3   | 6             | 7.0            | 10                | 690           | 41               |
| 1993/4   | 7             | 8.0            | 7                 | 1188          | 56               |
| 1993/5   | 9             | 11.0           | 8                 | 1035          | 75               |
| 1993/6   | 8             | 6.0            | 5                 | 830           | 33               |
| 1993/9   | 5             | 4.0            | 5                 | 772           | 19               |



Among the accessions of 1993 germplasm, Acc. No. 5/93 and 2/93 recorded the highest fruit yield of (75kg) and (67kg). This year we couldn't find the pink husk trait in Acc. No.2.

| Acc. No. | Number of bunches/palm | Bunch wt. (kg) | No. of fruits per<br>bunch | Fruit wt. (g) | Fruit yield /palm<br>(kg) |
|----------|------------------------|----------------|----------------------------|---------------|---------------------------|
| 1994/1   | 10                     | 10.0           | 11                         | 1107          | 121                       |
| 1994/2   | 8                      | 13.5           | 9                          | 1586          | 114                       |
| 1994/3   | 8                      | 8.0            | 10                         | 991           | 79                        |
| 1994/4   | 8                      | 9.0            | 7                          | 1220          | 68                        |
| 1994/5   | 10                     | 8.0            | 6                          | 850           | 51                        |

## Performance of palmyrah collections 1994:

Among the 1994 planted germplasm accessions. Most of the accessions are bigger sized fruits **Performance of palmyrah collections 1998:**  observed. The highest yield per palm (121kg) was recorded with Acc. No. 1/94 and 2/94

| Acc. No. | Number of bunches/palm | Bunch wt. (kg) | No. of fruits per<br>bunch | Fruit wt. (g) | Fruit yield/palm<br>(kg) |
|----------|------------------------|----------------|----------------------------|---------------|--------------------------|
| 1998/1   | 4                      | 4.5            | 6                          | 730           | 18                       |
| 1998/2   | 6                      | 3.4            | 8                          | 420           | 21                       |
| 1998/5   | 5                      | 4.0            | 8                          | 600           | 20                       |

In 1998 planted germplasm, Acc. No. 2/98 recorded the highest number of bunches (6.0) with

a greater number of fruits per bunch (8) with the highest fruit yield per palm (21kg).

## Performance of palmyrah collections 2000:

| Acc. No. | Number of bunches /palm | Bunch wt. (kg) | No. of fruits per<br>bunch | Fruit wt. (g) | Fruit yield per<br>palm (kg) |
|----------|-------------------------|----------------|----------------------------|---------------|------------------------------|
| 2000/2   | 7                       | 12             | 7                          | 1350          | 66                           |
| 2000/9   | 6                       | 6              | 10                         | 650           | 39                           |
| 2000/18  | 6                       | 19             | 13                         | 1650          | 128                          |

Among the germplasm accessions, flowering was observed only in few accessions in these accessions

the highest bunch weight (19kg), fruit weight (1650g) and fruit yield of 128 kg was recorded in Acc. No.18.

## Performance of palmyrah collections 2001:

| Acc. No. | Number of bunches /palm | Bunch wt. (kg) | No. of fruits/<br>bunch | Fruit wt.(g) | Fruit yield per<br>palm (kg) |
|----------|-------------------------|----------------|-------------------------|--------------|------------------------------|
| 2001/5   | 8                       | 6.8            | 8                       | 700          | 59                           |
| 2001/15  | 5                       | 7.0            | 9                       | 650          | 30                           |
| 2001/16  | 7                       | 5.2            | 8                       | 500          | 28                           |
| 2001/17  | 7                       | 5.0            | 7                       | 550          | 27                           |
| 2001/19  | 4                       | 5.2            | 9                       | 450          | 16                           |
| 2001/43  | 11                      | 7.2            | 10                      | 600          | 66                           |



In 2001 planted (20 years) germplasm accessions, Acc. No. 01/43 has recorded the highest number

of bunches (11), highest bunch weight (7.2 kg) and fruit yield of 66 kg.

| Acc. No. | Number of bunches/palm | Bunch wt. (kg) | No. of fruits/<br>bunch | Fruit wt.(g) | Fruit yield per<br>palm (kg) |
|----------|------------------------|----------------|-------------------------|--------------|------------------------------|
| 2003/1   | 7                      | 9              | 10                      | 1076         | 75                           |
| 2003/2   | 12                     | 9              | 12                      | 862          | 124                          |
| 2003/3   | 10                     | 5              | 9                       | 689          | 62                           |
| 2003/4   | 11                     | 17             | 18                      | 837          | 165                          |
| 2003/5   | 7                      | 9              | 10                      | 834          | 58                           |
| 2003/6   | 12                     | 18             | 29                      | 857          | 298                          |
| 2003/8   | 6                      | 8              | 14                      | 649          | 54                           |
| 2003/12  | 6                      | 27             | 77                      | 545          | 252                          |

## Performance of palmyrah collections 2003:

In the 2003 germplasm, Acc.no. 6 recorded 12 number of bunches with the highest bunch weight of 18 kg, with fruit yield per palm of 298 kg. These accessions have the feature of four branched bunches. Among all accessions, highest branches/ bunch (9) with 77 fruits per bunch was recorded in 12/2003.

## Performance of palmyrah collections 2004:

| Acc. No. | Number of    | Bunch wt. (kg) | No. of fruits/ | Fruit wt.(g) | Fruit yield per |
|----------|--------------|----------------|----------------|--------------|-----------------|
|          | bunches/palm |                | bunch          |              | palm (kg)       |
| 2004/1   | 5            | 13             | 15             | 726          | 141             |
| 2004/3   | 11           | 15             | 26             | 600          | 171             |
| 2004/4   | 11           | 15             | 25             | 683          | 187             |

In 2004 planted germplasm, Acc. No. 04 recorded, highest no. of bunches per palm (11), bunch weight

(15kg), with fruit yield per palm (187 kg).

## Performance of palmyrah collections 2006:

| Acc. No. | Number of bunches /palm | Bunch wt. (kg) | No. of fruits/<br>bunch | Fruit wt.(g) | Fruit yield per<br>palm (kg) |
|----------|-------------------------|----------------|-------------------------|--------------|------------------------------|
| 2006/5   | 6                       | 13             | 14                      | 805          | 67                           |
| 2006/6   | 9                       | 11             | 16                      | 740          | 106                          |
| 2006/10  | 13                      | 13             | 10                      | 1218         | 158                          |

In 2006 planted germplasm, Acc. No.10 recorded, highest no. of bunches per palm (13), bunch weight

(13kg), with fruit yield per palm (158 kg).



| Acc. No. | Number of bunches /palm | Bunch wt. (kg) | No. of fruits/<br>bunch | Fruit wt.(g) | Fruit yield per<br>palm (kg) |
|----------|-------------------------|----------------|-------------------------|--------------|------------------------------|
| 2009/1   | 4                       | 5              | 16                      | 400          | 25                           |
| 2009/2   | 4                       | 4              | 10                      | 265          | 11                           |
| 2009/3   | 3                       | 10             | 8                       | 947          | 23                           |
| 2009/5   | 6                       | 9              | 19                      | 429          | 49                           |
| 2009/9   | 8                       | 5              | 8                       | 434          | 28                           |

## **Performance of palmyrah collections 2009:**

In 2009 planted germplasm, Acc. No. 9 recorded, highest no of bunches per palm (8). The highest fruit yield was recorded in Acc. No.05 (49 kg)

## Performance of palmyrah collections 2010:

| Acc. No. | Number of bunches /palm | Bunch wt. (kg) | No. of fruits/<br>bunch | Fruit wt.(g) | Fruit yield per<br>palm (kg) |
|----------|-------------------------|----------------|-------------------------|--------------|------------------------------|
| 2010/1   | 2                       | 11             | 7                       | 1596         | 22                           |
| 2010/8   | 6                       | 10             | 16                      | 815          | 78                           |
| 2010/11  | 3                       | 5              | 10                      | 550          | 17                           |

In 2010 planted germplasm, Acc. No.8 recorded, highest no of bunches per palm (6), bunch weight (10 kg), with fruit yield per palm (78 kg).

| Acc. No. | Avg. yield per<br>day (L) | Neera yield /<br>palm (L) | Acc. No. | Mean Neera<br>yield/Day (L) | Neera Yield/<br>palm (L) |
|----------|---------------------------|---------------------------|----------|-----------------------------|--------------------------|
| 2/1991   | 1.4                       | 156                       | 4/1993   | 1.5                         | 128                      |
| 3/1991   | 1.3                       | 110                       | 7/1993   | 0.5                         | 66                       |
| 5/1991   | 1.4                       | 127                       | 8/1993   | 0.8                         | 78                       |
| 6/1991   | 0.9                       | 66                        | 3/1994   | 1.36                        | 130                      |
| 9/1991   | 0.45                      | 49                        | 5/1994   | 0.65                        | 98                       |
| 10/1991  | 1.6                       | 142                       | 1/1999   | 1.6                         | 155                      |
| 11/1991  | 1.3                       | 125                       | 9/2012   | 0.8                         | 66                       |

## Neera yield of palmyrah germplasm 1991, 1993, 1994

Among the male palms in 1991 accessions, highest Neera (1.6 l/day) collected in the Acc. No.10 followed by Acc. No.2(1.4 l/day). In 1993 accessions, Acc. No.4 recorded highest Neera 1.5 l/day whereas in 1999 Acc. No.1 recorded 1.6 l/ day.

## Growth observations of Palmyrah accessions

Among the 1991 collections, after 33 years of planting, minimum plant height of 8.6 m recorded in Acc.No.10/91 and maximum height

(11.2m) and minimum stem girth (1.4cm) was recorded in Acc. No. 2/91.

- Among the 1993 collections, after 31 years of planting, minimum height of 7.9 m recorded in Acc. No. 4/93 and maximum height (9.3 m) and minimum stem girth (142 cm) was recorded in Acc. No. 8/93.
- Among the accessions of 1994 collections, after 30 years of planting, minimum palm height of 9.2 m recorded in Acc.No.5 and maximum

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height (10.1m) in Acc. 2/94, maximum stem girth (170cm) was recorded in Acc. No. 4/94.

- Among the accessions 1995 collections, after 29 years of planting, minimum height was 3.6 m recorded in Acc.No.12 and maximum height (8.8m) in Acc. 2/95, maximum stem girth (152cm) were recorded in Acc. No. 3/95.
- Among the 1998 accessions, minimum plant height of 6.5 m recorded in Acc.No.7 and maximum plant height (9.6m) in 3/98, maximum stem girth (178cm) were recorded in Acc. No. 6/98
- Among the 1999 accessions, the minimum plant height was 4.6 m, recorded in Acc.No.1 and maximum plant height (8.7m) in 5/99 and maximum stem girth (181 cm) recorded in Acc. No. 6/99.

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 Among the 2000 collected accessions, the lowest plant height of 4.7 m recorded in Acc.No.13, highest plant height (9.0m) in Acc. No.17/00 and maximum stem girth (202 cm) in Acc. No. 17/00.



Palmyrah plantation





## 4.4. Cocoa

## Evaluation of Cocoa clones/Hybrids Ambajipeta

Six identified cocoa varieties/hybrids *viz.*, VTLCC 1, VTLCH 1, VTLCH 2, VTLCH 3, VTLCH 4, VTLC 1 (control) were planted during 2008, gap filled during December 2012 and are being evaluated for their performance as intercrop in coconut gardens.

Growth characteristics like girth, height at first branching and canopy spread for the year 2022 recorded no significant differences. Plant height was maximum in VTLCC-1 (3.26 m). Further, number of beans per pod was highest in VTLCH-2 (43.86) and on par with VTLCH-4 (40.58). VTLCH-1 recorded less no. of beans per pod (36.73) and VTLCC-1recorded less dry bean yield 1.04 kg/tree/ year. Single dry bean weight was recorded maximum in VTLCH – 2 (1.35 g) which was on par with VTLCH-4 (1.30 g). VTLCH-2 recorded significantly higher dry bean yield (2.15 kg/tree/year) followed by VTLCH-4 (2.09 kg/tree/year). Bean length was recorded maximum in VTLCH -2 (2.61 cm) and bean breadth was recorded maximum in VTLCH -3 (1.38 cm). Nib recovery was recorded maximum in VTLCC-1 (90.88 %), while the highest fat was recorded in VTLCH-4 (58.12 %) followed by VTLCH -2 (50.29 %).

| Cocoa clones/<br>Hybrids | Pod weight (g.) | No. of pod per<br>plant | No. of beans<br>per pod | Single dry<br>bean<br>weight(g.) | Dry bean<br>yield/tree/<br>year(kg.) |
|--------------------------|-----------------|-------------------------|-------------------------|----------------------------------|--------------------------------------|
| VTLCC – 1                | 461.26          | 33.85                   | 33.64                   | 1.13                             | 1.55                                 |
| VTLCH-1                  | 397.21          | 32.62                   | 34.11                   | 1.10                             | 1.55                                 |
| VTLCH-2                  | 488.98          | 38.18                   | 39.07                   | 1.35                             | 2.15                                 |
| VTLCH-3                  | 454.58          | 29.09                   | 36.95                   | 1.18                             | 1.74                                 |
| VTLCH-4                  | 477.33          | 35.74                   | 39.01                   | 1.30                             | 2.09                                 |
| VTLC-1                   | 342.70          | 25.44                   | 31.88                   | 1.16                             | 1.42                                 |
| SEm+                     | 27.29           | 2.13                    | 2.17                    | 0.04                             | 0.11                                 |
| CD at 5%                 | 82.27           | 6.43                    | NS                      | 0.12                             | 0.34                                 |
| CV (%)                   | 12.49           | 13.14                   | 12.13                   | 6.55                             | 13.00                                |

## Yield characteristics of cocoa clones/Hybrids at Ambajipeta

## Veppankulam

Among the cocoa clones and hybrids evaluated, the better types *viz.*, VTLCH 3 has performed well in terms of plant height (3.05 m), VTLCH 4 in stem

girth (40.57cm), VTLCH1 in canopy spread East West (2.73 m) and VTLCH2 in North South direction (2.83m). Six clones/ hybrids evaluated for yield and quality of cocoa from 2008 at CRS,



Veppankulam. The number of pods varied between 36.26 (VTLCH1) and 29.24 (VTLCH3). The highest single pod weight was recorded in VTLCH1 (145.13g) and the lowest in VTLCH3 (106.32g). The number of beans per pod ranged from 26 to

33. The single dry bean weight was higher in VTLCH 1 (1.84 g) and yield of 2.22 kg per plant which was higher and significantly different from other hybrids and clones.

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| Clones/<br>varieties | No. of pods/<br>tree | Single pod<br>weight(g) | No. of beans/<br>pod | Single dry<br>bean<br>weight(g) | Drybean<br>yield(kg/ tree) |
|----------------------|----------------------|-------------------------|----------------------|---------------------------------|----------------------------|
| VTLCC1               | 28.43                | 132.07                  | 28.65                | 1.58                            | 1.29                       |
| VTLCH1               | 36.26                | 145.13                  | 33.28                | 1.84                            | 2.22                       |
| VTLCH2               | 31.12                | 126.21                  | 28.43                | 1.58                            | 1.40                       |
| VTLCH3               | 29.24                | 106.32                  | 26.34                | 1.28                            | 0.99                       |
| VTLCH4               | 34.54                | 131.87                  | 28.39                | 1.38                            | 1.35                       |
| VTLC1                | 29.72                | 110.60                  | 26.18                | 0.98                            | 0.76                       |
| Mean                 | 31.55                | 125.37                  | 28.55                | 1.44                            | 1.34                       |
| CD (0.05)            | 1.98                 | 4.41                    | 1.88                 | 0.66                            | 0.85                       |
| CV                   | 10.00                | 8.61                    | 11.12                | 4.85                            | 2.68                       |

## Yield characteristics of cocoa clones/Hybrids at Veppankulam

## Multi-Location Trial (MLT) of cocoa clones under palms

## Aliyarnagar

Thirteen numbers of cocoa clones/hybrids (VTLCP 1, 3, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, and 16) along with one check variety (VTLC-9) were established during 2013-14 at a spacing of 3.75 m x 7.50 m with two replications and six cocoa plants per genotype at Aliyarnagar centre under the coconut canopy. Data recorded on vegetative characters showed significant differences among the cocoa genotypes. Among them, maximum plant height (298.7 cm), East-West canopy spread (3.1 m), North-South canopy spread (3.3 m), canopy area (13.0 m<sup>2</sup>) and number of branches per plant (5.1) were recorded in VTLC-16. Whereas the maximum jorquetting height (86.1 cm) was observed inVTLCP-11 followed by VTLCP-5 (83.9 cm).

Observations on the yield and yield attributing characters exhibited significant variations among the genotypes. Among them, VTLCP-16 recorded maximum number of pods per tree (55.5), number

of beans per pod (46.8), pod yield per plant (24.6 kg), single dry bean weight (1.5 g) and dry bean yield per plant (2.7 kg). This was followed by VTLCP-15 which has recorded 2.5 kg dry bean yield per plant.

## Kahikuchi

Sixteen numbers of cocoa clones/hybrids (VTLC 13, 15, 17, 18, 20, 23, 25, 28, 36, 38, 39, 40, 128, 4A, EYT) along with one check variety (VTLCH 1) were established during 2013-14 at a spacing of 3.75 m x 7.50 m with two replications and six cocoa plants per genotype. The highest plant height (325.0 cm), stem girth (45.6 cm), jorquette height (0.8 m), plant spread E–W (3.2 m) and N–S (3.4 m) and canopy area (14.54 m<sup>2</sup>) were recorded in VTLC-20 followed by VTLC-18 and the lowest values for the above characters were observed in EYT. Cocoa clone VTLC-20 also registered maximum no. of pods/tree (37.0), no. of beans/pod (39.0) and dry bean yield/tree/year (1.87 kg) as against the lowest under EYT.



| Treatments | No. of pods/<br>tree/year | Weight of pod<br>(g) | Wt. of single<br>dry bean (g) | No. of beans/<br>pod | Dry bean yield<br>(kg/tree) |
|------------|---------------------------|----------------------|-------------------------------|----------------------|-----------------------------|
| VTLC-13    | 32.0                      | 396.6.               | 1.1                           | 34.5                 | 1.21                        |
| VTLC-15    | 31.5                      | 390.0                | 1.1                           | 34.0                 | 1.18                        |
| VTLC-17    | 32.6                      | 401.5                | 1.2                           | 36.0                 | 1.40                        |
| VTLC-18    | 34.0                      | 425.0                | 1.2                           | 38.0                 | 1.55                        |
| VTLC-20    | 37.0                      | 476.0                | 1.3                           | 39.0                 | 1.87                        |
| VTLC-23    | 30.0                      | 377.0                | 1.2                           | 37.6                 | 1.35                        |
| VTLC-25    | 31.6                      | 375.0                | 1.1                           | 36.5                 | 1.27                        |
| VTLC-28    | 30.0                      | 358.0                | 1.1                           | 35.2                 | 1.16                        |
| VTLC-36    | 31.0                      | 372.8                | 1.0                           | 36.0                 | 1.11                        |
| VTLC-38    | 29.6                      | 340.6                | 1.2                           | 36.8                 | 1.23                        |
| VTLC-39    | 31.2                      | 335.0                | 0.99                          | 34.5                 | 1.30                        |
| VTLC-40    | 32.0                      | 374.5                | 0.99                          | 36.0                 | 1.12                        |
| VTLC128    | 33.2                      | 401.6                | 1.0                           | 36.8                 | 1.12                        |
| VTLC-4A    | 30.5                      | 385.8                | 1.1                           | 34.8                 | 1.17                        |
| VTLCH-1    | 32.0                      | 375.4                | 1.1                           | 35.8                 | 1.26                        |
| EYT        | 29.8                      | 330.0                | 0.98                          | 34.0                 | 0.99                        |
| S.Em+      | 0.81                      | 8.67                 | 0.05                          | 0.59                 | 0.13                        |
| CD (5%)    | 1.75                      | 18.68                | 0.11                          | 1.25                 | 0.22                        |

## Yield attributing characters and yield of cocoa clones and hybrid in coconut garden Kahikuchi Centre

## Ratnagiri

The experiment was initiated during Nov. 2012 under coconut (D x T) canopy at a spacing 3.0 x 7.5 m with 21 cocoa clones. The growth and yield attributing characters of cocoa and coconut are recorded and result revealed that at the age of  $11^{\text{th}}$ year, there was no significant variation in growth parameters *viz.*, plant height, branches and canopy volume. The girth of stem and plant spread was significantly varied. The highest number of beans/ pod (60.40) and dry bean yield per tree (1.39) was recorded in VTLC – 17 cocoa clone.

## Vijayarai

There were no significant differences among 12 clones and 2 hybrids planted during the year 2012 under oilpalm canopy for all growth and yield characters.VTLC-25 recorded highest dry bean yield of 0.92 kg/plant per year, while average dry bean weight differed among clones, VTLC-37 recorded highest bean weight of (1.43 g) which on par with clones VTLC-1 (1.34 g), VTLC-17 (1.33 g), VTLC-25 (1.26 g) and VTLC-36 (1.28 g)



## 4.5. Arecanut

# Evaluation of released arecanut varieties in different agro-climatic regions

## Wakawali

The experiment was initiated in the year 2015-16. After 98 months of planting, plant height ranged from 228.9-305.0 cm with a mean of 259.2 cm. Shriwardhani showed the shortest plant height of 228.9 cm, which remained on par with Madhurmangala and Mangala. The crown length ranged from 265.6 to 341.4 cm with mean of 289.46 cm. The variety Mohitnagar showed significantly highest crown length (341.35 cm) and girth (119.1 cm). The number of leaves ranged from 15.0 to 17.0 with mean of 16.06. In this case also variety Mohitnagar was observed to be statistically superior. Leaf length (217.0 cm) was significantly superior in Mangala, whereas leaf breadth was the highest (185.2 cm) in variety Sreemangala, though it remained on par with Mangala (182.1 cm). Mean nut yield ranged between 1.68 kg (Madhurmangala) and 2.62 kg (Mohitnagar).

## Shivamogga

Out of seven varieties evaluated, variety Shriwardhani showed shortest trunk height of 3.1 m while the highest trunk length was recorded in Mohitnagar (5.1 m). The highest collar girth of 70.9 cm was observed in Sumangala, which remained statistically like Sreemangala. Mean number of leaves on crown was the highest (11.9) in Mohitnagar followed by Madhuramangala and Swarnamangala with 10.40 leaves each. Shortest leaves of 143.9 cm were observed in Mohitnagar, while leaves were the longest (193.1 cm) in Sumangala. The highest nut yield was observed in Mangala (4.10 kg), which remained statistically similar with Sumangala (4.07 kg).

# Establishment of Nucleus seed garden of Arecanut

## Goa

The nuclear seed garden of Hirehalli Dwarf was established in different phases and is being maintained with currently 314 surviving palms of which 94 are available at reproductive stage. Growth parameters were recorded in the palms after 5 years of planting, which revealed the mean values as  $224.1 \pm 7.20$ cm (plant height),  $153.5 \pm 4.75$  cm (crown length),  $45.3 \pm 1.98$  cm (trunk circumference),  $8.6 \pm 0.16$ (no. of leaves per palm),  $79.8 \pm 2.76$  cm (leaf length) and  $2.2 \pm 0.13$  cm (intermodal length).

## **Port Blair**

To meet the plant material requirement of the island farmers, a nucleus seed garden of arecanut variety Samrudhi was established at the Garacharma farm of ICAR-CIARI, Port Blair during 2015-16. Morphological parameters *viz.*, plant height ( $6.9 \pm$ 0.27 m), plant girth ( $52.6 \pm 1.11$  cm) and mean number of leaves per palm ( $9.5 \pm 0.22$ ) were recorded in the palms. During the period, 407 seedlings of arecanut were produced from the block for providing to the island farmers.

## Wakawali

The nucleus seed garden was established at Wakawali centre with two varieties *i.e.* Hirehalli Dwarf and Shriwardhani during 2015-16. Growth observations were recorded at an interval of three months from the date of planting. After 98 months of planting, Hirehalli Dwarf plants recorded mean values of 84.8 cm (plant height), 82.4 cm (crown length), 63.4 cm (collar girth), 12.1 (leaves/ palm), 73.1 cm (leaf length) and 43.6 cm (leaf width). These parameters in case of variety Shriwardhini were 336.4 cm, 222.1 cm, 100.3 cm, 13.0, 155.7 cm and 143.8 cm, respectively. Mean nut yield of 1.12 kg/palm/year was observed in Hirehalli Dwarf, while it was 1.63 kg/palm/ year in Shriwardhini.





## **V. CROPPRODUCTION**

## 5.1 Coconut

## Studies on fertilizer application through microirrigation technique in coconut Sabour

Experiment was initiated during 2012 with six fertigation levels *viz.*,  $T_1$ : No fertilizer;  $T_2$ : 25% Recommended dose of fertilizer (RDF) (NPK) through drip system;  $T_3$ : 50% RDF (NPK) through drip system;  $T_4$ : 75% RDF NPK through drip system;  $T_5$ : 100% RDF (NPK) through drip system;  $T_6$ : 100% RDF (NPK) through soil application replicated four times in coconut variety Shakhigopal Tall. The recommended dose of fertilizer was 500:320:1200 g N:P:K per palm per year. The fertilizers were split into 8 parts for application through fertigation.

Fertigation with different doses of fertilizers had significant influence on plant growth parameters like palm height, palm girth, number of functional leaves and leaf characteristics. Maximum plant height of 5.91 m was recorded on application of 100% RDF as fertigation ( $T_5$ ) which was at par with 75% RDF through fertigation ( $T_4$ ) and 100% RDF as soil application with palm height of 5.71 m and 5.64 m, respectively. The lowest palm height of 4.69 m was observed in plants devoid of fertilizer application ( $T_1$ ). Similarly, maximum collar girth (205.0 cm), number

of functional leaves (31.5/ palm) and annual leaf production (9.25 per plant) was observed in  $T_5$ followed by  $T_4$  with collar girth of 197.0 cm, 28.5 number of functional leaves and annual leaf production of 9.0. Significantly lowest growth was recorded in  $T_1$  (No fertigation) with minimum collar girth (175 cm), number of leaves (22.5 / plant), annual leaf production (7.33 / plant). Palms under  $T_5$  produced maximum number of inflorescence (8.8 per palm) which was at par with  $T_4$ . Minimum number of inflorescences was noted in  $T_1$ .

Treatment T<sub>5</sub> exhibited maximum number of inflorescence (9.5 /palm) which was at par with  $T_A$ (100% RDF fertigation). Minimum inflorescence (6.0 per plant) was noted in  $T_1$ . Fertigation levels also influenced the extent of winter effect with maximum leaf affected in T1 and least effect of leaf injury in  $T_5$ . Similarly,  $T_5$  had the highest fruit set (9.2 per inflorescence) and fruit yield (59.8 per plant) and was at par with  $T_4$  (Table 1). Spathe emergence was observed by the end of April in all the treatments and inflorescence emergence started earliest in T<sub>5</sub> i.e., during 2nd week of June and latest during first week of July in  $T_1$ . Maximum nut yield of 59 nuts per palm was observed in  $T_5$  followed by  $T_4$  and least yield of 36 nuts per palm was recorded in palms without fertigation.

| Treatments            | No. of new<br>inflorescence per<br>plant | No. of<br>fruits /<br>bunch | Nut<br>yield /<br>palm | No of leaves<br>showing winter<br>injury (%) | Initiation of<br>opening of new<br>inflorescence |
|-----------------------|--|-----------------------------|------------------------|--|--|
| T <sub>1</sub>        | 6.0                                      | 7.2                         | 36.2                   | 23.0   | 1 <sup>st</sup> week July                        |
| <b>T</b> <sub>2</sub> | 7.33                                     | 8.0                         | 38.0                   | 15.0   | 4 <sup>th</sup> week June                        |
| T <sub>3</sub>        | 7.9                                      | 8.8                         | 44.0                   | 13.0   | 3 <sup>rd</sup> week June                        |
| T <sub>4</sub>        | 9.12                                     | 9.0                         | 50.24                  | 10.0   | 3 <sup>rd</sup> week June                        |
| T <sub>5</sub>        | 9.50                                     | 9.2                         | 59.58                  | 7.25   | 2 <sup>nd</sup> week June                        |
| T <sub>6</sub>        | 8.25                                     | 8.8                         | 51.00                  | 12.0   | 2 <sup>nd</sup> week June                        |
| CD (p = 0.05)         | 0.71                                     | 0.61                        | 4.49                   |  |  |

Table 1. Effect of different levels of fertigation on leaf length and flowering of coconut plant atSabour Centre



## Coconut based multispecies cropping systems under coastal littoral sandy soil

## **Centres: Bhubaneswar and Ratnagiri**

## Main Plot - Coconut based cropping system

|                 | Bhubaneswar                         | Ratnagiri  |
|-----------------|-------------------------------------|--|
| CS <sub>1</sub> | Coconut + Sapota + Vegetable (Rainy | Coconut + Garcinia indica + Vegetable Crops (Rainy |
|                 | season)                             | season)  |
| CS <sub>2</sub> | Coconut + Sapota + Pineapple        | Coconut + Garcinia indica + Pineapple              |
| CS <sub>3</sub> | Monocrop of coconut                 | Monocrop of coconut                                |

## Nutrient management practices

- N<sub>1</sub>: Green manuring+ biofertilizers + organic recycling+FYM (as per Package of Practice)
- N<sub>2</sub>: Green manuring + biofertilizers + organic recycling +Soil test-based nutrient (chemical fertilizers) application
- N<sub>3</sub>: Green manuring + biofertilizers + organic recycling+100% RDF
- Husk incorporation is common to all the sub plot treatments. Husk is placed in one layer in the trenches of planting zone.
- Biofertilizers: Azospirillum and Phosphobacteria
- Green manuring: Cowpea in the basin as well as in the interspaces of coconut.
- FYM: Recommended dose to coconut as well as component crops

#### **Bhubaneswar**

In coconut, maximum number of inflorescence (11.59/palm/year), female flowers

(224.61/palm/year) and nuts (82.13/palm/year) was recorded in the treatment N<sub>2</sub> (Green manuring + biofertilizers + organic recycling + soil test-based nutrient (chemical fertilizers) application. The interaction effect of cropping system and nutrient management was significant only for number of inflorescence/palm/year, female flowers/palm/year and numbers of nuts per palm per year (Table 2). The yield of pineapple (9853.20 kg/ha) as well as cowpea (4590 kg/ha) was maximum in plots receiving soil test based NPK nutrients (N2). Sapota plants in the cropping systems started yielding for the last 3 years and the maximum yield (852 kg/ha) was obtained in the treatment CS<sub>2</sub>N<sub>2</sub>. The maximum net returns (Rs. 4,63,857 /ha) was obtained in the treatment CS<sub>2</sub>N<sub>2</sub> whereas, lowest profit Rs. 60,250 was obtained from sole cropping system with organic manure application -  $CS_3N_1$ (Table 3).



Intercropping pineapple in coconut garden at Bhubaneshwar



| Treatment                      | Number of<br>leaves/palm | Number of<br>leaves/palm/<br>year | Number of<br>inflorescences/<br>palm/year | Number of<br>female<br>flowers/ palm<br>/year | Number of nuts/<br>palm/year |
|--------------------------------|--------------------------|-----------------------------------|---|---|------------------------------|
| CS <sub>1</sub>                | 38.45                    | 11.74                             | 11.39                                     | 222.24  | 74.22                        |
| CS <sub>2</sub>                | 38.49                    | 11.74                             | 11.40                                     | 227.90  | 77.25                        |
| CS <sub>3</sub>                | 38.54                    | 11.56                             | 10.94                                     | 177.66  | 68.52                        |
| CD (p=0.05)                    | *                        | *                                 | 0.39                                      | 21.62   | 5.32                         |
| N <sub>1</sub>                 | 38.04                    | 11.27                             | 10.59                                     | 195.19  | 64.66                        |
| N <sub>2</sub>                 | 38.92                    | 12.05                             | 11.59                                     | 224.61  | 82.13                        |
| N <sub>3</sub>                 | 38.52                    | 11.72                             | 11.55                                     | 207.99  | 73.20                        |
| CD (p=0.05)                    | *                        | *                                 | 0.20                                      | 13.40   | 4.52                         |
| CS <sub>1</sub> N <sub>1</sub> | 37.78                    | 11.28                             | 10.78                                     | 189.89  | 69.56                        |
| CS <sub>1</sub> N <sub>2</sub> | 38.67                    | 12.06                             | 11.83                                     | 248.17  | 80.39                        |
| CS <sub>1</sub> N <sub>3</sub> | 38.89                    | 11.89                             | 11.56                                     | 228.67  | 72.72                        |
| $CS_2N_1$                      | 38.03                    | 11.50                             | 10.57                                     | 208.86  | 67.42                        |
| CS <sub>2</sub> N <sub>2</sub> | 38.99                    | 12.11                             | 11.94                                     | 244.84  | 87.56                        |
| CS <sub>2</sub> N <sub>3</sub> | 38.45                    | 11.62                             | 11.70                                     | 229.98  | 76.77                        |
| CS <sub>3</sub> N <sub>1</sub> | 38.30                    | 11.02                             | 10.43                                     | 165.33  | 57.00                        |
| CS <sub>3</sub> N <sub>2</sub> | 39.11                    | 12.00                             | 11.00                                     | 180.83  | 78.44                        |
| CS <sub>3</sub> N <sub>3</sub> | 38.21                    | 11.66                             | 11.38                                     | 186.82  | 70.11                        |
| CD (p =0.05)                   | *                        | *                                 | 0.41                                      | 26.19   | 8.91                         |

## Table 2. Growth and yield of palms in the cropping system under littoral sand

## Table 3. Economics of coconut based cropping system

| Treatments                     | Gross return (Rs. /ha) | Cost of production (Rs. /ha) | Net return (Rs. /ha) |
|--------------------------------|------------------------|------------------------------|----------------------|
| CS <sub>1</sub> N <sub>1</sub> | 2,34,967               | 1,33,350                     | 1,01,617             |
| CS <sub>1</sub> N <sub>2</sub> | 2,84,017               | 1,55,350                     | 1,28,667             |
| CS <sub>1</sub> N <sub>3</sub> | 2,57,357               | 2,42,550                     | 1,14,807             |
| CS <sub>2</sub> N <sub>1</sub> | 5,00,987               | 1,87,450                     | 3,13,537             |
| CS <sub>2</sub> N <sub>2</sub> | 7,02,087               | 2,38,230                     | 4,63,857             |
| CS <sub>2</sub> N <sub>3</sub> | 6,14,868               | 2,13,840                     | 4,01,028             |
| CS <sub>3</sub> N <sub>1</sub> | 1,19700                | 59450                        | 60250                |
| CS <sub>3</sub> N <sub>2</sub> | 1,64,733               | 82,230                       | 82,503               |
| CS <sub>3</sub> N <sub>3</sub> | 1,47,233               | 75600                        | 71633                |



Sale price of Coconut @ Rs. 12/nut, Cowpea @ Rs. 20/kg, sapota @ Rs.30.00/kg and Pineapple @ Rs. 50/kg.

## Ratnagiri

Planting of Kokum has been done as per treatment details and initial soil samples have been collected for soil analysis. Number of functional leaves, number of inflorescences produced per year, number of female flowers/palm and yield did not differ significantly. The vegetable yield was maximum 101.33 kg/plot in  $CS_1N_3$ . Maximum pineapple yield of 229.67 kg/plot was recorded in  $CS_2N_3$  and maximum *Garcinia indica* height (321.43 cm) was recorded in  $CS_2N_2$ . The highest B: C ratio (2.38) was obtained in  $CS_2N_3$  where Coconut + *Garcinia indica* + Pineapple with Green manuring + biofertilizers + organic recycling + 100% RDF. Growth and yield performance together with economics is presented in Tables 4-6.

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| Treatments                     | No. of<br>functional<br>leaves/palm | No. of female<br>flowers/palm | Coconut<br>yield(nuts/<br>ha) | Vegetable /<br>Pineapple<br>yield<br>(kg/ha) | Garcinia<br>indica<br>plant<br>height<br>(cm) | Biomass<br>production<br>(kg/ha) |
|--------------------------------|-------------------------------------|-------------------------------|-------------------------------|--|---|----------------------------------|
| CS <sub>1</sub> N <sub>1</sub> | 29.87                               | 10.5                          | 174.3                         | 13594.6                                      | 4950  | -                                |
| CS <sub>1</sub> N <sub>2</sub> | 29.22                               | 10.9                          | 174.7                         | 14771.9                                      | 5484  | -                                |
| CS <sub>1</sub> N <sub>3</sub> | 31.47                               | 10.5                          | 176.7                         | 13599.4                                      | 6079  | -                                |
| CS <sub>2</sub> N <sub>1</sub> | 29.48                               | 10.9                          | 185.0                         | 14790.4                                      | -   | 7800.0                           |
| CS <sub>2</sub> N <sub>2</sub> | 29.72                               | 10.5                          | 189.3                         | 14429.7                                      | -   | 11899.8                          |
| CS <sub>2</sub> N <sub>3</sub> | 29.60                               | 10.9                          | 182.0                         | 16940.0                                      | -   | 13780.2                          |
| CS <sub>3</sub> N <sub>1</sub> | 29.62                               | 10.7                          | 166.0                         | 14194.4                                      | -   | -                                |
| CS <sub>3</sub> N <sub>2</sub> | 29.33                               | 10.6                          | 174.7                         | 17500.0                                      | -   | -                                |
| CS <sub>3</sub> N <sub>3</sub> | 29.25                               | 10.3                          | 162.3                         | 14972.2                                      | -   | -                                |
| S. Em ±)                       | 0.49                                | 0.16                          | 3.46                          | 1019.17                                      | -   | -                                |
| CD (p=0.05)                    | NS                                  | NS                            | NS                            | NS   | -   | -                                |

# Table 4. Growth and yield performance of coconut based multispecies croppingsystems under coastal littoral sandy soil at Ratnagiri



Coconut intercropped with snake gourd at Ratnagiri



 Table 5. Growth and yield performance of coconut based multispecies cropping systems under coastal littoral sandy soil (2022) at Ratnagiri

| Treatments                     | Coconut<br>functional<br>leaves (No.) | Coconut<br>yield(No.) | Garcinia<br>indica<br>height<br>(cm) | Garcinia<br>indica girth<br>(cm) | Snake<br>gourd<br>yield (kg/<br>plot) | Pineapple<br>yield (kg/<br>plot) |
|--------------------------------|---------------------------------------|-----------------------|--------------------------------------|----------------------------------|---------------------------------------|----------------------------------|
| CS <sub>1</sub> N <sub>1</sub> | 29.87                                 | 10.5                  | 174.3                                | 77.68                            | 299.46                                | 19.75                            |
| CS <sub>1</sub> N <sub>2</sub> | 29.22                                 | 10.9                  | 174.7                                | 84.41                            | 309.97                                | 20.22                            |
| CS <sub>1</sub> N <sub>3</sub> | 31.47                                 | 10.5                  | 176.7                                | 77.71                            | 268.63                                | 20.88                            |
| CS <sub>2</sub> N <sub>1</sub> | 29.48                                 | 10.9                  | 185.0                                | 84.52                            | 341.31                                | 26.82                            |
| CS <sub>2</sub> N <sub>2</sub> | 29.72                                 | 10.5                  | 189.3                                | 82.46                            | 332.89                                | 24.59                            |
| CS <sub>2</sub> N <sub>3</sub> | 29.60                                 | 10.9                  | 182.0                                | 96.80                            | 359.41                                | 25.49                            |
| CS <sub>3</sub> N <sub>1</sub> | 29.62                                 | 10.7                  | 166.0                                | 81.11                            | -                                     | -                                |
| CS <sub>3</sub> N <sub>2</sub> | 29.33                                 | 10.6                  | 174.7                                | 100.00                           | -                                     | -                                |
| CS <sub>3</sub> N <sub>3</sub> | 29.25                                 | 10.3                  | 162.3                                | 85.56                            | -                                     | -                                |
| A) Cropping System             | (Main plot)                           |                       |                                      |                                  |                                       |                                  |
| CS <sub>1</sub> : Coconut +    |                                       |                       |                                      |                                  |                                       |                                  |
| Garcinia +                     |                                       |                       |                                      |                                  |                                       |                                  |
| Vegetables                     | 30.19                                 | 10.63                 | 175.22                               | 79.94                            | 292.68                                | 20.28                            |
| CS <sub>2</sub> : Coconut +    |                                       |                       |                                      |                                  |                                       |                                  |
| Garcinia+Pineapple             | 29.60                                 | 10.78                 | 185.44                               | 87.92                            | 344.54                                | 25.63                            |
| CS <sub>3</sub> : Coconut      |                                       |                       |                                      |                                  |                                       |                                  |
| monocrop                       | 29.40                                 | 10.57                 | 167.67                               | 88.89                            |                                       |                                  |
| S.Em. +                        | 0.14                                  | 0.04                  | 0.48                                 | 2.52                             |                                       |                                  |
| CD (p=0.05)                    | NS                                    | NS                    | 1.89                                 | NS                               | NS                                    | NS                               |
| B) Nutrient Manager            | nent Practices                        | (Sub plot)            |                                      |                                  |                                       |                                  |
| N <sub>1</sub> : GM+BF+OR+     |                                       |                       |                                      |                                  |                                       |                                  |
| FYM                            | 29.65                                 | 10.72                 | 175.11                               | 81.10                            | 320.39                                | 23.28                            |
| N <sub>2</sub> : GM+BF+OR+     |                                       |                       |                                      |                                  |                                       |                                  |
| Chem                           | 29.42                                 | 10.69                 | 179.56                               | 88.96                            | 321.43                                | 22.41                            |
| N <sub>3</sub> : GM+BF+OR+     |                                       |                       |                                      |                                  |                                       |                                  |
| RDF                            | 30.11                                 | 10.57                 | 173.67                               | 86.69                            | 314.02                                | 23.18                            |
| S.Em. +                        | 1.48                                  | 0.49                  | 10.39                                | 17.47                            |                                       |                                  |
| C.D. at 5%                     | NS                                    | NS                    | NS                                   | NS                               |                                       |                                  |
| Interaction (M xV)             |                                       |                       |                                      |                                  |                                       |                                  |
| S.Em. +                        | 0.53                                  | 4.25                  | 9.14                                 | 0.75                             | 0.51                                  | 1.07                             |
| CD (p=0.05)                    | NS                                    | NS                    | NS                                   | NS                               | 1.52                                  | 3.64                             |



## Table 6. Economics of coconut based cropping system for different agro-climatic regions at Ratnagiri

| Treatments                     | Cost of Cultivation (Rs. /ha) | Gross income (Rs. /ha) | Net income (Rs. /ha) | <b>B: C</b> |
|--------------------------------|-------------------------------|------------------------|----------------------|-------------|
| CS <sub>1</sub> N <sub>1</sub> | 193866                        | 283504                 | 89638                | 1.46        |
| CS <sub>1</sub> N <sub>2</sub> | 198595                        | 309468                 | 110873               | 1.56        |
| CS <sub>1</sub> N <sub>3</sub> | 195079                        | 298652                 | 103573               | 1.53        |
| CS <sub>2</sub> N <sub>1</sub> | 198583                        | 340656                 | 142073               | 1.72        |
| CS <sub>2</sub> N <sub>2</sub> | 201321                        | 389552                 | 188231               | 1.93        |
| CS <sub>2</sub> N <sub>3</sub> | 190878                        | 454776                 | 263898               | 2.38        |
| CS <sub>3</sub> N <sub>1</sub> | 121632                        | 227108                 | 105476               | 1.87        |
| CS <sub>3</sub> N <sub>2</sub> | 124489                        | 280000                 | 155511               | 2.25        |
| CS <sub>3</sub> N <sub>3</sub> | 122979                        | 239568                 | 116589               | 1.95        |

#### **Sale Price:**

Coconut- Rs.16/nut, Snake gourd- Rs.30/kg, Pineapple - Rs.40/kg, Urea- Rs.6500/t, SSP-Rs.7300/t, MOP-Rs.19500/t, Biofertilizers- Rs.148/lit, Ormichem– Rs.65/kg

## **Organic Farming in Coconut**

Experiment was laid out during the year 2015 in four centres in Randomized Block Design comprising five treatments (Sole organic manure treatments -2, Conventional fertilization-1, Integrated options -2), each treatment replicated five times with six palms per treatment. A trench of 15m length and 1.3m (4 feet) width was excavated amidst six coconut palms for the treatments  $T_1 - T_4$ . PGPR consortia, organic manure, husk burial and 50% recommended  $K_2O$  (600 g  $K_2O$ ) as sulphate of potash were applied as per the treatments. Sunhemp seeds were sown @ 40 kg /ha in the interspaces of the coconut palms in the treatments  $T_1$  to  $T_4$  and was incorporated *insitu* at 45 days after sowing.

#### Aliyarnagar

Biomass added across different treatments vary from 22750 to 23150 kg per ha. Nutrient addition across different treatments is presented in Table 7. Although the differential effect of treatments did not bring noteworthy impact on height of the palm, palm girth and number of leaves per palm registered significant variation, with  $T_4$  superior over rest of the treatments. The highest yield was realized in  $T_4$  with 183 fruits per palm per year and the lowest was witnessed in  $T_1$  (Table 8). Although soil reaction and electrical conductivity did not vary among the treatments, the available status of macronutrients was higher in  $T_4$  and lower in  $T_5$ . Treatments receiving sole application of organic manures ( $T_1$  and  $T_2$ ) paved way for enhancing the soil organic carbon pool compared to the rest of the treatments (Table 9). Physical properties *viz.*, porosity and soil moisture content enhanced on addition of organic manures compared to sole chemical fertilization.



Organic farming in Aliyarnagar



| Table 7. Differential effect of | treatments on the growth | and yield of coconut |
|---------------------------------|--------------------------|----------------------|
|---------------------------------|--------------------------|----------------------|

| Treatments  | Total        | Ν       | Р           | K       |
|---|--------------|---------|-------------|---------|
| in cumiento   | biomass (kg) |         | (kg per ha) |         |
| $T_1$ - In situ organic matter recycling + PGPR consortia<br>+ In situ green manuring + Husk burial | 18740        | 140-150 | 45-50       | 130-140 |
| $\mathbf{T}_2 - \mathbf{T}_1 + 25 \text{ kg cow dung}$  | 18920        | 140-150 | 45-50       | 130-140 |
| $T_3 - T_1 + 50\%$ recommended $K_2O$ through the application of Sulphate of potash                 | 19210        | 140-150 | 45-50       | 130-140 |
| $T_4 - T_2 + 50\%$ recommended $K_2O$ through the application of Sulphate of potash                 | 19260        | 140-150 | 45-50       | 130-140 |
| $\mathbf{T}_{5}$ - Conventional method (Chemical fertilizer application)                            | -            | 150-160 | 45-50       | 150-160 |

## Table 8. Differential effect of treatments on the growth and yield of coconut

| Treatments   | Palm height<br>(m) |             | Palm girth (cm) |             | Leaves (No. s/<br>palm) |             | Nut yield (No.<br>s/palm/year) |             |
|--|--------------------|-------------|-----------------|-------------|-------------------------|-------------|--------------------------------|-------------|
|  | 2014 -<br>15       | 2022-<br>23 | 2014-<br>15     | 2022-<br>23 | 2014-<br>15             | 2022-<br>23 | 2014-<br>15                    | 2022-<br>23 |
| $T_1$ - <i>In situ</i> organic matter recycling<br>+ PGPR consortia + <i>In situ</i> green<br>manuring + Husk burial | 13.4               | 15.9        | 85.1            | 110         | 34                      | 34          | 157                            | 170         |
| $\mathbf{T}_2 - \mathbf{T}_1 + 25 \text{ kg cow dung}$   | 14.7               | 16.1        | 86.0            | 114         | 33                      | 37          | 145                            | 175         |
| $T_3 - T_1 + 50\%$ recommended $K_2O$<br>through the application of Sulphate<br>of potash                            | 15.4               | 16.6        | 85.3            | 117         | 38                      | 37          | 160                            | 180         |
| $T_4 - T_2 + 50\%$ recommended $K_2O$<br>through the application of Sulphate<br>of potash                            | 13.2               | 16.8        | 88.2            | 120         | 35                      | 39          | 148                            | 182         |
| <b>T</b> <sub>5</sub> - Conventional method<br>(Chemical fertilizer application)                                     | 13.1               | 16.0        | 82.2            | 118         | 36                      | 36          | 149                            | 179         |
| S. Ed  | 0.48               | 0.928       | 5.42            | 3.62        | 1.11                    | 2.21        | 12.4                           | 4.12        |
| CD (P=0.05)  | NS                 | NS          | NS              | 8.16        | NS                      | 4.32        | NS                             | 9.32        |



| Table 9. Influence of | Organic | <b>Farming on soi</b> | l fertility parameters |
|-----------------------|---------|-----------------------|------------------------|
|-----------------------|---------|-----------------------|------------------------|

| Traatmants  | pН    | EC      | KMnO  | Olsen P | 1NNH OAc K | Organic<br>C(g lyg;1) |
|---|-------|---------|-------|---------|------------|-----------------------|
| ireatinents   |       | (usin-) |       |         |            |                       |
| $T_1$ - <i>In situ</i> organic matter recycling                           | 7.20  | 0.51    | 132.2 | 5.78    | 81.2       | 0.43                  |
| + PGPR consortia + <i>In situ</i> green                                   |       |         |       |         |            |                       |
| manuring + Husk burial  |       |         |       |         |            |                       |
| $\mathbf{T}_2 - \mathbf{T}_1 + 25 \text{ kg cow dung}$                    | 7.20  | 0.64    | 145.4 | 6.21    | 90.6       | 0.45                  |
| <b>T</b> <sub>3</sub> - T <sub>1</sub> + 50% recommended K <sub>2</sub> O | 7.28  | 0.68    | 152.1 | 6.32    | 95.8       | 0.36                  |
| through the application of sulphate of                                    |       |         |       |         |            |                       |
| potash  |       |         |       |         |            |                       |
| $T_4 - T_2 + 50\%$ recommended $K_2O$                                     | 7.16  | 0.72    | 154.2 | 6.44    | 96.7       | 0.36                  |
| through the application of sulphate of                                    |       |         |       |         |            |                       |
| potash  |       |         |       |         |            |                       |
| $T_5$ - Conventional fertilizer   | 7.19  | 0.66    | 138.6 | 5.84    | 80.8       | 0.28                  |
| application   |       |         |       |         |            |                       |
| S. Ed   | 0.072 | 0.064   | 3.26  | 0.214   | 1.264      | 0.028                 |
| CD (p=0.05)   | NS    | NS      | 9.28  | NS      | 3.678      | 0.122                 |

## Ambajipeta

The trial was initiated during 2015 in 30 years old East Coast Tall coconut variety in RBD with four replications. Cocoa cv. Forastero and banana (cv. Tellachakkerakeli) were planted as intercrops. The growth and yield parameters of coconut are presented in Tables 10-11.

# Table 10. Influence of different treatments of organic farming on growth and yield parameters of coconut at Ambajipeta

| Treat<br>ments         | Palm<br>height<br>(m) | Palm<br>girth<br>(cm) | Annual<br>leaf<br>produ<br>ction | No. of<br>functional<br>leaves /<br>palm | No. of<br>bunches/<br>palm/<br>year | No. of<br>buttons /<br>inflore<br>scence | No. of<br>fruits /<br>palm /<br>year | Copra<br>yield<br>kg /<br>palm | Oil<br>yield<br>kg /<br>palm |
|------------------------|-----------------------|-----------------------|----------------------------------|--|-------------------------------------|--|--------------------------------------|--------------------------------|------------------------------|
| T <sub>1</sub>         | 10.74                 | 1.05                  | 12.42                            | 29.1                                     | 9.81                                | 14.72                                    | 71.28                                | 9.31                           | 5.25                         |
| <b>T</b> <sub>2</sub>  | 12.53                 | 0.95                  | 12.61                            | 31.6                                     | 9.48                                | 17.34                                    | 70.80                                | 9.63                           | 5.44                         |
| T <sub>3</sub>         | 11.58                 | 0.92                  | 12.71                            | 30.3                                     | 8.68                                | 14.65                                    | 77.00                                | 10.28                          | 5.79                         |
| T <sub>4</sub>         | 12.45                 | 0.92                  | 12.72                            | 31.4                                     | 9.08                                | 18.05                                    | 81.60                                | 10.89                          | 6.07                         |
| <b>T</b> <sub>5</sub>  | 12.55                 | 1.00                  | 12.86                            | 30.4                                     | 10.70                               | 18.98                                    | 87.13                                | 11.84                          | 6.81                         |
| SEm ±                  | 0.33                  | 0.03                  | 0.06                             | 1.11                                     | 0.38                                | 0.44                                     | 3.51                                 | 0.50                           | 0.28                         |
| <b>CD</b> ( <b>p</b> = |                       |                       |                                  |  |                                     |  |                                      |                                |                              |
| 0.05)                  | 1.00                  | NS                    | NS                               | NS                                       | 1.17                                | 1.35                                     | 10.82                                | 1.54                           | 0.86                         |
| CV (%)                 | 5.44                  | 7.23                  | 9.22                             | 8.24                                     | 7.97                                | 11.32                                    | 13.45                                | 9.64                           | 9.55                         |





| Treatments     |                  | Cocon            | Cumulative<br>nut yield | Pooled mean<br>yield (2015- |                            |       |     |     |
|----------------|------------------|------------------|-------------------------|-----------------------------|----------------------------|-------|-----|-----|
|                | 2018-19<br>(nos) | 2019-20<br>(nos) | 2020-<br>21 (nos)       | (Fruits/<br>palm)           | 22) (Fruits/<br>palm/year) |       |     |     |
| T <sub>1</sub> | 121.15           | 115.98           | 81.46                   | 62.12                       | 60.69                      | 71.28 | 873 | 97  |
| T <sub>2</sub> | 120.25           | 113.50           | 87.61                   | 75.44                       | 72.02                      | 70.80 | 909 | 101 |
| T <sub>3</sub> | 116.50           | 117.98           | 83.00                   | 60.62                       | 62.40                      | 77.00 | 872 | 97  |
| T <sub>4</sub> | 127.25           | 121.43           | 92.16                   | 79.50                       | 76.71                      | 81.60 | 955 | 106 |
| T <sub>5</sub> | 121.25           | 124.19           | 105.35                  | 75.27                       | 76.72                      | 87.13 | 985 | 109 |
| SEm ±          | 1.87             | 1.35             | 3.38                    | 4.74                        | 4.14                       | 3.51  |     | —   |
| CD (p = 0.05)  | 5.75             | 4.17             | 10.42                   | 14.61                       | 12.77                      | 10.82 |     | _   |

## Table 11. Influence of organic farming on coconut yield at Ambajipeta

With respect to coconut, no significant differences were noticed for palm girth, total number of functional leaves per palm and annual leaf production. Palm height was maximum in  $T_5$  - 12.55 m. Maximum number of inflorescence /plant/year was recorded in  $T_5$  (10.70) which is on par with  $T_1$ (9.81) and  $T_2$ . Treatment  $T_5$  recorded the highest yield (87.13 fruits/palm/year) which was on par with  $T_4$  (81.60) fruits/palm/year and  $T_3$  (77 fruits/palm/ year). Further, the pooled mean nut yield from 2015 to 2022 revealed that  $T_5$  and  $T_4$  had a high nut yield of 109 and 106 fruits/palm/year, respectively. Fatty acid content *viz.*, Caproic Acid (0.447-0.493), Caprylic acid (5.265-5.756) Capric acid (4.438-4.66), Lauric acid (42.742-43.675), Myristic acid (20.67-21.347), Palmitic acid (9.986-10.005), Linoleic acid (1.267-1.9), Oleic acid (8.295-8.801), Stearic acid (3.832-4.364) and Eicosanoic acid (0.056-0.091) was in the range depicted in Table 12 across various treatments.

| Fatty acid      |                |                       |                |                |                       |
|-----------------|----------------|-----------------------|----------------|----------------|-----------------------|
| composition     | T <sub>1</sub> | <b>T</b> <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> | <b>T</b> <sub>5</sub> |
| Caproic Acid    | 0.447          | 0.488                 | 0.468          | 0.493          | 0.462                 |
| Caprylic acid   | 5.756          | 5.679                 | 5.348          | 5.265          | 5.552                 |
| Capric acid,    | 4.660          | 4.652                 | 4.637          | 4.438          | 4.621                 |
| Lauric acid     | 43.675         | 42.742                | 42.842         | 43.634         | 43.451                |
| Myristic acid   | 20.670         | 21.117                | 20.873         | 21.347         | 21.076                |
| Palmitic acid   | 10.635         | 10.805                | 10.734         | 9.986          | 10.536                |
| Linoleic acid   | 1.374          | 1.651                 | 1.387          | 1.267          | 1.900                 |
| Oleic acid      | 8.801          | 8.647                 | 8.634          | 8.295          | 8.326                 |
| Stearic acid    | 3.927          | 4.150                 | 3.832          | 4.364          | 3.987                 |
| Eicosanoic acid | 0.056          | 0.070                 | 0.063          | 0.082          | 0.091                 |



Differential effect of treatments had no significant influence on cocoa with respect to plant height, stem girth, height at 1<sup>st</sup> branching and number of beans per pod. The treatment  $T_4$  had a high number of pods/plant (22) which was significantly on par with  $T_5$ (21.94). Further, the dry bean yield was high in  $T_4$  with 0.92 kg which was at par with  $T_5$  (0.87 kg). The yield characters of banana are influenced by the fertilizer treatments for total number of fingers and bunch weight, which was maximum in  $T_5$  with 72.3 fingers /bunch and 8.38 kg.

## Kasaragod

Experiment on cultivation of coconut under organic nutrient management practices revealed that the treatment T<sub>4</sub> -In situ organic matter (frond, leaf, inflorescence waste, husk) recycling in trenches made in the interspaces of six coconut palms (15 m length, 1.2 m width and 60 cm depth) + in situ green manuring in the basin +PGPR consortia in the basin + cow dung + 50% recommended  $K_2O$  using sulphate of potash recorded higher yield of 124.0 nuts/palm/year with 191.0 g of copra weight/nut over other treatments. Cocoa yield and yield parameters when intercropped in coconut, were also analyzed and found that treatment  $T_4$  recorded significantly higher single bean weight (1.08g) and dry bean yield (947.3 kg/ha). Economic analysis of the system revealed that treatment  $T_4$  recorded higher net returns of Rs. 2,67,366/- per ha (on matured nut basis) over other treatments.

## Management of Root (wilt) disease in coconut (Farmers' Garden) - Aliyarnagar

## Package of practices proposed based on the soil test results

- Addition of organic manure @ 25 kg per palm.
- Application of *Trichoderma sp.* @ 50 g/ palm.

- Sowing Daincha seeds in coconut basin @ 100 g/ palm and incorporation before flowering.
- Application of urea -1.0 kg, SSP -2.0 kg and MOP -3.0 kg
- Addition of 50 g zinc sulphate per palm
- Application of  $MgSO_4$  @ 1 kg per palm
- Excavation of trenches and providing subsurface drainage.

Management practices as per the package were continued in root (wilt) affected gardens at Manakkadavu village of Coimbatore district. The pH of samples was alkaline, organic carbon content was low and DTPA Zn was deficient. Based on the soil nutrient status, the above-mentioned package was developed, and treatments were imposed during 2017. Disease assessment was done based on the disease grades assigned to flaccidity, yellowing and necrosis symptom in the second or third spiral as per the score chart.

Disease intensity (DI) is calculated based on the following formula

where F, Y and N are the grade points assigned to flaccidity (0-5), yellowing (0-3) and necrosis (0-2) and L is the total number of leaves.

Regular agronomical management practices reduced the average root wilt disease index from 15.86 (2015-16) to 6.54 (2022-23) in Coimbatore district. Coconut yield in demonstration plot was maintained (82 fruits /palm /year) in Manakkadavu village compared to the pre-experimental period. However, the yield obtained was not consistent over a period of time and the intensity of disease reduction did not sustain over long run appreciably (Table 13).





| Table 13. | Root wilt | disease i | ndex in <sup>*</sup> | Manakkada | avu village. | Coimbatore l | Dist. |
|-----------|-----------|-----------|----------------------|-----------|--------------|--------------|-------|
| Table 13. | KUUU WIII | uiscase i | nuca m.              | lananaua  | avu village, | Compatore    | JISI. |

| Particulars            | Demonstration plot |                |  |  |  |
|------------------------|--------------------|----------------|--|--|--|
|                        | 2015-16            | 2022-23        |  |  |  |
|                        | Pre-treatment      | Post treatment |  |  |  |
| Range of disease index | 4 to 44            | 0-40           |  |  |  |
| Average disease index* | 15.86              | 6.54           |  |  |  |
| Nut yield              | 80                 | 80             |  |  |  |

## Tender nut harvesting

Experiment was laid out in Randomized Block Design comprising four treatments and five replications *viz.*, harvesting tender nuts throughout the year ( $T_1$ ), harvesting of alternate bunches for tender nuts( $T_2$ ), harvesting of tender nuts from Jan to June ( $T_3$ ) and harvesting of mature nuts throughout the year( $T_4$ ) at Aliyarnagar, Ambajipetta, Ratnagiri, Bhubaneswar, Jagdalpur.

# CentreCoconut varietyAliyarnagarWest Coast Tall varietyAmbajipetaGodavari GangaRatnagiriGodavari GangaBhubaneswarVHC 1JagdalpurPhilippines Ordinary Tall

## Aliyarnagar

Experiment was initiated during 2022 in West Coast Tall variety and the yield attributes is presented in Table 14.

| Month of harvest | T <sub>1</sub> (Tendernuts) | T <sub>2</sub> (Alternate<br>bunches) | T <sub>3</sub> (Tendernutsfrom<br>Jan. to June) | T <sub>4</sub> (Matured nuts) |  |
|------------------|-----------------------------|---------------------------------------|---|-------------------------------|--|
|                  |                             | (Nı                                   | uts per palm)                                   |                               |  |
| January          | 18.0                        | 18.0 (TN)                             | 18.0 (TN)                                       | 14.0 (MN)                     |  |
| February         | 17.0                        | 16.0 (MN)                             | 16.0 (TN)                                       | 16.0 (MN)                     |  |
| March            | 14.0                        | 15.0 (TN)                             | 14.0(TN)  | 18.0 (MN)                     |  |
| April            | 13.0                        | 14.0 (MN)                             | 13.0 (TN)                                       | 18.0(MN)                      |  |
| May              | 10.0                        | 11.0 (TN)                             | 10.0 (TN)                                       | 18.0(MN)                      |  |
| June             | 10.0                        | 12.0 (MN)                             | 10.0 (TN)                                       | 16.0(MN)                      |  |
| July             | 12.0                        | 12.0 (TN)                             | 12.0 (MN)                                       | 14.0(MN)                      |  |
| August           | 12.0                        | 13.0 (MN)                             | 11.0 (MN)                                       | 12.0 (MN)                     |  |
| September        | 14.0                        | 12.0 (TN)                             | 11.0 (MN)                                       | 12.0(MN)                      |  |
| October          | 15.0                        | 13.0 (MN)                             | 12.0 (MN)                                       | 12.0(MN)                      |  |
| November         | 16.0                        | 15.0 (TN)                             | 13.0 (MN)                                       | 10.0(MN)                      |  |
| December         | 16.0                        | 14.0 (MN)                             | 13.0 (MN)                                       | 10.0(MN)                      |  |

## Table 14. Yield parameters of coconut across different treatments at Aliyarnagar

TN – Tender nut; MN – Matured nut



## Ambajipeta

The trial was initiated during 2022 June in 34 years old Godavari Ganga hybrid coconut plantation with five replications. The initial growth and yield parameters of coconut were recorded and presented in Table 15. The treatments  $T_1$ ,  $T_2$  and  $T_4$  were initiated during June 2022. Treatment  $T_3$  initiated in the January 2023.

| Treatments            | Palm<br>height<br>(m) | Palm girth<br>(m) | No. of<br>functional<br>leaves /palm | No. of<br>bunches/<br>palm | No. of buttons/<br>palm | No. of nuts/<br>palm/year |
|-----------------------|-----------------------|-------------------|--------------------------------------|----------------------------|-------------------------|---------------------------|
| T <sub>1</sub>        | 10.93                 | 0.86              | 29.59                                | 13.13                      | 217.54                  | 87.0                      |
| <b>T</b> <sub>2</sub> | 10.75                 | 0.81              | 29.01                                | 13.15                      | 217.80                  | 87.1                      |
| T <sub>3</sub>        | 10.98                 | 0.86              | 29.79                                | 13.34                      | 220.06                  | 88.0                      |
| T <sub>4</sub>        | 10.67                 | 0.87              | 29.10                                | 13.10                      | 217.20                  | 86.9                      |
| SEm <u>+</u>          | 0.36                  | 0.02              | 0.42                                 | 0.44                       | 5.30                    | 4.55                      |
| CD at 5 %             | NS                    | NS                | NS                                   | NS                         | NS                      | NS                        |

## Table 15. Pre experimental observations of the palms at Ambajipeta

## 5.2 Oil Palm

## Nutrient management studies in oil palm under North East Region

Planting was done on 09/08/2019 as per the treatment details. The nutrient doses were applied as per the treatment details and growth parameters were recorded. The plant height was recorded maximum (270.14 cm) in  $T_3$  which was at par with  $T_1$  (255.80) and significantly higher than other treatments. The stem girth was recorded maximum (149.66 cm) in the palms treated with 1500:750:1500 g NPK/ palm/year which were at par with treatment of 1200:600:1200 g NPK/ palm/ year. Maximum number of leaves (24.02) was produced by the palms treated with 1500:750:1500 g NPK/ palm/ year which was significantly higher than any other treatments.

# Demonstration on oil palm production potential in North East Region

Twenty-nine oil palm seedlings planted in the year 2006 are being taken up as the experimental material for this "maximization plot and all the recommended crop management practices are being adopted to harvest maximum yield. Flowering and fruiting in all

the palms have been observed to be satisfactory over the years. The number of FFB produced per palm was 7.2 with an average bunch weight of 15.7 kg and the FBB yield was recorded as 16.2 t/h.

# Optimization of fertilizer dose for oilpalm plantation

Nutrient optimization in oil palm studies began in 2019 at Bavikere center through and experiment in Factorial RBD design. The grading of NPK levels as 0, 1 and 2;  $N_1$ -1200g,  $N_2$ -2400g,  $P_1$ -600g,  $P_2$ -1200g,  $K_1$ -1800g and  $K_2$ -3600 g. The study is still in its early stages, but two years of data showed no significant changes in palm height and girth across the treatments.

## Plant geometry studies in oil palm

Plant geometry in Oil palm studies initiated during 2019 at Bavikere center with four spacing *viz.*,  $M_1$ : 9m x 9m x 9m (Triangular planting);  $M_2$ : 9m x 9m (Square planting);  $M_3$ : 10m x 10m x 10m (Triangular planting) and  $M_4$ : 10m x 10m (Square planting ) in RBD design with five replications. The experiment is in initial stage and there are no significant differences among the treatments.



## **VI. CROP PROTECTION**

## **6.1 Disease Management**

## Survey and surveillance of coconut diseases Roving survey

Roving survey was conducted in four to five districts in each targeted state. In each district, four blocks were selected and from each block, seven villages comprising of ten gardens having minimum of seventy-five coconut palms/ garden were selected. Out of these seventy-five or more palms, 25 palms in each garden were selected randomly for assessing the disease incidence. The incidence of diseases *viz.*, bud rot, basal stem rot and stem bleeding were assessed. The observation were recorded based on the expression of characteristic symptoms of the respective disease on the selected palms. The per cent disease incidence was calculated using the formula.

PDI = <u>No. of infected palms</u> x100 Total number of palms

To assess the damage due to foliar diseases namely leaf blight and leaf spot, the leaflets have been observed for symptoms. This assessment was done through randomly observing twenty-five leaflets belonging to ten leaves in each of the selected coconut tree and grading was given using a score chart with scores ranging from 0-5. The following is the grade given for level of infection of foliar diseases

0 - No infection

- 1 <Ten percent leaf area infected
- 2 11–25% leaf area infected
- 3 26–50% leaf area infected
- 4 51–75% leaf area infected
- 5 >75% leaf area infected

The per cent disease Index (PDI) was calculated based on the formula PDI = (Sum of numerical ratings/Total number of leaves observed) × (100/Maximum disease grade) The severity (disease index) of basal stem rot, stem bleeding and per cent incidence of leaf spot and leaf blight were also calculated

## Aliyarnagar

Roving survey was conducted in seven districts of Tamil Nadu viz., Coimbatore, Tirupur, Dindigul, Theni, Tirunelveli, Thenkasi and Kanyakumari to assess the incidence of major diseases of coconut viz., bud rot, basal stem rot, stem bleeding, leaf blight and leaf spot during January 2023 to December 2023. The highest bud rot incidence of 9.5 per cent was recorded in Nullivillai village of Thuckalay block followed by Veeramarthandanpudur (8.1%) village of Thovalai block of Kanyakumari district. The block average of bud rot incidence was found to be high (5.26%) in Thuckalay followed by Thovalai block of Coimbatore district which recorded the bud rot incidence of 5.26 and 5.25 per cent, respectively. The district mean incidence of 4.36 and 1.19 per cent was observed in Kanyakumari and Coimbatore district respectively. Basal stem rot was found to be high in Gudimanagalam block, Udumalai followed by Tiruppur block. Among the blocks, Gudimanagalam block, Tirupur district recorded the highest block average of 7.06 per cent followed by Udumalai block with 6.63 per cent incidence. The highest district average of 5.23 per cent was recorded in Tirupur.

The highest stem bleeding incidence of 10.9 per cent was recorded in Periyapatti followed by Pulavadi village (9.73%) of Gudimangalam block and Udumalai block of Tirupur district. The mean disease incidence of the Gudimanagalam and Udumalai blocks were 4.91 and 1.73 per cent respectively. The district average for the Tirupur district was 1.66 per cent. The leaf blight intensity was high (27.7 PDI) in Kinadhukadavu village of Kinadhukadu block followed by Kallipalayam



village of Pollachi (South), Coimbatore district. The highest block average (14.29 PDI) was observed in Kinadhukadu block. The maximum district average (12.23 PDI) was recorded in Coimbatore district.

## Arsikere

The Roving survey on major coconut diseases viz., basal stem rot, stem bleeding, bud rot, leaf blight and leaf spot was conducted in five major coconut growing districts of Karnataka namely Chickkamagaluru, Hassan, Mandya, Shivamogga, and Tumakuru. The basal stem rot disease was noticed in all the five districts and the disease incidence ranged from 0.02 to 3.85 per cent. The maximum incidence of 3.85 per cent was recorded in Tumakuru taluk of Tumakuru district. However, the incidence of stem bleeding ranged from 0.01 to 8.44 per cent. Maximum incidence of 8.44 per cent was recorded at Arsikere taluk of Hassan district. With respect to bud rot disease incidence, the incidence ranged from 0.01 to 4.17 per cent. Maximum disease incidence of 4.17 per cent was noticed in Shivamogga. The foliar diseases of coconut namely leaf blight and leaf spot were separately recorded. The incidence of leaf blight ranged from 2.29 to 10.92 per cent during 2023-24. Maximum incidence was recorded at Turuvekere taluk in Tumakuru district. The disease incidence of leaf spot ranged from 2.08 to 14.58 per cent during 2023-24. Maximum incidence was recorded at Theerthahalli taluk in Shivamogga District

## Ambajipeta

Roving survey was conducted twice during the months of March and September following the standard operational procedure covering four blocks/mandalsin East Godavari, Eluru, Dr. B.R. Ambedkar Konaseema and West Godavari District of Andhra Pradesh to record the status of major diseases of coconut and also collected the disease Annual Report 2023

samples. Major diseases observed in all the coconut growing areas are basal stem rot and stem bleeding along with minor incidence of bud rot, leaf blight and grey leaf spot. The Basal stem rot disease is recorded highest incidence of 1.98% followed by leaf blight disease (1.50 DI), stem bleeding (0.69%) and leaf spot disease (0.12DI) as lowest incidence.

## **Fixed plot survey**

## Aliyarnagar

In order to understand the incidence of diseases on a long run basis, a fixed plot survey has been taken up. This will be useful in ascertaining the dynamics of incidence of coconut diseases over a period of time. On a quarterly basis, the observations have been made in order to ascertain the incidence of diseases.

Fixed plot survey was conducted at quarterly intervals from January 2023 to December 2023 in two villages *viz.*, Puliankandi and Aliyarnagar, Anamalai block, Coimbatore district. Observations were recorded on leaf blight and leaf spot diseases and the per cent disease incidence and percent disease index were calculated. Simultaneously the data on weather parameters namely, temperature and humidity were also collected to ascertain the correlation between disease incidence and weather parameters.

The intensity of leaf blight and leaf spot diseases were high in Puliyankandi when compared to Aliyarnagar. The leaf blight severity of 71.9 and 66.10 per cent were observed in Puliamkandi and Aliyarnager respectively and the leaf spot severity of 43.10 and 37.81 per cent were recorded in the above villages (Table.1). The leaf blight incidence was positively correlated with temperature and negatively correlated with RH. The leaf spot severity was negatively correlated with the temperature (Table 2).



| Month      |             | Puliya      | ankandi              |             | Aliyarnagar |             |                      |             |  |
|------------|-------------|-------------|----------------------|-------------|-------------|-------------|----------------------|-------------|--|
| WIOIIII    | Leaf blight |             | Pestolotia leaf spot |             | Leaf blight |             | Pestolotia leaf spot |             |  |
|            | PDI         | % incidence | PDI                  | % incidence | PDI         | % incidence | PDI                  | % incidence |  |
| Jan'2023   | 18.28       | 64.8        | 7.82                 | 38.6        | 16.70       | 58.00       | 6.57                 | 29.50       |  |
| April'2023 | 23.79       | 71.5        | 6.90                 | 33.0        | 19.85       | 66.10       | 7.15                 | 30.80       |  |
| July'2023  | 21.24       | 71.9        | 10.7                 | 40.80       | 17.29       | 61.90       | 9.24                 | 36.32       |  |
| Oct'2023   | 19.85       | 67.0        | 11.4                 | 43.10       | 16.40       | 60.00       | 10.39                | 37.81       |  |
| Mean       | 20.78±1.4   | 68.80       | 9.205±1.725          | 38.88       | 17.56±4.1   | 61.5        | 8.34±1.64            | 33.61       |  |

## Table 1. Incidence of coconut diseases in fixed plot survey

| Pul         | iyankar | ndi         |          |               | Aliy   | arnager     |      |
|-------------|---------|-------------|----------|---------------|--------|-------------|------|
|             |         | Corr        | relatior | n coefficient |        |             |      |
| Leaf blight |         | Leaf spo    | ot       | Leaf blig     | ght    | Leaf        | spot |
| Temperature | RH      | Temperature | RH       | Temperature   | RH     | Temperature | RH   |
| 0.89        | 0.68    | - 0.69      | 0.54     | 0.62          | - 0.75 | - 0.39      | 0.47 |

## Correlation between incidence of diseases in coconut and weather parameters

- The correlation coefficients calculated between incidence of coconut diseases and the weather parameters in both the villages resulted in the same trend. In both the villages, the correlation coefficient between incidence of leaf blight and temperature was significant, positive and higher which could be inferred as every unit increase in temperature likely to increase the incidence of leaf blight.
- Significant negative correlation was found between the incidence of leaf blight disease in coconut and RH which implied that every unit decrease in RH the incidence of leaf blight increases.
- The correlation coefficient worked out for the incidence of leaf spot and temperature was found to be negative and significant which could be interpreted as every one unit drop in temperature would increase the incidence of leaf spot in coconut. There was insignificant correlation between the incidence of leaf spot and RH.

The soil microbial population was analyzed in fixed plots, and it was found that among bacterial population, the colonies of *Pseuodomonas* sp. was found to be higher when compared to *Bacillus* sp. During the January quarter, the populations of both the bacterial species were observed to be higher when compared to the other three quarters, which was evident from the number of colonies identified. Among the fungal species, *Trichoderma* sp. was found to colonise more vigorously during January quarter than during the other three quarters.

## Arsikere

The fixed plots were identified by following the standard operational procedure and the study has been taken up to understand the both spatial and temporal distribution of diseases in a fixed plot and also to understand its relation with weather parameters. The plot is managed as per general management practices and no disease management measures were taken. Fixed plots selected for Basal stem rot, stem bleeding and Leaf blight diseases at Horticulture Research and Extension Centre, Arsikere and observation were recorded at quarterly



intervals. Per cent disease index of basal stem rot during January 2022 was 18.20% and increased to 22.53 % by the end of April-23. The Horizontal spread of the disease was increased from 9.56 to 10.36 %. In case of stem bleeding disease, the index and incidence was increased from 19.20 to 23.45 % and 13.33 to 13.96 respectively during January-22 to April-2023. The Leaf blight disease incidence was increased from 7.28 to 10.31% during the period. The correlation with the weather parameters and BSR resulted in positively with evening Relative Humidity and rainfall, whereas, in case of SB disease correlated negatively with rainfall and positively with temperature

## Ambajipeta

Fixed plots were identified by following the standard operational procedure and the study has been taken up to understand the both spatial and temporal distribution of diseases in a fixed plot and also to understand its relation with weather parameters. Fixed plots selected for stem bleeding and bud rot diseases at Vanapalli village of Ambajipeta mandal and for basal stem rot disease (*Ganoderma*) in farmer's field at Kesanapalli village in Malikipuram mandal Dr.B.R Ambedkar Konaseema District.

|            |                          | Dis                            | sease status            | 5                             |                   |                     | soil factors      |                  |
|------------|--------------------------|--------------------------------|-------------------------|-------------------------------|-------------------|---------------------|-------------------|------------------|
| Month      | Basal<br>Stem<br>Rot (%) | Basal<br>Stem Rot -<br>Disease | Stem<br>Bleeding<br>(%) | Stem<br>Bleeding -<br>Disease | Bud<br>Rot<br>(%) | Soil P <sup>H</sup> | Soil Temp.        | Soil<br>Moisture |
|            |                          | index[DI]                      |                         | index[DI]                     |                   |                     | ( <sup>0</sup> C) | (%)              |
| Jan'22     | 27.69                    | 19.68                          | 11.65                   | 2.2                           | 0                 | 6.7                 | 28.3              | 5.76             |
| April'22   | 27.69                    | 21.35                          | 12.21                   | 2.2                           | 0                 | 6.7                 | 32.24             | 3.81             |
| Jul-22     | 28.32                    | 22.56                          | 12.21                   | 3.1                           | 0                 | 6.8                 | 29.14             | 11.36            |
| Oct-22     | 28.95                    | 22.89                          | 13.85                   | 3.5                           | 0                 | 6.8                 | 29.54             | 11.89            |
| January-23 | 29.01                    | 22.91                          | 13.94                   | 3.8                           | 0                 | 6.7                 | 26.17             | 7.96             |
| Apr-23     | 30.21                    | 24.21                          | 13.94                   | 3.8                           | 0                 | 6.7                 | 33.0              | 4.0              |

 Table 3. Fixed plot survey on incidence of coconut diseases in Andhra Pradesh

In case of stem bleeding disease, the initial disease incidence (Horizontal Spread) 11.65 % was increased to 13.94 % by the end of May- 23. Similarly, the vertical spread (Disease index) also increased to 3.8 DI. The bud rot disease was not observed during the period. Soil microbial population of the fungi and bacteria were recorded as  $52 \times 10^4$ and 317 x 10<sup>7</sup> respectively in February 2022. The data recorded during February 2023 on soil microbial population showed it status as  $26 \times 10^5$ and  $337 \times 10^7$ . Correlation studies indicated that weather and soil parameters viz. Soil PH, Soil Temp., Soil Moisture, T Max, T Min, RH-Min and rainfall showed the non-significant positive correlation whereas the RH-Max showed nonsignificant negative correlation. Similarly, data of the

stem bleeding disease and soil and weather parameters *viz.*, Soil PH and Soil Moisture, and weather parameters *viz.*, T Max, T Min, RH-Min. rainfall showed the non-significant positive correlation whereas the RH-Max and Soil Temp., showed non-significant negative correlation.

## **Basal stem rot disease and Stem Bleeding Disease**

A new experiment initiated in January 2023 as Refining and developing effective IDM for management of BSR and Stem Bleeding Disease with four Modules at Ambajipeta, Veppankulam and Arsikere. Pre-data collected and initiated the treatment imposition in quarterly interval at all the centres.



## Leaf blight disease of coconut

## **Yield loss assessment**

Twenty-five healthy and twenty-five leaf blight infected palms were selected in Puliyankandi village,

Anamalai block, Coimbatore district and nut yield were recorded from January 2023–December 2023. The results are presented in Table.4. The per cent reduction in yield was assessed using the formula

Nut yield in healthy palm-Nut yield in infected palm x100 Nut yield in infected palm

From the results it was found that the percent reduction in nut yield due to leaf blight disease in coconut ranged from 6.45 to 18.86 per cent with an average nut yield loss of 13.59 per cent. In addition to leaf blight rugose spiraling white fly infestation was observed to an extent of 12 per cent.

| S No   | Data of harword | Nut yield (Mean of | twenty-five palms) | % reduction in |
|--------|-----------------|--------------------|--------------------|----------------|
| 5. 140 | Date of harvest | Healthy Palms      | Infected Palms     | Nut yield      |
| 1.     | 25.01.2023      | 23.13              | 19.50              | 18.61          |
| 2.     | 18.03.2023      | 19.80              | 16.87              | 17.36          |
| 3.     | 29.04.2023      | 22.50              | 19.68              | 14.32          |
| 4.     | 12.06.2023      | 21.45              | 20.15              | 6.45           |
| 5.     | 25.07.2023      | 20.75              | 19.24              | 7.84           |
| 6.     | 05.09.2023      | 19.23              | 17.95              | 7.13           |
| 7.     | 20.10.2023      | 19.10              | 16.17              | 18.11          |
| 8.     | 10.12.2023      | 18.65              | 15.69              | 18.86          |
|        |                 |                    | Mean               | 13.59          |

## Table 4. Assessment of yield loss due to leaf blight disease

## Epidemiology of leaf blight disease in coconut

The observations on symptoms of leaf blight disease in Coconut were taken on weekly intervals from January 2023 to December 2023 in order to understand the pattern on incidence in correlation with weather parameters prevailing in different seasons. The weather parameters namely Temperature, Rainfall, Relative Humidity (Morning and Evening) and Evaporation prevailed in Standard Meteorological Weeks (SMW) were recorded and the respective incidence of leaf blight during these weeks were also recorded. The observations are presented in following Table 5.



Symptoms of leaf blight in coconut









| Month  | Leaf blight<br>incidence | Temp | o (°C) | RI   | H (%)   | Rainfall | Evaporation |
|--------|--------------------------|------|--------|------|---------|----------|-------------|
|        | (PDI)                    | Max. | Mini.  | Morn | Evening | (mm)     | (cm)        |
| Jan-23 | 19.9                     | 32.6 | 17.6   | 95.5 | 89.2    | 0        | 3.7         |
| Feb-23 | 20.8                     | 33.2 | 17.5   | 90.8 | 87.9    | 0        | 4.6         |
| Mar-23 | 24.4                     | 34.9 | 21.4   | 83.1 | 79.3    | 1.2      | 5.0         |
| Apr-23 | 26.9                     | 35.2 | 22.0   | 84.8 | 82.9    | 2.1      | 5.1         |
| May-23 | 25.3                     | 35.2 | 22.0   | 86.8 | 82.3    | 10.1     | .5.2        |
| Jun-23 | 24.5                     | 33.9 | 23.3   | 82.4 | 76.2    | 10.8     | 3.3         |
| Jul-23 | 23.4                     | 32.8 | 25.5   | 85.3 | 80.3    | 25.8     | 3.4         |
| Aug-23 | 24.1                     | 33.2 | 24.4   | 85.0 | 77.7    | 2.9      | 3.7         |
| Sep-23 | 23.4                     | 32.1 | 24.8   | 86.0 | 80.7    | 1.6      | 3.3         |
| Oct-23 | 21.5                     | 32.3 | 23.2   | 90.6 | 84.2    | 0.0      | 2.9         |
| Nov-23 | 20.8                     | 32.4 | 21.1   | 91.1 | 88.2    | 0.7      | 2.6         |
| Dec-23 | 21.8                     | 32.4 | 21.1   | 90.1 | 87.2    | 0.1      | 2.3         |

## Table 5. Month wise weather data and intensity of leaf blight during Jan 2023 to Dec 2023

## Table 6. Week weather data and intensity of leaf blight during Jan 2023 to December 2023

|        | Std  | DI of          | Temp  | o (°C) | RH    | (%)   | Rainfall | Evaporation |
|--------|------|----------------|-------|--------|-------|-------|----------|-------------|
| Month  | week | leaf<br>blight | Max.  | Min.   | Max.  | Min.  | (mm)     | (cm)        |
| Jan'23 | 1    | 20.5           | 32.8  | 19.2   | 95.4  | 94.3  | 0        | 2.6         |
|        | 2    | 19.7           | 31.7  | 16.8   | 96.6  | 86.4  | 0        | 3.6         |
|        | 3    | 20.4           | 32.4  | 17.1   | 93.9  | 84.1  | 0        | 3.7         |
|        | 4    | 19.3           | 33.6  | 17.1   | 95.9  | 92.1  | 0        | 4.7         |
|        | Mean | 19.9           | 32.62 | 17.55  | 95.45 | 89.22 | 0        | 3.65        |
| Feb'23 | 5    | 21.5           | 33.6  | 17.4   | 93.3  | 91.3  | 0        | 3.9         |
|        | 6    | 20.9           | 32.9  | 18.2   | 90.4  | 86.7  | 0        | 4.7         |
|        | 7    | 21.2           | 33.2  | 17.5   | 88.9  | 85.9  | 0        | 4.5         |
|        | 8    | 19.9           | 33.1  | 16.7   | 90.7  | 88.4  | 0        | 5.1         |
|        | Mean | 20.8           | 33.2  | 17.45  | 90.82 | 87.96 | 0        | 4.55        |
| Mar'23 | 9    | 25             | 33.2  | 20.8   | 72.6  | 70.2  | 0        | 4.9         |
|        | 10   | 23.7           | 35.5  | 22.4   | 88.3  | 86.4  | 1.2      | 3.8         |
|        | 11   | 23.2           | 35.2  | 20.8   | 88.4  | 83.2  | 0        | 5.4         |
|        | 12   | 25.1           | 35    | 21.9   | 86.3  | 84.1  | 0        | 5.5         |
|        | 13   | 24.8           | 35.4  | 20.9   | 80    | 72.6  | 0        | 5.6         |
|        | Mean | 24.36          | 34.86 | 21.36  | 83.12 | 79.3  | 1.2      | 5.04        |

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| April'23 | 14   | 26.5  | 34.9   | 21.7  | 83.1  | 80.7   | 0.0  | 6.2   |
|----------|------|-------|--------|-------|-------|--------|------|-------|
|          | 15   | 25.4  | 35.7   | 22    | 83.3  | 81.7   | 0.0  | 6.1   |
|          | 16   | 28.3  | 34.6   | 22    | 82.4  | 80.8   | 2.1  | 4.6   |
|          | 17   | 27.6  | 35.66  | 22.3  | 90.2  | 88.4   | 0.0  | 3.6   |
|          | Mean | 26.9  | 35.215 | 22    | 84.75 | 82.9   | 2.1  | 5.12  |
| May'23   | 18   | 25.3  | 34.9   | 21.7  | 86.1  | 82.5   | 0    | 6.2   |
|          | 19   | 25.4  | 35.7   | 22    | 86.4  | 81.6   | 5.1  | 6.1   |
|          | 20   | 25.3  | 34.6   | 22    | 81.7  | 76.4   | 0.0  | 4.6   |
|          | 21   | 25    | 35.6   | 22.3  | 93    | 88.7   | 5.0  | 3.6   |
|          | Mean | 25.25 | 35.2   | 22    | 86.8  | 82.3   | 10.1 | 5.125 |
| June'23  | 22   | 24.7  | 34.5   | 23.3  | 87    | 83.2   | 0.0  | 3.9   |
|          | 23   | 23.5  | 34.1   | 23.3  | 81.4  | 76.8   | 5.0  | 3.4   |
|          | 24   | 26    | 35     | 23.4  | 80.6  | 72.4   | 0.4  | 2.9   |
|          | 25   | 24.2  | 33.5   | 23.8  | 82.6  | 77.3   | 5.0  | 3.7   |
|          | 26   | 24    | 32.6   | 22.5  | 80.4  | 71.4   | 0.4  | 2.6   |
|          | Mean | 24.48 | 33.94  | 23.26 | 82.4  | 76.22  | 10.8 | 3.3   |
| July'23  | 27   | 23.1  | 34.5   | 23.8  | 86.6  | 81.4   | 15.1 | 4     |
|          | 28   | 23.7  | 30.9   | 27.6  | 86.1  | 80.7   | 10.7 | 1.7   |
|          | 29   | 23.2  | 32.3   | 25.5  | 87.1  | 81.2   | 0.0  | 3.7   |
|          | 30   | 23.4  | 33.6   | 25.2  | 81.5  | 78     | 0    | 4.3   |
|          | Mean | 23.35 | 32.82  | 25.52 | 85.32 | 80.32  | 25.8 | 3.42  |
| Aug'23   | 31   | 24.5  | 33.3   | 24.8  | 89.4  | 81.9   | 0    | 4.3   |
|          | 32   | 23.7  | 33.9   | 23.9  | 91.1  | 80.6   | 11.2 | 4.4   |
|          | 33   | 24.5  | 33.4   | 23.1  | 81.1  | 76.4   | 6.5  | 2.5   |
|          | 34   | 23.7  | 32.1   | 25.8  | 78.5  | 71.9   | 5.2  | 2.6   |
|          | Mean | 24.1  | 33.17  | 24.4  | 85.02 | 77.7   | 2.9  | 3.73  |
| Sep'23   | 35   | 23.1  | 31.1   | 25.6  | 83.7  | 75.6   | 0.0  | 2.7   |
|          | 36   | 23    | 32.2   | 25    | 79.3  | 76.4   | 0    | 3.6   |
|          | 37   | 23.3  | 33.7   | 23.5  | 84.3  | 81.4   | 0    | 4.4   |
|          | 38   | 24.6  | 31.1   | 25.1  | 94.4  | 89.6   | 1.6  | 2.9   |
|          | 39   | 23.2  | 32.6   | 24.9  | 88.7  | 81.4   | 0    | 3.1   |
|          | Mean | 23.44 | 32.14  | 24.82 | 86.08 | 80.75  | 1.6  | 3.34  |
| Oct'23   | 40   | 22.5  | 34.3   | 24.8  | 89.7  | 82.8   | 0    | 4     |
|          | 41   | 21    | 33     | 24.4  | 95.9  | 89.4   | 0.0  | 2.4   |
|          | 42   | 21.3  | 31.4   | 22.1  | 89.3  | 82.3   | 0.0  | 2.6   |
|          | 43   | 21.1  | 30.6   | 21.3  | 87.5  | 82.4   | 0.0  | 2.5   |
|          | Mean | 21.47 | 32.325 | 23.15 | 90.6  | 84.225 | 0.0  | 2.875 |

| Nov'23 | 44   | 21.5  | 31.5 | 19.4   | 87.5  | 86.9  | 0.0 | 2.8   |
|--------|------|-------|------|--------|-------|-------|-----|-------|
|        | 45   | 19.3  | 33.7 | 20.7   | 89.4  | 88.9  | 0   | 2.7   |
|        | 46   | 20.5  | 32   | 21.5   | 94    | 87.7  | 0.7 | 2.6   |
|        | 47   | 21.7  | 30.5 | 22.7   | 93.6  | 89.4  | 0   | 2.6   |
|        | Mean | 20.75 | 32.4 | 21.075 | 91.12 | 88.22 | 0.7 | 2.675 |
| Dec'23 | 48   | 21.5  | 31.5 | 19.4   | 87.5  | 86.9  | 0.0 | 2.8   |
|        | 49   | 19.3  | 33.7 | 20.7   | 89.4  | 88.9  | 0.1 | 2.7   |
|        | 50   | 20.5  | 32   | 21.5   | 94    | 87.7  | 0.0 | 2.6   |
|        | 51   | 21.7  | 30.5 | 22.7   | 93.6  | 89.4  | 0.0 | 2.6   |
|        | 52   | 21.7  | 30.5 | 22.7   | 93.6  | 89.4  | 0.0 | 2.3   |
|        | Mean | 20.75 | 32.4 | 21.07  | 91.2  | 88.30 | 0.1 | 2.675 |

## Table.7 Correlation between leaf blight incidence and weather parameters

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| Weather parameters    | Correlation coefficient |
|-----------------------|-------------------------|
| Temperature (Maximum) | 0.74                    |
| Temperature (Minimum) | 0.55                    |
| RH (Morning)          | - 0.82                  |
| RH (Evening)          | - 0.70                  |
| Rainfall              | 0.36                    |
| Evaporation           | 0.52                    |

The results given in the above Table 6 revealed that nevertheless, the leaf blight symptoms were exhibited all through the year or in all months of the year, the incidence was maximum during hot months of March, April and May months of the year 2023 it got decelerated during October, November, December months of 2023.

The correlation results given in Table 7 revealed that there existed a positive correlation between temperature (Maximum and Minimum) and leaf blight incidence. It could be inferred as a rise in every degree of temperature there is every likelihood that there will be increase in the infection of leaf blight disease in coconut.

Similarly, there existed a negative correlation between RH and leaf blight incidence as shown in Table 7. This could be inferred as the increase in RH resulted in decrease in the incidence of the leaf blight disease which could be corroborated from the observations given in Table 6 that the months coinciding the increased RH experienced lesser incidence of leaf blight.

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## Management of leaf blight disease of coconut

Management of leaf blight disease using chemicals has been one of the pragmatic options and in order to arrive at the best option among the recent fungicides available, a field experiment has been contemplated with seven treatments. The fungicides namely propiconazole and tebuconazole have been selected for this experiment. Randomized block design was chosen for the study which involved seven treatments with three replications and the study was undertaken in the coconut garden of farmers in Puliyankandi village.

The results of the experiment for the management of leaf blight disease in Coconut revealed that root application of propiconazole @ 5 ml in 100 ml of water three times during January, July and October months has been found to effectively reduce the incidence of the disease by 27.03 per cent after 36 months of the treatment with 132 fruits/palm/year and a benefit cost ratio of 1:1.24. This was against the yield of only 101 fruits/palm/year from the gardens which were untreated control.

# Demonstration of Integrated disease management in Coconut

An Integrated Disease Management (IDM) protocol was arrived at, and it was demonstrated in one acre

## ICAR-AICRP on Palms

coconut farm which consisted of seventy-two palms located in Aliyarnagar village of Anaimalai block in Coimbatore district.

The following four components were demonstrated as integrated disease management strategy

- Removal and destruction of severely affected fronds (once in 3 months)
- Spraying of Bordeaux mixture 0.5% or copper oxychloride 0.3% two times at 45 intervals during summer months (Feb/April).
- Root feeding of Propiconazole @ 2ml + 100 ml water (Root feeding to be done at three months interval during Jan, April, July and October)
- Basal application of *Bacillus subtilis* @ 200g along with 50 kg FYM per year.

Integrated disease management modules *viz.*, removal of severely affected fronds, spraying of copper oxychloride 0.3% two times at 45 intervals, root feeding of propiconazole @ 2ml + 100 ml water and basal application of *Bacillus subtilis* @ 200g along with 50 kg FYM per year was a promising strategy for the management of leaf blight. The above management strategy reduced the leaf blight from 9.27 PDI to 6.15 PDI after 6 months of treatment. Clear difference was observed between control and the treated palms as there was increase in the incidence of leaf blight in control plot.

# Assessing the incidence of root (wilt) disease in Tamil Nadu

Roving survey was conducted during January 2023 – December 2023 to assess the incidence of root (wilt) in different villages of Coimbatore, Tirupur, Dindigul, Theni, Thenkasi, Tirunelveli and Kanyakumari districts. The highest root wilt incidence of 49.50 per cent was recorded in Thappatikelavenpudur village, Anaimalai block, Coimbatore District followed by Vellimalai (44.18%) and Thippiramalai villages (45.17%), Kuruthencode and Killiyoor blocks, Kanyakumari District. In Coimbatore district, among the four blocks surveyed, the severe root (wilt) incidence was observed in three blocks *viz.*, Pollachi South, Pollachi North and Anamalai and only meager incidence was observed in surveyed villages of Periyakalandai, Sheripalayam and Kappalankarai, Kinathukadavu block. The root wilt incidence of Coimbatore district ranged from 3.00 to 51.70 per cent.

The status of root (wilt) was surveyed in four blocks of Tirupur district and only meager incidence of root wilt was observed in Tirupur district with district average of 2.38 per cent. In Tirupur district, among the four blocks surveyed the root (wilt) incidence was observed in three blocks *viz.*, Gudimangalam (8.04%) and Udumalai (6.7%) and it was not found in surveyed villages of Avinashi block. The root (wilt) incidence was not recorded in surveyed villages of Dindigul and Tirunelveli districts.

In Theni district, severe incidence of root (wilt) was recorded in Kamayangoundanpatti (21%), Kombai (28.2%), Anaipatti (25.1%) and Pudupatti (22.1%) villages of Cumbum block. The mean root (wilt) incidence of Bodinaickenur block was found to be 11.65 per cent. The root (wilt) incidence was not found in surveyed villages of Periyakulam blocks.

A total of six blocks were surveyed for assessing the status of root (wilt) incidence in Kanyakumari district. The disease was recorded in six blocks *viz.*, Kuruthencode, Rajakamangalam, Thovalai, Killiyoor, Agastheeswaram and Thuckalay. The maximum incidence of 45.17 per cent was recorded in Thippiramalai village of Killiyoor block. In Kuruthencode block, the disease was observed in all the four villages surveyed with the block average of 28.4 per cent. The district average of Kanyakuamri district was 11.26 per cent. Table . 8. Incidence of coconut root (wilt) disease in different districts of Tamil Nadu (Jan 2023 - Dec 2023)

| Blocks                | Villages             | Koot wilt<br>incidence          | Blocks        | Villages              | Koot wilt<br>incidence |
|-----------------------|----------------------|---------------------------------|---------------|-----------------------|------------------------|
|                       |                      | COIMBATO                        | RE DISTRICT   |                       |                        |
| Pollachi North        | R. Ponnapuram        | 0.00                            | Anamalai      | Samiyandipudur        | 12.47                  |
|                       | Podipalayam          | 32.60                           |               | Aliyar                | 13.58                  |
|                       | Kovilpalayam         | 0.00                            |               | Jalathur              | 18.20                  |
|                       | Vadakipalayam        | 7.50                            |               | Thappataikelavenpudur | 49.50                  |
|                       | Devarayapuram        | 0.00                            |               | Kaliappangoundenpudur | 35.80                  |
|                       | Kollupalayam         | 0.00                            |               | Thattur               | 11.69                  |
|                       | Nanjaigoundenpudur   | 7.00                            |               | Vadugapalayam         | 13.82                  |
|                       | Thimmankuthu         | 16.66                           |               | Alankadavu            | 15.35                  |
|                       | Subaiyangoundenpudur | 10.00                           |               | Vazhaikombennagur     | 16.90                  |
|                       | Puravipalayam        | 0.00                            |               | Pongaliur             | 3.00                   |
|                       | Mean                 | 7.37±0.7                        |               | Mayiladuthurai        | 5.21                   |
| <b>Pollachi South</b> | Zamin Kottampatti    | 6.00                            |               | Ponalammanthurai      | 10.5                   |
|                       | Singanallur          | 5.80                            |               | Mean                  | $17.16\pm 0.25$        |
|                       | Ambarampalayam       | 51.7                            | Kinathukadavu | Pachappalayam         | 0.00                   |
|                       | Kanjampatti          | 0.00                            |               | Kuruvaikondampalayam  | 0.00                   |
|                       | Komangalampudur      | 11.50                           |               | Mayileripalayam       | 0.00                   |
|                       | Naickenpalayam       | 0.00                            |               | Vadapudur             | 0.00                   |
|                       | Kolarpatti           | 0.00                            |               | Solavampalaym         | 0.00                   |
|                       | Unjavelampatti       | 10.90                           |               | Kondampatti           | 0.00                   |
|                       | Veeralpatti          | 5.00                            |               | Andipalayam           | 0.00                   |
|                       | Ponnapuram           | 4.80                            |               | Periyakalandai        | 6.12                   |
|                       |                      |                                 |               | Sheripalayam          | 6.58                   |
|                       | Mean                 | $\textbf{9.57}\pm\textbf{0.48}$ |               | Kappalankarai         | 5.50                   |
|                       | District Mean        | $8.97 \pm 0.51$                 |               | Mean                  | $1.82 \pm 0.55$        |

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|               |                    | TIRUPUR         | DISTRICT          |                  |                 |
|---------------|--------------------|-----------------|-------------------|------------------|-----------------|
| Udumalai      | Kosavampalayam     | 12.60           | Avinashi          | Rachiapaalyam    | 0.00            |
|               | Mukkonam           | 0.00            |                   | Karunkattupudur  | 0.00            |
|               | Udumalai           | 5.00            |                   | Seyoor           | 0.00            |
|               | Deepalapatti       | 9.10            |                   | Mean             | $0.0 \pm 0.0$   |
|               | Mean               | $6.67 \pm 1.25$ | Gudimangalam      | Vagaitholuvu     | 7.14            |
| Tirupur       | Ettivearmpalayam   | 0.0             |                   | Veethampatti     | 4.50            |
|               | Rachiapatti        | 0.0             |                   | Pethapampatti    | 3.00            |
|               | Managalam          | 0.0             |                   | Ramachandrapuram | 0.00            |
|               |                    |                 |                   | Kosasavampatti   | 12.90           |
|               |                    |                 |                   | Alamarathur      | 0.00            |
|               |                    |                 |                   | Virugalpatti     | 13.74           |
|               |                    |                 |                   | Anikkadavu       | 10.89           |
|               |                    |                 |                   | Mongiltholuvu    | 19.25           |
|               |                    |                 |                   | Gudimangalam     | 8.93            |
|               | Mean               | $0.00\pm0.00$   |                   | Mean             | $8.04\pm0.3$    |
|               |                    |                 |                   | District Mean    | $3.68 \pm 0.39$ |
|               |                    | DINDIGUI        | L DISTRICT        |                  |                 |
| Palani        | Ayyampalayam       | 0.00            | Reddiyarchathiram | Semadaipatti     | 0.00            |
|               |                    |                 |                   | Palakanathu      | 0.00            |
|               | Eramanayakkanpatti | 0.00            |                   | Nadupatti        | 0.00            |
|               | Madathukulam       | 0.00            |                   | Karisalpatti     | 0.00            |
|               | Akkaraipatti       | 0.00            |                   | Mean             | $0.0\pm0.00$    |
|               | Mean               | $0.0\pm0.00$    | Nilakottai        | Pallapatty       | 0.00            |
| Oddanchathram | Oddanchathram      | 0.00            |                   | Silukkuvar patty | 0.00            |
|               | Chatirapatti       | 0.00            |                   | Nilakotai        | 0.00            |
|               | Virupakshi         | 0.00            |                   | Vilampatty       | 0.00            |
|               | Naganampatti       | 0.00            |                   | Mean             | $0.0\pm 0.00$   |
|               | Mean               | $0.0\pm0.00$    |                   | District Mean    | $0.0\pm0.00$    |


|               |                 | <b>THENI</b>     | DISTRICT      |                     |                  |
|---------------|-----------------|------------------|---------------|---------------------|------------------|
| Periyakulam   | Lakshmipuram    | 0.00             | Uthamapalayam | Anaimalaiyanpatti   | 9.51             |
|               | Saruthupatti    | 0.00             |               | Mallingapuram       | 7.10             |
|               | Endappuli       | 0.00             |               | Rayappanpatti       | 8.20             |
|               | Kamatchipuram   | 0.00             |               | Kokilapuram         | 9.50             |
|               | Thenkarai       | 0.00             |               | Mean                | $8.58 \pm 1.78$  |
|               | Mean            | $0.0\pm0.00$     | Cumbum        | Anaipatti           | 25.10            |
| Podinayakanur | Markaiyankottai | 15.51            |               | Kamayangoundanpatti | 21.00            |
|               | Ellapatti       | 14.60            |               | Pudupatti           | 22.10            |
|               | Ammapatti       | 10.40            |               | Kombai              | 28.20            |
|               | Ayyampatti      | 9.81             |               | Sikaiyanpatti       | 15.71            |
|               | Sindalacherry   | 10.72            |               | Govindanpatti       | 0.00             |
|               | Sankarapuram    | 8.83             |               | Mean                | $18.69 \pm 2.62$ |
|               | Mean            | $11.65 \pm 1.47$ |               | District Mean       | $9.73 \pm 1.47$  |
|               |                 | TIRUN            | ELVELI        |                     |                  |
| Ambasamudram  | Vellanguli      | 0.00             | Mannur        | Alagiyapandipuram   | 0.00             |
|               | Vagaikulam      | 0.00             |               | Manur               | 0.00             |
|               | Mannarkovil     | 0.00             |               | Vannikonanthal      | 0.00             |
|               | Sethupattu      | 0.00             |               | Melaiilanthaikulam  | 0.00             |
|               | Sivanthipuram   | 0.00             |               | Madavakurichi       | 0.00             |
|               | Mean            | $0.00\pm0.00$    |               | Mean                | $0.00\pm0.00$    |
|               |                 |                  | Vallioor      | Valliyoor           | 0.00             |
| Radhapuram    | Ovari           | 0.00             |               | Palavoor            | 0.00             |
|               | Radhapuram      | 0.00             |               | Panankudi           | 0.00             |
|               | Udayathur       | 0.00             |               | Anaikulam           | 0.00             |
|               | Vijayapathi     | 0.00             |               | Vadakkankulam       | 0.00             |
|               | Koodankulam     | 0.00             |               | Mean                | $0.00\pm0.00$    |
|               | Mean            | $0.00\pm0.00$    |               | District Mean       | $0.00 \pm 0.00$  |

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|                |                      | TEN              | IKASI                |                           |                   |
|----------------|----------------------|------------------|----------------------|---------------------------|-------------------|
| Kadaiyanallur  | Aachampatti          | 2.60             | Vasudevanallur       | Puliyangudi               | 0.00              |
|                | Kumunthapuram        | 5.85             |                      | Vasudevanallur            | 0.00              |
|                | Aachampudur          | 7.83             |                      | Chinthamani               | 0.00              |
|                | Elathoor             | 9.59             |                      | Subramaniyapuram          | 0.00              |
|                | Kasitharmum          | 10.20            |                      | Mean                      | $0.00\pm0.00$     |
|                | Mean                 | 7.21±0.52        | Senkottai            | Senkottai                 | 0.00              |
| Thenkasi       | Panboli              | 28.20            |                      | Thenpothai                | 25.50             |
|                | Kannakkapillaivalasu | 22.00            |                      | Meenashipuram             | 22.30             |
|                | Vadakarai            | 19.31            |                      | Peiyakanakkapillaivalasai | 2.90              |
|                | Karisalkudieruppu    | 15.20            |                      | Mean                      | $12.68 \pm 0.125$ |
|                | Mean                 | $21.18 \pm 3.8$  | <b>District</b> Mean | $10.12 \pm 1.11$          |                   |
|                |                      | KANYAKUM         | <b>ARI DISTRICT</b>  |                           |                   |
| Kuruthencode   | Vellichanthai        | 24.74            | Thovalai             | Therichananamkoppu        | 0.00              |
|                | Vellimalai           | 44.18            |                      | Aralvaiozhi               | 0.00              |
|                | Ammandivilai         | 5.50             |                      | Kadukarai                 | 0.00              |
|                | Manavalakuruchi      | 15.80            |                      | Veeramarthandanpudur      | 5.15              |
|                | Mean                 | $22.55 \pm 1.37$ |                      | Siramadam                 | 2.50              |
|                |                      |                  |                      | Mean                      | $1.53\pm0.5$      |
| Rajakamangalam | Dharmapuram          | 6.05             | Killiyoor            | Thippiramalai             | 45.17             |
|                | Puthalam             | 3.00             |                      | Nattalam                  | 35.88             |
|                | Otaithengaivilai     | 0.00             |                      | Kollenchy                 | 0.00              |
|                | Pannaiyoor           | 0.00             |                      | Mathicode                 | 0.00              |
|                | Pudur                | 1.30             |                      | Midalam                   | 0.00              |
|                | Mean                 | $2.07 \pm 0.26$  |                      | Mean                      | $10.21 \pm 7.18$  |

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# **6.2 Pest management**

# Multi location evaluation trial of the nylon net for the management of rhinoceros beetle in coconut palms

Centres: Aliyarnagar, Ambajipeta, Arsikere and Ratnagiri

## Aliyarnagar

Trial was conducted both in Coconut Research Station Farm, Aliyarnagar (Variety: ALR 1) and in farmers field located at Puliyankandi village, Anamalai block, Coimbatore district (DXT hybrid). A total of 30 palms (age 2 - 3 years) were selected and spear leaf base with 2-3 adjacent leaf base were wrapped with nylon net. Per cent leaf damage was calculated before and after imposing treatment and per cent reduction in leaf damage was worked out. Observations on number of adult beetles trapped were made at weekly intervals. Before imposing treatment (April, 2022), the leaf damage by rhinoceros beetle ranged from 6.17 % to 6.43 % and spindle damage ranged from 5.42 % to 6.10 % (Table 2). Monthly observations revealed that there was gradual reduction in leaf and spindle damage in the nylon net wrapped palms (Table 2). During December 2022, the leaf and spindle damage were 1.33 % and 0.45 %, respectively in the treatment and 5.95 % & 5.22 % in the control. During the observation period, the mean number of adult rhinoceros beetles trapped in the nylon net was 0.87.

#### Ambajipeta

The experiment was conducted at ICAR-AICRP on Palms, Dr. YSRHU-Horticultural Research Station, Ambajipeta, Dr. B.R.Ambedkar Konaseema District, Andhra Pradesh. A total of 30 coconut palms with age of 4-6 years old were selected to evaluate the effectiveness of the nylon netting technology for management of rhinoceros beetle and a separate control also maintained. A total of 18 beetles were trapped in experimental observation period. The data on per cent leaf and spindle damage was recorded at weekly intervals. The results revealed that, there is a significant difference with respect to leaf damage in treatment (15.73) when compared with control (42.24). (Table 9).



Beetle trapped in Nylon net



| Table  | 9          | Leaf  | damage | by | rhinoceros | beetle |
|--------|------------|-------|--------|----|------------|--------|
| during | <u>z</u> 2 | 022-2 | 3      |    |            |        |

| Month &          | Mean of 3        | ) palms/plot     |
|------------------|------------------|------------------|
| Year             | % Leaf           | f damage         |
|                  | Treatment        | Control          |
|                  |                  | (Farmer's field) |
| April            | 31.81            | 32.50            |
| May              | 31.51            | 38.46            |
| June             | 30.13            | 42.85            |
| July             | 27.57            | 46.15            |
| August           | 22.44            | 52.50            |
| September        | 19.49            | 56.25            |
| October          | 15.81            | 54.55            |
| November         | 12.92            | 55.12            |
| December         | 8.47             | 51.85            |
| January          | 6.52             | 48.25            |
| February         | 5.15             | 44.25            |
| March            | 4.25             | 45.45            |
| April            | 2.75             | 46.25            |
| May              | 1.5              | 47.05            |
| Mean <u>+</u> SE | $15.73 \pm 3.03$ | 47.24 ± 1.77     |
| Sig(p=0.05)      | Sig              |                  |
| 'T' - Value      | -7.75            |                  |
| 'P' - Value      | 0.0000032        |                  |

- The mean values in the table represent means of per cent leaf and spindle damage.
- Figures in parentheses are analyzed by using paired T-test.
- Means followed by significantly different from each other (P>0.05) using paired T-test.

#### Arsikere

Thirty Tiptur Tall (TPT) coconut palms were selected for evaluation of the nylon net for the management of rhinoceros beetle in coconut palms over natural control for each treatment against rhinoceros beetle. The method of treatment which includes wrapping the spear leaf base with 2-3 adjacent leaf base with Annual Report 2023

nylon nets (size  $-3.2 \times 3.2 \text{ cm}$ ), when new leaf emerges, nylon net has loosened and rewrapped suitable to the newly emerged leaf was implemented in the plot as per the experimental protocol. Precount observations on leaf and spindle damage by rhinoceros beetle were recorded in both the treatments during April, 2022. The post treatment observations were recorded on leaf, spindle damage and no. of adults beetle trapped on nylon net. The data indicated that the minimum leaf damage (4.9 %), spindle damage (5.8%) and adults beetle trapped on nylon net (0.26 nos.) were observed in  $T_1$ - treated palms. However, maximum leaf and spindle damage were found 46.5 and 20.2 per cent, respectively in T<sub>2</sub>-untreated palms. The same trends were noticed in every month during the year 2022 and 2023. The T<sub>1</sub>- treated palms with nylon net treatment was found significantly superior over T<sub>2</sub>- untreated control in respect of leaf and spindle damage by rhinoceros beetle in coconut. The Nylon-net wrapped treatment trapped maximum adult's rhinoceros beetle population, which ranges from 0.04 to 0.85 beetles/ week which was significantly superior over natural control.

#### Ratnagiri

The present experiment was carried out in plot no. 9 at RCRS, Ratnagiri using thirty-six palms of most susceptible coconut dwarf varieties. The leaf and spindle damage was recorded at weekly intervals. Pre-count observations on leaf and spindle damage were recorded during April, 2022. The post treatment observations were recorded on leaf, spindle damage and no. of adult beetles trapped on nylon net. The data indicated that the minimum leaf damage (14.2%), spindle damage (9.49%) and adult beetles trapped on nylon net (0.74 nos.) were observed in T<sub>1</sub>. However, maximum leaf and spindle damage were found 37 and 33.7 per cent, respectively in T<sub>2</sub>-untreated palms. The same trends were noticed every month during the year 2022-23. The T<sub>1</sub> nylon net treatment was found significantly

superior over  $T_2$ - untreated control in respect of leaf and spindle damage by rhinoceros beetle in coconut.

# Surveillance, assessment of natural enemies and management of whitefly complex in coconut

# Aliyarnagar

Observations on incidence and intensity of Rugose Spiraling Whitefly (RSW) and Bonder's nesting whitefly (BNW) were made at monthly intervals from January 2023 to December 2023 in three whitefly infested gardens at Coconut Research Station (CRS), Aliyarnagar (Variety: Chowghat Orange Dwarf); Puliyankandi village, Anamalai block (DxT hybrid) and Angalakuruchi village, Pollachi block (Variety: ALR 1). RSW incidence ranged from 17.7 to 23.5 per cent. Highest incidence was observed during the month of December (23.5%) and lowest during January (17.7%). The mean incidence recorded was 20.7 per cent. RSW

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intensity ranged from 21.4 to 26.3 per cent. Lowest intensity was observed during the months of January and highest during December (Table 10). BNW incidence and intensity ranged from 14.3 to 20.0 per cent and 17.6 to 20.9 per cent, respectively. Incidence was highest during the month of February and lowest during October.

Highest Infestation Grade Index (IGI) was recorded during June (1.6) and lowest during January (0.9). Mean intensity and IGI recorded were 23.3 per cent and 0.66, respectively. Parasitisation by *Encarsia guadeloupae* ranged from 47.5 to 65.3 per cent. Maximum parasitisation was observed during the month of January (65.3%) and minimum during May (47.4%) (Table 10). Mean parasitisation recorded was 52.7 per cent. Among the alternate hosts, higher RSW incidence was observed in banana (12.3% to 15.2%), custard apple (12.3% to 15.4%) and cocoa (4.4% to 6.4%).

Table 10: Extent of Rugose Spiraling Whitefly (RSW) infestation in coconut and their natural enemies in Tamil Nadu

| Months       | Months Incidence Internet Months |              | Grade<br>Index  | No. o           | f live colo      | nies *          | Encarsia<br>parasitism | Natural E       | Enemies **  |
|--------------|----------------------------------|--------------|-----------------|-----------------|------------------|-----------------|------------------------|-----------------|-------------|
|              | (%)                              | RSW(%)       |                 | Eggs            | Nymphs           | Adults          | (%)                    | Spiders         | Predators   |
| January 23   | 17.7                             | 21.4         | 0.9             | 17.9            | 15.2             | 20.4            | 65.30                  | 0.4             | 0.4         |
| February 23  | 18.3                             | 22.2         | 1.1             | 18.3            | 14.9             | 27.3            | 60.23                  | 0.5             | 0.5         |
| March 23     | 18.7                             | 22.4         | 1.2             | 18.5            | 16.5             | 24.3            | 55.34                  | 0.8             | 0.8         |
| April 23     | 20.5                             | 23.2         | 1.4             | 19.4            | 17.2             | 25.4            | 52.27                  | 0.5             | 0.5         |
| May 23       | 21.3                             | 23.7         | 1.4             | 19.2            | 16.6             | 19.5            | 47.43                  | 0.7             | 0.7         |
| June 23      | 20.4                             | 22.3         | 1.1             | 18.5            | 15.7             | 22.4            | 49.54                  | 0.5             | 0.5         |
| July 23      | 19.3                             | 22.8         | 1.2             | 18.0            | 14.5             | 20.6            | 48.32                  | 0.5             | 0.5         |
| August 23    | 22.5                             | 22.5         | 1.1             | 18.5            | 15.3             | 20.5            | 48.54                  | 0.7             | 0.5         |
| September 23 | 21.4                             | 23.2         | 1.4             | 18.6            | 16.2             | 21.6            | 51.25                  | 0.6             | 0.7         |
| October 23   | 22.3                             | 25.4         | 1.5             | 19.5            | 15.4             | 19.5            | 52.50                  | 0.8             | 0.6         |
| November 23  | 23.4                             | 25.3         | 1.5             | 19.4            | 16.3             | 19.4            | 51.15                  | 0.7             | 0.5         |
| December 23  | 23.5                             | 26.3         | 1.6             | 19.6            | 16.4             | 20.5            | 50.64                  | 0.5             | 0.7         |
| Mean ±<br>SE | 20.78 ± 0.64                     | 23.39 ± 0.66 | $1.28 \pm 0.08$ | 18.78<br>± 0.27 | $15.85 \pm 0.30$ | 21.78<br>± 0.33 | 52.71 ± 0.67           | $0.60 \pm 0.05$ | 0.58 ± 0.04 |

\*Live colony/ four leaflets /palm; \*\*Natural enemies/ four leaflets/ palm



# Ambajipeta

Rugose spiraling whitefly (RSW) and Bondar's nesting whitefly (BNW) incidence was recorded at monthly interval from three infested gardens. Five palms were selected at random in each garden for observation. High incidence of RSW was observed in January (50.8%) followed by 42.5 per cent in February. Mean number of different stages of RSW was recorded high in the month of January followed by February. Higher population of spiders was observed in the month of December was a 0.2/four leaflet followed by November was 0.1/four leaflets. *Encarsia guadeloupae* parasitisation was ranged between 1.8 to 42.1 per cent. Predator *A. astur* 

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population was ranged between 0.75 to 1.75 per four leaflets (Table 11).

High incidence of BNW was observed in March (65.8%) followed by 60.5% in February with the intensity 66.2 and 64.2 per cent, respectively. Mean number of different stages of BNW was recorded high in January followed by February. Higher population of spiders and predator *A. astur* population were ranged between 0.75 to 1.75 per four leaflets. The percent incidence of RSW was recorded in the alternate hosts banana and cocoa. RSW incidence was ranged between 0.5 to 16.5 per cent in banana and 0.25 to 8.25 per cent in cocoa.

| Table 11 : Extent of infestation of Rugose Spiraling Whitefly (RSW) in Coconut and their national statement of the statement | ural |
|---|------|
| enemies in Andhra Pradesh   |      |

| Months       | Incidence<br>of RSW | Intensity<br>of RSW | Grade<br>Index                                 | Noc         | of live colo | nies*        | Encarsia<br>parasitism | Natural E       | Enemies** |
|--------------|---------------------|---------------------|--|-------------|--------------|--------------|------------------------|-----------------|-----------|
|              | (%)                 | (%)                 |  | Eggs        | Nymphs       | Adults       | (%)                    | Spiders         | A. astur  |
| January 23   | 50.85               | 47.25               | 0.5  | 6.1         | 4.25         | 1.22         | 42.14                  | 0.1             | 1.75      |
| February 23  | 42.5                | 38.14               | 0.5  | 4.45        | 3.19         | 1.1          | 38.85                  | 0.05            | 1.25      |
| March 23     | 31.28               | 30.1                | 0.7  | 2.2         | 1.55         | 1.00         | 34.16                  | 0.04            | 1.10      |
| April 23     | 25.6                | 24.2                | 0.5  | 4.30        | 2.61         | 0.49         | 22.10                  | 0.02            | 1.00      |
| May 23       | 20.8                | 19.8                | 0.4  | 4.91        | 3.38         | 3.38         | 11.10                  | 0.02            | 0.90      |
| June 23      | 18.5                | 17.5                | 0.3  | 2.69        | 1.67         | 0.14         | 5.21                   | 0.01            | 0.75      |
| July 23      | 17.5                | 15.2                | 0.2  | 1.02        | 0.98         | 0.09         | 4.90                   | 0.01            | 0.75      |
| August 23    | 14.2                | 13.4                | 0.1  | 0.07        | 0.34         | 0.05         | 3.10                   | 0.01            | 1.0       |
| September 23 | 12.3                | 10.5                | 0.1  | 0.05        | 0.11         | 0.04         | 2.25                   | 0.02            | 1.22      |
| October 23   | 10.2                | 8.2                 | 0.1  | 0.15        | 0.29         | 0.14         | 1.80                   | 0.04            | 1.28      |
| November 23  | 8.5                 | 6.4                 | 0.2  | 0.34        | 0.15         | 0.23         | 3.75                   | 0.1             | 1.30      |
| December 23  | 11.5                | 8.2                 | 0.2  | 3.01        | 0.75         | 0.65         | 4.25                   | 0.2             | 1.45      |
| Mean ± SE    | 21.9 ± 3.8          | 19.9 ±<br>3.7       | $\begin{array}{c} 0.32 \\ \pm 0.0 \end{array}$ | 2.4±<br>0.6 | 1.6± 0.4     | 0.71±<br>0.2 | $14.4 \pm 4.4$         | $0.05 \pm 0.02$ | 1.1± 0.0  |

\*Live colonies/four leaflets/palm; \*\*Natural enemies/four leaflets/palm

# Arsikere

The different species of whitefly on coconut was recorded at monthly interval from three infested gardens. Five palms were selected at random in each garden for observation. Observations revealed that the range of incidence of RSW from 3.8 to 17.1 per cent (Table 12). However, the intensity of RSW was ranged from 1.2 to 9.5 per cent. The maximum incidence and intensity of RSW were recorded 17.1 and 9.5 per cent, respectively in December 2023.



Whereas minimum incidence (3.8%) and intensity (1.2%) was observed in October 2023. The average RSW pest records *viz.*, incidence, intensity, grade index, no. of live colonies of eggs, nymphs and adults were recorded 12.5, 6.2, 0.6, 1.3, 3.5 and 5.7/

four leaflets, respectively. The mean population of natural enemies like spiders and predators was noticed 2.4 and 4.4 per four leaflets. However, *Encarsia* parasitisation (27.1%) was observed during the period. The low-grade index for RSW was noticed in all the months.

| Months       | Incidence<br>of RSW | Intensity<br>of | Intensity Grade No. of live colo |               | nies *         | Encarsia<br>parasitism | Natural E   | Enemies **     |            |
|--------------|---------------------|-----------------|----------------------------------|---------------|----------------|------------------------|-------------|----------------|------------|
|              | (%)                 | RSW(%)          |                                  | Eggs          | Nymphs         | Adults                 | (%)         | Spiders        | Predators  |
| January 23   | 10.1                | 3.4             | 0.5                              | 2.6           | 3.8            | 8.7                    | 32.1        | 1.5            | 3.6        |
| February 23  | 11.8                | 5.5             | 0.6                              | 0.5           | 2.4            | 4.3                    | 33.5        | 2.1            | 3.1        |
| March 23     | 12.2                | 6.3             | 0.9                              | 0.7           | 3.2            | 4.7                    | 34.6        | 2.4            | 3.7        |
| April 23     | 13.7                | 7.8             | 1.1                              | 0.9           | 3.5            | 5.6                    | 36.7        | 2.8            | 4.9        |
| May 23       | 15.2                | 8.4             | 0.7                              | 0.8           | 3.1            | 5.2                    | 38.4        | 2.6            | 4.5        |
| June 23      | 15.1                | 9.5             | 1.0                              | 3.9           | 10.6           | 12.4                   | 18.5        | 1.5            | 6.5        |
| July 23      | 13.8                | 6.1             | 0.8                              | 1.8           | 5.4            | 9.6                    | 16.6        | 1.9            | 5.8        |
| August 23    | 11.5                | 5.7             | 0.5                              | 1.3           | 3.5            | 6.2                    | 16.1        | 2.5            | 4.5        |
| September 23 | 8.4                 | 2.4             | 0.3                              | 1.1           | 1.6            | 3.1                    | 21.7        | 3.3            | 4.2        |
| October 23   | 3.8                 | 1.2             | 0.2                              | 0.7           | 1.2            | 1.6                    | 23.8        | 2.8            | 3.7        |
| November 23  | 16.8                | 8.2             | 0.2                              | 0.2           | 0.5            | 0.7                    | 25.4        | 2.6            | 3.9        |
| December 23  | 17.1                | 9.5             | 0.6                              | 1.8           | 3.8            | 6.3                    | 27.8        | 3.1            | 4.7        |
| Mean ± SE    | $12.5 \pm 0.31$     | 6.2 ±<br>0.23   | 0.6 ± 0.02                       | 1.3 ±<br>0.09 | $3.5 \pm 0.22$ | 5.7 ±<br>0.28          | 27.1 ± 0.66 | $2.4 \pm 0.05$ | 4.4 ± 0.08 |

# Table 12: Extent of infestation of rugose Spiraling whitefly (RSW) in coconut and their natural enemies in Karnataka

\*Live colonies/four leaflets/palm; \*\*Natural enemies/four leaflets/palm

Bondar's nesting whitefly (BNW) incidence was also recorded at monthly interval from three infested gardens. Five palms were selected at random in each garden for observation. However, intensity of BNW was recorded 2.1 to 9.7 per cent from January to December 2023. The maximum incidence and intensity of BNW was recorded 16.9 and 9.7 per cent, respectively in April 2023, respectively. Whereas minimum incidence (9.4%) and intensity (2.1%) was observed in July 2023. The average BNW pest records *viz.*, incidence, intensity, grade index and no. of live colonies were recorded 13.3, 5.48, 0.43 and 5.56/four leaflets, respectively. The mean population of natural enemies like spiders and predators was noticed 0.62 and 0.46 per four leaflets during the period.

## Ratnagiri

The incidence and intensity of RSW and BNW on coconut was recorded at monthly interval from three infested gardens. Five palms were selected at random in each garden for observation. The incidence of RSW was ranged from 5.46 to 15.4 per cent. However, intensity of RSW was recorded



between 6.11 to 18.8 per cent from January to December 2023. The maximum incidence and intensity of RSW were recorded 15.4 and 18.8 per cent in November 2023, respectively. Whereas minimum incidence (5.46%) and intensity (6.11%) was observed in October 2023. The average RSW pest records *viz.*, incidence, intensity, grade index, numbers of live colonies of eggs, nymphs and adults were recorded 11.1, 12.9, 0.7, 5.3, 6.8 and 5.5/ four leaflets, respectively. The mean population of natural enemies like spiders and predators was noticed 0.6 and 0.4 per four leaflets. However, *Encarsia* parasitisation (39.1%) was observed during the period. The low-grade index for RSW was noticed in all the months.

The incidence of BNW was noticed in the range of 4.83 to 18.1 per cent. However, intensity of BNW was recorded 3.59 to 21.6 per cent from January to December 2023. The maximum incidence and intensity of BNW were recorded 18.1 and 21.6 per cent in March 2023, respectively. Whereas minimum incidence (4.83%) and intensity (3.59%) was observed in August 2023. The average BNW pest records *viz.*, incidence, intensity, grade index and numbers of live colonies were recorded 12.8, 14.3, 0.80 and 26.9/four leaflets, respectively. The mean population of natural enemies like spiders and predators was noticed 0.6 and 0.4 per four leaflets during the period.

The mean incidence of whitefly complex (WF) was noticed on banana, mango, cashew nut and cocoa which recorded 11.6, 8.6, 6.6 and 10.9 per cent, respectively. The maximum WF population was observed during December 2023 on mango (12.3%), cashew nut (11.5%) and cocoa (15.3%). The highest infestation of WF (15.3%) noticed on banana in March 2023. Whereas least incidence was observed in August 2023 on banana, mango, cashew nut and cocoa which recorded 6.15, 4.61, 2.30 and 6.92 per cent, respectively.

# Coconut based crop habitat diversification for pest regression

# Ambajipeta

The experimental field of coconut-based crop habitat diversification for pest regression was selected at Dr. YSRHU-HRS, Ambajipeta farm. The Godavari Ganga plantation aged 30 years in an area of 1 acre was selected. The intercrops viz., Banana, Cocoa, Pineapple and Heliconia already existed in the selected plantation. Pre data and Post data on insect pests of coconut was collected in treated and untreated plots. Planting of following inter crops were done in coconut plantation viz., medicinal plants (Tulasi, Lemon grass, sweet basil), flower crops (Marigold, Rose, Crossandra, Hibiscus, Chrysanthemum, Tuberose and Cosmos), vegetable crops (Brinjal, Capsicum). Tuber crops (Colocasia, Tapioca, Yam) Fruit crops (Banana, Papaya, Guava, Mulberry, Avocado, Citrus), Navadhanya (Nine grains), Coriander were also planted during 2023. Apis mellifera colonies were also introduced.

The experimental results in treatment plot revealed that incidence of rhinoceros beetle was 12.2 per cent and leaf damage was 6.7 per cent and spindle damage was 0.2 per cent. No incidence of RPW was recorded in treated plot. Incidence of *Eriophyid* mite incidence and grade index was 55.1 per cent, 1.7, respectively. RSW incidence was recorded 62.5 per cent. In case of untreated plot incidence of Rhinoceros beetle (18.1%), Eriophyid mite (68.2%) and Rugose Spiraling Whitefly (66.1%) were recorded (Table13).

## Arsikere

The experiment was carried out at Horticulture Research and Extension Centre, Arsikere in an area with 50 Tiptur tall (TPT) coconut palms and 60 different intercrops. In the treated plot, rhinoceros beetle incidence (10.2%), leaf damage (2.3%), 0.7 per cent spindle damage was observed (Table 14),



| Treatments                            | Rhinoce   | eros beet            | tle (%)                                       | Eriophyi             | d mite               | Rugose sj<br>whitefly (R | piraling<br>SW)(%)   | Total                | Total             | Total                 |
|---------------------------------------|-----------|----------------------|---|----------------------|----------------------|--------------------------|----------------------|----------------------|-------------------|-----------------------|
|                                       | Incidence | Leaf<br>damage       | Spindle<br>damage                             | Incidence<br>(%)     | MGI                  | Incidence                | Intensity            | Palm                 | /Palm             | palm                  |
| T <sub>1</sub> –<br>treated<br>plot   | 12.2      | 6.7 <u>+</u><br>0.6  | $\begin{array}{c} 0.2 \\ \pm 0.1 \end{array}$ | 55.1 <u>+</u><br>2.4 | $1.7\pm 0.1$         | 62.2 <u>+</u><br>5.2     | 46.4 <u>+</u><br>1.3 | $31.3 \\ \pm 0.5$    | 12.4 <u>+</u> 0.1 | 109.5 <u>+</u><br>4.2 |
| T <sub>2</sub> -<br>untreated<br>plot | 18.1      | 11.1 <u>+</u><br>1.9 | 3.9 ±<br>2.1                                  | 68.2 <u>+</u><br>1.7 | 1.9 <u>+</u><br>0.25 | 66.1 <u>+</u><br>3.0     | 50.5 ±<br>3.7        | 31.6 <u>+</u><br>1.1 | 12.2 ± 0.8        | 100.5 ± 5.1           |
| Sig.<br>(P=0.05)                      |           | 0.003                | 0.001   | 0.005                | 0.002                | NS                       | NS                   | NS                   | NS                | 0.001                 |
| T value                               |           | -3.9                 | -4.2  | -3.7                 | -2.0                 |                          |                      |                      |                   | 4.5                   |

Table 13: Impact of coconut- based crop-habitat diversification model for pest regression during2023 in Andhra Pradesh

Average means  $\pm$  standard error

there was no incidence of red palm weevil and black headed caterpillar in the crop-habitat plot. Infested nuts (15.5%), grade index (1.1%) was due to eriophyid mite and RSW incidence (9.8%), intensity (7.9%) as well as nut yield of 63.8 nuts per palm per year were recorded. Whereas in case of an untreated plot, rhinoceros beetle incidence was higher at 11.5 per cent with 5.1 per cent leaf damage and 1.4 spindle damage. However, Infested nuts 17.7%, mite grade index (1.9) due to eriophyid mite and rugose spiraling white fly incidence was increased to 17.7%, intensity (12.4%) as well as nut yield (47.4 nuts per palm per year) was also declined.

| Table 14: Impact of coconut-based crop-habitat diversification model for pest Regression during | ng |
|---|----|
| 2023 in Karnataka   |    |

| Treatme                 | Treatme Rhinoceros beetle (% |                | tle (%)           | Eriophyi         | d mite | Whitef    | ly (%)        | Total  | Total           | Total |
|-------------------------|------------------------------|----------------|-------------------|------------------|--------|-----------|---------------|--------|-----------------|-------|
| nts                     | Incid<br>ence                | Leaf<br>damage | Spindle<br>damage | Incidence<br>(%) | MGI    | Incidence | Inten<br>sity | palm   | ce/palm         | palm  |
| T <sub>I</sub> -treated | 10.2±                        | 2.3±           | 0.7±              | 15.5±            | 1.1±   | 9.8±      | 7.9±          | 34.3 ± | $11.5 \pm 0.23$ | 63.8± |
| plot                    | 0.7                          | 0.7            | 0.5               | 1.3              | 0.3    | 1.9       | 1.2           | 1.28   |                 | 2.15  |
| <b>T</b> <sub>2</sub> - | 11.5±                        | 5.1±           | 1.4±              | 22.6±            | 1.9±   | 17.7±     | 12.4±         | 25.1 ± | $8.3 \pm 0.48$  | 47.4± |
| Untreated<br>plot       | 0.9                          | 0.9            | 0.2               | 2.5              | 0.5    | 2.3       | 1.3           | 1.35   |                 | 2.07  |
| Sig.<br>(P=0.05)        | Sig.                         | Sig.           | Sig               | Sig.             | Sig.   | Sig.      | Sig.          | Sig.   | Sig.            | Sig.  |
| 't' value               | 0.14                         | 0.28           | 0.03              | 1.21             | 1.08   | 0.65      | 0.32          | 2.10   | 0.72            | 2.54  |

Average means  $\pm$  standard error



# Ratnagiri

The present experiment was conducted in block no. 12 at RCRS, Ratnagiri wherein 25-year-old coconut orchard having intercrops of nutmeg, cinnamon, banana and pineapple. Sixty different crops which includes star apple, Jamun, water jam, aonla, sapota, mangosteen, jackfruit, champak, drumstick etc. are planted in same plot. Also applied recommended dose of fertilizers to the orchard. The pre-count observations were recorded before planting of intercrops. The data presented in Table 15 revealed that the  $T_1$ - treated plot consists of minimum rhinoceros beetle (RB) incidence and leaf damage at 21.4 and 19.3 per cent, respectively. No infestation of red palm weevil and black headed caterpillar was observed in  $T_1$ -treated plot. The



minimum nut damage by eriophyid mite was observed 16.4 per cent with 0.25 mean grade index in  $T_1$ -treated plot. The invasive whitefly incidence and intensity was recorded less 7.87 and 16.0 per cent, respectively. However,  $T_2$ - untreated plot shows maximum incidence of rhinoceros beetle, eriophyid mite, whitefly incidence and intensity were recorded 28.5, 18.1, 12.1 and 24.3 per cent, respectively. The  $T_1$ - treated plot treatment was found significantly superior over  $T_2$ - untreated control in respect of nut damage by eriophyid mite and mean grade index. The higher leaf (29.6), inflorescence (11.5) and nuts (56.4 nos.) were recorded in  $T_1$ treated plot over  $T_2$ -untreated plot which noticed 25.8, 10.8 and 47.8 nos., respectively.

|                                       | Rhinoce        | eros beet      | tle (%)           | Eriophy          | id mite     | Whitef        | ly (%)      | Total         | Total                  | Total         |
|---------------------------------------|----------------|----------------|-------------------|------------------|-------------|---------------|-------------|---------------|------------------------|---------------|
| Treatments                            | Incidence      | Leaf<br>damage | Spindle<br>damage | Incidence<br>(%) | MGI         | Incidence     | Intensity   | leaf/<br>palm | Infloresce<br>nce/palm | nuts/<br>palm |
| T <sub>1</sub> -treated               | 21.4 ±         | 19.3 ±         | $0.0 \pm$         | 16.4 ±           | 0.25 ±      | 7.87 ±        | 16.0 ±      | 29.6 ±        | 11.5 ±0.30             | $56.4 \pm$    |
| plot                                  | 3.64           | 3.11           | 0.0               | 5.2              | 0.07        | 1.6           | 2.7         | 1.0           |                        | 5.9           |
| T <sub>2</sub> -<br>Untreated<br>plot | 28.5 ±<br>4.34 | 24.6 ±<br>2.83 | 0.0 ±<br>0.0      | 18.1 ±<br>4.5    | 0.29 ± 0.09 | 12.1 ±<br>1.5 | 24.3 ± 0.72 | 25.8 ± 0.8    | 10.8 ±0.44             | 47.8 ±<br>4.0 |
| Sig.<br>(P=0.05)                      | N.S.           | N.S.           | N.S.              | Sig.             | Sig.        | N.S.          | N.S.        | N.S.          | N.S.                   | N.S.          |
| 't' value                             | 1.69           | 0.80           | 0.0               | 3.11             | 3.97        | 0.62          | 0.29        | 0.19          | 0.0                    | 0.90          |

Table 15: Impact of coconut-based crop-habitat diversification model for pest Regression during2023 in Maharashtra

Average means  $\pm$  standard error



# VII. POST-HARVEST TECHNOLOGY IN PALMYRAH

# Pandirimamidi

**Freeze drying of sap and its shelf life studies** Freeze drying of inflorescence sap of Palmyrah was performed at -50 °C to -55°C for 2 hours with different levels of matodextrin at 0, 5, 10 and 15% of total weight was evaluated. The physico-chemical characterization of the raw sap and the powder obtained were compared to determine the powder solubility. It was revealed that a minimum 10 % of matodextrin is required to get stable powder. The powder showed good solubility and satisfied the legislative requirements with respect to moisture. The water activity obtained (0.48) allowed inhibition of bacterial growth and significant reduction of chemical and enzymatic reactions, contributing to extending the shelf life of products.

## Mechanization of Neera tapping in male palms

The physical properties of palmyrah spathe were measured and cutter mechanism was designed with ordinal and timing motor and required frame, fabrication is undertaken for tapping purpose effective length 20 cm with average slicing of 1 mm which yield about 3 months during the season. A theoretical design was completed and during the year, design patent and fabrication were undertaken.

## Studies on Neera concentrate

Storage studies for Palmyrah Neera Concentrate (PNC) revealed only slight changes up to 90 days. Indicating PNC as a best alternate for cane sugar use in food preparations. Moisture content, protein and ash increased slightly, where as the fat content was decreased.

Further, storage studies conducted using various packing material i.e. food grade Low density polyethylene (LDPE), LAF (laminated aluminum pouch) and Glass Bottle (GB) at accelerated storage (90 % RH and 40°C) to know the changes of

physico-chemical properties of palmyrah Neera concentrate (liquid jaggery). Results showed that PNC stored in glass bottles given the best results among the other packing materials (Table.1).

**Table. 1** proximate composition of Neeraconcentrate at room temperature ( $29\pm1^{\circ}C$ )

|   | Properties      | Value At | After 90 |
|---|-----------------|----------|----------|
|   |                 | fresh    | days     |
| 1 | Moisture (%)    | 22.12    | 21.44    |
| 2 | Protein (%)     | 1.43     | 1.48     |
| 3 | Fat (%)         | 0.23     | 0.18     |
| 4 | Ash(%)          | 3.23     | 3.42     |
| 5 | Carbohydrates   | 72.17    | 72.46    |
| 6 | Density (g/cm3) | 1.54     | 1.48     |

Standardization of Tuber Flour Based Food Products (Like Pizza, Bakery items, confectionery, health mix etc.)

# Value added products from tuber

Biscuits, Cookes and bread trials were taken up at commercial bakery unit with replacing maida with tuber flours of 5, 15, 25, 35 and 45%, results show that bitterness is increasing with increase of tuber flour after 25 %. Also observed that addition of tuber flour enhances taste and flavor of the products.

# Estimation of starch in tuber and its quality

Palmyrah tuber is a cheap and rich source of starch. Flours and starches isolated from tuber have physical and chemical properties suitable for food applications. Modifications of native starches are carried out to provide starch products with specific properties. The physico-chemical and functional properties of the native and modified palmyrah tuber



starch were evaluated and the applicability of the palmyrah modified starch as a thickener in instant soup was tested. The recovery yields of modified starches ranged from 76 to 92 %. The starch showed significantly the lowest swelling power and the highest average solubility. The particle sizes of the starch granules varied from 1.308-7.346  $\mu$ m. The study revealed that the modification processes can greatly improve the physico-chemical and functional characteristics of native starch. According to the sensory analysis of instant soup among trained panelists, high preference was observed for palmyrah pre gelatinized starch over commercially available corn starch.

# Utilization of palmyrah plant parts for the extraction of fibre and fuel

Palmyrah have three types of fibers and analyzed for basic properties. These fibers are leaf base (sheath), petiole and fruit fibre. Mechanical properties of fruit fibre were analyzed and presented (Table 2).

| Property                     | Value    |
|------------------------------|----------|
| Density (g/cm <sup>3</sup> ) | 1.03     |
| Tensile strength (MPa)       | 99-192   |
| Tensile modulus (GPa)        | 2.5 -5.6 |
| % elongation                 | 2-4.5    |
| Cellulose (%)                | 52.4     |
| Hemi cellulose (%)           | 21.5     |
| Lignin(%)                    | 22.5     |

#### Table 2. Mechanical properties of fruit fibre

# Standardization of Preservation Technique for Palmyrah Tender Fruit Endosperm

# Studies on tender fruit endosperm-based candy (Similar to nata de coco)

Fresh tender nungu easily deteriorates and gets fermented due to its high sugar content. Utilization of tender nungu for production of nata by using *Acetobacter xylinum* is considered beneficial to add variety of products made from tender nungu. Experiment was carried out to determine effect of combination of ammonium sulphate and yeast extract

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(in ratio of 1:1), added at concentration of 0.6 % on characteristics of nata produced from 100 % tender nungu incubated at 30°C for 15 days. A comparison sample without addition of nitrogen source was also produced. All samples showed a trend of decreasing pH during fermentation. Combination of ammonium sulphate and yeast extract was observed to produce samples with the highest texture profile including hardness, springiness, chewiness, and gumminess. Trials show that nata with relatively high yield ( $82.13 \pm 4.02$  %) and crude fibre content ( $1.8 \pm 0.10$  %), with sufficient hardness and moderate overall acceptance. This study has shown that tender nungu has potentials to be used as medium for production of nata.

# Process development for ice cream from tender fruit endosperm

The process for manufacturing a palmyrah tender fruit endosperm (TFE) enriched ice cream was optimized. The effect of different level of TFE and sugar on the sensory characteristics of TFE enriched Ice Cream was studied by employing central composite rotatable design. The best formulations with 15% TFE and 13.5% sugar yielded 48.5% of the product as an overrun. This formulation was found to be the most appropriate for manufacturing of TFE enriched ice cream with Overall Acceptability (OAA).

# Popularization of climbing device

The palm climbing device (Joseph model) was demonstrated on palmyrah to the tappers during the Neera tapping season 2023-24 as part of HRD trainings and farmers visits. It was observed that skilled palmirah climbers did not show interest in using climbing device whereas rural youth who has passion towards agriculture and unskilled newer tappers showed interest in using the same. Individual farmers of 23 members purchased the palm climbing device for their own use. As per feedback, the device needed modification for palmyrah palms considering the varying thickness of palmyrah palms at different heights.





# VIII. MONITORING, REVIEWS AND MEETINGS

#### **Monitoring and Reviews**

Approved technical programmes were monitored regularly by visiting the centers and reviewing the monthly progress reports from the centres. Reviewed the Centres and ascertained the implementation of technical programmes as per the schedule through physical and online modes. Time to time advices and directions were deliberated for proper implementation of the technical programmes. Monthly progress report and budget utilization information were obtained from centres regularly and the same were reviewed critically. During the review meetings, discussions were held with concerned scientists of ICAR-AICRP on Palms for the smooth functioning of the research programmes. During review meetings, suggestions were given for proper utilization of budget, meeting the targets, publications and improving the technical programmes.

| Dates                    | Place / Centre visited                                   |
|--------------------------|--|
| 01.06.2023 to 02.06.2023 | Arsikere, Bavikere & Shivamogga (Karnataka)              |
| 05.07.2023 to 06.07.2023 | Kahikuchi (Assam)  |
| 16.08.2023 to 17.08.2023 | TNAU, Aliyarnagar (Tamil Nadu)                           |
| 18.08.2023 to 19.08.2023 | Veppankulam, Pattukottai (Tamil Nadu)                    |
| 11.09.2023 to 16.09.2023 | Kahikuchi (Assam)  |
| 18.09.2023               | Pasighat (Arunachal Pradesh)                             |
| 12.10.2023 to 13.10.2023 | TNAU, Coimbatore (Tamil Nadu)                            |
| 3.11.2023                | Killikulam (Tamil Nadu)                                  |
| 09.12.2023 to 11.12.2023 | Konda Mallepally (Telengana), Pandirimamidi & Ambajipeta |
|                          | (Andhra Pradesh)   |
| 12.12.2023 to 14.12.2023 | Pedavegi (Andhra Pradesh)                                |

#### Visit of Project Coordinator (Palms) to AICRP on Palms centres

## **Events Conducted:**

The 32<sup>nd</sup> Annual Group Meeting of ICAR - All India Coordinated Research Project on Palms was inaugurated at AICRPP Centre, Horticultural Research Station, Kahikuchi under Assam Agricultural University, Jorhat on September 13, 2023. Dr. V. B. Patel, Assistant Director of General (Fruits and Plantation Crops), Horticulture Science Division, ICAR, New Delhi presided over the function wherein, Dr. N. K. Mohan, Hon'ble Member, Agricultural Commission, Govt. of Assam was the Chief Guest. Dr. K. B. Hebbar, Director ICAR- CPCRI, Kasaragod, Dr. K. Suresh, Director, ICAR-IIOPR, Pedavegi, Dr. R. K. Mathur, Director, ICAR-IIOR, Hyderabad, Dr. V. Venkatasubramanian, Director, ICAR-ATARI, Bangalore, Dr. G. Kathirvel, Director, ICAR-ATARI, Guwahati, Dr. D. Prasath, Project coordinator (Spices), ICAR-IISR, Kozhikode were present for the inauguration. Dr. KUK. Namboothiri, and Dr. P. Chowdappa, Former Directors of ICAR-CPCRI have participated in the Inaugural Session as invited experts. Dr. M. Saikia, Director of Research, Assam Agricultural University, Jorhat

welcomed the dignitaries and delegates in which he overwhelmed that in this (Assam) region having average of 2300 mm annual rainfall, paddy is slowly being replaced by coconut, arecanut and cocoa which provides increased returns. He opined that coconut demand is increasing for its use in religious front apart from food uses.

Dr. B. Augustine Jerard, Project Coordinator (Palms), ICAR-AICRP on Palms, ICAR-CPCRI, Kasaragod in his report, presented a brief note on the mission of the AICRP since its genesis in 1972, on five mandate crops - coconut, oil palm, palmyrah, arecanut and cocoa in 28 centres distributed across fifteen States/UTs through thirteen State Agricultural/ Horticultural Universities, four ICAR institutes and one Central Agricultural University. During the 31st Annual Group Meet of AICRP on Palms held during 16-18 September 2022, three release proposals on improved coconut varieties with desirable traits viz., Dweep Sona, Dweep Haritha and Kalpa Vajra were recommended for submission to Central Subcommittee on Seed standards and release of varieties of horticultural crops towards notification in gazette. The proposals on these varieties have subsequently been submitted by the respective centres to Central sub-committee and are in various levels of consideration. Three technologies viz., Integrated Nutrient Management for cultivation of dwarf coconut, Leaf blight management in coconut and Arecanut Intercropping options in coconut gardens have emanated from different projects. The total budget outflow during financial year 2022-23 was 681 lakhs. Review meetings were scrupulously conducted by the Nodal centre to monitor the technical programme and budget utilization across the sub centres.

Development and evaluation of Tall x Tall and Dwarf x Dwarf coconut hybrids, coconut based multispecies cropping systems, location specific Integrated Farming System models, Bioagents for the control of black headed caterpillar in coconut, crown choke disease in arecanut, and identification of best performing cocoa clones *viz.*, VTLCH-1,

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VTLCH-2 for intercropping in coconut gardens are the noteworthy contributions made and identified for further studies/promotion. Effective Transfer of Technology from lab to land through diverse extension tools & modes and need-based diagnostic field visits across the states continued to remain the major strength of this programme.

Dr. V. B. Patel, Assistant Director General (F&PC) in his Presidential Address, congratulated the group of Palm Scientists for doing exemplary work in the sector. He also enumerated the vision of Government of India to minimize imports and to maximize the export potential of plantation crops and products. He desired to focus work on Technologies to preserve Neera tapped from palmyrah. He also wished that a bouquet of publications viz., 'Compendium of Technologies for the Farm Front" across different centres and "Success Stories of Technologies with High Impact" may be brought out in view of completion of fifty years of research under AICRP on Palms. He urged the Palm Scientists to take concerted efforts to transform India into a developed nation by 2047, marking India's 100<sup>th</sup> year of Independence through palm sector in all possible ways.

Dr. K. B. Hebbar, Director, Central Plantation Crops Research Institute, Kasaragod expressed that the centres of ICAR – AICRP on Palms are well positioned in different agro climatic regions of India to address location specific problems and highlighted the existing scope for multi-disciplinary and multilocation research. He opined that the soil and plant data is very crucial to develop sustainable technologies across growing regions and for precision agriculture in mitigating climate change effects. Dr. K. Suresh, Director, IIOPR, Pedavegi invited the palm scientists to work in tandem on yield improvement in oil palm and to enhance oil content with unsaturated fatty acids. He also expressed the need to work on carbon and water footprints of the plantation sector.



The Chief guest, Dr. N. K. Mohan in his Special Address underlined the rich biodiversity of horticultural sector in the Northeastern Region and the role of Britishers in establishing the first Tea Garden in the country and uplifting the economy of the region. He also narrated the historical importance of how the Ahom Kings contributed to the introduction of coconut and arecanut during their regime of  $12^{th} - 18^{th}$  century from SE Asian regions. In the interim period, although coconut was neglected, after Independence, the importance of this was greatly felt which paved way for the establishment of Research Centres at Southern bank of Brahmaputra and another at Harwaai in Assam. He applauded these research hubs for scraping the maladies from plantation sector like crown choke disorder, for introduction and promotion of varieties like Kamrupa and for the array of technologies like muti-tier cropping system with black pepper to improve the standard of living of small and marginal farmers of the state amidst climatic vagaries. He appreciated the efforts of palm scientists over the years and indicated the need to address the future challenges in increasing profitability.

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Aliyarnagar Centre, TNAU, Tamil Nadu was adjudged as the Best AICRP (Palms) Centre for the year 2022-23 and the scientists of the Centre were presented the certificate and memento by the dignitaries. Dr. JC Nath, a long serving palm scientist from Kahikuchi Centre who was due to superannuation during the year was felicitated by the President, Project Coordinator & other dignitaries. The AGM appreciated his significant contributions to the palm sector of NE region for over two decades which includes improved varieties and technologies for cultivation. Five publications prepared by the palm scientists from different centres and PC Cell including technical bulletins, booklets and folders on various aspects of cultivation of palms were released by the dignitaries during the inaugural session. About 80 participants from different AICRP centres and ICAR-CPCRI attended the meeting. Dr. J. C. Nath, Chief Scientist, HRS, Kahikuchi proposed the vote of thanks. The inaugural session ended with National Anthem.

The inaugural session was followed by technical sessions on Variety Release, Genetic Resources and Crop Improvement, Crop Production, Crop



# ICAR-AICRP on Palms

Protection, Post Harvest Technology of palmyrah and Transfer of Technology efforts followed by Plenary session held from 13<sup>th</sup> to 15<sup>th</sup> September 2023.

# Technologies recommended to farming community at 32<sup>nd</sup> AGM

# VPM 6 – Coconut variety proposed by Veppankulam centre was recommended

- VPM 6 (IC 599264) recorded a higher yield of 166.25 nuts per palm per year with a mean yield 107 nuts/palm/annum. The variety is well adapted in the East Coast region of Tamil Nadu and performed better in terms of nut and oil content even under several forms of stress (under planting, drought, cyclone) conditions due to its quick recovering habit. The variety recorded mean copra content of 137g, mean oil content of about 68%, estimated copra yield of 18 kg per palm per year having oil yield of 2.67 t/ha.
- The variety is recommended for cultivation in coconut growing zones of Tamil Nadu.

# VTLCH 1 – Cocoa hybrid proposed by ICAR-CPCRI was recommended.

The VTLCH 1 variety has early bearing, high yielding potential with medium canopy both under arecanut and coconut shades and as seedlings and clones. It has shown suitability under high density planting. The trees with a height of 3.5-4 m and an optimum canopy (16-18 m<sup>2</sup>) - yielded an average of 50 pods/tree/ year. Pods are 350-400 g weight with 35-44 beans/pod. With a single dry bean weight of 1 to 1.10 g this variety recorded an average yield of 1.5 kg in 3 locations and the yield/ha is 750 kg (500 trees). Beans are of international standard with >1 g bean size, suitable for chocolate industry with a shelling percentage of 13%, nib recovery of 87%, >50% fat and 1% free fatty acids.

The variety is recommended for cultivation in Kerala, Tamil Nadu and Karnataka.

# VTLCH 2 -Cocoa hybrid proposed by ICAR-CPCRI was recommended

- This variety is having early bearing, high yielding potential with medium canopy both under arecanut and coconut shades and as seedlings and clones, showed suitability under high density planting. Average yield (dry beans/tree/year) 1.5-2.0 kg/tree/year in 6-year-old hybrid tree. Potential yield 5 kg per 20 m<sup>2</sup> canopy. The trees with a height of 3.5-4 m and an optimum canopy  $(15-20 \text{ m}^2)$  yielded an average of 50 pods/tree/year. Pods are 350-400 g weight with 35-42 beans/pod. With a single dry bean weight of 1 to 1.20 g, this variety recorded an average yield of 1.5 kg. Beans are of international standard with >1 g bean size, suitable for chocolate industry with a shelling percentage of 13%, nib recovery of 87%, >50% fat and 1% free fatty acids. This variety is tolerant to black pod rot, tea mosquito bug, low moisture stress.
- The variety is recommended for cultivation in Kerala, Andhra Pradesh, Karnataka and Gujarat.

# Management of leaf blight disease

 At Aliyarnagar centre, root feeding with propiconazole @ 5 ml in 100 ml of water at three months intervals during January, April, July and October reduced the leaf blight incidence by 27.0 per cent after 36 months of treatment. This treatment also resulted in highest yield of 138 nuts/ palm/year and the B:C ratio of 3.7 as against 97 nuts/ palm/year in the untreated control.

# Nylon net for the management of rhinoceros beetle in coconut palms

 Wrapping spear leaf with nylon fish net (3.2 x 3.4 mm mesh) was found effective to safeguard the juvenile coconut palms from infestation by rhinoceros beetle at Aliyarnagar, Ratnagiri, Ambajipeta and Arsikere.





# IX. TRANSFER OF TECHNOLOGY

# Aliayrnagar

The beneficiaries of TSP mission were invited for capacity building programmes organized at Aliyarnagar centre on Value addition in coconut, Coconut soap making, Virgin coconut Oil preparation, Vermicomposting of coconut fronds and wastes etc.,

# TRAININGS ORGANIZED

| S.<br>No. | Title of the training   | Venue & Date                                  | Date       | No. of beneficiaries |
|-----------|---|---|------------|----------------------|
| 1         | Scheduled Castes Sub Plan Scheme training on<br>"Technical Interventions and Input distribution for<br>Improving the Socio - Economic Status of<br>Coconut growing SC farmers in Western Ghats<br>of Tamil Nadu | Kaliyapuram village<br>Anaimalai Block        | 09.01.2023 | 20                   |
| 2         | Tribal Sub Plan Scheme training on Technological interventions and input distribution for improving   | Narikkalpathi village,<br>Anaimalai Block     | 10.01.2023 | 25                   |
| 3         | the socio economic status of Tribal coconut<br>growers in Western Ghats of Tamil Nadu   | Muthaliyarpathi village,<br>Anaimalai Block   | 11.01.2023 | 25                   |
| 4         |   | Gopalpathi village,<br>Anaimalai Block        | 20.01.2023 | 25                   |
| 5         | National Workshop on Hi tech cultivation of spice<br>crops cum Farmers training   | CRS, Aliyarnagar                              | 27.02.2023 | 100                  |
| 6         | Scheduled Castes Sub Plan Scheme training on<br>"Technical Interventions and Input distribution for   | Thensangampalayam<br>village, Anaimalai block | 16.03.202  | 20                   |
| 7         | Improving the Socio - Economic Status of<br>Coconut growing SC farmers in Western Ghats<br>of Tamil Nadu  | Narikkalpathi village,<br>Anaimalai block     | 30.03.2023 | 40                   |
| 8         | Tribal Sub Plan Scheme training on Technological<br>interventions and input distribution for improving<br>the socio economic status of Tribal coconut<br>growers in Western Ghats of Tamil Nadu                 | Vepparai village,<br>Anaimalai block          | 31.03.2023 | 50                   |
| 9         | Nanofertilizers in Agriculture in collaboration with IFFCO Pvt. Ltd., and Nanoventions  | Kaliyapuram, Anaimalai<br>block               | 09.06.2023 | 50                   |
| 10        | One day training on Imparting technical skills on<br>the identification of coconut root wilt disease<br>symptoms and assessing its severity under field<br>conditions   | CRS, Aliyarnagar                              | 09.09.2023 | 130                  |
| 11        | ODL Award ceremony for the certificate course<br>on Coconut Cultivation Technology  | CRS, Aliyarnagar                              | 21.09.2023 | 72                   |

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| 12 | Training on coconut production technologies and<br>distribution of inputs to the tribal farmers and<br>celebration of World Coconut Day | C. Gopalapuram,<br>C. Arthanaripalayam | 02.09.2023 | 100 |
|----|---|--|------------|-----|
| 13 | Tribal Sub Plan Scheme training on Technological  | Narikkalpathi and                      | 31.10.2023 | 50  |
|    | interventions and input distribution for improving  | K.P.M colony,                          |            |     |
|    | the socio economic status of Tribal coconut   | Anaimalai block                        |            |     |
|    | growers in Western Ghats of Tamil Nadu  |  |            |     |













Distribution of Coconut seedlings, Biofertilizers, Biocontrol agents and vermicompost to the beneficiaries



# Ambajipeta

#### **Training programmes**

Scientist from the centre has participated in Rythu Sadassu at KVK, VR Gudem, P. Gannavaram (V) of East Godavari district jointly organized by Horticulture department, Amalapuram and Veterinary department, P. Gannavaram. Lectures on Seasonal crop condition of coastal zone – I and Management of Rugose Spiraling white fly in plantation crops were delivered.

#### **Technology Demonstration**

Field demonstrations were conducted for effective transfer of developed technologies on various aspects of coconut to create awareness among farmers. Demonstrated entomo pathogenic fungus (*Isaria fumasorosea*) spray against Rugose spiralling whitefly on coconut, Rugose spiralling whitefly infestation symptoms and parasitoid release technique of *Encarsia guadelopae* and paste application of *Trichoderma reesei* against stem bleeding disease of coconut. A total of 350 farmers were benefited.

| Sl.No | ТОТ  | No. of     | No of        |  |
|-------|--|------------|--------------|--|
|       |  | Programmes | Participants |  |
| 01    | Training programme for farmers & Extension functionaries | 35         | 890          |  |
| 02    | Demonstrations conducted                                 | 26         | 542          |  |
| 03    | Facilitating farmer producer organisations (FPOs)        | 18         | 353          |  |
| 04    | Linkage with the District KVK and ATMA/RBK               | 05         | 83           |  |
| 05    | Conducting exhibitions                                   | 03         | 760          |  |
| 06    | Popular article published                                | 06         |              |  |
| 07    | Press coverage   | 43         |              |  |
| 08    | Television programme presented                           | 01         | -            |  |



Field demonstrations





# Arsikere

### Training programmes organized

| SI. |  | Date       | Number of    |
|-----|--|------------|--------------|
| No  | Training on  |            | participants |
| 1   | Integrated nutrient management in coconut                            | 11-1-2023  | 60           |
| 2   | Vermicompost production  | 18-1-2023  | 36           |
| 3   | Value addition in coconut  | 25-1-2023  | 23           |
| 4   | Integrated pest management for Rugose spiralling whitefly in coconut | 28-1-2023  | 50           |
| 5   | Integrated disease and pest management in coconut                    | 19-2-2023  | 60           |
| 6   | Use of coconut climbing machine                                      | 9-3-2023   | 50           |
| 7   | Importance of honey bee in plantation crops                          | 22-5-2023  | 30           |
| 8   | Pre monsoon cultivation practices in coconut                         | 24-6-2023  | 40           |
| 9   | Integrated management of Rugose spiraling whitefly in coconut        | 20-9-2023  | 36           |
| 10  | Honey bee rearing and value addition in honey                        | 26-10-2023 | 50           |

Scientist from the centre has participated in five training programmes organized by various bodies like KVK, NABARD and NIPHM as resource person. The farmers interacted on various aspects *viz.*, recent advances in coconut, IPM on coconut, integrated crop management in coconut, pest and disease management in coconut.

# **Diagnostic field visits/ consultancy**

## Diagnostic field visits/ consultancy by Scientists

| Field visit/ consultancy  |   | Problems identified and solution given on  |
|---------------------------|---|--|
| Field visits: 2           | 2 | Moisture conservation in coconut gardens   |
| Through Phone: 32         | 1 | Intercropping in coconut plantations       |
| Farmers visit to HRES: 11 | 2 | Drip irrigation in coconut cultivation     |
|                           |   | Nutrient management in coconut plantations |
|                           |   | Pest management in coconut                 |
|                           |   | Disease management in coconut              |
|                           |   | Varieties of coconut for higher yield      |
|                           |   | Planting method in coconut                 |

## Bhubaneswar

# **Training programmes**

Organized training programmes on "Livelihood improvement through integrated coconut farming"

and "Coconut farming for more profit" at the centre benefiting 104 farmers. Organized exposure visit of 50 farmers at the centre to enlighten about the technologies developed.

# Linkage with the District KVK and ATMA

| Name of KVK/ATMA          | Nature of linkage established | Technology highlighted            |
|---------------------------|-------------------------------|-----------------------------------|
| 1.KVK, Puri, Sakhigopal   | Training programme and FLD    | Production technology of coconut, |
| 2.KVK, CIFFA, Bhubaneswar |                               | Coconut based cropping system     |
| 3.ATM, Ganjam             |                               | and value addition in coconut     |



# Kahikuchi

**Diagnostic visits:** 

| Sl. No. | Highlight of visit  | Location | Date       |
|---------|---|----------|------------|
| 1       | Coconut stem bleeding and management                                | Најо     | 28.09.2023 |
| 2       | Problems of crown choking disorder in coconut and mites infestation |          |            |
|         | in coconut and their control measures                               | Rani     | 10.10.2023 |
| 3       | Stem bleeding and RSW infestation in coconut and suggested          |          |            |
|         | control measures  | Boko     | 08.12.2023 |

## Exhibitions

| Sl. No. | Exhibition   | Date                          |
|---------|--|-------------------------------|
| 1       | Participated in the exhibition organised by APEDA, Guwahati  | 22 <sup>nd</sup> August, 2023 |
| 2       | Organized exhibition in connection with 32 <sup>nd</sup> Annual Group Meeting<br>of AICRP (Palms) held at AAU – HRS, Kahikuchi | 13-15 September 2023          |
| 3       | 10 <sup>th</sup> Indian Horticulture Congress, Khanapara, Guwahati   | 6-9 November, 2023            |
| 4       | 8th Assam International Agri-Horti Show 2023   | 16-18 December, 2023          |

## Radio talk/TV programme broadcasted

Radio programme

| Sl. No. | Name of scientist | Торіс  | Date of broadcasting |
|---------|-------------------|--|----------------------|
| 1       | Dr. A. Borah      | Significance and utilities of coconut in NE region | 02.09.2023           |

## Technology advisory:

Number of visitors comprising of farmers from various locations, students from colleges and schools, personnel from various NGO's and Govt. institution are used to visit the centre time to time. In this visits, the scientists of the centre have been apprising them showcasing of developed technologies of the centre with respect to coconut as well other horticultural crops besides imparting spot training on the relevant aspects to the visitors. Technology advisory was constituted with a group of scientist of the station through which advisory services were being provided to the various visitors so as to solve their problems in spot.

## World Coconut Day, 2023

On the occasion of World Coconut Day on 2<sup>nd</sup> September, 2023, a day long programme was organized in the Farmers' Field at Bijoynagar under Kamrup district by All India Coordinated Research Project on Palms, AAU–HRS, Kahikuchi, Guwahati. The programme included tree plantation, awareness generation, training and farmer-scientist interaction. All together about 100 farmers including progressive women actively participated in the said programme. In the training session, nursery management and production technology of coconut were discussed elaborately. An interactive session with scientists and participants ended the programme, where various issues related to coconut production were discussed.

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## Pandirimamidi

#### Capacity building programmes

| Sl.No. | Title of the Training   | Place  | Date       | No. of participants |
|--------|---|--|------------|---------------------|
| 1.     | Value added products from<br>neera, fruit, nungu & tuber from<br>Palmyrah               | Suvarlavada, ASR Dt., Andhra<br>Pradesh                            | 03.06.2023 | 25                  |
| 2.     | Palmyrah : Important edible and<br>non-edible products promotion<br>and its utilisation | AICRP on Palms Pandirimamidi<br>center, ASR Dt., Andhra<br>Pradesh | 12.08.2023 | 25                  |
| 3.     | Palmyrah products - Promotion and demonstration   | Intuluru vagu Chintur, ASR district, Andhra Pradesh                | 23.11.2022 | 25                  |
| 4.     | Palmyrah - Importance,<br>promotion and its utilisation                                 | AICRP on Palms Pandirimamidi<br>center, ASR Dt., Andhra<br>Pradesh | 08.07.2023 | 30                  |
| 5.     | Cashew production technology<br>and Importance of Palmyrah                              | AICRP on Palms Pandirimamidi<br>center, ASR Dt.,Andhra<br>Pradesh  | 20.07.2023 | 50                  |
| 6.     | Mango production technology   | Bhimavaram, ASR Dt., Andhra<br>Pradesh                             | 02.08.2023 | 50                  |
| 7.     | Palmyrah promotion and utilization  | Suddagommu, ASR Dt., Andhra<br>Pradesh                             | 11.09.2023 | 30                  |
| 8.     | Advances in lime production technology  | Folkspeta, ASR Dt., Andhra<br>Pradesh                              | 20.09.2023 | 25                  |
| 9.     | Promotion of Fishtail palm in agency areas of ASR district                              | Aakur, Maredumilli, ASR Dt.,<br>Andhra Pradesh                     | 10.12.2023 | 20                  |

# **Jaggery making**

Tribal farmers and more particularly women are much interested in jaggery making after training from the centre. They have gained acquaintance in preparing the jaggery and syrup in an efficient manner. Previously palm neera was mostly utilized in the form of toddy and the surplus was disposed off or used in preparation of crude alcohol by name "chiguru". Now, after the training and awareness meetings, they are interested in making the Jaggery



and surplus neera is converted to suger which enhanced their livelihood.

# Ratnagiri

Distribution of inputs and imparting training for 500 tribal farmers from nine blocks during 2023 was undertaken under aegis of ICAR-AICRP (Palms)-TSP project, RCRS, Ratnagiri in collaboration with Agril. Dept., Palghar and BAIF organization. The project revealed that the farmers were very poor with low literacy and without any awareness of advance agricultural crops management practise resulting in poor yield and less benefit. In the present project, inputs distribution and different extension activities like training, workshop-cum-demonstration of advance agricultural practices etc. were carried out in the said area to improve the livelihoods of tribal.

# **Demonstrations Conducted**

Method demonstrations on planting of coconut seedling was organized in Mokhada, Jawhar, Dahanu, Mandangad blocks during inputs distribution cum training programme for beneficiaries. It covered selection of seedlings, planting, fertilizer application and after care etc. Following demonstrations on planting of coconut seedlings in farmer field were given,

- Soil with a minimum depth of 1.2 meters and fairly good water holding capacity is preferred for coconut cultivation.
- A spacing of  $7.5 \times 7.5$  m is used to cultivate the palm and the pit size of  $1 \times 1 \times 1$  m<sup>3</sup> filled up with soil, 10 kg farmyard manure and 2 kg single super phosphate.
- The seedling after planting is to be protected by providing shade artificially thatched shed net and by planting shade tree nearby like banana, glyricidia etc.
- Irrigation and after care Plants are irrigated regularly during dry months for its proper growth. Provision of proper drainage to protect it from bud rot in initial years. The palms be frequently examined for any insect or fungal attacks.
- Management of exotic whiteflies- IPM based technology including spraying of neem oil and fixing yellow sticky trap was demonstrated.



Beneficiaries of TSP project in Palghar district



| S.<br>No. | Districts | Block   | Pada /<br>Village | No. of<br>Beneficiaries | Planting material supply per beneficiary   |
|-----------|-----------|---------|-------------------|-------------------------|--|
| 1         | Palghar   | Mokhada | Mokhada           | 100                     | Coconut seedlings-8, Nutmeg graft-<br>2, Bracon/Reduviid-10  |
| 2         | Palghar   | Jawhar  | Waiganpada        | 100                     | Coconut seedlings -7, Nutmeg graft<br>-2, Cinnamon graft -2, Black pepper-<br>5Bracon bioagents -100 |
| 3         | Palghar   | Dahanu  | Kalgipada         | 100                     | Coconut seedlings – 3, Cinnamon<br>graft -1, Bracon bioagents -18, Amar<br>loranthus cutter -2       |

# Input distributed under Tribal Sub Plan in Ratnagiri Centre



Input Distribution to the Tribals of Dahanu Settlement





Input Distribution to the Tribals of Jawhar Settlement



Inputs distribution to the tribal farmers at Mokhada



# Navsari

Under the TSP project, different types of extension works like front line demonstrations, farmers trainings, input distributions etc. were done periodically in Navsari, Valsad, Narmada, Tapi and Dang districts of south Gujarat. The details of demonstrations are given below:

| 1 | Application of organics in coconut                      | 16-08-23 | 113 | RHRS, NAU (Navsari)   |
|---|---|----------|-----|-----------------------|
| 2 | Use of organic nutrients and bio-fertilizers in coconut | 16-03-23 | 75  | KVK, Ambheti (Valsad) |
| 1 | Making of different articles form coconut fibre         | 02-09-23 | 60  | KVK, Vyara (Tapi)     |
| 2 | Planting of coconut plants                              | 02-09-23 | 60  | KVK, Vyara (Tapi)     |
| 3 | Planting and care of coconut plant                      | 05-09-23 | 42  | KVK, Waghai (Dang)    |

# **Training Farmers**

















# Pattukottai

## **Radio/Television Programme: 2**

| Sl. | Date             | Department/  | Name of the Scientist | Торіс                            |
|-----|------------------|--------------|-----------------------|----------------------------------|
| No. | Date             | Centre       |                       |                                  |
| 3.  | 25.01.2023       | ARS,         | Dr. M. Tamil Selvan   | Oil palm cultivation and its     |
|     | (Doordarshan)    | Pattukkottai | Assoc.Prof. (Hort.)   | importance                       |
| 4.  | 14.02.2023 (AIR, | ARS,         | Dr. M. Tamil Selvan   | Scope and importance of oil palm |
|     | Kodaikkanal)     | Pattukkottai | Assoc.Prof. (Hort.)   | cultivation in Tamil Nadu-Live   |
|     |                  |              |                       | programme                        |

# Chattisgrah

# **Inputs distributed**

A variety of agricultural farm inputs including coconut seedlings, vegetable seeds, fertilizers, fungicides, vermicompost and other agricultural farm inputs, are provided to coconut producers as part of the Tribal sub plan program during the training programmes that were conducted. In addition, trainings on FoCT are offered in the field of coconut research for forwardthinking farmers who cultivate coconut as a component crop on their farms or homesteads. The participants who complete the course that lasts for six days are provided with coconut climbers.

# World Coconut Day Celebration

World Coconut Day is celebrated annually on September 2<sup>nd</sup>, with the purpose of recognizing the significance of coconut and the numerous advantages they offer. Annually, a field day is held in the study field of the AICRP in order to commemorate the theme. The training is attended by a large number of coconut farmers, and they are given coconut seedlings to encourage their participation.

# World Coconut Day Celebration

















# **X. PUBLICATIONS**

# **10.1 Research Articles**

- Arun Kumar R., Surulirajan M., Babu R., Mathirajan V.G., Sumitha S., Ravi Bhat. 2023. Impact of cyclone on phytology of tall coconut (*Cocos nucifera L*) genotypes in East coast province of India. AMA, *Agricultural Mechanization in Asia*. Vol.54 (6) June, 6.29.
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- Jagadeesha S.K., Chandrashekar G.S., Swetha and Basavaraju T.B. 2023. Development of coconut based cropping system for sustainable productivity. *The Pharma innovation Journal*. Vol.12 (4):1436-1438.
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### XI. WEATHER DATA OF CO-ORDINATING CENTRES (2023)

| ALIYARNAGAR |         |           |          |           |               |  |  |
|-------------|---------|-----------|----------|-----------|---------------|--|--|
| Month       | Tempera | ture (°C) | RH       | [ (%)     | Rainfall (mm) |  |  |
|             | Max.    | Min.      | Forenoon | Afternoon | ]             |  |  |
| January     | 30.7    | 15.1      | 83.8     | 49.2      | 0             |  |  |
| February    | 33.1    | 16.4      | 67.6     | 32        | 0             |  |  |
| March       | 34.4    | 18.1      | 70       | 36.5      | 0             |  |  |
| April       | 36.1    | 20.7      | 76.4     | 37.8      | 54            |  |  |
| May         | 34.8    | 22.7      | 78.6     | 47.1      | 87.6          |  |  |
| June        | 31.4    | 22.5      | 83.4     | 66.9      | 57.6          |  |  |
| July        | 27.3    | 21.8      | 90.7     | 85.1      | 238.2         |  |  |
| August      | 30      | 21.5      | 91.8     | 73        | 40            |  |  |
| September   | 29.6    | 21.3      | 90.9     | 78.9      | 45.2          |  |  |
| October     | 32.2    | 20.6      | 88       | 62        | 3.2           |  |  |
| November    | 31      | 20.1      | 88       | 67        | 103.2         |  |  |
| December    | 30.8    | 17.7      | 86.2     | 61.2      | 0             |  |  |

| AMBAJIPETA |         |           |          |           |               |  |  |
|------------|---------|-----------|----------|-----------|---------------|--|--|
| Month      | Tempera | ture (°C) | RH       | [ (%)     | Rainfall (mm) |  |  |
|            | Max.    | Min.      | Forenoon | Afternoon | ]             |  |  |
| January    | 32.2    | 17.4      | 98.9     | 51        | 2             |  |  |
| February   | 35.8    | 19        | 98.8     | 46.4      | 0             |  |  |
| March      | 36.7    | 20.5      | 99.1     | 46.5      | 30.5          |  |  |
| April      | 40.2    | 23.9      | 98.3     | 50.4      | 20            |  |  |
| May        | 40.9    | 25.8      | 98       | 57        | 119.5         |  |  |
| June       | 43      | 27.7      | 93.2     | 50.6      | 43            |  |  |
| July       | 32.4    | 24.4      | 93.3     | 63.2      | 166.5         |  |  |
| August     | 38.2    | 26.2      | 96.8     | 60.8      | 72.5          |  |  |
| September  | 35.7    | 25.9      | 99.7     | 69.4      | 25.5          |  |  |
| October    | 37.7    | 24        | 99.6     | 53.4      | 9.5           |  |  |
| November   | 34      | 22.3      | 99.5     | 59.6      | 4             |  |  |
| December   | 31      | 19.7      | 99.5     | 57.2      | 319.8         |  |  |





| PILICODE  |                  |      |          |           |               |  |  |
|-----------|------------------|------|----------|-----------|---------------|--|--|
| Month     | Temperature (°C) |      | RH       | [(%)      | Rainfall (mm) |  |  |
|           | Max.             | Min. | Forenoon | Afternoon |               |  |  |
| January   | 32.9             | 20.3 | 92.5     | 61.6      | 0             |  |  |
| February  | 32.9             | 21.8 | 92.9     | 61.8      | 0             |  |  |
| March     | 34.2             | 22.2 | 89.5     | 56.5      | 0             |  |  |
| April     | 33.8             | 24.9 | 86       | 73.2      | 0             |  |  |
| May       | 34.2             | 25.6 | 81.1     | 67.8      | 26.8          |  |  |
| June      | 32.4             | 24.5 | 90.7     | 78.7      | 454.2         |  |  |
| July      | 30.4             | 23.2 | 92.2     | 86.5      | 1084.9        |  |  |
| August    | 31.5             | 23.9 | 88       | 80        | 148.8         |  |  |
| September | 30.4             | 23.7 | 91.3     | 85.9      | 672.4         |  |  |
| October   | 32               | 24.5 | 91       | 82.6      | 109.3         |  |  |
| November  | 33.1             | 24.2 | 90.1     | 82.5      | 133.9         |  |  |
| December  | 34.1             | 24.4 | 88.1     | 82.3      | 17.8          |  |  |

| THRISSUR  |         |           |          |           |               |  |  |
|-----------|---------|-----------|----------|-----------|---------------|--|--|
| Month     | Tempera | ture (°C) | RH       | (%)       | Rainfall (mm) |  |  |
|           | Max.    | Min.      | Forenoon | Afternoon | -             |  |  |
| January   | 32.7    | 21.9      | 73       | 39        | 0             |  |  |
| February  | 35.4    | 21.9      | 71       | 27        | 0             |  |  |
| March     | 36.1    | 24.2      | 76       | 39        | 1.7           |  |  |
| April     | 36.8    | 25.5      | 84       | 50        | 108.3         |  |  |
| May       | 34.7    | 25.7      | 89       | 58        | 23.4          |  |  |
| June      | 31.8    | 24.4      | 94       | 73        | 276.3         |  |  |
| July      | 29.6    | 23.7      | 96       | 79        | 667.3         |  |  |
| August    | 32.5    | 24.4      | 93       | 62        | 625.3         |  |  |
| September | 30.7    | 23.7      | 95       | 78        | 516.7         |  |  |
| October   | 32.5    | 23.8      | 93       | 65        | 186.8         |  |  |
| November  | 33.1    | 24.2      | 86       | 61        | 278.6         |  |  |
| December  | 32.4    | 24.2      | 80       | 56        | 32.3          |  |  |





| ARSIKERE  |                  |       |          |           |               |  |  |
|-----------|------------------|-------|----------|-----------|---------------|--|--|
| Month     | Temperature (°C) |       | RH       | [ (%)     | Rainfall (mm) |  |  |
|           | Max.             | Min.  | Forenoon | Afternoon |               |  |  |
| January   | 31.70            | 20.98 | 55.48    | 35.7      | 0             |  |  |
| February  | 33.10            | 24.60 | 52.28    | 43.78     | 0             |  |  |
| March     | 34.72            | 25.43 | 69.09    | 51.32     | 0             |  |  |
| April     | 38.75            | 27.15 | 67.63    | 49.63     | 0             |  |  |
| May       | 39               | 25.85 | 76.48    | 55.83     | 198.1         |  |  |
| June      | 35.88            | 24.31 | 72.13    | 56.70     | 64.6          |  |  |
| July      | 29.74            | 23.29 | 73.61    | 69.54     | 49.4          |  |  |
| August    | 31.20            | 23.72 | 71.54    | 57.67     | 21.0          |  |  |
| September | 31.21            | 23.93 | 77.63    | 67.63     | 95.4          |  |  |
| October   | 30.87            | 23.89 | 73.39    | 59.35     | 69.8          |  |  |
| November  | 30.97            | 23.18 | 70.67    | 60.63     | 81.4          |  |  |
| December  | 30.10            | 19.69 | 70.29    | 61.55     | 30.2          |  |  |

| JAGDALPUR |         |           |          |           |               |  |  |
|-----------|---------|-----------|----------|-----------|---------------|--|--|
| Month     | Tempera | ture (°C) | RH       | (%)       | Rainfall (mm) |  |  |
|           | Max.    | Min.      | Forenoon | Afternoon |               |  |  |
| January   | 29.6    | 10.8      | 87       | 32        | 0             |  |  |
| February  | 32.3    | 11        | 79.7     | 26.1      | 0             |  |  |
| March     | 32.1    | 17        | 85.4     | 45.2      | 105.5         |  |  |
| April     | 34.4    | 20.1      | 85.9     | 41.3      | 64.9          |  |  |
| May       | 35.3    | 21        | 81.8     | 42.6      | 163.5         |  |  |
| June      | 35.7    | 22.7      | 78.8     | 44.8      | 232.9         |  |  |
| July      | 29.5    | 22.6      | 91.5     | 76        | 398.3         |  |  |
| August    | 29.9    | 22.1      | 91.5     | 71.2      | 213.3         |  |  |
| September | 29.4    | 22.1      | 93.6     | 75.9      | 232.3         |  |  |
| October   | 31.7    | 17.9      | 89.7     | 48.7      | 6.2           |  |  |
| November  | 30.4    | 16.1      | 87.5     | 49.3      | 15.8          |  |  |
| December  | 27.5    | 11.7      | 87.6     | 49.3      | 54            |  |  |





| KONDAMALLEPALLY |                  |      |          |           |               |  |  |
|-----------------|------------------|------|----------|-----------|---------------|--|--|
| Month           | Temperature (°C) |      | RH       | [(%)      | Rainfall (mm) |  |  |
|                 | Max.             | Min. | Forenoon | Afternoon |               |  |  |
| January         | 30.2             | 18.4 | 80.5     | 57        | 0             |  |  |
| February        | 32.7             | 18.1 | 75.5     | 51        | 0             |  |  |
| March           | 32.8             | 18.1 | 75.2     | 42        | 2             |  |  |
| April           | 37.9             | 23.6 | 56.6     | 39        | 2             |  |  |
| May             | 39.5             | 26.3 | 43       | 33        | 3             |  |  |
| June            | 39.3             | 28.1 | 34.6     | 51        | 6             |  |  |
| July            | 32.9             | 26.9 | 68.7     | 63        | 10            |  |  |
| August          | 34               | 26.5 | 67.8     | 70        | 9             |  |  |
| September       | 33.2             | 25.5 | 80.4     | 72        | 9             |  |  |
| October         | 33.8             | 22.6 | 75.5     | 67        | 0             |  |  |
| November        | 31.7             | 22.2 | 81.9     | 64        | 5             |  |  |
| December        | 28.8             | 19.1 | 81.8     | 58        | 1             |  |  |

| MONDOURI  |         |           |          |           |               |  |  |
|-----------|---------|-----------|----------|-----------|---------------|--|--|
| Month     | Tempera | ture (°C) | RH       | [ (%)     | Rainfall (mm) |  |  |
|           | Max.    | Min.      | Forenoon | Afternoon |               |  |  |
| January   | 24.632  | 11.51     | 93.18    | 53.76     | 0             |  |  |
| February  | 29.9    | 14.78     | 93.6     | 40.43     | 0             |  |  |
| March     | 33.03   | 19.28     | 92.38    | 44.75     | 21.4          |  |  |
| April     | 35.41   | 22.19     | 86.81    | 45.32     | 128.9         |  |  |
| May       | 35.79   | 24.35     | 88.03    | 55.37     | 83            |  |  |
| June      | 35.16   | 26.83     | 88.56    | 63.96     | 142.7         |  |  |
| July      | 34.19   | 26.44     | 89.89    | 70.13     | 172.6         |  |  |
| August    | 33.2    | 26.06     | 94.37    | 72.7      | 203.1         |  |  |
| September | 32.47   | 25.87     | 94.04    | 77.42     | 166.7         |  |  |
| October   | 31.82   | 23.18     | 94.3     | 68.88     | 175.5         |  |  |
| November  | 29.92   | 17.95     | 92.57    | 55.04     | 3.1           |  |  |
| December  | 25.46   | 13.89     | 94.87    | 57.62     | 77.1          |  |  |





| MULDE     |                  |      |          |           |               |  |  |
|-----------|------------------|------|----------|-----------|---------------|--|--|
| Month     | Temperature (°C) |      | RH       | [ (%)     | Rainfall (mm) |  |  |
|           | Max.             | Min. | Forenoon | Afternoon |               |  |  |
| January   | 34.5             | 14.8 | 92       | 35.1      | 0             |  |  |
| February  | 37.2             | 15.3 | 89.1     | 31.4      | 0             |  |  |
| March     | 37.5             | 18   | 87.9     | 33.5      | 0             |  |  |
| April     | 36.8             | 21.3 | 84.4     | 48.6      | 0             |  |  |
| May       | 37.4             | 23.1 | 86.3     | 48.9      | 30            |  |  |
| June      | 33.8             | 23.2 | 90.5     | 62.7      | 168           |  |  |
| July      | 28.4             | 21.7 | 95.9     | 89.4      | 634           |  |  |
| August    | 30.9             | 21.8 | 94.4     | 76.3      | 120           |  |  |
| September | 31.3             | 21.8 | 93.9     | 76.7      | 170           |  |  |
| October   | 34.4             | 21.5 | 93.9     | 58.1      | 350           |  |  |
| November  | 35.5             | 19   | 90.9     | 50.7      | 260           |  |  |
| December  | 35               | 17.6 | 91.5     | 44.5      | 0             |  |  |

| GOA       |         |           |          |           |               |  |  |
|-----------|---------|-----------|----------|-----------|---------------|--|--|
| Month     | Tempera | ture (°C) | RH       | (%)       | Rainfall (mm) |  |  |
|           | Max.    | Min.      | Forenoon | Afternoon |               |  |  |
| January   | 33.8    | 19.4      | 83.5     | 36.7      | 0             |  |  |
| February  | 36.4    | 20.6      | 82.4     | 35.1      | 0             |  |  |
| March     | 35.9    | 21.6      | 79.4     | 37.5      | 0             |  |  |
| April     | 35.2    | 24.5      | 86.3     | 52.3      | 0             |  |  |
| May       | 36      | 26.1      | 81.8     | 50        | 0             |  |  |
| June      | 33      | 25.4      | 90.4     | 68.5      | 597           |  |  |
| July      | 28.6    | 23.8      | 95       | 88.       | 1763.4        |  |  |
| August    | 30.6    | 24.3      | 91.3     | 75.2      | 320.2         |  |  |
| September | 30.7    | 31.2      | 94.8     | 77.4      | 606.3         |  |  |
| October   | 33.7    | 23.5      | 92       | 61.2      | 126.2         |  |  |
| November  | 34.7    | 23.7      | 87.3     | 54.2      | 96.8          |  |  |
| December  | 34.8    | 22.6      | 75.6     | 41.2      | 0             |  |  |





| BHUBANESWAR |         |            |          |           |               |  |  |
|-------------|---------|------------|----------|-----------|---------------|--|--|
| Month       | Tempera | nture (°C) | RH       | [ (%)     | Rainfall (mm) |  |  |
|             | Max.    | Min.       | Forenoon | Afternoon |               |  |  |
| January     | 29.5    | 16.4       | 88       | 46        | 0             |  |  |
| February    | 32.4    | 18.4       | 90       | 35        | 0             |  |  |
| March       | 34.2    | 21.4       | 91       | 51        | 48.5          |  |  |
| April       | 37.2    | 24.7       | 90       | 52        | 92.2          |  |  |
| May         | 37.8    | 26.4       | 88       | 57        | 103.7         |  |  |
| June        | 37.9    | 27.1       | 89       | 64        | 142.3         |  |  |
| July        | 33.3    | 26.8       | 93       | 79        | 215.5         |  |  |
| August      | 33.1    | 26.2       | 91       | 74        | 488.7         |  |  |
| September   | 32.9    | 25.2       | 93       | 76        | 448.2         |  |  |
| October     | 33      | 23.5       | 86       | 60        | 52.7          |  |  |
| November    | 30.9    | 20.3       | 87       | 51        | 18.5          |  |  |
| December    | 27.7    | 16.1       | 87       | 50        | 21.3          |  |  |

| SHIVAMOGGA |         |           |          |           |               |  |  |
|------------|---------|-----------|----------|-----------|---------------|--|--|
| Month      | Tempera | ture (°C) | RH       | [ (%)     | Rainfall (mm) |  |  |
|            | Max.    | Min.      | Forenoon | Afternoon |               |  |  |
| January    | 30.7    | 15.1      | 83.8     | 49.2      | 0             |  |  |
| February   | 33.1    | 16.4      | 67.6     | 32        | 0             |  |  |
| March      | 34.4    | 18.1      | 70       | 36.5      | 0             |  |  |
| April      | 36.1    | 20.7      | 76.4     | 37.8      | 54            |  |  |
| May        | 34.8    | 22.7      | 78.6     | 47.1      | 87.6          |  |  |
| June       | 31.4    | 22.5      | 83.4     | 66.9      | 57.6          |  |  |
| July       | 27.3    | 21.8      | 90.7     | 85.1      | 238.2         |  |  |
| August     | 30      | 21.5      | 91.8     | 73        | 40            |  |  |
| September  | 29.6    | 21.3      | 90.9     | 78.9      | 45.2          |  |  |
| October    | 32.2    | 20.6      | 88       | 62        | 3.2           |  |  |
| November   | 31      | 20.1      | 88       | 67        | 103.2         |  |  |
| December   | 30.8    | 17.7      | 86.2     | 61.2      | 0             |  |  |





| PORT BLAIR |                  |      |          |           |               |  |  |
|------------|------------------|------|----------|-----------|---------------|--|--|
| Month      | Temperature (°C) |      | RH       | [ (%)     | Rainfall (mm) |  |  |
|            | Max.             | Min. | Forenoon | Afternoon |               |  |  |
| January    | 30.5             | 23.4 | 67       | 70        | 3.5           |  |  |
| February   | 30.9             | 23.9 | 68       | 73        | 39.4          |  |  |
| March      | 31.6             | 25   | 69       | 73        | 11.9          |  |  |
| April      | 32               | 26   | 66       | 72        | 0             |  |  |
| May        | 33.3             | 27   | 70       | 74        | 110           |  |  |
| June       | 30.9             | 25.3 | 83       | 86        | 653.5         |  |  |
| July       | 30.3             | 25   | 84       | 87        | 622.1         |  |  |
| August     | 30.4             | 25.4 | 84       | 86        | 443.7         |  |  |
| September  | 28.8             | 24   | 86       | 92        | 940.1         |  |  |
| October    | 30.7             | 24.8 | 82       | 89        | 307.5         |  |  |
| November   | 31               | 25.4 | 76       | 81        | 360.2         |  |  |
| December   | 31               | 26   | 77       | 80        | 91.1          |  |  |

| VEPPANKULAM |         |           |          |           |               |  |  |
|-------------|---------|-----------|----------|-----------|---------------|--|--|
| Month       | Tempera | ture (°C) | RH       | (%)       | Rainfall (mm) |  |  |
|             | Max.    | Min.      | Forenoon | Afternoon |               |  |  |
| January     | 30.5    | 19.6      | 90.7     | 71.9      | 6             |  |  |
| February    | 30.2    | 19.9      | 92.3     | 65.8      | 69            |  |  |
| March       | 33.7    | 22.7      | 92.6     | 70.4      | 8.2           |  |  |
| April       | 35.5    | 24.5      | 91.9     | 72.3      | 26.8          |  |  |
| May         | 36.5    | 25.5      | 91.9     | 77.1      | 173           |  |  |
| June        | 37      | 25.2      | 90.5     | 82.3      | 27.2          |  |  |
| July        | 38.3    | 24.2      | 85.5     | 65.3      | 18.2          |  |  |
| August      | 37      | 33.1      | 90.5     | 82.7      | 27.2          |  |  |
| September   | 38.8    | 24.5      | 84.4     | 61.5      | 179.4         |  |  |
| October     | 39.6    | 32.8      | 91.1     | 77.5      | 36.2          |  |  |
| November    | 39.2    | 32.2      | 92.6     | 77        | 241.6         |  |  |
| December    | 38.8    | 32.2      | 84.9     | 71.7      | 111.6         |  |  |





| BAVIKERE  |                  |       |          |           |               |  |  |
|-----------|------------------|-------|----------|-----------|---------------|--|--|
| Month     | Temperature (°C) |       | RH       | [ (%)     | Rainfall (mm) |  |  |
|           | Max.             | Min.  | Forenoon | Afternoon |               |  |  |
| January   | 30.39            | 11.97 | -        | -         | 0             |  |  |
| February  | 32.18            | 12.89 | -        | -         | 0             |  |  |
| March     | 33.48            | 15.13 | -        | -         | 0             |  |  |
| April     | 35.23            | 20.23 | -        | -         | 29.8          |  |  |
| May       | 33.06            | 22.34 | -        | -         | 6.66          |  |  |
| June      | 32.27            | 21.27 | -        | -         | 60.1          |  |  |
| July      | 26.58            | 19.5  | -        | -         | 365           |  |  |
| August    | 29.18            | 19.24 | -        | _         | 31.5          |  |  |
| September | 28.98            | 19.65 | -        | -         | 64.5          |  |  |
| October   | 31.4             | 19.42 | -        | -         | 21            |  |  |
| November  | 29.91            | 18.63 | -        | -         | 60.5          |  |  |
| December  | 29.93            | 16.69 | -        | -         | 0             |  |  |

\*RH parameters are not recorded

| RATNAGIRI |         |           |          |           |               |  |  |
|-----------|---------|-----------|----------|-----------|---------------|--|--|
| Month     | Tempera | ture (°C) | RH       | [ (%)     | Rainfall (mm) |  |  |
|           | Max.    | Min.      | Forenoon | Afternoon |               |  |  |
| January   | 31.4    | 18.3      | 69.9     | 56.8      | 0             |  |  |
| February  | 35.4    | 19.7      | 54.2     | 52.3      | 0             |  |  |
| March     | 34.4    | 22.2      | 55.2     | 49.8      | 0.1           |  |  |
| April     | 33.5    | 24.1      | 70.3     | 61.5      | 1.2           |  |  |
| May       | 34.2    | 26.2      | 69.9     | 65.5      | 3             |  |  |
| June      | 33.1    | 26.4      | 78.3     | 71.2      | 371.1         |  |  |
| July      | 29      | 24.7      | 90.2     | 87.8      | 1389          |  |  |
| August    | 30.2    | 24.8      | 86       | 78.4      | 254.8         |  |  |
| September | 30.7    | 24.3      | 87.7     | 80        | 561.9         |  |  |
| October   | 33.3    | 24.2      | 78.8     | 70.6      | 236.9         |  |  |
| November  | 34.9    | 23.2      | 68.5     | 60.9      | 30.3          |  |  |
| December  | 34.4    | 21.9      | 59.5     | 55.4      | 0             |  |  |





| KILLIKULAM |                  |      |          |           |               |  |  |
|------------|------------------|------|----------|-----------|---------------|--|--|
| Month      | Temperature (°C) |      | RH       | [ (%)     | Rainfall (mm) |  |  |
|            | Max.             | Min. | Forenoon | Afternoon |               |  |  |
| January    | 31.4             | 15.9 | 70       | 41        | 10.00         |  |  |
| February   | 33.2             | 15.3 | 68       | 34        | 44.00         |  |  |
| March      | 34.7             | 18.6 | 69       | 43        | 18.00         |  |  |
| April      | 36.3             | 19.3 | 67       | 43        | 40.20         |  |  |
| May        | 36.7             | 20.3 | 67       | 46        | 103.00        |  |  |
| June       | 38.2             | 22.2 | 59       | 43        | 0             |  |  |
| July       | 36.6             | 21.5 | 61       | 42        | 10.40         |  |  |
| August     | 38.4             | 20.7 | 61       | 37        | 7.80          |  |  |
| September  | 36.5             | 20   | 64       | 40        | 49.00         |  |  |
| October    | 33.8             | 18.5 | 69       | 50        | 41.40         |  |  |
| November   | 30.9             | 17.7 | 70       | 60        | 267.80        |  |  |
| December   | 30.3             | 17.1 | 71       | 59        | 436.20        |  |  |

| KAHIKUCHI |         |           |          |           |               |  |  |
|-----------|---------|-----------|----------|-----------|---------------|--|--|
| Month     | Tempera | ture (°C) | RH       | (%)       | Rainfall (mm) |  |  |
|           | Max.    | Min.      | Forenoon | Afternoon |               |  |  |
| January   | 26      | 11.9      | 88       | 74        | 0             |  |  |
| February  | 28.2    | 15.7      | 80       | 65        | 0.2           |  |  |
| March     | 30.4    | 18.3      | 76       | 60        | 137.5         |  |  |
| April     | 32.8    | 20.8      | 74       | 63        | 111           |  |  |
| May       | 33.2    | 22.7      | 73       | 65        | 148.9         |  |  |
| June      | 33.5    | 24.9      | 84       | 78        | 337.8         |  |  |
| July      | 34.4    | 25.8      | 81       | 78        | 170           |  |  |
| August    | 33.8    | 25.4      | 84       | 82        | 90.1          |  |  |
| September | 35.1    | 25.7      | 80       | 81        | 100.7         |  |  |
| October   | 32.1    | 21.5      | 83       | 81        | 111.2         |  |  |
| November  | 30.4    | 16.8      | 81       | 77        | 0             |  |  |
| December  | 27.2    | 15.3      | 89       | 79        | 6.8           |  |  |





| PASIGHAT  |                  |       |          |           |               |  |  |
|-----------|------------------|-------|----------|-----------|---------------|--|--|
| Month     | Temperature (°C) |       | RH       | (%)       | Rainfall (mm) |  |  |
|           | Max.             | Min.  | Forenoon | Afternoon |               |  |  |
| January   | 22.77            | 10    | 69.03    | 59.03     | 56.5          |  |  |
| February  | 22.96            | 10    | 77.21    | 64.13     | 143.01        |  |  |
| March     | 25.29            | 10    | 72.16    | 60.16     | 164.7         |  |  |
| April     | 28.7             | 16    | 73.74    | 59.59     | 115.7         |  |  |
| May       | 27.7             | 21.9  | 79.6     | 71.8      | 283           |  |  |
| June      | 32.2             | 22.93 | 83.1     | 72.87     | 603.9         |  |  |
| July      | 29.84            | 23.1  | 83.266   | 77.61     | 1366.1        |  |  |
| August    | 31.42            | 24.29 | 86.26    | 79.26     | 702.3         |  |  |
| September | 29.12            | 25.31 | 69.12    | 65.31     | 12.1          |  |  |
| October   | 19.55            | 19.55 | 62.87    | 63.81     | 30.6          |  |  |
| November  | 28.13            | 26.4  | 44.94    | 58.26     | 2.6           |  |  |
| December  | 13.8             | 13.8  | 52.3     | 47.3      | 5             |  |  |

| PANDIRIMAMIDI |         |           |          |           |               |  |  |
|---------------|---------|-----------|----------|-----------|---------------|--|--|
| Month         | Tempera | ture (°C) | RH       | [ (%)     | Rainfall (mm) |  |  |
|               | Max.    | Min.      | Forenoon | Afternoon | -             |  |  |
| January       | 28.7    | 18.2      | 94       | 55        | 27.4          |  |  |
| February      | 30.8    | 20.5      | 92       | 39        | 22            |  |  |
| March         | 34.5    | 21.9      | 88       | 46        | 5.6           |  |  |
| April         | 37.6    | 24.2      | 81       | 39        | 68.6          |  |  |
| May           | 38.8    | 24.6      | 61       | 42        | 27.4          |  |  |
| June          | 40.6    | 25.5      | 72       | 52        | 147           |  |  |
| July          | 37.3    | 24.6      | 94       | 71        | 226.2         |  |  |
| August        | 34.3    | 26.8      | 97       | 76        | 338.4         |  |  |
| September     | 32.4    | 26.8      | 98       | 73        | 216.2         |  |  |
| October       | 32.8    | 2.9       | 95       | 76        | 10.2          |  |  |
| November      | 30.2    | 24.4      | 98       | 73        | 37            |  |  |
| December      | 28.7    | 20.8      | 99       | 79        | 138           |  |  |





| PATTUKOTTAI |                  |      |          |           |               |  |  |
|-------------|------------------|------|----------|-----------|---------------|--|--|
| Month       | Temperature (°C) |      | RH       | [ (%)     | Rainfall (mm) |  |  |
|             | Max.             | Min. | Forenoon | Afternoon |               |  |  |
| January     | 30.5             | 19.6 | 90.7     | 71.9      | 0             |  |  |
| February    | 30.2             | 19.9 | 92.3     | 65.8      | 69.7          |  |  |
| March       | 33.7             | 22.7 | 92.6     | 70.4      | 25.5          |  |  |
| April       | 35.5             | 24.5 | 91.9     | 72.3      | 0             |  |  |
| May         | 36.5             | 25.5 | 91.9     | 77.1      | 113.2         |  |  |
| June        | 37               | 25.2 | 90.5     | 82.3      | 57.7          |  |  |
| July        | 38.3             | 24.2 | 85.5     | 65.3      | 25            |  |  |
| August      | 37               | 33.1 | 90.5     | 82.7      | 0             |  |  |
| September   | 38.8             | 24.5 | 84.4     | 61.5      | 116           |  |  |
| October     | 39.6             | 32.8 | 91.1     | 77.5      | 0             |  |  |
| November    | 39.2             | 32.2 | 92.6     | 77        | 227.6         |  |  |
| December    | 38.8             | 32.2 | 84.9     | 71.7      | 52.85         |  |  |

| SABOUR    |         |           |          |           |               |  |  |
|-----------|---------|-----------|----------|-----------|---------------|--|--|
| Month     | Tempera | ture (°C) | RH       | [ (%)     | Rainfall (mm) |  |  |
|           | Max.    | Min.      | Forenoon | Afternoon |               |  |  |
| January   | 20.3    | 7.8       | 95.5     | 71.2      | 0.0           |  |  |
| February  | 28.2    | 10.9      | 88.6     | 53.3      | 0.0           |  |  |
| March     | 31.9    | 16.0      | 88.0     | 53.8      | 47.4          |  |  |
| April     | 36.4    | 19.4      | 78.0     | 41.5      | 22.0          |  |  |
| May       | 36.9    | 22.3      | 75.6     | 39.5      | 27.0          |  |  |
| June      | 38.4    | 25.4      | 76.8     | 49.5      | 253.8         |  |  |
| July      | 33.8    | 26.1      | 89.1     | 65.6      | 198.6         |  |  |
| August    | 33.3    | 25.5      | 92.2     | 70.1      | 358.2         |  |  |
| September | 33.2    | 25.2      | 91.8     | 69.9      | 445.6         |  |  |
| October   | 32.1    | 21.0      | 93.5     | 62.7      | 222.0         |  |  |
| November  | 30.0    | 15.6      | 93.6     | 64.0      | 0.0           |  |  |
| December  | 25.0    | 11.0      | 94.0     | 77.3      | 8.0           |  |  |



| SIRSI     |                  |      |          |           |               |  |  |
|-----------|------------------|------|----------|-----------|---------------|--|--|
| Month     | Temperature (°C) |      | RH       | (%)       | Rainfall (mm) |  |  |
|           | Max.             | Min. | Forenoon | Afternoon |               |  |  |
| January   | 31               | 16   | 74       | 70        | 0             |  |  |
| February  | 34               | 16   | 79       | 68        | 0             |  |  |
| March     | 35               | 18   | 78       | 75        | 4             |  |  |
| April     | 37               | 22   | 84       | 82        | 0             |  |  |
| May       | 37               | 22   | 84       | 79        | 69.4          |  |  |
| June      | 33               | 23   | 87       | 83        | 144.8         |  |  |
| July      | 28               | 22   | 95       | 94        | 1170.6        |  |  |
| August    | 30               | 22   | 92       | 88        | 93.4          |  |  |
| September | 30               | 22   | 95       | 90        | 170           |  |  |
| October   | 33               | 21   | 91       | 86        | 77.6          |  |  |
| November  | 31               | 21   | 88       | 84        | 14.8          |  |  |
| December  | 30               | 17   | 85       | 80        | 0             |  |  |

| NAVSARI   |         |            |          |           |               |  |  |
|-----------|---------|------------|----------|-----------|---------------|--|--|
| Month     | Tempera | nture (°C) | RH       | [ (%)     | Rainfall (mm) |  |  |
|           | Max.    | Min.       | Forenoon | Afternoon |               |  |  |
| January   | 29.1    | 13.4       | 84.5     | 39.5      | 0             |  |  |
| February  | 34.5    | 14         | 83.3     | 25.9      | 0             |  |  |
| March     | 34.2    | 18.9       | 81.8     | 40.7      | 0             |  |  |
| April     | 36      | 22.2       | 89.1     | 43.2      | 5             |  |  |
| May       | 35      | 25.7       | 83.5     | 55.5      | 0             |  |  |
| June      | 33.8    | 26.9       | 83.9     | 68.3      | 306           |  |  |
| July      | 29.5    | 24.8       | 96.4     | 89.4      | 1130.7        |  |  |
| August    | 30.6    | 25.2       | 91.3     | 76.3      | 40            |  |  |
| September | 31.8    | 24.3       | 94.5     | 73.5      | 289           |  |  |
| October   | 35.1    | 21.8       | 92.3     | 48.3      | 0             |  |  |
| November  | 33.7    | 19.1       | 80.4     | 43.1      | 42            |  |  |
| December  | 30.9    | 17.1       | 87       | 45.6      | 0             |  |  |





### **XII. STAFF POSITION**

| Head Quarters, ICAR-CPCRI, Kasaragod, Kerala - 671 124 |   |  |  |
|--|---|--|--|
| Project Coordinator                                    | Dr. K. Muralidharan (upto 22.01.2023) – Additional Charge         |  |  |
|  | Dr. K B Hebbar (from 23.01.2023 to 07.5.2023) – Additional Charge |  |  |
|  | Dr. B Augustine Jerard, PC (Palms) (from 08.5.2023)               |  |  |
| Scientist, PC Cell                                     | Dr. Sumitha S, Scientist (SPMA)                                   |  |  |
| Stenographer   | Mrs. Narayani   |  |  |
| Clerical Assistant                                     | Vacant  |  |  |

| ICAF   | ICAR- AICRP on Palms Coordinating Centres                   |  |  |
|--|---|--|--|
| Horticultural Research Station, Ambajipeta, Andhra Pradesh                         |   |  |  |
| 1.   | Dr. Govardhan, Sr. Scientist (Plant Pathology)              |  |  |
| 2.   | Dr. Anoosha, Scientist (Agri. Entomology)                   |  |  |
| 3.   | Dr. Kireethi, Scientist (Horticulture)                      |  |  |
| Horticultural Research Station, Pandirimamidi, Andhra Pradesh                      |   |  |  |
| 4.   | Dr. K. Rajendra Prasad, Sr. Scientist (Horticulture)        |  |  |
| 5.   | Dr. P.C. Vengaiah, Sr.Scientist (Food Science & Technology) |  |  |
| Horticultural Research Station, Kahikuchi, Assam                                   |   |  |  |
| 6.   | Dr. J.C. Nath, Professor (Horticulture)                     |  |  |
| Saheed Gundadhur College of Agriculture & Research Station, Jagdalpur, Chattisgarh |   |  |  |
| 7.   | Dr. Beena Singh, Asst. Professor (Horticulture)             |  |  |
| 8.   | Dr. P.K. Salam, Asst. Professor (Agronomy)                  |  |  |
| Horticultural Research& Extension Station, Arsikere, Karnataka                     |   |  |  |
| 9.   | Dr. Kiran Kumar, Asst. Professor (Plant Pathology)          |  |  |
| 10.  | Dr. G.S. Chandrasekhar, Asst. Professor (Agri.Entomology)   |  |  |
| 11.  | Dr. Jagadeesha, Asst. Professor (Horticulture)              |  |  |
| Regional Coconut Research Station, Bhatye, Ratnagiri, Maharshtra                   |   |  |  |
| 12.  | Dr. K.V. Malshe Asst. Professor (Agronomy)                  |  |  |
| 13.  | Dr. S. M. Wankhede, Asst. Professor (Agri.Entomology)       |  |  |
| 14.  | Dr. S.L. Ghavale, Asst. Professor (Horticulture)            |  |  |
| Department of Horticulture, OUAT, Bhubaneshwar, Odisha                             |   |  |  |
| 15.  | Dr. A.K. Sahoo, Asst. Professor (Horticulture)              |  |  |

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| Coconut Research Station, Aliyarnagar, Tamil Nadu                     |  |  |
|---|--|--|
| 16.   | Dr. Arul Prakash, Associate Professor (Agri.Entomology)        |  |
| 17.   | Dr. C. Sudhalakshmi, Associate Professor (Soil Science)        |  |
| 18.   | Dr. J.Suresh, Professor (Horticulture)                         |  |
| 19.   | Dr. Latha, Associate Professor (Plant Pathology)               |  |
| Coconut Research Station, Veppankulam, Tamil Nadu                     |  |  |
| 20.   | Dr. Arun Kumar, Associate Professor (Horticulture)             |  |
| 21.   | Dr. M. Surulirajan, Associate Professor (Plant Pathology)      |  |
| 22.   | Dr. N Senthilkumar, Associate Professor (Agronomy)             |  |
| Agrie   | cultural College & Research Institute, Killikulam, Tamil Nadu  |  |
| 23.   | Dr. Manivannan, Asst. Professor (Horticulture)                 |  |
| Department of Plantation Crops, BCKVV, Mondouri, West Bengal          |  |  |
| 24.   | Dr. D.K. Ghosh (LKN), Asst. Professor (Agronomy)               |  |
| Agricultural Research Station, Pattukkottai, Tamil Nadu               |  |  |
| 25.   | Dr. M. Tamil Selvan, Asst. Professor (Horticulture)            |  |
| Regi  | onal Agricultural Research Station, Pilicode, Kerala           |  |
| 26.   | Dr. Remya Rajan, Asst. Professor (PBG)                         |  |
| Coco  | a Research Centre, KAU, Thrissur, Kerala                       |  |
| 27.   | Dr. Minimol, Professor & Head                                  |  |
| Colle   | ege of Horticulture, Mulde, Maharshtra                         |  |
| 28.   | Dr. Debaje, P.S, Asst. Professor (Horticulture)                |  |
| Hort  | icultural Research Station, Vijayarai, Andhra Pradesh          |  |
| 29.   | Dr. Mathavilatha, Asst. Professor (Horticulture)               |  |
| Biha  | r Agricultural College, Sabour, Bihar                          |  |
| 30.   | Dr. Ruby Rani, Asst. Professor (Horticulture)                  |  |
| 31.   | Dr. Ahmar Aftab, Associate Professor (Horticulture)            |  |
| Navs  | ari Agricultural University, Navsari, Gujarat                  |  |
| 32.   | Dr. Pankaj P. Bhalerao, Asst. Professor (Fruit Science)        |  |
| Colle   | ege of Horticulture & Forestry, Pasighat, Arunachal Pradesh    |  |
| 33.   | Dr. Barun Singh, Scientist (Horticulture) (upto November 2023) |  |
| UAHS, Shivamogga, Karnataka   |  |  |
| 34.   | Dr. Shreeshail Sonyal, Asst. Professor (Plant Pathology)       |  |
| AHRS, Bavikere, College of Agriculture, Navile, Shivamogga, Karnataka |  |  |
| 35.   | Dr. Sadashiv Nadukeri, Asst. Professor (Horticulture)          |  |
| CES, Wakawali (Dapoli), Maharashtra                                   |  |  |
| 36.   | Dr. Prafula Mali, Assoc. Professor (Horticulture)              |  |



| ICAR-CCARI, Goa  |   |  |
|--|---|--|
| 37.  | Dr. V. Arunachalam, Pr. Scientist (Horticulture)        |  |
| ICAR- IIOPR, Pedavagi, Andhra Pradesh  |   |  |
| 38.  | Dr. G. Ravichandran, Principal Scientist (Seed Science) |  |
| ICAR- CIARI, Port Blair, Andaman and Nicobar Islands                         |   |  |
| 39.  | Dr. Ajit Arun Waman, Scientist (SPMA)                   |  |
| HRS, Konda Mallepally, Telangana (ASKLTSHU)                                  |   |  |
| 40.  | Dr. Raja Goud, Asst Professor (Agri.Entomology)         |  |
| Horticulture Research and Extension Centre, Sirsi, Uttara Kannada, Karnataka |   |  |
| 41.  | Dr. Sudheesh Kulakarni, Scientist (Horticulture)        |  |
| ICAR-CPCRI, Kasaragod, Kerala  |   |  |
| 42.  | Dr P Subramanian, Principal Scientist and Head          |  |



