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वार्षिक प्रतिवेदन 2024
Annual Report 2024

भा.कृ.अ.प.-केन्द्रीय रोपण फसल अनुसंधान संस्थान
कासरगोड़, केरल, भारत
ICAR-CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
KASARAGOD 671 124, KERALA, INDIA

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April, 2025

CONTENTS

6 new varieties of coconut, arecanut and cocoa, were released: Kalpa Nakshatra, Kalpa Suvarna and Kalpa Shatabdi (coconut); Terai Shankar (arecanut); and VTLCH 1 and VTLCH 2 (cocoa) .

6

6 new inclusions to coconut germplasm collection enriched to a total of 469. Arecanut has 173 and cocoa 531.

5

5 MoUs were signed with CPCRI for collaborative research with other ICAR institutes and universities.

5

5 products, coconut flakes, cocoa fermenters, tender coconut punching machines, flavoured coconut milk, trimmed tender coconut developed.

5.3

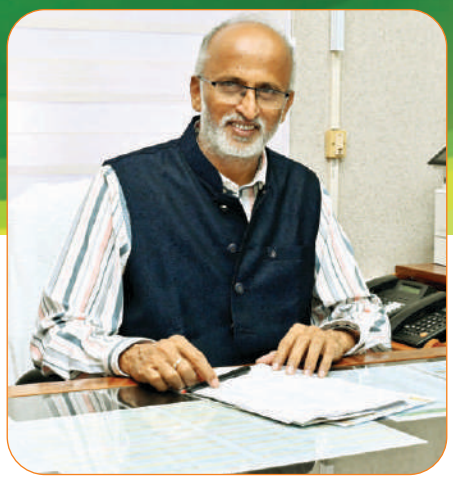
5,30,557 planting materials produced and distributed.

71

71 research papers published, of which 52 had NAAS ratings above 6.0.

31

31 technologies licensed to 71 entrepreneurs.



प्रस्तावना

इस वार्षिक रिपोर्ट के रूप में संस्थान के अनुसंधान विकास के एक समग्र दस्तावेज को हितधारकों के समक्ष प्रस्तुत करते हुए बहुत खुशी हो रही है। यह इस क्षेत्र में अनुसंधान और विकास की घटनाओं के संबंधित क्षेत्रों में हमारी भागीदारी की झलक भी देता है।

हमारा देश दुनिया के लिए उत्पादन का केंद्र बनने के लिए तैयार है। बागवानी क्षेत्र में, उच्च गुणवत्ता वाले वस्तुएं और मूल्य वर्धित उत्पाद विश्व बाजार की न्यूट्रास्यूटिकल जरूरतों को पूरा करने जा रहे हैं। बायोफोर्टिफिकेशन बागवानी मूल्य श्रृंखला में उभरता हुआ बज़वर्ड है। तो, हरा नारियल के सूक्ष्म तत्व, सुपारियों से अल्कलॉइड और कोको के एंटीऑक्सीडेंट प्राकृतिक अवयवों के साथ उपभोक्ता उत्पादों को मजबूत कर रहे हैं।

बाजार की कीमतें सभी फसलों में अच्छे संकेत दे रही हैं। हालांकि, वर्तमान मौसम के दौरान फसल की उत्पादकता कम है, जो उत्पादन चुनौतियों से निपटने के लिए अधिक अनुसंधान हस्तक्षेपों का संकेत देती है । कम उत्पादकता को हल करने और फसल के नुकसान को रोकने के लिए प्रौद्योगिकियां हमारे लक्ष्य हैं।

अंतरराष्ट्रीय स्तर पर, हम न केवल नारियल और सुपारी फसलों के उत्पादन में, बल्कि हमारे आनुवंशिक संसाधनों के संग्रह और उपयोग के संदर्भ में भी पहले स्थान पर रहे हैं। कोको में भी, हमारे पास अपने प्रजनकों के लिए सबसे बड़े आनुवंशिक विविधता संसाधनों में से एक है। इस वर्ष एक नारियल किस्म और दो कोको संकरों को विमोचित करने की सिफारिश की गई है।

सर्कुलर बायो–इकोनॉमी, नर्सरी के लिए बिना–मिट्टी का मीडिया के उत्पाद कल्प भूम का विमोचन, स्वच्छ रोपण सामग्री के उत्पादन के लिए एक कदम आगे है।

सुपारी पर राष्ट्रीय वैज्ञानिक समिति ने सुपारी की लीफ स्पॉट बीमारी, सुपारी की रिंग स्पॉट बीमारी और स्वास्थ्य संबंधी मुद्दों जैसे विभिन्न मुद्दों को संबोधित करने के लिए वैज्ञानिकों, किसानों, नीति निर्माताओं और विकासात्मक एजेंसियों के साथ अपनी बैठकें की हैं। इसके परिणामस्वरूप सुपारी और मानव स्वास्थ्य पर एक बहु–संस्थागत परियोजना को मंजूरी दी गई है। हमें उम्मीद है कि नेटवर्क मोड पर इस परियोजना के परिणाम निश्चित रूप से लंबे समय में इस क्षेत्र की मदद करने जा रहे हैं।

एफपीओ, छोटे किसानों और एलएसजी से जुड़े अभिनव विस्तार दृष्टिकोण नारियल आधारित सूक्ष्म उद्यमों के लिए आजीविका को बढ़ावा देने जा रहे हैं। भाकृअप – केरोफअसं आधिकारिक वेबसाइट के लिए एक आभासी सहायक जनता को जो वे चाहते हैं वह जानकारी प्राप्त करने में मदद करने जा रहा है।

हाई–टेक तकनीकी विकास, एआई, साइबर एक्सटेंशन और मोबाइल ऐप आधारित प्रौद्योगिकियों के साथ तालमेल बनाए रखने के लिए, निकट भविष्य में और परिवर्तन होने जा रहे हैं। एफपीओ और कृषि समुदायों से जुड़े बाजार स्पर्धा से जुड़े हितधारक समावेशी कार्रवाई अनुसंधान से दीर्घकालिक सतत विकास को भी लाभ होगा।

इस वर्ष पांच महत्वपूर्ण समझौता ज्ञापनों पर हस्ताक्षर किए गए ताकि हमारे अनुसंधान प्रयासों जैसे आरआरएससी बैंगलूरु, बागवानी और वानिकी महाविद्यालय, पासीघाट, निट्टे विश्वविद्यालय, मोंडेलेज़ इंडिया प्राइवेट लिमिटेड, और केरल वन विभाग को अतिरिक्त गति प्रदान की जा सके।

पारिस्थितिकी तंत्र सेवाओं की इस यात्रा में, हमें उच्च अधिकारियों से उनके सहयोग और इसे प्राप्त करने में मदद करने का समर्थन मिला। संस्था की ओर से, हम इस अवसर पर परिषद् के महानिदेशक और सचिव, डेयर, उप महानिदेशक (बागवानी), सहायक महानिदेशक (एफपीसी) और एसएमडी के सभी सदस्य, संस्थान की परिषद के सदस्य हमारे सभी प्रयासों में मूल्यवान समर्थन और मार्गदर्शन के लिए को धन्यवाद देते हैं। उनके ईमानदार प्रयासों के लिए संपादकीय बोर्ड विशेष सराहना की पात्र है।

के. बालचंद्र हेब्बार
निदेशक

कूडलु
31 मार्च 2025

PREFACE

It gives immense pleasure to present before the aspirants a holistic document of research developments of the institute in the form of this Annual Report. It also gives glimpses of our involvement in the related areas of R&D happenings in the sector.

Our country is gearing up to become a hub of production for the world. In the horticultural sector, commodities and value-added products of high quality are going to address the nutraceutical needs of the world market. Biofortification is the emerging buzzword in the horticultural value chain. So, microelements of tender coconuts, alkaloids from arecanuts and antioxidants of cocoa are fortifying the consumer products with natural ingredients.

Market prices are showing good indications in all the crops. However, crop productivity is lower during the current season, indicating greater research interventions to tackle the production challenges.Technologies to solvelow productivity and prevent crop loss are our goals.

At the international level, we are performing first not only in the production of coconut and arecanut crops but also in terms of our genetic resources collections and utilization. In cocoa also, we have one of the largest genetic diversity resources for our breeders. One coconut variety and two cocoa hybrids were recommended for release this year.

Launch of the product Kalpa Bhooma, a product of circular bio-economy, soil-less media for nurseries, is a step forward for the production of clean planting materials.

The National Scientific Committee on Arecanut has had its meetings with the scientists, farmers, policymakers, and developmental agencies to address various issues such as leaf spot disease of arecanut, ring spot disease of arecanut and health related issues. This has resulted in sanctioning of a multi-institutional project on arecanut and human health. We hope that the outcomes of this project on network mode are certainly going to help the sector in the long run.

Innovative extension approaches involving FPOs, marginal farmers, and LSGs are going to boost the livelihood for the coconut based micro-enterprises. A virtual assistant for the ICAR-CPCRI official website is going to help the public get the information they want.

To keep pace with the hi-tech technological developments, AI, cyber extension, and mobile app based technologies, further transformations are going to happen in the near future. A stakeholder inclusive action research involving FPOs and market players connected with farming communities also would benefit long-term sustainable development.

Five important MoUs were signed this year to give additional pace to our research endeavor, such as RRSC Bangalore, College of Horticulture & Forestry, Pasighat, Nitte University, Mondelez India Pvt. Ltd., and Kerala Department of Forestry.

In this journey of ecosystem services, we received support from the higher officials extending their cooperation and help to achieve it. On behalf of CPCRI, we take this opportunity to thank the Director General, ICAR and Secretary, DARE, the Deputy Director General (Hort. Sci), the Assistant Director General (FPC) and all the members of SMD, members of the Council of the Institute for their valuable support and guidance in all our endeavors. A special appreciation is due to the Editorial Board for their sincere efforts.

Kudlu
31 March 2025

K. Balachandra Hebbar
Director

कार्य सारांश

जलवायु लचीले लक्षणों/जीनोटाइप और गुणवत्ता मापदंडों के लिए फेनोटाइपिंग और जीनोटाइपिंग

भाकृअनुप–कें.रो.फ.अ.सं ने जलवायु–लचीली और उच्च गुणवत्ता वाले नारियल और सुपारी किस्मों के विकास और विमोचन में महत्वपूर्ण प्रगति हासिल की है। चंद्रशंकर संकर की तुलना में नट, कोपरा और रस उपज में बेहतर प्रदर्शन का प्रदर्शन करने वाले उच्च उपज वाले नारियल संकर कल्प नक्षत्र (डी × टी चौघाट नारंगी बौना × पश्चिम अफ्रीकी लंबा) को एसवीआरसी द्वारा केरल में खेती के लिए विमोचित किया गया था।

कल्पा सुवर्ण और कल्पा शताब्दी को फसल मानक, कृषि फसलों के लिए किस्मों की अधिसूचना और विमोचन पर केंद्रीय उप–समिति द्वारा जारी करने के लिए मंजूरी दी गई थी; कल्पा सुवर्ण, एक बौना दोहरे उद्देश्य की किस्म, ने कोपरा और निविदा नट उत्पादन दोनों में आशाजनक परिणाम दिखाए और व्यावसायिक रूप से कर्नाटक स्थित दो फर्मों को लाइसेंस दिया गया था। इसके अतिरिक्त, कल्पा शताब्दी को कोको हाइब्रिड्स वीटीएलसीएच 1 और वीटीएलसीएच 2 के साथ, कई राज्यों के लिए उच्च उपज क्षमता और ब्लैक पॉड रोट जैसी बीमारियों के प्रति सहिष्णुता के साथ अनुशंसित किया गया था।

सुपारी में, हाइब्रिड तराई शंकर को उप–हिमालयी तराई और निचले ब्रह्मपुत्र क्षेत्रों में रिहाई के लिए मंजूरी दी गई थी। इसने उच्च अखरोट की उपज और कर्नेल की वसूली का प्रदर्शन किया, जिससे यह इन कृषि–जलवायु क्षेत्रों के लिए उपयुक्त हो गया। कई नारियल किस्मों में निविदा नट प्रसंस्करण अध्ययन भी किए गए, जिसमें मूल्य संवर्धन की उनकी क्षमता पर प्रकाश डाला गया।

आनुवंशिक संसाधनों के मोर्चे पर, वर्तमान में फील्ड जीन बैंकों में 469 नारियल और 172 सुपारी पहुंच संरक्षित हैं। भाकृअनुप–एनबीपीजीआर (भारतीय कृषि अनुसंधान परिषद – राष्ट्रीय पादप आनुवंशिक संसाधन ब्यूरो) के सहयोग से भ्रूण, पराग और डीएनए का क्रायोप्रिजर्वेशन भी प्रगति पर था। आरसी केडीयू और वाईएसआरएचयू, एपी में वैकल्पिक जीन बैंकों के साथ एक और 531 कोको जर्मप्लाज्म संग्रह का भी संरक्षण किया जाता है। सूखा सहिष्णुता के लिए दक्षिण अमेरिकी कोको जीनोटाइप की स्क्रीनिंग चल रही है, जिसमें जैव रासायनिक विश्लेषण मानक स्कोरिंग सिस्टम का उपयोग करके जीनोटाइप को वर्गीकृत करने में मदद करते हैं।

द्रव्यमान गुणन प्रोटोकॉल का अनुकूलन

भाकृअनुप–कें.रो.फ.अ.सं ने नारियल ऊतक संस्कृति के लिए द्रव्यमान गुणन प्रोटोकॉल को अनुकूलित करने के लिए व्यापक अध्ययन किया। विभिन्न बेसल मीडिया (Y3, MS और उनके अर्ध–शक्ति संस्करण), ऑक्सिन उपचार, सुक्रोज सांद्रता, सक्रिय चारकोल और प्रकाश/अंधेरे ऊष्मायन शासन का उपयोग करके रूट इंडक्शन परीक्षणों ने 0 से 15% तक की जड़ दर के साथ सीमित सफलता प्राप्त की। सात दिनों तक पूरा अंधेरा उपचार

पादपों के लिए हानिकारक साबित हुआ। एक्सिलरी शूट कल्चर में, अपरिपक्व पुष्पक्रम से प्राप्त शूटों ने बार–बार ट्रिमिंग के बावजूद एक प्रसार द्रव्यमान नहीं दिया, जबकि डब्ल्यूसीटी के भ्रूण सुसंस्कृत पौधे आगे के विकास के लिए नियंत्रित परिस्थितियों में बनाए रखे जा रहे हैं। इसके अतिरिक्त, मीठे कर्नेल नारियल जीनोटाइप में भ्रूण बचाव प्रयासों के कारण 65 भ्रूण की सफल संस्कृति हुई, जड़ माध्यम में 30 पौधे और वर्तमान में ग्रीनहाउस में स्थापित 10 कठोर पौधे थे।

उच्च उत्पादकता और पर्यावरणीय सुरक्षा के लिए इनपुट उपयोग दक्षता

कसारगोड में एक हेक्टेयर में नारियल आधारित खेती प्रणाली मॉडल, जिसमें नारियल, नारियल के तने पर काली मिर्च, भूखंडों की सीमा में केला, नारियल के इंटरस्पेस में चारा ज्वार (सह–31, मल्टी–कट चारा ज्वार) शामिल है। एक डेयरी इकाई, बकरी इकाई और मुर्गी पालन के साथ, रुपये का शुद्ध रिटर्न प्राप्त किया। 5,43,682 और 884.9 केजे प्रति हेक्टेयर के उत्पादन के साथ उच्च ऊर्जा दक्षता का प्रदर्शन किया। नारियल के बगीचों में 100 प्रतिशत जैविक पोषण के साथ इंटरक्रॉपिंग मल्टी–कट सोरघम (सीओ–31) से 79.9 टन प्रति हेक्टेयर हरा चारा प्राप्त हुआ। रोपण की पेंटागोनल विधि (5 पौधे प्रति पिट के साथ 0.6 मीटर × 1.2 मीटर की दूरी पर) के बाद नारियल के बगीचे में इंटरक्रॉपिंग दालचीनी ने 631.92 ग्राम प्रति पेड़ और 979.0 किलोग्राम प्रति हेक्टेयर की काफी अधिक शुष्क क्विल उपज दर्ज की। किसानों के लिए सर्कुलर बायो–इकोनॉमी, नर्सरी, कल्पा भूमि के लिए मिट्टी–रहित मीडिया का एक उत्पाद जारी किया गया है।

आर्टिफिशियल इंटेलिजेंस (एआई) और सूचना और संचार प्रौद्योगिकी (आईसीटी) कृत्रिम बुद्धिमत्ता (एआई) और सूचना एवं संचार प्रौद्योगिकी (आईसीटी)

भाकृअनुप–कें.रो.फ.अ.सं ने दक्षता बढ़ाने और वृक्षारोपण प्रबंधन में लागत कम करने के लिए ड्रोन आधारित कीटनाशक एप्लिकेशन के माध्यम से कृत्रिम बुद्धिमत्ता (एआई) और आईसीटी के उपयोग का पता लगाया। विभिन्न स्प्रे हाइट्स (1, 2, और 3 मीटर) और अवधि (5, 8, और 11 सेकंड) का आकलन करने वाले परीक्षणों से पता चला है कि 8 सेकंड के मँडराने के साथ 2 मीटर की ऊंचाई ने वृक्ष छतरी के नीचे स्प्रे कवरेज, प्रवेश और ड्रॉपलेट जमाव का सबसे अच्छा संतुलन पेश किया, जिससे यह नारियल जैसी लंबी फसलों के लिए आदर्श बन गया। अक्टूबर 2024 में, कें.रो.फ.अ.सं में बौने भूखंड पर 1% बोर्डो मिश्रण और क्लोरोथलोनिल 75 डब्ल्यूपी का उपयोग करके एक रोगनिरोधी ड्रोन स्प्रे आयोजित किया गया था। क्लोरोथलोनिल ने बोर्डो मिश्रण (22 28%, 3.5 $l cm^2$ तक) की तुलना में बेहतर कवरेज (27 35%) और उच्च जमाव (10.1 $l cm^2$ तक) हासिल किया। विशेष रूप से, स्प्रे के बाद किसी भी नए बड रॉट मामले की सूचना नहीं दी गई थी, और अध्ययन जारी है।

टिकाऊ उत्पादन के लिए एकीकृत कीट और रोग प्रबंधन

भाकृअनुप–कें.रो.फ.अ.सं ने टिकाऊ फसल उत्पादन के लिए एकीकृत कीट और रोग प्रबंधन में महत्वपूर्ण प्रगति की। आरएनए–अनुक्रमण और माइक्रोस्कोपी का उपयोग करके कर्नाटक में रोगग्रस्त एरेका पाम नेक्रोटिक रिंगस्पॉट वायरस 2 (ए.एन.आर.एस.वी. 2) में एक उपन्यास एरेपावायरस, एरेका पाम नेक्रोटिक रिंगस्पॉट वायरस 2 (ए.एन.आर.एस.वी. 2) की पहचान की गई और आरटी–पीसीआर के माध्यम से पुष्टि की गई। इसके अतिरिक्त, ट्रांसक्रिप्टोम खनन के माध्यम से एक गैर–पाम मेजबान साइकोट्रिया रूब्रा में एक संबंधित वायरस का पता लगाया

गया था। उभरते हुए सुपारी पत्ती स्पॉट रोग का प्रबंधन करने के लिए, माइक्रोन्यूट्रिएंट एप्लिकेशन (जिंक, बोरोन, मैग्नीशियम) के साथ मिलकर फंगिसिडल स्प्रे (प्रोपिकोनाज़ोल और टेबुकोनाज़ोल) के दो दौर ने बीमारी की गंभीरता को प्रभावी ढंग से कम कर दिया। कोको में, ट्राइकोडर्मा हार्ज़ियानम, ट्राइकोडर्मा एटी 172 और बेसिलस एसपीपी, जैसे बायोकंट्रोल एजेंटों ने 1 प्रतिशत बोर्डो मिश्रण के साथ, काली फली बीमारी के खिलाफ पौधों के स्वास्थ्य में काफी सुधार किया। संगतता अध्ययनों से पता चला कि टी. हरजियानम चूने के साथ असंगत था लेकिन डोलोमाइट और नारियल की भूसी बायोचर के साथ व्यवहार्य था। मृदा स्वास्थ्य और फसल उत्पादकता को बढ़ाने के लिए डोलोमाइट, नीम तेल और *टी. हरजियानम* को मिलाकर एक उपन्यास निर्माण विकसित किया गया था।

बायोएक्टिव यौगिकों का निष्कर्षण और लक्षण वर्णन और हथेलियों और कोको में मूल्य वर्धन/पूर्व और फसल कटाई के बाद मशीनीकरण

हाइपरस्पेक्ट्रल विश्लेषण और बायोकेमिकल प्रोफाइलिंग का उपयोग करके बायोएक्टिव यौगिकों के निष्कर्षण और लक्षण वर्णन पर भाकृअनुप–कें.रो.फ.अ.सं उन्नत अनुसंधान। हाइपरस्पेक्ट्रल डेटा ने शुद्ध और मिलावटी वर्जिन नारियल तेल (वीसीओ), नारियल चीनी और सुपारी के बीच स्पष्ट अंतर को सक्षम किया। आरआरएससी–इसरो, बेंगलुरु के सहयोग से, एक साधारण मिलावट डिटेक्टर विकसित करने के लिए प्रमुख भेदभावपूर्ण तरंग दैर्ध्य की पहचान की जा रही है, जो मुफ्त फैटी एसिड, आयोडीन मूल्य, फेनोलिक्स और एरेकोलीन सामग्री जैसे जैव रासायनिक मापदंडों के व्यापक विश्लेषण द्वारा समर्थित है। विभिन्न प्रक्रियाओं से वीसीओ की चयापचय प्रोफाइलिंग से कई स्वास्थ्य–लाभकारी बायोएक्टिव यौगिकों का पता चला। सुपारी परिपक्वता के साथ सुपारी सामग्री में कमी पाई गई, जैसा कि 15 जीनोटाइप और हितधारक–आपूर्ति नमूनों में एचपीएलसी के माध्यम से मान्य किया गया था। प्रसंस्करण विधियों ने एरेकोलीन के स्तर को उबलने और भूनने वाले परिवर्तित जैव रासायनिक संरचना को भी प्रभावित किया, जिसमें भुना हुआ सुपारी एरेकोलीन और कार्बोहाइड्रेट सामग्री में वृद्धि दिखाता है लेकिन पेरोक्साइड मूल्य, एफएफए और प्रोटीन को कम करता है। भुने हुए सुपारी से कच्चे को अलग करने के लिए एक जैव रासायनिक सूचकांक का मूल्यांकन किया जा रहा है।

भाकृअनुप–कें.रो.फ.अ.सं. ने फसल कटाई पूर्व और बाद के मशीनीकरण और उत्पाद विकास में उल्लेखनीय प्रगति की। 10 प्रतिशत नारियल दूध अवशेष (सीएमआर) का उपयोग करके एक बीन–टू–बाइट चॉकलेट फॉर्मूलेशन ने महंगे कोको मक्खन को प्रभावी ढंग से बदल दिया, फाइबर सामग्री और संवेदी अपील में सुधार किया, हालांकि एंटीऑक्सीडेंट स्तर थोड़ा कम हो गए थे। एआईसीआरपी–फेट के तहत अपस्केलिंग की योजना के साथ 66.03 प्रतिशत दक्षता और 9.23 किलोग्राम एच–1 उत्पादन के साथ एक नारियल स्लाइसिंग–कम–फ्लेक्किंग मशीन विकसित की गई थी। कार्बोनेटेड टेंडर नारियल के पानी के लिए, इष्टतम स्थितियां 1 सेकंड के लिए 5 सी और 10 प्रतिशत कार्बोनेशन थीं। दालचीनी के साथ स्वाद वाली नारियल के दूध–आधारित जमे हुए मिठाई ने वाणिज्यिक आइसक्रीम पर बेहतर एंटीऑक्सीडेंट गतिविधि और उपभोक्ता वरीयता दिखाई। इसके अतिरिक्त, डिफेटेड नारियल के आटे से बने स्वादिष्ट नारियल के दूध का उत्पाद कल्पा ब्लिज, स्वस्थ वसा, लॉरिक एसिड और उच्च बायोएक्टिव और फाइबर सामग्री प्रदान करता है।

प्रौद्योगिकी मूल्यांकन, प्रभाव और उद्यमिता विकास

प्रौद्योगिकी मूल्यांकन, प्रभाव और उद्यमिता विकास के तहत, भाकृअनुप–कें.रो.फ.अ.सं. ने नवाचार और आउटरीच में महत्वपूर्ण प्रगति की। कें.रो.फ.अ.सं. डेटा पर कस्टम–प्रशिक्षित और 100 से अधिक भाषाओं का समर्थन करने वाला एएसके कल्पा एआई चैटबॉट एक शक्तिशाली डिजिटल सहायक के रूप में उभरा। कल्पा बिलडेस्क आवेदन ने क्यूआर कोड–सक्षम क्रॉस–सर्वर सत्यापन के माध्यम से सुरक्षित और कुशल बिलिंग को बढ़ाया।

आईपीआर प्रशिक्षण और दस राष्ट्रीय प्रदर्शनियों में भागीदारी सहित प्रौद्योगिकी जागरूकता को बढ़ावा देने के लिए सितंबर 2024 में कल्पा स्टार्टअप मास्टर क्लास की शुरुआत हुई। कल्पा एबी के माध्यम से, केआरआईएसपी कार्यक्रम के तहत 2024 में 19 उद्यमियों को शामिल किया गया था, हालांकि कई छात्रों के नेतृत्व वाले स्टार्टअप बंद हो गए थे। दस इनक्यूबेट्स ने स्नातक किया और व्यवसाय शुरू किया। पांच उद्यमिता विकास कार्यक्रम (ईडीपी) और चार कृषि व्यवसाय विकास कार्यक्रम भी आयोजित किए गए, जिसमें 126 प्रतिभागियों को प्रशिक्षित किया गया।

किसान प्रथम कार्यक्रम (एफएफपी) ने मूंगफली, दालों, सब्जियों, मछली पालन और फूलों की खेती सहित विविध कृषि प्रणालियों का नेतृत्व किया, अंडे के उत्पादन में आत्मनिर्भरता (1600 अंडे दिन –1) प्राप्त की और फसल विविधता सूचकांक को दोगुना कर दिया। महिलाओं की एसएचजी आय में 43.25 प्रतिशत की वृद्धि हुई, और आहार विविधता में 40– 61 प्रतिशत की वृद्धि हुई।

नारियल फर्मेंटर, नीरा सिरप–इन्फ्यूज्ड फ्लेक्स, टेंडर नारियल पंचिंग मशीन, कल्पा ब्लिज, खाद्य कोटिंग, डिसिकेटेड नारियल मिलावट डिटेक्टर, कल्पा इको पॉट्स, पैलीनोलॉजिकल नारियल किस्म की पहचान, ट्रिम्ड नारियल संरक्षण प्रोटोकॉल, त्वरित वीसीओ उत्पादन, फ्रोजन नारियल व्यंजन और कल्पा ईपीएन, एक पर्यावरण के अनुकूल जड़ ग्रब नियंत्रण सूत्रीकरण सहित कई प्रौद्योगिकियों का मूल्यांकन और प्रचार किया गया।

इस वर्ष संस्थान ने 71 शोध पत्र प्रकाशित किए हैं, जिनमें से 56 एनएएस स्कोर >6.0 थे। कुल नौ तकनीकी समाधानों को व्यावसायीकरण परिषद द्वारा प्रमाणित किया गया था। व्यावसायीकरण के मोर्चे पर, उद्यमियों को कुल 71 प्रौद्योगिकियों का लाइसेंस दिया गया था, जिनकी राजस्व कमाई रु। 17,87,500 शुल्क के रूप में। संस्थान क्षमता निर्माण और उद्यमिता विकास के लिए किसानों, एफपीओ, एससीएसपी युवाओं को शामिल करके आउटरीच गतिविधियों के नवीन तरीकों को अपना रहा है।

III.

EXECUTIVE SUMMARY

Phenotyping and Genotyping for Climate Resilient Traits/Genotypes and Quality Parameters

ICAR-CPCRI achieved significant progress in the development and release of climate-resilient and high-quality coconut and arecanut varieties. The high-yielding coconut hybrid Kalpa Nakshatra (D×T: Chowghat Orange Dwarf × West African Tall) demonstrating superior performance in nut, copra, and sap yield compared to the Chandra Sankara hybrid was released by SVRC for cultivation in Kerala.

Kalpa Suvarna and Kalpa Shatabdi were approved for release by the Central Sub-Committee on Crops Standards, Notification and Release of Varieties for Agricultural Crops; Kalpa Suvarna, a dwarf dual-purpose variety, showed promising results in both copra and tender nut production and was commercially licensed to two Karnataka-based firms. Additionally, Kalpa Shatabdi, along with cocoa hybrids VTLCH 1 and VTLCH 2, was recommended for multiple states with high yield potential and tolerance to diseases like black pod rot.

In arecanut, the hybrid Terai Shankar was approved for release in the Sub-Himalayan Terai and lower Brahmaputra regions. It demonstrated high nut yield and kernel recovery, making it suitable for these agro-climatic zones. Tender nut processing studies were also conducted across several coconut varieties, highlighting their potential for value addition.

On the genetic resources front, at present there are 469 coconut and 172 arecanut accessions conserved in the field gene banks. Cryopreservation of embryos, pollen and DNA were also in progress in collaboration with ICAR-NBPGR. Another 531 cocoa germplasm collections are also conserved, with alternate gene banks at RC Kidu and YSRHU, AP. Screening of South American cocoa genotypes for drought tolerance is underway, with biochemical analyses helping classify genotypes using standard scoring systems.

Optimization of Mass Multiplication Protocols

ICAR-CPCRI undertook extensive studies to optimize mass multiplication protocols for coconut tissue culture. Root induction trials using various basal media (Y3, MS, and their half-strength versions), auxin treatments, sucrose concentrations, activated charcoal, and light/dark incubation regimes yielded limited success, with rooting rates ranging from 0 to 15 per cent. Complete dark treatment for seven days proved detrimental to plantlets. In axillary shoot culture, shoots derived from immature inflorescences did not yield a proliferating mass despite repeated trimming, while embryo-cultured plantlets of WCT are being maintained under controlled conditions for further development. Additionally, embryo rescue efforts in sweet kernel coconut genotypes led to the successful culture of 65 embryos, with 30 plantlets in rooting medium and 10 hardened plantlets currently established in the greenhouse.

Input Use Efficiency for Higher Productivity and Environmental Security

Coconut based farming system model in one hectare at Kasaragod comprising coconut, pepper trailed on the coconut trunk, banana in the border of the plots, fodder sorghum (CO-31, multi-cut fodder sorghum) in the interspaces of coconut, along with a dairy unit, goat unit and poultry, achieved a net return of Rs. 5,43,682 and demonstrated high energy

efficiency with an output of 884.9 KJ per hectare. Intercropping multi-cut sorghum (CO-31) in coconut gardens with 100 per cent organic nutrition yielded 79.9 tons per hectare of green fodder.Intercropping cinnamon in the coconut garden following the pentagonal method of planting (0.6 m x 1.2 m spacing with 5 plants per pit) recorded a significantly higher dry quill yield of 631.92 g per tree and 979.0 kg per hectare.A product of circular bio-economy, soil-less media for nurseries, Kalpa Bhooma, has been released for farmers.

Artificial Intelligence (AI) and Information and Communication Technology (ICT)

ICAR-CPCRI explored the use of Artificial Intelligence (AI) and ICT through drone-based pesticide application to enhance efficiency and reduce costs in plantation management. Trials assessing different spray heights (1, 2, and 3 meters) and durations (5, 8, and 11 seconds) showed that a 2-meter height with 8 seconds of hovering offered the best balance of spray coverage, penetration, and droplet deposition under tree canopies, making it ideal for tall crops like coconut. In October 2024, a prophylactic drone spray using 1% Bordeaux mixture and Chlorothalonil 75WP was conducted on the Dwarf plot at CPCRI. Chlorothalonil achieved better coverage (27–35%) and higher deposition (up to 10.1 L cm^{-2}) than Bordeaux mixture (22–28%, 3.5 L cm^{-2}). Notably, no new bud rot cases were reported post-spraying, and the study is continued.

Integrated Pest and Disease Management for Sustainable Production

ICAR-CPCRI made significant advancements in integrated pest and disease management for sustainable crop production. A novel arepavirus, Areca Palm Necrotic Ringspot Virus 2 (ANRSV2), was identified in diseased areca palms in Karnataka using RNA-sequencing and microscopy, and confirmed via RT-PCR. Additionally, a related virus was detected in *Psychotria rubra*, a non-palm host, through transcriptome mining. To manage emerging arecanut leaf spot disease, two rounds of fungicidal sprays (Propiconazole and Tebuconazole) coupled with micronutrient application (zinc, boron, magnesium) effectively reduced disease severity. In cocoa, biocontrol agents like *Trichoderma harzianum*, Trichoderma AT172, and *Bacillus* spp., alongside 1 per cent Bordeaux mixture, significantly improved plant health against black pod disease. Compatibility studies revealed *T. harzianum* was incompatible with lime but viable with dolomite and coconut husk biochar. A novel formulation combining dolomite, neem oil, and *T. harzianum*was developed to enhance soil health and crop productivity.

Extraction and Characterization of Bioactive Compounds and Value Addition / Pre- and Post-Harvest Mechanization in Palms and Cocoa

ICAR-CPCRI advanced research on the extraction and characterization of bioactive compounds and value addition using hyperspectral analysis and biochemical profiling. Hyperspectral data enabled clear differentiation between pure and adulterated virgin coconut oil (VCO), coconut sugar, and arecanut. In collaboration with RRSC-ISRO, Bengaluru, key discriminating wavelengths are being identified to develop a simple adulteration detector, supported by extensive analysis of biochemical parameters like free fatty acids, iodine value, phenolics, and arecoline content. Metabolite profiling of VCO from various processes revealed several health-beneficial bioactive compounds. Arecoline content was found to decrease with arecanut maturity, as validated through HPLC across 15 genotypes and stakeholder-supplied samples. Processing methods also influenced arecoline levels—boiling and roasting altered biochemical composition, with roasted arecanut showing increased arecoline and carbohydrate content but reduced peroxide value, FFA, and protein. A biochemical index to distinguish raw from roasted arecanut is under evaluation.

ICAR-CPCRI made notable progress in pre- and post-harvest mechanization and product development. A bean-to-bite chocolate formulation using 10 per cent coconut milk residue (CMR) effectively replaced costly cocoa butter, improving fibre content and sensory appeal, though antioxidant levels were slightly reduced. A coconut slicing-cum-flaking machine with 66.03 per cent efficiency and 9.23 kg per hour output was developed, with plans for upscaling under AICRP-PHET. For carbonated tender coconut water, optimal conditions were 5°C

and 10 per cent carbonation for 1 second. A coconut milk-based frozen dessert flavored with cinnamon showed superior antioxidant activity and consumer preference over commercial ice creams. Additionally, Kalpa Bliz, a flavoured coconut milk product made from defatted coconut flour, offers healthy fats, lauric acid, and high bioactive and fibre content.

Technology Evaluation, Impact and Entrepreneurship Development

Under the Technology Evaluation, Impact, and Entrepreneurship Development, ICAR-CPCRI made significant strides in innovation and outreach. The ASK Kalpa AI chatbot, custom-trained on CPCRI data and supporting over 100 languages, emerged as a powerful digital assistant. The Kalpa Billdesk application enhanced secure and efficient billing through QR code-enabled cross-server verification.

The Kalpa Startup Master Class began in September 2024 to promote technology awareness, including IPR training and participation in ten national exhibitions. Through the Kalpa ABI, 19 entrepreneurs were incubated in 2024 under the KRISP program, though several student-led startups discontinued. Ten incubatees graduated and started businesses. Five Entrepreneurship Development Programs (EDPs) and four agribusiness development programs were also conducted, training 126 participants.

The Farmer FIRST Programme (FFP) led to diversified farming systems including groundnut, pulses, vegetables, pisciculture, and floriculture, achieving self-sufficiency in egg production (1600 eggs per day) and doubling the crop diversity index. Women's SHG incomes rose by 43.25 per cent, and dietary diversity improved by 40–61 per cent.

Several technologies were evaluated and promoted, including the coconut fermenter, neera syrup-infused flakes, tender coconut punching machine, Kalpa Bliz, edible coatings, desiccated coconut adulteration detectors, Kalpa Eco Pots, palynological coconut variety identification, trimmed coconut preservation protocol, accelerated VCO production, frozen coconut delicacy, and Kalpa EPN, an eco-friendly root grub control formulation.

This year the institute has published 71 research papers, of which 56 were with >6.0 NAAS score. A total of nine technological solutions were certified by the Council for commercialization. On the commercialization front, a total of 71 technologies were licensed to entrepreneurs with a revenue earning of Rs. 17,87,500 as fees. The institute is adopting innovative methods of outreach activities by involving farmers, FPOs, SCSP youth for capacity building and entrepreneurship development.

IV.

Vision, Mission and Mandate

Vision

To develop CPCRI as a technology generation and repository centre, wherein the Institute strives to showcase, demonstrate and compare world-wide technologies in the commodity chains of coconut, arecanut and cocoa to make India the global leader.

Mission

To develop technologies that enhance resource use efficiency, profitability and livelihood security of people who depend on plantation crops.

Mandate

- Basic, strategic and applied research to enhance sustainable productivity, quality and utilization of coconut, arecanut and cocoa,
- Repository of plantation crops genetic resources and scientific information,
- Transfer of technology, capacity building and impact assessment of technologies,
- Coordinate research and validation of technologies on plantation crops through AICRP on Palms.

V.

Institute Profile

ICAR-Central Plantation Crops Research Institute (ICAR-CPCRI), the premier research institution in the National Agricultural Research System of India, is presently mandated to conduct research on plantation crops (coconut, arecanut, cocoa and palmyrah). It had a modest beginning as Coconut Research Station in 1916 under the erstwhile Madras Presidency. Since its inception, it has served the farming community with distinction through exemplary research, generation of appropriate technologies and development of skilled human resource.

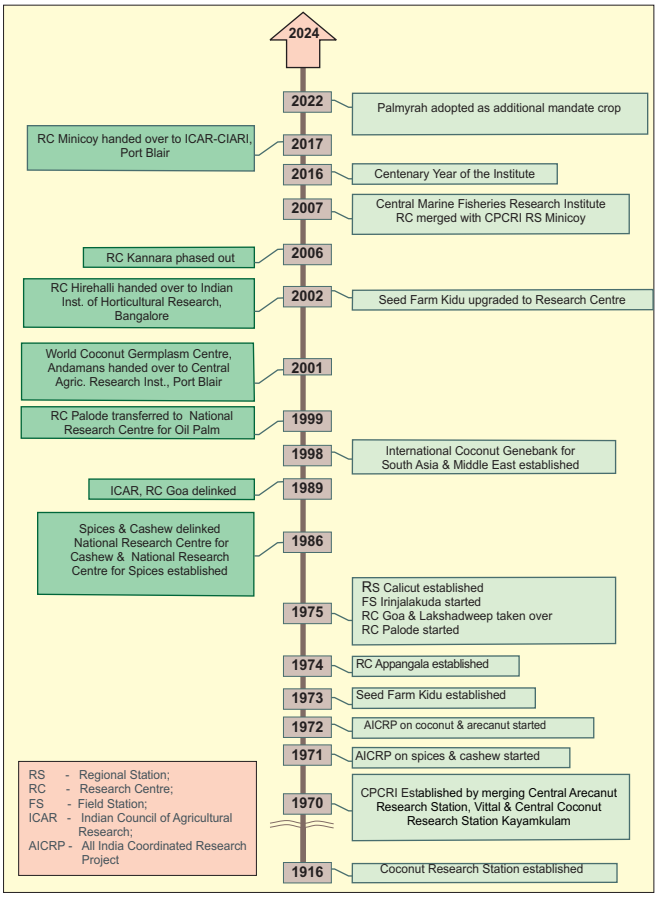
Historical Perspective

The Coconut Research Station at Kudlu (Kasaragod) was taken over by the Indian Central Coconut Committee, which established the Central Coconut Research Station (CCRS), Kasaragod, in 1947 and the Central Coconut Research Station (CCRS) at Kayamkulam was also established exclusively for tackling diseases in coconut. Coconut research became an integral part of the national agricultural research system in 1966 when the Indian Central Coconut Committee was abolished and the coconut research was taken over directly by the Indian Council of Agricultural Research. In 1970, the Central Plantation Crops Research Institute was established with the headquarters at Kasaragod by merging the Central Coconut Research Stations at Kasaragod and Kayamkulam and the Central Arecanut Research Station at Vittal along with its five substations at Kannara, Mohitnagar, Kahikuchi, Hirehalli and Palode.

Since 1986, crops like spices, cashew, and oil palm were taken out of the purview of the institute with the formation of dedicated research institutions like Indian Institute of Spices Research, Kozhikode, Directorate of Cashew Research, Puttur and Indian Institute of Oil Palm Research, Pedvegi. Some of the erstwhile Research Centres at Hirehalli, Palode, Appangala, Kannara, Port Blair and Minicoy were either handed over to sister ICAR institutions or phased out. At present, the mandated crops are limited to coconut, arecanut, cocoa and palmyrah and the research and frontline extension aspects of these crops are undertaken under five divisions *viz.,* Crop Improvement, Crop Production, Crop Protection, Physiology, Biochemistry and Post-Harvest Technology and Social Sciences at the Institute. The Regional Station at Kayamkulam (Kerala) is mandated to work on pests and disease problems in coconut, while the Regional Station at Vittal (Karnataka) caters to research and extension in arecanut and cocoa. The Research Centres at Kahikuchi (Assam) and Mohitnagar (West Bengal) undertake location-specific research in these crops, while the Research Centre at Kidu (Karnataka) hosts the International Coconut Gene Bank for South-Asia and the Middle East (ICG-SAME) and also caters to the large-scale production of quality planting materials in the mandate crops. Besides, there are two KVKs (at Kasaragod and Kayamkulam) functioning under the Institute.

All India Co-ordinated Coconut and Arecanut Improvement Project (AICCAIP) started functioning from 1972 at CPCRI, Kasaragod which was later renamed as All India Coordinated Research Project (AICRP) on Palms in 1986, which has 15 centres working on coconut, six on oil palm, four on arecanut, four on palmyrah and seven on cocoa.

MILESTONES IN THE TIMELINE OF ICAR-CPCRI

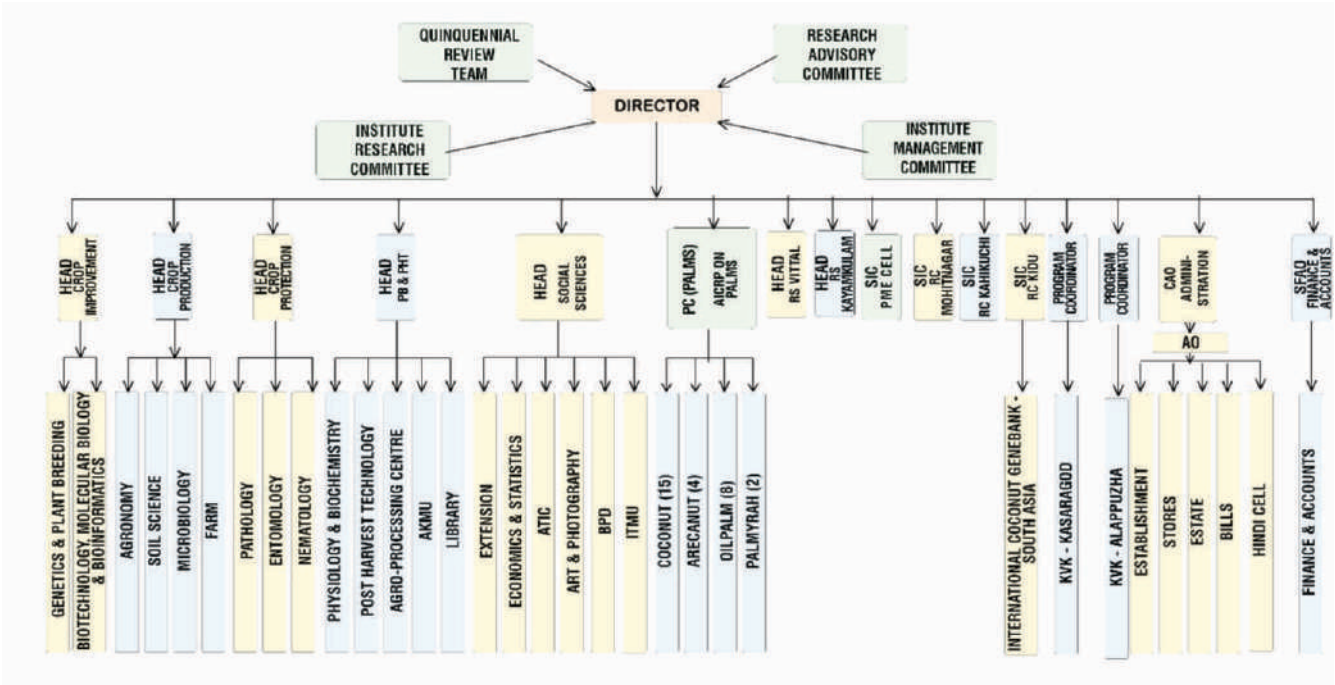


Achievements at a Glance

Phenotyping and Genotyping for Climate Resilient Traits/Genotypes and Quality Parameters

- Coconut varieties Kalpa Suvarna for Kerala and Karnataka and Kalpa Shatabdi for Kerala, Karnataka and Tamil Nadu were approved for release by CVRC and notified in the Gazette. Coconut variety, Kalpa Nakshatra, a DxT hybrid between Chowghat Orange Dwarf and West African Tall was recommended by SVRC for cultivation in Kerala. It is a multipurpose variety suitable for copra, oil, tender nut and kalparasa production.
- Variety registration proposals of coconut varieties viz., Kalpa Ratna and Kalpa Srestha submitted to PPVFRA for registration and published in Plant Variety Journal
- Coconut varieties, Kalpa Suvarna, Kalpa Samrudhi, Kalpa Shatabdi and arecanut variety Shatamangala were licensed to Entrepreneurs
- Complementary conservation of 30 core germplasm as zygotic embryos, DNA and pollen were undertaken at NBPGR.

Organogram



- The Institute has been producing quality planting materials annually in coconut, arecanut and cocoa to the tune of 1.2 lakhs, 5 lakhs and 0.5 lakhs respectively, for distribution to farmers and other stakeholders.

Optimization of mass multiplication protocols

- Woody Plant Medium (WPM) with TDZ (5 mg per L) alone or in combination with NAA was found best suited for culture initiation in terms of minimum browning and enhanced vegetative bud formation. Maximum number of multiple shoots (12.5) were recorded in MS media supplemented with 1 mg per L of NAA and BAP (2 mg per L).
- Sixty-five sweet endosperm-type coconut embryos were rescued and grown in a culture medium. Thirty plantlets from previous cultures are in the rooting medium. Ten hardened plantlets are in the greenhouse. Embryos from 29 accessions, pollen from 20 accessions and DNA from 16 accessions have been cryopreserved.
- The first successfully hardened tissue culture WCT palm, planted on 27 November 2020, began flowering in April 2024, with new bunches emerging at 25-28 day intervals, showcasing the potential for accelerated growth and increased yield.

Input use efficiency for higher productivity and environmental security

- Three Bacillus isolates were screened for their tolerance to high temperatures and varying NaCl concentrations. *Bacillus safensis* tolerated up to 14% NaCl, while *Bacillus cereus* tolerated up to 10% NaCl.
- Four *Komagataeibacter* isolates were effective for producing *nata-de-coco*, bacterial cellulose, and vinegar, yielding higher bacterial cellulose output. Optimal fermentation parameters, such as pH, acetic acid concentration, carbon, and nitrogen sources, were standardized to enhance cellulose synthesis from coconut water for industrial use.
- Organic nutrient management resulted in the highest green multi-cut fodder sorghum yield (CO 3) in both years (79.9 t ha^{-1} $year1^{-1}$ and 70.7 t ha^{-1} $year2^{-1}$) surpassing yields from chemical and integrated nutrient management (INM) methods.
- The pentagonal method of high-density planting (0.6m x 1.2m) for cinnamon as an intercrop in coconut resulted in higher quill yield (631.9 kg ha^{-1} in the first, 900 kg ha^{-1} in the second, and 971.0 kg ha^{-1} in the third harvest) compared to the traditional 2m x 2m planting method.
- Geographical variability in the heavy metal content of cocoa beans was observed across major cocoa-growing regions in India. All values were within the safe limits set by EU food safety standards.
- Applying 150-200 per cent of the recommended soil test based nutrient application through fertigation to Hybrid coconut (Kalpa Sankara) resulted in significantly higher yields, reduced puny coconuts, and improved copra size.
- Soil moisture conservation practices, such as husk incorporation combined with leaf mulching, resulted in higher soil moisture retention and lower soil temperature compared to individual husk or leaf treatments. Control plots showed the lowest moisture retention, highlighting the importance of these conservation practices.
- In organic coconut cultivation, applying organic manure alone reduced the potassium (K) content in leaves below the critical level. Therefore, supplementing with 50 per cent K through sulfate of potash was found effective in increasing the leaf K content.
- Diagnosis and severity evaluation of nutrient deficiency symptoms in cocoa was successfully carried out using machine learning and deep learning approaches.

Integrated pest and disease management for sustainable production

- Molecular and morphological characterization of fourth valid *Steinernema sp* (*S.keralense*) in India.

- Development of invert emulsion formulation of *Beauveria bassiana* (CPCRI Bb-045) for the management of red palm weevil with over 90 per cent mortality.
- IPM module for the management of rhinoceros beetle through integration of biocontrol agents *viz.*, *Oryctes rhinoceros* Nudivirus (OrNV), Green Muscardine Fungus (GMF), *Metarhizium anisopliae*, botanicals (leaf axil filling with neem/ marotti/pongamia cake @ 250 g mixed with equal volume of sand) and aggregation pheromone embedded nanomatrix trap @ 1trap per hectare has been developed. Area-wide (1575 ha) farmer-participatory experiments undertaken at Krishnapuram (Kerala), Semanampathy (Tamil Nadu), Voodimudi (Andhra Pradesh) and Doddenhally (Karnataka) significantly reduced the spear leaf and inflorescence damage to an extent of 81.2 per cent.
- Integrated management technologies involving complete destruction of infested palm, close monitoring and sustained surveillance for early diagnosis, leaf axil filling of chlorantraniliprole sachet, curative management with imidacloprid (0.02%) and pheromone trap @1 trap per hectare were effective in the management of red palm weevil. Community level technology convergence and large-area adoption of IPM technologies conducted in 2150 ha in Bharanikavu (Kerala), Palladam (Tamil Nadu), Ambajipet (Andhra Pradesh) and Bidramamandi (Karnataka) could reduce the pest incidence to 56.8 per cent.
- An acoustics-sensor based red palm weevil detector in coconut was developed with 80 per cent accuracy.
- IPM technologies for the suppression of eriophyid mite developed by the Institute involving 2 per cent neem oil-garlic emulsion spray, root feeding of azadirachtin 10000 ppm @ 10 mL + 10 mL water and soil and palm health management practices reduced pest incidence to the tune of 71.4 per cent. From an initial pest incidence of 58.6 per cent observed in Krishnapuram (Kerala), Kottur (Tamil Nadu), Ambajipet (Andhra Pradesh) and Boranakoppalu (Karnataka), the pest incidence was reduced to 16.3 per cent in a period of two years indicating the success of the technology at national level.

Use of artificial intelligence (AI) and information and communication technology (ICT) for increased efficiency and reduced costs

- A UAV spraying configuration of 2 m height with an 8 s duration was recommended as the most effective strategy for tall crops with dense canopies, such as coconut trees. This approach maximizes pesticide application efficiency while minimizing environmental contamination and resource wastage.
- Installed automated fertigation system in coconut based cropping system.
- CPCRI entered into a collaboration with Amrita University, Kollam, to develop an innovative system for ground-assisted detection and delivery of pest control measures at the tree canopy level, using fiber poles to enhance reach and effectiveness.
- Species Distribution model was used to predict the potential current and future distribution of lepidopteran pest, *Opisina arenosella,* under three typical emission scenarios in 2050 and 2070 with 19 bioclimatic variables in India. Potential suitable areas for *O.arenosella* establishment were mostly found in all coastal and southern states of India. Model predicted that the unsuitability areas are found to increase under future changing climate scenarios in contrast to the current scenario indicating that this pest pest will not be spread and expanding to newer areas in the future climate scenarios. However, the pest will continue to pose as a major problem in the southern states necessitating the need for refining management strategies under changing climate scenarios.
- Temperature plays a crucial role in the pathogenicity and survival of *Phytophthora* isolates, impacting their ability to spread and cause disease.

- An Android-based whitefly detection system was developed utilizing deep learning techniques, specifically leveraging the YOLOv5 algorithm

Extraction and characterization of bioactive compounds and Value addition

- Kalpa Crown Observatory helps recording for the first time the physiological parameters of intact coconut leaves of adult palms.
- System analysis revealed distinct differences in soil and leaf nutrient status, leaf metabolites, and rhizosphere microbiome in water-stress-resistant adult coconut palms in farmers fields.
- Major alkaloids, arecoline, arecaidine and guvacine, in mature arecanuts estimated for 13 genotypes
- Geographical differences in cocoa beans for functional molecules *viz*. theobromine, epicatechin, and caffeine detected.
- A positive impact of virgin Coconut oil (VCO-Hot) in arresting cell cycle observed in Triple-Negative Breast Cancer Cell lines (CPCRI-KSHEMA).
- CMR plus cereal flour composites being analyzed for *in vivo* glycemic index in human trials (CPCRI-MDRF).

Pre and post-harvest mechanization in palms and cocoa

- Developed and commercialized rotary dryer cum flavor coating machine to produce coconut chips
- Developed and commercialized process technology to produce flavoured coconut milk
- Developed coconut slicing cum flaking machine
- Optimized two variants of carbonated coconut water based beverage
- Developed spice infused frozen coconut delicacy
- Developed coconut milk residue incorporated bean-to-bite dark chocolate
- Developed infrared assisted hot air dryer to produce coconut chips

Technology evaluation, impact and entrepreneurship development

- FFP activities were scaled up: crop varieties were enhanced to 54 from 8, cropping intensity to 163 from 106, and livelihood index to 75.62 from 62.57.
- Completed field survey in 5 states for standardization of conversion factor of coconut fruit number to weight.
- Developed computer/mobile apps like Ask Kalpa & CPCRI Bill desk.
- Developed/refined term sheet for Restructured weather-based Crop Insurance in coconut
- Delineated the reasons for price fluctuations experienced in the coconut sector and strategies were suggested.
- Field study in perspective value chain of arecanut was conducted in the major trade hubs across the country
- Global value chain analysis of coconut sector in perspective of food safety standards was conducted among coconut manufacturing exporters.
- Brain storming was conducted on issues of declining coconut productivity with the participation of 52 stakeholders.

Other events

- Conducted Kisan Mela, farmer interfaces, seminars, workshops and field demonstrations to popularize the technologies
- The Institute has commercialized more than 60 technologies, signed 446 MoAs for transfer of technology know-how and realized a revenue of Rs. 1.224 cr.
- Procured high end equipments viz., Atomic Absorption Spectrophotometer, Texture analyser, Microscopes etc.

CROPS, AREA, ALTITUDE AND RESEARCH UNDERTAKEN AT DIFFERENT LOCATIONS

Headquarters

KASARAGOD (Estd.: 1916), Crops: Coconut and Cocoa, Area 71.17 ha; 10.7m MSL

Priority areas of research: Genetic resources management, breeding, biotechnology, water and nutrient management, organic cultivation, cropping/ farming system, microbiology, pests and diseases management, physiology and biochemistry, value addition and farm mechanisation, economics, statistics and transfer of technology. Various activities are envisaged under five divisions *viz.,* Crop Improvement, Crop Production, Crop Protection, Physiology, Biochemistry and Post Harvest Technology and Social Sciences.

Regional Stations

KAYAMKULAM (Estd.: 1947), Crops: Coconut, Area 24.17ha, 3 m MSL

Priority areas of research: Etiology and management of root (wilt) and other diseases, pests and nematodes management.

VITTAL (Estd.: 1956), Crops: Arecanut and Cocoa, Area 68.34 ha; 58 m MSL

Priority areas of research: Genetic resources management, breeding, production and protection, cropping systems and drought tolerance.

Research Centres

KAHIKUCHI (Estd.: 1958), Crops: Arecanut and Cocoa, Area 15.76 ha; 48 m MSL

Priority areas of research: Cropping system, crop protection and production of quality planting materials.

KIDU (Estd.: 1972), Crops: Coconut, Arecanut and Cocoa, Area 120 ha; 281 m MSL

Priority areas of research: National coconut gene bank, International Coconut Gene bank for South Asia (ICGSA), soil and water conservation, quality planting material production.

MOHITNAGAR (Estd.: 1958), Crops: Coconut and Arecanut, Area 25.99 ha; 91.3 m MSL

Priority areas of research: Genetic resources management, cropping system, soil, water and nutrient management.

Staff Strength as on 31-03-2025

ICAR-CPCRI, KASARAGOD

Category	Sanctioned	In position	Vacant
Scientific	65	54	11
Technical	75	61	14
Administrative	46	34	12
Supporting	128	44	84
Total	314	195	119

Details in chapter XVII – Personnel

ICAR-KVK, KASARAGOD

Category	Sanctioned	In position	Vacant
Scientific	1	1	-
Technical	11	8	3
Administrative	2	1	1
Supporting	2	0	2
Total	16	10	6

ICAR-KVK, ALAPPUZHA

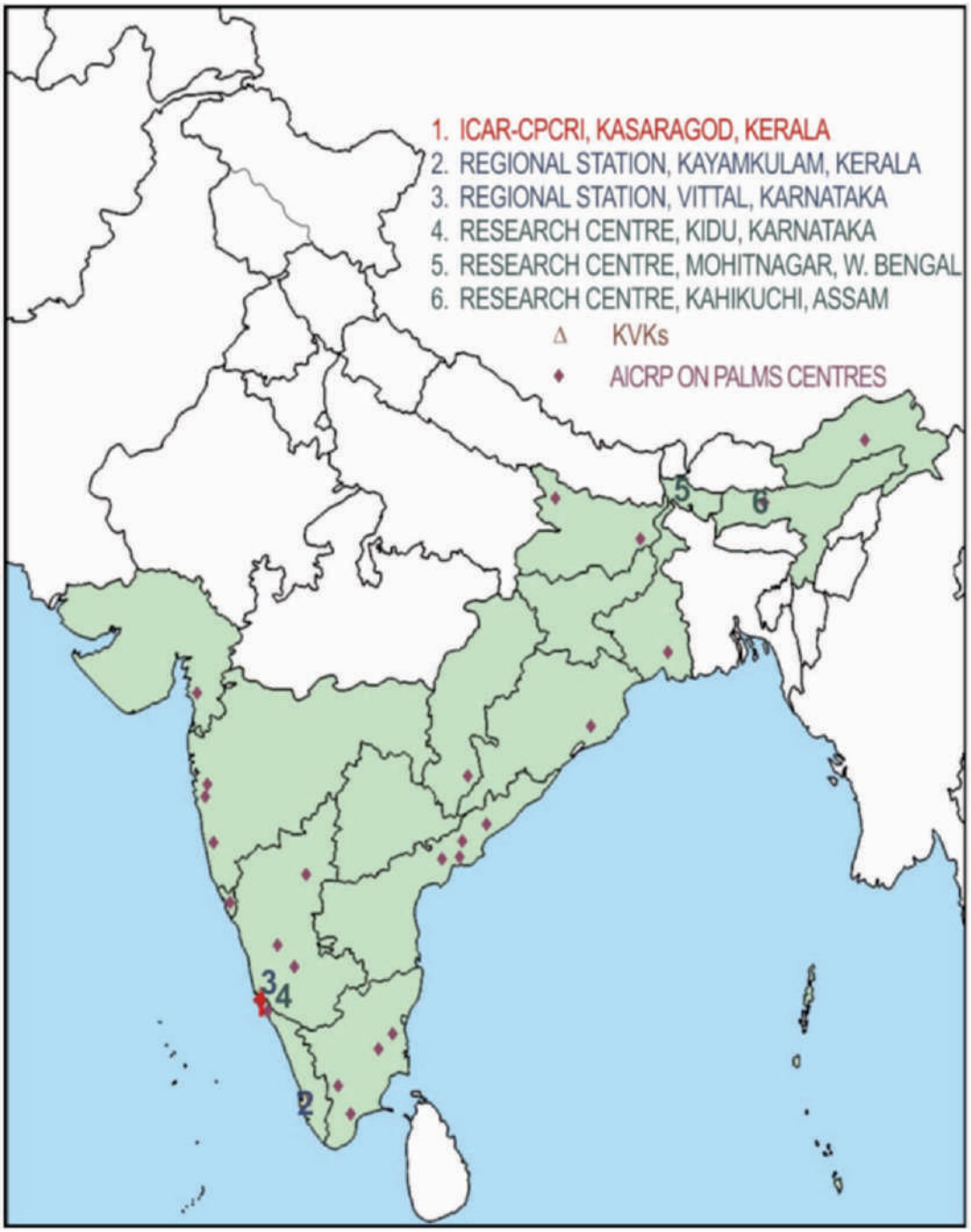
Category	Sanctioned	In position	Vacant
Scientific	1	1	-
Technical	11	10	1
Administrative	2	0	2
Supporting	2	2	0
Total	16	3	3

BUDGET AND EXPENDITURE (RS. IN LAKHS)

Head	Allocation	Expenditure
Budget	9274.58	9274.58
Revenue generation	384.85	

Details in chapter XXIII – Budget and Expenditure

Location of Stations / Centres under CPCRI



6.1

Phenotyping and Genotyping for Climate Resilient Traits / Genotypes and Quality Parameters

PALMYRAH

Ten unique germplasm were identified from palmyrah growing regions of Assam, Andaman and Nicobar Islands, Gujarat, Chhattisgarh, Tamil Nadu, and Kerala. Fruits of these accessions were collected and seed nuts were sown in the nursery. Wide variation was observed among the seed nuts collected from different places for size, weight, fibre attachment, number of days taken for germination, tuber growth length of roots, weight of scaly leaf (tuber), and number of roots. Biometrical analysis for morphological and reproductive traits indicated variation across palmyrah growing regions for leaf production, petiole length, inflorescence branches, and petiole spines. A rich diversity was also observed with respect to palm height (dwarf and tall), fruit size (small to large), fruit shape (oval and round), fruit colour (blackish, orange, dark brown and yellowish), and number of endosperm per fruit (one to four). Observations on floral biology indicated differences in the flowering period over the locations (Table 1).

Table 1 : Variability observed in flowering period of palmyrah over the locations

Location	Flower initiation (month)	Flowering duration	No. of inflorescences produced
Kasaragod, Kerala	June 2023 to April 2024	10 months	8
Pandirimamidi, Andhra Pradesh	December 2023 to April 2024	5 months	10
Madurai, Dindigul, Killikulam, Tamil Nadu	February to April 2024	3 months	10
Navsari, Gujarat	April to September 2024	6 months	8
Kahikuchi, Assam	February to April 2024	3 months	8

COCONUT

The coconut germplasm holding was enhanced with the inclusion of new collections, genetic stocks and released varieties from other centres under the NARES. The latest inclusions, include CIARI Sona, CIARI Haritha, VPM 3 as well as two pink husked selections in Jamaican SanBlas and Philippines Lono population from AICRPP CRS, Veppankulam, enhancing the total coconut germplasm holding to 461. The field gene bank located at Kasaragod and Kidu, together account for the conserved coconut germplasm holding. Additionally, selected duplicates are held at ICAR-CPCRI, Research Centres in Mohitnagar and Kahikuchi. Notably, the ICAR-CPCRI, Research Centre in Kidu also hosts the International Coconut Gene Bank for South Asia and the Middle East

(ICG-SAME). Further, complementary cryo-conservation of 30 core germplasm as zygotic embryos, pollen and DNA is undertaken in collaboration with ICAR-NBPGR, New Delhi. During the year, cryo-conservation of zygotic embryos (4 accessions), DNA (14 accessions) and pollen (5 accessions) was undertaken. Passport information of 29 exotic and 65 indigenous accessions, collected and conserved in NAGS, was submitted to NBPGR for obtaining IC/EC numbers.

Germplasm characterization and evaluation

At Kasaragod, Benaulim Tall, Lifou Tall, Kappadam Tall, Jamaica Tall, Surinam Tall, Gangapani Tall, East Coast Tall, Nigerian Dwarf, Fiji Longtongwan, Nugli Tall, Federated Malay States Tall, Fiji Tall, Niu Hake Tall, Samoan Tall, Dhanei Tall recorded higher fruit yield than local control. Jamaica Tall with consistently high nut production, copra output and inflorescence sap yield, is proposed for release.DNA fingerprinting is in progress for 18 accessions.

Evaluation of Sweet kernel population

All nine palm progenies of the sweet kernel coconut population, Mohacho Narel, from Ratnagiri, conserved at Kasaragod, yielded sweet kernel fruits (2-52%). Palms producing a higher percentage of sweet kernel fruits were inter se mated, and seedlings are under observation. Seed nuts germinated in 117 to 155 days from sowing.

Comparative evaluation of dwarf accessions

In the comparative evaluation of dwarfs at Kasaragod, planted during 2011 and 2013, observations on growth parameters indicated significant variations for inflorescence, stem and leaf traits. Variation in tender nut water content was also observed among the accessions. Fruit component traits (indicated in kg fruit^{-1}) showed wide variation, with lower copra content in Niu Guinea Orange Dwarf and Samoan Yellow Dwarf (Fig. 1.). Observations on fruit yield indicate higher annual fruit yield in SUBD, RRD, NGOD, LCOD, AGD03, GBGD and RTB04, while estimated copra yield per palm was higher in SUBD, LCOD, GBGD, AGD03, RRD, RTB04, CRD nd MGD.

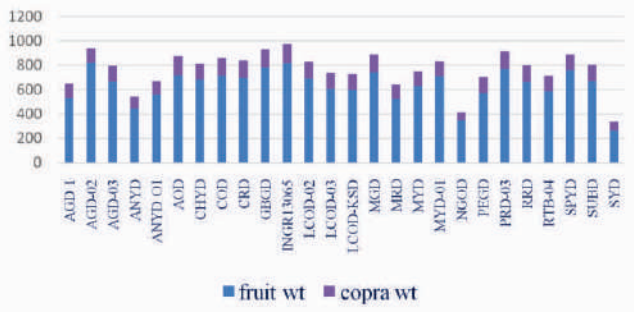


Fig.1. Variation in fruit component traits among dwarf accessions

Evaluation of germplasm for inflorescence sap yield

Three dwarf accessions of Pacific origin, namely Niu Leka Dwarf, Nikkore Dwarf and Hari Papua Orange Dwarf, were evaluated for inflorescence sap yield. Higher sap yield (52 L inflorescence^{-1}) as well as tapping period (50 days) was recorded in Nikkore Orange Dwarf. The lowest tapping period was recorded in Niu Leka Dwarf (32 days), while the neera yield of Hari Papua Orange Dwarf and Niu Leka Dwarf was around 31 L per inflorescence and 29 L per inflorescence, respectively.

Nine coconut genotypes, *viz.,* TPT, PKBT, FLJT, NIT, WCT, KTYT, SKGT, COD and GDD were evaluated for inflorescence sap yield. Among the genotypes TPT recorded higher sap yield per inflorescence (38 L) followed by WCT (31 L) whereas lower sap yield was recorded in COD (8.6 L). Duration of tapping was maximum in TPT (41 days) followed by FJLT (38 days) whereas minimum tapping days recorded in COD and KTYT (26 days). A higher average sap yield per day was recorded in PKBT (935 mL) followed by TPT (927 mL) and lower sap yield per day was recorded in COD (299 mL). Total sugar was the highest in TPT followed by WCT. Highest reducing sugar and amino acid content was recorded with TPT whereas higher protein content was recorded in PKBT.

Evaluation of germplasm at Kidu

In the National Gene Bank and the ICG-SAME at Kidu, 64 accessions were characterized for descriptor traits revealing a remarkable diversity across the accessions studied. Unique germplasms were identified for higher inflorescence length, higher fruit weight and copra content, longer leaves,

high leaf number, higher tender nut water content, and higher fruit yield. Standard Kudat Tall exhibited the longest spikelet-bearing portion (45.33 cm), the highest number of spikelets per inflorescence (38), and higher yield of 70.21 fruits per palm, indicating robust growth potential. Similarly, Borneo Tall (planted in 1999) displayed the longest leaf length (6.0 m), longest leaf petiole (139.81 cm), longest leaflet-bearing portion, and longest inflorescence length (133.14 cm). Among the accessions planted during 1997, Laccadive Ordinary Tall exhibited highest number of fruits per palm (117), while Philippines Ordinary Tall and Zanzibar Tall displayed superiority for most of the matured fruit traits that includes fruit weight, husked fruit weight, and copra yield, underlining greater potential of these accessions for copra production. Kalpa Suvarna, a high yielding dwarf (selection from GBGD), dual purpose (tender nut and copra) variety for cultivation in Kerala and Karnataka was submitted to CVRC for release & notification.

Genetic diversity analysis conducted on 31 conserved accessions native to island and coastal (Kerala) ecosystem, using 19 polymorphic SSR markers, grouped the accessions into five major clusters, with Nicobar Tall Katchal forming a separate group.

Fruit component studies among the accessions planted in 1997 at RC, Kidu indicated higher fruit weight (1351.33 g) with copra content of 227.33 g in Panama Tall, followed by Pao Pao Tall (fruit weight - 1037 g, copra content - 228.61 g), and Chandan Nagar Tall (fruit weight - 968.73 g, copra content - 220.03 g), indicating their potential for higher copra yield (Fig. 2). Meanwhile, San Ramon Tall (2001 planted) displayed remarkable tender nut traits with the highest tender coconut weight (3.08 kg) and tender nut water content of 787 mL per fruit, followed by Philippines Lono Tall (672.2 mL fruit^{-1}). This diversity in both fruit and tender nut characteristics reflects the wide-ranging potential across the accessions studied.

Fig. 2. Variation in fruit component traits in different accessions

Evaluation of germplasm at Mohitnagar

Fruit yield was recorded for 31 accessions including five hybrids, five dwarfs and 21 tall accessions under Sub Himalayan Terai region (Fig. 3). Among the talls, the higher number of fruits per palm per year was recorded in BARI Narikel 1 (95.2) followed by Agailjhara Tall (92.8) and LMT (92.4), while significantly highest copra yield was recorded in Agailjhara Tall (22.43 kg palm^{-1} year^{-1}). Among the coconut hybrids, the annual fruit yield ranged from 42.0 fruits per palm (Kera Ganga) to 58.5 fruits per palm (Chandra Sankara), with higher copra yield in Kera Sankara (13.14 kg palm^{-1}) followed by Chandra Sankara (11.93 kg palm^{-1}). Among the dwarfs, higher annual fruit yield palm^{-1} was recorded in MYD (62.3) followed by MGD (58.8), while copra yield was higher in MGD (8.84 kg plam^{-1} year^{-1}), followed by MYD (8.40 kg plam^{-1} year^{-1}).

Observations on phytochemical parameters of leaves from cold-stressed and apparently healthy palms indicated that the total phenol content, flavonoid, metal chelating activity and anti-inflammatory activity were reduced in leaves showing cold stress, while DPPH scavenging activity was increased in these leaves.

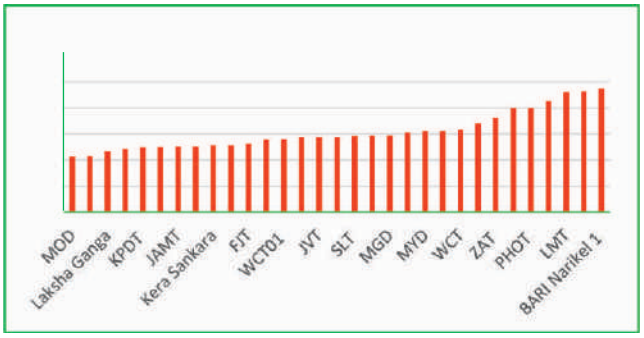


Fig. 3. Fruit yield of coconut accessions at RC, Mohitnagar

Evaluation of coconut accessions under Assam conditions

Fruit yield of 15 coconut accessions being evaluated under Assam conditions indicated higher fruit yield in the Kera Sankara hybrid (108.2 palm^{-1} year^{-1}). Studies on floral biology of these 15 lines, showed higher inflorescence length (1.27 m) and greater number of female flowers inflorescence^{-1} (39.50) in the hybrid Kera Sankara. The mean number of inflorescences produced during the six month period was higher in WCT (0.65 month^{-1}). Pollen recovery of 1000 male flowers was highest in Chandra Laksha (0.86 g).

Studies on tender nut parameters in dwarf accessions, *viz.*, COD, MOD, MYD, MGD and GBGD, showed the higher weight of fruit in MGD (1656.3 g), higher volume of tender nut water in COD (502.3 mL). TSS of the tender nut water ranged from 4.06 to 5.00o Brix. Potassium content in tender nut water was higher in GBGD (3451 ppm).

Evaluation of germplasm for resistance/tolerance to coconut root (wilt) disease

The root (wilt) disease incidence recorded in the evaluation trial planted at RS,Kayamkulam during 2014 involving 13 tall accessions, revealed lowest disease incidence in Tiptur Tall (8.3%) followed by Andaman Giant Tall and Cochin China Tall (12.5%). Higher root (wilt) disease incidence was recorded in Andaman Ordinary Tall (41.7%) followed by Federated Malay States Tall (35.7%). During the reporting period, the average fruit yield was highest in Kalpa Haritha (72.0 fruits palm^{-1}) which was at par with St. Vincent Tall (71.9 fruits palm^{-1}).

In the evaluation trial involving six green dwarfs planted in 2013 at RS, Kayamkulam, the root (wilt) incidence was highest in Niu Leka Dwarf (50%) followed by Gangabondam Green Dwarf (42.1%). Kalpa Sree remained disease-free even after ten years of planting. During the reporting period, the average fruit yield was highest in Kalpa Raksha (86.6 fruits palm^{-1}) followed by Kalpa Sree (77.6 fruits palm^{-1}).

Studies on inflorescence developmental stages

Observations on inflorescence development were undertaken in a dwarf and tall accession, *viz.*, COD and WCT, respectively, at Kasaragod. The earliest stage of inflorescence development observed, under the microscope, in the cabbage of adult COD palms is stage-18, wherein rachilla bract and rachilla primordia initiation at the base of the rachilla bract were visible (Fig. 4). The rachilla developed gradually through stages -17 and -16, with rachilla bract enlargement observed at stage -15. Floral primordia initiation and development of floral bracts took approximately 7 months, being first visible in rachilla at stage-14 and continuing until stage -8. The development of perianth with tepals was visible at stage-6, and differentiation of male and female flower was visible at stage-5. Male flowers with tepals were clearly visible at stage-3, while fully developed male flowers were observed at stage -1.

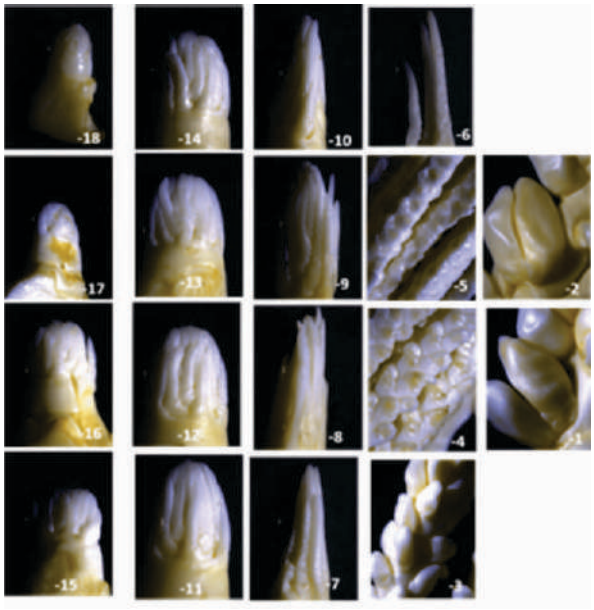


Fig. 4. Inflorescence developmental stages in COD palm

In WCT, the earliest stage at which developing inflorescence was visible by light microscopy is stage -22 (Fig. 5). At this stage, the initiation of rachis, enclosed by the peduncular bract and the prophyll is visible. During further developmental process, production of rachilla bracts as well as axillary rachilla are observed, and continue to be enclosed by the peduncular bract until stage-19. The rachilla bract initiation is visible at stage-18. The development of rachilla bract and elongation takes place until stage -16. The completely developed rachilla bract and rachilla primordia initiation at the base of each rachilla bract are visible at stage -15. The rachilla develops slowly at stage -14, outgrowing the rachilla bract at stage -11. At stages -10 to -8, rachilla produces a series of floral bracts. Reproductive organ initiation in both male and female flowers is observed at stage -7. Floral whorls are clearly visible at stage -6. The differences in male and female flowers are visible during stage -5. Male flower containing six stamens in two whorls is visible at stage -3, with complete development visible at stage -1.

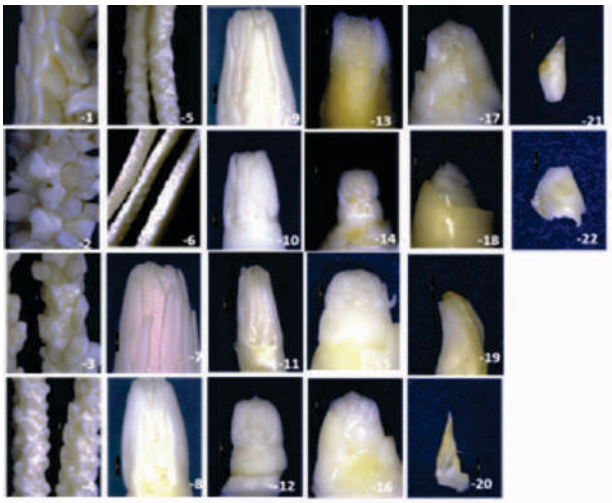


Fig. 5. Inflorescence developmental stages in WCT palm

Studies on phenology of coconut genotypes in different climatic zones

Studies on the phenological growth stages of coconut were initiated this year at four experimental locations: Kasaragod, Kidu, Kahikuchi and Mohitnagar. Six palms of the West Coast Tall coconut accession, all of the same age, were identified at each experimental location, and phenological observations on leaf development under field conditions (Principal Growth Stage 1), inflorescence emergence (Principal Growth Stage 5), and flowering (Principal Growth Stage 6) were initiated. Observations on Principal Growth Stages 0 (Germination and Emergence) and 1 (Leaf Development) in the nursery were also initiated by sowing a total of sixty WCT seed nuts (10 nuts palm^{-1}) in polybags at each experimental location.

Studies on impact of high temperature stress on reproductive phase

An *in vitro* experiment was initiated at Kasaragod to evaluate stigma receptivity and nectar secretion in coconuts under different temperatures. Female flowers were collected, maintained on a growth medium containing 10% sucrose, 0.01% boric acid, and 1% agar, and exposed to various temperatures (30, 32, 34, 36, 38, 40, 42, and 46°C) at 72 per cent relative humidity (RH). Preliminary observations indicated nectar secretion at all temperature levels tested with reduction in nectar secretion duration at temperatures above 38°C. However, 40°C and above temperatures showed negative impact on stigma receptivity. This requires confirmation through repeated experimentation.

Pollen germination on the stigma was observed on the first and second day after pollination. Pollen tube growth in the transmitting tissue and tubular region was also recorded (Fig. 6).

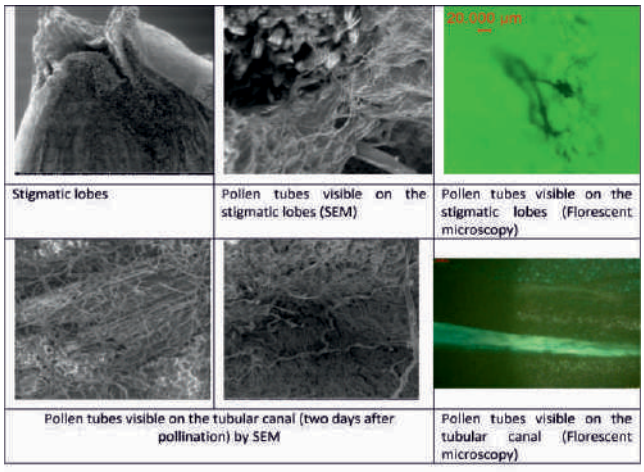


Fig. 6. Pollen Germination on stigma of female flowers of coconut and pollen tube in tubular canal

Association mapping

A collection of 96 palms, representing 16 diverse coconut accessions, were screened with 240 SSR markers for detection of polymorphism, and a total of 66 primers were observed to be polymorphic in nature. Thirty SSR primers reported in CIRAD's Tropgene database for coconuts were used for SSR analysis in the reporting period, and among these 10 primers were polymorphic and were selected for characterization of the 96 palms to identify markers for MAS through association mapping.

Genomic studies

The Chowghat Green Dwarf cultivar was sequenced utilizing Illumina, PacBio, ONT, and Hi-C technologies to produce a chromosome-level genome of ~2.68 Gb with a scaffold N50of ~174 Mb. Approximately 97.94 per cent of the genome could be anchored to 16 pseudo-molecules. In total, 34,483 protein-coding genes were annotated and 96.80 per cent of BUSCO genes were fully represented. The assembled genome includes 2.19 Gb (81.64%) of repetitive sequences, with long terminal repeats (LTRs) constituting the most abundant class at 53.76 per cent. Additionally, a whole-genome duplication event in the C. nucifera lineage was confirmed. The 'Kalpa Genome Resource' (http://115.246.222.210:3000/) was developed to manage and store a comprehensive array of genomic data, including genome sequences, structural and functional annotations, transcriptomic profiles, and metabolic pathways. Stand-aloneJBrowse and BLAST services were implemented that enable users to visualize genome and RNA-Seq data and conduct searches of genome and annotated gene sequences.

Hybrid evaluation trials

At ICAR-CPCRI, RC, Kidu, in the hybrid trial planted in 1996, COD × WCT recorded highest annual fruit yield (85 fruits palm^{-1}), while PHOT × GBGD recorded higher tender nut water content (499 mL). In the 1998 hybrid evaluation trial, CRD × WCT recorded the highest fruit yield of 92.11 fruits per palm per year, followed by CGD × LCT (89.03 fruits palm^{-1} year^{-1}). In the D × T hybrid evaluation trial (planted in 2014), GBGD × KWGT exhibited shorter plant height of 480 cm (10 years after planting), followed by CRD × KWGT (717 cm) and GBGD × SNRT (750 cm). Tender nut studies, revealed higher tender coconut water content in COD × CCNT (729 mL fruit^{-1}), followed by MOD × CCNT, COD × SNRT (each with 560 mL fruit^{-1}) and COD × PHLT (547.5 mL fruit^{-1}). In Dwarf × Dwarf trial planted at Kidu in 2003, CGD × GBGD recorded higher tender nut water content followed by GBGD × HPOD (550-595 mL), while higher fruit yield was observed in GBGD × COD and MYD × COD. Variety release proposals of two D × D hybrids *viz.,* COD × GBGD, COD × MYD, were prepared and submitted to AICRP Palms for presentation in the Group Meeting.

In the HET VI at Kasaragod, among the six Dwarf × Tall hybrid combinations evaluated over 32 years, COD × WAT and COD × LCT consistently recorded higher fruit (151.41and 142.82 fruits palm^{-1} year^{-1}, respectively) and copra yield (32.42 and 28.29 kg palm^{-1} year^{-1}, respectively) than Chandra Sankara (107.68 fruits palm^{-1} year^{-1} and 23.42 kg palm^{-1} year^{-1}). These two hybrids also recorded higher sap yield and tender nut water quality. Further DNA finger printing of the hybrid Kalpa Nakshatra was done with 10 SSR markers, namely, CnCirE10, CnCirc12, CnCirE12, CnCirE2, CAC65, CAC72, CNZ09, CNZ37, CnCirH1 and CnCirF2. Initially, parental palms used in hybrid production were screened with around 25 SSR markers for distinguishing COD and WAT. Primers which are polymorphic and capable of differentiating the parental palms were then utilized for hybrid purity assessment based on the complementary banding pattern of both male and female parents. A proposal for release of COD × WAT for cultivation in Kerala under the name Kalpa Nakshatra was presented in the AICRP Group Meeting and subsequently was approved for release in Kerala by the Kerala State Variety Release Committee.

Among the 14 D × D hybrids planted at Kasaragod in 2016, significantly higher plant height was recorded in NLAD combinations *viz.,* COD × NLAD, MOD × NLAD and MYD × NLAD and shorter plant height in CGD combinations *viz.,* CGD × MYD, CGD × MOD and CGD × GBGD (Fig. 7). Stem girth was lowest in CGD × MYD. Variations in

fruit yield, fruit weight, tender nut water content as well as copra content was observed among the treatments. Higher tender nut water yield potential (>49 L palm^{-1} year^{-1}) was recorded in COD × GBGD, MOD × NLAD, MYD × NLAD, MYD × CGD. The D ×D hybrids showed higher trichome density and lower stomatal density, implying better stress tolerance potential than the dwarf check COD. The hybrids CGD × CRD, CGD × GBGD, and MYD × CGD showed higher antioxidant activity and higher protein content, while CRD × GBGD, CGD × CRD and CGD × GBGD recorded higher proline and MDH content, associated with lesser membrane damage.

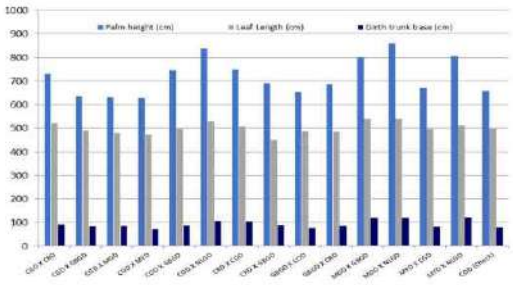


Fig. 7. Variation in palm height and girth among D × D hybrids

Thirty-six cross combinations, involving nine parents, planted at Kasaragod in 1972, were evaluated for vegetative, reproductive and fruit component traits. Highest palm height was observed in SNRT × JVT (1270 cm), followed by JAMT × GBGD (1239.5 cm) and JVT × NGT (1175.5 cm). SNRT × JVT (36.5) and LCT × FJT (34) had the highest number of leaves per palm. Larger stem girth at the base was observed in LCT × JAMT (119 cm) and SNRT × JVT (118 cm). The highest fruit yield per palm was recorded in LCT × GBGD (130.5), followed by WCT × JVT (96) and LCT × SNRT (70). Fruit weight was highest in JAMT × JVT (1842.88g), followed by WCT × JAMT (1773.13 g) and JAMT × GBGD (1490.63). WCT × JAMT (642.75g), SNRT × FJT (610g), and JAMT × GBGD (599.50g) recorded higher husk weight. Higher copra content was recorded in JAMT × JVT (316.88 g), followed by WCT × JAMT (275.38 g) and JAMT × GBGD (265.38 g). Two of these accessions, namely, WCT × JAMT (255.25 g) and JAMT × JVT (247.88 g) recorded higher shell content.

During the year, a new evaluation trial involving three D × D (CGD × GBGD, CGD × MGD, CGD × AGD) and five D × T (CGD × ADOT, CGD × AGT, CGD × STV, CGD × TT, CGD × CCT) combinations were planted in Block-VI of ICAR-CPCRI, RS,Kayamkulam, with three replications and plot size of nine palms.

Inter-se pollination and hybridization activities

At Kasaragod, inter-se pollination was taken up in Lifou Tall, Kappadam Tall, Laguna Tall, Markham Tall, West African Tall, Niu Leka Dwarf, Cameroon Red Dwarf, Nigerian Green Dwarf, Gudanjali Dwarf, Laccadive Orange Dwarf, West Coast Tall, Federated Malay States Tall, Jamaica Tall, Chowghat Orange Dwarf, Malyan Yellow Dwarf and San Ramon Tall, encompassing 485 inflore scences from 69 palms.

Inter-se pollination was undertaken in 19 accessions at RC, Kidu, viz., Coco Bleu, Gudanjali Dwarf, COD, Andaman Giant Tall, Kulasekharam Orange Dwarf, Pattukottai Green Dwarf, Cameroon Red Dwarf, Niu Leka Dwarf, Rennel Tall, Nikkore Dwarf, Hari Papua, Arasampatti Tall, Sakigopal Tall, Niu Hake Tall, Fiji Rotuma Tall, Malayan Yellow Dwarf, Comoros Yellow Dwarf, Seychelles Tall and Yellow Spicata Tall, for producing planting material for conservation and to facilitate multi-location evaluation. Approximately 11,109 female flowers across 475 inflorescences from 95 palms were pollinated.

Further, at RC, Kidu, a series of hybrid cross combinations were carried out in order to breed new hybrids with desirable traits such as higher yield, improved fruit quality (both tender and matured fruit components) and better adaptability. The crosses undertaken include, KGD × GBGD (279 female flowers), COD × KGD (345 female flowers), COD × TPT (592 female flowers), COD × FMST (593 female flowers), MGD × TPT (317 female flowers), MGD × FMST (593 female flowers), GBGD × KGD (450 female flowers), GBGD × TPT (967 female flowers), GBGD × FMST (927 female flowers), CGD × TPT (102 female flowers) and CGD × FMST (228 female flowers).

Screening seedlings for haploids

Around 7400 WCT, 2850 CGD, 150 COD, 200 MGD seedlings from Demonstration cum Seed Production Farm, Neriamangalam, under the Coconut Development Board and ICAR-CPCRI, Regional Station, Kayamkulam, were observed for identifying morphological off-types. The morphologically weak seedlings were selected and are being tested for identifying haploids using cytological analysis and flow-cytometry.

ARECANUT

Evaluation of arecanut germplasm planted in different batches is in progress at ICAR-CPCRI, Vittal, Mohitnagar and Kahikuchi. At Vittal, among the germplasm collected from Karnataka, Maharashtra, and Gujarat, Ganapathipule recorded the highest chali yield, with dry kernel yield of 2.81 kg per palm per year. Among the northeastern collections, Moralpara recorded the highest chali yield with dry kernel yield of 3.39 kg per palm per year, followed by Shell Shella with 3.23 kg dry kernel per palm per year. In another batch of North Eastern-III collections, arecanut germplasm Devadari recorded dry kernel yield of 3.12 kg per palm year^{-1}. Among the collections from the Andaman and Nicobar Islands, arecanut germplasm Cal-1 and Cal-17 showed high yielding tendency. In the indigenous collections batch of arecanut germplasm, Kamrup recorded the highest chali yield. Among the Assam-West Bengal collections, Sweet arecanut recorded highest chali yield with dry kernel yield of 2.29 kg per palm per year.

At Mohitnagar center, among the fourteen germplasms planted in 1988, higher fruits (355) and dry kernel yield (3.62 kg palm^{-1} year^{-1}), respectively was recorded in Mohitnagar. In the case of germplasms planted during 1990, higher fruits per palm were recorded in VTL 17, but higher dry kernel yield of 1.29 kg per palm per year was recorded in Shrivardhana. In 1991 planting, higher dry kernel yield (4.16kg palm^{-1} year^{-1}) was recorded in VTL-27, followed by VTL-13. In case of 1992 planting, higher dry kernel yield was recorded in VTL-18 (2.85 kg palm^{-1} year^{-1}). Higher dry kernel yield (3.73 kg palm^{-1} year^{-1}) was recorded in Nalbari, followed by Kahikuchi (3.36 kg palm^{-1} year^{-1}) and K & J Hills (2.47 kg palm^{-1} year^{-1}) in the accessions collected from West Bengal and NE states. Among the different accessions planted in the year 1997, higher dry kernel yield of 3.08 kg per palm per year was recorded in Calicut 30, followed by Calicut 27 (3.07 kg palm^{-1} year^{-1}).

Characterization of germplasm for fat content

Fat content from dry kernels was estimated in arecanut germplasm, *viz.,* Boragari, Devadari, Rajarhat, Bakwabari, Panithala, Ketakibari, Kalirhat, Goralbari, Kumaragoan, Bokul, Darangiri, Jorepakri, Tura, Rongron, Dhupguri and Haldibari. For each accession, dry kernel samples were taken from five palms. The fat content ranged from 10 to 17.6 per cent. Higher fat content of 17.6 per cent was recorded in Bakwabari, followed by Goralbari (15.8%), Jorepakri (15%), and the lowest fat content of 10 per cent was observed in Haldibari.

Genetic Variability for Zinc use efficiency

Zinc (Zn) has emerged as a critically deficient micronutrient, especially in traditional arecanut growing areas like Kerala and Karnataka. The disorders like crown choking, crown bending, shortened internodes have become more prevalent in these areas due to Zn deficiency in soils, coupled with the plants inability to effectively absorb and utilize the available Zn. Genetic variability serves as an important tool for enhancing the efficiency of crop plants to take up and utilize nutrients. In this context, a pot experiment was conducted at ICAR - Central Plantation Crops Research Institute, Regional Station, Vittal, to assess the genetic variability for zinc use efficiency (ZUE) in arecanut varieties. Three-month-old seedlings of eight genotypes, *viz.,* Mangala, Swarnamangala, Madhuramangala, Shatamangala, South Kanara Local, Thirthahalli Local, Sirsi Arecanut Selection-1 and Hirehalli Dwarf, were grown with three different levels of Zn (0.031 ppm, 0.093 ppm, and 0.156 ppm) for six months. The findings highlighted the significant interactions between Zn levels and arecanut genotypes (Fig. 8). Among different genotypes, Madhuramangala exhibited the higher total leaf area (1445.5 cm^2), specific leaf area (289.10 cm^2), total dry matter production (9.92 g) and Zn uptake (309.47 µg), where as Thirthahalli Local recorded the

highest Zn absorption efficiency (174.90 µg g^{-1}), and fine root weight (0.53g) at moderate Zn level. Furthermore, Thirthahalli Local and Madhuramangala exhibited higher Zinc use efficiency (ZUE) of 0.034 g per µg at lower Zn level. However, when exposed to higher Zn concentrations, Madhuramangala exhibited the highest ZUE of 0.039 g per µg. Thus, the Madhuramangala can be classified as both efficient and responsive to Zn, while Thirthahalli Local was deemed efficient but unresponsive to Zn. In contrast, Hirehalli Dwarf exhibited the lowest ZUE irrespective of Zn levels. With respect to interaction of Zn with other nutrients, nitrogen, potassium, magnesium, manganese and copper showed synergistic effects, whereas phosphorous displayed antagonism. On the other hand, iron and boron exhibited both positive and negative interactions with Zn.

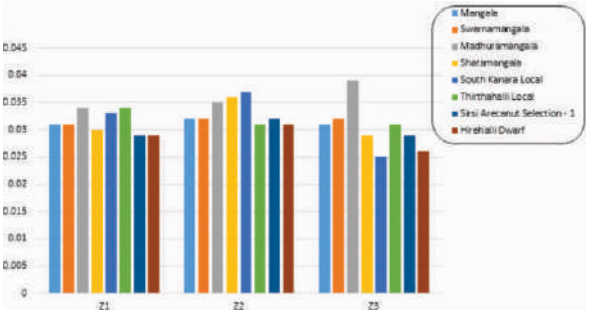


Fig. 8. Zinc use efficiency of arecanut genotypes at different zinc levels

Evaluation of arecanut hybrids

Evaluation of eight dwarf hybrids involving Hirehalli Dwarf and released varieties, *viz.,* Mangala, Sumangala, Sreemangala, and Mohitnagar is in progress at Vittal, Mohitnagar and Kahikuchi centres. At Vittal, higher dry kernel yield was recorded from the cross Mangala × HD and Mohitnagar × HD. Among the parental lines, Mohitnagar followed by Sumangala variety produced more dry kernel yield. At Mohitnagar center, higher number of fruits and dry kernel yield was recorded in Mohitnagar × HD (264.1 fruits $palm^{-1}$ $year^{-1}$ and 2.28 kg $palm^{-1}$ $year^{-1}$, respectively). Among the parental lines, higher fruits per palm per year was recorded in Sumangala (431.7) whereas, higher dry kernel yield was recorded in Mohitnagar (3.86 kg $palm^{-1}$ $year^{-1}$) followed by Sreemangala (3.49 kg $palm^{-1}$ $year^{-1}$).

Varietal development

Arecanut dwarf hybrid Terai Shankar (Mohitnagar × Hirehalli Dwarf)was recommended for cultivation in the homestead gardens of West Bengal and Assam during the XXXIII Annual Group Meeting of AICRP (Palms) held at Bihar Agricultural University, Sabour, Bihar, from 21 to 23 August 2024. It is a hybrid between Mohitnagar (female parent) and Hirehalli Dwarf (male parent). This hybrid is dwarf in stature with medium thick stem, superimposed nodes, medium-sized round to oval fruits (Fig. 9). The average yield of this hybrid is 2.19 kg dry kernel per palm per year.

Fig. 9. High yielding Terai Sankar arecanut hybrid from Mohitnagar

COCOA

Collection and conservation

Two related species of cocoa, *Theobroma grandiflorum* (Cupuassu fruit) and *Theobroma bicolour* (Mocambo tree/White cocoa), which are suitable for soils of low fertility and flooding situations, respectively were collected and conserved in field gene bank at CPCRI, RS, Vittal, Karnataka (Fig. 10).

Theobroma grandiflorum (Cupuassu fruit)

Theobroma bicolour (Mocambo tree/ White cocoa)

Fig. 10. Related species of cocoa collected and conserved at Vittal

Passport data prepared for two types of *Cola nitida* (Kola tree/fruit/nut) with white and purple coloured beans, which is a permanent shade tree for cocoa as well as used for production diversification and four cocoa collections of Vittal and ten Kahikuchi cocoa collections (Fig. 11).

VTLCK 14 (Vittal Kola 14)

VTLCK 16 (Vittal Kola 16)

Fig. 11. Cola nitida shade trees for cocoa

Documentation of description based on BBCH scale of germination, branching, flowering and fruiting stages in cocoa was done (Fig. 12).

Germination

Jorquetting

Flowering

Fig. 12. Morphological discripters of cocoa

Cocoa Genetic Stocks

Through artificial pollination over three to six seasons, cocoa clones of different geographical origins were identified as self-incompatible and cross compatible lines both among old and young collections, for their effective utilization in hybrid development as well as for establishment of clonal orchards (Table 2).

Evaluation for Performance of Peruvian Cocoa Clones

Among 29 Peruvian cocoa clones evaluated over 12 years, VTLC-233, VTLC-215, VTLC-241 and VTLC-205 exhibited high yields of 60, 58, 56 and 52 pods per tree per year in an optimal canopy of 15-18 m2 in the mixed cropping system under arecanut and with dry bean yields of 2.2, 2.1, 2.0 and 2.0 kg per tree per year, respectively and showed suitability for processing as well.

Table 2 : Self Incompatible and Cross Compatible Cocoa Clones

Malaysian clones	Lower Amazon Forasteros	Peruvian clones
VTLC 1	VTLC 8	VTLC 181
VTLC 2	VTLC 9	VTLC 182
VTLC 3	VTLC 10	VTLC 185
VTLC 4	VTLC 11	Trinidad clones
VTLC 5	Upper Amazon Forasteros	VTLC 62
VTLC 6	VTLC 57	VTLC 69
VTLC 7	VTLC 61	VTLC 85
Nigerian clones	VTLC 63	VTLC 86
VTLC 15	VTLC 64	VTLC 156
VTLC 19	VTLC 65	
VTLC 30	VTLC 66	
VTLC 32	VTLC 67	

Evaluation for Shade Tolerance in Cocoa

Cocoa under agro-forestry, oil palm based cropping systems and high density plantings are often faced with excess shade and less production. Shade tolerance refers to the minimum level of light required for survival and development. The effect of different levels of shade on performance of eight cocoa varieties was studied using 50, 75, and 90 per cent shade nets (Fig 11). Morpho-physiological characters such as canopy shape/density, branching/flushing intensity, flowering/fruiting/cherelle wilting were recorded in different shade levels. Temperature, humidity, atmospheric pressure, light intensity during morning and afternoon hours inside and outside shade nets were recorded during post monsoon and summer months over three consecutive years. Among shade levels, the light intensity varied from 4904-7832 lux during summer months and among varieties, it ranged from 5304 lux in VTLCC-1 to 7028 lux in VTLCH-5. Comparatively, the cocoa varieties, VTLCC-1, VTLCS-1 and VTLCS-2 showed early flowering and found more shade tolerant from their yield performance under 75 per cent shade net. Canopy architecture was modified with two pruning regimes and one thinning in 90 per cent shade to induce flowering.

50% shade 75% shade 90% shade

Fig. 13. Light Interception over Cocoa Canopy under Different Shade Levels

Cocoa evaluation and varietal development

Cocoa Variety for North East Region

Clonal evaluation and multi-location assessment of selective Nigerian genotypes, resulted in identification of a cocoa variety VTLCC 1, which is both self and cross compatible in nature. This variety performed well with 50-75 pods in a canopy of 12-18 m^2 both under arecanut and coconut. Pods are of 320-350 g weight, with 35-40 beans of 0.9-1.0 g size. The dry bean yield potential ranged from 1-2.8 kg per tree per year in multi locations including Assam and West Bengal. Beans are processable with 12-15 per cent shelling, 86-88 per cent nib recovery, 45-50 per cent fat, rich in stearic, palmitic and oleic acids. This variety can withstand low moisture stress, tolerate black pod rot, tea mosquito bug and exhibited N and Zn use efficiency, suitable for marginal lands and high density planting.

Table 3: Performance of VTLCC 1 for the past four years at Kahikuchi

Year	Plant height (m)	Girth (cm)	Canopy area (m^2)	Pod number $tree^{-1}$	No. of beans pod^{-1}	Single dry bean wt. (g)	Dry bean yield (kg $tree^{-1}$)
2023	2.84	34.25	13.66	47.7	37.4	1.02	1.82
2022	2.26	33.33	12.25	52.2	34.23	0.94	1.68
2021	2.91	32.33	14.02	35.3	33.4	1.01	1.19
2020	2.15	32.11	13.01	45.6	30.2	0.84	1.15
Mean	2.54	33.01	13.24	45.2	33.8	0.95	1.46

Cocoa Hybrids for Low Moisture Stress

The current change in climate, prolonged rainless periods of six months necessitated identification of climate resilient cocoa varieties. Systematic screening of Malaysian and Nigerian clones for low moisture stress, hybridization and progeny trials identified cocoa hybrids tolerant to low moisture stress with high yields. These were further evaluated as clones under comparative yield trial (CYT) and multi-location trial (MLT) in different agro climatic regions. Based on quantitative, qualitative, physiological and biochemical parameters both under field and controlled conditions, VTLCH 3 and VTLCH 4 were selected as adaptive and productive hybrids (Fig. 12). They produced an average of 45-50 pods per tree per year in an optimal canopy of 18-20 m^2, with dry bean yields of 1.7-2.5 kg per tree per year in palm based cropping systems. With single bean weight of >1g, 10-15 per cent shell, 85-90 per cent nib recovery and >50 per cent fat, they are suitable for chocolate industry as well. They are recommended both for traditional and non-traditional zones.

VTLCH 3 VTLCH 4

Fig. 14 . Resilient and high yielding cocoa varieties

Multilocation Trial (MLT) on Cocoa

The proximate composition of cocoa nibs such as fat, ash, protein, carbohydrate contents influencing the quality of cocoa beans were analysed (Table 4). The lipid fraction, amino acids and simple sugars act as aroma along with flavour precursors. The fat, ash, protein and carbohydrate contents varied significantly in the cocoa genotypes planted at

CPCRI, RC, Mohitnagar, West Bengal representing the Terai region which ranged from 38.36 to 47.34,3.38 to 4.66,1.39 to 1.66,and 39.21 to 47.86 per cent, respectively.

Table 4 : Proximate composition of beans of different cocoa genotypes at CPCRI RC Mohitnagar

Sl. No.	Cocoa genotypes	Moisture (%)	Fat (%)	Ash (%)	Protein (%)	Carbohydrate (%)
1	VTLCH 2	5.26	44.27	3.38	1.40	45.69
2	VTLC 19A	6.23	45.56	4.05	1.39	42.76
3	VTLC 61	7.93	38.36	4.36	1.48	47.86
4	VTLC 5	7.70	39.94	4.66	1.66	46.08
5	VTLC 8	9.50	42.41	4.09	1.42	42.59
6	VTLC 11	9.43	40.61	3.53	1.43	45.01
7	VTLC 66	7.97	47.34	4.04	1.45	39.21
	SE(m)±	0.23	0.11	0.02	0.02	0.26
	CD (p≤0.05)	0.69	0.35	0.07	0.05	0.78

Among different cocoa genotypes evaluated for the past nine years at CPCRI, RC, Kahikuchi, Assam representing the North East region, VTLCC 1, VTLCH 2, VTLC 19, VTLC 11, VTLC 30 and VTLC 5, recorded dry bean yield of 1.80 to 2.92 kg per tree per year and were identified for clonal evaluation (Table 5).

Table 5: Growth and yield performance of cocoa genotypes at CPCRI, RC, Kahikuchi

Cocoa genotypes	Plant height (m)	Girth (cm)	Canopy area (m^2)	Pod yield $tree^{-1}$ $year^{-1}$	No. of beans pod^{-1}	SBW (g)	DBY (kg $tree^{-1}$)
VTLCH 2	3.09	37.50	21.87	79.75	35.22	1.04	2.92
VTLCH 1	3.12	30.20	16.53	36.33	31.32	0.92	1.04
VTLCH 3	2.77	30.50	10.62	25.75	37.16	0.95	0.90
VTLCH 4	2.96	31.60	15.16	27.20	34.22	0.93	0.86
VTLCC 1	2.84	34.10	13.66	47.66	37.38	1.02	1.82
VTLC 61	3.27	27.00	18.51	33.60	38.67	0.66	0.85
VTLC 66	3.52	35.25	19.44	40.00	41.50	0.88	1.46
VTLC 11	3.17	35.33	19.15	60.00	37.66	0.94	2.12
VTLC 5	3.30	30.58	18.38	76.20	30.67	0.86	2.00
VTLC 19	3.32	30.83	22.91	75.40	33.19	0.90	2.25
VTLC 30	3.20	33.80	17.97	56.80	40.16	0.90	2.05
VTLC 1A	3.10	32.00	20.31	32.40	38.25	0.97	1.20
SEm (+/-)	0.27	1.43	2.26	4.27	1.08	0.03	0.12
CD (5%)	NS	4.12	6.58	12.95	3.23	0.07	0.36
SBW- Single dry bean weight, DBY- Dry bean yield							

Variety notification, registration and licensing

Coconut varieties Kalpa Suvarna recommended for Kerala and Karnataka and Kalpa Shatabdifor Kerala, and Tamil Nadu were approved for release by the 31st CVRC during July 2024 and notified in the Gazette. Cocoa varieties VTLCH1 recommended for Kerala and Karnataka and Tamil Nadu and VTLCH2 recommended for Karnataka, Kerala, Andhra Pradesh and Gujarat were approved for release by the 31st CVRC during July 2024 and notified in the Gazette. Variety registration proposals of coconut varieties *viz.,* Kalpa Ratna and Kalpa Srestha submitted to PPVFRA for registration.

Dwarf coconut variety Kalpa Suvarna was licensed to two firms from Karnataka, withlicense fee of Rs.1 lakh + 1% royalty. Kalpa Samrudhi, hybrid coconut variety was licensed to aperson from Gujarat, with license fee of Rs.45,000/ + 1% royalty. Kalpa Shathabdi coconut variety was licensed to a firm from Tamil Nadu, with license fee of Rs.1 lakh + 1% royalty. Shatamangala arecanut variety was licensed to two persons, one each from Karnataka and Tamil Nadu, with license fee of Rs.2 lakh + 1% royalty.

Planting material production activities

Coconut

Seed production of released varieties as well as parental lines was undertaken at different centres. In addition, breeder seed production was undertaken in released varieties like Kera Chandra, Kalpa Prathiba, Kalpa Raksha, Kera Keralam, Kalpatharu, Kalpa Ratna, Kalpa Haritha, Kalpa Surya and Kalpa Jyothi both at Kasaragod and Kidu.

Ground pollination

Pollination using modified ground pollination technique was carried out on 55 tall and 11 dwarf mother palms at three centres of ICAR-CPCRI (Kasaragod, Kayamkulam and Kidu). The modified ground pollination technique gave a fruit set of 24-27 per cent which was comparable with fruit set obtained with manual pollination. A total of 819 female flowers from 37 inflorescences of 10 West Coast Tall (WCT) mother palms were pollinated from Chowghat Orange Dwarf (COD) male parents using ground pollination technology at RC Kidu. Additionally, 853 female flowers from 53 inflorescences of 14 Chowghat Orange Dwarf (COD) mother palms were ground pollinated using pollen from West Coast Tall (WCT) male parents.

Kasaragod

From the flowers pollinated last year, 25,306 hybrid seed nuts were produced and sown in the nursery. This year 1,08,712 female flowers from 480 WCT, 15 LCT, 30 COD, 8 MYD palms were pollinated. About 26,919 seed nuts of other coconut varieties were produced and sown in the nursery for seedling production.

Kidu

During the reporting period, about 23,341 coconut seeds, arecanut sprouts, 2,12,500 arecanut seeds and cocoa seedlings, were produced and sold. A total of 56,334 female flowers from 3,237 inflorescences of 501 West Coast Tall (WCT) mother palms were pollinated using pollen from Chowghat Orange Dwarf (COD) for the production of Kera Sankara hybrid. In addition, 7,192 female flowers from 372 inflorescences of 60 Laccadive Ordinary Tall (LCT) mother palms were pollinated with COD pollen for the production of Chandra Laksha Hybrid. For production of Chandra Sankara Hybrid, a total of 3,341 inflorescences from 1,374 Chowghat Orange Dwarf (COD) mother palms bearing 43,483 female flowers were emasculated to facilitate natural pollination from pollen of adjacent West Coast Tall male parent. Furthermore, 1,614 female flowers from 105 inflorescences of 15 Malayan Yellow Dwarf mother palms were pollinated with pollen from selected Tiptur Tall to produce the Kalpa Sreshta hybrid. Another 1,447 female flowers from 97 inflorescences of 12 MYD mother palms were pollinated with selected West Coast Tall pollen for the production of Kalpa Samrudhi hybrid. Additionally, 2,740 female flowers from 173 inflorescences were pollinated for the production of inter-se seed nuts of the Kalpa Suvarna variety.

Kayamkulam

A total of 32,746 seed nuts of Kalpasree, Kalparaksha, Chowghat Orange Dwarf, Kalpa

Sankara, WCT and Kalpa Vajra were collected for distribution to farmers in the root (wilt) tract. Artificial pollination was carried out on 144 dwarf parental palms involving 476 inflorescences and10,306 female flowers and 47 tall parental palms involving 148 inflorescences and 4,101 female flowers. Further, to enhance planting material production of Kalpa Vajra variety, survey was intensified in the root (wilt) disease 'hotspots'of Alappuzha District of Kerala and 75 root (wilt) disease-free, high yielding West Coast Tall palms were identified and are being used as parental palms for the production of Kalpa Vajra variety of coconut.

Arecanut

About 2,42,690 arecanut seed nuts have been produced and 1,96,650 seed nuts have been distributed to the farmers and nearly 39,298 seed nuts have been sown for seedling production at Vittal.

During the period about 1,156 arecanut polybag seedlings and 405 VTLAH-2 hybrid polybag seedlings have been produced and distributed to the farmers.

Studies were undertaken for increasing the shelf life of biodegradable eco grow bags (prepared from arecanut leaf sheath) by coating leaf sheath bags with eco-friendly resins/gums/wax for raising arecanut seedlings as alternative to polythene bags and also to add value to arecanut leaf sheath.

Earlier these arecanut leaf sheath eco grow bags were prepared manually. But, during this year further improvements were made and arecanut leaf sheaths are moulded into bags/pots using machinery.

Cocoa

About 10,000 cocoa pods were also distributed to farmers.

Cocoa husk bio-pots

The dried cocoa husks were used as Bio- Pots to raise cocoa seedlings, which started rotting in two months. To increase the shelf life, oven dried/ painted / varnished cocoa husks were used, which stayed for longer period up to three months without rotting (Fig. 15).

Cocoa husk Painted husk Varnished husk

Fig. 15. Cocoa husk bio-pots

Table 6 : Planting Material Production (Numbers)

Station	Coconut	Arecanut	Cocoa	Other
Kasaragod	54647	-	-	-
Kayamkulam	16994	-	-	-
Vittal	26	64000	41342	-
Kidu	44321	152067	3039	-
Kahikuchi	575	35369	3032	-
Mohitnagar	1250	109520	1500	2875
Total	**1,17,813**	**3,60,956**	**48913**	**2875**

Table 7: Planting Material Production (Lakh Rupees)

Category/Location	Coconut	Arecanut	Cocoa	Others	Total
Kasaragod	61.14	-	0.30	-	-
Kayamkulam	35.54	-	-	-	-
Vittal	-	13.08	3.29	-	-
Kidu	73.73	44.22	0.07	-	-
Kahikuchi	-	9.76	0.15	0.23	-
Mohitnagar	1.73	16.09	-	0.94	-
Total	**172.30**	**83.15**	**3.81**	**1.17**	**260.43**

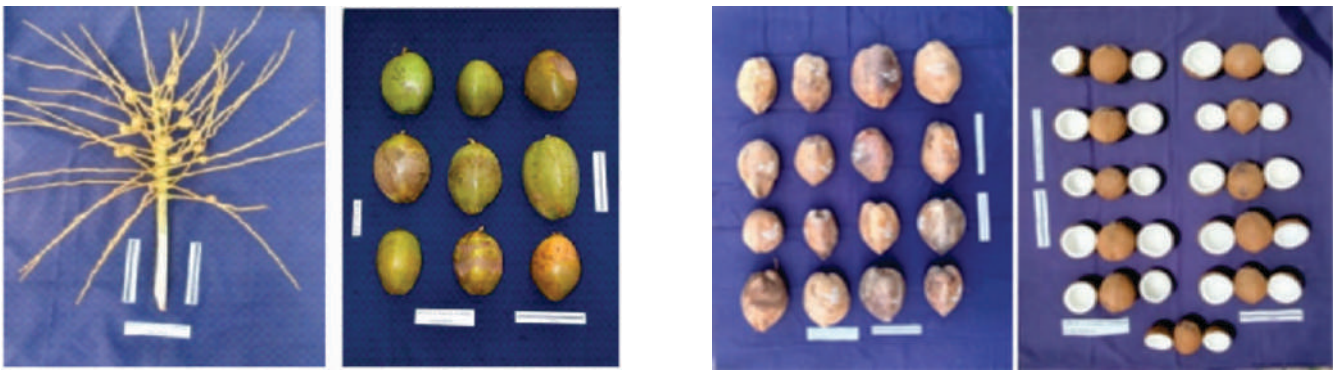
DUS Centre on Coconut

DUS testing of candidate coconut variety viz., REG/2015/415 is in progress in the DUS centre. During the current year, flower initiation was observed in 75 per cent palms in candidate variety. Observations on fruit characters as well as tender nut traits were recorded both at the DUS centre as well as onsite at RCRS, Bhatye.

On site recording of data of the farmer's variety, Edava Long Fibre Coconut from Thiruvanthapuram (Reg/2014/1949) was continued in current year (Fig. 16). DUS table of characteristics was recorded in consultation with Mr. S. Sreekumar, Secretary of Karshika Karmasena, Kappil, Edava, Trivandrum. The seedlings, juvenile, inflorescence and tender nut characters were measured and photo-documented. Mature fruits were harvested, and fruit characters were also recorded.

Adult palm of REG/2014/1949 (Green & Brown variant)

Seedling & Juvenile palm



Inflorescence and Tendernut

Fruits & Nuts of REG/2014/1949

Fig. 16. DUS characterization of Edava coconut variety

A set of reference/released/extant coconut varieties are maintained for validation of DUS descriptor characters in the DUS nodal centre. The unproductive palms in 4m × 4m spacing were uprooted and area cleaned for new planting. Palms planted in 6m × 6m spacing were productive with good fruit yield and are being utilized for seed production. Observations on plant petiole color were recorded on petiole of one year old seedlings and fruit color in seven month old tender fruits of 20 accessions in order to fix the colour of varietal representatives using RHS color chart.

DUS Centre on Cocoa

Cocoa hybrids were specifically observed for their fresh bean colour, which ranged from pale pink to purple. Criollo and Trinitario types were observed for their fresh bean colour which ranged from pale yellow to pale pink colour (Fig .17).

Criollo- RHS 11D Pale Yellow

VTLCP 11 - RHS 56D Pale Purplish Pink

VTLCP 8 - RHS 62C Light Purplish Pink

Others - RHS N77B Greyish Purplish Red

Fig. 17. DUS characterization of cocoa

6.2

Optimization of Mass Multiplication Protocols

Coconut Tissue Culture

Callus induction, formation of embryogenic calli and somatic embryos using novel growth regulators

Response of plumular explants from coconut inoculated in Y3 medium with picloram (200 or 100 µM) and meta-topolin (5 µM) was recorded. The proliferation of callus, formation of embryogenic calli, per cent germination of somatic embryos and shoot regeneration were enhanced in Y3 medium supplemented with 200 µM picloram and 5 µM meta-topolin compared with Y3 medium supplemented with 2, 4-D and TDZ. A maximum of 20 shoots were obtained from plumular explant in media supplemented with 5 µM of meta-topolin and 200 µM of picloram, which enhanced somatic embryogenesis (Fig. 18).

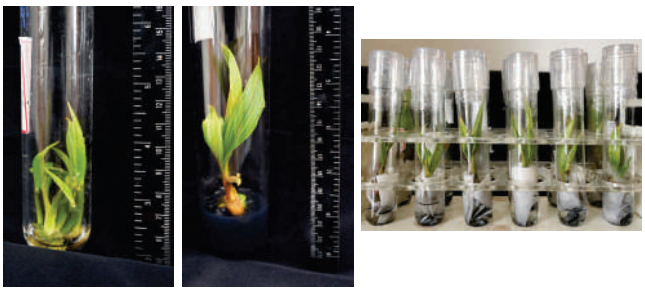


Fig. 18. Shoot regeneration from plumular explants of coconut in medium supplemented with meta-topolin

Axillary in *vitro* shoots in coconut

Zygotic embryos from indigenous accessions of coconut were tested for the initiation of proliferating mass and regeneration of axillary shoots. About 25 per cent of the cultures produced proliferating mass. Five plantlets obtained through the regeneration of proliferating mass were shifted to light and are now in the rooting stage (Fig. 19).

Fig. 19. Initiation of proliferating mass, its multiplication and regeneration

Immature inflorescence culture

Effect of various hormones on culture initiation in Woody Plant Medium (WPM)

The rachillae bits from Kalpa Sankara and WCT were inoculated in Woody Plant Medium along with TDZ (5 mg L^{-1}) alone or in combinations with various auxins and cytokinins (Table 8). Among the varieties, browning was minimum in Kalpa Sankara (3%) as compared to WCT (5.86%). Among the treatments WPM supplemented with TDZ (mg L^{-1}) alone resulted in minimum browning (0.75%) which were on a par with WPM media supplemented with TDZ (5 mg L^{-1}) and NAA (10 mg L^{-1}). Browning was maximum (10.36%) in WPM supplemented with TDZ (5 mg L^{-1}), 2, 4-D (1.5 mg L^{-1}) and 2ip (5 mg L^{-1}). The results indicated that Woody Plant Media with TDZ (5 mg L^{-1}) alone or in combination with NAA is best suited for culture initiation in terms of minimum browning and enhanced vegetative bud formation.

Table 8: Effect of various culture initiation media on browning

Sl. No.	Media combination	WCT	Kalpa Sankara	Mean
1.	WPM+TDZ (5 mg L^{-1})	0.75^{c}	0.75^{c}	0.75^{c}
2.	WPM+ TDZ (5 mg L^{-1})+ NAA (10 mg L^{-1})	1.25^{c}	1.00^{c}	1.13^{c}
3.	WPM+ TDZ (5 mg L^{-1})+ 2,4-D (7 mg L^{-1})	7.25^{b}	3.75^{b}	5.50^{b}
4.	WPM+ TDZ (5 mg L^{-1}) +2,4-D (1.5 mg L^{-1}) + 2iP (5 mg L^{-1})	14.25^{a}	6.50^{a}	10.36^{a}
	Mean	5.86	3.00	
	CD (0.05)	2.11	3.23	

Varietal response to in vitro culture using immature inflorescence explant

In order to study the varietal differences in in vitro shoot regeneration, inflorescences from Kalpasree, Kalparaksha, Kalpa Sankara, Gangabondam Green Dwarf, Niu Leka Dwarf, Malayan Yellow Dwarf and WCT were collected and rachillae bits were inoculated in Y3 medium with 2,4-D (1 mg L^{-1}). There were no significant differences in terms of browning among these varieties in the culture initiation media. However, palm to palm variation was observed in subsequent subcultures. Among these, highest shoot like structures were recorded in Kalpa Sankara (95%) and lowest was in MYD.

Effect of various hormone combinations / additives on multiple shoot induction

The vegetative buds obtained from Niu Leka Dwarf were evaluated for shoot multiplication using ½ MS basal medium along with various auxins and cytokinins. The treatments details are given below.

1. ½ MS + NAA (1 mg L^{-1}) + BAP (1 mg L^{-1})
2. ½ MS + NAA (1mg L^{-1}) + BAP (1 mg L^{-1}) + 2ip (1 mg L^{-1})
3. ½ MS + TDZ (1 mg L^{-1}) + BAP (1 mg L^{-1})
4. ½ MS + NAA (1 mg L^{-1}) + BAP (1 mg L^{-1}) + GSH (1 mg L^{-1})
5. ½ MS + NAA (1 mg L^{-1}) + TDZ (1 mg L^{-1})
6. ½ MS + NAA (1 mg L^{-1}) + mT (1 mg L^{-1})

There was no significant difference in the number of multiple shoots among the treatments and the average number of multiple shoots was 4±2.6.

Effect of various media - hormone combinations on multiple shoot induction

Vegetative buds developed from rachillae bits of West Coast Tall palms were evaluated for shoot multiplication using Woody Plant Medium, full MS and ½ MS medium as basal media along with various hormone combinations. The details of treatments are given below.

1. MSI-I : WPM+ NAA (1 mg L^{-1}) + BAP (1 mg L^{-1}) TDZ (5 mg L^{-1})
2. MSI- II : MS + NAA (1 mg L^{-1}) + BAP (2 mg L^{-1})
3. ½ MS-I : ½ MS + NAA (1 mg L^{-1}) + BAP (1 mg L^{-1})
4. ½ MS-II : ½ MS + NAA (1 mg L^{-1}) + BAP (1 mg L^{-1}) + 2ip (5 mg L^{-1})

Among the treatments, maximum number of multiple shoots (12.5) were recorded in MS media supplemented with 1 mg per L of NAA and BAP (2 mg L^{-1}) whereas average length of shoots was highest (9.2 cm) in ½ MS media supplemented with 1 mg per Leach of NAA and BAP and 2ip (5 mg L^{-1}).

Effect of media - hormone combinations on shoot elongation

Multiple shoots developed from rachillae bits of West Coast Tall palms were separated and individual shoots were transferred to shoot elongation media (Table 9). Among the three treatments evaluated, shoot length was maximum (8.6 cm) in Y3 medium supplemented with NAA (2 mg L^{-1}) and BAP (5 mg L^{-1}).

Table 9: Effect of media hormone combinations on shoot elongation

Sl. No.	Shoot elongation media	Shoot length (cm)
1	SEM-I: Y3+ NAA (1 mg L^{-1}) + BAP (1 mg L^{-1})	6.4[b]
2	SEM-II: Y3+ NAA (1 mg L^{-1}) + 2ip (2 mg L^{-1})	6.5[b]
3	SEM-III: Y3+ NAA (2 mg L^{-1}) + BAP (5 mg L^{-1})	8.6[a]
	CD (0.05)	1.5

Effect of various media— hormone combinations on rooting

None of the plantlets developed roots in the shoot elongation medium and therefore the plantlets with 3-4 leaves were transferred to root induction medium with various treatments involving Y3, ½ Y3, MS and ½ MS as basal media. Other treatments for enhancing root induction were basal darkening by covering the basal part of culture vessel with aluminium foil, intermittent shaking at 90 rpm for 30 minutes, dark incubation of plantlets for one week followed by incubation in 16 hours of light, root induction in two phases, *i.e.,* culturing in hormone free medium for one month followed by rooting medium with various auxins, culturing in medium with various auxins followed by transferring to hormone free media. Treatments involving different levels of sucrose (15, 20, 30 and 40 g L^{-1}), activated charcoal (0, 1, 1.5 and 2 g L^{-1}) and agar (0, 4 and 8 g L^{-1}) were also evaluated for their effect on root initiation. The root induction in these treatments was non-significant and varied from 0 to 15 per cent. All the plantlets used in these treatments remained green, except those which had undergone seven days of complete dark incubation and these plantlets senesced and did not survive indicating that complete dark treatment for seven days is detrimental to the plantlets.

Hardening

Plantlets with sufficient roots were transferred to small pots containing sterilized cocopeat, soil and perlite and placed in container tightly covered with kling film. Primary hardened plants were transferred to polybags and kept in green house for secondary hardening.

Clonal fidelity testing

DNA amplification profiles generated using six simple sequence repeats (SSRs) were compared with that of respective mother palms and banding patterns were monomorphic indicating the clonal fidelity of the plantlets.

Flowering of tissue culture WCT palm

The first successfully hardened tissue culture WCT palm, planted on 27 November 2020 started flowering in April 2024. Subsequently new bunches have been emerged at an interval of 25-28 days (Fig. 20). Number of female flowers in each bunch ranged from 24 to 38 and pollen germination was more than 75 per cent.

a b c d e

Fig. 20. Immature inflorescence culture in coconut. a-c; Multiple shoot initiation from the explants, d; hardened plant of Kalpa Sankara, e; flowering in immature inflorescence derived plant in the field

Arecanut tissue culture

Embryogenic callus cultures and somatic embryos originated from immature inflorescence cultures of arecanut varieties (VTLAH-1, VTLAH-2, Hirehalli Dwarf (HD), Shatamangala) were sub cultured at regular intervals for multiplication and embryo maturation. The number of callus cultures with somatic embryogenesis in these elite palms is 150 in VTLAH2, 80 in VTLAH1, 60 in Shatamangala, 350 in YLD-tolerant palms, and 30 in Hirehalli Dwarf. The approximate number of somatic embryos in the above cultures are 2500, 400, 700, 6000, and 100, respectively. Around 1300 dwarf hybrid and Shatamangala plantlets and 800 plantlets from YLD- tolerant palms, in different growth stages are being maintained under a 16 h photoperiod (Fig. 21).

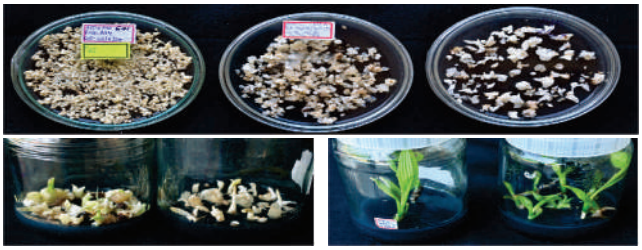


Fig. 21. Callogenesis, somatic embryogenesis and regeneration of plantlets from immature inflorescence cultures of elite arecanut varieties

Multiple shoot initiation in arecanut

In vitro plantlets originated from the immature inflorescence culture of dwarf hybrid, YLD tolerant and Shatamangala were tested for the potential to get multiple shoots. Plantlets (4-5 cm long) were trimmed near the meristem and cultured in Y3 medium with TDZ (0.2 mg L^{-1}). After repeated trimming four times, multiple shoots from these in vitro raised plantlets were achieved (Fig. 22). Clumps with multiple shoots were separated and grown in the regeneration medium, and efforts were made to separate them and develop them in the rhizogenesis medium.

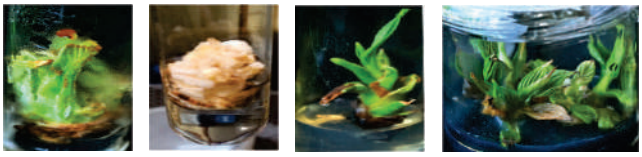


Fig. 22. Use of in vitro raised plantlet from immature inflorescence culture of arecanut to initiate multiple shoots.

Standardizing media combinations for potting mixture and standardizing various methods (*e.g.*, hydroponics) for acclimatization and hardening

The hydroponics method of *ex vitro* hardening has improved the recovery of the immature inflorescence culture-derived plantlets of arecanut by more than two-fold (~60%) than the direct potting method (~20%). The average increment in height (5.9 cm) of the hydroponic plantlets was comparable with that of directly potted plantlets (5.6 cm) after four months of shifting to the misting chamber. Hydroponically grown plantlets exhibited lower stomatal resistance (3.66 s m^2 μmol^{-1}) and higher chlorophyll index (40.88%) and Fv/Fm ratio (0.77) in comparison with directly potted plantlets (4.74 s m^2 μmol^{-1}, 24.7% and 0.73, respectively).

Fig.23. Hardening of *in vitro* raised plantlets of arecanut from dwarf hybrid and YLD tolerant palms in an automated temperature-regulated misting chamber cum greenhouse.

6.3

Input use Efficiency for Higher Productivity and Environmental Security

Development of liquid formulations of bioinoculants

Four different liquid formulations were tested for multiplication, survival and viability of 'Kera Probio' and 'Cocoa Probio' cultures. The respective cultures were inoculated in LM3 medium containing different additives. Viable counts of the cultures were determined after each month of storage under ambient conditions. The media formulations have maintained multiplication, survival and viability of 'Kera Probio' and 'Cocoa Probio' cultures. The cultures are meeting the stipulated viable value counts after 8 months of storage under ambient conditions.

Alternative microbiological uses for mature coconut water

Taxonomic characterization of 10 autochthonous acetic acid bacteria from coconut sap vinegar capable of producing bacterial cellulose (BC) from coconut water was done following different approaches. While MALDI-ToF profiles and biochemical characters revealed the distinctiveness of the isolates, molecular characterization following 16S rDNA analyses helped in species-level identification. Five isolates belonged to Komagataeibacter intermedius, three belonged to K. melomenusus and the remaining two belonged to K. diospyri, showing more than 99 per cent similarity with their respective type strains. Four isolates were screened for higher cellulose/nata yield and under the optimized cultural conditions, they recorded an average yield increase of 57 per cent at ambient temperature, with BC yield ranging from 200 to 600 g per L on wet weight basis. Isolate BC4 had showed maximum BC production in wider pH ranging from 5-10, indicating its industrial potential in converting wide range organic wastes to bacterial cellulose (Fig. 24). Isolate BC4 showed higher tolerance to acetic acid demonstrating its application in vinegar production. Isolate BC5 was suitable for 'nata' quality cellulose production utilizing mature coconut water.

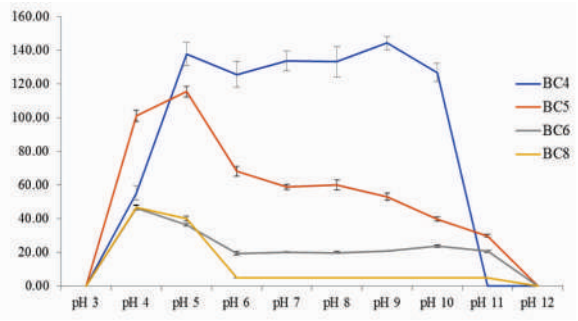


Fig. 24. Effect of pH on BC yield (mg/mL^{-1})

Bioprospecting of actinobacteria for bioactive metabolites including plant growth/health-promoting traits and hydrolytic enzymes

Bioprospecting actinobacteria from coconut palm agro residues-amended soils and compost was attempted to explore actinobacterial diversity of coconut palm waste-amended soils to screen plant growth-promoting traits and hydrolytic enzyme activities. Population count of actinobacteria in coconut agro residues mulched soils ranged from 1.62×10^6 - 5.52×10^6 CFU per g dry wt. of soil on starch casein agar media and it was in the range of 2.29×10^6 - 10.27×10^6 CFU per g dry wt. of soil on

Kennight's agar medium. Of the 16 actinobacterial isolates, eleven solubilized tricalcium phosphate and thirteen recorded zinc solubilization activity. None of the isolates solubilized silica and potassium minerals. Solubilization indices of actinobacterial isolates ranged from 1.11 to 1.28 for tricalcium phosphate solubilization and 1.08 to 1.60 for zinc oxide. A good proportion of selected actinobacterial isolates were capable of producing extracellular hydrolytic enzymes, which are the essential factors in nutrient recycling and composting of agro residues. The isolate S2S3 recorded maximum protease activity with a relative enzyme activity of 4.17 followed by S2K1 (3.00) and S2S2 (2.60). S2K3 and S2K4 showed maximum cellulose (3.40) and amylase (3.00) activity, respectively. Eleven out of sixteen isolates recorded lipase activity (Fig. 25). Six of 16 isolates were positive for all five hydrolytic enzymatic activities tested. Two isolates, S1S1 and S1S5, showed antagonistic activity against the coconut leaf rot pathogen Colletotrichum sp. on dual culture assay plate. The percentage inhibition in plate assay was 35 and 40 respectively. Bioprospecting of microbes for soil and plant health beneficial traits appears encouraging for crop health management strategies, including bio inoculant enrichment for specific applications like biomass recycling or plant growth promotion or biocontrol.

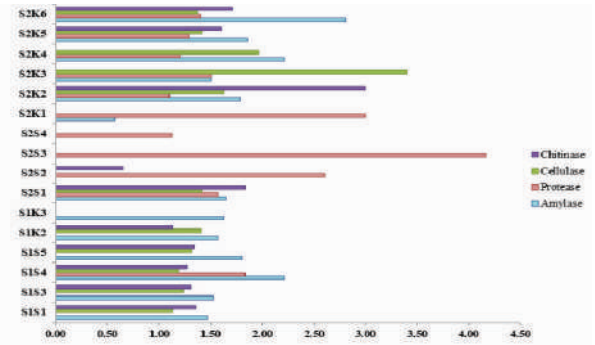


Fig. 25. Hydrolytic enzyme activity of actinobacterial isolates

Evaluation of organic cultivation of coconut-based farming system under coastal agroecosystem

The study to evaluate the impact of organic nutrient management practices on coconut-based farming system aimed to assess the effectiveness of different practices on fruit yield of coconut and bean yield of cocoa and economic returns.

Among the treatments tested, T4 which involved *in situ* organic matter recycling (fronds, leaves, inflorescence waste, and husks were incorporated into trenches measuring 15 m in length, 1.2 m in width, and 60 cm in depth located in the interspaces of six coconut palms, *in situ* green manuring within the tree basins, application of plant growth-promoting rhizobacteria (PGPR) consortia, cow dung, and 50 per cent of the recommended potassium (K-O) in the form of sulphate of potash, recorded the highest coconut yield, producing 17,850 fruits per ha per year, significantly outperforming the other nutrient management treatments.

The study also examined the performance of cocoa when intercropped in a coconut plantation under the same organic nutrient management practices. The results indicated that T4 not only enhanced cocoa yield but also significantly improved cocoa yield parameters. Trees under T4 recorded the highest cocoa dry bean yield (1,062 kg ha^{-1}), confirming the effectiveness of organic amendments in enhancing beans production in the intercropping system.

Further, an economic analysis of the system demonstrated that the treatment T4 recorded the highest net economic, returns amounting to Rs. 3,84,398 per hectare, surpassing all other treatments. This indicates that organic nutrient management practices, particularly those incorporating *in situ* organic matter recycling, PGPR consortia, and partial potassium supplementation, can contribute to improved nut productivity and economic viability in coconut-based intercropping systems.

Studies on microbial community in rhizosphere and endophytic matrix of healthy and root (wilt) affected coconut palms

Biopriming effects of PGPR strains and consortia on coconut seedlings

Biopriming effects of PGPR strains and consortia on biotic stress (RWD) tolerance are being studied in field-planted coconut seedlings bioprimed with different PGPR strains and consortia (planted in

Block V, CPCRI, Regional Station, Kayamkulam during March, 2021). Bioinoculant treatments included T1- *Pseudomonas* sp.- KH3PSB2 (multiple nutrient solubilizing rhizobacteria); T2-*Bacillus* sp.- CRE-9 (Root endophyte); T3- *Margalitia* sp.- CRE-15 (Root endophyte); T4-*Azospirillum* sp.-AzoL8; T5-Consortium (of above 4 strains), T6-Control and T7-control with Fungicide (Hexaconazole-5% EC) drenching. Symptoms of RWD such as leaf flaccidity and leaf rot (10% and 4%, respectively), have been noticed among the 3-year-old seedlings and the progression of RWD is monitored with respect to different treatments. Disease progression is comparatively lesser in bioprimed seedlings than the control as observed from the newly emerged leaves.

Performance of multi-cut fodder sorghum CO 31 as intercrop in the coconut garden under red sandy loam soil

A multi-cut fodder sorghum cv. CO 31 was grown as an intercrop in the interspaces of coconut garden under different nutrient management practices, *viz*., Integrated Nutrient Management (INM), organic management, and chemical fertilization alone.

The results indicated a significant influence of nutrient management on fodder productivity (Fig. 26). The highest yield was observed under the 100 per cent organic system, with a first-year yield of 79.9 t per hectare and a second-year yield of 70.7 t per hectare, followed by INM, which recorded yields of 69.9 t per hectare and 62.8 t per hectare, respectively. The lowest yield was obtained under 100 per cent chemical fertilization, with 52.8 t per hectare in the first year, declining to 46.3 t per hectare in the second year.

The decline in yield across all treatments in the second year suggests possible factors such as soil nutrient depletion or environmental influences. Notably, the superior performance of the organic and INM treatments underscores the long-term benefits of organic amendments and balanced nutrient inputs in sustaining soil health and enhancing biomass productivity in coconut-based fodder sorghum intercropping systems (Fig. 27 & 28). These findings highlight the potential of integrating organic and INM approaches for improving sustainability and yield stability in coconut-based agroecosystems.

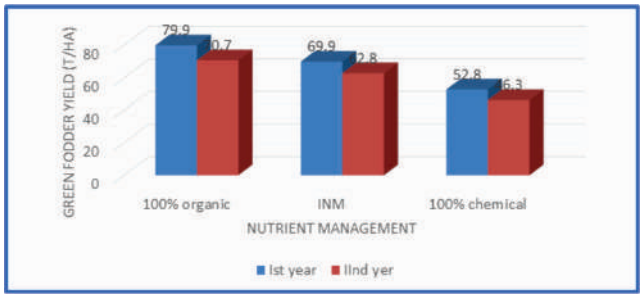


Fig. 26. Effect of different nutrient management practices on the performance of fodder sorghum

Fig. 27. Fodder grass in CBFS

Fig. 28. Sorghum intercropping in CBFS

Evaluation of coconut based high density multispecies cropping system under organic and integrated management (Kasaragod)

The organic and integrated nutrient management practices under high-density multi-species cropping system in 2023-24 exhibited a significant difference in fruit yield. Treatment T2 (1/3rd of the recommended NPK fertilizer + recycling biomass (vermicompost) + biofertilizer + green manuring + vermiwash) recorded the highest yield of 20,717 fruits per ha per year, which was significantly higher than T3 (fully organic with recycling biomass (vermicompost) + biofertilizer application + green manuring + vermiwash application + husk burial + mulching with coconut leaves) at 19,469 fruits per ha

per year. Treatment T1 (integrated nutrient management with 2/3rd of the recommended NPK fertilizer + recycling biomass (vermicompost)) recorded the lowest yield among the treatments, with 18,814 fruits per ha per year.

Similarly, pepper yield was highest in T2, recording 328 kg per ha, which was higher than T3 (281 kg ha^{-1}) and T1 (278 kg ha^{-1}). Banana, cv. Kadali recorded a bunch weight ranging from 7.4 to 8.4 kg, while *cv.* Robusta recorded a bunch weight ranging from 13.8 to 15.7 kg. The application of 1/3rd of the recommended NPK fertilizer + recycling biomass (vermicompost) + biofertilizer + green manuring + vermiwash resulted in higher net returns of Rs. 4,48,628 per hectare, with a benefit-cost (B:C) ratio of 3.34 outperforming the other treatments in terms of economic viability.

Performance of dwarf jack in juvenile coconut garden

Jackfruit varieties Sindoor Varikka, Gumless, Thailand Red and Thailand Pink were planted in the interspaces of root (wilt) tolerant coconut hybrid Kalapa Sankara, planted at a wider spacing of 9 m × 9 m at a distance of 4.5 m from the palm basin during September 2021 as simultaneous planting. Among the varieties, the first fruiting was recorded at 9 months after planting (June 2022) in Var. Thailand pink. Fruiting was 100 per cent during the second (June to September 2023) and third (June to September 2024) fruiting seasons. It produced fruits with an average weight of 3.61 kg with 54 fruitlets per fruits in the first and 4.63 kg with 85 fruitlets in the second season, respectively. During the third season, the var. Thailand pink recorded an average fruit weight of 6.02 kg with 124 fruitlets. The average weight of a fruitlet was 35 g with a seed weight of 10 g during first season which reduced to 18.5 g, 4.8 g in second and 20 g, 8.2 g during third season. Only the Thailand pink recorded fruit formation among 4 varieties during first 3 years. The variety did not record extensive canopy and hence pruning was not required during initial growth phase. The leaf area index (LAI) was recorded the highest in Thailand Red variety (7.18) followed by Thailand Pink (5.98). The palms in the system recorded an average height (m) and number of leaves during 1st year (2.3, 8.3), 2nd year (5.6, 12.3) and 3rd year (6.2, 20.6) respectively. Hence, Var. Thailand Pink can be recommended for simultaneous intercropping in coconut gardens to give additional income to farmers during the juvenile phase of coconut garden (Fig. 29).

Fig. 29. Performance of Var. Thailand Pink in coconut system

Assessment of soil carbon fractions in coconut-based cropping systems

Soil carbon fractions in different land-use systems, such as coconut-fodder grass, spices, fruit crops and monocropping, were estimated. The total organic carbon content at 25 cm and 50 cm depth was 0.68 and 1 per cent for coconut-spices and 0.66 and 0.62 per cent for the coconut-fodder grass system. Root activity and turnover were greater for the intercropping of spice crops such as nutmeg. Among the coconut-based land use systems, the content of labile carbon was greater in the soil cultivated with fodder grass followed by that cultivated with spices as intercrops. The study indicated that land use and cropping components can influence the type of fractions which in turn play a role in carbon sequestration in the long run.

Palm based cropping system under Sub-Himalayan Terai region

Orchid

Three numbers of orchid – *Dendrobium nobili*, *Epidendrum* and *Zygopetalam* was planted on arecanut and coconut plantations (Fig. 30). Among the three orchid types, the performance of *Dendrobium nobili* was better than the other two orchids *Epidendrum* species and *Zygopetalum*

(Table 10). Number of shoot, shoot length, leaf number, root characters, number of florets spike^{-1}, flower duration of *D. nobili* were more in arecanut garden than coconut gardens. 100 per cent plants have flowered under arecanut plantation. The performance of *Epidendrum* species and *Zygopetalum* was better under arecanut garden than coconut garden. The spike length of *Zygopetaum* ranged from 15-55 cm and number of florets ranged between 4 to 28 under arecanut garden.

Table 10: Evaluation of three orchids under different conditions

Parameter	*Dendrobium nobili*		*Epidendrum* sp		*Zygopetalum*	
	Arecanut plantation	Coconut plantation	Arecanut plantation	Coconut plantation	Arecanut plantation	Coconut plantation
Number of Shoot	5.3	4.2	3.4	3.2	3.2	3.5
Shoot Length (cm)	22.4	18.2	35.4	33.2	18.4	21.2
Leaf number	14.2	12.5	9.5	10.8	18.0	16.5
Leaf Length (cm)	8.4	7.8	6.5	5.9	5.9	6.2
Leaf width (cm)	2.4	2.2	1.8	1.7	1.4	1.3
Plant flowered (%)	90	85	25	18	0	0
Flower duration (days)	22-25	18-23	32-40	28-30	---	–

Fig. 30. Orchid—*Dendrobium nobile* under arecanut and coconut

Kalpa Poshak and Kalpa Vardhini for the growth and productivity of juvenile and adult coconut palms

The performance of Kalpa Poshak and Kalpa Vardhini was validated in the field demonstration trials. Kalpa Poshak is the nutrient mixture developed and field validated for the growth enhancement of juvenile palms. The mixtures were applied ten days after the application of recommended dose of major nutrients. Sixty per cent of the Kalpa Sankara hybrid palms treated with Kalpa Poshak flowered at 26th month after planting. Observations on fruit setting in 25 year old WCT palms after the application of Kalpa Vardhini indicated that the number of fruits in the tagged inflorescence increased from 11 (2018-2019) to 31 (2023-2024). The average annual fruit yield in the treated WCT palm was 74 per palm per year in the Onattukara sandy tract. In the Kalpa Sankara hybrids treated with Kalpa Poshak @ 100 g per year in the juvenile phase followed by the application of Kalpa Vardhini @ 500 g per year, the average annual yield was 86 fruits. Thirty six per cent improvement over the pretreatment was recorded with the application of Kalpa Vardhini. The average values for pH, EC, organic carbon, available P, K, Ca, Mg and Zn at 25 cm depth were 5.86, 0.11 dS per m, 0.74 per cent, 64.29 ppm, 157.8 ppm, 286.35 ppm, 99.22 ppm and 4.13 ppm respectively. At 50 cm, the average values were 5.26, 0.11 dS per m, 0.63 per cent, 51.17 ppm, 155.72 ppm, 172.63 ppm, 61 ppm and 2.90 ppm respectively. The total content of P, K, Ca, Mg, Zn and Cu in the Kalpa Vardhini treated palms were 0.14 per cent, 1.88 per cent, 0.34 per cent, 0.19 per cent, 39.90 mg per kg and 20.57 mg per kg respectively.

The technology has been certified by ICAR and is transferred to Odanad FPO, Green FPO Kollam, KVK Pathanamthitta, KVK Mitraniketan, Thiruvananthapuram ESAF Co-operatives, Thrissur, Kannur, RLCO Innovative Agri Pvt. Ltd

(an on campus incubate at ICAR IISR, Kozhikkode), Agro Service Centre Kankol (Karshika Sevana Kendram Kankol) Payyannur, Kannur.

Studies on soil aggregation and aggregate associated carbon

Soil aggregation is the physical process that protects the soil organic carbon by providing necessary barriers between organic matter and its decomposers, thereby influencing the distribution and stability in a system. Hence, appropriate land use systems that promote soil aggregation are of utmost importance for enhancing the stability of carbon in the soil organic matter complex. The present study was conducted at ICAR-CPCRI, Regional Station, Kayamkulam, by assessing the soil aggregation and the aggregate associated carbon in two different land use systems: 1. Coconut with intercrops such as spices and fruit crops 2. Mono cropping of coconut with different levels of chemical fertilizers. The distribution of aggregate was estimated through wet sieving and the proportion of aggregates in each size fraction was estimated. The macroaggregate proportion at 25cm depth in the palm basin of coconut based cropping system was 1.9 per cent, whereas in the interspace, it was 0.7 per cent. The proportion of microaggregate was 23 and 19.2 per cent in the palm basin of coconut and in the interspaces, respectively. In the subsurface soil, the proportion of microaggregate was 37.4 per cent in the basin and 9.6 per cent in the interspaces. The proportion of macroaggregates was negligible in the surface and subsurface soil of coconut monocrop. But the proportion of microaggregate in the surface and subsurface soil was 25.19 and 24.83 per cent, respectively. A greater proportion of microaggregates was observed in the subsurface samples of the coconut based cropping system. The organic carbon associated with microaggregates was 0.60 and 0.39 per cent in the surface and subsurface of coconut basin in cropping system. In coconut monocropping, the organic carbon content associated with microaggregates in the surface and subsurface soil was 0.41 and 0.37 per cent, respectively. The results of the study indicated that aggregate stability is greatly influenced by landuse pattern. Litter decomposition in the surface soil might have facilitated the greater proportion of macroaggregates in the coconut intercropping system. Greater root activity and *in situ* palm residue recycling facilitated an enhanced amount of microaggregates in the surface samples of coconut basin under monocropping.

Aggregation studies in the fertigation experiment were also conducted in 2023-2024 to assess the influence of different levels of chemical fertilizers on the distribution of aggregates and associated carbon content. The levels of fertigation were 50, 100, 150 and 200 per cent recommended dose of fertilizer (RDF) as fertigation and 100 per cent RDF as basal dose with drip irrigation. In the surface soil, the proportion of smaller macroaggregates with size up to 0.25mm in the 0-25cm depth was highest with 100 per cent RDF as basal dose (78.03%). At the 26-50cm depth the highest value of 73.58 per cent was recorded with fertigation of 200 per cent RDF. However, the proportion of microaggregates with size up to 0.053mm having the silt and clay fraction was significantly highest for the fertigation treatments compared to the application of fertilizers as basal dose both in the surface as well as in the subsurface soil. The highest value at 25 and 50cm depth was shown with 100 per cent RDF as fertigation with the values 32.02 and 28.60 per cent, respectively. The 100 per cent RDF as fertigation showed the highest content of aggregate associated carbon in smaller macroaggregates at 25 cm (0.45%) and 50 cm (0.35%) depth. In the microaggregates, the highest content of aggregate associated carbon was 0.33 per cent with fertigation of 200 per cent RDF followed by (0.32%) with fertigation of 150 per cent RDF.

Soil Sorption Studies for assessing the nutrient requirement of coconut

Soil sorption studies were conducted in Onattukara sandy soil to understand the release of nutrients such as potassium, phosphorus, copper, manganese and zinc. Soil samples with a gradation in nutrient levels were sorbed with the specific nutrients at varying concentrations. Results of the sorption study for potassium indicated that addition of 0.56 meqvt potassium per 100 mL is required for maintaining three times the critical level of potassium (0.154 m

eqvt 100 mL^{-1}). In the case of copper, addition of 11 mg copper mL^{-1} is required, where the initial concentration in the soil was less than the critical level.

Hydroponics studies for understanding water and nutrient uptake in healthy and root (wilt) disease-affected juvenile coconut palms

Healthy and root (wilt) disease-affected juvenile coconut palms were raised through hydroponics techniques in Hoagland nutrient solution for a period of one year. The objective of the study was to understand the nutrient and water uptake pattern in both categories of coconut palms. Two healthy and two diseased West coast tall palms of two years age and one healthy and diseased CGD coconut palm were raised in the nutrient solution. The preliminary analysis indicated the differential rate of nutrient uptake by the healthy and diseased palms. It was found that the uptake of nutrients and water was greater for the healthy palms owing to greater root development compared to the diseased palms. One year study indicated that irrespective of nutrient the absorption rate is higher for the healthy juvenile palms.

Physico-chemical and biological studies of YLD affected soil

The chemolithotrophic potential microbial groups in the arecanut rhizosphere are the key players of the nutrient transformations of N, Fe, S, P in YLD endemic rhizosphere. Iron and sulphur are the key elements in chemolithotrophic metabolism in rhizosphere microorganisms. The elite sulphur oxidizing rhizobacteria isolates were studied for their *in vitro* growth promotion and they are identified as *Metabacillus* sp., *Acinetobacter* sp. and *Pseudomonas* sp. based on 16S rDNA sequencing. The liquid formulation of the elite PGPR isolates *Burkholderia* sp., *Acinetobacter* sp., *Bacillus* sp., *Pseudomonas* sp. have been studied for their extended shelf life. The i*n vivo* growth promoting studies of elite plant growth promoting rhizobacteria *viz*., *Burkholderia* (ARsB 9, AREB 7), *Acinetobacter* (ARsB 4*)*, *Pseudomonas* (*RBC 18-25)*, *Bacillus (ARsB 8, RBC 18-5)* in arecanut revealed their potential to enhance plant biomass and vigour under nursery conditions.

Fertigation Methods

Fertigation studies in hybrid coconut (Kalpa Sankara)

In order to improve the resource use efficiency and productivity in hybrid coconut Kalpa Sankara, a field experiment with new planting was taken from July 2017 with 5 treatments viz., 50, 100, 150, and 200 per cent of soil test based nutrient recommendation of N and K through drip fertigation and one control with basin application of nutrients under drip irrigation. Recommended dose of fertilizers was given in 20 split doses from July to May. Results of the experiment show that plant height was significantly different among the treatments with fertigation of 150 and 200 per cent RDF recording a height of 10.45m compared to fertigation with 50 per cent RDF (9.16m). Height of stem to the base of crown was maximum with fertigation of 150 per cent RDF (3.03m) and 200 per cent RDF (2.93m). Fruit yield (June 23 to May 24) recorded was 227 with fertigation of 200 per cent RDF which was significantly higher than fertigation with 50 per cent RDF (187 Nos.). Good nuts were significantly higher in fertigation with 200 per cent RDF (205 Nos.) followed by fertigation with 150 per cent RDF(192 Nos.) than fertigation with 50 (149 Nos.) and 100 per cent RDF (163 Nos). Puny nuts were maximum (38 nos.) in fertigation with 50% RDF followed by fertigation with 200 per cent RDF (22 nos.) indicating prominence of reduced nut size with lower dose of fertigation and also with prolific production. The fruit set was maximum in soil application of nutrients with drip irrigation (50.46%) and minimum in fertigation with 50 per cent RDF (30.78%). Fruit weight, nut weight, husk weight and copra weight were significantly lower in fertigation with 50 per cent RDF. Tender nut water volume (302.5 mL) and weight (292.75 g) were significantly lower in soil application with drip irrigation.

Initial readings show that the rate of photosynthesis and stomatal conductance was not significantly different among treatments. During rainy season (2023), free-living nitrogen fixing bacteria were significantly higher in fertigation with 200 per cent RDF (7.65 log cfu g^{-1} dry wt. of soil) compared to

fertigation with 50, 100 and 150 per cent RDF. A similar trend was noticed during the summer season (2024) with maximum number of free-living nitrogen fixers (7.14 log cfu g^{-1} dry wt. of soil) in fertigation with 200 per cent RDF.

Fig. 31. SCSP Trainees given training on fertigation

Fig. 32. Uniform and full bunches under fertigation

Water and nutrient management through fertigation for early flowering and harvest of tendernuts in dwarf palms

A field experiment was taken up with the objective to study the combined effect of water and nutrients on the growth and flowering of dwarf coconut and to standardize a cost-effective fertigation schedule for dwarf palms grown for tender nut purpose (Fig. 33). The variety selected for the study is COD, the dwarf variety released by ICAR-CPCRI for tender nut production. The experiment was laid out in FRBD with nine treatments and one control (C: 100% STBNR (530:150:1200 NPK) as soil application in four splits + 66% PE drip irrigation). The treatments comprised of three levels of irrigation (66%, 100%, and 133% of evaporation) and three levels of nutrition (C+1/3C, C+2/3C and C+C). The data from 2019-2024 were analyzed during the year for standardizing fertigation scheduling for early flowering and harvest of tender nuts in dwarf palms grown in coastal humid tropics. The nutrients were supplied in 20 equal splits at fortnightly intervals from August to May. The palms were irrigated on an average 127 days per year. The study reveals that 100 per cent PE irrigation and 200 per cent nutrients resulted in early flowering and harvest of tender nuts (33 months after planting). The palms produced an average of 133 tender nuts per palm during the first year of production with an average production of 12 bunches. The tender nuts produced in this treatment recorded on average 336 mL of tender nut water with higher potassium (2689.5 ppm) and TSS (5.2 Brix). Irrespective of irrigation levels, nitrogen fixing bacterial count was lower (16.5 to 21.29 X 10^5) at 200 per cent nutrients. The leaf water potential measurement during March 2024 showed that the palms supplied with 66 per cent PE irrigation recorded lower leaf water potential (-11.63 k Pa) and it decreased at higher levels of nutrient concentration (-15.67 k Pa) revealing the plant stress at higher nutrient levels with reduced irrigation. BCR of treatment supplied with 100 per cent PE irrigation and 200 per cent nutrients during the first year of harvest was 3.44 whereas the control (drip irrigation 66% PE and 100% STBNR as basal application) recorded 2.37.

Fig. 33. General view of the experimental plot

Management strategies for production, health and nutrition of arecanut and cocoa

Geographical variability of heavy metal content in cocoa beans across major cocoa-growing regions in India

Heavy metal concentrations were analyzed in dry cocoa beans collected from 65 cocoa farms across major cocoa-growing regions of South India (Karnataka, Kerala, Tamil Nadu, and Andhra Pradesh) and Assam (Kamrup). The study

examined levels of cadmium (Cd), chromium (Cr), mercury (Hg), lead (Pb), arsenic (As), nickel (Ni), copper (Cu), iron (Fe), manganese (Mn), and zinc (Zn). Results showed regional variations in heavy metal content, though all concentrations remained within the maximum permissible limits. Notably, Cu levels in the nib were higher in traditional cocoa-growing regions, whereas samples from Idukki, Kerala, recorded the lowest concentrations of Cd and Hg. These findings confirm that cocoa beans grown in India have very low heavy metal content, making them safe and compliant with EU food safety standards.

Identification of nutrient deficiencies in cocoa using machine learning and deep learning approaches

Deficiency symptoms for N, P, K, Ca, Mg, Fe, Mn, B, Zn and Mn were established in cocoa plants by growing them in hydroponic system without the specific nutrient. The images were taken and datasets for deficient leaves and healthy leaves were created using image processing approaches. The study leveraged a dataset of 10,728 images of cocoa leaves, encompassing both healthy and those affected by nutrient deficiencies. The Conv Next model was utilized for detecting nutritional deficiencies, achieving an accuracy of 96 per cent with a macro average precision, recall, and F1-score of 96, 95, and 95 per cent, respectively, showcasing its robust performance. Severity levels - categorized as critical, moderate, and low - were predicted using the Random Forest Classifier, which achieved an overall accuracy of 91.61 per cent. Precision values ranged from 0.88 to 0.95, and recall values ranged from 0.82 to 0.97, demonstrating the model's reliability in severity prediction. Additionally, the system recommends the appropriate type and amount of fertilizer based on the identified deficiency, offering a comprehensive solution to improve cocoa plant health and productivity.

Developing nutrient deficiency symptoms in arecanut

Deficiency symptoms for boron was developed in arecanut seedlings. The size of young leaves reduced and the leaflets were fused. Later, there was necrosis at the tip of new leaves and eventually they dried. The leaf sheath in B-deficient plants was thicker than normal plants.

Genotypic variability in potassium use efficiency in cocoa

Potassium-use-efficient (VTLC 19A) and -inefficient genotype (VTLC 150) were identified in cocoa. Transcriptome analysis of cocoa seedling in contrasting K levels indicated that, K transporters were up-regulated, and the genes related to nitrate and magnesium were down-regulated. This resulted in lower N and Mg uptake with high K in the nutrient solution. Transcriptome analysis also revealed a discernible upregulation in genes associated with potassium transport (potassium transporter-TCM_042171) in potassium-use-efficient genotype, highlighting the genotype's heightened proficiency in managing potassium. The study also unveiled an enhanced expression of proteins implicated in conferring drought tolerance and disease resistance. The gene responsible for disease resistance was identified as Disease Resistance Protein RPP8.

High density planting system in cocoa for higher productivity

Grafts of cocoa variety Netra Centura were planted in five planting distances *viz.*, 1.35, 1.35 × 2.7 m, 1.35 × 2.7 m, 1.35 × 5.4 m, 2.7 × 2.7 m and 2.7 × 5.4 m with planting density ranging from 650 to 3712 plants per hectare in 2016. During the initial years, pod yield per hectare (2088-2695 kg) and dry bean yield per hectare (177-241 kg) were similar among different spacing. However, the cumulative dry bean yield per hectare was significantly higher in closely planted grafts (966– 2627 kg ha^{-1}) than grafts under recommended spacing of 2.7 × 5.4 m, having low population density. Higher dry cocoa bean yield per hectare in closely planted grafts was due to higher plant population. The single bean weight was significantly higher in closely planted cocoa. The data indicates that, high density planting of cocoa can give bolder bean and significantly higher productivity in the initial years.

Impact of water/ soil moisture conservation for enhancing production of coconut under rainfed and deficit irrigated farms

Soil moisture conservation is essential for sustaining productivity in coconut-based cropping systems, particularly in regions prone to water stress. A field

study was conducted from February 2024 to December 2024 at ICAR-CPCRI, Kasaragod, to evaluate the effectiveness of soil moisture conservation measures on soil moisture availability under rainfed conditions. Four conservation measures—husk, leaf, husk + leaf, and control (no measures) were assessed (Fig. 34, 35 & 36). Soil moisture was monitored fortnightly throughout the year to quantify the impact of these practices.

The results demonstrated that the Husk + Leaf combination consistently retained the highest soil moisture across all areas, followed by Husk and Leaf individually (Fig. 37). Control plots exhibited the lowest moisture retention, emphasizing the critical role of conservation practices.

Area-specific analysis revealed that Coconut Basins showed the most significant response to conservation measures, with substantial moisture variation between treatments.

This study underscores the importance of integrating organic materials such as husk and leaf for optimizing soil moisture retention. The implementation of these strategies can enhance water use efficiency and bolster the resilience of coconut-based systems against water stress.

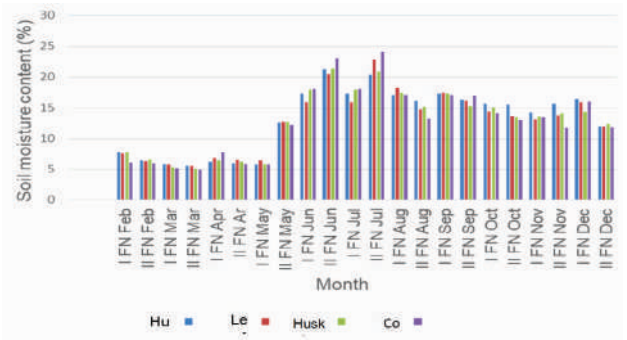


Fig. 34. Effect of soil moisture conservation measures on moisture availability in coconut basin

The total microflora *viz*., bacteria, fungi, actinomycetes, P solubilizers and diazotrophs in the moisture conservation coconut field sites has been evaluated and forty six rhizobacterial isolates isolated and studied for their growth-promoting potential under *in vitro* conditions for multi-nutrient solubilization potential and *in vivo* conditions for growth promotion, and a few elite isolates were identified as B*acillus* sp., *Acinetobacter* sp. and *Pseudomonas* sp.

Fig. 35. Soil moisture conservation measure with leaf mulching in coconut basin

Fig. 36. Soil moisture conservation measures with husk mulching in coconut basin

Fig. 37. Soil moisture conservation measure with leaf + husk mulching in coconut basin

Demonstration of Kalpa Vardhini as component of integrated nutrient management in coconut for sustained soil and palm health

The project was initiated during November 2022 in five panchayaths of Alleppy and Kollam district. A total of 750 palms were selected for demonstration in the farmers' field with the objective to demonstrate the efficiency of Kalpa Vardhini as component of integrated nutrient management on sustaining palm health and productivity. The pretreatment crown health observations indicated the severity in attack with regard to rhinoceros beetle, coreid bug and mite. Crown cleaning operations and appropriate plant protection operations were done in all the 750 demonstration palms. Major nutrients and Kalpa Vardhini were applied as per the schedule in split doses. The average content of available K, Ca and Mg in the soil where there was the application of Kalpa Vardhini was 75.13, 340.42 and 70.63 ppm at 25 cm depth and 60.69, 251.97 and 56.65 ppm at 50cm depth, respectively. An improvement in the leaf nutrient status over the pre treatment was also observed. The average foliar levels of P, K, Ca and Mg in the coconut palms treated with Kalpa Vardhini was 0.25, 1.08, 0.29 and 0.14 per cent, respectively.

Natural farming in coconut based farming system

The natural and non-natural farming coconut rhizosphere soil has been analysed for bacteria, fungi, actinomycetes, P solubilizers diazotrophs. The results revealed abundance of P solubilizers and diazotrophs in the natural farming coconut rhizosphere over the non-natural farming fields.

Soil potassium supplying capacity of different soil types under coconut cultivation

Potential buffering capacity of potassium (PBC^k) for different soil types under coconut cultivation were determined in order to understand and quantify the potassium supplying power of different soils to meet the higher potassium requirement of the coconut. PBC^k was estimated by incubation study with different concentration of K which ranged between 13.9 to 345.8 c.moles K per kg of soil (Fig. 38). Clay soils were having higher PBC^k followed by loam and found to be least in sandy soil. Soil potassium supplying capacity of those soil types were also quantified from cumulative K release which ranged from 98.6 to 2352 kg K per ha. Results showed the highest quantity of K release as well as sustained release of potassium was observed from clayey and loamy soils compared to the sandy soils.

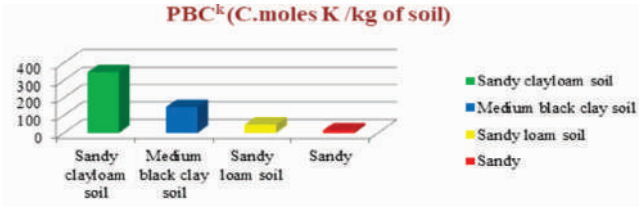


Fig. 38. Potential buffering capacity of potassium for different soil types under coconut

Effect of nutrient application in coconut seedlings

In order to see the effect of nutrients on seedling growth in coconut, seedlings were raised in hydroponics with and without Hoogland solution. Seedlings raised with Hoogland solution showed better growth, early splitting of leaves, more root mass etc. The nutrient content of the leaves and roots of the seedlings raised with Hoogland solution were significantly higher for K, Mg, S and micronutrients content than the seedlings without Hoogland solution (Fig. 39). The concentration of N, P, K, Ca, Mg, S and micronutrients in root tissues were significantly higher in hydroponic culture with Hoogland solution compared to seedlings grown without Hoogland solution (Fig. 40). Hence it is concluded that the application of nutrients through fertilizer could improve the growth of coconut seedlings.

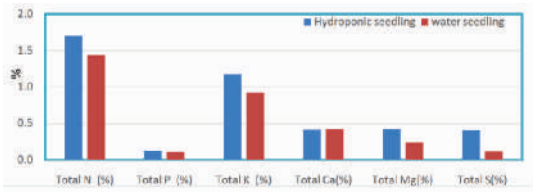


Fig. 39. Effect of external application of nutrients to seedling leaf nutrient content

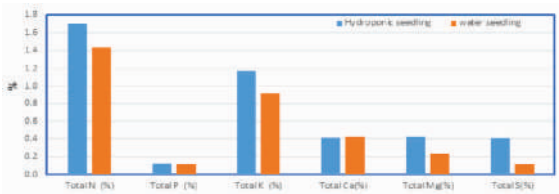


Fig. 40. Effect of external application of nutrients to seedling Root nutrient content

Effect of KCl application in fronds of coconut

To study the absorption of K through the coconut fronds, KCl solution (1%) was prepared and cotton was dipped in the solution and kept on the fronds of the coconut tree of 10 years old for a period of one month. Leaf tissues were collected every day and analyzed for the K content. It was found that there was significant increase in K content in the leaf tissues compared to control after application of Kcl (Fig.41). The study was continued to revalidate the results in the next season.

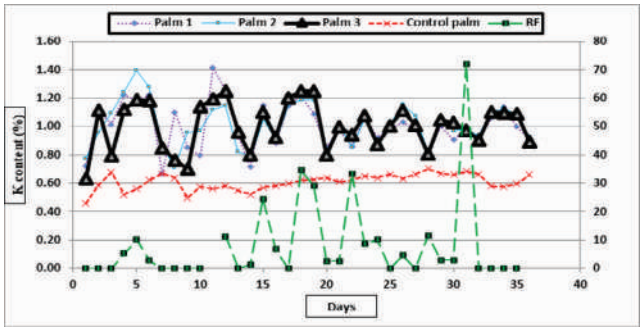


Fig. 41. Potassium in leaf tissue at daily interval

6.4

Artificial Intelligence (AI) and Information and Communication Technology (ICT)

Predicting the geographical distribution potential of the coconut leaf eating black headed caterpillar in India through Maxent modelling

Species Distribution model such as the maximum entropy (Max Ent) algorithm was used to predict the potential current and future distribution of lepidopteran pest, *Opisina arenosella,* under three typical emission scenarios in 2050 and 2070 with 19 bioclimatic variables in India. Among 19 bioclimatic environmental variables, BIO 5 (maximum temperature of the warmest month), BIO 4 (temperature seasonality), BIO 15 (precipitation seasonality), BIO 16 (mean temperature of the coldest quarter (°C)), BIO 17 (precipitation of the driest quarter), BIO 18 (precipitation of the warmest quarter) and BIO 19 (precipitation of the coldest quarter) are found to be the environmental variables influencing its distribution. The best MaxEnt model parameters were determined by employing Akaike's Information Criterion with a small sample size correction (AIC) through a random 10-fold cross-validation technique. The MaxEnt model was run with subsample and cross validate replicated run type. The probability of suitability was divided into high (0.8-1), optimum (0.6–0.8), moderate (0.4–0.6), low (0.2–0.4) and unsuitable (0.0-0.2) habitat. The model's performed accurate with area under curve (AUC) values of 0.943 and true skills statistics (TSS) of 0.781, respectively. Potential suitable areas for *O.arenosella* establishment were mostly found in all coastal and southern states of India (Fig.42). Model predicted that the unsuitability areas are found to increase under future changing climate scenarios in contrast to the current scenario. Similarly the areas categorized as low to highly suitable areas are following the declining trend in the future climate scenarios by 2050 and 2070s, which indicates that this particular pest will not be spread and expanding to newer areas in the future climate scenarios (Fig. 43). However, the pest will continue to pose as a major problem in the southern states necessitating the need of refining management strategies under changing climate scenarios.

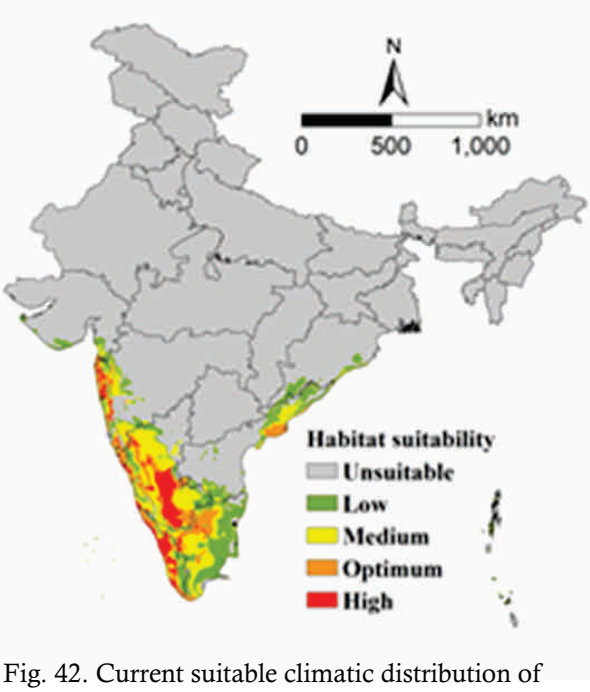


Fig. 42. Current suitable climatic distribution of *O. arenosella* in India

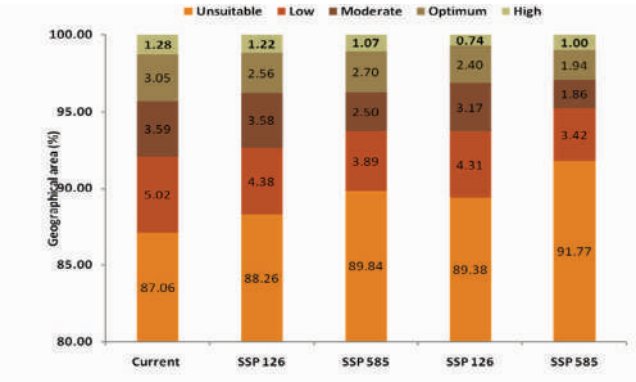


Fig. 43. Projected shift of *O. arenosella* in India under shared socioeconomic pathways (SSP) during the 2050s and 2070s climate scenarios

Activity of Pollinators in Coconut Inflorescence

The activities of various pollinators and their visits to the coconut inflorescence were monitored through a camera (Fig. 44). Coconut inflorescence was predominantly visited by honey bee species (Indian bee, *Apis cerana indica*, Rock bee, A. *dorsata*, Floral bee, *A. florea;* Stingless bee, *Trigona iridipennis*) followed by wasps and different ant species. During the observational period, pollen beetles and black earwigs (*Chelisoches morio*) were also observed on some occasions. Honeybee activity was high during the daylight from 9.00 hrs to 11.00 hrs, and they were noticed visiting the flowers till sunset.

Fig. 44. Camera installed to monitor the activity of pollinators and insect pests

Understanding the acclimatization potential of *Phytophthora palmivora* at varying temperature conditions

Understanding the response of *Phytophthora palmivora* to rising temperatures is crucial for predicting future disease dynamics and developing effective management strategies. Two isolates of *P. palmivora* from distinct thermal environments were subjected to a 440-day acclimation process under progressively increasing or decreasing temperatures. The results showed that prolonged temperature exposure significantly enhanced the fitness and adaptation of the pathogen, particularly at 36°C. In the unacclimated population, there was zero mycelial grow that this temperature, whereas in the acclimated population, substantial mycelial growth was observed, indicating its ability to adapt to higher temperatures over time.

These findings suggest that *P. palmivora* can rapidly adjust to changing thermal conditions, potentially leading to increased disease severity and expansion into new geographic regions as global temperatures continue to rise. The polynomial regression analysis of colony size and lesion size versus temperature for the *Phytophthora* isolates CBP and TN highlights distinct growth and infection patterns influenced by temperature. Both colony size and lesion size exhibit non-linear trends, with growth and infection potential increasing up to an optimal temperature before declining. Acclimated isolates demonstrate greater thermal adaptability, maintaining larger colony and lesion sizes over a broader temperature range, whereas unacclimated isolates show more restricted growth and infection potential, peaking within a narrower range. The strong R^2 values (0.94 to 0.98) indicate that the polynomial models effectively capture these variations (Fig. 45). These findings suggest that temperature plays a crucial role in the pathogenicity and survival of *Phytophthora* isolates, impacting their ability to spread and cause disease.

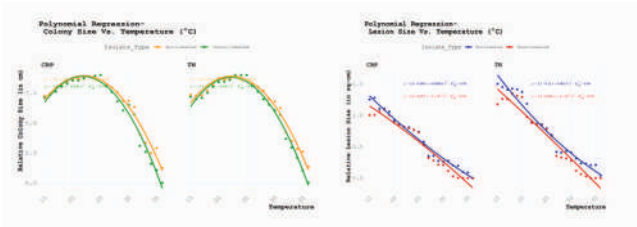


Fig. 45.Polynomial regression analysis to understand the temporal changes in mean relative colony size and aggressiveness of acclimated and unacclimated *Phytophthora palmivora* isolates growing in the low- and high-temperature acclimation treatments

Studies on the effect of spray drone flight height and spray time on ground loss

This study investigated the impact of different UAV spray heights (1, 2, and 3 m) and spray times (5, 8, and 11 s) on pesticide ground loss under tree canopies (Table 11). The results showed that increasing spray height reduced droplet size, likely due to UAV downwash effects influencing droplet movement and dispersion. The droplet size at the ground layer varied significantly across treatments, with the maximum recorded with a spray height of 1 m and spray time of 11 s (243±5.64 µm), followed by spray height of 1 m and spray time of 8 s (238±3.65 µm), with no significant difference between these treatments. Similarly, spray height of 1 m with spray time of 5 s and spray height of 2 m with spray time of 8 s showed no significant difference in droplet size. The smallest droplet size of 124±8.48 µm was observed in spray height of 3 m with spray time of 11 s indicating a strong influence of spray height on droplet behavior. As the spray height increased, droplet size at the ground level gradually decreased. This reduction can be attributed to the lower UAV height generating a stronger downwash effect, disturbing the canopy structure and increasing droplet movement through the leaf pore spaces, thereby enhancing their reach to the ground.

Spray coverage at the ground level was highest in spray height of 1 m with spray time of 11 s (18.20±0.397 %) and lowest in spray height of 2 m with spray time of 5 s (5.60±0.057 %). A general increasing trend in spray coverage on water-sensitive paper (WSP) was observed as spray time increased from 5 s to 11 s across all spray heights. However, higher spray heights resulted in reduced ground-level coverage, except for the 5 s spray duration. This could be due to increased drift or greater deposition outside the canopy, as reported in previous studies. The interaction of UAV downwash and canopy structure played a crucial role in determining how the droplets dispersed before reaching the ground.

Spray deposition followed a different trend, with the highest recorded in spray height of 1 m with spray time of 8 s (2.26±0.046 µL cm^{-2})and the lowestin spray height of 3 m with spray time of 8 s (0.26±0.010 µL cm^{-2}). Unlike coverage, no consistent trend was observed between spray height and spray time in relation to ground-level deposition. The maximum deposition in spray height of 1 m with spray time of 8 s may be due to stronger downwash airflow at lower spray heights, which increased branch movement and transported more droplets beyond the canopy. Additionally, a longer spray duration allowed for more droplets to settle at the ground level. These findings indicate that optimizing spray height and duration is crucial to balancing canopy penetration, spray efficiency, and minimizing pesticide loss. Based on these findings, a UAV spraying configuration of 2m height with an 8 s duration was recommended as the most effective strategy for tall crops with dense canopies, such as coconut trees. This approach maximizes pesticide application efficiency while minimizing environmental contamination and resource wastage.

Table 11: Effect of different spray height and time on spray coverage and deposition of droplets at ground level

Treatment	VMD	Coverage	Deposition
T1 (1m, 5s)	199±4.48^{b}	8.20±0.02^{e}	0.45±0.010^{f}
T2 (1m, 8s)	238±3.65^{a}	16.20±0.42^{b}	2.26±0.046^{a}
T3 (1m, 11s)	243±5.64^{a}	18.20±0.397^{a}	1.82±0.072^{b}
T4 (2m, 5s)	184±1.08^{c}	5.60±0.057^{g}	0.54±0.010^{e}
T5 (2m, 8s)	199±4.81^{b}	12.10±0.273^{c}	0.86±0.006^{d}
T6 (2m, 11s)	172±3.43^{d}	12.40±0.237^{c}	0.89±0.021^{d}
T7 (3m,5s)	146±1.90^{e}	8.19±0.00^{e}	0.39±0.010^{g}
T8 (3m, 8s)	132±1.12^{f}	7.40±0.140^{f}	0.26±0.010^{h}
T9 (3m, 11s)	124±8.48^{g}	9.20±0.288^{d}	1.19±0.015^{c}
CV	2.190	2.352	3.096

Development of an AI-based mobile application for detection and advisory of diseases in coconut

Collected images (with both handheld camera and drone camera) for all major diseases of coconut (>500 images per disease). All the images were annotated; verified and validated images were uploaded in the NIBPP database for machine learning and image analysis. The process of developing the algorithms based on the annotated disease symptom images is in progress.

Android-based palm whitefly detection using deep learning techniques

An Android-based whitefly detection system was developed utilizing deep learning techniques, specifically leveraging the YOLOv5 algorithm (Fig. 46). The objective was to create a robust and efficient solution capable of real-time whitefly detection in palm fields. The network was optimized to accurately identify and localize whiteflies within the crop environment by training the model on a comprehensive dataset of images of two species of whiteflies (*Aleurodicus rugioperculatus* and *Paraleyrodes bondari*). The trained YOLOv5 model was integrated into an Android application (Whitefly detector) to ensure the practicality and accessibility of the solution. This application provides a user-friendly interface for farmers and agricultural experts, enabling real-time deployment on mobile devices commonly used in the field.

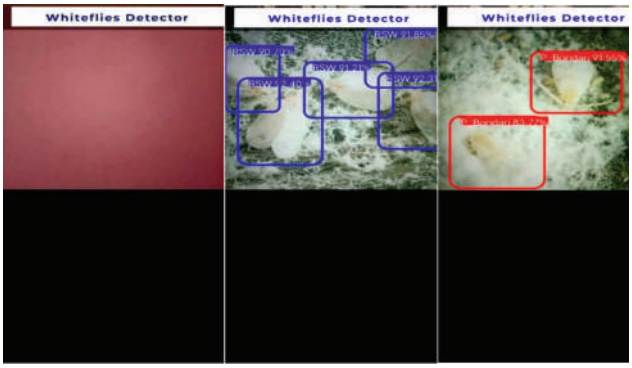


Fig. 46. User Interface of Android application

Developing standard operating procedures (SoPs) for drone-based spraying of nutrients in arecanut

The flight height (2.5m above the canopy), speed (3 m sec^{-1}), and application rate (2.64 L min^{-1}) were standardized for the aerial spray using UAV, and this can be the base for any aerial sprays in arecanut gardens. A solution of 75 L per ha is required to cover the canopy using an anti-drift flat fan with a swath of 4 m. A nutrient mixture comprising magnesium, zinc, and boron was prepared. Aerial spray of this nutrient mixture using a UAV on the leaf spot affected arecanut palms, along with a PGR increased the chlorophyll content of the leaf spot affected palms.

Effect of foliar application of Nanourea on leaf nitrogen content and physiological parameters of seedlings and adult coconut

A study was carried out to understand the effect of nanourea on the growth and yield of adult palms and seedlings of coconut. The experiment was laid out in RBD with 5 treatments [2 mL L^{-1} and 4 mL L^{-1} applied in 30 and 60 days interval with a control (POP)] with 3 replications in adult palms and 3 treatments [4 mL L^{-1} in 45 and 90 days interval with a control (POP)] in seedlings. Physiological observations like chlorophyll content, stomatal resistance, Chl fluorescence reading, etc., were recorded for seedlings. For adult palm chlorophyll content was estimated immediately after the spray. The total nitrogen content in index leaf after spray of nanourea for both seedling and adult palms was analysed (Fig. 47). It was noticed that there was a significantly high content of nitrogen in the leaf compared to the control after each spray in adult palm. In seedlings, leaf nitrogen content increased significantly. Also, the physiological parameters like chlorophyll content showed gradual improvement in adult palms from 40 to 45 µmol m^{-2}. Similarly the chlorophyll content, leaf fluorescence values and stomatal resistance were directly correlated to the nanourea application in coconut seedlings (Fig. 48).

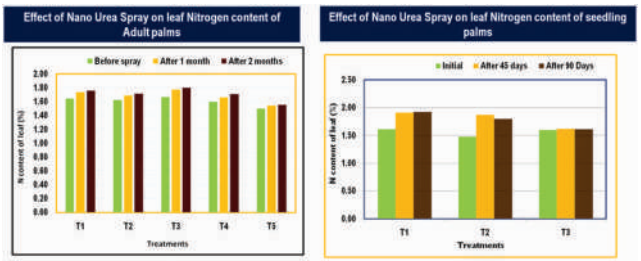


Fig. 47. Effect of nanourea spray through drone on leaf nitrogen content in coconut

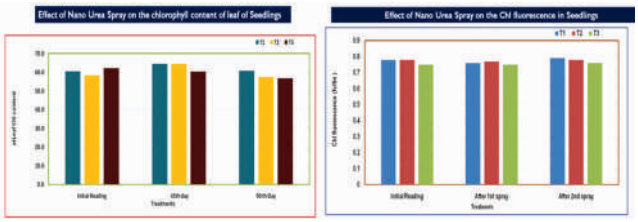


Fig. 48. Effect of nanourea spray through drone on chlorophyll content in coconut

6.5

Integrated Pest and Disease Management for Sustainable Production

Coconut rhinoceros beetle (*Oryctes rhinoceros)*

Invasive Guam haplotype of coconut rhinoceros beetle

The *Oryctes rhinoceros* nudivirus insensitive Guam haplotype of coconut rhinoceros beetle (CRB) is reported to cause huge production setbacks in coconut from South-East Asian countries. In order to ascertain the presence/absence of this Guam haplotype, about 35 coconut rhinoceros beetles were characterized for *COI* gene collected from various coconut belts in India, *viz.,* Kerala (11), Karnataka (5), Tamil Nadu (10), Maharashtra (7) and Andhra Pradesh (2). It is clearly evident (Fig.49) that no A to G transition at nucleotide position 288 on a *Mse1* restriction site could be observed for any of the samples indicating the absence of the invasive *Oryctes rhinoceros* nudivirus insensitive Guam haplotype in the country.

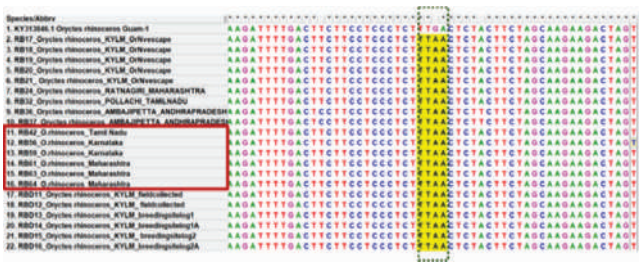


Fig. 49. Partial nucleotide sequence of *COI* gene of CRB

Essential oils against rhinoceros beetle

An array of essential oils was evaluated for its repellency against coconut rhinoceros beetle under *in vitro* conditions. In 'Y' tube olfactometer bioassay, the maximum repellency was recorded with citriodora oil wherein, 72 per cent of adult beetles oriented towards control arm and the remaining 28 per cent of beetles oriented towards the arm treated with citriodora oil. However, when the other essential oils were placed in treatment arm about 60-70 per cent of beetles moved towards the odour arm. Repellent property of citriodora was further confirmed by wind tunnel assay in which only 13.33 per cent beetles exhibited an upwind flight response and 23.33 per cent beetles moved up to mid-point and then exhibited downwind flight response. About 63.33 per cent beetles remained at the point of release itself in the wind tunnel.

Citriodora impregnated calcium alginate beads were placed in leaf axil for prophylactic treatment at 6 weeks interval (June- Nov) on 1.5 years old coconut palms and a pheromone trap was kept outside the garden at Bayar in Kasaragod district for field evaluation citriodora oil. Results indicated a reduction of spindle leaf damage from 50 to 8.8 per cent over a period of 18 weeks. The total number of beetles captured was 321, with an average of 53.5±20.9 beetles per month inferring pest suppression through stimulo-deterrency.

GC-MS analysis of citriodora oil indicated presence of citronellal as the major component which read a relative abundance of 64.57 per cent and retention time is 16.524 min. Second most abundant component was dl- isopulegol (11.75%) which retained at 16.098 min. Another chief component present is citronellol (6.41%) which retained at 19.672 min (Fig. 50).

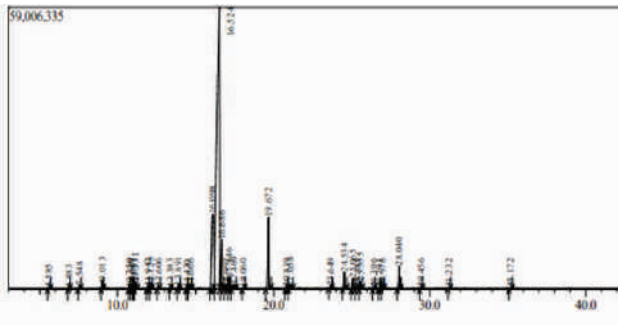


Fig. 50. Volatile profile of citriodora oil using GC-MS

Evaluation of botanicals against coconut rhinoceros beetle

A laboratory study was carried out to evaluate different botanicals against rhinoceros beetle. Botanical powders (1:19 mixture) of *Clerodendrum infortunatum* L. (CI), *Chromolaena odorata* (L.) R.M.King & H.Rob. (CO) and *Vitex negundo* L. (VN) and their combinations mixed with coir pith were tested for the mortality of rhinoceros grubs. All the treatment combinations were superior to control. Cent per cent mortality of rhinoceros grubs was observed in all the treatments within 19 days after treatment. Among the treatments, CI was the most efficient treatment which induced mortality within 9 days followed by CI+VN, CI+CO+VN and CI+CO (Fig. 51). Grubs developed to pupae and adults in control. The weight of grubs also reduced in treatments with leaf powders. *C. infortunatum* can be utilized for further development of a bio-pesticide against coconut rhinoceros grubs.

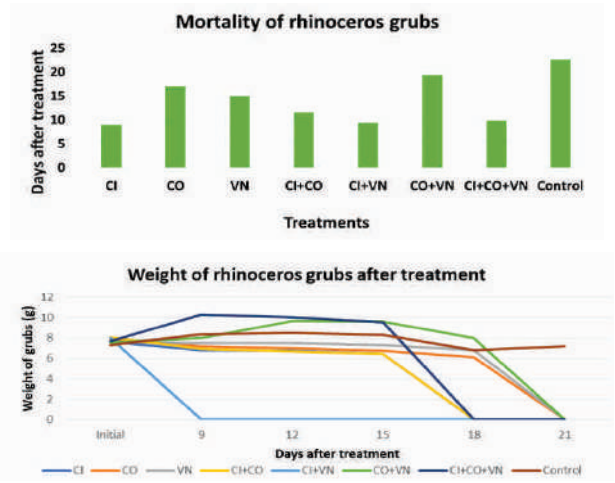


Fig. 51. Mortality and larval weight of coconut rhinoceros beetle

Red palm weevil (*Rhynchophorus ferrugineus*)

Refinement in red palm weevil detector

The hardware of red palm weevil detector has been refined to provide better endurance in the application environment and the software has been refined to improve accuracy and reduce the processing time. Detection efficiency ranged from 70 to 75 per cent.

Red palm weevil attack in palms

Survey conducted in parts of Dakshina Kannada district indicated a severe incidence (41.37%) of red palm weevil through collar region in aromatic coconut variety (Basmati scented coconut) cultivated at Bantwal (12°55'15.95496" N, 75°2'36.28788" E). Curative treatment resulted in recovery of 75 per cent of the palms. A mild incidence of red palm weevil (0.1%) was noticed in five-year-old arecanut garden in Moorje, Bantwal (12°53'37" N, 74°59'41" E) during Jan 2024. The garden was infected by collar rot disease (0.3%). Similarly, a mild incidence of RPW was noticed in Mittur, near Puttur (12.7867° N, 75.2071° E) on arecanut through crown. A few mild incidences were noticed in Manjeswaram (12.7246° N, 74.8850° E), Sullia (12.5569° N, 75.3895° E) and Chittarikkal in Kannur district also. Incidence of RPW was noticed in seedling of palmyrah in ICAR-CPCRI Kasaragod (Fig. 52).

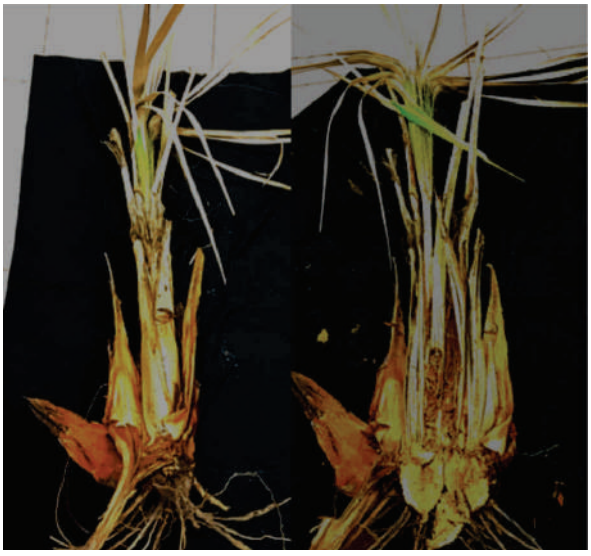


Fig. 52. Incidence of RPW through collar region of palmyrah

Efficacy of indigenous strain of *Beauveria bassiana* (Bb- 045) against Red palm weevil, *Rhynchophorus ferrugineus*

An indigenous isolate of entomopathogenic fungi isolated from larval cadavers of red palm weevil, *Rhynchophorus ferrugineus* was identified as *Beauveria bassiana* (CPCRI Strain – Bb– 045) based on morphological traits and molecular techniques (Fig. 53a; b). Bb - 045 isolate exhibited its pathogenicity against third-instar larvae of *R. ferrugineus* by causing highest mortality (>98%) in 4 DAT (Days after treatment) at the highest spore concentration tested (1×10^{8} conidia mL^{-1}). Furthermore, an invert emulsion formulation of Bb-045 tested through palm trunk inoculation studies, achieving over 90 per cent mortality of red palm weevil larvae within 14 days at a spore concentration of 5.2×10^{8} conidia per mL suggesting its utilization as a potential bio-pesticide in RPW management programs (Fig. 54).

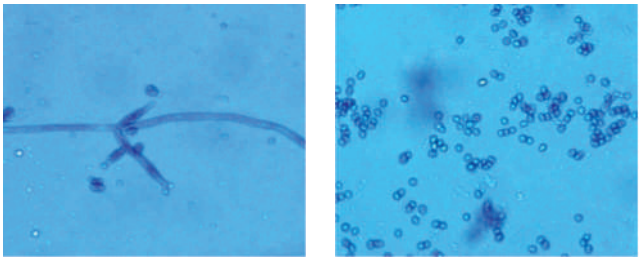


Fig. 53a. *B. bassiana* conidiogenous cells
Fig. 53b. *B. bassiana* Bb045 conidia

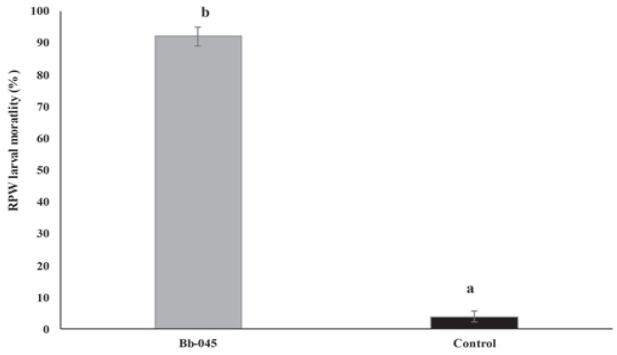


Fig. 54. Mortality of RPW larva with an invert emulsion

Coconut white grub, *Leucopholis coneophora* Burm.

Integrated pest management (IPM) package for the suppression of white grub comprised four components *viz.*, hand picking and destruction of beetles in June, patch application of imidacloprid 17.8 SL @ 625 g ai per ha during the second week of August along interspaces and a second round root zone application of chlorpyriphos 20 EC @ 2kg ai per ha or imidacloprid@ 625 g ai per ha at 45 days after the first treatment, and finally application of two rounds of EPN aqua suspension, *ie.*, *Steinernema carpocapsae* in palm basin in October and November and ploughing the interspaces to expose grubs for predation. Such a module was demonstrated in four coconut gardens in Kerala which covered an area of 8.5 ha. The larval population in one square metre area at 35 cm depth had been reduced from 8.3 to 4.4, 6.7 to 1.6, 3.6 to 1.3 and 5.7 to 3.3 in plots I, II, III and IV, respectively after one year of IPM intervention. The number of larvae per palm basin was reduced to 7.1, 3.5, 1.5, 2.2, respectively, in four demonstration plots in the first year and subsequently reduced to 3.2, 0.6, 0.8 and 1.6 in that order during the second year. The reduction in grub population during the first year was 36.26, 46.73, 51.93 and 33.14 per cent in plot I, II, III and IV, respectively which further enhanced to 69.3, 63.9, 72.3 and 67.6 per cent at the end of the second year (Fig. 55). Over all, population reduction of 42.015 ± 76 per cent was achieved after first year of IPM interventions, and a reduction of 68.26± 3.03 per cent was achieved in the second year in 4 demonstration plots. The average yield increase was 70.85 fruits per palm per year from 63 fruits during the start of the experiment validating the IPM module in the successful management of coconut white grub in the endemic zone (Fig. 56).

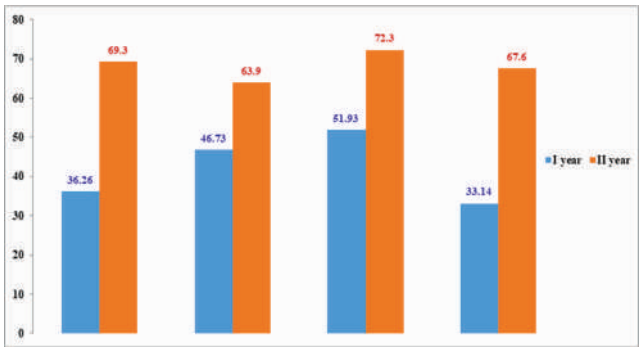


Fig. 55. Per cent reduction in *Leucopholis* grub population in demonstration plots

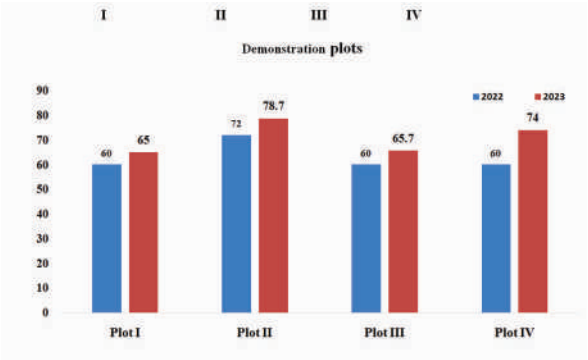


Fig. 56. Average yield of the palms in demonstration plots

Black headed caterpillar (*Opisina arenosella* Walker)

Technology connect in the bio-suppression of black headed caterpillar outbreak at Kanniyakon, Kerala

Localized outbreak of coconut black headed caterpillar, *Opisina arenosella* Walker (Oecophoridae: Lepidoptera) was reported from Kanniyakon bordering three panchayats *viz.,* Vechoor, Arpookara and Kallara in Kottayam district, Kerala during November 2024 (Fig. 57). Augmentative release of the stage specific parasitoids*viz., Goniozus nephantidis* and *Bracon brevicornis* was undertaken by ICAR-CPCRI on 19 November 2024 on the pest inflicted gardens. In addition, officials from the Parasite Breeding Station, Kozha, Kottayam district also supplied the parasitoids for the augmentative release programme.

Fig. 57. Black headed caterpillar affected field in Kanniyakon

On 06 December 2024 ICAR-CPCRI convened an awareness campaign empowering the role of bioagents in the bio-suppression of black headed caterpillar. ICAR-CPCRI in collaboration with the State Department of Agriculture and Parasite Breeding Station visited the affected coconut plantation at Kanniyakon and re-released more than 500 parasitoids (Fig. 58). Currently, about 50 ha area was badly affected with around 85 per cent pest damage. The pupal parasitoid, *Brachymeria nosatoi* (Fig. 59) was recovered from the affected gardens indicating the biodiversity driven approach in pest suppression. The coconut community in the region was highly convinced of the success of the technology and the interventions made by ICAR-CPCRI in the bio-suppression of the pest.

Fig. 58. Release of parasitoids

Fig. 59. *Brachymeria nosatoi*

Coreid bug (*Paradasynus rostratus* Distant)

Standardization of rearing technique for egg parasitoid, *Anastatus* sp.

Mass multiplication of *Anastatus* sp. in laboratory was standardized on eggs of eri silk moth, *Samia ricini* (Donovan). The larvae of eri silk moth were reared on castor leaves (*Ricinus communis* L.). The total life cycle of eri silk moth ranged between 50-58 days, in which egg period, larval period pupal period and adult period were 9-11 days, 20-22 days, 18-20 days and 3-5 days, respectively (Fig. 60). The eggs of eri silk moth were provided to *Anastatus* sp. females for egg laying at a ratio of 10 eggs per female per day. The parasitoids were maintained at a temperature of 25 °C in BOD.

Eggs

Larvae

Pupa

Adults

Fig. 60. Life stages of eri silk moth

Influence of age of factitious host egg on parasitic potential of *Anastatus* sp.

The laboratory experiments were conducted with eri silk worm eggs of different ages. Host eggs glued to paper strips (1 cm × 1 cm) were offered to *Anastatus* sp. females for parasitization at the parasitoid: host ratio of 1:10 in laboratory conditions. Highest level of parasitism (70%) was registered on those eggs that are <1 day old followed by 1-day and 2-day old eggs, respectively (Fig. 61). The host eggs were avoided by the parasitoid from 6th day onwards and hence no parasitism occurred. The developmental duration of *Anastatus* sp. on eri-silk worm eggs was around 20±2 days. The parasitoid therefore, exhibited selective preference for fresh eggs than the matured ones. This necessitated storage of fresh eggs which can lead to uninterrupted production and supply of egg cards, especially during pre-monsoon showers coinciding the peak pest incidence.

Female | Male | Females parasitizing eggs of eri silk moth

Fig. 61. *Anastatus* sp. female, male

Anastatus egg cards for the management of coreid bug

The mated female adults of *Anastatus* sp. may be released in the field against coreid bugs. Anastatus egg cards were prepared with the parasitized eggs of eri silk moth for easy handling, storage and application. The egg cards can be clipped to the palm leaves or to intercrops at the rate of 1 card per 10 palms (Fig. 62).

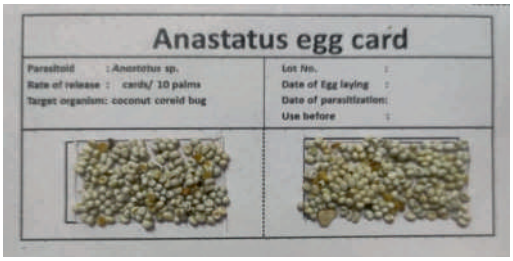


Fig. 62. Anastatus egg card

Whiteflies

Competitive displacement and current status of exotic whiteflies

Five non-native whiteflies invaded coconut plantations all over the country including Lakshadweep and Andaman & Nicobar Islands since 2016. Among the five non-native invasive species and one native whitefly species known from coconut so far, two exotic species *viz., Aleurodicus rugioperculatus* and *Paraleyrodes bondari* are still prevailing and coexisting in the coconut system in India displacing three exotic species (*Aleurodicus dispersus*, *Paraleyrodes minei* and *Aleurotrachelus atratus*) and the native arecanut whitefly, *Aleurocanthus arecae*. Currently two whitefly species *viz.,* rugose spiralling whitefly (*A. rugioperculatus*) and Bondar's nesting whitefly (*P. bondari*) prevail and their population dynamics fluctuates *vis-à-vis* weather conditions and parasitism/predation by defenders. In many parts of the country, population intensity of Bondar's nesting whitefly, *P. bondari* (1.75 live colonies leaflet^{-1}) exceeded that of rugose spiralling whitefly, *A. rugioperculatus* (0.8 live colonies leaflet^{-1}). Weather, particularly temperature, precipitation and humidity play a substantial role in the population dynamics of non-native whiteflies.

Integrated pest management strategies evolved by ICAR-CPCRI included tolerant tall varieties, installation of yellow sticky traps around the palm trunk, conservation biological control using aphelinid parasitoids *viz.*, *Encarsia guadeloupae, Encarsia dispersa* & predators such as *Apertochrysa* sp., *Cybocephalus* sp., spray application of neem oil (0.5%) or *Simplicillium lanosoniveum* (CPCRI SL 951 -1 x 10^8 conidia mL^{-1}) @ 5 mL per litre at fortnightly intervals if parasitism is found <50 per cent, *in situ* bio-cleansing through sooty mould scavenger beetle, *Leiochrinus nilgirianus*, ecological intensification through composite cropping and palm health improvement through need-based nutrient application. As part of nursery management and quarantine restrictions, coconut seedlings should be free from any whiteflies during distribution to farmers and transboundary movements across the states.

b) Discovery of *Aleuroclava canangae* whitefly on ornamental *Coleus* in coconut system from India

Aleuroclava canangae (Corbett, 1935) was discovered on an ornamental *Coleus* species in Kerala, India in coconut system and represents the first occurrence of this species in India and on this plant host. *Aleuroclava canangae* can be distinguished from other species in the *canangae* species group by: lateral margin differentiated at the opening of the thoracic tracheal furrow as a cleft (Fig. 63c); submedian area of the dorsum of the cephalothorax with three pairs of enlarged tubercles (Fig. 63b); and the entire dorsum with microtubercles (Fig. 63b). *A. canangae* has two pairs of very elongate, tuberculate setae which appear two-jointed because they have a wider basal part separated from a long slender apical part by a fine suture (Fig. 63a). Male genitalia has a bulged structure at the tip (Fig. 63d). Marginal crenulation pronounced with papillae (Fig. 63e).

Fig. 63. *Aleuroclava canangae* a) habitus
b) dorsal tubercle and vasiform orifice
c) thoracic cup d) male genitalia with bulged tip
e) marginal crenulation

c) Gut extracts of sooty mould scavenger beetle

The sooty mould scavenger beetle, *Leiochrinius nilgirianus* involved in the bio-cleansing of coconut palms encrusted with sooty mould deposits upon whitefly infestation possessed trypsin-like protease activity from the gut extracts. Benzoyl-alanine *p*-nitroanilide-ase activity was established which could form a core base in detergent industry.

Agro-ecological crop protection in coconut

Composite cropping with a wide array of intercrops in Kalpa Sankara coconut hybrid plantation yielded an average of 156 fruits per palm per year, aiding habitat for defenders and subdued pest incidence by 2-3 folds due to stimulo-deterrance (Fig. 64). More than 60 per cent parasitism by *Encarsia guadeloupae* was also recorded against rugose spiralling whitefly.

Fig. 64. Composite cropping with coconut

Soil temperature was considerably lower in composite cropping garden with 33.3°C at 7.0 cm depth as compared to 42.7°C in open field condition. About 0.3 per cent increase in organic carbon was realized with enhanced population of actinobacteria ranging from 6.02 to 7.01 log cfu g^{-1} dry weight of soil. Actinobacteria favoured IAA production, solubilization of P and Zn and suppressed the leaf rot pathogen. Such heterogenous landscaping was found as climate smart, produced higher farm income, reduced pest incidence, enhanced soil health and boosted carbon credit.

Incidence of insect pests affecting the palmyrah germination

Various insect pests affecting the germination process of the palmyrah nuts and their seedling stage was recorded. Termites (*Odontotermes* sp.) (Fig 65c) affected the germination of the nuts and incidence was noticed up to 63 per cent. Hardened pulp (Endosperm) of Palmyrah was observed with the incidence of Ambrosia beetles (*Xyleborus* sp.) (Fig. 65b) and Dried fruit beetle (*Carpohilus* sp.) (Fig. 65a) affecting the germination of palmyrah nuts to the level of 12 per cent. The larvae of dried fruit beetle were white in colour, slender with a length of 0.1 to 0.22 inch. They had tan to dark colored head with three pairs of true legs, and two hornlike structures on the anal end.

Fig 65 a) *Carphilus* sp. b) *Xyleborus* sp. c) *Odondotermes* sp.

Entomopathogenic nematode and integrated nematode management

Isolation of EPN from different regions

A total of 180 soil samples were systematically collected from different coconut-based cropping systems across five districts in two states: Alappuzha, Kollam, Kottayam, and Pathanamthitta in Kerala, as well as Tenkasi in Tamil Nadu. These samples were baited with *Galleria mellonella* larvae for the isolation of entomopathogenic nematodes (EPNs). Twelve EPN isolates were successfully recovered from the collected samples. Based on the distinct coloration of the infected insect cadavers, it was determined that eight of these isolates belong to the genus *Heterorhabditis*, two to the genus *Steinernema* and the remaining two are from the Metarhabditid group.

Description of new EPN species

The molecular and morphological characterization of the superior entomopathogenic nematode (EPN) isolate *Steinernema* sp. S0804 and its symbiotic bacteria was done. This morphological analysis was carried out in collaboration with ICAR-NBAIR. The EPN isolate has been found to be distinct both molecularly and morphologically from any previously described species, yet it belongs to the 'longicaudum clade.' Key characteristics of the infective juveniles of the new species include a mean body length of 1067 µm (ranging from 914 to 1268 µm), a distance of 82 µm (ranging from 73 to 92 µm) from the anterior end to the excretory pore, and a distance of 105 µm (ranging from 91 to 118 µm) from the anterior end to the nerve ring (Fig. 66). A significant diagnostic feature that differentiates this species from all other described species within the 'longicaudum' clade is the presence of seven ridges in the mid-body region of the infective juveniles, as all other species in this clade have eight. The distinctiveness of this species is further confirmed by the genetic sequences of the ITS, D2-D3 segment of 28S rRNA, and *COI* genes (Fig. 67 & 68). Therefore, the combined morphological, morphometric, and molecular data substantiate that the Steinernema strain S0804, isolated from Kayamkulam, Kerala, represents a new species that is accepted to be published as *Steinernema keralense* n. sp. This species will be the fourth valid Steinernematid described from India. Phylogenetic analysis indicates that the symbiotic bacterium associated with *S. keralense* n. sp. (bacterial strain S0804) likely represents a new species within the *Xenorhabdus* genus. This new strain appears to be closely related to *X. griffiniae* and *X. ehlersi*. The *recA* and *gyrB* gene sequences of *Xenorhabdus* sp. S0804 exhibit approximately 96 per cent similarity to those of *X.griffiniae* and about 96.3 to 97 per cent similarity with *X. ehlersi*.

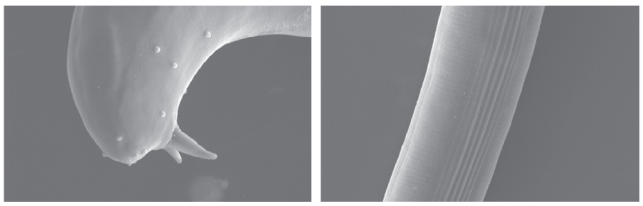


Fig. 66. Tail region of adult male; Lateral field of infective juveniles showing 7 ridges

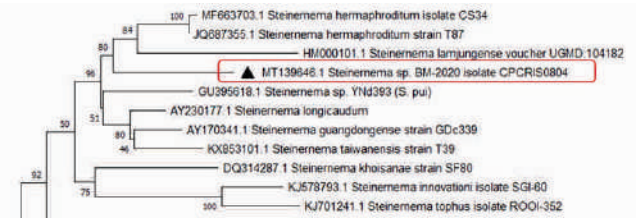


Fig. 67. Phylogenetic relationships of *Steinernema* sp. S0804 based on ITS rDNA region

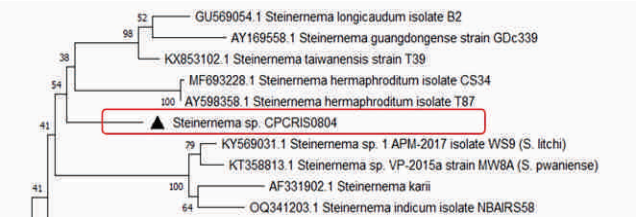


Fig. 68. Phylogenetic relationships of *Steinernema* sp. S0804 based on D2–D3 segments of 28S rDNA

Standardization of low cost *in vivo* EPN production

Evaluated 12 different diets for rearing *Galleria mellonella*, with the goal of reducing the cost of *in vivo* production of entomopathogenic nematodes (EPN). One particular diet combination, referred to as "D7," successfully reduced costs by 60 per cent compared to the standard diet (D1), without any significant decrease in the development of *G. mellonella*. The production cost for one larva using diet D1 was Rs. 1.20, whereas it dropped to Rs. 0.48 when using diet D7. Laboratory and field evaluation for the standardization of application technology and dosage of EPNs against RPW and important pests of coconut intercrops is in progress.

Rearing technique of RPW in the laboratory using sugarcane

A laboratory rearing technique for the red palm weevil (*Rhynchophorus ferrugineus*), a major pest of coconut and palm species, was developed using sugarcane as a cost-effective and easily available rearing medium. Fresh sugarcane stems were used as a larval diet, providing optimal nutrition and moisture for the growth and development of RPW. Adult weevils were maintained in controlled conditions to ensure consistent egg laying, larval development, and pupation. The rearing method facilitated high survival rates and reduced developmental time, making it suitable for large-scale insect culture. This technique offers a reliable and sustainable approach for maintaining RPW colonies in laboratory conditions, supporting research on pest biology, behavior, and management strategies. The standardized protocol will be instrumental in developing and testing biocontrol measures, insecticide resistance studies, and integrated pest management (IPM) strategies for effective RPW management in infested regions.

Root knot nematode (RKN) in coconut system

Root samples were collected from different vegetable, spice and fruit crops in the coconut system. All the locations sampled were observed to be infested with RKNs with varying levels of infestation. Ginger, guava, West Indian cherry and tomato were most severely affected, while comparatively less incidence of RKN infestation was observed in amaranthus. The morphological characterization based on perineal pattern of adult females, revealed the association of *Meloidogyne enterolobii*, an invasive RKN, in tomato, guava, star apple and West Indian cherry, whereas the RKN population encountered in all other crops were either *M. incognita* or *M. javanica*. The identity of the invasive RKN, *M. enterolobii* was confirmed by molecular characterization using species specific SCAR marker. Integrated nematode management strategies are being popularized among farming community. Significant reduction in the nematode infestation was realized through the adoption of farmer participatory integrated nematode management strategies.

Field evaluation of EPN against red palm weevil

The effectiveness of using a capsule formulation of entomopathogenic nematodes (EPN) as a preventative measure is being evaluated on various farms in the Alappuzha, Kollam, and Pathanamthitta districts (Fig. 69). So far, 14 farmers have been selected for the study, which includes a total of 699 palms. Awareness has been raised among the farmers about integrated management strategies for controlling rhinoceros beetles (RB) and red palm weevils (RPW). All palms were treated with EPN capsules at a rate of 5 capsules per tree, along with eco-friendly methods for managing the rhinoceros beetle. Preliminary observations indicate a significant reduction to the tune of 63 per cent and 46 per cent in the incidence of RPW and RB respectively.

Fig. 69.Demonstration plots for the evaluation of EPN against RPW

Area wide demonstration of *Heterorhabditis indica* for sustainable management of coconut root grubs in Karnataka

Field demonstration of Kalpa EPN, *Heterorhabditis indica* liquid suspension containing live infective juveniles (Ijs), soil drenching @ 20 lakh IJs per palm during September-October followed by application of neem cake @ 5kg per palm during December – January resulted in substantial reduction of root grub populations to 2.10 from 6.62 grubs at the root zone of the palms in farmer's gardens (Table 12) at Kundapur and Puttur Taluk of Karnataka and also observed overall improvement in the health of the palms and yield (Fig. 70).

Table 12: Population reduction of white gub after EPN application

Plot Number	Number of root grubs in the root zone of palm		Reduction in number of root grubs
	Pre IPM (2021)	Post IPM (2024)	
I	7.89	3.18	4.71
II	5.36	1.03	4.33
I & II	**6.62**	**2.10**	**4.52**

Fig. 70. Healthy and H. indica infected root grub larvae & infective juveniles (Ijs)

Whole genome sequence of EPN, *Steinernema carpocapsae*

The sequencing of native indigenous isolate of EPN, *S. carpocapsae* using hybrid platform was carried out using Oxford nanopore technology for long reads and Illumina platform for short reads. The reference base assembly resulted a total genome of around 137MB. Around 14 pseudo-molecules in *S. carpocapsae* were recorded (Fig. 71). Further analysis is in progress to find out the specific traits of *S. carpocapsae* to establish entomopathogenic property and useful genes trying to annotate.

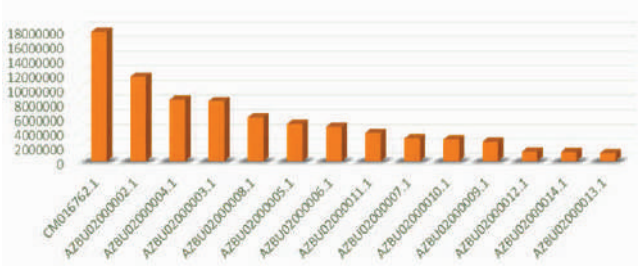


Fig. 71. Assembly of pseudomolecules

Farmer's experience with Kalpa EPN aqua suspension in organic pest management in watermelon cultivation under coconut eco-system – A success story

Fig. 72. Kalpa EPN aqua suspension with farm women

Fig. 73. Visit of local farmers recognition to her field, organically harvesting watermelon by adopting organic based EPN technology for pest management

Soil application of Kalpa EPN @ 10 units per 1000 square meter at 15 day interval and foliar application @1 unit (150ml) per day 10 liters water at weekly interval during early morning or late evening hours during the period of early notice of pest incidence

acted as a natural shield against the leaf folder and pumpkin beetle attack and saved the crop from potential devastation. It is an innovative biological approach that promised both effectiveness and adherence to organic principles. After 3 – 4 application of Kalapa EPN liquid suspension of *S. carpocapsae* and *Heterorhabditis indica,* significant reduction of pest population was observed to the tune of 66.2 per cent and an impressive seven tons yield of water melon was recorded from seventy five cents land, underlining the economic viability of sustainable and organic farming practices. Story of successful management using EPN based eco-friendly technology was shared in the Face Book and farmers WhatsApp groups (Fig. 72 & 73).

ARECANUT

a) Characterization of red palm mite, *Raoiella indica*

Scanning electron microscopic studies were conducted to document the key morphological features of *Raoiella indica*. The female of *R. indica* is broader with an ovoid body and a rounded opisthosoma, while the males are smaller, characterized by a distinctly triangular abdomen that ends with a complex reproductive organ. Key taxonomic features were identified, including the morphology of the dorsal setae, which were either setiform or spatulate. Specifically, setae c1, d1, and e1 were mildly spatulate, while seta h2 was setiform with a finely tapered tip. Additionally, the palp of *R. indica* bears one solenidion and one tapered, setiform eupathidium distally. In terms of the tarsi I-II, the companion seta was notably longer than the solenidion, providing important insights for species identification.

COCOA

Tea mosquito bug (*Helopeltis theivora* Waterhouse)

a) Laboratory rearing protocol for Tea mosquito bug, *Helopeltis theivora* Waterhouse (Heteroptera: Miridae) on cocoa

Tea mosquito bug (TMB) is a most serious pest on cocoa worldwide that inflicts huge economic loss under epidemic situations. Laboratory colonies are necessary to perform year- round research to develop suitable management strategies for this pest. Medium sized green cocoa pod and tender shoot were used as a food substrate and compared the biological parameters of *H. theivora* between them. The adult females preferred to lay more eggs on the pods (32.20 ± 1.86 eggs female^{-1}) either singly or in a small group and low fecundity was observed on shoots (20.75 ± 1.16 eggs female^{-1}). Meanwhile, the egg hatching was highest on pods (92.48 ± 2.91%) than shoots (74.08 ± 3.73%). This pest consists of five nymphal instar and the total nymphal duration was 13.40 ± 1.33 and 14.73 ± 0.75 days on pods and shoots, respectively (Fig 28). In addition, the per cent survival of *H. theivora* was highest on pods (78.66 ± 3.46) and lowest on shoots (51.85 ± 2.33). No significant differences were recorded in adult longevity and the mean life span of male and females were 12.77 ± 1.58 and 16.63 ± 1.64 days on pods; 11.10 ± 1.41 and 15.36 ± 1.53 days on shoots, respectively. Although TMB will survive both on pods and tender shoots; but, rearing on pods could be more suitable and reliable to establish a sizeable population of *H. theivora* under laboratory conditions (Fig. 74).

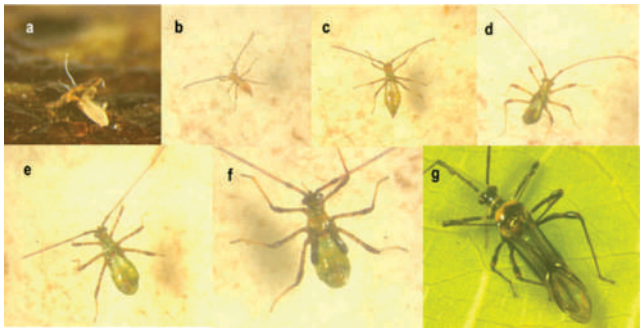


Fig. 74. Developmental stages of *H. theivora*. (a) egg, (b) I instar (c) II instar, (d) III instar, (e) IV instar, (f) V instar, (g) Adult.

A new pod bioassay method to determine the toxicity of insecticides against tea mosquito bug, *Helopeltis theivora* (Heteroptera: Miridae)

The insecticide susceptibility of *Helopeltis theivora* Waterhouse (Hemiptera: Miridae) is being evaluated using shoot and glass-vial assay as described by IRAC. However, the reliability of the assay depends on feeding preference and contact toxicity. Hence, cocoa pod was used as a substrate to test the susceptibility of *H. theivora* in comparison with existing methods (Fig. 75). Green cocoa pods

(30-40 days old, 100 -150g) and tender shoots were collected from the cocoa garden, washed with running water for 10 s and air dried under a ceiling fan. Insecticide stock solution was prepared with 0.1% Triton-X 100 in distilled water and serial dilutions were made. The pods were immersed in the corresponding solution for 15 s and air-dried at room temperature by placing them on butter paper. Each pod pedicel was wrapped in cotton moistened with 10 per cent sucrose solution to prevent dehydration and deterioration; while, tender shoots are placed in 10 per cent sucrose solution. The experimental results revealed that the LC_{50} value of all the insecticides was relatively lower in the pod bioassay than the other two methods and exhibited maximum mortality within 6 h of post-exposure. Among insecticides, fipronil was the most effective molecule followed by lambda-cyhalothrin. *H. theivora,* which prefers to feed on a pod due to more tissue turgidity, facilitated adequate sap ingestion; whereas, these were limited in shoot and glass-vial bioassays. Therefore, green pods could be used to determine the susceptibility of *H. theivora* against a wide range of insecticide molecules.

Pod assay Shoot assay Glass vial assay

Fig. 75. Bioassay method to determine toxicity of insecticides against tea mosquito bug

Minor pests

Field detection of tea tortrix, *Homona coffearia* Neitner (Lepidoptera: Tortricidae): A new pest on cocoa (*Theobroma cacao*. L)

The survey was conducted in 2022-2023 and found significant damage to cocoa nurseries and fields caused by the larvae of *H. coffearia*. The caterpillars web the young leaves, feeds within the sheltered nests and affects the crop canopy. The per cent incidence was 27.55 ± 1.81 in the nursery and 43.77 ± 3.42 in open fields. A detailed morphological examination and molecular characterization using the mitochondrial cytochrome c oxidase I (*COI*) gene confirmed the identity of the pest as *H. coffearia*. Key biological parameters of *H. coffearia* on cocoa under laboratory conditions were also documented. The life cycle from egg to adult was completed in about 49 ± 2.32 days. Female moths laid an average of 106 ± 3.48 eggs, which hatched into larvae that underwent five instars before pupation. Both the larval and pupal stages lasted around 27.69 ± 0.72 and 7.72 ± 0.17 days respectively (Fig. 76). To our knowledge, this is the first report of the tea tortrix, *H. coffearia* infesting cocoa in India. As a polyphagous pest, the ability of *H. coffearia* to adapt and feed on new host plants like cocoa poses a significant threat to cocoa production.

Larva Pupa Adult

Fig. 76. Tea tortrix, *Homona coffearia*

Standardization of laboratory rearing of cocoa mealybug and evaluation of bio-efficacy of essential oils against it

Mealybugs such as *Ferrisia virgata* and *Planococcus lilacinus* were successfully reared in a wooden cage under controlled laboratory conditions using pumpkin and potato sprouts as substrates. It was observed that *F. virgata* showed a higher rate of multiplication compared to *P. lilacinus* when pumpkin was used. Additionally, the bio-efficacy of six essential oils (eucalyptus, lemongrass, cedarwood, peppermint, basil, and citronella) was assessed against the striped mealybug (*F. virgata*) using a cherelle bioassay. Among the treatments, basil oil exhibited the highest mortality rate, achieving 56.66 per cent at 3 days after treatment (DAT) and 77.46 per cent at 7 DAT, showing promising results for pest control.

Disease Management

Genotyping by sequencing (GBS) analysis to study genetic diversity, population structure, and evolutionary relationships among *Ganoderma* populations causing Basal stem rot in coconut

A total of 30 different Ganoderma isolates from various regions across India, including Kerala,

Tamil Nadu, Karnataka, Andhra Pradesh, and Assam, were selected to investigate their genetic diversity. Genotyping-by-sequencing (GBS) analysis was performed using high-throughput sequencing data, which identified a total of 49,51,129 single nucleotide polymorphisms (SNPs).

Cluster analysis revealed that the genetic grouping of the isolates was congruent with *Ganoderma* species and virulence traits but did not correlate with their geographical origins (Fig. 77). This suggests that genetic variation within the isolates is driven more by species-specific factors and pathogenic characteristics rather than by regional separation. To infer the population structure, Structure software was run with a range of K values from 2 to 12, using 50,000 MCMC iterations and a 1,50,000 burn-in period. The results showed a peak at K = 10, indicating that the isolates belonged to 10 distinct genetic clusters.

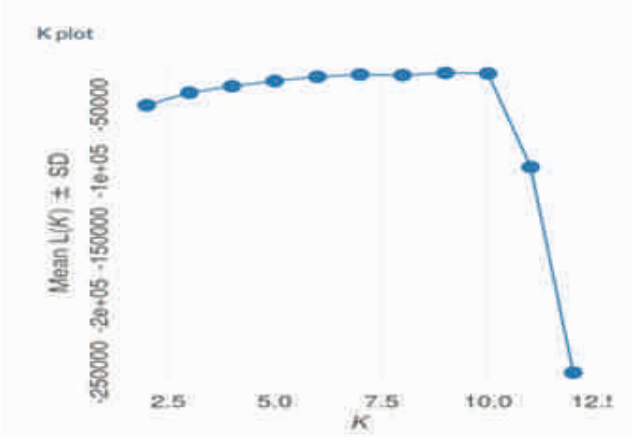


Fig. 77. Structure analysis using Admixture protocol revealed the presence of a total of 10 different genetic clusters among the Ganoderma populations (k=10)

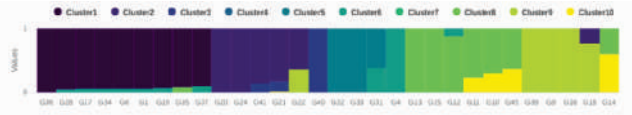


Fig.78. The presence of the same species in multiple genetic clusters suggests localized evolution within certain areas, whereas genetically similar isolates found in different geographic regions indicate long-distance dispersal, likely mediated by contaminated soil, infected planting material, or human activities.

Principal Coordinate Analysis (PCoA) provided additional insights into the genetic relationships among the isolates (Fig. 78.). The analysis revealed that *G. lucidum*, positioned in the upper-right quadrant, and *G. boninense*, located in the lower-right quadrant, represented two distinct populations that, despite their differences, share common genetic adaptations. In contrast, *G. ryverdenii*, *G. gibbosum*, and *G. carnosum* were clustered on theleft side of the plot, predominantly in the lower-left quadrant. The clear separation of this cluster from the others suggests that these species have undergone a fundamentally different genetic adaptation, reinforcing their uniqueness within the broader *Ganoderma* population. Overall, the study highlights the complex genetic landscape of *Ganoderma* isolates, influenced by both species-level differentiation and potential long-distance dispersal mechanisms.

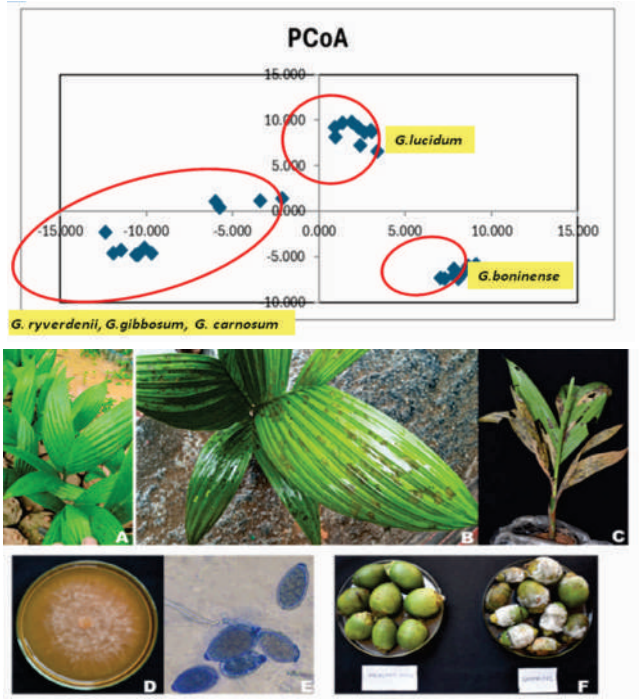


Fig. 79. A) Water-soaked lesions on arecanut seedlings, B) Light to dark brown lesions observed on arecanut leaves, C) Leaf spot coalesced to form leaf blight symptoms, D) Pure culture and E) Sporangia of Phytophthora colocasiae VTL24, F) Pathogenicity test proven on healthy arecanut

Documentation of diseases and pests of arecanut in Assam

The area under arecanut has increased because of its higher returns in most places including the northeastern states. Though there were reports of different diseases and pests of arecanut from Assam, there was no systematic recording of the same. Hence an effort was made to document the diseases and pests occurring on arecanut in the state of Assam (Fig. 80). Basal stem rot, also known as Ganoderma disease, has an incidence rate of 10 per cent, affecting areas such as Agchia, Borjhar, Goalpara, Nahira, Nalbari, Kokrajhar, and Bongaigaon. Boron deficiency-induced bud rot is observed with a 5 per cent incidence in Borjhar, Kokrajhar, Bongaigaon, and Goalpara. The Arecanut ring spot virus has been recorded with a 7 per cent incidence in Borjhar, Goalpara, Nahira, and Nalbari. Additionally, the Red Palm Weevil has an incidence of 2 per cent in the Borjharand Kahikuchi

Ganoderma infected arecanut palm

Red palm weevil infected arecanut

Boron deficiency-inducedbud rot disease in arecanut palm

Ring spot virus infected arecanut leaves

Fig. 80. Arecanut diseases and pests observed in the state of Assam during 2024

Studies on physiological traits of *Colletotrichum* isolates associated with leaf spot disease of arecanut

Endemic incidence of leaf spot disease was observed in major areca nut-growing districts of Karnataka and parts of the Kasaragod district of Kerala States of India from 2019 onwards. *Colletotrichum gloeosporioides* was previously identified as the causative organism of the arecanut leaf spot. Recent studies demonstrated the association of different species viz., *C. siamense, C. fructicola* which belong to the *C. gloeosporioides* species complex. To understand the role of climatic factors as well as congenial conditions for the development of disease, *Colletotrichum* isolates (n=25) collected from leaf spot disease endemic districts of Karnataka and Kasaragod district of Kerala, were subjected to different temperature regimes from 20 to 35°C and relative humidity of 70, 80 and 90 per cent. Results revealed that 25 *Colletotrichum* isolates were grouped in five clusters in PCA Biplot and hierarchical clustering for their colony growth rate, colony forming units and spore germination (Fig. 81). The isolate COLGELS falls in a separate cluster which manifested significant colony growth rate and spore germination at 35°C. A temperature of 25°C was congenial for colony growth, sporulation (cfu) and germination for all the isolates. However, *C. siamense* isolates belonging to Musae Clade of *C. gloeosporioides* species collected from Chikmagalur, Shivamogga and Uttara Kannada were able to grow well and sporulate at higher temperatures (30 & 35°C) and relative humidity of 70 per cent and also found highly virulent. While the RH of 90 per cent was congenial for growth, sporulation, germination and infection of *C. aoteaora* isolates belonging to the Kahawae clade sampled from Dakshina Kannada, Udupi and Kasaragod. The study demonstrated that temperature and humidity requirement differs with *Colletotrichum* species belonging to different clades and geographical locations.

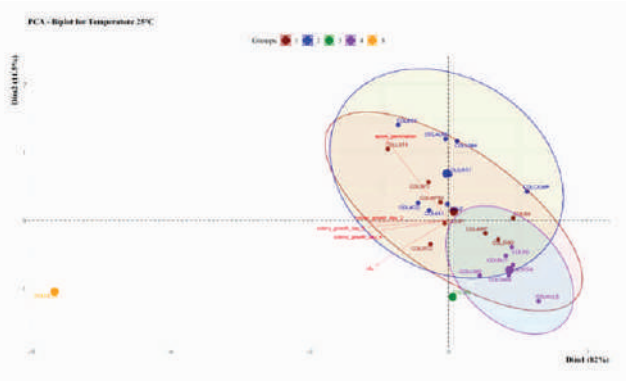


Fig. 81. PCA Biplot depicting clustering of *Colletotrichum* isolates associated with leaf spot disease of arecanut.

Evaluation of novel fungicides, botanicals and plant extracts under *in-vitro* and field conditions for the management of *Colletotrichum* diseases in palms and cocoa

Field evaluation of newer fungicide molecules *viz.,* Hexaconazole 5% EC (0.1%), Propiconazole 25% EC (0.1%), Tebuconazole 38.9% SC (0.1%), Carbendazim 12% + Mancozeb 63% WP (0.2%), Copper Sulphate 47.15% + Mancozeb 30% WDG (0.2%) and Mancozeb 75% WP (0.3%) were conducted against emerging arecanut leaf spot disease in a farmer plot at Swarga, Kasaragod District, Kerala during post-monsoon for two consecutive years (2022-24). Two rounds of fungicidal spraying at 25-30 days intervals (first round during September and Second during October), followed by application of micronutrients (Zinc sulphate, Boron and Magnesium sulphate) were followed. The disease severity was reduced to 34.4 per cent and 31.6 per cent in Propiconazole 25% EC and Tebuconazole 38.9% SC sprayed palms as compared to control.

Bio chalk for eco-friendly management of diseases

Indiscriminate pesticide use to manage plant diseases leads to several unforeseen problems like environmental pollution and health hazards worldwide. Management of plant diseases using biocontrol agents is becoming popular as it has an advantage over chemical pesticides. Among them, *Trichoderma* is of immense importance in plant disease management because of its bio-control potential against an array of phytopathogens through several modes of action. The success of biocontrol of plant diseases depends on the shelf life and efficient delivery system of biocontrol agents. In ICAR-CPCRI, *T. harzianum* (CPTD 28) has already been found very effective in the management of the majority of soil-borne pathogens in the coconut system and in addition, the isolate possesses growth promotion activity. Bio chalk is a formulation developed at ICAR-CPCRI containing *T. harzianum* (CPTD 28) for site-specific application. Bio chalk had highest colony forming units (400×10^9 cfu g^{-1}), which slowly declined after 12 months of incubation and the viability of *T. harzianum* (CPTD28) (40.4×10^9 g^{-1}) was detected up to 18 months. This formulation has longer shelf life (one and a half years) as compared to the Trichoderma talc formulation commonly recommended for the management of diseases in the coconut system. Bio chalk could be effectively used for site-specific application on bleeding patches as well as basal application against stem bleeding and basal stem rot diseases of coconut and also stem canker of cocoa (Fig. 82). In addition, it could be easily applied through the drip irrigation system.

Bio chalk Management of stem bleeding disease

Fig. 82. Bio chalk for management of stem bleeding disease of coconut

Development of cost Effective *Trichoderma-Dolomite* formulations for Coconut based cropping system

To facilitate the one-time soil application of *Trichoderma harzianum* (CPTD 28), its compatibility with various materials *viz.*, lime (calcium oxide), dolomite (calcium magnesium carbonate), and coconut husk biochar was assessed. The study revealed that *Trichoderma* was incompatible with lime, likely due to its highly alkaline nature, which negatively affects fungal viability. However, dolomite and biochar provided a suitable environment, supporting *Trichoderma* survival over an extended period. The shelf life of *Trichoderma* in dolomite remained within an acceptable range for up to six months, with a stable population of 6.2×10^8 cfu per g, monitored at monthly intervals. Building on these findings, a novel ball formulation was developed by integrating dolomite, neem cake, and *Trichoderma* to harness their combined benefits for soil health and plant growth (Fig. 83). This formulation aims to provide long-term soil conditioning by gradually releasing nutrients, maintaining optimal soil pH, and promoting beneficial microbial activity. Additionally, neem cake contributes to soil fertility and possesses bioactive compounds that help

suppress soil-borne pathogens. The *Trichoderma*-based formulation is currently undergoing pot culture evaluations to assess its effectiveness in enhancing soil structure, improving nutrient availability, suppressing plant pathogens, and boosting plant vigor under controlled conditions.

Fig. 83. *Trichoderma* dolomite ball formulation

Evaluation of effective fungal and bacterial biocontrol agents against black pod rot disease of cocoa

An experiment was laid out at ICAR-CPCRI, RS, Vittal with six treatments comprising two fungal bio-control agents (*Trichoderma harzianum*, *Trichoderma asperellum* At172), two bacteria (*Bacillus licheniformis* PAL3 *Bacillus* spp. SHIS11), 1 per cent Bordeaux and untreated control. The treatments were imposed as spray and soil drench at 1 per cent concentration. Before treatment imposition total pod count was taken in all the treatments and per cent Black Pod Rot (BPD) disease was recorded, which ranged from 2 per cent to 11 per cent. The pods were free from the disease after six months of treatment imposition.

Molecular identification and characterization of arecanut ring spot disease virus

Arecanut palm is a commercially important plantation crop valued for its nut. In this investigation, a putative novel arepavirus, named areca palm necrotic ringspot virus 2 (ANRSV2), was reported in necrotic ring spot diseased areca palms in Bantwal, Dakshina Kannada, Karnataka, India through RNA-sequencing and transmission electron microscopy (Fig. 84). Further, the presence of ANRSV2 in the diseased samples was confirmed through reverse transcriptase-polymerase chain reaction assays. In addition, by mining public domain transcriptome data for arepaviral sequences, a putative novel arepavirus was identified in *Psychotria rubra*, a non-palm host. The genome sequences of the areca palm necrotic ring spot virus were recovered in honeybees, tomato, *Onobrychis viciifolia*, and *Rhamnus heterophylla* (Fig. 85). These findings broaden the comprehension of arepaviral diversity and host range and suggest an intriguing possibility of pollen-mediated arepaviral transmission that necessitates empirical validation. Further studies are needed to understand the biology of identified putative novel arepaviruses.

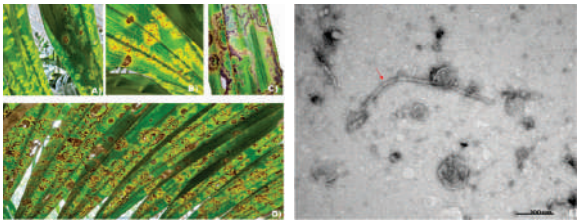


Fig. 84. Arecanut necrotic ring spot disease symptoms; A) Chlorotic ringspots on lower leaves; B) progression of chlorotic ringspots to necrotic ringspots; C) Necrotic ring spots seen on lower leaves; D) Severely infected lower leaves with necrotic ringspots; E) Flexuous filamentous particle (indicated by red arrow) of ANRSV2 in the crude sap of a diseased areca palm visualized under transmission electron microscope.

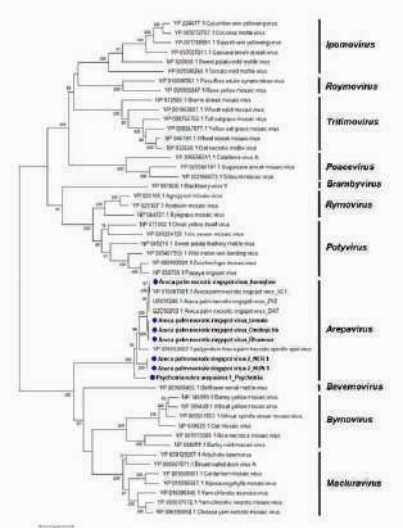


Fig. 85. Phylogenetic tree showing the relationships of identified viruses with other viruses of the family *Potyviridae* based on polyprotein sequences. The tree was constructed using maximum-likelihood method and LG+G+I+F model with 100 bootstrap replicates. Bootstrap support values more than or equal to 50 per cent are only shown. Viruses/viral isolates identified in this study are shown in bold and indicated by blue dots.

6.6

Extraction and Characterization of Bioactive Compounds and Value Addition / Pre- and Post- Harvest Mechanization in Palms and Cocoa

Current and future climate suitability for arecanut (*Areca catechu* L.) in India

Climate change poses a significant impact on plant growth, physiology, and distribution patterns. The arecanut (*Areca catechu* L.), a tropical crop with a lifespan of 60–70 years, is particularly susceptible to various abiotic and biotic stresses. Understanding its adaptive responses to climate change is crucial. To evaluate the crop's potential adaptability, the Biomod2 ensemble platform was employed for species distribution modelling. The study focused on India, using 894 occurrence points and 9 climatic variables, divided into 80 per cent training and 20 per cent validation sets. The ensemble of six models achieved high accuracy, with area under the curve (AUC) values of 0.943 and true skills statistics (TSS) of 0.741. The analysis classified the study area into five categories: very high, high, moderate, low, and very low suitability. Projections were made for the 2050s and 2070s under two shared socio-economic pathways (SSP 2–4.5 and SSP 5–8.5) (Fig. 86). The findings indicated a shift in climate-suitable areas, with regions currently categorized as 'very high' or 'high' moving towards 'moderate' or 'very low' suitability, underscoring the need for adaptive strategies to maintain crop productivity. Karnataka, which accounts for over 50 per cent of the current cultivation area, emerged as particularly vulnerable, with more eastern regions falling under 'very low' and 'low' suitability. Conversely, in the northeastern part of India, a shift in highly suitable areas was observed from the northwest to the southwest. Overall, the model highlights the urgency of focusing on some western and southern interior regions for adaptation measures, while parts of the northeast may offer potential for future cultivation.

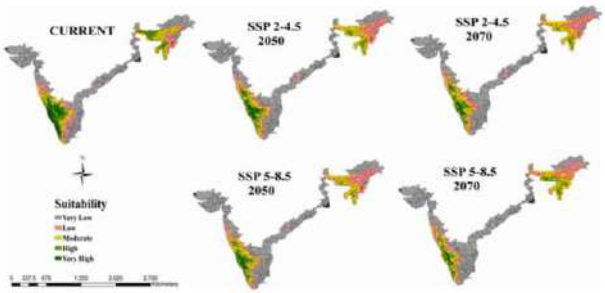


Fig. 86. Climatically suitable regions for arecanut cultivation under current conditions and projected scenarios (SSP 2–4.5 and SSP 5–8.5) for the 2050s and 2070s, as analyzed using an ensemble modelling approach

Flavonoids and methylxanthines in cocoa beans from diverse geographic regions of India

Influence of geographical regions on the polyphenol and methylxanthine content, as well as the antioxidant activity of fermented cocoa beans from various cocoa-growing areas in India was investigated. Cocoa samples were collected from multiple locations across India including the Maidan region in Karnataka, Sagara in Malnad (Karnataka), Holenarasipura in Hassan, Semi-Malnad in Karnataka, Kodaikanal in Annamalai, Coimbatore in Tamil Nadu, Chintalapudi in Eluru (Andhra Pradesh), Wayanad in Kerala, and Lingapalem in Eluru (Andhra Pradesh) (Fig 87).

The biochemical analysis revealed significant variations in antioxidant potential, measured through total phenolic and flavonoid content. Cocoa beans from Wayanad, Kerala, and Sagara, Maidan (Karnataka) showed the highest total phenolic content at 10.95 ± 0.665 mg GAE per g and 8.11 ± 0.253 mg GAE per g, respectively. Notably, free fatty acids in cocoa fat were highest in Chintalapudi, Eluru (17.5 mg KOH g^{-1}) and Wayanad (14 mg KOH g^{-1}), indicating a higher risk of degradation. Protein content also varied significantly across regions, ranging from 11.1 ± 0.95 to 17.35 ± 0.52 per cent. The study standardized an HPLC-based profiling method to quantify phenolics and flavonoids including theobromine, (-)-epicatechin, and caffeine. Theobromine levels ranged from 1.1045 ± 0.00 to 3.1128 ± 0.0245 mg g^{-1} DW, while caffeine content varied from 0.1095 ± 0.00 to 0.5400 ± 0.0038 mg g^{-1} DW. (-)-Epicatechin levels showed notable variation, from 0.04475 ± 0.0011 to 1.4057 ± 0.0129 mg g^{-1} DW, with recovery rates for bioactives between 80.35 per cent (for (-)-epicatechin) and 100 per cent (for theobromine) (Fig 87b). The established method proved to be reproducible andreliable, making it a valuable tool for characterizing and ensuring the quality control of methylxanthines and flavanols in cocoa samples from diverse regions in India.

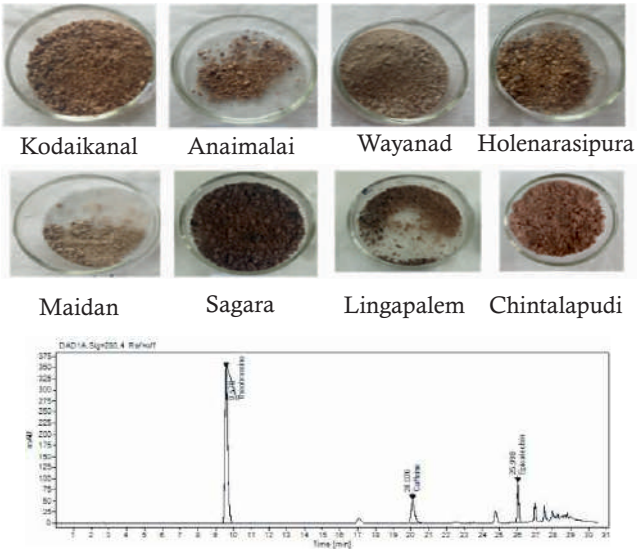


Fig. 87 (a). Defatted cocoa nibs collected from different geographic regions of India
(b) Sample HPLC- chromatogram depicting the separation of methylxanthines and epicatechin extracted from cocoa beans.

Untargeted metabolite analysis of Virgin coconut oils (VCOs)

Untargeted metabolite analysis of virgin coconut oil (VCOs) produced by the fermentation method revealed the presence of several bioactive compounds, including tetratetracontane (anticancer properties), L-fucose (prevents tumor cell colonization), 7, 3', 4', 5'-Tetramethoxyflavanone (a flavone compound), and 4, 5-dihydro-5-(phenoxymethyl) -N-2-oxazolamine (antidepressant activity). Similarly, VCO obtained through the hot process showed characteristic compounds such as 3, 5, 9-Trioxa-4-phosphaheneicosan-1-aminium, 4-hydroxy-N, N, N-trimethyl- (with anti-inflammatory, antioxidant, and cardio protective properties), and 13-Heptadecyn-1-ol (a novel phenolic compound) (Fig. 88). In contrast, the oil expelled from dried gratings contained Ethyl iso-allocholate (with anti-cancer properties) as a characteristic compound. The medicinal properties of virgin coconut oil (VCO) are attributed to its lauric acid content, tocopherols, phenols, various bioactive compounds, and antioxidant activity.

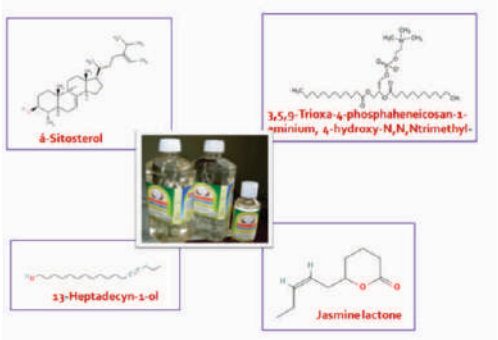


Fig. 88. Bioactives of VCO-Hot as analyzed by GC-MS

Flavoured coconut mylk

Defatted coconut flour (DCF) obtained from virgin coconut oil processing was utilized for the extraction of low fat coconut milk. The milk extracted was utilized in the development of ready-to-drink flavoured coconut mylk. The extracted coconut milk had 69.60 ± 0.39 per cent moisture, 14.85 ± 0.31 per cent crude fat, 11.65 ± 1.35 per cent total carbohydrates, 2.8 ± 0.26 per cent crude protein, and 1.10 ± 0.02 per cent total minerals (ash). The optimum level of pH, fat content, sweetness, emulsifier, skimmed milk powder, colour, and flavor

in the milk was standardized. The optimized composition is the second extract of coconut flour with 4 per cent fat with Almond (Badam) flavor. The moisture, fat, carbohydrates, protein, and ash content of the flavoured coconut milk was 82.45, 4.17, 9.62, 2.85, and 0.92 per cent, respectively, contributing to 94 kcal. The inference of the study revaluated that pasteurized flavoured milk would stay fresh up to 18 days under refrigerated condition and further increase in shelf life is possible through retort processing. The phenolic content (2333 µg mL^{-1}) and antioxidant activities of the flavoured coconut milk were DPPH: 2775 µg TE mL^{-1} and FRAP: 95.85 µg TE mL^{-1} respectively. This technology of flavoured coconut milk was unveiled as "Kalpa Bliz" on 2 September 2024 by Shri. P. Prasad, Agriculture Minister, Govt. of Kerala on the occasion of World Coconut Day celebrations (Fig. 89).

Fig. 89. Kalpa Bliz - fortified coconut milk

Sweet kernel of 'Mohachao Narel' for frozen coconut delicacy

The kernel of the 'Mohachao Narel' variety of coconut, which belongs to the Ratnagiri district of Maharashtra, is characterized by a sweeter kernel compared to coconut kernel in general. Total solids, total soluble solids, total sugar, and reducing sugar content in the endosperm milk extract of sweet and non-sweet kernel of the variety were 56.14±10.74 & 49.72±5.98 per cent, 20.23±4.35 & 15.43±5.41° Brix, 12.85±5.83 & 7.66±2.34 per cent and 1.184±0.23 & 1.03±0.42 per cent, respectively. Two frozen delicacies were successfully prepared with sweet kernel extract without sugar *i.e.* 0 per cent sugar, and added with 8 per cent refined sugar and compared with the commercial coconut delicacy (16% sugar) Furthermore, the panel found the sugar-free version acceptable.

Fig. 90. Frozen coconut delicacy

Coconut milk residue to substitute cocoa butter in bean to bar dark chocolate

Bean to bar dark chocolate is mainly processed with cocoa nibs, cocoa butter, and sugar. This study investigated the potential of incorporating coconut milk residue (CMR) as an alternative to cocoa butter, in varying proportions (0, 5, 10, 15, and 20%), addressing the high cost and limited availability of cocoa butter. The formulations were assessed based on proximate composition, functional quality parameters, mineral content, sensory evaluation, texture, and color attributes. Results indicated that incorporating CMR significantly influenced the ash, protein, fat, carbohydrate, and fiber content of the chocolates. While CMR addition led to a decrease in antioxidant potential, CMR demonstrated improved fiber content and enhanced sensory acceptability. The optimized 10 per cent CMR formulation exhibited superior quality, making it a promising option for low-investment chocolate production. The proximate composition of the optimized chocolate included moisture (1.58±0.09%), crude fat (38.09±0.25%), total carbohydrate (49.99±0.07%), crude protein (8.25±0.04%), ash (1.86±0.14%), and fiber (10.68±0.71%). Color analysis (L, a, b values) confirmed a darker appearance, with the product remaining stable under ambient conditions. Furthermore, the correlation analysis of the variables was conducted, highlighting

their complementary effects on the final product. The optimized product contains 60 per cent cocoa nibs, 10 per cent CMR and 30 per cent sugar (Fig. 91). This study highlights the potential of CMR as a sustainable and cost-effective alternative for enhancing fiber-rich bean-to-bar chocolate formulations.

***A-5% CMR; B-10% CMR; C-15% CMR ; D-20% CMR**

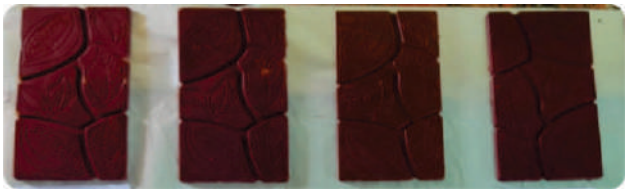


Fig. 91. Chocolate made with
60% cocoa nibs, 10% CMR and 30% sugar

Spice infused frozen coconut delicacy

The study focused on fortifying coconut milk-based frozen delicacy (ice cream) by incorporating cinnamon, clove, and cardamom (Fig. 92). Three formulations were developed with 1per cent incorporation and assessed for the basic ice cream quality including pH, titratable acidity, density, over run and sensory attributes, with the cinnamon flavoured variant emerging as the best. These spiced versions also showed enhanced antioxidant activity, with a total phenolic content (TPC) of 48.74 ± 100.79 mg per 100g GAE and improved DPPH scavenging activity.

Fig. 92. Flavoured coconut delicacies

Kalparasa infused coconut flakes

A novel methodology has been developed to produce ready-to-eat coconut flakes by employing various drying techniques following osmotic dehydration in kalparasa syrup (50° Brix) which significantly improved the bioactive profile of the developed flakes. The infusion of kalparasa syrup enhances the taste, flavor, color, and nutritional value of the flakes. Coconut flakes demonstrated superior nutritional qualities, including improved rehydration ratio, hygroscopicity, bulk density, and tapped density. Additionally, analysis showed substantial increases in protein, carbohydrate, and fat content, along with elevated total phenolic content, antioxidant activity (DPPH), and ferric reducing antioxidant power (FRAP). Drying experiments conducted at 55, 65, and 75 °C aimed to determine the optimal drying method and temperature indicated that coconut flakes dried at 65 °C using, infrared-assisted hot air dehydration (IRAHAD) exhibited superior nutritional and physical properties (Fig. 93). Key findings include a Hausner ratio of 1.04, Carr's index of 4.22, rehydration ratio of 2.37, hygroscopicity of 1.68 per cent, bulk density of 0.552 g per mL, tapped density of 0.610 g per mL, protein content of 3.92 per cent, carbohydrate content of 33.86 per cent, fat content of 34.29 per cent, ash content of 1.92 per cent, total phenolic content of 105.38 mg GA per 100 g, DPPH activity of 88.81 per cent, and FRAP value of 0.00893 mg TE per 100 g. Future studies are recommended to evaluate the shelf life of the flakes, examine the impact of different packaging materials, and further explore the biochemical properties of the dried samples.

Fig. 93. Coconut flakes prepared from Infrared assisted hot air dryer

Baked coconut chips: enhanced nutritional benefits

Coconut chips, commonly produced through frying, have garnered significant popularity. The quality of fried coconut chips of thickness 0.5 mm and 1.4 mm,

made using sunflower and coconut oil were analyzed. Deep frying was done at 160 °C for both types of oil. The coconut oil-fried chips, regardless of thickness, exhibited superior sensory attributes (i.e. appearance, colour, crispiness and flavour). All sensory attributes (except appearance) were rated the highest for coconut oil fried chips. The biochemical properties of chips fried in both oils were largely similar, yet coconut oil-fried chips displayed slightly better characteristics compared to their counterparts. For instance, the 0.5 mm thick coconut oil-fried chips were noted for their improved protein content and fat content, leading to a higher overall acceptability of the 0.5 mm thickness. With growing health concerns, consumers are increasingly seeking reduced-fat products, prompting the development of nutritious alternatives through recipe and process modifications. While coconut-based products are gaining popularity, limited research exists on baked coconut chips, particularly regarding the impact of baking temperatures and product thicknesses. This study bridges the gap by creating baked coconut chip samples (BCSs) as healthier alternatives to traditional fried chips. Baking experiments were conducted at 140, 160 and 180°C, identifying 160°C as the optimal temperature for achieving a balance between processing time and product quality. Additionally, baked coconut chips were compared with those that were first dried and then baked (dried baked coconut chip samples [DBCS]). Among the trials, 0.5-mm-thick coconut chips baked at 160°C demonstrated superior sensory qualities and biochemical properties, including 3.13 per cent moisture content, 1.13 per cent ash, 40.49 per cent fat, and notable antioxidant activity (Fig. 94).

Fig.94. Baked coconut chips

Rotary dryer cum flavour coating machine for coconut chips

The rotary drum with a flavor-coating function is an advanced machine designed to dehydrate coconut chips while simultaneously applying colors and flavors to the dried product (Fig. 95). With a capacity of 5-7 kg of coconut slices, the machine is optimized for producing salted and spicy coconut chips. Trials revealed that dehydrating 0.5 kg of coconut slices takes approximately 25-30 minutes. Equipped with a stainless steel rotary drum holding up to 7 kg, the machine operates using a 0.5 hp motor at 30 rpm, along with a 1 kW heating coil providing hot air at a velocity of 0.1 m per s. The production of 5 kg of coconut chips is completed in about 2 hours. In contrast, the conventional method requires a 4 kW heating coil to run for nearly 6 hours to produce 10 kg of chips. This machine achieves a 50 per cent reduction in both drying time and energy consumption.

Fig. 95. Rotary dryer

Infrared-aided hot-air drying of coconut

Properly dried coconut kernel, or copra, is essential for producing coconut oil with consistent quality, taste, aroma, and nutritional properties. Various drying techniques and temperatures were studied to assess their effects on the drying kinetics and quality of copra. The initial moisture content of coconut kernels, ranging from 50–55 per cent (w.b.), was reduced to 5–6 per cent (w.b.) through the drying process. The individual and combined effects of infrared drying (IRD) and hot-air drying (HAD)

have been evaluated to improve copra quality. Three methods—IRD, HAD, and infrared-assisted hot-air drying (IRAHAD) - were employed, with drying temperatures set at 50, 60, and 70°C and a constant airspeed of 2 m per s. Optimal results were obtained using the IRAHAD method at 60°C, which preserved a crucial fat content of 68.4 per cent, essential for maximizing oil extraction from copra, while achieving significantly higher drying rates (Fig. 96). Notably, the drying rates for IRAHAD were twice as high as those for IRD and HAD. At a drying temperature of 60°C, the logarithmic model best fit the HAD data, while the diffusion approximation model was most suitable for IRAHAD.

Fig. 96. Infrared assisted hot air dryer

The impact of different drying techniques -hot air drying (HAD), infrared drying (ID), and infrared-assisted hot air drying (IRAHAD) - on the quality of coconut oil extracted from copra was also evaluated. Fresh oil samples extracted from copra dried with these techniques displayed a zero peroxide value, indicating high quality. Among the methods, IRAHAD at 60 °C proved most effective, yielding high-grade copra and superior oil quality while preserving essential nutrients. The physical and biochemical properties of coconut oil produced via IRAHAD at 60 °C, such as specific gravity, refractive index, moisture content, antioxidant capacity, and total phenolic content, confirmed its enhanced quality (Fig. 97)

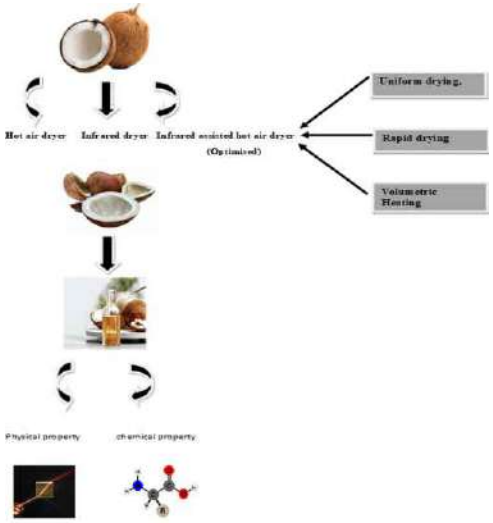


Fig. 97. Effect of different drying methods of coconut on its physicochemical properties

6.7

Technology Evaluation, Impact and Entrepreneurship Development

The social science activities for societal outreach, augmenting awareness on technologies and activities of institute in the coconut growing states of the nation, training program for stakeholders, area wide participatory demonstration of technologies, research projects including participatory research, price spread and value chain of mandate crops, agri business incubation, entrepreneurship development and statistical investigations of coconut, areacanut and cocoa are covered.

Training Programs for farmers

A total of 33 training programs for farmers of Thiruvananthapuram, Kollam, Alappuzha, Kottayam, Thrissur districts of Kerala and three districts of Tamil Nadu was organized. The main focus of the training was on palm health management, treatment of Rhinoceros breeding sites with *Metarhizium* fungus, Coconut Cropping systems for women farmers and intercropping of Groundnut/Tubers/sweet potato/upland paddy/fodder in coconut garden and training for Scheduled caste farmers on coconut health management.

Exposure visit and field programs

Seven exposure visits benefiting 218 farmers of various panchayats (Kumarakom, Aranmula, Attingal, Varapetty) were organized for learning and discussing on the farmer oriented research activities and first-hand information on advisory services, training and outreach programs through laboratory visits and interactions with scientists, demonstration and experimental field visits.

Awareness program and distribution of *Metarhizium majus,* thegreen muscardine fungus (GMF) to the coconut farmers of Varapetty panchayath was organized on 7 July 2024 for the bio-suppression of coconut rhinoceros beetle.

Stage-specific parasitoids (*Goniozus nephantidis* and *Bracon brevicornis*) were released on 19 November 2024 in Kanniyakon (Aruppukara Panchayat, Kottayam) infested by black headed caterpillar in 50 acres of coconut plantation with the support of State Department of Agriculture.

Institute visit by students

Lectures and Interactive sessions conducted for school, college and agricultural students of various educational institutions wherein 683 students participated. The institutions included Navodaya Vidayalaya, Chennithala, PM Shri programme, ANGRAU, gifted students from various schools of Alappuzha District, two batches of Block Resource Centre (BRC) sponsored students Alappuzha District, St. Aloysius College Edathva, Viswabharathi Model School, Krishnapuram, Research station module as part of RAWE programme for 15 BSc (Ag.) students from COA, Vellayani during 8-13 February 2024. B.Sc Botany (Model II) degree students of DB college, Pampa, Three post-graduate students in the discipline of Entomology from KAU were trained on staining of white fly puparium for morphological diagnosis and characterization, MSM college, Kayamkulam, undergraduate students from NSS college,

Changansseri, Agricultural diploma students from Onattukara Regional Agricultural Research Station (ORARS), Kayamkulam, B.Sc. Agricultural students of RARS, Kumarakom in Deeksharamb programme and St John's Higher Secondar School on the prospects of Agriculture education in Mini-DISHA programme (Fig. 98).

Fig. 98. Students visit to ICAR CPCRI, RS, information gallery

Training program for Extension officials

Three programs for extension officials were organized on rugose spiralling whitefly and root (wilt) disease identification and management was conducted at Kayamkulam during 4-6 March 2024 and 2 July 2024 for 60 officials of Department of Horticulture, Tamil Nadu sponsored by Coconut Development Board (CDB). Scientists of ICAR CPCRI, RS, Kayamkulam delivered sessions in the National training programme on IPM on Biodiversity, Biocontrol and Biosecurity issues associated with coconut organized by CIPMC, Kochi on 09 July 2024 for the Agricultural Officers of Kerala. Organized diagnostic field visit of multidisciplinary team to the Palmyra fields affected by drying symptoms in Tirunelveli district, Tamil Nadu on 7 February 2024.

National Seminar and workshop

Organized two days National Seminar on 'Climate Smart Agriculture for Sustainable Soil and Plant Health in Plantation Crops' during 13-14 June 2024. About 100 delegates, including scientists, faculty, students and researchers from different parts of the country as well as from abroad participated the event. Organized workshop on Biofuels at ICAR-CPCRI, Regional Station, Kayamkulam on 13 June 2024 which was attended by eminent scientists and students.

Important days organized

National Science Day Programme was organized with a workshop on 'climate change in plantation sector' on 28 February 2024 at Kayamkulam. Director, ICAR- CPCRI inaugurated the programme with key note lectures by experts. Elocution and quiz contests were convened for the college students to inculcate passion-studded science. More than 80 students and farmers participated the event (Fig. 99).

Fig. 99. National Science Day 2024 participants

Organized International Yoga celebration at the Station on 21 June 2024 and the staff members performed different yogasanas. Convened World Coconut Day celebration on 02 September 2024, empowering SCSP farmers on inclusive coconut production, distribution of coconut seedlings and field-level acquaintance of composite cropping (Fig. 100). Farmers were also exposed on experience sharing of a progressive coconut entrepreneur.

Fig. 100. World Coconut Day 2024, ICAR CPCRI, Regional Station, Kayamkulam

Laying out Demonstration Plots (LoDP) program on integrated root (wilt) disease management in Tamil Nadu

ICAR CPCRI, Regional Station, Kayamkulam, is implementing the "Integrated management of coconut root (wilt) disease" in four clusters at Kanakapillaivalasu, Vadakkarai, Kadayanallur and Puliyara of Tenkasi district in 100 ha area. The scheme is aimed at integrated management of coconut root (wilt) disease through technologies evolved by ICAR-CPCRI. The programme is funded by Coconut Development Board (Govt. Of India), Kochi and implemented with the support of Dept. of Horticulture (Tenkasi, Kadiyanallloor and Puliyara). The programme was launched on 15 November 2024 by Dr. K.B. Hebbar, Director, ICAR-CPCRI, Kasaragod in the presence of Sri Elango, DD (Horticulture), Sri Aravazhi , Director (CDB) and Dr. Regi J. Thomas, Head, ICAR-CPCRI, Kayamkulam (Fig. 101). A technical pamphlet on root (wilt) disease and a technical session on the palm health management was also conducted.

The activities and interventions implemented were surveillance on RWD and exotic whiteflies on coconut in Pollachi, Tamil Nadu, facilitated the interface meeting on coconut technologies at CRS, Aliyarnagar and an action plan for the management of root (wilt) disease and exotic whiteflies in Tamil Nadu was evolved. As part of the LoDP program, diagnostic field survey on root (wilt) disease was conducted in in three blocks of Tenkasi district and recorded the preliminary data on disease incidence in the identified gardens. An awareness campaign on LoDP programme at Tenkasi, Tamil Nadu on the integrated management of root (wilt) disease was organized on 1 August 2024, 09 October 2024 and 29 October 2024 and distributed cowpea seeds to farmer beneficiaries for basin management. Organized training for farmers at Puliyara in Tenkasi district on 13 December 2024 and Vadakarai, Kanakkappilllai Valasari, Kadayanlloore in Tenkasi district on 19 December 2024 and distributed CPCRI product 'Kera Probio.'

Farm Advisory report

Various farm advisory services were offered to farmers and other stakeholders through Agricultural

Fig. 101. Launching of LoDP on integrated root (wilt) disease management in at Tenkasi district, Tamil Nadu

Technology Information Centre numbering 3538, 7155, 2696, 342, 3853 and 64 farmers' queries at Kasaragod, Kayamkulam, Vittal, Kahikuchi, Kidu and Mohitnagar, respectively on various aspects of crop management were replied as part of farm advisory services through ATIC.

Farmer FIRST Programme (FFP) Participatory technology integration to empower and ensure livelihood security of farmers in Alappuzha district

The Farmer FIRST Project has been implemented since 2016-17, in Pathiyoor panchayat of Alappuzha district and the social, individual-based farm models was up-scaled to seven panchayaths namely Pathiyoor, Devikulangara, Krishnapuram, Arattupuzha, Cheppad, Muthukulam, Kandalloor panchayaths, and Kayamkulam Municipality in Alappuzha District, Kerala. The total Area of FFP interventions is 19,979 ha, in 113 wards of panchayats and 44 wards of municipality.

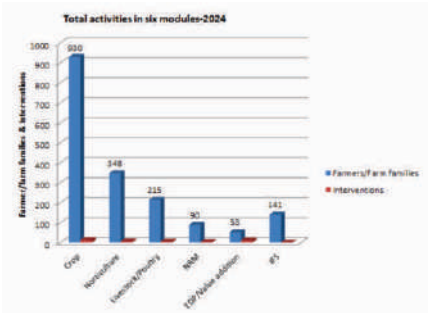


Fig. 102. Total activities in six modules- 2024

The intervention modules during 2024 were on Crop (13 technologies, 930 farmers), Horticulture (6 technologies, 348 farmers), Livestock and Poultry

(5 technologies, 215 farmers, 96 animals & 3400 birds), Natural Resource Management (3 technologies, 90 farm families), Value addition and EDP (11 technologies, 53 units) and Integrated Farming Systems (IFS) (1 technology, 141 farm families). Thus, in the reporting period, a total of 39 technologies from various sources in six modules benefiting 1647 farmers were achieved in a 1600-hectare area. The critical inputs provided to FFP participant farmers during this period were 385.5 kg of Seeds/planting materials of HYV of various crops for area spread and adoption, 3.308 tons of Chemical fertilizers (Soil test-based nutrition management) for various crops, 20 kg and 22.5 liters of bio and chemical Insecticides/Fungicides, in which the farmers shared 40 per cent cost, ensuring their participation.

Improvement in Livelihood capital

The livelihood capital of FFP participant farmers improved in terms of financial, human, physical, social and natural capitals of farmers, farm women and rural youths. Results are depicted in Fig. 103.

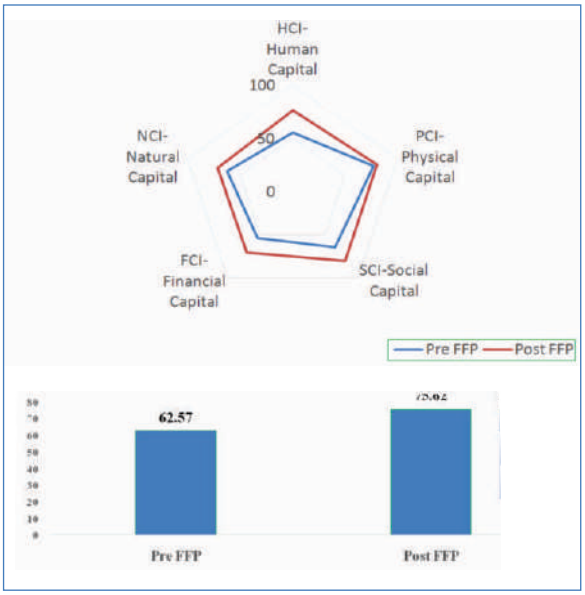


Fig. 103 Improvement in livelihood index – Impact of FFP

The highest livelihood capital improvement attained was in the human, and social capitals. Financial capitals improvement was distributed among landless and land holders and the capital quantum seems to be comparatively low but distributed among the communities equitably, Improvement in Physical capital, was the processing facilities established in FFP for coconut, turmeric, livestock products, mushroom etc. The overall livelihood index showed improvement from 62.57 (pre FFP) to 75.62 (post FFP) indicating the impact of interventions in livelihood status of FFP beneficiaries.

Technological intervention combinations

Bio-nutri priming of polybag WCT coconut seedlings is in progress at FFP community nursery using Kera probio, Trichoderma and Kalpa poshak individually and in combination along with control. The treatments of Kera Probio combined with Trichoderma and the combination treatment with Kalpa poshak foliar spray, Trichoderma and Kera Probio had recorded better attributes of polybag coconut seedlings.

Groundnut as inter crop in coconut gardens

Onattukara sandy loam tract of Alappuzha district is suitable for groundnut cultivation. On-farm and off-farm training programs with method demonstration on intercultural operations in 75 wards of FFP panchayats were carried out with procured G-252 (variety from University of Agricultural Sciences, Dharwad) and *Kadiri Lepaskhi(*from ARS, Kadiri, ANGRAU) varieties of groundnut. The productivity obtained as inter-crop in coconut gardens ranged between 800 and 1100 kg per ha. The higher yield increased farmers income by Rs. 65,000 per year and low pests and diseases recorded as added advantage for chemical free fodder.

Fig. 104. Groundnut harvest from FFP beneficiary farm in Onattukara, Alappuzha, Kerala

HYVs and area expansion of fodder cultivation among IFS farmers

HYVs of fodder grass from Kerala Agricultural University and Tamil Nadu Agricultural University viz., Red Napier, Super Napier, Susthira, CO-3, and CO-5 were introduced to increase the yield and improve the health of animals. Farmers ranked Co 5 as the best suited based on palatability by the animals, quick regeneration after cutting in the first phase. Based on the feedback, area expansion with the variety Co-5 of Tamil Nadu Agricultural University were carried out.

Fig. 105. Fodder production under the coconut cultivation

Price spread and domestic value chain studies of arecanut

A field survey was conducted to understand the marketing aspects of arecanut with initial respondents being traders and merchants from the production centers of chali in Northern Kerala and Dakshina Kannada District of Karnataka. In the initial phase, information was gathered from major private traders as well as cooperative sectors operating in the sector. The main idea was to gather the basic information on trade practices followed and snowball it into the major consuming markets (Ahmedabad, Rajkot, and Nagpur). Subsequently, snowballing technique was deployed to identify the major traders in the consuming markets. The major destination of the best quality chali was Ahmedabad and Rajkot. The traders, sales representatives, cutting agents, retailers (including Pan waalah's) were contacted in Ahmedabad and Rajkot for elucidating information. Survey was also done in the second major hub, the Nagpur, which handles the second grade arecanut mainly originating from Central and Southern Kerala.

Prima facie it has been observed that, for the past six months, the illicit/illegal import has been rampant (almost 50% share of the total market). Since the prices are high, the quality consciousness on the best markets (hubs of Gujarat), has deteriorated. We would also be examining global trade data and trade practices, including legitimate and illegitimate imports. The illicit/disguised imports of arecanut have been raised as a major issue by the traders with whom we have interacted.There has been grave concern over the increasing illegal imports of arecanut into the country. There were 260 cases of illegal imports busted by the concerned agencies in 2021–22, and they increased to 454 in 2022–23. In 2023–24 (up to December 2023) there were 416 cases registered, amounting to 6760 MT of quantity seized. The traders reported on the smuggled entry through various borders, including Silchar and Falakanta. Furthermore, reports suggest that arecanuts, disguised as millets, dates, or dry fruits, are a common import. A rough estimate indicates that the actual import intensity is around 10% of the total production. Exploiting the loopholes in SAARC and SAFTA agreements through violations of the rule of origin is another area of concern. Prima facie, it has been observed that, for the past six months, illicit imports have been rampant (almost 50% of the total market). Since the prices are high, the quality consciousness in the best markets (the hubs of Gujarat), has deteriorated. This scenario has certainly been detrimental to the arecanut farmers of Kerala and Karnataka, and in the long run, it will deteriorate the value chain of arecanut.

Production economics of mandate crops

An assessment was done on integration of MSP of copra with the price of coconut received by the farmers. Usually, fluctuation in price occurs due to changes in market conditions aroused in response to seasonal and annual variation in production apart from the competition from other edible oil,

particularly palm oil. Coconut prices in India have been historically integrated with coconut oil prices. Therefore, indubitably the coconut prices received by the farmers are integrated with the MSP of copra. In general, the farmer prefers to sell fresh coconut when the price of coconut is attractive. He receives a remunerative sum in his hand immediately and can get rid of processing and transportation charges. Contrary to this, if the copra and oil prices are lucrative; the farmer prefers to do at least primary level processing, augmenting farm-level copra production. Therefore, the MSP for copra fixed at higher levels would certainly influence and act as an incentive for the primary value addition in coconut. It should be in such a way that the MSP ensures an incentive for processing to the coconut farmers compared to that of selling fresh coconut. Other pertinent factors in this context of discussion are lack of effectiveness and efficiency in copra procurement by the agencies and inadequate infrastructural facilities for copra storage.

Trade policy and price analysis of mandate crops

A preliminary analysis of cocoa scenario in India and world, considering the surging market prices was done. The global cocoa production is predominantly centred on Ivory Coast and Ghana, rendering the market exceedingly susceptible to the conditions affecting the harvests in these countries. In the period of 2023-24, adverse weather conditions, diseases, and the ageing of cocoa trees had a detrimental impact on the production in Ivory Coast and Ghana, which together account for 60 per cent of global cocoa production. As a result, there was a significant global scarcity of cocoa, leading to a surge in the price of cocoa to USD12,000 per ton in the international market. Upon further analysis, it is apparent that the current price increase was precipitated by the interconnected effects of climate change and El Nino. These factors resulted in the proliferation of cocoa pests and diseases, including black pod disease and cocoa swollen shoot virus disease in cocoa-growing regions, as well as erratic rainfall and elevated temperatures. Together, these climate-induced disruptions have significantly diminished yields. The proliferating supply shortage is evident in the fact that the Ivory Coast shipped 1.5 million tons of cocoa to overseas locations from October 2023 to May 2024, a 30 per cent decrease from the same period last year. According to the International Cocoa Organisation (ICCO), there will be a deficit of 3,74,000 metric tons in cocoa production compared to demand in the 2024 season. Another source of scarce supply is structural issues, such as the ageing of trees in the main cocoa growing tracts. In general, producers provide minimal long-term investment for cocoa trees. Due to the low-income predicament that cocoa farmers are in, there is minimal replanting in major cocoa-growing regions. As a matter of fact, cocoa farmers receive only a small portion of the high value commodity chain of cocoa-based products.

In India, the impact of surging cocoa prices was very much reflected in the domestic prices, wherein in the month of June 2024, the domestic prices hovered around Rs. 600 per kg of dry beans, and Rs. 190 per kg of wet beans.The country's cocoa production is small compared to the rest of the world, but it has been slowly growing. Nevertheless, it is still not enough to meet domestic demand, which makes the imports inevitable. In response to the challenging situation regarding cocoa prices, prominent Indian chocolate makers have introduced moderate price hikes up to 9 per cent to partially counterbalance the escalating expenses. Significantly, their primary focus lies on enhancing internal operations by enhancing the efficiency in the domestic cocoa value chain.

In the case of coconut, the presence/supply of adulterated and blended coconut oils is directly linked to the rise in coconut oil prices. Whenever the prices of coconut oil escalated much above the normal levels, the arrival and presence of adulterated coconut oil (even branded) was on a surge and in this context, Government of Kerala alone had banned umpteen brands of coconut oil from the retail markets. As it has been suggested by the Commission for Agricultural Costs and Prices (CACP), an efficient and frequent monitoring system would certainly help to control such practices, and there is a need to have a system to control the market hoarding which leads to artificial supply crunch in copra; that may eventually lead to abnormal rise in coconut oil prices.

In order to encourage a more favourable price system for domestic coconut sector, coconut oil should be distributed through the public distribution system in place of palm oil. Rather than importing palm oil from other countries at a cost of around Rs 150 per kg and selling it in the PDS outlets with at a subsidised rate, the government should procure coconut from farmers. If the government procures copra for the PDS at an appropriate price, it will incentivise coconut producers to persist in their agricultural endeavours. Although the cost of coconut oil exceeds that of palm oil, extending the same subsidy currently allocated to palm oil will benefit both consumers and coconut growers.

Global value chain of coconut products

In the case of value-added products of coconuts, a comprehensive field study was conducted covering 30 manufacturing cum export units across Kerala, focusing on operations related to coconut oil, virgin coconut oil (VCO), coconut milk, coconut chips and byproducts. Data have been collected on production processes, economic aspects, export challenges, food safety standards followed and market dynamics. Comprehensive data were collected from units processing up to 900 MT per month, exporting to regions including the Middle East, UK, and Africa. Competitive advantages like the "Malabar" tag and challenges from low-cost exporters such as Indonesia and Sri Lanka were identified while delving into export dynamics. The major challenges include high production costs in Kerala due to labor charges and raw material scarcity, marketing hurdles from cheaper imports and adulterated products, limited export opportunities due to inadequate organic certifications and competition. A comprehensive database on food safety standards adhered to during the export of coconut products to various countries were developed. The data, including details on consignment rejections and corrective actions, highlights the enforcement of food safety protocols sourced from platforms like Rapid Alert System for Food and Feed (RASFF), FDA Import alerts, Food Standards Australia New Zealand (FSANZ), Canadian Food Inspection Agency (CFIA), International Food Safety Authorities Network (INFOSAN) etc. The database provides valuable insights, such as identifying countries with the highest rejection rates, the largest exporters of coconut products, the most common causes of rejection, and the diverse approaches adopted by different countries to address these issues.

Statistical investigations for refinement of research methodology

Various applications of statistical methods in plantation studies provide valuable insights that drive informed decision-making.

Climate Suitability Predictions for Coconut Cultivation

Coconut cultivation is highly sensitive to climatic variability, making it imperative to develop predictive tools that support sustainable agricultural planning under future climate scenarios. In this study, multiple machine learning techniques were applied to improve the predictive accuracy and robustness of a coconut climate suitability model. The algorithms evaluated included Decision Tree (DT), Random Forest (RF), Artificial Neural Network (ANN), Support Vector Machine (SVM), and Gradient Boosting Machines (XGBoost). Using district-level spatial data from the Coconut Development Board and 55 climate-related variables derived from CMIP6 downscaled projections (WorldClim v2.1), models were developed across four future 20-year intervals (2021–2040, 2041–2060, 2061–2080, and 2081–2100). The SVM model demonstrated superior performance, achieving the highest accuracy of 99.65%, and was selected for final suitability mapping. Feature selection identified 15 influential variables from the initial 55, including bioclimatic and temperature-based indicators such as Mean Temperature of the Coldest Quarter (BIO11), Isothermality (BIO3), Temperature Seasonality (BIO4), Minimum Temperature of the Coldest Month (BIO6), Temperature Annual Range (BIO7), Precipitation of May, October, and November, Maximum Temperature of January and February, and Minimum Temperature of January to March, November, and December.

Under the low greenhouse gas concentration scenario (RCP2.6), projections for the 2040–2060 period show that the major coconut-growing

states—Karnataka (185,824 sq km), Andhra Pradesh (160,748 sq km), Tamil Nadu (130,171 sq km), and Kerala (39,028 sq km)—are expected to retain vast tracts of land with high climatic suitability for coconut cultivation (Fig. 104). In total, these states alone account for at least 5.2 million hectares of highly suitable area. In addition, emerging or supplementary regions such as Odisha (70,094 sq km), West Bengal (45,444 sq km), Assam (16,307 sq km), and Tripura (4,528 sq km) exhibit promising zones of moderate to high suitability, expanding the geographic scope for potential coconut expansion. These findings highlight the value of integrating machine learning with climate projection data for spatial suitability assessments. The approach not only aids in identifying future climate-resilient zones for perennial crops like coconut but also supports region-specific agricultural adaptation strategies aligned with sustainable development goals.

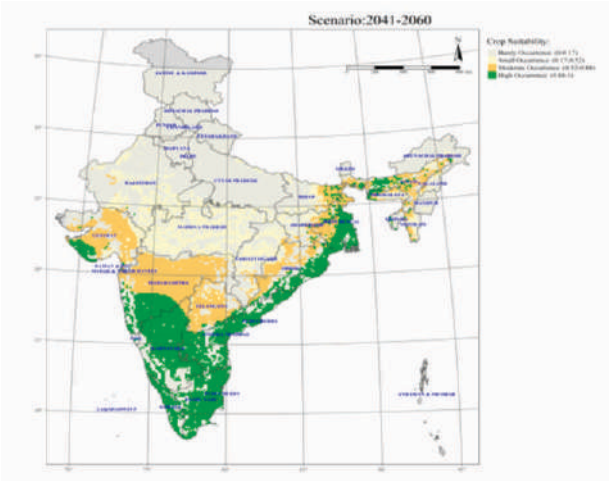


Fig. 106. Area under coconut under CMIP6: SSP 1-2.6 climate scenario in 2060.

Spatio-temporal Dynamics of Temperature and Precipitation

Climate change, especially shifts in temperature and precipitation, plays a key role in guiding decision-making across sectors. India's diverse geography and population make climate monitoring essential. Using data from the Indian Meteorological Department (1971–2020), the Mann-Kendall trend test and Sen's slope identified significant temperature increases across most states, except Chhattisgarh and Odisha (Fig.105). Future projections from GCMs under RCP 2.6 and 8.5 scenarios show temperatures rising, especially in Andhra Pradesh, Gujarat, and Telangana. Precipitation trends varied, with increases in northeastern states and reduction in others. Elevated precipitation under SSP5-8.5 raises concerns on extreme events like floods and landslides, demanding proactive planning.

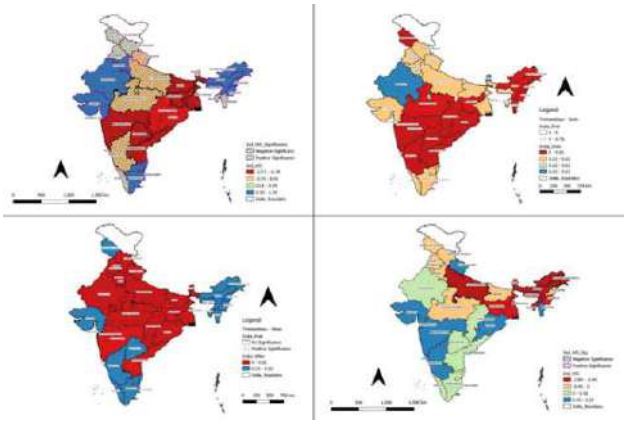


Fig. 107. Map showing annual Kendall trend analysis of temperature, and the total precipitation across Indian States

Disease Hotspots identification

An extensive survey was conducted in 2022-2023 to assess the spread of leaf spot disease (LSD) in areca-growing taluks of Kerala and Karnataka. The severity of LSD varies depending on geographical location, climatic conditions, cultural practices, and the prevalence of fungal pathogens. Inverse Distance Weighting (IDW) was used to predict the distribution of LSD severity across the area, while Moran's I Index was applied to assess spatial autocorrelation and examine how taluks were clustered or dispersed. Indicator Kriging (IK) helped identify hotspot and cold spot areas within the study region. Results indicated that LSD severity rates were highest in the Hosanagara, Tirthalli, Narasimharajapura, Sringeri, Koppa, and Mudigere taluks of Karnataka (Fig. 108 & 109).

Development of Tailored Bioinformatics Programs

A set of Linux-based Python scripts was customised alongside well-established whole genome

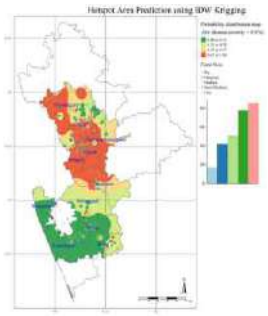


Fig. 108. Predicted LSD risk regions in Kerala and Karnataka

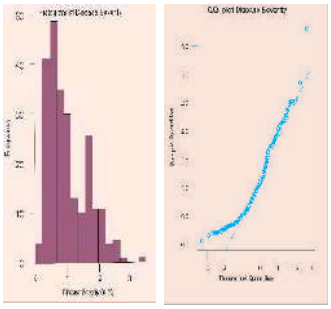


Fig. 109. LSD distribution pattern plotted with histogram and QQ plot

sequencing assembly tools, including SPAdes and Velvet, to analyze the genomes of two bacterial species: *Microbacterium enclense* and *Paenibacillustyphae*. These bacteria have attracted interest due to their potential in enhancing coconut cultivation by promoting plant health and improving soil fertility. *Microbacterium enclense* is typically found in the rhizosphere of coconut palms. Genome annotation was carried out using tools such as Prokka, BUSCO, and EggNOG-mapper. The genome of *Microbacterium enclense* consists of approximately 21,241 CDS, 21,589 genes, 30 rRNA, 6 tmRNA, and 312 tRNA, including vital nutrient recycling proteins such as Iron-sulfur cluster assembly protein, Fe-S metabolism-associated domains, and Phosphoserine phosphatase. In contrast, *Paenibacillustyphae* has 67,258 CDS, 68,414 genes, 24 repeat regions, 64 rRNA, 12 tmRNA, and 1,080 tRNA, with important proteins like Zinc uptake system ATP-binding protein, Zinc-binding protein, and Alkaline phosphatase-like protein.

ASK Kalpa

ASK Kalpa is a groundbreaking AI-powered chat interface custom-trained exclusively with CPCRI's extensive database, including annual reports, news, and updates, ensuring it is tailored specifically to the institute's needs. It serves as a cutting-edge digital assistant capable of human-like interactions.

Powered by advanced AI similar to ChatGPT 4.0, ASK Kalpa supports over 100 languages, making it accessible to a global audience. It provides accurate and detailed responses to a wide array of queries, such as disease management, seedling production, staff information, and insights from CPCRI's annual reports. With its ability to interact conversationally and its deep understanding of data used in training, ASK Kalpa encapsulates the platform's purpose: to serve as a trusted knowledge hub for coconut, arecanut, and cocoa.

CPCRI Billdesk

CPCRI Billdesk is an innovative web and mobile application designed by incorporating dynamic cross-server verification through QR codes. Developed using Google Appsheet, PHP MVC CodeIgniter, and JavaScript, this application offers a seamless and secure way to generate and verify invoices. Each bill generated within the system includes a unique QR code, which, when scanned, triggers a cross-server verification process that checks encrypted data stored in the database, presenting the bill information online.

One of the standout features of the CPCRI Billdesk is its ability to maintain a comprehensive transaction history for each customer, enabling users to trace and access all transactions over time, even if they span different years. The application is designed with a highly intuitive, user-friendly interface that makes it easy for customers and staff alike to navigate. It works both online and offline, ensuring accessibility even in areas with limited connectivity. Additionally, the cross-server verification system is protected by a password feature, ensuring that transaction history is securely stored and only accessible to authorized CPCRI staff. When scanned, the QR code in the bill directs to the cross-

server system, where staff can access the complete transaction history related to a particular customer. The CPCRI Billdesk is designed to enhance both user convenience and confidentiality while providing efficient and secure billing management.

Agri Business Incubation Centre (NAIF)

Kalpa ABI incubated 19 entrepreneurs in 2024 of which six were recruited under the program Kalpa Rapid Incubation for Startup and Small Business Prospects (KRISP). Under KRISP, ideas were called for, evaluated and selected for incubation. However, most of the student entrepreneurs discontinued the programme for different reasons. Ten incubatees registered earlier graduated and started their own business.

The Third Rural India Business Conclave (RIBC 3.0), a flagship progarmme of Kalpa Agri Business Incubator, was concluded on 15 December 2024 at ICAR-Central Plantation Crops Research Institute, Kasaragod. The multiple events of the Conclave include conferences, panel discussions, women entrepreneurship development programme, founder development program, VC boot camp, Investor-innovator interface and the rural agri-tech hackathon. The RIBC 3.0 was conducted in partnership with the Kerala Startup Mission and Central University of Kerala (CUK).

Responding to the five problems announced for the hackathon, 120 teams got registered. There were five problem statements on the following area:(I) coconut maturity detection;(ii) coconut harvesting robots; (iii) coconut canopy estimation; (iv) heritage mapping platform for tourism; and (v) platform for direct sale of small farmers' produces. The evaluation committee shortlisted 40 entries for participation of which 21 expressed their willingness and 18 finally participated in the 30 h hackathon held at CUK during 14-15 December 2024. After the technical and business evaluation, the following teams were adjudged as winners. The team Coco-bot from Kozhikode as the winner to receive a cash prize of Rs.50,000/-. There were three runners up: MITS Kochi, SCET Thrissur and LBS Kasaragod. The prize money was sponsored by NABARD.

Five EDPs were conducted during 2024 in which a total of 126 people participated. The topics covered are:

Training programme for Agriculture officers of Tamil Nadu, Kerala and Karnataka (CDB Sponsored); 4-6 Jan 2024 (20 participants Fig. 110)

EDP on Cocoa Processing 12-15 March 2024 (15 participants Fig. 111)

Startup Orientation Programme, 6-7 March 2024 at Kerala Startup Mission, Kinfra Hi-Tech Park, Kalamassery, Kochi (for 10 KRISP incubatees Fig. 112)

Women Entrepreneurship Development Program (15 December 2024 as part of RIBC 3.0)

The Kalpa ABI conducted four agribusiness development programmes at different places *viz.,* Thiruvananthapuram, Kayamkulam, Thrissur, and Erode.

Exhibitions conducted/participated for outreach and awareness building through ATIC, ICAR-CPCRI, Kasaragod

Sl. No	Programme Organized for Technology Commercialize/Transfer*	Date	
		From	To
1	RARS Wayanad, Poopolis	01.01.2024	15.01.2024
2	Mahatma Gandhi Charitable Trust, Malom, of Balal Grama Panchayath	12.01.2024	21.01.2024
3	36th Kerala Science Congress and exhibition at Govt. College, Kasaragod. "Transforming Kerala's Economy through one health Approach"	08.02.2024	11.02.2024
4	Kisan Mela, at RC Kidu, ICAR-CPCRI	11.03.2024	11.03.2024
5	CODISSIA– Agri Intex 2024 ICAR CPCRI Participation at CODISSIA, Coimbatore	11.07.2024	15.07.2024
6	96th ICAR Foundation and Technology Day on 15-16 July 2024 at NASC, Pusa, New Delhi	15.07.2024	16.07.2024
7	ICAR- Central Tuber Crops Research Institute (ICAR-CTCRI) Sreekariyam 695 017, Thiruvananthapuram District level seminar - 'Coconut based cropping systems for agri food systems and higher income' at Tiruppur	29.08.2024	29.08.2024
8	Kudumbasree Exhibition at Trithala Palakkad	12.09.2024	14.09.2024
9	2ndICAR-IIHR-Industry Meet-2024 at Bangalore	24.10.2024	
10	Exhibition At Kavarathi in connection with coconut festival	19.11.2024	22.11.2024
11	Global Soils Conference 2024 Caring Soils Beyond Food Security: Climate Change Mitigation & Ecosystem Services 19-22 November 2024 NASC Complex, New Delhi	19.11.2024	22.11.2024
12	Lead expert in Farmers-Scientist interface and participation in the Coco Fest-2024 (Coconut Festival) of Lakshadweep Islands FPO and Department of Agriculture, UT Administration of Lakshadweep. The festival is supported by ICAR-CPCRI, ICAR- ATARI-Bangalore, ICAR- DCR for Cashew, NABARD, NCDC and others.	20.11.2024	22.11.2024

Fig.110. Training programme on coconut value addition for Agriculture officers (Sponsored by Coconut Development Board)

Fig. 111. EDP on cocoa processing at ICAR-CPCRI, Kasaragod

Fig. 112 (a). KRISP-Incubatees participated in the Startup Orientation Programme, 6-7 March 2024 at Kerala Startup Mission, Kinfra Hi-Tech Park, Kalamassery, Kochi (jointly conducted by ICAR-CPCRI and ICAR-IISR)

Fig. 112 (b). Orientation training at Kinfra Hi-Tech Park, Kalamassery, Kochi

Fig. 113. Inhouse incubation for coconut value addition at Kalpa ABI, ICAR-CPCRI, Kasaragod

SUCCESS STORIES

Coconut value addition-income and safe product for consumers

Mr. Sasikumar, Panickasseril house, Ward 10, Devikulangara panchayat is a retired police Sub Inspector and a coconut based IFS farmer (Fig. 114). He initiated a small coconut-based entrepreneurship with support from the PMEGP scheme and started coconut oil production named S.K. Industries. ICAR CPCRI FFP modernized this unit with an electrical copra dryer of 1000 nuts capacity and a copra cutter for hygienic and quality copra production from nuts procured from local farmers. The products added were virgin coconut oil (VCO), curry powder, coconut chutney powder, coconut rice powder snacks, and organic pepper and turmeric powder from his homestead and neighbours. He is selling quality coconut oil, VCO, and coconut-based food products branded as "Janvi". Twenty-five kg copra could be converted to cold-pressed coconut oil within 20 minutes. He could earn Rs. 20,000 to 30,000 per month as per the demand.

Fig. 114. Coconut value addition unit at Devikulangara

Mushroom and value-added products

Mrs. Minimol found her livelihood in mushroom cultivation after attending training program on 'scientific mushroom cultivation' (Fig.115). She started with one mushroom shed of 8 m x 2.5 m space and FFP interventions made to expand and modernize to reduce drudgery in mushroom production process. One more unit of 8m x 3m size was added for doubling production of fresh mushroom and mushroom cutlets were made to increase the income. The total mushroom produced monthly is 25-30 Kg at Rs.400 and mushroom cutlets 150 nos. at Rs.20, thus earning Rs.13,000 to15,000. Presently an electric drier was added for further value addition as dried mushroom powder, during peak production in rainy seasons. Automatic misting system was installed through FFP support reducing drudgery and additional 15 per cent production during the initial phase.

Fig. 115. Mushroom production by farm woman in Alappuzha

Coconut intercropping with 'Sweet potato Village' Program

The concept formulated to enable area wide adoption of HYVs, improve farm income and creating entrepreneurship among rural society. Arattupuzha panchayat was selected for sweet potato village program. Six released varieties of ICAR Central Tuber Crops Research Institute (CTCRI) were initially introduced for farmers participatory evaluation. The varieties are Sree Arun, Sree Varun, Sree Kanaka, Sree Bhadra, Bhu Sona and Bhu Krishna. All six varieties were assessed as suitable and yielding upto 3.2 Kg (average) per mound (Fig. 116). Accordingly, stakeholder meeting of ICAR CTCRI scientists, ICAR CPCRI FFP scientists, Agricultural extension officials of Department of Agriculture, progressive farmers, peoples representations, women SHGs, MGNREGS were conducted and agreed to the concept of sweet potato village. The nurseries for each variety were prepared for cultivating an area of 30 ha in Arattupuzha panchayat (19 wards). The program is first of its kind in the state and elicited good response from farmers. The ICAR CPCRI FFP evolved an extension approach through convergence and linkage. Total yield of 4500 Kg per ha is expected and a total income of Rs. 2.5 lakhs per ha is anticipated besides adding to dietary diversity and higher consumption.

Fig. 116. Sweet potato intercropping under coconut at Alappuzha

Community Coconut seedling production

The ICAR CPCRI, FFP is being implemented in the coconut root (wilt) disease hotspot district, Alappuzha (Fig. 117). Sustainable coconut cultivation demands for scientific management and planting of disease tolerant seedlings produced from RWD tolerant/resistant mother palms. A panchayat level replicable model was evolved in FFP as a participatory program involving relevant stakeholders.

- Community Approach
- Training and field-level skill testing for identification of RWD tolerant/resistant mother palms
- Conducting a survey of Devikulangara panchayat (15 wards) for locating RWD tolerant/resistant mother palms
- 51 wards - Panchayath members- Agri officials- Coconut producers societies
- 967 mother palms- GPS marked
- 5982 quality seed nuts- QR coded for affirmation of source palms
- 3 community coconut nurseries
- Bio-primed polybag coconut seedlings
- Selected from among one lakh adult palms of three panchayats

Fig. 117. Disease-free planting material produced under the FFP

- Fund of Rs. 1.72 lakh mobilized as seednuts price from Farmers Cooperative society and direct transfer to accounts of farmers
- Converged with FFP FPO for palm harvesting
- Technology adoption at each level ensured Disease-free planting material produced under the FFP

A total of 2400 poly bag coconut seedlings bio primed with Kera Probio was produced and sold at the rate of Rs.120 per seedling realizing a gross income of Rs.3,15,840. This two years intervention enabled 15.3 ha of additional area under coconut with locally available tolerant/resistant seedlings.

Fig. 118. Panel Discussion in the Institute-Industry Interface meeting (Dream Big-Kalpa)






Fig. 119. Exchange of MoA with entrepreneurs for technology commercialization

Fig. 120. Exhibition at Kochi – Agrl Sci. Congress

Fig. 121. Pooppoli Expo at Wayanad

6.8

ICAR-
All India Coordinated Research Project (AICRP) on Palms

The All India Coordinated Research Project on Palms has been functioning since 1972 with an objective of conducting location-specific research in the mandate crops. The project has coconut, oil palm, arecanut, palmyrah and cocoa as mandate crops and it is implemented in 28 centres, of which 15 centers are undertaking research on coconut, six on oil palm, four on arecanut, four on palmyrah and seven on cocoa with Headquarters at ICAR-CPCRI, Kasaragod. These centres are located across the country in 14 states and one union territory covering 13 SAUs/SHUs, one CAU and four ICAR institutes.

Map showing coordinating centres of ICAR-AICRP on Palms

The budget for the year 2024 (January-December) was Rs. 720.83 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 Universities. The centers of Central Agricultural Universities and ICAR Institutes have 100% funding from ICAR.

RESEARCH ACHIVEMENTS

COCONUT

Under coconut, 30 projects are in operation at various centres on Crop Improvement, Crop Production and Crop Protection. The salient achievements are as follows:

- Among the location specific crosses at Bhubaneswar, the hybrid SKL x GBGD recorded higher fruit yield (137 fruits palm^{-1} year^{-1}) and high quantity of tender nut water (455 mL fruit^{-1}) with Total Soluble Solids (TSS) content of 5.28 Brix. The hybrid fruit recorded copra content of 192.35 g per fruit with an oil content of 66.28 per cent with an increased fruit yield of 24.75 per cent and higher copra content (34.63 %) over the ruling variety Sakhigopal Local.
- Novel trait of pink husk was observed in three conserved coconut populations at Veppankulam centre. The progenies were produced from those selections and separate IC numbers obtained from ICAR- NBPGR.
- The better performing accessions/released varieties from different centres *viz.,* VPM 6, Seychelles, Gandevi, Kamrupa and Orissa Giant were identified for MLT under different regions. Besides, 9 Talls and 11 Dwarfs were identified for new MLT trials based on their performance at ICAR- CPCRI.

- **Tall X Tall hybrids:** Among five Tall x Tall cross combinations evaluated from 2011 at Aliyarnagar, BGR x ADOT was the highest fruit yielder (78 fruits palm^{-1} year^{-1}), which was at par with WCT x TPT (61 fruits palm^{-1} year^{-1}).
- **Dwarf x Dwarf hybrids:** Among the Dwarf x Dwarf combinations evaluated since 2011 at Ratnagiri centre, GBGD x MOD is identified as a promising cross for earliness. The hybrid COD x MYD recorded the highest tender nut yield (76.7 fruits palm^{-1} year^{-1}) followed by the hybrid GBGD x MOD (68.3 fruits palm^{-1} year^{-1}). The hybrid COD x MYD recorded maximum volume of tender nut water (602.7 mL fruit^{-1}) whereas, the hybrid GBGD x MOD recorded maximum TSS with a score of 5.7^{0} Brix**.**
- At Veppankulam centre, the fruit yield recorded was 55.60 and 95.56 fruits per palm per year in COD and GBGD x MOD respectively. Regarding the tender nut quality parameters, GBGD x MOD recorded maximum volume of tender nut water (628.10 mL) during the 7th month. Regarding the TSS, all the crosses exhibited around 6 Brix. The cross, GBGD x MOD recorded higher number of fruits (95.56 fruits palm^{-1} year^{-1}).
- **Coconut based multispecies cropping systems:** Evaluation of Coconut based multispecies cropping systems under coastal littoral sandy soil indicated maximum fruit yield in $^{CS}{}_{2}{}^{N}{}_{3}$ at Ratnagiri (Coconut + *Garcinia indica* + Pineapple cropping system with recommended nutrient application) with B: C ratio of 2.38. At Bhubaneshwar centre, maximum net returns (Rs. 4,63,857 ha^{-1}) was obtained in CS_2N_2(Coconut + Sapota + Pineapple cropping system with Green manuring + biofertilizers + organic recycling +Soil test-based nutrient (chemical fertilizers) application, whereas less profit (Rs. 60,250) was obtained in CS_3N_1 (Monocrop of coconut+ Green manuring + biofertilizers + organic recycling +FYM).
- Under organic cultivation of coconut at four centres, highest system productivity and profitability was realized in T_4 – *In situ* organic matter recycling + PGPR consortia + *in situ* green manuring + 25 kg cow dung + husk burial + 50 per cent recommended dose as Sulphate of Potash.
- **Management of leaf blight disease in coconut:** Root feeding with propiconozole @ 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 fruits per palm per year and the B:C ratio of 3.7 as against 97 fruits per palm per year in the untreated control.
- **Initiatives for Pest Management:** 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 numbers of *P. astur* eggs were supplied to the farmers of Tamil Nadu, Andhra Pradesh, Karnataka and Maharashtra. Coconut fronds or leaflets containing parasitized puparia were collected from the affected ecosystem and released in newer areas of infestation.

OIL PALM

Oil palm research under AICRP on Palms isoperation at seven centers on Crop Improvement and Crop Production. 38 hybrids are under evaluation in four trials. The salient achievements are as follows.

- **Better Performing hybrids:** Among the 10 hybrids evaluated at Vijayarai for growth and yield parameters, the hybrid NRCOP 37 (Pedavegi 1) recorded a bunch weight of 19.9 kg per bunch along with moderate number of bunches (10.7 palm^{-1}) per annum resulting in a good FFB yield of 29.69 tons per ha.At Pattukkotai, NRCOP 9 recorded a bunch weight of 20.20 kg per bunch along with moderate number of bunches (10.60 palm^{-1}) per annum resulting in FFB yield of 30.62 tons per ha with high oil content of 21.50 per cent.

COCOA

- **Better performing cocoa hybrids and clones:** Cocoa genotypes are under evaluation in seven AICRP (Palms) centres covering West Coast,

East Coast and NE regions across different cropping systems including arecanut, coconut and oil palm gardens. Cocoa hybrids VTLCH-2 and VTLCH-1 were identified as best performers under coconutfrom a 12 year old trial at Kasaragod (Kerala), Ambajipeta (Andhra Pradesh) and Veppankulam (Tamil Nadu) and recommended for release and later notified. From the initial years of evaluation, it was observed that among eight year old trees at 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.

PALMYRAH

Palmyrah research under AICRP on Palms is in operation at four centers on Crop Improvement and Post-Harvest Technology. So far, 272 germplasm accessions at HRS Pandirimamidi and 265 accessions at AC & RI, Killikulam, have been conserved. The salient achievements under Post Harvest Technology are as follows;

- Freeze drying of fresh neera with maltodextrin with 10 per cent or more resulted in a sap powder with good stability at room temperature and excellent solubility. Sap powder shows easy rehydration by adding water to its original characteristic of the process. The sap powder obtained meets the current legislation standards for fruits and vegetable products, with moisture values of less than 5.0 per cent.
- Palmyrah Neera Concentrate (PNC) or palmyrah syrup can be stored up to 90 days in glass bottle without affecting physicochemical properties at accelerated storage (90 % RH and 4^0C).
- Palmyrah tuber is a cheap and rich source of starch. Modifications of native starches are carried out to provide starch products with specific properties and can be used as a thickener in instant soup.
- The yields and characteristics of pectin extracted from palmyrah fruit pulp were comparable to extracted pectin from other sources. The yield ranged from 5.8 - 20.4 per cent.

Annual Group Meet

The XXXIII Annual Group Meet of All India Coordinated Research Project on Palms was organized at Bihar Agricultural University (BAU), Sabour, Bhagalpur during 21-23 September 2024. Dr. V. B. Patel, Assistant Director General (Fruits and Plantation Crops), ICAR, New Delhi presided over the inaugural session. Dr. D. R. Singh, Vice Chancellor, Bihar Agricultural University, Sabour was the Chief Guest of the event. Dr. P. Rethinam, Former Director, Asian and Pacific Coconut Community, Jakarta, Dr. K. Balachandra Hebbar, Director, ICAR- CPCRI, Kasaragod, Dr. K. Suresh, Director, ICAR-IIOPR, Pedavegi and Dr. R. K. Mathur, Director, ICAR-IIOR, Hyderabad were the Guests of Honour. Dr. A. K. Singh, Director of Research, Bihar Agricultural University, Sabour welcomed the gathering in which he narrated the research accomplishments of BAU for taking palm research to the next level. Dr. B. Augustine Jerard, Project Coordinator, AICRP (Palms), ICAR-CPCRI, Kasaragod, in his report presented the achievements of AICRP (Palms) on five crops - coconut, oilpalm, palmyrah, arecanut and cocoa distributed across 28 AICRP centres of 14 states and one Union Territory. Release of coconut varieties VPM6, Kalpa Suvarna, cocoa varieties VTLCH 1 and 2, enriching germplasm pool with pink husked coconut and pink nungu genotypes, fostering research for the development of T x T and D x D coconut hybrids, development of location specific Integrated Farming System models, developing pest and disease distribution maps for early forewarning besides developing Integrated Pest and Disease Management modules for leaf blight and Spiraling Whitefly in coconut, identification of promising VTLCP cocoa cultures and oil palm varieties *viz.,* NRCOP 9 and 37 were the noteworthy contributions of 2023-24. Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI invited the scientists to develop economically feasible and socially viable technologies to empower the farmers. He appreciated the work of palm scientists in developing biocontrol strategies to manage pests like black headed caterpillar and hairy caterpillar in coconut. He underlined the importance of working in tandem with the officials of the State Department

of Horticulture to provide suitable remedies for the maladies in the farm front. Dr. K. Suresh, Director, ICAR-IIOPR lauded the scientists for their contributions and invited the scientists to use technological interventions to tide over the challenges in the farm front viz., price aberrations, pest and diseases, climatic vagaries etc. Dr. V. B. Patel, ADG (F &PS) applauded the scientists for the contribution towards release of four varieties by Hon'ble Prime Minister of India. He opined that non-traditional coconut belts with climatic vulnerabilities can offer excellent platform for screening varieties for tolerance to abiotic stress which should be positively exploited. Production of quality planting materials is the need of the hour, he added. Dr. D. R. Singh, Vice Chancellor, BAU, Sabour gave a bird's eye view of the accomplishments of the University and highlighted the status of coconut plantations in the state of Bihar. Farmers can tap tender nut markets during summer and matured nut demand during festival times in the State. Palmyrah of Bihar is unique with dwarf stature which eases climbing operations and neera tapping, which could be explored further for the betterment of the farming community. He besieged over the immense employment opportunities provided by the palm sector and spelled out the need for bioconversion of waste to wealth in the plantation crops.

Dr. S. Ruby Rani, SIC, Sabour proposed vote of thanks. About 80 participants from different AICRP centres participated in the meeting. The inaugural session was followed by technical sessions on variety release proposal, genetic resources and crop improvement, crop production, crop protection and post-harvest technology.

Scientists – Farmers – Officials of the Department of Horticulture Interface Meet

An Interface Meet captioned "Recent Technologies in Coconut Farming" with special reference to Root (wilt) disease and Rugose Spiraling Whitefly management, mustering Scientists of Tamil Nadu Agricultural University and Central Plantation Crops Research Institute (CPCRI), Kasaragod and Kayamkulam, Kerala, Officials of the Coconut Development Board (CDB), Chennai and Dhali and State Department of Horticulture and Plantation Crops, Government of Tamil Nadu together with progressive farmers of the state, was organized at Coconut Research Station, TNAU, Aliyarnagar, ICAR – AICRP (Palms), Tamil Nadu on 5th February 2024.Outcome of the meet ended with the following Action Plan for the future.

- Replanting/under planting in senile plantations should be encouraged by providing support to the farmers to increase productivity.
- Six-days training for the officials of the State Department of Horticulture should be organized three days each at Aliyarnagar Centre and at CPCRI (RS), Kayamkulam to get acquainted with the symptoms of Root(wilt) disease.
- Google spreadsheet bearing particulars on variety, age of the palm, soil type, pH, EC, organic carbon content, root(wilt) disease intensity along with GPS co-ordinates shall be framed and updated by the field level workers of the State Department of Horticulture once every 15 days.
- Pamphlets on diagnosis, symptomatology and management technologies of coconut root (wilt) disease is to be prepared for distribution to the farmers and soft copy of the same should be circulated among the stakeholders and uploaded in CPCRI website. Training on production of quality planting materials comprising of disease tolerance capacity to be organized
- Strict 'within the state' internal quarantine may be enforced for transportation of coconut seedlings.
- Training may be imparted on identification of *Encarsia* parasitoids to the stakeholders and video of the same may be uploaded in social media.
- Systems Approach ensuring soil-water-plant health, Integrated Farming System, Integrated Cropping System and organic manuring to enrich soil microbiome may be advocated.

6.9.1

ICAR - Krishi Vigyan Kendra, Kasaragod

The ICAR-KVK, Kasaragod, has initiated 2 OFTs, 12 frontline demonstrations, one EDP programme, one nutri-garden programme, SCSP, and various extension activities during 2024-25. The major achievements under these are given below.

a) Salient achievements under OFT

Assessment of different varieties of HY hybrids of ridge gourd

Assessment of two high-yielding hybrids (*Luffa acutangula* L. Moench) of ridge gourd, KRH-1 and Arka Vikram was conducted in the 5 farmers' fields (0.2 ha) of the Kasaragod and Manjeshwar block of Kasaragod Dist. The planting was done during December 2024. It was observed that the vegetative growth of the crop was not satisfactory during this season and the incidence of downy mildew was severe. The assessment needs to be repeated during the rainy season in Kasaragod district.

Assessment of technologies to produce coconut sugar

Under this OFT, two technologies are being tested to produce coconut sugar from neera. The CPCRI method of production of coconut sugar by heating in a double-jacketed kettle and the method of freeze-drying. Under the CPCRI method, the neera is heated for about 6 to 7 hours, by which the neera gets converted into coconut sugar. The recovery is about 150 grams of sugar per litre of neera. The moisture content is further reduced by drying in an oven for two hours, and the final recovery of coconut sugar is 145 grams per litre of neera. Under the freeze-drying method, the neera is frozen to (-) 36°C, and the reduction of moisture content takes place as sublimation with the heat provided. The time required for conversion of neera into sugar is 50 hours. The neera gets converted into a thick, viscous liquid by this method with very low moisture content. Further studies on shelf life and reconstitution are in progress.

b) Salient achievements under FLD

Rejuvenation of degraded coconut gardens with soil and water conservation measures

The ICAR-KVK, CPCRI Kasaragod has carried out various activities for the conservation of rainwater in Pakkam village in Kanhangad block. Contour trenches were laid in an area of 10 acres belonging to 8 farmers with a total length of 434 m, having 0.8 m width and 0.6 to 0.8 m depth. The trenches have a total storage capacity of 217 cubic meters, or 2.17 lakh liters of water. With 100 rains per year, which can fill the pits, this will have an infiltration or recharge capacity of about 2 crore liters of water. Apart from this, the pits are being filled with biomass, including coconut husk, for increasing the organic matter content and water-holding capacity of the soil.

Demonstration of drone technology in rice

ICAR-KVK, CPCRI, Kasaragod conducted a frontline demonstration on the application of micronutrients in paddy using drone technology at Bellur Padasekhram in Manjeshwar during October 2023 with the participation of 10 farmers in an area of 4 ha. The KAU Sampoorna micronutrient mixture was used, which contains zinc, boron, copper, iron, manganese, and molybdenum for crop growth, pest and disease resistance, and grain filling in paddy crop. The initial observation of higher grain filling and overall improvement in crop growth observed with the greening of leaves is observed.

Demonstration of organic pest management in paddy in coastal agri-ecosystem

The demonstration on organic pest management in paddy in coastal agri-ecosystems was conducted in 8 farmers plots in an area of 2 ha at Manjeshwar village of Manjeshwar taluk during the year. The programme was focused on using biological, cultural, and natural pesticide control measures to manage pests and diseases while maintaining environmental sustainability. The application of integrated pest management practices resulted in significant reductions in pest and disease pressure. Key outcomes included enhanced plant health through *Pseudomonas fluorescens* treatment (20 g L^{-1} of water) and foliar application (2.5 kg ha^{-1}), reduced caterpillar and other insect pests via *Trichogramma chilonis* releases and pheromone traps, and efficient pest management through neem oil sprays (2.5 L ha^{-1}). The demonstration plot yielded 24.7 q ha^{-1}, which is 42 per cent higher than the check plot. The benefit-cost ratio (BCR) was found to be 1.1. It is recommended that these practices be followed for sustainable paddy cultivation to improve yield and reduce reliance on chemical pesticides.

Demonstration of integrated management of inflorescence dieback disease in arecanut (Ongoing—2nd Year)

The demonstration of integrated management of inflorescence dieback disease in arecanut was conducted in 10 farmers' plots at Bambrana village of Kumbla Panchayath. The programmes were initiated during 2024 and will continue for three years. In this programmes ICAR-CPCRI technology, *i.e.,* spraying Propiconazole 25EC @ 1 mL per liter of water during the February month for control of fungal growth and a second spray scheduled after 30 days. The disease incidence percentage in pre-treatment variation was found to be high (82.69%) to low (77.5%). The FLD will continue for three years.

Demonstration of integrated management of leaf spot disease in arecanut (Ongoing-2nd Year)

The demonstration of integrated management of leaf spot disease (LSD) in arecanut was conducted in 10 farmers' plots at Yethadka and Padre Village of Enmakaje Panchayath. The programme was initiated during 2024. The disease occurrence of LSD was first seen in 2021-2022 in this area. In this programme, ICAR-CPCRI technology, *i.e.,* spraying Propicinazole 25EC @ 1 mL $liter^{-1}$ and a second spray of Propineb 70%WP @ 2 gm $liter^{-1}$ of water during October-November with proper nutrient management in arecanut. The disease incidence percentage was very high in 2023-24. The FLD will continue for three years.

Demonstration of salt-tolerant rice varieties Ezhom-4 in Kasaragod

The demonstration of the salt-tolerant rice variety, Ezhom-4, was introduced in this programme in the Kaipad region of Manjeshwar grama panchayath of Kasaragod. The FLD was laid out in 1 acre of land belonging to 10 farmers in Manjeshwar. It is found that the introduced variety has performed well with a yield of 24.7 q ha^{-1}, whereas the average yield recorded in the control plot is 17.4 q ha^{-1}, and a 41.95 per cent yield increase is noticed. The benefit-cost ratio (BCR) was 1.3.

Demonstration of an integrated approach for management of subclinical mastitis in dairy cows

A frontline demonstration on the integrated approach for management of subclinical mastitis in dairy cows was conducted at Mogral Puthur and Karichery in Panayal village. The technology demonstrated was the Masti-Guard Kit-a combination of a subclinical mastitis screening kit (TAUCHECK SCC kit) and teat spray (teat protect spray) - and the technology was taken from TANUVAS, Chennai. The FLD is in progress. Till now, 11 cows were tested, and no positive results were obtained. The technology was demonstrated to 10 farmers, and kits were distributed for usage.

Demonstration of INM in coconut for increasing productivity

A frontline demonstration on INM in coconut for increasing productivity was conducted in 15 farmers plots at the Panayal village of Pallikere grama panchayath. The programme was initiated during 2024. In this programme the application of 250 gm each of micronutrient mixture, Kalpa Vardhini, was done during September and February. The FLD will continue for three years.

Introduction of mosaic virus-resistant cassava *var.* Sreeraksha

The mosaic disease in cassava is a major threat in cassava cultivation, and it causes 25-80 per cent yield reduction. The ICAR-CTCRI released a high-yielding, mosaic-resistant variety Sree Raksha was introduced in this programme. The FLD was laid out in 1 acre of land belonging to 10 farmers in Kodom-Belur panchayath. The introduced variety is not affected by mosaic virus disease, and an average yield of 36.8 t per ha was recorded in this demonstration compared to 28.6 t per ha for local varieties, which is an increase of 28 per cent.

Demonstration of nutri-gardens in homesteads

A nutri-garden demonstration was carried out in 25 households under SC category. Vegetable seed kits consisting of amaranthus, chilli, local cucumber, ash gourd, pumpkin, okra, cowpea, bitter gourd, and inputs were distributed to each household. Through nutri-gardening, the use of biopesticide formulations for crop management is promoted.

c) Capacity Development Programmes

KVK, Kasaragod, organized 72 farmer trainings with a participation of 899 people, 1 rural youth training with a participation of 25, 1 extension training with 21 participants, and 2 sponsored with 30 participations. The trainings included scientific management practices in coconut and arecanut; entrepreneurship development programme on millets, vegetable cultivation, mushroom cultivation, nutri-gardens, beekeeping, fruit processing, baked coconut chips, composting techniques, etc., for income generation among farmers and rural youth.

Training programmes conducted by the KVK during the period

Trainings	Programmes	M	F	T
Farmers & Farmwomen	72	458	441	899
Rural youth	1	14	11	25
Extension persons	1	21	0	21
Sponsored	2	0	30	30
TOTAL	76	493	482	975

d) Extension activities

The extension activities carried out by KVK Kasaragod during 2024 are listed below. The major programmes and activities are also explained in detail.

Details of extension activities carried out by KVK Kasaragod

Type of Activity	Number of Activities	Male	Female	SC	ST	Total
Kisan Goshthi	3	130	57	17	14	218
Group Meetings	10	284	209	10	102	605
Field Day	3	16	0	0	0	16
Agriculture Exhibition	2	6500	4500	400	1400	12800
Agriculture method demonstration	9	51	17	0	0	68
Seminar	4	165	136	11	52	364
Workshop	3	5	12	0	0	17
Scientist visit to farmer's field	19	165	67	14	30	276
Farmer's visit to KVK	12	1277	698	201	124	2300
Other extension activities	23	296	310	179	149	934
Total	88	8889	6006	832	1871	17598

KVK Swarna Samriddhi 2024 and Tree Plantation Drive at ICAR-KVK Kasaragod

ICAR-KVK, Kasaragod, celebrated World Environment Day by organizing different programmes on 5 June 2024. The theme of the programme was "Land restoration, desertification, and drought resilience" under the slogan Our land, our future. KVK organized an awareness programme and also felicitated senior staff through a tree plantation drive on the campus. Shri Subramanian R.N., Senior Administrative Officer, ICAR-CPCRI Kasaragod, was the chief guest for the programme and Shri P. Krishnakumar P., Administrative Officer, also participated in the programme at KVK. The dignitaries and KVK staff members planted avocado plants in the KVK farm. During the event, around 350 fruit plants and forest plant seedlings were distributed among the KVK-DFI farmers. A total of 40 farmers and 60 students participated in the programme. Planting materials such as neem, tamarind, cassia, amla, custard apple, citrus, and jack seedlings were distributed to the participants.

During Phase II on the occasion of ICAR Foundation Day on 16 July 2024, 96 trees were planted in Adoor of Delampady Panchayat. During Phase III, on Independence Day, 15 August 2024, a total of 934 plants were planted in Badiadka, Pullur Periya, Pallikkara, and Bedadka panchayats.

50000+ Tree Plantation Campaign									
Phase I (On World environment Day, 5 June 2024)			Phase II (On ICAR Foundation Day, 16 July 2024)			Phase III (On Independence Day, 15 August 2024)			Total
Name of tree species planted	No. of saplings planted	Location	Name of tree species planted	No. of saplings planted	Location	Name of tree species planted	No. of saplings planted	Location	
Guava, Jack, Mango, Tamarind, Sapota Lemon, Amla	270	KVK Kasaragod and farmers field	Guava, Jack, Mango, Tamarind, Sapota Lemon, Amla	96	Adoor	Guava, Jack, Mango, Tamarind, Sapota Lemon, Amla	934	Badiadka, Pullur-Periya, Pallikera, Bedadka	1300

Golden Jubilee torch

The Golden Jubilee torch, a symbol of knowledge transfer, was received from KVK Kannur on the 19 July 2024. The programme was attended by the Director, CPCRI and 20 extension personnel from Kudumbasree, Kasaragod. The torch was further handed over by the Head KVK, Kasaragod, to KVK, Dakshina Kannada, on 23 July 2024.

Two-day 'Apiculture Farmers Conclave and Honey Festival 2024'

In a joint effort to promote biodiversity conservation and pollination assistance through honey bees, ICAR-KVK, CPCRI, and the Federation of Indigenous Apiculturists (FIA) organized a two-day 'Apiculture Farmers Conclave and Honey Festival 2024' during 24 – 25 October 2024, at CPCRI, Kasaragod. Dr. K.B. Hebbar, Director, ICAR-CPCRI, presided over the function. The event was inaugurated by Mr. N.A. Nellikkunnu, the Hon'ble MLA of Kasaragod. Approximately 175 farmers participated in the two-day workshop.

Flag-off Ceremony: Export of Honey from Tulunadu Ecogreen FPC, Kasaragod

The Tulunadu Ecogreen Farmers Producer Company Ltd. at Pallathinkal, Kasaragod, is an FPO mentored by ICAR-KVK, Kasaragod, established during 2016 with the financial support of NABARD. The company is engaged in the agglomeration and value addition of the various agricultural commodities like honey, coconut,

spices, etc. The company completed all licensing formalities for export of honey during 2024. The first export consignment of 360 kgs honey was flagged off to Qatar by Shri. K. Inbasekar IAS on 19 November 2024. The FPC has 1500 registered farmers. The representatives from CPCRI Kasaragod, ATMA, the Dept. of Agriculture, DIC, APEDA, and KVK, Kasaragod also participated in the programme. The programme was attended by around 60 registered members of FPC and local farmers.

World Soil Day 2024—Caring for Soils

ICAR-KVK, Kasaragod, celebrated World Soil Day with an awareness program on natural farming at Aravath in Panayal village in Kasaragod district on 5 December 2024. The event was inaugurated by Sri. M. Kumaran, President, Pallikkara Grama Panchayath, and was presided over by Smt. Geetha, Member, Kanhangad Block Panchayath. The programme was attended by 30 farmers.

Kisan Diwas celebration

The Kisan Diwas celebration was organized at ICR-CPCRI, Kasaragod, on 23 December 2024with the participation of 50 farmers which included method demonstrations. Shri Sharonvas, DDM, NABARD was the chief guest of the event and told that the farmers need to use the latest technologies for sustainability and climate resilience.

6.9.2

ICAR - Krishi Vigyan Kendra - Alappuzha

I. On Farm Testing: Three OFTs as listed below are implemented in Kanjikuzhy and Cherthala South panchayaths during 2024-25

Sl. No.	Title
1.	Assessment of high yielding hybrid ridge gourds in coastal plains
2.	Management of mites during summer season in chilly
3.	Assessment of feed combinations for higher productivity in dairy animals

Frontline Demonstrations: Fourteen FLDs are implemented in Kanjikuzhy, Muhamma and Cherthala South panchayaths during 2024-25

Sl. No.	Title
1.	Demonstration of cocoa hybrids as intercrop in coconut gardens
2.	Demonstration of open precision farming of bhindi hybrid Arka Nikhita for higher income
3.	Demonstration of HY mosaic resistant cassava variety - Sree Raksha
4.	Application of IISR bactolime for soil health management in turmeric
5.	Integrated crop management in coconut for higher productivity
6.	Nematode management through marigold crop rotation in Bhindi fields of coastal plains
7.	Demonstration of KAU Deepikato manage biotic stress in yard long bean
8.	Demonstration of the package of control measures against Giant African snail in homesteads
9.	Demonstration of Tricholime for the management of foot rot disease in betel vine
10.	Demonstration of hybrid chilly variety Arka Khyati against cucumber mosaic virus disease
11.	Demonstration of organic manure production from trash fish
12.	Demonstration of nutrient management packages to enhance the milk yield in dairy animals
13.	Culturing of snake head fish 'Murrel' in fresh water ponds
14.	Fodder cafeteria for enhancing profitability of dairy farmers

II. Programmes under SCSP: During 2024, 150 beneficiaries belonging to Scheduled Caste were provided improved breeds of poultry birds (10 each), fruit plants (mango, jack, and sapota grafts, and curry leaf and bush pepper plants) and vegetable seed kit (comprising of six types of vegetable seeds, bio pesticide Nanma, yellow sticky trap, and micronutrient mix sampoorna) under the Scheduled Caste Sub Plan (SCSP) Programme of the KVK in liaison with Bharanikkavu Gramapanchayath. For the year 2024 many interventions are planned and implemented in Muhamma, Vallikunnam and Thekkekkara panchayaths of the district. Under the NICRA project being implemented at Edathua panchayath by the KVK, fruit plants (mango, jack, sapota grafts and curry leaves) were provided to

50 selected families andbrush cutter and garden tillers were provided to farmer groups belonging to SC.

Skill Training cum Entrepreneurship Development (STED) programme for SC youth: Six months long 'Skill Training cum Entrepreneurship Development (STED) programme' for rural scheduled caste youth commenced on 2 September 2024 under the SCSP programme of the KVK. Eight rural youth selected based on a selection process would undergo the programme up to 28 February 2025. During the period they would learn the skills for plant propagation and nursery techniques, vegetable seed production and grafting of vegetable seedlings, organic manure and bio-agent production, mushroom and spawn production, apiculture and meliponiculture, livestock and poultry management, agro-processing and value addition, operation of farm machineries/equipments and plant protection techniques. On completion of the programme, they are expected to establish their enterprises for employment income. They also have to take a leadership and coordinating role in the implementation of various development programmes implemented by the state and central Govts in the agricultural and allied sectors for the upliftment of SC/ST population at the panchayath level.

Portable incubator unit established:A layer chick production unit using portable incubator was initiated under SCSP programme based at the residence of Smt. Reshmi, Kannikkal, Ward No.7 of Muhamma Grama panchayath. The portable incubator having a capacity to hatch 240 eggs per batch was 'switched on' on 22 August 2024.

III. Training / Capacity building / Extension Programmes

1. DAESI programme: Third batch of the DAESI programme in Alappuzha district was conducted by the KVK from March 2023 – March 2024. Adv. U. Prathibha, MLA, Kayamkulam was the chief guest for the valedictory function for the certificate distribution to 40 participants of batch. Fourth batch of the DAESI (2024–25) was inaugurated on the same day. The one year diploma programme is coordinated by MANAGE, Hyderabad at national level and by SAMETI and ATMA at state and district levels, respectively.

2. Farmer Field School on integrated management of juvenile coconut palms: During 2023-24 a Farmer Field School (FFS) on "Integrated management of juvenile coconut palms" was conducted from November 2023 to August 2024 in Thanneermukkom panchayath with the objective of managing juvenile coconut palms with appropriate scientific practices in pest, disease and nutrient management, leading to successful establishment of a healthy palm. Twenty five participants attended the entire school period of fourteen fortnightly sessions. Valedictory session of the FFS was organized at the school venue on 22 August 2024 in which apart from the regular participants, other progressive farmers, department officials, people's representatives and Head, KVK also participated.

3. Orientation cum training for branding at state level: Orientation cum training on "Standard Operation Procedure for preparation of banana products for branding at state level" for 56 master trainers of Kudumbasree mission (@4 each from all the 14 districts of Kerala) in two batches was conducted at the Agro-Processing Training cum Incubation centre of the KVK during 22-29 July 2024. This is organized as part of the initiative of the Kudumbasree mission, Kerala to market their products in a single brand with uniform specifications, quality and standard packing. Banana chips and banana-jaggery fries prepared uniformly by different units/groups of the mission were targeted towards the Onam market in September. State level officials of the mission took part in the planning and conduct of the programme.

4. Master Trainers from Mizoram attended capacity-building programme: Four master trainers from Mamit district of Mizoram state attended a capacity-building programme on 'Value addition in Jackfruit, Pineapple and Orange' from 10 to 13 September 2024 at the Agro-Processing Training cum Incubation Centre (APTIC) of the KVK. The programme was organized in linkage with the Kudumbasree NRO, focusing on promoting enterprises under NRLM in different states of India,

as part of the SVEP (Start-up Village Entrepreneurship Programme) implemented in Mizoram. Two Community Resource / Extension Persons and two officials of the project attended the programme to attain skills with the objective of attaining skills for utilizing the fruit resources in their block like jack fruit, pineapple and orange (which are available in plenty) through enterprises of food based and beauty products. The trainees expressed their satisfaction and excitement in acquiring skills on preparation of value added products which would help them a long way in the economic empowerment of their community

5. Friends of Coconut Tree (FoCT) programme conducted: KVK in collaboration with Coconut Development Board, Kochi organized the six days long capacity building program on Friends of Coconut Tree (FoCT) for twenty participants from Muhamma and Thanneermukkom panchayaths during 12-20February 2024. The skill set for learning included climbing coconut tree using machine, scientific coconut cultivation practices like selection of mother palm, seed nut collection, coconut nursery raising, selection of seedlings, nutrients, pests, and disease management of coconut palms, identification of maturity of nuts, harvesting etc. Climbing machines and accident insurance coverage worth Rs.5 lakhs were provided to all the participants.

6. Capacity building programme on 'Natural Farming Practices': Orientation cum capacity building programme on 'Natural Farming Practices' was organized by the KVK at Kanjikuzhy Grama Panchayath Community Hall during 29 – 30 August 2024. The two-day programme had five sessions *viz.*, (i) Preparation and use of NF formulations (ii) Natural farming as Eco-friendly farming for future (iii) Relevance of mulching in Natural farming (iv) Relevance of Indigenous cows in Natural farming and (v) Crop protection methods in Natural farming. Fifty-five farmers interested in natural farming practices actively participated in the two days programme.

7. Skill training on commercial mushroom production for 'Koon gramam' project: Agriculture Development and Farmers' Welfare Department of the Government of Kerala has initiated a state wide project *viz.*, Koon gramam (Mushroom village) for the promotion of production, processing, consumption and export of mushroom and value added products in the state. Two blocks of Alappuzha district are selected for implementation in the first phase. Out of these, 15 farmers/entrepreneurs selected from Chengannur block by the Asst. Director of Agriculture underwent a five days skill training programme in the KVK from 9 to 13 September 2024. The participants at the end of the programme exuded confidence in setting up the enterprise and earning a decent income.

8. Skill Training on 'Laying out open precision farming plot for vegetable production': Five days skill training programme on 'Laying out open precision farming plots for vegetable production' was organized for rural youth at KVK from 23 to 27 September 2024. The plot in the KVK farm was set up for vegetable seed production as well as a demonstration unit. Twenty-one participants including B.Sc (Ag) students were very much enthusiastic in gaining the skill on this specialized agricultural technique for efficient utilization of resources like water and nutrients and scientific weed and crop management.

9. Other events conducted

Launching of activities and Golden jubilee celebrations of Krishi Vigyan Kendra: Launching programme of KVK action plan (2024-25) activities in Kanjikuzhy and Cherthala South panchayaths was conducted at Kanjikuzhy Grama Panchayath Community Hall on 29 August 2024. About 125 selected farmers from different parts of the district actively participated in the programme.

Office building cum procurement and processing centre of OSFPC inaugurated: Onattukara Spices Farmer Producer Company (OSFPC) promoted by KVK-Alappuzha started functioning in 2017 with funding support from NABARD, but the long cherished dream of having an own building was materialized in 2024. The office building cum procurement and processing centre of the FPC, established with support from different Govt. agencies and director board members, was

inaugurated on 4 November 2024 by Sri. Saji Cherian, Hon. Minister of the Government of Kerala. The programme was attended by Adv. U. Prathibha, MLA, Adv. M. Arunkumar, MLA, Smt. K. G. Rajeswary, Alappuzha District Panchayath President, and Sri. Baiju N Kurup, CGM, NABARD, Kerala. Associated enterprises of the FPC *viz.*, a seedling production unit and a snack cum catering unit also were inaugurated by the VIPs on the occasion. About 250 persons including a large number of shareholders attended the function with enthusiasm.

Launching of Custom Hiring Centre: KVK-Alappuzha in collaboration with Vallikunnam Agricultural Improvement Cooperative Society (VAICoS) launched a custom hiring centre of farm machineries for the benefit of farmers in Bharanikkav block. Farm equipments viz., tractor with attachments like cultivator and rotavator, power tiller, mulching machine, shredder, zero till cum fertilizer drill and walk behind paddy transplanter owned by the KVK were handed over to VAICoS on a MoA for making available to farmers of the area at a nominal cost. Sri. M S Arunkumar, MLA, Mavelikkara launched the programme on 26 November 2024 by handing over the machineries to the society. About 100 farmers of the panchayath attended in the meeting.

Scientific Advisory Committee meeting: Twenty second SAC meeting of the KVK was conducted on 21 March 2024 under the chairmanship of Dr. K. B Hebbar, Director, ICAR-CPCRI, Kasaragod. The chairman in his introductory remarks highlighted the achievements of KVK during the past years and appreciated the KVK team for the sustained performance. Dr. DVS Reddy, Principal Scientist, ICAR-ATARI, Bengaluru, Dr. Sreevalsan J Menon, Associate Director of Extension, KAU, Dr. Regi Jacob Thomas, Head, ICAR-CPCRI, Regional Station, Kayamkulam, SAC members representing various agencies, and selected farmers representing different agro ecological situations of the district were present in the meeting. Dr. P. Muralidharan, Head, KVK presented the action taken report of the 21st SAC meeting and activities taken up by the KVK during the past year. Three Award winning farmers during the last year *viz.*, Sri P A Thomas (Millionaire farmer), Smt. Krishnakumari (Akshayasree) and Sri. Mujeeb A Pulliyil (Agri. Entrepreneur) were honored and KVK newsletter (Oct-Dec 2023) and revised edition of the extension booklet on 'Oyster mushroom cultivation' were released by the dignitaries on the occasion. All members and invitees actively participated in the discussion and made suggestions for the future activities of the KVK.

World environment day celebrations:KVK celebrated World Environment day on 5June 2024 initiating the planting of 1000 perennial (fruit) plants in selected 200 farmers' fields to mark the occasion of the Golden Jubilee Year of KVKs. Sri. K.C. Chandramohanan, a renowned environmentalist inaugurated the programme by planting a Jackfruit plant in the KVK campus in the presence of staff members and 50 farmers from different parts of the district who have made significant achievements in farming through collaboration with the KVK. It was followed by the simultaneous planting of 50 plants by the invited farmers in the KVK farm. 'Fellow farmer' certificates to the farmers, whose success stories were documented earlier by the KVK and published by the ICAR, were distributed on the occasion. All the 50 invited farmers were given away five tree (fruit) plants each for planting in their homesteads.

World Soil Day celebrated: World Soil Day was celebrated with farmers on 5 December 2024 in collaboration with the Department of Agriculture at the Kanjikuzhy Panchayath Community Hall. Soil health cards were distributed to selected 25 farmers on the occasion, followed by an awareness programme on importance of plant nutrition for quality farm produce. About 30 persons including officials participated in the programme.

10. Exposure Visits by Farmers / entrepreneurs /students

Farmers, officials, entrepreneurs and students from different parts of the state and other states visited the Agro Processing Training cum Incubation Centre (APTIC) of the KVK to acquaint, learn and build capacity on agro-processing and value addition aspects of different agricultural produces.

1. As a part of the ATMA-Inter State Exposure visit, 35 farmers from Kanyakumari district of Tamil

Nadu visited the Agro Processing Training cum Incubation Centre (APTIC) of the KVK on 7 February 2024.

2. A batch of 30 B.Sc Home Science students with 8 teaching staff from Govt. Women's College, Trivandrum visited the APTIC on 27 February 2024 as a part of the academic activities and institution visit.

3. Forty-eight participants, mostly entrepreneur men and women, from 11 districts of Kerala (except Kozhikode, Palakkad and Wayanad) attended a two day paid training programme on "Processing and value addition of fruits and vegetables" organized on 25-26 November 2024.

4. Eight farmer leaders of a FPO along with two SMS's from KVK-Uttar Kannada, Karnataka visited the KVK and attended orientation cum training programme on value addition of banana and other crops on 29 November 2024.

11. Regular training programmes: One hundred and twelve training programmes were organized during 2024 for 2842 participants as detailed below.

Training	No. of Programmes	Participants
Farmers/Farm women	57	1565
Rural Youth	28	587
Extension Officials	3	93
Vocational/Skill	9	132
SCSP Training	6	172
Sponsored	**9**	**293**
Total	**112**	**2842**

12. Other Extension Activities

1. Radio talks / TV programmes

Sl. No.	Name and designation of officer	Topic	Station and Date
1	Dr S. Ravi, SMS (AH)	Alleviation of Heat stress in livestock & poultry	AIR 08.04.2024
2	Jissy George SMS (Home Science)	Value added products of Mushroom	AIR 31.10.2024

1. **TV programmes:** Two programmes 'On KVK trained Women entrepreneurs' in Krishi Darshan Programme, Asianet on 10 July 2024 and 03 August 2024
2. **Other programmes:** Help line service (calls attended and responded) – 1796, Agro-clinic – 329, Method demonstration–11, Messages to farmers–67, Soil & water testing–298, Newspaper coverage –25, Soil testing campaign – 07

IV. Educational programmes

1. Rural Agricultural Work Experience Programme for B Sc (Ag) students

(I) Five weeks duration programme was organized for four B Sc (Ag) final year students of Lovely Professional University, Punjab from 1 February to 7 March 2024.

(ii) Three weeks duration programme was organized for 24 B Sc (Ag) final year students of Amrita School of Agricultural Sciences, Coimbatore from 6-28 March 2024.

(iii) Fourteen students of B.Sc (Agriculture) from College of Horticulture, Kerala Agricultural University, Vellanikkara have undergone their RAWE–KVK Module for three days from 2 – 4 April 2024.

(iv) Six B.Sc (Ag) final year students of Theerthankar Mahavir University, Moradabad, UP completed their RAWE programme of five weeks duration from 5August to 6 September 2024.

(v) Thirteen B.Sc (Ag) final year students from three Agricultural universities *viz.*, Lovely Professional University, Jalandhar (Punjab), Guru Kashi University, Bhatinda (Punjab) and Theerthankar Mahaveer University, Moradabad (U.P) undertook RAWE programme of five weeks duration from 23 September to 25 October 2024.

2. Students' Internship Programme

i) Fifteen students undergoing their B Tech (Food Processing) programme at Sree Buddha Engineering College, Pattoor attended a two-day hands-on-training programme in the KVK on 18-19 April 2024 on value addition of banana and plantains.

ii) Three students undergoing B Tech (Food Processing) at Saint Gitts College, Kottayam underwent an internship cum skill training programme for five days from 1 to 5 July 2024 at the Agro-Processing Training cum Incubation Centre (APTIC) of the KVK.

V. External funded projects

1. National Innovations in Climate Resilient Agriculture (NICRA) - Phase II

Technology Demonstrations under the project, "National Innovations in Climate Resilient Agriculture' (NICRA) Phase II is being implemented at Edathua village of Kuttanad Taluk. Various technology demonstrations like Climate resilient practices for paddy in Kuttanad region, Modified rain shelter for year round vegetable production, Short duration cassava variety- Shree Jaya for escaping flood during monsoon season, Large scale composting of aquatic weeds using EM solution and use for vegetable cultivation, Soil health card for better nutrient and soil health management, Recycling of organic residues for energy generation and crop production using portable biogas plants, modified season cultivation of HY ginger for vegetable purpose, improved goat shelters to withstand water logging/flood, climate resilient cages for poultry rearing, stress, disease and nutritional management in dairy animals are being demonstrated in the farmer participant fields. 'Village Climate Risk Management Committee (VCRMC) is formed with farmers and LSG members for overseeing and institutionalizing the activities of the project on long term basis in the village.

2. Mushroom Spawn Production Unit

With a funding support Rs.15 lakhs from the State Horticulture Mission, a mushroom spawn production unit is established in the KVK for meeting the demand for spawn from the mushroom entrepreneurs trained by the KVK and from adjoining districts.

3. Natural Farming Project (NFP)

This national network project funded by ICAR through ATARI was initiated in 2022-23. The project activities were initiated in Cheppad panchayath. Demonstrations in farmers' fields and awareness programmes are conducted in different panchayaths in different parts of the district.

1. Field day: Field day of the Front Line Demonstration on 'Short duration variety ofturmeric – IISR-Pragati' was conducted on 20 February 2024 at Muhamma panchayath with the participation of partner farmers along with farmers, officials and LSG representatives of the locality.

2. Technology Demonstrations on foliar nutrition in paddy fields using drone: As part of the technology demonstration on 'Climate resilient practices for paddy in Kuttanad region' under the NICRA project, foliar nutrition of multi-nutrient mixture 'KAU-Sampoorna' was carried out using drone in 16 ha paddy fields of Vayalattumali Padasekharam of Thalavady Grama Panchayath on 15 February 2024. Agricultural Officer and farmer leaders were present along with 25 farmers on the occasion.As a result of the awareness created by the demonstrations using drone from 2022 by the KVK, based on the demand from the farmers, Department of Agriculture, Govt. of Kerala has taken steps to adopt this technology to larger area during 2023-24. About 2000 ha paddy fields in Champakulam and Ramankary blocks of Kuttanad region was covered with drone spraying of micronutrients. Among the NICRA villages 287 ha of the 690 ha paddy area in Muttar, 348 ha out of 839 ha in Thalavady, and 56 ha out of 1592 ha in Edathua were covered with this new resource efficient technology.

3. Arka Nikhita giving rich dividends to vegetable farmers on precision farming: In order to recommend an ideal hybrid variety of

Bhindi under open precision farming conditions to commercial vegetable farmers of Karappuram region of Alappuzha district, an assessment was conducted by introducing two new hybrids *viz*., Arka Nikhita from ICAR-IIHR, Bengaluru and COBH 4 from TNAU, Coimbatore for comparison with Samrat, the one practiced by farmers. Adhoc recommendations of KAU for open precision farming were followed for all the three varieties. The partner famers from Muhamma, Thanneermukkom and Kanjikuzhy panchayaths were very happy and convinced by the performance of Arka Nikhita with a higher yield of 18.8 t per ha, and good appearance and cooking qualities. Open precision farming in general leads to higher yield, and lesser infestation of pests, diseases and weeds but Arka Nikhita outperformed the other varieties (at least by 5 t ha^{-1}) with advantages in marketing also. Convinced by the added performance, farmers have initiated the next crop by procuring seeds directly from IIHR. Thus, the variety has become popular among the commercial vegetable farmers very soon through the intervention of the KVK.

4. **Technology Awareness Camp' organized:** On behalf of the Agri Business Incubator (ABI) of ICAR-CPCRI, Kasaragod, a one day technology awareness camp was organized in the KVK on 17 April 2024 for entrepreneurs of Alappuzha and Kollam districts. Prime objective of the camp was to create awareness among the entrepreneurs on technologies of ICAR-CPCRI which are available for transfer to them including coconut varieties, bio-agents, machineries and processed products. Dr. K. Muralidharan, PS and OIC of the ABI explained the technologies available and their prospects. Dr. Regi Jacob Thomas, Head, ICAR-CPCRI, Regional Station, Kayamkulam and Dr. P. Muralidharan, Head, KVK also addressed the entrepreneurs on the occasion. Following this, a detailed orientation on the preparation of value added products from coconut was given to the participants by Smt. Jissy George, SMS, KVK. Forty-one small-scale entrepreneurs and farmer group coordinators attended the programme with great enthusiasm.

VI. Revolving fund activities of KVK

Different inputs were made available to the farmers of the district (as resource centre) through revolving fund activities *viz.,* vegetable seeds and seedlings, planting materials, bio-agents, Methyl euginol, cue lure and yellow sticky traps, layer chicks, mushroom spawn, mother spawn, multi nutrient mixture for banana and vegetables, azolla, processed products, publications etc. A custom hiring centre is also functioning to provide farm implements like tractor mounted rotavator and transplanter to farmers on hire for land preparation, paddy transplanting etc. The progressive closing balance of revolving fund as on 31 March 2024 was Rs.33,93,892/-.

VII. New facilities/demonstration units

Vertical Garden demonstration unit established in the KVK farm

A 'Vertical Garden' demonstration unit is established at KVK farm to educate the visitors on effective and efficient use of the natural resources *viz.,* land, solar energy and water and to replicate at their homesteads on 21 March 2024. This vertical garden structure can accommodate 50 pots vertically arranged which is enough for growing of selected vegetables required for a family. This structure has three major sub components *viz.* (1) 3 base frames of 6', 5', and 4' one side squares placed from bottom to top, respectively (2) a central support of 8 feet height and (3) a roof structure of 7 feet diameter. Mist irrigation system is also installed for efficient utilization of water. Earthen pots of 10-12 inch diameter have been used for growing vegetables. Trailing vegetables can also be grown using the central support and rooftop of this unit. The unit was officially inaugurated by Dr. K.B. Hebbar, Director, ICAR-CPCRI, Kasaragod in the presence of Dr. D.V.S. Reddy, PS, ICAR-ATARI, Bengaluru.

VII

Publications

Research Articles

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VIII

Technologies Assessed and Transferred

Varieties Released and Notified

Varieties released by the AICRP on Palms

Coconut hybrid – Kalpa Nakshatra

It is a superior, high yielding D x T hybrid, involving Chowghat Orange Dwarf as female parent and West African Tall as male parent (Fig. 122). The palms are semi- tall in habit with compact spherical canopy. The hybrid bears brown coloured, oval shaped fruits and the husked fruits are round in shape. 'Kalpa Nakshatra' is high yielding, with high fruit yield (151 fruits palm^{-1} year^{-1}) and copra out turn (31.3 kg palm^{-1} year^{-1}). The tender nut water quality is good (TSS 5.9° Brix), with higher tender nut water content (432.5 mL). The variety also gives higher inflorescence sap yield (70 L inflorescence^{-1}). Considering the nut yield, tender nut water quality and sap yield potential, the variety is recommended as a multi-purpose variety, for cultivation in Kerala. This variety was also released by the Kerala State Variety Release Committee.

Fig. 122. Kalpa Nakshatra coconut hybrid

Fig. 123. Terai Shankar

Arecanut dwarf hybrid Terai Shankar

It is a T x D hybrid with Mohitnagar as female and Hirehalli Dwarf as male parent (Fig. 123). The palms of this hybrid are dwarf in habit, with medium thick stem with super imposed nodes, intermediate crown shape. Fruits are medium in size, oval in shape and on ripening exhibit orange colour. The dry kernel weight is 6.75 g and dry kernel yield per palm per year is 2.19 kg with a 21 per cent kernel recovery. The variety is recommended for cultivation in homesteads in Sub Himalayan Terai region of West Bengal and lower Brahmaputra zone of Assam.

Varieties recommended by CVRC & dedicated to nation by Hon. PM

Coconut varieties

Kalpa Suvarna

Dwarf, medium early in flowering, dual purpose (tender nut water and copra), with a yield of 108 nuts per palm per year and 20.1 kg copra per palm per year. Recommended for the states of Karnataka and Kerala.

Kalpa Shatabdi

Tall with large fruit size, dual purpose (tender nut water and copra) with a yield of 105 fruits per palm per year and 28.7 kg copra per palm per year. Recommended for the states of Karnataka, Kerala and Tamil Nadu.

Cocoa

VTLCH 1

Trees with medium canopy of 15-18 m^2, yield an average of 45-50 pods per tree per year and 1.5 – 2.5 kg dry bean per tree per year. Pods are green to yellow with 35-44 beans per pod and single bean weight of 1.0-1.1 g. The variety has 13-15 per cent shelling, 85-87 per cent nib recovery and 50 per cent fat content. Rich in Fe and Zn contents. Suitable for

palm based cropping systems in Karnataka, Kerala and Tamil Nadu.

VTLCH 2

Trees with medium canopy of 14-20 m^2 yield an average of 45-50 pods per tree per year and 1.5 – 2.5 kg dry bean per tree per year. The pods are green to yellow with 35-50 beans per pod and single bean weight of 1.0-1.2 g. The variety has 13-15 per cent shelling, 85-87 per cent nib recovery and 50 per cent fat content. Rich in Fe and Zn contents. The variety is tolerant to black pod rot. Suitable for palm based cropping systems in Karnataka, Kerala, Andhra Pradesh and Gujarat.

Technologies

Whole genome pipeline tool for plantation bacterial analysis

A set of Linux-based Python scripts was developed alongside well-established whole genome sequencing assembly tools, including SPAdes and Velvet, to analyze the genomes of two bacterial species: *Microbacterium enclense* and *Paenibacillus typhae*. These bacteria have attracted interest due to their potential in enhancing coconut cultivation by promoting plant health and improving soil fertility. *Microbacterium enclense* is typically found in the rhizosphere of coconut palms. Genome annotation was carried out using tools such as Prokka, BUSCO, and EggNOG-mapper. The genome of *Microbacterium enclense* consists of approximately 21,241 CDS, 21,589 genes, 30 rRNA, 6 tmRNA, and 312 tRNA, including vital nutrient recycling proteins such as iron-sulfur cluster assembly protein, Fe-S metabolism-associated domains, and phosphoserine phosphatase. In contrast, *Paenibacillus typhae* has 67,258 CDS, 68,414 genes, 24 repeat regions, 64 rRNA, 12 tmRNA, and 1,080 tRNA, with important proteins like zinc uptake system ATP-binding protein, zinc-binding protein, and alkaline phosphatase-like protein.

Kalparasa syrup infused coconut flakes

A protocol and methodology for a ready to serve coconut flakes was developed (Fig. 124). It involved the use of different drying systems of osmotic process based on coconut inflorescence sap concentrates (kalparasa syrup: 50°Brix). The infusion of kalparasa syrup not only enhanced the product's nutritional value but also contributed to its sensory profile as it improved the overall taste, flavour, and colour. Coconut flakes underwent drying through various methods at three distinct temperatures (55, 65, and 75 °C) to determine the optimal drying method and temperature. Evaluating the bioactive profile, coconut flakes dried at 65° C using infrared-assisted hot air dehydrated coconut flakes (IRAHAD) exhibited an outstanding nutritional and physical profile, featuring a Hausner ratio of 1.04 and carr's index 4.22, rehydration ratio 2.37 per cent, hygroscopicity 1.68 per cent, bulk density 0.552 g per mL, tapped density 0.610 g per mL, protein 3.92 per cent, carbohydrate 33.86 per cent, fat 34.29 per cent, ash 1.92 per cent, total phenolic content 105.38 mg GA per 100g, DPPH activity 88.81 per cent and FRAP 0.00893 mg TE per 100g.

Fig. 124. Ready-to-eat coconut flakes

Cocoa fermenter

Traditionally, cocoa beans undergo box fermentation and sun-drying, resulting in inconsistent quality, contamination risks, weather dependency, and limited control over processing. Therefore, study was undertaken to optimize different fermentation methods, utilizing a fermenter unit developed at ICAR-CPCRI and the traditional box fermentation method to comprehend the biochemical transformations at each stage and their collective impact on the overall quality of final products. In the case of box fermentation, pH decreased significantly from 5.8 to 3.74, while in the CPCRI fermenter unit, it decreased from 5.8 to 3.78. Notably, cocoa beans from the CPCRI fermenter unit exhibited higher values for bulk density

(434 kg m^{-3}), shell mass (16.6%), and nib mass (86.4%). Biochemical analyses, encompassing fat, protein, carbohydrate, ash, moisture, total phenol, and antioxidant activity, were conducted on both fermented and dried cocoa bean samples. Cocoa beans from the CPCRI fermenter unit displayed elevated values for carbohydrate (28.94%), ash (3.64%), moisture (7.17%), total phenol content (4.67 mg GAE $100g^{-1}$), and FRAP (3.23 mg TE $100g^{-1}$). In sensory evaluation, chocolates crafted from cocoa beans processed in the CPCRI fermenter unit garnered higher preference compared to those from the traditional box fermentation method.

Semi-Automatic Tender Coconut Punching Machine

Tender coconut water is a nutritionally superior drink and has gained worldwide attention. The extraction of water from the tender coconut is quite a difficult task. Street vendors initially cut through the thick fibrous husk to expose a part of the shell. This is done by chopping the husk in bits with a heavy machete. The exposed shell is then punched. The existing facilities, mainly traditional tools used are unsafe, messy and need skill and training. The risk of getting injured is also high. There are some manually operated tools that exist to punch a hole and split it open but it is time consuming and hard to operate continuously. To increase the production and to reduce the human drudgery, the semi-automatic coconut punching machine has been developed. It is working based on the principle of slider crank mechanism. The developed machine consists of a stand to hold the machine, platform to place the sample, slider crank punching unit, drive motor, and gear reduction assembly along with a limit switch. The speed of the penetration bit was 61.5 mm per s. This invention will assure the quick and efficient punching processing of 300 tender coconuts per h.

Gum arabic as a novel edible coating for storageofhaustorium

An edible coating of coconut haustorium with 15 per cent gum arabic effectively preserved its biochemical attributes for up to 20 days under refrigerated conditions (Fig. 125). This coating maintained a comprehensive acid value (CAV) of 6.1±0.5 mg NaOH per g, significantly lower than the 18.6±1.57 mg NaOH per g in untreated control. After 20 days, the treated haustorium contained gallic acid (183.43 µg g^{-1}), chlorogenic acid (8.13 µg g^{-1}), caffeic acid (65.23 µ g g^{-1}), vanillic acid (72.69 µg g^{-1}), traces of p-coumaric acid, sinapic acid (1.59 µg g^{-1}), 2, 4-DHBA (2.49 µg g^{-1}), and ferulic acid (1.19 µg g^{-1}) comparable to that of freshly collected untreated haustorium. Thus, the gum arabic-based coating effectively delayed quality changes and extended the haustorium's shelf life under refrigerated conditions (4-10 °C).

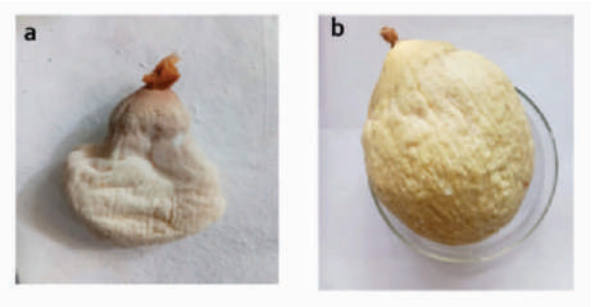

Fig. 125. Coconut haustoria without and with shelf life coating

Flavoured coconut milk

Defatted coconut flour (DCF) obtained while processing virgin coconut oil was utilized for the extraction of low fat coconut milk for developing ready to drink coconut milk (Fig. 126). The extracted coconut milk had 69.60 ± 0.39 per cent moisture, 14.85 ± 0.31per cent crude fat, 11.65 ±1.35 per cent total carbohydrates, 2.8 ± 0.26 per cent crude protein, and 1.10 ± 0.02 per cent total minerals (ash). The optimum level of pH, fat content, sweetness, emulsifier, skimmed milk powder, colour, and flavour in the milk was found out. The optimized composition is second extract of coconut flour with 4per cent fat with Almond (Badam) flavour. The moisture, fat, carbohydrates, protein, and ash content of the flavoured coconut milk was 82.45 per cent, 4.17 per cent, 9.62 per cent, 2.85 per cent, and 0.92 per cent, respectively, contributing to 94 kcal. The inference of the study revaluated that pasteurized flavoured milk would stay fresh up to 18 days under refrigerated condition and further increase in shelf life is achieved through retort processing. The phenolic content (2333 µg mL^{-1}) and antioxidant activities of the flavoured coconut milk were DPPH: 2775 µg per mL and FRAP: 95.85 µg per mL respectively.

Fig. 126. Flavoured coconut milk as health drink

Preservation protocol for trimmed tender coconut

Formulation is to increase the shelf life of trimmed tender coconut. Tender coconuts of 6-7 months old were trimmed using the trimming machine. These were then dipped in the chemical solution. The combination of organic acids, substituted resorcinols, aromatic carboxylic acids and complexing agents were used to formulate the anti-browning solution. Then, it was shrink wrapped and kept under low temperature storage (5±1°C). Browning-free storage life of the minimally processed tender coconut was extended to five weeks with 10 min dipping in anti-browning solution.

Rapid detection of adulteration in desiccated coconut powder

The desiccated coconut powder (DCP) was mixed with CMR in different proportions, such as 0 (pure DCP), 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 per cent (w/w) (pure CMR). For each level of adulteration, 20 samples were prepared, resulting in a total of 220 (11×20) samples. The spectral reflectance values of these samples were recorded using an IR spectrophotometer (Field Spec® 3, ASD Inc., Malvern Panalytical Ltd, Malvern, UK) within the range of 350–2500 nm by placing the samples in Petri plates (100 mm diameter × 15 mm height). Each sample underwent the scanning process 10 times at different positions, and the results were averaged into a single value. The developed model can be used to predict the level of adulteration in less than 10 seconds.

Accelerated virgin coconut oil (VCO) production using skimmed coconut milk

The coconut milk was thoroughly mixed to achieve a homogeneous state. Then, 10 per cent of 24-hour fermented skimmed coconut milk was mixed with fresh coconut milk and incubated at a room temperature of 27±3°C and 75±5 per cent relative humidity. The productivity gain of the technology is 5 L of oil from 20 L of coconut milk. It saved 5 hours of time compared to the traditional method. Three per cent more yield was observed compared to the traditional method. 10 per cent of 24-hour fermented skimmed coconut milk could be used as a potential starter to improve virgin coconut oil yield.

IX

Awards and Recognition

Awards

- Kasaragod centre of AICRP on PHET bagged second best centre award during the 40th annual workshop of AICRP on PHET held at Assam Agricultural University, Jorhat from 20-22 November 2024.
- A team of Dr. R. Pandiselvam, Dr. M.R. Manikantan, Dr. A.C. Mathew, Dr. Shameena Beegum, P.P., Dr. S.V. Ramesh, Dr. Murali Gopal and Dr. K.B. Hebbar bagged ICAR-CPCRI best scientific team research award on the occasion of 108th Foundation day on 05 January 2024.
- Dr. M.R. Manikantan, Principal Scientist, (AS & PE) was conferred with National Academy of Agricultural Sciences (NAAS) Fellow award on 15 June, 2024.

Recognition

- Dr. K. Balachandra Hebbar, Director, has been nominated as the Chair to coordinate the 61st Steering Committee of the International Coconut Community, Jakarta, Indonesia.
- Dr. M.R. Manikantan received Certificate of Excellence award by Arecanut Growers Association, Gobichettipalayam, Erode District, Tamil Nadu for his outstanding contributions for capacity building of coconut and arecant stakeholders.
- Dr. R. Pandiselvam, Scientist (Agricultural Structures & Process Engineering), ICAR-CIRCOT, Mumbai, has been featured in the world 2 per cent scientists list published by the Stanford University, USA and Elsevier.

Best Oral Presentation Award

The paper titled "Varietal variation in arecanut *(Areca catechu L.)* for zinc absorption, zinc translocation and zinc use efficiency" authored by Thanuja, G., Nagaraja, N.R., Bhat Ravi, Vishnuvardhana, Bhavishya, Neenu, S., Nayana. H. presented in the National Seminar on Climate Smart Agriculture for Sustainable Soil and Plant Health in Plantation Crops organized by ICAR-CPCRI, Regional Station, Kayamkulam, Kerala during 13 to 14 June 2024 received best oral presentation award (second prize).

The paper titled "Economic analysis of different stocking densities of whiteleg shrimp production in Tamil Nadu, India" authored by Kalidoss, R., Prakash, S., Ananthan, P.S., and Shil, S. presented in the 11th International Conference on Fisheries and Aquaculture 2024 held in Bangkok, Thailand received the best oral presentation award.

The paper "Mating frequencies and the ovipositional behaviour of tea mosquito bug, *Helopeltis theivora* (Hemiptera: Miridae) authored by Madhu T.N., Thava Prakasa Pandian, R., Bhavishya, Saneera, E.K., Nagaraja, N.R. and Chaithra M., presented in the International Conference on Plant Protection in Horticulture (ICPPH-2024) - Advances and Challenges, organized at ICAR-IIHR, Hesaraghatta, Bengaluru, Karnataka during 25 to 27 September 2024 received best oral presentation award.

The paper titled "Bionutripriming, a promising technology for developing polybag coconut seedlings" authored by Jeena Mathew, S. Indhuja, P. Anithakumari, Sajitha S Jayan, Asha K Chandran and Alka Gupta presented at Agriculture Session of 31st Swadeshi Science Congress held at ICAR-CIFT, Kochi, Kerala on 9 November 2024 received best oral presentation award.

The paper titled "Technical Performance of Farmer Producer Companies in Southern India in the International Conference on Innovative education, research and extension approaches for transmitting scientific know-how to augment livestock production in the contemporary scenario", authored by Akshith Sai Pabba and K. Ponnusamy, "Future proofing extension education in agricultural universities: stakeholders perspective in the International Conference on Innovative education, research and extension approaches for transmitting scientific know-how to augment livestock production in the contemporary scenario" authored by Mohammad Saifuddin, K.Ponnusamy, K Manasa and S Sidharth and "A Multi-Stakeholder Perspective on Correlates of Milk Consumption Level vis-a-vis Lifestyle Diseases in Salem District of Tamil Nadu in the International Conference on Innovative education, research and extension approaches for transmitting scientific know-how to augment livestock production in the contemporary scenario" authored by Surya K T and K. Ponnusamy at Veterinary College and Research Institute, TANUVAS, Orathanadu, Thanjavur district, Tamil Nadu on 10-12 July received best oral presentation award.

Institute Awards

- The best administrative staff award was conferred to Mr. Pradeep Kumar Vasu, Asst. Administrative Officer, ICAR-CPCRI Regional Station, Kayamkulam.
- The best technical staff awards were conferred to Sri Bhavani Shankar Naik K.M. and Sri Dinesh Kumar N., ICAR-CPCRI, Kasaragod.
- The best skilled support staff award was conferred to Mr. Sundaran C., ICAR-CPCRI Regional Station, Kayamkulam.

X

Training and Capacity Building

Scientific

Name and Designation	Programme	Place & Date
Dr. Ravi Bhat, Principal Scientist and SIC, PME, Dr. Elain Apshara, S., Principal Scientist, Dr. Jeena Mathew, Senior Scientist and Dr. Jilu V. Sajan, Scientist.	Online short course on patents (Agri IP 2024) jointly organized by IP & TM, ICAR, New Delhi and Zonal technology Management Agri Business Incubation centre, ICAR-CIFT	Online, 1 January 2024 to 15 February 2024
Dr. Sujithra, M., Sr. Scientist and Dr. Daliyamol, Scientist	Smart Farming driven by Artificial Intelligence	ICAR-CTCRI, Thiruvananthapuram 5- 9 February 2024
Dr. Elain Apshara, S., Principal Scientist	Online training on 'Women in Agri Business Navigating Challenges, Seizing Opportunities'	MANAGE, Hyderabad 3-6 December 2024
Dr. Rajkumar, Senior Scientist	Training programme SRIJAN Empowering ZTMCs/ITMUs: ICAR institutes	NAASC Complex, Pusa, New Delhi, 17-19 January 2024.
Dr. Suchithra, M., Scientist	Winter school training on 'Phenotyping horticultural crops for abiotic stress tolerance to enhance resilience under climate change'	ICAR- Indian Institute of Horticulture Research, Bengaluru, 1- 21 February 2024.
Dr. Chaithra, M., Scientist, RS, Vittal	CAFT Training on 'Influence of microbiome and native biota on conservation of genetic resources of important horticulture GI crops and their inherent qualities'	College of Horticulture, Mysore 05-25 January 2024.
Dr. Chaithra, M., Scientist, RC, Kahikuchi.	Summer school and training on 'New advancements in agricultural sciences from green revolution to Viksit Bharat 2047'.	Agri Meet Foundation Bharat in Collaboration with ICAR- DCR Puttur, Karnataka, SKLTSHU Telangana, MGUVV Durg Chattisgrah & ICAR NIBSM Raipur, (Online mode) from 15 August to 4 September 2024.

Name and Designation	Programme	Place & Date
Dr. Sandip Shil, Senior Scientist, (Agrl.Statistics)	Online training on Intellectual Property Rights.	ICAR-IIHR, Bengaluru, 5-9 August 2024.
Dr. Sudha, R., Dr. Neenu, S., Dr. Paulraj, S., Dr. Ramesh, S.V., Dr. Rajkumar, Dr. Sujithra, M., Dr. Anes, K.M., Dr. Prathibha, P.S., Dr. Merin Babu, Dr. Shareefa, M., Dr. Nihad, K., Dr. Jeena Mathew, Dr. Surekha, and Dr. Nagaraja, N.R., Sr. Scientists, Dr. Bhavishya, Dr. Thava Prakash Pandian, R., Dr. Madhu, T.N., Dr. Chaithra, M., Dr. Suchithra, M., Dr. Saneera, E.K., Dr. Singh, L.S., Dr. Shameena Begum, P.P., Dr. Daliya Mol, Mrs. Ranjini, T.N., Dr. Sumitha, S., Dr. Panjavarnam, G., Dr. Indhuja, S., Dr. Jilu V. Sajan, Dr. Chaithra, M., and Dr. Y., Diwakar, Scientists	Online training programme on Statistical Applications in Plantation Crops	ICAR-CPCRI, Kasaragod and ISPC, during 11-15 November 2024

Technical

Name and Designation	Programme	Place & Date
Shri. Arunji, G., Technical Assistant (Library)	Regional awareness programme on J-Gate@CeRA for South Region	Kerala Agricultural University, Thrissur, 16 October 2024
Dr. Mayalekshmi, Technical Officer (Lab) and Dr. Kamalkumar, Technical Assistant (Field/Farm)	Hands on training on 'Cryopreservation'	Malabar Botanical Garden & Institute for Plant Sciences, Kozhikode. 25 December 2024

XI

Workshops, Seminars, Summer Institutes, Farmers Days, Organized

Farmer's Meet and Agricultural Technology Exhibition at Kidu

Sushri Shobha Karandlaje, Hon'ble Minister of State for Agriculture and Farmers Welfare inaugurated a Farmer's meet at ICAR-CPCRI, Research Centre, Kidu, Karnataka on 11 March 2024 (Fig. 127). About 2000 farmers from coconut and arecanut growing districts attended the mela along with officials from State Govt., Development Agencies, FPOs, KVKs and other agencies. Hon'ble Minister highlighted various measures taken by central government to protect the interest of coconut and arecanut farmers of the region to manage some of the sudden outbreak of pest and diseases and prevailing price fluctuation and to prevent illegal import of commodities from neighbouring countries. She also emphasized that the approved multi-institutional project involving reputed research organizations like AIIMS, IISc, CSIR - CCMB, JIPMER, NIMHANS, NBRI and other private medical institutes would establish scientific evidence to show that chewing arecanut alone is not carcinogenic and instil confidence in beleaguered farmers.

Dr. S.K. Singh, Deputy Director General (Hort. Sci.), ICAR, New Delhi presided over the function and urged the farmers to adopt improved technologies in agriculture to reduce the cost of production and tide over the climate crisis. Dr. Prabhat Kumar, Horticulture Commissioner Govt. of India called upon farmers to make use of the Coconut Development Board (CDB) schemes to rejuvenate old gardens with improved high yielding varieties to check declining crop productivity. Vegan population in Europe/America is particularly looking for coconut products and advised the farmers to think of eco-friendly produce (harmless harvest), use minimum water and adopt multi cropping. Sushri Bhagirathi Murulya, MLA (Sullia), Dr. Homey Cheryian Director DASD, Dr. B. Hanumanthe Gowda CCDO, CDB, Shri Kishore Kumar Kodgi President, CAMPCO and Shri Satish Kalige, Bilinele Ward Member, graced the occasion.

Technical sessions on latest technologies on plant and soil health management, value addition, farmers support initiatives, marketing *etc.*, demonstrations of drone enabled spraying; hybridization technique in coconut; coconut tree climbing device were also conducted.

A training session on Agro-techniques in coconut, arecanut and cocoa for Scheduled Caste and Scheduled Tribe communities was conducted during the programme with more than 120 participants.

Fig. 127. Sushri Shobha Karandlaje, Hon'ble Minister of State for Agriculture and Farmers Welfare, inaugurated the programme at Kidu

Dream Big-Kalpa: Institute-Industry Interface Meeting

"Problems of many are the opportunities for the entrepreneurs", opined Shri Nagaraja Prakasam, startup mentor and investor, while inaugurating Dream Big-Kalpa, the Institute-Industry Interface at ICAR-CPCRI on 5 March 2024. Agriculture sector

will continue to be a driving force in the Indian start-up ecosystem and the research institutions and agri-business incubators have a decisive role to convert such initiations to successful ventures, he said (Fig. 128-131).

"Interaction between researchers and industrialists will enable much needed refinements in technologies for effectiveness and wide adoption" said Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI, in his presidential address.

Fig. 128. Shri Nagaraja Prakasam, start-up mentor and investor, delivering inaugural speech

Fig. 129. Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI, addressing the gathering

Fig. 130. Exhibition at CPCRI Kasaragod on the occasion of Dream Big-Kalpa: Institute-Industry Interface Meeting

Fig. 131. Panel discussion on farming in the 5G Era: Leaving drudgery for leisure

Four MoAs were exchanged for technology transfer: Mr. Shivakumar, P., Production and Marketing Manager, Ecophytocare India Pvt. Ltd., Mysuru for microbial probiotic technologies (Kera Probio', 'Kera Probio+', 'Cocoa Probio' and 'KerAM); Gramalakshmi Marketing Producer Company Limited for Kalpa Soil Care; Ramnagara Zilla Mango and Coconut Crop Farmer Producer Company Ltd. for Kalparasa; and Praveen, R. for Coconut chips.

108th Foundation Day of the ICAR-CPCRI

ICAR-CPCRI, Kasaragod celebrated 108th Foundation Day on Friday 5th January 2024 in a befitting manner. Dr. N.K. Krishna Kumar, Former Deputy Director General (Horticultural Sciences), ICAR, New Delhi delivered the Foundation Day address (Fig. 132).

Fig. 132. Exchanging of MoAs for technology transfer

Dr. Krishna Kumar in his address emphasized that innovation is the key for facing the challenges experienced in coconut, arecanut, cocoa and other plantation crops in the current scenario.

Dr. George V Thomas, former Director, ICAR-CPCRI Kasaragod delivered Dr. K.V. Ahamed Bavappa, memorial lecture on "Biodiversity and conservation-based approaches to enhance soil health, system productivity and ecosystem services in plantation crops" (Fig. 133). He also distributed climbing devices and certificates to palm climbers under the Scheduled Tribe Component scheme.

Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI gave introductory remarks. Dr. J. Dinakara Adiga, Director, ICAR-Directorate of Cashew Research, Puttur, Dr. Anitha Karun, former Director, ICAR-CPCRI Kasaragod, Dr. B. Hanumanthe Gowda, Chief Coconut Development Officer, Coconut Development Board, Kochi, and Shri Dadasaheb Desai, Deputy Director, Directorate of Cashew nut and Cocoa Development, Kochi, graced the occasion.

Fig. 133. Dr. N.K. Krishna Kumar, Former DDG (HS) addressing the gathering

Fig. 134. Dr. George V. Thomas, Former Director, ICAR-CPCRI delivering Dr. KVA Bavappa memorial lecture

Meeting of Members of NSC on Arecanut and Arecanut Farmers with Sushri Shobha Karandlaje

The Minister of State for Agriculture and Farmers Welfare Sushri Shobha Karandlaje called upon a meeting of members of the National Scientific Committee on Arecanut and representative farmers of All India Arecanut Grower's Association on 7 January 2024 at Chikkamagaluru to discuss about the yellow leaf disease (YLD) and leaf spot disease (LSD) of arecanut. The Chairman of NSC on Arecanut Dr K.B. Hebbar, Director, ICAR-CPCRI and members of NSC including Dr. Homey Cheriyan, Director, DASD, Dr. Ravi Bhat, Principal Scientist, ICAR-CPCRI, Dr. H.R. Naik, Deputy Director of Horticulture, Dakshina Kannada, Dr. B. Gangadhar Naik, Prof. & Head (Plant Pathology), KSNUAHS, Shivamogga and Dr. Vinayaka Hegde, Head, Division of Crop Protection, ICAR-CPCRI, Kasaragod, attended the meeting. The meeting was also attended by Shri Araga Jnanendra, MLA, Thirthahalli, Shivamogga, Shri Jeevaraj, former MLA, Sringeri, Mr. Mahesh H.S., Vice President and other members of MAMCOS, Shivamogga, Officers from Dept. of Horticulture and Agricultural, Chikkamagaluru, Mr. M.J. Dinesh, Chairman, Coffee Board and Mr. Talavane Prakash, President, Areca Grower's Organisation.

Later Minister mentioned that the case regarding the harmful effect of arecanut is pending at the Hon'ble Supreme Court and there is a need to provide the published evidence that arecanut is 'not harmful' before the Supreme Court. For which, Dr. K.B. Hebbar explained that ICAR-CPCRI has recently conducted a workshop with doctors from reputed institutes like AIIMS, CCMB *etc*., and preparing a project proposal that will be submitted to the Ministry soon.

Meeting on 'Multi-institutional project on arecanut and human health'

The meeting was held at Krishi Bhavan, New Delhi, purpose with Sushri Shobha Karandlaje, Minister of State for Agriculture and Farmer Welfare, Government of India, on 8 February, 2024. A detailed discussion was held on the arecanut in India, including the proposed 'Multi-institutional project on arecanut and human health'. Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI, Kasaragod, put forward the merits and demerits of arecanut on human health. He also highlighted historical aspects of research carried out on arecanut and submitted the project proposal. The Hon'ble Minister spoke about the importance of this study to educate the general public on arecanut use. She said arecanut consumption should be treated similarly to the consumption of coffee and tea, for which she urged the scientific committee to undertake evidence-based research to bring facts to the public. Shri Rakesh Ranjan (Special Secretary), Dr. Prabhath Kumar (Horticulture Commissioner), Shri Priya Ranjan (Joint Secretary-MIDH), Dr. Naveen Kumar Patle (Additional Commissioner, Hort.), Dr. K. Balachandra Hebbar (Director, CPCRI, Kasaragod), Dr. Homey Cheriyan (Director, DASD, Calicut), Dr. K. Satyamoorthy (Director of Research, SDM University, Dharwad), Dr. Ramesh S.V. (CPCRI, Kasaragod) attended the meeting and Principal Investigators from all the collaborating centres attended the meeting online and delivered their views on the importance of arecanut and its use. The officers stressed upon the awareness to be created for the causes to human health by arecanut, since it is widely produced and consumed in India.

Dr. Prabhat Kumar mentioned the health issues associated with the consumption of arecanut and stressed the need for systematic studies to evolve evidence-based research in India.

Dr. K. Balachandra Hebbar briefed the participants that about 20 million people are dependent on arecanut for their livelihood. Arecanut is produced from about 9 lakh ha in India and its value is about Rs. 44,000 crores. He also highlighted the deliberations of the multi-institutional meeting held at Kasaragod on 14 of November 2023.

Dr. Satyamoorthy presented briefly the various proposals submitted by the institutions across India on arecanut research. These were broadly classified into the following categories: a) clinical epidemiology; b) metabolisms and metabolites of various cultivars of arecanut; c) cancer-related studies; and d) neuropsychiatric studies.

The house recommended the project and gave their consent to proceed forward.

Horticulture Fair at ICAR-CPCRI, Regional Station, Vittal

A one-day Horticulture Fair funded by the Directorate of Cashew nut and Cocoa Development (DCCD) was organized at ICAR- CPCRI, Regional Station, Vittal, Karnataka on 28 February 2024 in commemoration of National Science Day. Padmashri. Sathyanarayana Beleri was the chief guest about 650 farmers, department officials, students and 126 women participated. Lectures, discussions, demonstrations and exhibitions were held on coconut, arecanut, cocoa, cashew and black pepper.

National Seminar on Climate Smart Agriculture

ICAR-CPCRI, Regional Station, Kayamkulam organised a national seminar on 'Climate smart agriculture for sustainable soil and plant health in plantation crops' during 13-14, June 2024. About 100 delegates, including scientists, faculty, students and researchers from different parts of the country as well as from abroad participated in the event (Fig. 135-137).

Fig. 135. Dr. K.B. Hebbar, Director, ICAR-CPCRI inaugurating the seminar

Fig. 136. Dr. S.K. Singh, DDG (HS), ICAR, addressing the seminar

Fig. 137. Releasing of publications during the seminar

Brainstorming session on 'Addressing productivity issues in coconut: Status, strategies, and way forward'

ICAR-CPCRI, Kasaragod organized a Brainstorming Session on 'Addressing Productivity Issues in Coconut: Status, Strategies, and Way Forward' on 4 September 2024 (Fig. 138). The session was conducted in a hybrid mode. The participants represented all the relevant institutions such as Directorate of Economics and Statistics (DES), State Agricultural Directorates (Kerala, Tamil Nadu, Karnataka and Andhra Pradesh), Coconut Development Board, Agricultural Universities, State Planning Boards, Commission for Agricultural Costs and Prices (CACP), and ICAR-National Institute of Agricultural Economics and Policy Research (NIAP). Altogether, there were 52 participants representing 14 institutions. Key stakeholders and experts enriched the discussion by identifying context-specific solutions and also by developing a strategic actionable framework.

It was suggested to have collaboration between CDB and ICAR-CPCRI to develop a district-level database on coconut area and productivity to resolve discrepancies in current data. It was also suggested for collecting reliable data at the national level using a uniform methodology, addressing region-specific issues like homestead farming in Kerala, drought in Karnataka, and root wilt disease in Tamil Nadu, as well as replanting old coconut trees.

Fig. 138. A view of the meeting at ICAR-CPCRI Kasaragod

Workshop on 'Geospatial applications for plantation crops'

One-day Workshop on "Geospatial Applications for Plantation Crops" was jointly organized by the ICAR-CPCRI, Kasaragod, Kerala and the Regional Remote Sensing Centre–South (RRSC-South), NRSC–ISRO, Bengaluru at ICAR-CPCRI, Kasaragod on Thursday, 5 September 2024 (Fig. 137). Directors from five Institutes (DCR, IIOPR, DASD, DCCD, CDB) and Scientists / Officials from ICAR-CPCRI, NRSC-ISRO and IIT-G participated in the workshop. Dr. Prakash Chauhan, Director, NRSC/ISRO, Hyderabad graced the occasion as Chief Guest. More than 100 Scientists / Officials participated in the workshop (both offline and online modes). It was decided to draft a comprehensive collaborative project proposal by CPCRI along with Relevant Centres / Institutes and NRSC for assessment of area under plantation crops (such as coconut, arecanut, oil palm, cashew and palmyrah) using geospatial technology, ground based hyperspectral studies on food products and site suitability analysis. It was also suggested to initiate research studies on detection of pests and disease, above ground biomass and carbon sequestration.

The following actionable points were identified during the workshop:

i. A pilot-scale study on the area estimation of plantation crops will be undertaken (~0.6 m resolution).

ii. Detection of the geographic spread of yellow leaf disease in arecanut using remote sensing approaches.

iii. Above-ground biomass estimation for analysing the carbon sequestration potential of plantation crops.

iv. Development of a soil suitability map for coconut cultivation in India using high-resolution maps.

Fig. 139. A view of the workshop at ICAR-CPCRI, Kasaragod

Research Collaboration for Horticulture in North East India

A meeting between the Directors and Scientists of ICAR-CPCRI and Indian Institute of Technology, Guwahati was held at Indian Institute of Technology Guwahati (IITG) on 03 July 2024 to explore the possible areas of research collaboration between CPCRI and IITG (Fig. 140). After a detailed discussion with scientists of School of Agro & Rural Technology, a detailed work plan on some of the areas that both the organization could work together in the NE region were chalked out. These include, area estimation using remote sensing/ UAV, waste to wealth products, gaseous emission measurements under different management aspects, precision agriculture, solar powered arecanut dehusker, Entrepreneurship Development Programmes (EDP) and capacity building programmes.

Fig. 140. Dr. K.B. Hebbar, Director, ICAR-CPCRI along with Prof. Devendra Jalihal, Director, IITG, Prof. Sudip Mitra, Head, School of Agro & Rural Technology, IITG and CPCRI Scientists

Annual Group Meeting of AICRP on Palms

The 33rd Annual Group Meet of AICRP on Palms was organized at Bihar Agricultural University (BAU), Sabour during 21-23 September 2024. Dr. V.B. Patel, Assistant Director General (Fruits and Plantation Crops), ICAR, New Delhi presided over the inaugural session. Dr. D.R. Singh, Vice Chancellor, Bihar Agricultural University, Sabour was the Chief Guest of the event. Dr.P. Rethinam, Former Director, Asian and Pacific Coconut Community, Jakarta, Dr. K.B. Hebbar, Director, ICAR-CPCRI, Kasaragod, Dr. K. Suresh, Director, IIOPR, Pedavegi and Dr. R.K. Mathur, Director, IIOR, Hyderabad were the Guests of honour.

The Project Co-ordinator of AICRP (Palms), CPCRI, Kasaragod, Dr. B. Augustine Jerard presented the report. Dr. V.B. Patel, ADG, (Fruits and Plantation Crops) applauded the scientists for the contribution towards release of four varieties by Hon'ble Prime Minister of India. He also drew the road map that non-traditional coconut belts with climatic vulnerabilities can offer excellent platform for screening varieties for tolerance to abiotic stress which should be positively exploited. Dr. D.R. Singh, Vice Chancellor, BAU, Sabour highlighted the status of coconut plantations in the state of Bihar.

There were technical sessions on variety release proposal, genetic resources and crop improvement, crop production, crop protection and post-harvest technology. About 80 participants from different AICRP centres attended the meet.

National Conference on Plant Physiology – 2024

The National Conference on Plant Physiology – 2024 with the theme "Frontiers in Cell to Whole Plant Physiology: Bridging Science and Sustainability" was inaugurated on 17 December, 2024 at ICAR-CPCRI, Kasaragod. This three-day conference was jointly organised by the ICAR-CPCRI and the Indian Society for Plant Physiology (ISPP), New Delhi (Fig. 141).

Dr. R. Chandra Babu, Former Vice Chancellor, Kerala Agricultural University and the President, ISPP inaugurated the conference and briefed about the salient activities and the history of the ISPP. He called the young researchers for exchanging ideas and to take up collaborative initiatives to have a futuristic plan in plant physiology of crop plants.

The Chief Guest Dr. P.V. Varaprasad, Professor, Kansas State University, USA highlighted ten major innovations in the fields of, speed genomic level breeding, gene editing, stress tolerant crop varieties, nutritious and climate resilient plants, biofortified varieties, above and below ground intercropping, agroforestry, perennial grains (Kernza, sorghum), cross cutting-edge disciplines, climate resilient agriculture. He spoke on global challenges of the relative yield gain decrease as an impediment for development.

Dr. K.B. Hebbar, Director, ICAR-CPCRI, Kasaragod, during his presidential address highlighted the achievements of CPCRI and the importance of plantation crops in the economy of India. He urged the younger plant physiologists to take up active interdisciplinary research in plantation crops. Dr. Brajesh Singh, Director, ICAR-CPRI, Shimla spoke about storage physiology and post-harvest handling of potatoes benefiting the world. Dr. Jagdish Rane, Director, ICAR-CIAH urged the younger scientists to work for goal oriented research aimed at bringing out disruptive technologies for the benefit of the society.

The conference had Technical Sessions: *viz.*, Physiological responses to stresses, Cutting-edge technologies, Sustainable agriculture practices, Post-harvest physiology and processing, and Field physiology and adaptation strategies, besides Lead talks, young scientists presentation, flash talks and concurrent poster presentations.

The Valedictory session on the National Conference of Plant Physiology 2024 was held on 19 December 2024, presided over by Dr. K. Balachandra Hebbar, Director, ICAR- CPCRI.

The Chief Guest Dr. Sanjay Kumar, Chairman ASRB, who is also newly elected President, ISPP told that plant physiology has important role in the prosperity of the nation with examples of Asafoetida seed germination enhancement in India, Saffron taken out of Kashmir to other states, tulips bulb production in Kashmir and tulips offered in Ayodhya Ram Mandir due to production of tulips in

large quantity in the country, which was dominated by Australia earlier.

The conference was attended by more than 300 delegates from the national and international research organisations, agricultural and traditional universities as well as NGOs. A panel discussion featuring plantation scientists and eminent plant physiologists explored the challenges and opportunities in integrating science with sustainability.

The organization of this conference at CPCRI was considered timely, given the growing focus on the plantation sector. The government's proposal to implement the National Mission on Edible Oils highlights the potential of oil palm and coconut in contributing to this initiative. However, there is a critical need to identify physiologically elite breeding lines with superior productivity and quality. Additionally, plant height remains a concern, making research on dwarfism in palms a priority.

Further, characterizing and identifying functional molecules can aid in developing alternative value-added products for crops like arecanut. Establishing a robust temporal and spatial biomass quantification methodology is essential for accurately estimating carbon content, enabling the initiation of carbon credit programs for farmers.

Climate resilience research is also imperative to enhance preparedness and response to climate-related disturbances, trends, and extreme events. A deeper understanding of these factors will help farmers adapt to changing weather conditions, ultimately leading to improved crop yields, reduced losses, and greater food security.

Fig. 141. Dr. P.V. Varaprasad, inaugurating NCPP programme

Rural India Business Conclave (RIBC 3.0)

Rural India Business Conclave (RIBC) was organized in collaboration with the Kerala Start-ups Mission and Central University of Kerala (CUK) during 14-15 December 2024 in which 300 delegates participated.

Fig. 142. Hon'ble District Collector, Kasaragod inaugurating RIBC at Kasaragod

XII

Participation in Conferences, Meetings, Workshops, Symposia, Webinars, *etc.* in India and Abroad

Participation in International Webinar

Name and Designation	Programme	Place & Date
Dr. S. Elain Apshara, Principal Scientist	International Webinar Cocoa Research Centre (CRC) Annual Research and Development Symposium-CARDS-2024-Strengthening the cocoa value chain and building sustainability	Cocoa Research Centre (CRC), University of the West Indies, St Augustine Campus, Trinidad, 5-6 June 2024
Dr. S. Elain Apshara, Principal Scientist	International Webinar on responses and adaptation of cocoa to a variable and changing climate	International Cocoa Quarantine Centre (ICQC), Reading University, UK, 23 October 2024
Dr. Jeena Mathew, Senior Scientist	International Webinar on Functional Phenomics for Improved Climate Resilience in Tropical Agriculture	ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram, Kerala, 04 January 2024
Dr. S.V. Ramesh, Senior Scientist	International Webinar on 'Functional Phenomics for Improved Climate Resilience in Tropical Agriculture'	ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram, Kerala, 04 January 2024

Participation within India

Name and Designation	Programme	Place & Date
Dr. Regi Jacob Thomas, Head Dr. A. Joseph Rajkumar, Principal Scientist Dr. Merin Babu, Senior Scientist	Surveillance on root (wilt) disease and exotic whiteflies on coconut-Technology updates and Action plan	Pollachi, Tamil Nadu on 3-4 January 2024

Name and Designation	Programme	Place & Date
Dr. M.R. Manikantan Principal Scientist	Agri Business Opportunities in Banana & Coconut Crops Using Improved Production and Value Addition Technologies	NIFTEM, Thanjavur 23January 2024
Dr. Regi Jacob Thomas, Head Dr. P. Anithakumari and Dr. A. Joseph Rajkumar, Principal Scientist and Dr. Merin Babu, Senior Scientist	Interface meeting on coconut technologies and action plan for root (wilt) disease and exotic whiteflies	Tamil Nadu, 5 February 2024
Dr. Jilu, V. Sajan, Scientist Dr. A. Joseph Rajkumar, Principal Scientist and Dr. K. M. Anes, Senior Scientist.	Workshop on 'Climate Change in Plantation Sector'	ICAR- CPCRI, RS, Kayamkulam, Kerala 28 February 2024
Dr. S. Elain Apshara, Principal Scientist	Dream Big Kalpa- Small level cocoa management and farm level value addition	ICAR- CPCRI, Kasaragod, 5 March 2024
Dr. M.R. Manikantan, Principal Scientist Dr. K. Ponnusamy, Head and Dr. R. Pandiselvam, Scientist	Annual Workshop of AICRP on PHET	CIPHET, Ludhiana, Punjab from 13-15 March 2024
Dr. Regi Jacob Thomas, Head	International Seminar on 'Sustainable Urban Agriculture Practices & Community Resilient Cities	KAU, Vellayani, 22-23 March 2024
Dr. M.R. Manikantan, Principal Scientist	National Conference on Paradigm and Dynamics of Digital Horticulture for Food, Nutrition, and Entrepreneurship	JAU, Junagadh 28-31 May 2024
Dr. Ravi Bhat, Dr. Kmuralidharan., Dr. P. Subramanian and Dr. Vinayaka Hedge, Principal Scientists	National Workshop on Dynamics of Coconut Production and utilization and Strategies for addressing the challenges in Amrit Kaal organized by the ASM Foundation	Junagadh Agricultural University on 29 May 2024
Dr. Regi Jacob Thomas, Head and Dr. A. Joseph Rajkumar, Principal Scientist	International Seminar on Spices	College of Agriculture, Vellayani, Thiruvananthapuram on 05 June 2024
Dr. B.A. Jerard, PC (Palms), Dr. M. K. Rajesh, Dr. Regi Jacob Thomas, Dr. V. Niral, Dr. Murali Gopal, Dr. Vinayaka Hegde, Dr. P. Subramanian, and Dr. K. Ponnusamy, Heads Dr. S. Elain Apshara, Dr. Anithakumari,	National Seminar on "Climate Smart Agriculture for Sustainable Soil and Plant Health in Plantation Crops	ICAR-CPCRI, Regional Station, Kayamkulam 13-14 June 2024

Name and Designation	Programme	Place & Date
P., Dr. K. Muralidharan, Dr. Ravi Bhat, Dr. A. Abdul Haris, Dr. M.R. Manikantan, Dr. C. Thamban, Dr. K. Samsudeen, and Dr. P. Muralidharan, Pr. Scientists., Dr. M. Shareefa, Dr. Nihad, K., Dr. Jeena Mathew, Dr. Merin Babu, Dr. S. Neenu, Dr. P.S. Prathibha, and Dr. K.M. Anes, Sr. Scientists Dr. S.Indhuja, Dr. P.P. Shameena Beegum, Dr. Y. Diwakar, Dr. Saneera E.K., and Dr. Jilu V. Sajan, Scientists , Dr. Mayalekshmi, Technical Officer		
Dr. A. Joseph Rajkumar, Principal Scientist	Annual Group Meeting of AICRP on Biological Control	Dr. YS Parmar University of Horticulture and Forestry, Solan 13-14 June 2024.
Dr. K. Ponnusamy, Head	International Conference on Innovative education, research and extension approaches for transmitting scientific know-how to augment livestock production in the contemporary scenario	Veterinary College and Research Institute, TANUVAS, Orathanadu, Tanjavur district, Tamil Nadu 10-12 July 2024
Dr. S. Elain Apshara, Principal Scientist	Agri Seminar- Uzahave Thalai Edition 6.0	The Indian Chamber of Commerce and Industry, Codissia Trade Fair Complex, Coimbatore, 13 July 2024
Dr. Vinayaka Hegde, Dr. P. Subramanian, and Dr. V. Niral, Heads., Dr. S. Elain Apshara, Dr. Ravi Bhat, Dr. C. Thamban, Dr. S. Jayasekhar, Dr. K. Samsudeen, Dr. K.P. Chandran, and Dr. A. Joseph Rajkumar, Pr. Scientists Dr. N. R. Nagaraja, Dr. R. Sudha, Dr. M. Sujitra, and Dr. V.H. Prathibha, Sr. Scientist, Dr. Surekha, Scientist	XXXIII Annual Group Meeting of AICRP on Palms	BAU, Sabour, Bihar 21-23 August 2024
Dr. S. Elain Apshara, Pr. Scientists Dr. G. Panjavarnam and Dr. Bhavishya, Scientists	International Conference on Precision in Horticulture (ICPH 2024)	HC & RI, TNAU, Periyakulam, Tamil Nadu 22-24 August 2024

Name and Designation	Programme	Place & Date
Dr. S. Elain Apshara, Pr. Scientist	AI Webinar- Advances in Artificial Intelligence and Sensor based Smart Precision Farming	Agriculture and Food Engineering Dept., IIT Kharagpur, 28 August 2024
Dr. B.A. Jerard, PC (Palms) Dr. Vinayaka Hegde, Dr. P. Subramanian, and Dr. V. Niral, Dr. Ponnusamy, K., Dr. Murali Gopal, Heads, Dr. Ravi Bhat, Dr. C. Thamban, Dr. Jayasekhar, S., Dr. K. Samsudeen, Dr. K.P. Chandran, Dr. M.R. Manikantan, Dr. Selvamani V., Principal Scientists, Dr. S. Neenu, Dr. S. Paulraj, Dr. S.V. Ramesh, and Dr. M. Sujithra, Sr. Scientists, Dr. P.P. Shameena Beegum, and Dr. Daliyamol Total 52 participants, including scientists from regional stations / centers joined online	Brainstorming Webinar on Addressing productivity issues in coconut: Status, Strategy and Way Forward	ICAR-CPCRI, Kasaragod, 4 September 2024
Dr. B. Augustine Jerard, Project Coordinator (Palms), Dr. P. Subramanian, Dr. K. Ponnusamy, Dr. Vinayaka Hegde, Dr. Murali Gopal, and Dr. P. Muralidharan, Heads, Dr. S. Elain Apshara, Dr. Ravi Bhat, Dr. Tamban, C., Dr. S. Jayasekhar, Dr. Alka Gupta, Dr. K.P. Chandran Dr. Manikantan, M.R., Dr. V. Selvamani, Dr. A. Joseph Rajkumar, Dr. Abdul Haris, and Dr. Arunkumar Sit, Pr. Scientists, Dr. S. Neenu, Dr. Sandeep Shill, Dr. S. Paulraj, Dr. S.V. Ramesh, and Dr. M. Sujithra, Sr. Scientists, Dr. P.P. Shameena Beegum, Dr. Daliyamol, Dr. S. Sumitha, Dr. Chaithra, Dr. Bhavishya, Dr. N.R. Nagaraja, Dr. M. Suchithra., Dr. E.K. Saneera., Dr. T.N. Madhu Dr. Jilu, V. Sajan and Dr. Anok Uchoi Scientists	Virtual Workshop/Webinar on Geospatial Applications for Plantation Crops	ICAR-CPCRI, Kasargod, RRSC-South, NRSC-ISRO, Bengaluru, 5 September 2024
Dr. N.R. Nagaraja and Dr. M. Sujithra, Sr. Scientists Dr. T.N. Madhu, Dr. E.K. Saneera and Dr. M. Chaithra, Scientists	International Conference on Plant Protection in Horticulture (ICPPH) – Advances challenges	ICAR-IIHR, Bangalore 25-27 September 2024

Name and Designation	Programme	Place & Date
Dr. S. Elain Apshara, Pr. Scientist	Cocoa workshop	Cottanad Plantations, Thamarassery, Kerala, 9 October 2024
Dr. S. Elain Apshara, Pr. Scientist	Stakeholders meet on cocoa	DCCD, Dept. of Horti, Vijayawada, 16 October 2024
Dr. M.R. Manikantan, Principal Scientist	Green Technology for Sustainable Food Production and Processing" (Under the aegis of Agricultural Engineering Division Board, IEI)	Hindusthan College of Engineering and Technology, Coimbatore 24 & 25 October 2024
Dr. M.R. Manikantan, Principal Scientist	58th Annual Convention of Indian Society of Agricultural Engineers and International Symposium	Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra , 12-14 November 2024
Dr. S. Elain Apshara, Pr. Scientist	International Conference on Futuristic Horticulture (ICFH)	HC & RI, TNAU, Coimbatore, 14-15 November, 2024
Dr. Jeena Mathew, Sr. Scientists	Global Soils Conference 2024	NAAS Complex New Delhi 19-22 November 2024
Dr. M.R. Manikantan, Principal Scientist	40th Annual Workshop of AICRP on PHET	Assam Agricultural University, Jorhat 20-22 November 2024
Dr. P. Muralidharan, Head, ICAR-KVK, Alappuzha	National Seminar on 'Soil Security: Challenges and Strategies'	College of Agriculture, KAU, Padannakkad 5 December 2024
Dr. M.K. Rajesh, Head, ICAR-CPCRI, RS, Vittal	International Conference on 'Plant biotechnology for sustainable productivity and environment (ICPBSPE)'	Manipal School of Life Sciences, Manipal, Karnataka, 9 -10 December 2024
Dr. S. Elain Apshara, Pr. Scientist	National Level Training on Cocoa	DCCD, AAU, Assam, 10-12 December 2024
Dr. Vinayaka Hegde, Head	IPS South zone meet & National Symposium on Plant Health Management a Sustainable Tool in Addressing Crop Diseases Under Climate Resilient Agriculture	UAS Dharwad 11-12 December 2024

Name and Designation	Programme	Place & Date
Dr. Vinayaka Hegde, Dr. V. Niral, Dr. P. Subramanian, Dr. Murali Gopal, and Dr. K. Ponnusamy, Heads Dr. H.P. Maheshwarappa, Dr. A. Joseph Rajkumar, Dr. C. Thamban, Dr. Alka Gupta, Dr. Ravi Bhat, Dr. S. Elain Apshara, Dr. Abdul Haris, Dr. M.R. Manikantan and Dr. V. Selvamani, Pr. Scientists, Dr. S.V. Ramesh, Dr. S. Paulraj, Dr. Rajkumar, Dr. V.H.Prathibha, Dr. S. Neenu, Dr. M.Sujithra, Dr. P. S.Prathibha, Dr. N.R. Nagaraja, Dr. Surekha, and Dr. Nihad Sr. Scientists Dr. P.P. Shameena Beegum, Dr. G. Panjavarnam, and Dr. Daliyamol, Dr. Bhavishya, Scientists	National Conference of Plant Physiology (NCPP 2024)	ICAR-CPCRI, Kasaragod 17-19 December 2024
Dr. A. Joseph Rajkumar, Principal Scientist	Assessment of Agrarian Issues in the Tribal Settlements of Kalvarayan Hills, Kallakurichi District Tamil Nadu and interactive meeting with Hon'ble Secretary, Tribal welfare and District Collector, Kallakurichi	Kallakurichi, Tamil Nadu 27-28 December 2024.

XIII

Linkages and Collaborations

International

International Coconut Community (ICC), Jakarta,	Indonesia Cooperation between coconut growing countries, Coconut genetic resources network, International Coconut Gene Bank for South Asia & Middle East and socio-economic collaboration
International Coconut Genetic Resource Network (COGENT)	Biotechnological activities related to coconut genetic resources

National
ICAR Institutes

ICAR-Central Institute of Fisheries Technologies (CIFT), Kochi	Food processing R&D collaboration
ICAR-Central Tuber Crop Research Institute, Thiruvananthapuram	Cassava and coconut based value added products, intercropping of tuber crops in coconut gardens
ICAR-CIARI, Port Blair	Coconut genetic resources collection, conservation and utilization
ICAR-CIPHET, Ludhiana	Agricultural pre- and post-harvest machinery
ICAR-CRIDA, Hyderabad	Climate change network and NICRA
ICAR-Directorate of Cashew Research, Puttur, Karnataka	Nematological and entomological programmes, cropping systems, value addition
ICAR-DMR, Solan	Agricultural pre- and post-harvest technology development
ICAR-Indian Institute of Horticultural Research, Bengaluru	*Phytoplasma* diseases, varietal screening, cropping systems, agricultural tools and machinery and horticultural IP related activities
ICAR-Indian Institute of Oil Palm Research (IIOPR), Pedavegi	*Phytoplasma* diseases, tissue culture and biotechnological investigations, cropping system
ICAR-Indian Institute Spices Research, Kozhikode	Cropping system studies, Phytophthora diseases in plantation crops
ICAR-National Bureau of Plant Genetic Resources (NBPGR), New Delhi	Germplasm registration and exchange of PGPR, Cryo -preservation of germplasm
ICAR-NBAIM, Mau	Microbial research network R&D

ICAR-NBAIR, Bengaluru	Biological control of pests and diseases R&D.
ICAR-NRC for Orchids, Pakyong	Intercropping of orchids in coconut/arecanut multispecies based cropping system
ICAR-Sugarcane Breeding Institute, Coimbatore	Cytological studies of in vitro cultures of coconut and arecanut and Food processing R&D

Universities

Central University of Kerala, Kasaragod, Kerala	R & D collaboration in Biotechnology
K.S. Hegde Medical Academy, NITTE – Deemed to be University, Deralakatte, Mangalore	Deciphering the biochemical machinery underlying in vitro regeneration in coconut and arecanut
KCAET, KAU, Tavanur	Technology programmes
Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga	NSC of arecanut and academic programmes
Kerala Agricultural University	R & D collaboration
KVASU, Wayanad	Technology programmes
Nitte University, Mangalore	Research and frontier diagnostic collaboration
Onattukara Regional Agricultural Research Station (ORARS), Kerala Agricultural University	KVK, Alappuzha for NICRA activities
University of Horticultural Sciences, Bagalkot	PG Research

Others

Agricultural Technology Management Agency (ATMA)	ToT activities
All India Radio (AIR), Kannur, Mangalore, Thiruvananthapuram, Doordarshan (Prasar Bharati)	Transfer of technology programme through media
Bannari Institute of Technology, Sathyamangalam, Tamil Nadu	Food technology R & D collaboration
CAMPCO, Mangalore	Arecanut/ cocoa research and development
Coconut Development Board (CDB), Kochi	Research and development in coconut
CSIR-NIIST, Thiruvananthapuram	Technology programmes
DBT, New Delhi	Advancements in Biotechnology and Bioinformatics
Department of Agricultural Development and Farmers Welfare, Govt. of Kerala	ToT activities, Plating material production
Directorate of Arecanut and Spices Development (DASD), Kozhikode	Research and development in arecanut
Directorate of Cashew and Cocoa Research (DCCD), Kochi	Research and development in cocoa

District Industries Centre, Kasaragod	Capacity building and entrepreneurship programmes
District Panchayath, Alappuzha	ICAR-CPCRI,RS, Kayamkulam ToT activities
District Panchayath, Kasaragod	ICAR-CPCRI, Kasaragod & KVK, Kasaragod ToT activities
DIT, New Delhi	Bioinformatics programmes
DST, New Delhi	Molecular biology research and women empowerment programmes
General Aeronautics Ltd., Bangaluru	Unmanned Aerial Vehicle (UAV- Drone) for palm spraying
IIPM, Bengaluru	Technology programmes in plantations management
Kerala State Council for Science Technology & Environment (KSCSTE), Thiruvananthapuram	R & D collaboration
Kerala State Planning Board	R & D collaboration
Mondelez India Foods Private Limited	Cocoa cropping system studies
National Remote Sensing Centre Regional Remote Sensing Centre-South, Bengaluru	Utilization of hyperspectral imagining techniques for plantation crops
National Bank for Agriculture and Rural Development (NABARD), Mumbai	Developmental programmes/ demonstrating model coconut clusters in root (wilt) affected areas
National Innovation Foundation (NIF), Gandhinagar, Gujarat	Evaluation of innovator's technology
National Institute of Food Technology, Entrepreneurship and Management (NIFTEM), Thanjavur, Tamil Nadu	R & D collaboration in PHT
PPV & FRA, New Delhi	DUS Centre on coconut, arecanut and cocoa
Rastriya Krishi Vikas Yojana (RKVY)	R & D collaboration
State Forest Development Agency	Assessment of impact of Green India Mission
Vegetable and Fruit Promotion Council, Kerala	R & D collaboration
Kerala Agricultural University, Andhra Pradesh Agricultural University, University of Agricultural Sciences Bengaluru, NABARD, Tamil Nadu Agricultural University, Local governments (Grama Panchayats, Block and District panchayaths, Farmer NGOs, Krishi Vigyan Kendra, Women SHGs, MGNREGS program, FPOs, ICAR Indian Institute of Spices, Kozhikode, ICAR Central Tuber Crops Research Institute Thiruvananthapuram, Department of Agriculture Kerala	ICAR CPCRI Farmer FIRST Program (FFP)

Linkages and Collaborations with educational institutes

- Dr. YSR Horticultural University, Venkataramanagudem, Andhra Pradesh
- Jawaharlal Nehru Institute of Arts & Science, Idukki
- JSS Academy of Higher Education & Research, Mysuru
- KSHEMA, NITTE University, Mangaluru
- College of Horticulture and Forestry, CAU, Pasighat, Arunachal Pradesh
- Sree Sankara College, Kalady
- SN College, Chathannur
- St. Berchmans College, Changanassery, Kottayam
- St. Joseph Engineering College, Mangaluru
- St. Mary's College for Women, Thiruvalla
- Alvas College, Moodbidri
- Amrita Viswavidyapeetham, Kollam
- BAM College, Thuruthicad
- BCM College, Kottayam
- CHRIST (Deemed University), Bengaluru
- College of Indigenous Food Technology, Konni
- Govt. College, Kasaragod
- Hindustan College of Arts & Science, Coimbatore
- Hindustan College of Engineering & Technology, Coimbatore
- Kannur University
- Kelappaji College of Agricultural Engineering and Technology, Tavanur, Mallapuram
- Khansa Women's College, Kumbla, Kasaragod
- KUFOS, Kochi
- Lovely Professional University, Punjab
- MES MK Mackar Pillay College for Advanced Studies, Aluva
- Mangalore University, Mangalore
- Mar Athanasios College of Advanced Studies, Thiruvalla
- Marthoma College of Science and Technology, Kollam
- Marthoma College, Thiruvalla
- National Center for Aquatic Animal Health, CUSAT, Kochi
- Nehru Arts and Science College (Autonomous), Coimbatore
- NIFTEM, Haryana
- NMAM Institute of Technology, Nitte, Karkala, Karnataka
- PA First Grade College, Mangalore
- Pazhassiraja College, Pulpally, Wayanad
- PGP College of Arts & Science, Namakkal
- Sacred Heart College Thevara, Kochin
- SAFI Institute of Advanced Study, Vazhayur, Kozhikode
- St. Agnes College Autonomous, Mangalore
- St. Aloysius College (Autonomous), Mangalore
- St. George College, Aruvithura, Kottayam
- TNAU, Coimbatore
- UAS, Raichur
- University of Calicut, School of Health Science
- Uttar Banga Krishi Vidyalaya, West Bengal
- Vimala College, Thrissur
- Vivekananda College of Engineering & Tech., Puttur, DK, Karnataka

XIV

Research Projects

There were 43 institute projects and 33 externally funded projects during the period.

Institute projects

Project No.	Project title	Project leader	Co-PI / Associates
1000761101	Studies on phenology of coconut genotypes in different climatic zones	T.N. Ranjini	V. Niral, R. Sudha, Arun Kumar Sit, L.S. Singh and Y. Diwakar
1000761102	Studies on impact of high temperature stress on reproductive phase in coconut	R. Sudha	K. Samsudeen, S.V. Ramesh, K.B. Hebbar, T.N. Ranjini, V. Niral and Ravi Bhat
1000761103	Development of descriptor and basic studies on growth and development of palmyrah	S. Sumitha	B. Augustine Jerard, S. Elain Apshara, M.R. Manikantan, Anok Uchoi, A. Abdul Haris, scientists from AICRP on Palms- Killikulam, Pandirimamidi and Kondamallepally,
1000761104	Phenotyping and gene expression studies for low moisture stress tolerance in cocoa genotypes	M. Suchithra	S. Elain Apshara and S.V. Ramesh
HORTPCSIL 202400100123	Genetic resources management and genetical investigations and breeding for improved varieties of coconut	V. Niral	K. Samsudeen, Arun Kumar Sit, L.S. Singh, Alpana Das, R. Sudha, Y. Diwakar, T.N. Ranjini, M. Sujithra, V.H. Prathibha, K.B. Hebbar, S.V. Ramesh, P.P. Shameena Beegum, M.R. Manikantan, M.K. Rajesh, B. Augustine Jerard, S. Elain Apshara, N.R. Nagaraja, M. Suchithra, P. Subramanian, M. Chaithra, C. Thamban
HORTPCSIL 202400200124	Genetic resources management and genetical investigations and breeding for improved varieties of arecanut	N.R. Nagaraja	V. Niral, Arun Kumar Sit, L.S. Singh, Y. Diwakar, T.N. Ranjini, T.N. Madhu, E.K. Saneera, R. Thava Prakasa Pandian, M.K. Rajesh

Project No.	Project title	Project leader	Co-PI / Associates
HORTPCSIL 202400300125	Genetic resources management and genetical investigations in cocoa (*Theobroma cacao* L.)	S.Elain Apshara	M. Suchithra, M.R. Manikantan, M. Shareefa, L.S. Singh, Anok Uchoi, Murali Gopal, Arun Kumar Sit, E.K. Saneera, Y. Diwakar, M. Chaithra, Babli Mog, ICAR-DCR, Puttur
HORTPCSIL 202400400126	Breeding for resistance/ tolerance to coconut root (wilt) disease	Regi Jacob Thomas	M. Shareefa, A. Josephrajkumar, Sandip Shil, S. Sumitha, V. Niral, K. Samsudeen, S. Elain Apshara, N.R. Nagaraja, M. Suchithra, Y. Diwakar, Alpana Das, Merin Babu, L.S. Singh
HORTPCSIL 202400500127	Molecular characterization of cocoa accession and identification of genotypes tolerant to *Phytophthora* disease	Alpana Das	M. Chaithra, S. Elain Apshara, L.S Singh
HORTPCSIL 202400600128	Qualitative breeding for development of fine cocoa varieties (*Theobroma cacao* L.)	S. Elain Apshara	S.V. Ramesh, P.P. Shameena Beegum
HORTPCSIL 202400700129	Genetic diversity assessment and development of markers for sex determination and dwarfness in palmyrah (*Borassus flabellifer* L.)	M.K. Rajesh	B. Augustine Jerard, S. Sumitha
HORTPCSIL 202400700130	Enhancing mass multiplication and germplasm conservation of coconut and arecanut through tissue culture and cryopreservation techniques	M.K. Rajesh	V. Aparna, M. Shareefa, Regi Jacob Thomas, V. Niral, K. Samsudeen, T.N. Ranjini, S. Paulraj, R. Sudha, N.R. Nagaraja, M. Suchithra, Y. Diwakar, Surekha, G. Panjavarnam, Thava Prakasa Pandian, Alpana Das
1000761030	Biotechnological applications in palms and cocoa	M.K. Rajesh	V. Aparna, Murali Gopal, Alpana Das, V. Niral, K. Samsudeen, R. Sudha, S.V. Ramesh, Elain Apshara, N.R. Nagaraja, V.H. Prathibha, M. Sujithra, T.N. Ranjini, M. Suchithra, K.P. Chandran, Y. Diwakar, Bhavishya, G. Panjavarnam, A . Josephrajkumar, Merin Babu, R. Thava Prakasa Pandian, Rajkumar and S. Paulraj

Project No.	Project title	Project leader	Co-PI / Associates
1000761031	Development of tissue culture techniques in coconut.	M.K Rajesh	V. Aparna, M. Shareefa, Regi Jacob Thomas, V. Niral, K. Samsudeen, Y. Diwakar, Alpana Das, A. Abdul Haris, G. Panjavarnam, K. Nihad and Daliyamol
1000761032	Development of double stranded RNA based food bit for the suppression of red palm weevil	M.K Rajesh	A. Josephrajkumar, S.V. Ramesh, M. Sujithra and V. Aparna
1000763057	Cropping/ farming approaches for improving soil health and system productivity in coconut, arecanut and cocoa	P. Subramanian	Ravi Bhat, Surekha, G. Panjavarnam, S. Neenu, Alka Gupta, V. Selvamani, K. Nihad, A. Abdul Haris, Bhavishya, S. Indhuja, S. Jayasekhar, U.K. Priya, L.S. Singh, Anok Uchoi, S. Paulraj, Arun Kumar Sit, M. Chaithra, Alpana Das
1000763058	Enhancing nutrient and water use efficiency for sustained productivity in coconut, arecanut and cocoa	V. Selvamani	P. Subramanian, Ravi Bhat, S. Neenu, A. Abdul Haris, Jeena Mathew, K. Nihad, Surekha, U.K. Priya, Bhavishya, G. Panjavarnam, S. Indhuja, S. Paulraj, Anok Uchoi, P. Anithakumari, R. Thava Prakasa Pandian, V. Niral, B. Augustine Jerard, S. Sumitha, Merin Babu, Jilu V. Sajan, S.V. Ramesh, L.S. Singh
1000763055	Bioresources management in coconut, arecanut and cocoa	Alka Gupta	P. Anithakumari, Murali Gopal, P. Subramanian, Ravi Bhat, Surekha, S. Elain Apshara, Rajkumar, Sandip Shil, V. Selvamani, U.K. Priya, S. Indhuja, A. Abdul Harris, K. Nihad, Jeena Mathew, S. Neenu, Merin Babu, Shameena Beegum and S.V. Ramesh
1000763103	Bioprospecting of phyllosphere bacteria in coconut and cocoa	S. Paulraj	M.K. Rajesh, S.V. Ramesh, Ravi Bhat, Thava Prakasa Pandian, M. Sujithra
1000763106	Studies on carbon sequestration potential of coconut based fruit cropping system — A strategy to mitigate climate change	H. P. Maheswarappa	P. Subramanian, S. Neenu, Murali Gopal

Project No.	Project title	Project leader	Co-PI / Associates
1000765039	Integrated approaches for management of fungal diseases of palms and cocoa	Vinayaka Hegde	V.H. Prathibha, R. Thava Prakasa Pandian, M. Chaithra, M.K. Rajesh, Bhavishya, M. Chaithra, Rajkumar, T.N. Madhu, Daliyamol
1000765040	Diagnostics and management of root (wilt) disease (RWD) in coconut and yellow leaf disease (YLD) in arecanut	Vinayaka Hegde	K.B. Hebbar, Murali Gopal, A. Josephrajkumar, M.K. Rajesh, S.V. Ramesh, Merin Babu, Daliyamol, S. Indhuja, R. Thava Prakasa Pandian, M. Chaithra, Bhavishya, Jilu V. Sajan, Saneera E.K., Madhu, T. N., and Chaithra M.
1000765041	Integrated management of pests and nematodes in palms and cocoa	A. Josephrajkumar	P.S. Prathibha, Rajkumar, M. Sujithra, Jilu V. Sajan, E.K. Saneera, T. N. Madhu, Merin Babu, K. M. Anes, M. Chaitra, R. Thava Prakasa Pandian, Daliyamol, Bhavishya
1000765101	Elucidating host pathogenic response against fruit rot disease in arecanut	V.H. Prathibha	N.R. Nagaraja, M.K. Rajesh, R. Thava Prakasa Pandian, Daliyamol and Vinayaka Hegde
1000765102	Epidemiology and management of *Colletotrichum* diseases in palms and cocoa	R. Thava Prakasa Pandian	Vinayaka Hegde, Merin Babu, V.H. Prathibha, M. Chaithra, Daliyamol, M. Chaithra, M.K. Rajesh, S. V. Ramesh, Bhavishya, T.N. Madhu, N.R. Nagaraja, Y. Diwakar, and K.P. Chandran
1000765108	Biological management of *Phytophthora* diseases in cocoa with indigenous microbes	M. Chaithra	S. Elain Apshara, M. Suchithra, Vinayaka Hegde, R. Thava Prakasa Pandian, Bhavishya, T.N. Madhu, E.K. Saneera
1000765104	Management of sucking pests using microbial volatile and essential oils in palms and cocoa	T.N. Madhu	E.K. Saneera, Y. Diwakar, R. Thava Prakasa Pandian, A. Josephrajkumar, Jilu V. Sajan, M. Sujithra, P.S. Prathibha, Murali Gopal, M. Chaithra
1000765106	Biological control of coconut coreid bug, *Paradasynus rostratus* Distant using egg parasitoid, *Anastatus* sp.	Jilu V. Sajan	A. Josephrajkumar, P.S. Prathibha, Merin Babu, K.M. Anes, T.N. Madhu

Project No.	Project title	Project leader	Co-PI / Associates
1000765105	Characterization of mite complex in arecanut and development of botanical based formulations for their management	E.K.Saneera	N.R. Nagaraja, P.S. Prathibha, M. Suchithra, M.K. Rajesh, T.N. Madhu, S.V. Ramesh, A. Josephrajkumar, M. Chaitra
1000765107	Studies on host range expansion of red palm weevil and IPM in arecanut	P.S. Prathibha	E.K. Saneera, T.N. Madhu, M. Chaithra
1000766014	Physiological and biochemical investigations of yield and quality in palms and cocoa	Murali Gopal	S.V. Ramesh, S. Elain Apshara, Arun Kumar Sit, N.R. Nagaraja, L.S. Singh, Anok Uchoi, R. Sudha, Y. Diwakar, M.R. Manikantan, Surekha, Bhavishya, Sandip Shil and S. Neenu
1000767018	Mechanization, processing, product diversification, and nutraceutical properties	M.R. Manikantan	P.P. Shameena Beegum, S.V. Ramesh, Murali Gopal, S. Paulraj, Alka Gupta, S. Elain Apshara
1000767027	Development of process technology for coconut milk based dairy analogues	P.P. Shameena Beegum	M.R. Manikantan, Murali Gopal, K.B. Suresha, UAS, Bangalore
1000767028	Development and evaluation of rotary dryer cum flavour coating machine for production of coconut chips	M.R. Manikantan	P.P. Shameena Beegum
1000767029	Development and characterization of biodegradable plate from cocoa pod husk	M.R. Manikantan	S. Elain Apshara, Anjineyulu Kothakota, CSIR-NIIST
1000767110	Use of simulation models for the production system analysis of palms and cocoa	M. Sujithra	K.B. Hebbar, B. Augustine Jerard, K.P. Chandran, Sandip Shil, K. Muralidharan, V. Selvamani, R. Sudha, Anok Uchoi, A. Josephrajkumar, P. Subramanian, Daliyamol, T.N. Madhu, E.K. Saneera, P.S. Prathibha, R. Thava Prakasa Pandian, Bhavishya, Surekha, T.N. Ranjini, V.S. Santhosh Mithra, ICAR – CTCRI, Thiruvananthapuram
1000765103	Studies on acclimatization potential of Phytophthora palmivora under climate change scenario for prediction of disease risk	Daliyamol	M.K. Rajesh, Sandip Shil, Vinayaka Hegde, V.H. Prathibha, M. Sujithra, V. Selvamani, K.P. Chandran
1000765109	Development of standard operating procedures (SoPs) for drone based spraying operations in the management of pest and diseases in coconut and arecanut	Daliyamol	Vinayaka Hegde, V.H. Prathibha, R. Thava Prakasa Pandian, M. Sujithra, Bhavishya

Project No.	Project title	Project leader	Co-PI / Associates
1000765110	Developing standard operating procedures (SoPs) for drone based spraying of nutrients in coconut and arecanut	Bhavishya	Ravi Bhat, R. Thava Prakasa Pandian, Surekha, P. Subramanian, Daliyamol, Vinayaka Hedge, M.K. Rajesh, Jeena Mathew, Manjunatha K., ICAR-DCR Puttur
1000765111	Development of an AI based mobile application for detection and advisory of diseases in coconut	Daliyamol	Vinayaka Hegde, R. Thava Prakasa Pandian, Jilu V. Sajan, B. Augustine Jerard, V.H. Prathibha, Merin Babu, M. Chaithra, M. Chaithra, Md. Ashraful Haque ICAR-IASRI, New Delhi, Shashi Dahiya ICAR-IASRI, New Delhi
HORTPCSIL 202400900131	Development of sensor based smart farming system for coconut	V. Selvamani	P. Subramanian, Ravi Bhat, Surekha
HORTPCSIL 202401000132	Development of UAV-based foliar spray of nano-urea for coconut	S. Neenu	P. Subramanian, Ravi Bhat, Daliyamol, P.S. Prathibha
1000769020	Technology transfer and co-learning action research approaches	C. Thamban	P. Anithakumari, K. Muralidharan, K.P. Chandran, S. Jayasekhar, Alpana Das, Arun Kumar Sit, Sandip Shil, K.M. Anes, P.S. Prathibha, Daliyamol, R. Thava Prakasa Pandian, Bhavishya
1000769013	Socioeconomic dimensions and value chain dynamics in policy perspective	S. Jayasekhar	K.P. Chandran, Sandip Shil, K. Muralidharan, C. Thamban, K. Ponnusamy
1000769019	Development of statistical and computational techniques for improving research methodology	K.P. Chandran	K. Muralidharan, Sandip Shil, S. Jayasekhar, K. Ponnusamy, T.N. Madhu, R. Thava Prakash Pandian, E.K. Saneera and Bhavishya

Revolving Fund Scheme

Project No.	Project title (PPV & FRA)	Project leader	Co-PI / Associates
2010760004	Seed Production in Coconut, Arecanut and Cocoa (RFS)	K. Samsudeen	V. Niral, S. Elain Apshara, N.R. Nagaraja, Regi Jacob Thomas, M. Shareefa, Y. Diwakar, R. Sudha, T.N. Ranjini, Arun Kumar Sit, L.S. Singh, M.K. Rajesh, K.M. Anes

Externally funded projects

Project No.	Project title (PPV & FRA)	Project leader	Co-PI / Associates
1050761086	DUS Centre for coconut (PPV&FRA)	V. Niral	K. Samsudeen
1050761114	Development of DUS testing criteria and establishment of genebank for arecanut (PPV&FRA)	N.R. Nagaraja	Arun Kumar Sit, L.S. Singh
1050761115	DUS Centre for cocoa (PPV&FRA)	S. Elain Apshara	-
1050761150	Identification of drought tolerant coconut palms in Tamil Nadu and utilization for developing adaptive gene pool	K. Samsudeen	P. Subramanian, V.Niral
1050761151	Evaluation of Farmer's 'MM 20' Betel vine variety	A.K. Sit	V. Niral
1050761142	Refinement of in *vitro* inflorescence culture of coconut for mass multiplication of true-to-type planting material	M. Shareefa	Regi J. Thomas, M.K. Rajesh
1050761156	Cocoa seed gardens/ clonal orchards – Establishment and enrichment	S. Elain Apshara	M. Chaithra
1050761157	Establishment of centre of excellence of biotechnology for plantation crops breeding	N.R. Nagaraja	S. Elain Apshara
1050761143	Impact of water / soil moisture conservation to enhancing production of coconut under rainfed and deficit irrigated farms	P. Subramanian	Ravi Bhat, C. Thamban, S. Paulraj, Surekha, V. Selvamani
1050761155	Demonstration of Kalpa Vardhini as a component of integrated nutrient management for sustained soil and palm health of coconut	Jeena Mathew	A. Abdul Haris, S. Indhuja

Project No.	Project title	Project leader	Co-PI / Associates
HORTPCSOL 202401300138/ 1050761171	Integration of beekeeping and mushroom cultivation to increase the income of farmers under plantation based cropping system in coastal region of Karnataka	T.N. Madhu	Rajkumar, R. Thava Prakasa Pandian, E.K. Saneera
1050761149	Diversity analysis of Ganoderma sp. infecting coconut and their eco-friendly management	Daliyamol	V.H. Prathibha, Vinayaka Hegde, L.S. Singh
1050761158	Design, fabrication and field demonstration of portable electrical in-situcocosap concentrator	K.B. Hebbar	M.R. Manikantan, S.V. Ramesh
1050761159	In situ structure for recording real-time observation on coconut crown	Ravi Bhat	V. Niral, Vinayaka Hegde, A. Abdul Haris, Jeena Mathew, V. Selvamani, A. Kireeti (AICRPP, Ambajipeta), Ruby Rani (AICRPP, Sabour)
1050761117	Participatory technology integration to empower and ensure livelihood security of farmers in Alappuzha district(Farmer FIRST Programme)	K.B. Hebbar/ P. Anithakumari	A. Josephrajkumar, Merin Babu, K. Nihad, Jeena Mathew, S. Indhuja, M. Shareefa, K.M. Anes
1050761137	Farmer Producer Organization with ICAR-CPCRI as Producer Organization Promoting Institution (POPI)	P. Anithakumari	A. Joseph Rajkumar, Merin Babu, M. Shareefa, Jeena Mathew, K., Nihad, S. Indhuja
1050761162	Global value chain analysis of plantation crops of India with special emphasis on food safety standards	S. Jayasekhar	K.P. Chandran
1050761168	Value chain analysis of arecanut in India	S. Jayasekhar	K.P. Chandran
1050761163	Standardisation of fruit weight conversion factor for coconut production in India	K.P. Chandran	K. Muralidharan, S. Jayasekhar, B. Augustine Jerard, S. Sumitha, P.P. Shameena Beegum, K.M. Anes, and Jilu V. Sajan
2010760007	Intellectual property management and transfer/ commercialization of agricultural technology scheme	K. Muralidharan	S. Jayasekhar, R. Sudha, Rajkumar,
1050761110	Establishment of Agri-Business Incubation (ABI) Center at ICAR-CPCRI, Kasaragod	K.Muralidharan	M.R. Manikantan, K. Ponnusamy
1050761136	Establishing demonstration plots on arecanut dwarf hybrids	N.R. Nagaraja	Rajkumar
1050761152	Front Line Demonstration of biointensive integrated pest management strategies for coconut white grub *Leucopholis coneophora* Burmeister (CDB)	P. S. Prathibha	Jilu V. Sajan, C. Thamban, Rajkumar, S. Neenu

Project No.	Project title	Project leader	Co-PI / Associates
1050761153	Demonstration of effective and eco-friendly management of white grubs using entomopathogenic nematodes in arecanut	Rajkumar	N. R. Nagaraja, Bhavishya, Surekha, M. Sujithra, V.H. Prathibha, T.N. Madhu, R. ThavaPrakasa Pandian, and E.K. Saneera
1050761165	Coconut based enterprises in Lakshadweep Island: Present status and development of a revamped strategic framework	C. Thamban	K.P. Chandran, S. Jayasekhar, P.P. Shameena Beegum, P.N.Ananth, KVK Lakshadweep
1050761167	Natural farming in coconut based farming system – An analysis of farmers experiences and impact	C. Thamban	B. Augustine Jerard, P. Subramanian, Ravi Bhat, Surekha, K.P.Chandran, S.Jayasekhar,S.Sumitha, S. Paulraj, S. Neenu From AICRP centres: Jagadeesha, C. Sudhalakshmi, A. Kireeti,
1050761169/ HORTPCSOL 202401100136	Agricultural Technology Entrepreneurship Incubation Center for integrated development in Muthukulam Block Panchayat	P. Anithakumari	S. Indhuja, M. Shareefa, K.M. Anes
HORTPCSOL 202401200137	Participatory Demonstration Plots of Cinnamon intercropping in coconut	Surekha	P. Subramanian, Ravi Bhat, Alka Gupta, V. Selvamani, S.V. Ramesh, Rajkumar
HORTPCSOL 202401400139	Laying out demonstration plots for demonstration of technologies for integrated management of root (wilt) disease of coconut	Regi Jacob Thomas	
HORTPCSOL 202401600141	A comparative study on the performance of cocoa (*Theobroma cacao* L.) in intensive monocropping and mixed cropping system	Ravi Bhat	Elain Apshara, S., Anok Uchoi, Bhavishya, R. Thava Prakasa Pandian, T.N.Madhu, Jagadesha (AICRP Centre on palms,
HORTPCSOL 202401700142	Cocoa based FPO in Kottayam district	Regi J Thomas	HRS, Arasikere Kreeti, (AICRP Centre on palms, HRS, Ambajipeta) Basavana Gowda (KVK, Taralabalu, Davanagere) Sudha Laksmi (AICRP Centre on palms, ARS, Aliyarnagar) Augustine Jerard, PC (Palms) P. Subramanian, Head, Crop Production division
HORTPCSOL 202401800143	Establishment of demonstration plots on arecanut based multispecies cropping system at Tripura	L.S. Singh	

XV

Research and Organisational Management

Research Advisory Committee meeting

The 26th Research Advisory Committee meeting was held at ICAR-CPCRI, Kasaragod on 4th April 2024 in hybrid mode. Dr. V.A. Parthasarathy, Chairman, Former Director ICAR-IISR, Calicut, Chaired the meeting. Dr. George V. Thomas, Former Director, ICAR-CPCRI (Member), Dr. Nirmal Babu, Former Director, ICAR-IISR Calicut (Member), Dr. Vishwa Bandhu Patel, ADG (Fruits and Plantation Crops), ICAR-New Delhi (Member), Dr. R.N. Padaria, Joint Director (Extension), ICAR-IARI, New Delhi (Member), Dr. C.A Jayaprakas, Former Principal Scientist and Head, Div. of Crop Protection, ICAR-CTCRI (Non-Official Member), Dr. Tejaswi G. Gowda (Agril. Entomology) Mudigere (Non-official member), Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI, Kasaragod (Member), Dr. Vinayaka Hegde, Head Division of Crop Protection (Member Secretary) were present in the meeting.

Dr. H.B. Singh, Former Professor & Head (Plant Pathology), Banaras Hindu University, and Dr. Pradeep Singh Negi, Chief Scientist, CSIRCFTRI, Mysore, attended the meeting online. Dr. K.B. Hebbar, Director, welcomed all the participants and made a brief presentation on recent research achievements of the Institute during 2023-24.

Later research achievements under the eight mega-projects were presented by respective mega project leaders. After the deliberations the following recommendations were given by the RAC.

- The efficacy of bio-control agents developed by ICAR-CPCRI, should be compared with commercially available formulations before registration with CIB&RC.
- The precision farming model for coconut shall be initiated with already available data.
- The reasons for declining coconut productivity in India need to be analyzed.
- Data on nano fertilizers should be generated, for plantation crops.
- The *in vitro* glycemic index (GI) of plantation products should be determined for better comprehension of their health promotional properties

Fig. 143. Planting of cocoa by RAC member at Vittal

Fig. 144. ADG visit to Vittal Cocoa Nursery

Institute Research Committee Meeting

The 52nd IRC meeting was held at ICAR-CPCRI, Kasaragod, from 13 to 17 May, 2024, under the chairmanship of Dr. K.B. Hebbar (Director). All the scientists from ICAR-CPCRI, Kasaragod, Regional Stations and Research Centres, KVK Kasaragod, and KVK Alappuzha participated in the meeting (Fig. 145 & 146).

Presentations of 7 sessions under the five divisions were made by Principal Investigators and co-investigators. The presentations were continued for four days. The Plenary Session was held on 17 May 2024. In the plenary session, farmers, personnel from developmental agencies from different organisations including cooperative and banking institutions attended and they suggested relevant activities to be included in the technical programme for the coming year. The following invitees participated in the meeting:

Dr. D. Chandrashekhara Chowta, (Progressive Farmer), Dr. Tejaswi G. Gowda Ph.D (Agril. Entomology) Mudigere (Non-official member, RAC), Dr. C.A Jayaprakas, Former Principal Scientist and Head, Div. of Crop Protection, ICAR-CTCRI (Non-Official Member, RAC), Mr. Krishna, Exec. Officer Agriculture, CAMPCO, Mr. Roopak Bhat, Mondelez, Dr. K.M. Sreekumar, College of Agriculture, Padannakkad, Mr. Shairon (ADM, NABARD, Kasaragod), Dr. B. Hanumanthe Gowda, CCDO, CDB, Shri Babulal Meena, Deputy Director, DASD, Dr. Dadasaheb Desai, Deputy Director, DCCD, Dr. Rashmi R., Sci. Horti. KVK Dakshina Kannada, Shri. Mahesh H.S., Vice President, MAMCOS, Mr. Srikanth Baruve, Managing Director, MAMCOS, Dr. V. Srinivasan, Head, Crop Production and PHT, IISR Kozhikode, Mrs. Ajitha C., Production Manager, Dinesh Foods and Dr. T.N. Ravi Prasad, Principal Scientist, DCR, Puttur.

Some of the suggestionsfrom the progressive farmers and other agencies include the following:

Indigenous tender nut varieties like COD and recently released Kalpa Suvarna variety may be mass multiplied and supplied.

- Research on wild animal management and bean quality aspects in cocoa may be initiated.
- Research on storage pests management and ideal conditions for storing cocoa may be carried out.
- Work on waste to wealth may be expanded to bioenergy and biofuel production.
- Coconut products developed from private companies may be checked for quality assessment.
- Three Cocoa varieties including 2 hybrids VTLCC1, VTLCH3, VTLCH4 respectively were recommended for release.

It was decided to update the Package of Practices and Organic farming in coconut with latest findings. New trials were approved for nutrient management of Palmyrah. New projects on Sensor based smart farming in coconut was approved.

During the meeting, ongoing projects, including 35 externally funded projects, were discussed, and the technical programme for the years 2024–25 was also finalized.

Fig. 145. Director K.B. Hebbar along with CCDO, CDB addressing the IRC delegates

Fig. 146. Dr. K. Balachandra Hebbar, Chairman along with Members of IRC

Institute Management Committee Meeting (IMC)

The Institute Management Committee Meeting was convened in a hybrid mode on 04 September 2024 at ICAR-CPCRI, Kasaragod under the Chairmanship of Dr. K. Balachandra Hebbar, Director ICAR-CPCRI, Kasaragod (Fig. 147). Dr. V.B. Patel, Asst. Director General (Fruits & Plantation crops), ICAR New Delhi, Dr. V. Srinivasan, Head (Crop Production & PHT) ICAR IISR, Kozhikode, Dr. R.H. Laxman, Principal Scientist, ICAR-IIHR Bengaluru, Dr. Mohana, G.S., Principal Scientist, ICAR-DCR-Puttur, , Dr. Vinayaka Hedge, Head (Crop Protection), ICAR-CPCRI, Kasaragod, Dr. Tejaswi Gowda, Chikkamagalur, Karnataka, Shri R.N. Subramanian, Senior Administrative Officer, ICAR-CPCRI, Kasaragod were present in the meeting. During the meeting the IMC has overviewed the progress on the research achievements and financial management aspects and taken appropriate decisions for implementation.

Fig. 147. A view of the IMC meeting

XVI

Intellectual Property and Technology Management

Intellectual property registrations

Two designs were registered *viz.*, coconut punching machine (433372-00); solar assisted linear actuated tender coconut cutting machine (433372-00). Four trademarks have been renewed. Variety registration with PPV & FRA is in force; registration of two varieties renewed.

Certification of products/ technologies/ process/ methodology/ model/ policy, etc. by ICAR

The following intellectual innovations from the institute could gain certificates from the ICAR, New Delhi.

Sl.No.	Title of the products/ technology/ process/ methodology	Developer	Associate Developers
1.	Climate suitability for coconut cultivation future approach	K.B. Hebbar	S.V. Ramesh
2.	Frozen coconut delicacy	M.R. Manikantan	Shameena Beegum, R. Pandiselvam, K.B. Hebbar
3.	Rapid detection of adulteration in desiccated coconut powder	M.R. Manikantan	R. Pandiselvam, Shameena Beegum, Subir Kumar Chakraborty
4.	Kalpa Eco Pots: Eco-friendly areca stem pots for raising nursery seedlings	N.R. Nagaraja	T.N. Madhu, M.K. Rajesh, K. Samsudeen, MJ. Shahala, Shreeranjini, V. Niral, K.B. Hebbar
5.	Preservation protocol for diced tender coconut	R. Pandiselvam	M.R. Manikantan, Shameena Beegum, S.V. Ramesh, Murali Gopal, K.B. Hebbar
6.	Accelerated virgin coconut oil (VCO) production using skimmed coconut milk	R. Pandiselvam	M.R. Manikantan, Shameena Beegum, S.V. Ramesh, Murali Gopal, K.B. Hebbar
7.	Textural properties of coconut for designing and developing processing machineries	R. Pandiselvam	M.R. Manikantan, D. Balasubramanian, Shameena Beegum, S.V. Ramesh
8.	Technique to identify the coconut varieties through palynological parameters	R. Sudha	V. Niral, K. Samsudeen, V. Aparna, V. Selvamani, M. Neema
9.	Integrated nutrient management in Napier Bajra Hybrid for coconut-based system	K. Nihad	Abdul Haris A., P. Subrahmanian, Jeena Mathew, Induja S., Neenu S., Ravi Bhat

Contract Research Project

Project No.	Project title	Project leader
HORTPCSCL 202401500137	Evaluation of bio-efficacy and phytotoxicity of Tebuconazole 50% + Trifloxystrobin 25% WG (Nativo) against leaf spot (Colletotrichum spp.) in arecanut	Dr. R. Thava Prakasa Pandian
HORTPCSCL 202401600138	Evaluation of bio-efficacy and phytotoxicity of Indaziflam 20 G/L + Glyphosate-Isopropylammonium 540 G/L SC (ALION PLUS) as a herbicide in arecanut plantation	Dr. Bhavishya
HORTPCSOL 202401600141	A comparative study on the performance of cocoa (*Theobroma cacao* L.) in intensive monocropping and mixed cropping systems	Dr. Ravi Bhat

Technologies commercialised

Sl. No.	Name of Technology Commercialized	Date of Signing MOU	Value (In INR)	To Whom Commercialized
1.	Aqua formulation of EPN Kalpa EPN (CPCRI- SC1)	05-01-2024	5000	Mr. Jaiju M. Bernerdose, Muttath house, Mudrady post, Hebri taluk, Udupi district, Karnataka state, 576112, India
2.	Trichoderma Coir Pith Cake	05-01-2024	5000	M/s Ecophytocare India Pvt. Ltd., 185/A, Gaddige Road, Bogadi, Mysuru - 570026, Karnataka
3.	-do-	24-06-2024	5000	The Superintendent, District Agricultural Farm, Taliparamba, Karimbam P.O. - 670142, Kannur District., Kerala, India
4.	-do-	27-06-2024	25000	Mr. Yumnam Parun Meitei, proprietor M/s Imphal Nursery, Sagolband Takyel Kolom Leikai, P.O. Langjing, Pin – 795113, Dist – Imphal west, State – Manipur, India
5.	Know-How on utilization of *Metarhizium anisopliae* culture	05-01-2024	5000	M/s Ecophytocare India Ltd., Pvt. 185/A, Gaddige Road, Bogadi, Mysuru - 570026, Karnataka
6.	Technology for mass production of *Trichoderma harzianum* using arecanut leaf sheath	05-01-2024	5000	M/s Ecophytocare India Pvt. Ltd., 185/A, Gaddige Road, Bogadi, Mysuru - 570026, Karnataka

Sl. No.	Name of Technology Commercialized	Date of Signing MOU	Value (In INR)	To Whom Commercialized
7.	-do-	09-02-2024	5000	Ms Thejasri K.P., Lalithamma Nilaya, Ramdas Nagar P.O., Vivekananda Nagar, Kudlu, Kasaragod, Kerala
8.	Preservation of coconut gratings	05-01-2024	10000	M/s. Geeta Foods, 18-117/1, Near Masjid, Ramalayam street, Mogalturu, Mogalturu mandalam, West Godavari, Andhra Pradesh – 534281, India
9.	-do-	17-01-2024	10000	Ms. Shali A, Meppanattil (H), Makkada (PO), Kakkodi (via), Kozhikode (Dist), 673611 (Pin), Kerala
10.	-do-	07-08-2024	10000	The Secretary, Golden Greenz FPO, Near Mini Civil Station, Koduvally, Pin - 673572, Kozhikode, Kerala
11.	Bacterium – *Bacillus cereus*	05-01-2024	-	National Institute of Technology Karnataka, Srinivasnagar PO, Surathkal, Mangalore, Karnataka 575025
12.	Bacterium –*Bacillus licheniformis*	05-01-2024	-	National Institute of Technology Karnataka, Srinivasnagar PO, Surathkal, Mangalore, Karnataka 575025
13.	Bacterium – *Bacillus pumilus*	05-01-2024	-	National Institute of Technology Karnataka, Srinivasnagar PO, Surathkal, Mangalore, Karnataka 575025
14.	Bacterium – *Bacillus safensis*	05-01-2024	-	National Institute of Technology Karnataka, Srinivasnagar PO, Surathkal, Mangalore, Karnataka 575025
15.	Foam mat dried coconut milk powder	08-01-2024	10000	Saptasagar Mahila Bachat Gat, Vengurla – 416516, Sindhudurg, Maharashtra
16.	-do-	16-04-2024	10000	M/s Kana Plus Food Products Pvt Ltd, 2/269, Konattu Building, Kashimanapady, Ezhakkaranadu P.O., Maneed, Ernakulam – 682308, Kerala, India

Sl. No.	Name of Technology Commercialized	Date of Signing MOU	Value (In INR)	To Whom Commercialized
17.	Technical Knowhow of production of Coconut Chips	09-02-2024	25000	Mrs. Ambika, W/o Sivaraja, 2-201A, Mariamman Kovil Street, Appanthiruppathi Post, Mathur Village, Madurai District, Tamil Nadu – 625301, India
18.	-do-	05-03-2024	25000	Mr Praveen R, 82, West kudi Street, Devanaluur, Selampalayam Post, Dharapuram (tk), Tirupur District, Tamil Nadu – 638672, India
19.	-do-	18-03-2024	25000	Mrs. T.M. Annamma, Bless Farm Flave, MP/15/81, Parakkatta, P.O. R.D. Nagar, Kasaragod – 671124, Kerala, India
20.	-do-	02-07-2024	25000	Mr. Muhammed Navas, Festino foods, Padikkal, Velimukku Post, Malappuram – Dist, Pin – 676317, Kerala, India
21.	-do-	02-09-2024	25000	M/s Maharaja Eco Products, Chukkamkonam, Thenkurissi, Vilayannur P.O., Palakkad - 678671, Kerala, India
22.		02-09-2024	25000	Mrs Manjula T.P., Lodhra foods, Near AR Police camp, Padinjttumuri Post, Koottilangadi Village, Malappuram - 676506, Kerala, India
23.	-do-	21-10-2024	25000	Mr. R Vadivel, S/o P. Ramer, 3/233, M. Savuloor (village), Noolahalli (P.O.), Dharmapuri (Dist), Pin code – 636704, Tamil Nadu, India
24.	-do-	14-12-2024	25000	Mr. A. S. Elavarasan, M/s ASP & Sons Enterprises Pvt Ltd, No 208, Maravapalayam, Chennimalai Road, Kangayam-638701, Tiruppur District, Tamil Nadu,India
25.	Matured coconut water based value added	09-02-2024	Comple-mentary	Mrs. Ambika, W/o Sivaraja, 2-201A, Mariamman Kovil

Sl. No.	Name of Technology Commercialized	Date of Signing MOU	Value (In INR)	To Whom Commercialized
			with Chips	Street, Appanthiruppathi Post, Mathur Village, Madurai District, Tamil Nadu – 625301, India
26.	-do-	12-02-2024	Complementary with VCO	M/s DMS Industries, Industrial Area Plot No 23A1 and 23A2 B Kattihalli, Hassan, Karnataka, India
27.	-do-	12-02-2024		Complementary with VCO Sri Venkateshwara Industries, Ground Floor, 22 23 26, Peenya II Stage, Bengaluru (Bangalore), Urban, Karnataka, 560058, India
28.	-do-	05-03-2024		Complementary with Chips Mr. Praveen R, 82, West kudi Street, Devanaluur, Selampalayam Post, Dharapuram (tk), Tirupur District, Tamil Nadu – 638672, India
29.	-do-	18-03-2024		Complementary with Chips Mrs. T.M. Annamma, Bless Farm Flave, MP/15/81, Parakkatta, P.O. R.D. Nagar, Kasaragod – 671124, Kerala, India
30.	-do-	16-04-2024		Complementary with VCO M/s Kana Plus Food Products Pvt Ltd, 2/269, Konattu Building, Kashimanapady, Ezhakkaranadu P.O., Maneed, Ernakulam – 682308, Kerala, India
31.	-do-	21-05-2024	15000	The Secretary, Jaivasree FPO, Wandoor Block, Wandoor P.O. Reg No. MPM/CA/154/2023, Pin - 679328, Malappuram Dist, Kerala, India
32.	-do-	02-07-2024		Complementary with Chips Mr. Muhammed Navas, Festino foods, Padikkal, Velimukku Post, Malappuram – Dist, Pin – 676317, Kerala, India

Sl. No.	Name of Technology Commercialized	Date of Signing MOU	Value (In INR)	To Whom Commercialized
33.	-do-	02-09-2024		Complementary with Chips M/s Maharaja Eco Products, Chukkamkonam, Thenkurissi, Vilayannur P.O., Palakkad - 678671, Kerala, India
34.	-do-	02-09-2024		Complementary with Chips Mrs Manjula T.P., Lodhra foods, Near AR Police camp, Padinjttumuri Post, Koottilangadi Village, Malappuram - 676506, Kerala, India
35.	-do-	21-10-2024		Complementary with VCO Mr R Vadivel, S/o P. Ramer, 3/233, M. Savuloor (village), Noolahalli (P.O.), Dharmapuri (Dist), Pin code – 636704, Tamil Nadu, India
36.	-do-	21-10-2024		Complementary with Chips Mr. R Vadivel, S/o P. Ramer, 3/233, M. Savuloor (village), Noolahalli (P.O.), Dharmapuri (Dist), Pin code – 636704, Tamil Nadu, India
37.	-do-	14-12-2024		Complementary with chips Mr. A. S. Elavarasan, M/s ASP & Sons Enterprises Pvt Ltd, No 208, Maravapalayam, Chennimalai Road, Kangayam-638701, Tiruppur District, Tamil Nadu,India
38.	Technical knowhow and machineries for the production of Virgin Coconut Oil (VCO)	12-02-2024	40000	M/s DMS Industries, Industrial Area Plot No 23A1 and 23A2 B Kattihalli, Hassan, Karnataka, India
39.	-do-	12-02-2024	40000	Sri Venkateshwara Industries, Ground Floor, 22 23 26, Peenya II Stage, Bengaluru (Bangalore), Urban, Karnataka, 560058, India
40.	Technical knowhow of production of Virgin Coconut Oil (VCO)	16-04-2024	40000	M/s Kana Plus Food Products Pvt Ltd, 2/269, Konattu Building, Kashimanapady,

Sl. No.	Name of Technology Commercialized	Date of Signing MOU	Value (In INR)	To Whom Commercialized
				Ezhakkaranadu P.O., Maneed, Ernakulam – 682308, Kerala, India
41.	-do-	18-09-2024	40000	Mr. N.K. Riyas Abdulla, Nariyan Kandy House, P.O. Poolakool, Kakkattil Via, Kozhikode – 673507, Kerala, India.
42.	-do-	21-10-2024	40000	Mr. R Vadivel, S/o P. Ramer, 3/233, M. Savuloor (village), Noolahalli (P.O.), Dharmapuri (Dist), 636704, Tamil Nadu, India
43.	Machineries (Renewal of MoA signed on 29-02-2016)	12-02-2024	30000	M/s Pro B Products, No.20/3B, 2nd Phase, KIADB Main Road, Opp. BWSSB, Peenya 1st Stage, Bengaluru – 560058, Karnataka, India
44.	Preservation protocol for trimmed tender coconut	21-02-2024	15000	The Secretary, Kodotty Block Karshaka Sangham FPO, Room No. 30/318, Kondotty Municipality, Kuruppath Post, Pin-673638, Kondotty Taluk, Malappuram District, Kerala
45.	-do-	27-06-2024	15000	M/s Marshal Industries, Koottalida, Avidanallur P.O., Kozhikode – 673614, Kerala, India
46.	Snowball Tender Nut Machine	21-02-2024	2500	The Secretary, Kodotty Block Karshaka Sangham FPO, Room No. 30/318, Kondotty Municipality, Kuruppath Post, Pin-673638, Kondotty Taluk, Malappuram District, Kerala
47.	Frozen Coconut Delicacy	01-03-2024	25000	Mrs Kavitha Balakrishnan, 35 Arum Lily, Kalapatti, Coimbatore - 641048, Tamil Nadu, India
48.	-do-	27-06-2024	25000	Mr. Abdulla Jawad B.M., Vadakkekara (H), Bevinja, Thekkil Ferry P.O., Kasaragod – 671541, Kerala, India
49.	'Kera Probio', 'Kera Probio+', 'Cocoa Probio' and 'KerAM'	05-03-2024	25000	M/s Ecophytocare India Pvt. Ltd., 185/A, Gaddige Road, Bogadi, Mysuru - 570026, Karnataka, India

Sl. No.	Name of Technology Commercialized	Date of Signing MOU	Value (In INR)	To Whom Commercialized
50.	Kalpa Soil Care - Coir pith composting (urea free) technology'	05-03-2024	15000	The Managing Director, Gramalakshmi Marketing Producer Company Limited, Udayapuram P.O. Kodothe, Anandasrem, Kasaragod, Kerala
51.	-do-	16-04-2024	25000	Mr. Joseph Jobby Eapen, Ananathakkattu House, Pariyaram P.O., Taliparamba, Kannur, Kerala- 670502, India
52.	-do-	10-06-2024	25000	Secretary, Pallikkara Grama Panchayath Jaivavala Nirmmana Society, Bangad, Panayal P.O. Kasaragod Dist - 671318, Kerala
53.	Collection of fresh and hygienic Kalparasa and production of natural coconut sugar	05-03-2024	100000	M/s Ramanagara Zilla Mango and Coconut Crop Farmer Producer Company Limited ®, APMC Market, Ramanagara – 562159, Ramanagara Dist, Karnataka, India
54.	-do-	02-09-2024	100000	Mr. Solanki Abhishek Naranbhai, Supasi railway station road, Ta – veraval, Dist – gir somnath, Gujarat – 362255, India
55.	Modified ground pollination technique for Hybridization In Coconut	11-03-2024	25000	Ygp Coconut Farmers Producer Company Limited, Avaragere Davanagere Davangere Karnataka- 577003, India
56.	Kalpa Organic Gold - Coconut Leaf Vermicomposting	11-03-2024	25000	South Canara Coconut Farmers Producer Company Limited, 1/101, Near Mangala Mantama CPCRI, Vittal, Dakshina Kannada, Karnataka - 574243, India
57.	-do-	04-06-2024	20000	Mr. Pratik Solanki, Chaduvav, Veraval, Gir Somnath District, Gujarat-362266, India
58.	Preservation of Carbonated Tender Coconut Water	05-04-2024	25000	Mr. Anil Kumar P, Sree Food Products, Near Parambath Kavu Temple, Thenhipalam post, Malappuram District, PIN - 673636, Kerala

Sl. No.	Name of Technology Commercialized	Date of Signing MOU	Value (In INR)	To Whom Commercialized
59.	-do-	07-08-2024	25000	The Secretary, Golden Greenz FPO, Near Mini Civil Station, Koduvally, Pin - 673572, Kozhikode, Kerala
60.	-do-	08-08-2024	25000	Mr. Zainuddin A, Bandara house, Paivalike, Manjeswaram, Kasaragod – 671348, Kerala, India
61.	-do-	24-10-2024	25000	Mr. Jiji Antony Varghese, C/o JeeJee Coco's and Agro Products, Kongandoor P.O., Pin-686564, Kottayam Dist, Kerala
62.	-do-	13-11-2024	25000	Mr. Retheesh Unnipravan, M/s Koko Drinks, MP-III-56-A, Nadakkuthazhe, Vengara P.O., Kannur Dist, Pin-670305, Kerala, India
63.	-do-	14-12-2024	25000	Mr. Anantha Nayak N, M/s Shri Bhagavathi Prasad oil , Flour & Rice mill , Naikap , P.O edanad, Kumbla.Pin-671321, Kerala
64.	Shatamangala	13-08-2024	200000	Mr. Mohan Kumar Velicheti, Sagare village (Near Kabini Dam), Saragur taluk, Mysore Dist, Karnataka, India
65.	-do-	02-09-2024	200000	Shri. R. Kumarasamy, Kumar Hitech Nursery, Annur, Coimbatore Dt., Tamil Nadu, India
66.	Rotary dryer for the production of coconut chips	03-10-2024	25000	M/s Pro B Products, No.20/3B, 2nd Phase, KIADB Main Road, Opp. BWSSB, Peenya 1st Stage, Bengaluru – 560058, Karnataka, India
67.	Flavoured coconut milk	15-10-2024	25000	M/s Maharaja Eco Products, Chukkamkonam, Thenkurissi, Vilayannur P.O., Palakkad - 678671, Kerala, India
68.	Kalpa Suvarna	02-09-2024	100000	South Canara Coconut Farmers Producer Company Limited, 1-101, Near CPCRI, Vittal, Mangala Mantapa, Dakshina Kannada, Karnataka – 574243, India

Sl. No.	Name of Technology Commercialized	Date of Signing MOU	Value (In INR)	To Whom Commercialized
69.	Kalpa Samrudhi	04-09-2024	45000	Mr. Babubhai M Solanki, Kishan Coconut Plant Nursery, Supasi railway station road, Ta – veraval, Dist – Gir Somnath, Gujarat – 362255, India
70.	Kalpa Vardhini	18-09-2024	25000	The Director, RLCO Innovative Agri Pvt Ltd, 17/313, Atheetham, Melakirath parambu, Chelavur P.O., Kozhikode – 673571, Kerala, India.
71.	Kalpa Poshak	18-09-2024	25000	The Director, RLCO Innovative Agri Pvt Ltd, 17/313, Atheetham, Melakirath parambu, Chelavur P.O., Kozhikode – 673571, Kerala, India.
	TOTAL		**17,87,500/-**	

Sale of products

During 2024 seedlings and other farm inputs worth Rs. 2,61,84,098/- were sold to farmers and other stakeholders as per the following details.

Sl. No.	ITEM	Quantity (nos.)	Amount (Rs)
1	Coconut seedlings (hybrids)	31,248	91,80,520
2	Coconut seedlings (tall varieties)	20,550	28,35,400
3	Coconut seedlings (dwarf varieties)	8,866	19,29,040
4	Coconut seed nuts	4,370	5,54,620
5	Coconut leaf vermicompost (kg)	576	8,830
6	Earthworms	14,400	10,368
7	Trichoderma (kg)	44	4,400
8	Polybag seedlings	168	48,070
9	Extension publications	8	810
10	Arecanut seed nuts	1,65,612	54,71,415
11	Arecanut Seedlings	1,05,740	44,16,090
12	Arecanut sprouts	25,000	8,75,000
13	Kalpa EPN (SC&H1) aqua suspension	292	34,456
14	Kalpa EPN Galleria cadaver formulation	521	3,074
15	Cocoa pods	14,206	64,0175
16	Cocoa seedlings	107	8,620
17	Cocoa grafts	3,253	55,630
18	Black pepper Cuttings	1,332	19,980
19	Cinnamon layers	704	21,120
20	Acid Lime Cuttings	60	1,500
21	Bey leaf rooted cuttings	1,487	59,480
22	Metarhizium majus	10 kg	1,000
23	Others	3	4,500
	Total		**2,61,84,098**

XVII

PERSONNEL

Scientific Staff

Sl. No.	Name	Designation
	Headquarters, Kasaragod	
1	Dr. K. Balachandra Hebbar	Director
2	Dr. B. Augustine Jerard	PC (Palms)
3	Dr. Vinayaka Hegde	HoD (Crop Protection)
4	Dr. P. Subramanian	HoD (Crop Production)
5	Dr. Murali Gopal	HoD (PB& PHT)
6	Dr. (Smt.) V. Niral	HoD (Crop Improvement)
7	Dr. K. Ponnusamy	HoD (Social Science)
8	Dr. K. Muralidharan	Principal Scientist (Agril Statistics)
9	Dr. H.P. Maheswarappa	Principal Scientist (Agronomy)
10	Dr. Ravi Bhat	Principal Scientist (Agronomy)
11	Dr. C. Thamban	Principal Scientist (Agril. Extension)
12	Dr. (Smt.) Alka Gupta	Principal Scientist (Agril. Microbiology)
13	Dr. K. Samsudeen	Principal Scientist (Economic Botany)
14	Dr. M.R. Manikantan	Principal Scientist (Agril. Structure & Process Engg.)
15	Dr. K.P. Chandran	Principal Scientist (Agril. Statistics)
16	Dr. S. Jayasekhar	Principal Scientist (Agril. Economics)
17	Dr. (Ms) V. Selvamani	Principal Scientist (Soil Science)
18	Dr. (Smt.) R. Sudha	Senior Scientist (Fruit Science)
19	Dr. (Smt.) S. Neenu	Senior Scientist (Soil Science)
20	Dr. S. Paulraj	Senior Scientist (Agril. Microbiology)
21	Dr. S.V. Ramesh	Senior Scientist (Agril. Biotechnology)
22	Dr. Rajkumar	Senior Scientist (Nematology)
23	Dr. (Smt.) V. H. Prathibha	Senior Scientist (Plant Pathology)
24	Dr. (Smt.) M. Sujithra	Senior Scientist (Agril. Entomology)
25	Dr. (Smt.) P. S. Pratibha	Senior Scientist (Agril. Entomology)
26	Dr. (Smt.) Surekha	Scientist (Agronomy)
27	Dr. (Smt.) P.P. Shameena Beegum	Scientist (SPM&AP)
28	Dr. (Smt.) Daliya Mol	Scientist (Plant Pathology)
29	Dr. R. Pandiselvam	Scientist (Agril. Process & Food Engg.) (up to 04.04.2024)
30	Smt. T.N. Ranjini	Scientist (SPM&AP)
31	Dr. (Smt.). S. Sumitha	Scientist (SPM&AP)
32	Dr. (Smt.) Aparna Veluru	Scientist (SPM&AP)
33	Dr. (Smt.) G. Panjavarnam	Scientist (Fruit Science)

Sl. No.	Name	Designation
	KVK, Kasaragod	
34	Dr. T.S. Manojkumar	Principal Scientist (Agril. Structure & Processing Engg.) & Head, KVK
	Regional Station, Kayamkulam	
35	Dr. Regi Jacob Thomas	Head
36	Dr. (Smt.) P. Anithakumari	Principal Scientist (Agril. Extension)
37	Dr. A. Abdul Haris	Principal Scientist (Agronomy)
38	Dr. A. Joseph Rajkumar	Principal Scientist (Agril. Entomology)
39	Dr. (Smt.) M. Shareefa	Senior Scientist (Horticulture)
40	Dr. (Smt.) Merin Babu	Senior Scientist (Plant Pathology)
41	Dr (Smt.) K. Nihad	Senior Scientist (Horticulture)
42	Dr. (Smt.) Jeena Mathew	Senior Scientist (Soil Science)
43	Dr. K.M. Anes	Senior Scientist (Nematology)
44	Dr. (Smt.) S. Indhuja	Scientist (Agril. Microbiology)
45	Dr. (Smt.) Jilu V. Sajan	Scientist (Agril. Entomology)
46	Dr. (Smt.) U.K. Priya	Scientist (Soil Science)
	KVK, Alappuzha	
47	Dr. P. Muralidharan	Principal Scientist (Soil Science) & Head, KVK
	Regional Station, Vittal	
48	Dr. M.K. Rajesh	Head
49	Dr. S. Elain Apshara	Principal Scientist (Fruit Science)
50	Dr. N.R. Nagaraja	Senior Scientist (Plant Breeding)
51	Dr. Bhavishya	Scientist (SPM &AP)
52	Dr. R. Thava Prakash Pandian	Scientist (Plant Pathology)
53	Dr. T.N. Madhu	Scientist (Agril. Entomology)
54	Dr.(Ms.) M. Chaithra	Scientist (Plant Pathology)
55	Dr. (Smt.) M. Suchithra	Scientist (SPM &AP)
56	Dr. (Smt.) E.K. Saneera	Scientist (Agril. Entomology) (up to 06.12.2024)
57	Dr. Mahendran B.	Scientist Agriculture Entomology (w.e.f. 09.12.2024)
	Research Center, Mohitnagar	
58	Dr. Arunkumar Sit	Principal Scientist (Hort.) & Scientist-In-charge
59	Dr. Sandip Shil	Senior Scientist (Agril. Statistics)
	Research Center, Kahikuchi	
60	Dr. (Smt.) Alpana Das	Principal Scientist (Agril. Biotechnology)& Scientist-In-charge
61	Dr. Leichombam Singhajit Singh	Scientist (SPM &AP)
62	Dr. Anok Uchoi	Scientist (SPM &AP) (up to 05.09.2024)
63	Dr. (Smt.) M. Chaithra	Scientist (Plant Pathology)
	Research Center, Kidu	
64	Shri Y. Diwakar	Scientist (SPM&AP) and Scientist-In-Charge

Technical Staff

Sl. No.	Name	Designation
	Headquarters, Kasaragod	
1	Shri H. Muralikrishna	Chief Technical Officer (Technical Information)
2	Shri K. Shyam Prasad	Chief Technical Officer
3	Shri G.S. Hareesh	Senior Technical Officer (Instrumentation Engg.)
4	Shri K. Ajith Kumar	Senior Technical Officer (Civil Engg.)
5	Shri. Vikas Joon	Senior Technical Officer (w.e.f. 14.06.2024)
6	Shri V.K. Gopalakrishnan	Technical Officer
7	Shri S. Manohara	Technical Officer (Vehicle)
8	Shri K. Krishnan Nair	Technical Officer (Field /Farm)
10	Shri K. Devaraj	Technical Officer (Jr. Eng.) (on study leave)
11	Dr. K.S. Muralikrishna	Senior Technical Assistant (Laboratory)
12	Shri A.V. Satheeshkumar	Senior Technical Assistant (Vehicle)
13	Shri P. Santhosh Kumar	Senior Technical Assistant (Field /Farm)
14	Shri K. Panduranga	Senior Technical Assistant (up to 30.06.2024)
15	Shri K. Bhavani Shankar	Technical Assistant
16	Shri S. Sunil	Technical Assistant (Electrical Engineering)
17	Shri G. Arunji	Technical Assistant (LIB)
18	Shri P.P. Anoop Kumar	Technical Assistant (Field/Farm)
19	Shri N. Dinesh Kumar	Senior Technician (Field /Farm)
20	Smt. E.P. Ashamol	Technician (Field/Farm)
21	Shri P.S. Suvith	Technician (Field/Farm)
22	Shri R. Ajith Kumar	Technician (Field/Farm)
23	Shri M. Krishnan	Technician (Field/Farm)
24	Smt. Chithralekha Kodoth	Technician (Field/Farm)
25	Shri B. Sundara	Technician (Field/Farm)
26	Shri B. Chandrahasa	Technician (Field/Farm)
27	Shri V.T. Rameshan	Technician (Field/Farm) (up to 30.04.2024)
28	Shri K. Sukumaran	Technician (Field/Farm)
29	Shri Vishnu Pooniya	Technician (Field/Farm) (w.e.f. 02.05.2024)
30	Shri Pavan Kumar	Technician (Field/Farm) (w.e.f. 06.05.2024)
31	Shri Rahul Meena	Technician (Field/Farm) (w.e.f. 08.05.2024)
32	Shri Avadhesha Maurya	Technician (Field/Farm) (w.e.f. 09.05.2024)
33	Shri Vishal Singh	Technician (Field/Farm) (w.e.f. 09.05.2024)
	KVK, KASARAGOD	
34	Dr. (Smt.) Saritha Hegde	Chief Technical Officer (SMS-Home Science)
35	Dr. (Smt.) Neelofar Illias Kutty	Chief Technical Officer (Programme Assistant) (Home Science)
36	Smt. M.P. Jayasree	Assistant Chief Technical Officer (SMS) (Agril. Extension.) (On study leave)
37	Shri K. Manikandan	Senior Technical Officer (Programme Assistant)
38	Dr. Benjamin Mathew	Senior Technical Officer (SMS – Horticulture)
39	Dr. Ramavath Pandu	Senior Technical Officer (SMS - Livestock Production Management). (w.e.f. 31.07.2024)
40	Shri Dinesh Kumar Yadav	Senior Technical Officer (SMS – Entomology) (w.e.f. 19.06.2024) (w.e.f 19.06.2024)

Sl. No.	Name	Designation
41	Dr. Kiranmoy Patra	Senior Technical Officer (SMS – Agronomy) (w.e.f. 29.11.2024)
42	Shri K.P. Lagesh	Technician (Vehicle)
	Regional Station, Kayamkulam	
43	Dr. Bikash Chowdhari	Chief Technical Officer (Field/Farm) (w.e.f. 06.08.2024)
44	Dr. C.G. Narayanan Namboothiri	Chief Technical Officer ((Field/Farm)
45	Shri B. Anilkumar	Assistant Chief Technical Officer (Field Farm)
46	Dr. (Mrs.) Maya Lekshmi	Technical Officer (Field/Farm)
47	Shri Sunny Thomas	Technical Officer (Field/Farm)
48	Smt. Asha K. Chandran	Technical Assistant (Field/Farm)
49	Smt. Poonam Khatri	Technical Assistant (Field/Farm)
50	Dr. V. Kamal Kumar	Technical Assistant (w.e.f. 12.08.2024)
51	Shri Premjith Antony	Technician (Field Farm)
	KVK, Alappuzha	
52	Smt. Jissy George	Chief Technical Officer (SMS –Home Science)
53	Smt. G. Lekha	Chief Technical Officer(SMS-Plant Pathology)
54	Shri M.S. Rajeev	Chief Technical Officer(SMS-Agronomy)
55	Shri S. Ravi	Chief Technical Officer(SMS-Animal Husbandry)
56	Dr. T. Sivakumar	Chief Technical Officer(SMS-Agricultural Entomology)
57	Dr. K. Sajnanath	Assistant Chief Technical Officer (SMS-Soil Science)
58	Shri K.M. Ansary	Assistant Chief Technical Officer (Computer)
59	Smt. P.V. Bijila	Assistant Chief Technical Officer (Horticulture)
60	Shri Dayanandan Unnithan	Technical Officer (Vehicle)
61	Shri B.J. Sajin	Technician
	Regional Station, Vittal	
62	Shri M. Narayana Naik	Technical Officer (F/F)
63	Shri B. Tharanath Naik	Senior Technical Assistant (Vehicle)
64	Shri B.J. Nirmal Kumar	Technical Assistant (Field/Farm)
65	Shri Bisun Bhaskar	Technical Assistant (Lab)
66	Shri D. Isubu	Technician (Field/Farm)
67	Shri Dharmapala	Technician (Field/Farm)
68	Shri Mohana	Technician (Field/Farm)
69	Mr. Priy Ranjan Bharti	Technician (Field/Farm) (w.e.f 09.05.2024)
	Research Center, Mohitnagar	
70	Shri Avarjyothi Gosh	Chief Technical Officer (Field/Farm)
71	Shri Pratap Kumar Sarkar	Technical Officer (Field/Farm)
72	Shri Jagadish Roy	Technical Officer (Vehicle)
73	Shri Prakash Burman	Senior Technician (Field/Farm)
74	Shri Kartick Chandra Biswas	Technician (Field/Farm)
	Research Center, Kahikuchi	
75	Dr. Bikash Chowdhari	Chief Technical Officer (w.e.f. 06.05.2024) (up to 05.08.2024)
76	Shri Gopinath Malakar	Technical Officer (Vehicle)
77	Shri Pradipta Mondal	Technician (w.e.f 06.05.2024)

Sl. No.	Name	Designation
	Research Center, Kidu	
78	Shri A.S. Gopalakrishna	Technical Officer (Field/Farm)
79	Shri V. Kamal Kumar	Technical Assistant (Field/Farm) (up to 11.08.2024)
80	Shri V. Chennappa	Technician (Field/Farm)
81	Shri S. Chennappa	Technician (Field/Farm) (up to 31.12.2024)
82	Shri V. Jathappa Gowda	Technician (Field/Farm)
83	Mr. Anjesh Kumar	Technician (w.e.f. 08.05.2024)
84	Mr. Roshan Sharma	Technician (w.e.f.09.05.2024)

Administrative Staff

Sl. No.	Name	Designation
	Headquarters, Kasaragod	
1	Shri Ram Avtar Parashar	Chief Finance & Accounts Officer
2	Shri R.N.Subramanian	Senior Administrative Officer (w.e.f. 07.02.2024)
3	Shri P. Krishna Kumar	Administrative Officer
4	Shri Pradeep Kumar Vasu	Assistant Administrative Officer
5	Shri K.K. Sasi	Assistant Finance & Accounts Officer
6	Shri M. Ravindran	Assistant Administrative Officer
7	Shri A. Neil Vincer	Assistant Administrative Officer
8	Smt. Narayani K.	Principal Private Secretary
9	Smt. Girija Chandran	Private Secretary
10	Smt. Sulochana Nair	Private Secretary (up to 31.03.2024)
11	Smt. A.R. Arathi	Stenographer Gr. III
12	Shri P.M. Thomas	Assistant
13	Smt. K.T.K. Sheenakumari	Assistant
14	Shri P. Narayana Naik	Assistant
15	Smt. Rupa Manikandan	Assistant
16	Shri Paulson Sam George	Assistant
17	Smt. K. Preethi	Assistant
18	Shri Aswin Regunath	Assistant
19	Shri T. J. Saji	Assistant (upto 18.03.2024)
20	Shri T.K. Gangadharan	UDC (up to 30.04.2024)
21	Shri Mohammed Haneefa	UDC (up to 02.07.2024)
22	Shri N. Udayakumar	UDC
23	Smt. A.J. Mary	UDC
24	Shri P.K. Pramod Kumar	UDC
25	Shri V. Jayarajan	LDC (on deputation) (w.e.f. 21.05.2024)
26	Shri Ratan Singh	LDC (on deputation)
27	Shri Dinesh	LDC (on deputation)
28	Shri K.P. Ibrahim	LDC (up to 31.01.2024)
29	Shri Sathya Bratha Moharana	LDC (on deputation)

Sl. No.	Name	Designation
	KVK, Kasaragod	
30	Smt. K. Jayashree	Assistant
	Regional Station, Kayamkulam	
31	Smt. Prasanna Sarngan	Private Secretary
32	Shri K. Haridasan	Assistant (up to 31.05.2024)
33	Shri K. Venu Gopal	Assistant
34	Smt. K. Sreelatha	Assistant
35	Smt. T. Deepa	UDC
36	Shri N.K. Arun Raj	AFAO (w.e.f. 22.08.2024)
	KVK, Alappuzha	
37	Smt. K.R. Regitha	Personal Assistant
	Regional Station, Vittal	
38	Shri Vivek Singh	Stenographer Gr. III (Up to 08.11.2024)
39	Shri Mohammed Haneefa	UDC (w.e.f 03.07.2024)
40	Shri Chandu Naik	LDC
41	Shri Laxmi Narayana	UDC
42	Shri K.N. Sajeev	LDC
43	Shri B. Choma	LDC (up to 30.04.2024)
	Research Centre, Mohitnagar	
44	Shri Subash Paul	Assistant
	Research Centre, Kahikuchi	
45	Shri Deepak Meena	LDC (on deputation)
46	Shri Umesh Kumar	LDC (on deputation)
47	Shri T.J. Saji	Assistant (w.e.f. 19-03-2024)
	Research Center, Kidu	
48	Shri M. Durgesha	LDC

Skilled Support Staff

Sl. No.	Name
	Headquarters, Kasaragod
1	Shri K.G. Sureshbabu
2	Shri V.S. Pakeeran (up to 31.10.2024)
3	Smt. V. Thambai
4	Shri K. Jayaprakash (up to 31.05.2024)
5	Shri V. Krishnankutty (up to 31.01.2024)
6	Shri P.P. Prabhakaran
7	Shri B. Ramachandran (up to 30.04.2024)
8	Shri B. Sanjeeva Patali (expired on 03.04.2024)
9	Smt. N.V. Sasikala (up to 31.05.2024)

Sl. No.	Name
10	Shri Laxshmana Naik (up to 30.06.2024)
11	Smt. Lalitha Bai
12	Shri M. Velayudhan
13	Shri N. Bhaskaran
14	Shri K. Sureshan
15	Shri A. Madhu
16	Shri K.A. Madhavan
17	Smt. Vanamalini
18	Shri E.M. Aneesh
19	Shri Praveen Raj

Sl. No.	Name
20	Shri R. Ashok Kumar
21	Shri Sarath Kumar
22	Shri Kripesh
23	Smt. N. Rohini
24	Shri J. Vignesh (up to 18.07.2024)
	KVK, Kasaragod
25	Shri P. Chaniya Naik (up to 30.04.2024)
	Regional Station, Kayamkulam
26	Shri M. E. Sivan
27	Shri K. Omanakuttan
28	Shri K. Ravi (up to 31.05.2024)
29	Shri C. Sukumaran (up to 31.05.2024)
30	Smt. K. Valsala (up to 30.04.2024)
31	Shri C. Sundaran
32	Shri A.T. Harikuttan
33	Shri S. Rajesh
34	Smt. N. Suma
35	Smt. L. Leena
36	Smt. A.S. Aswathy
	KVK, Alappuzha
37	Shri R. Rajesh
38	Smt Arathi R. Pillai
	Regional Station, Vittal
39	Shri Ibrahim

Sl. No.	Name
40	Shri K. Somappa
41	Shri M. Ananda
	Research Center, Mohitnagar
42	Shri Sailen Seal
43	Shri Krishna Kumar Mandal
44	Shri Nripendra Chandra Roy
45	Shri Mahadev Misra
46	Shri Sushanta Burman
	Research Center, Kahikuchi
47	Shri Sathish Baishya
48	Shri Pankaj Das
49	Shri Thanka Bahadur Thapa
	Research Center, Kidu
50	Smt. N. Bhavani (up to 31.05.2024)
51	Shri Padmayya Gowda (up to 31.05.2024)
52	Smt. C. Rukmini (up to 24.07.2024)
53	Smt. S. Chandravathi
54	Shri S. Bhojappa
55	Smt. Komalangi
56	Shri S. Neelappa
57	Shri S. Regappa (up to 31.05.2024)
58	Smt. B. Meenakshi
59	Shri J. Vignesh (w.e.f. 19.07.2024)

XVIII

Distinguished Visitors

Sl. No.	Visitors	Place & Date
1.	Dr. N. K. Krishna Kumar, Former Deputy Director General (Horticultural Science), ICAR, New Delhi Dr. George V Thomas, former Director, ICAR-CPCRI Kasaragod, Dr. J. Dinakara Adiga, Director, ICAR-Directorate of Cashew Research, Puttur Dr. B. Hanumanthe Gowda, Chief Coconut Development Officer, Coconut Development Board, Kochi, Shri Dadasaheb Desai, Deputy Director, Directorate of Cashew nut and Cocoa Development, Kochi	ICAR-CPCRI, Kasaragod on 05 January 2024
2.	Shri. G.P. Sharma, Joint Secretary (Finance), ICAR, New Delhi	ICAR-CPCRI, Kasaragod on 18 January 2024
3.	Dr. Ramachandra Hebbar, Scientist G & General Manager RRSC-South, NRSC, Bangalore Dr. Manoj P. Samuel, Executive Director, CWRDM, Kozhikode	ICAR-CPCRI, Kasaragod on 05 March 2024
4.	Mr. Dilip K. Kainikkara, IAS, Assistant Collector Mr. Sajith Kumar, General Manager, DIC	ICAR-CPCRI, Kasaragod on 06 March 2024
5.	Sushri Shobha Karandlaje, Hon'ble Minister of State for Agriculture and Farmers Welfare, Sushri Bhagirathi Murulya, MLA (Sullia), Dr. Homy Cheryian, Director, DASD, Dr. Hanumanthe Gowda CCDO, CDB, Shri Kishore Kodgi, President CAMPCO and Shri Satish Kalige, Bilinele Ward Member	ICAR-CPCRI, RC, Kidu on 11 March 2024
6.	Dr. Sanjay Kumar Singh, DDG, (Hort. Sci.), ICAR, New Delhi	ICAR-CPCRI, RC, Kidu & ICAR-CPCRI, RS, Vittal 11 March 2024
7.	Dr. Sanjay Kumar Singh, DDG, (Hort. Sci.), ICAR, New Delhi	ICAR-CPCRI, Kasaragod on 12 March2024
8.	Dr. S.N. Jha, DDG (Agricultural Engineering), ICAR, New Delhi	ICAR-CPCRI, Kasaragod on 29 April 2024
9.	Prof. V.K. Ramachandran, Vice-Chairman of the Kerala State Planning Board	ICAR-CPCRI, RS, Kayamkulam on 13 June 2024

Sl. No.	Visitors	Place & Date
10.	Dr. Sanjay Kumar Singh, DDG, (Hort. Sci.), ICAR, New Delhi	ICAR-CPCRI, RS, Kayamkulam on 14 June 2024
11.	Sri. P. Prasad, Hon'ble Minister for Agriculture, Govt. of Kerala, Dr. S.K. Singh, DDG (Hort. Sci.) ICAR New Delhi, Shri N.A. Nellikkunnu, Hon'ble MLA, Kasaragod	ICAR CPCRI, Kasaragod on 02 September 2024
12.	Dr. Prakash Chouhan, Director of NRSC-ISRO The CGM of Regional Centres, NRSC-ISRO, New Delhi, Dr. J.D. Adiga, Director, Directorate of Cashew Research (DCR), Dr. K. Suresh, Director, Indian Institute of Oil Palm Research (IIOPR), Dr. Homey Cheriyan, Director, Directorate of Arecanut and Spices Development (DASD)	ICAR CPCRI, Kasaragod on 05 September 2024
13.	Shri Rajmohan Unnithan, the Honourable Member of Parliament, Kasaragod, Shri N.A. Nellikunnu, Hon'ble MLA, Kasaragod	ICAR CPCRI, Kasaragod on17 September to 02 October 2024
14.	Dr. R. Chandra Babu, Former Vice Chancellor, Kerala Agricultural University and the President, ISPP Dr. P.V. Varaprasad, Professor, Kansas State University, USA, Dr. Brajesh Singh, Director, ICAR-CPRI, Shimla, Dr. Jagdish Rane, Director, ICAR-CIAH, Bikaner	ICAR CPCRI, Kasaragod on 17 December 2024
15.	Dr. Sanjaya Kumar, Chairman, ASRB, New Delhi	ICAR-CPCRI, Kasaragod, 19 December 2024

XIX

SCSP Activities

Skill development training programmes and farm inputs distribution

The focus of the institute is on empowering the scheduled caste communities in coconut, arecanut and cocoa growing regions by offering six to eight months long duration skill development programmes to find better job prospects in planation sector, supply of high yielding quality planting material of coconut & arecanut (10491 Nos) seedlings to bring available land with SC communities under plantations and increase the productivity per unit area, extending support of farm inputs including small equipment's/machineries like coconut climbing machines (120 Nos), sprayer (25 Nos), pronged hoe, rose can & spade (120 Nos), cocoa pruning kit consist of Grafting/Budding knives, secateurs, sickles, pruning shears (12 Nos) to reduce drudgery and bring down capital requirement for starting farming, poultry birds (1000 Nos) to promote integrated farming system to improve overall productivity of coconut/arecanut farms. Vegetable seeds kit (200 Nos), nutrient kit (130 Nos) and bio-pesticides kits (200 Nos), mushroom spawn kit (110 Nos) were provided to the beneficiaries to improve nutrition security and produce pesticide free food material from coconut farming. In this connection,a total of 49 farmers training / skill development programmes on scientific cultivation practices, bee keeping, bio-pesticide production etc., were organized at Kasaragod and its regional stations at Vittal, Kidu, Kayamkulam and Mohitnagar during 2024-25 financial year and benefitted to 2395 farmers, unemployed youths and farm women (Fig. 148-153).

Fig. 148. Training on coconut climbing for SC farmers at CPCRI, RS, Kayamkulam, Kerala

Fig. 149. Training on Bee keeping at CPCRI, RS, Kayamkulam, Kerala

Fig. 150. Distribution of Farm inputs under SCSP at ICAR-CPCRI, Mohitnagar, West Bengal

Fig. 151. Distribution of farm implements at ICAR-CPCRI, Kayamkulam, Kerala

Fig. 152. Distribution of cocoa pruning kit at ICAR-CPCRI, Vittal, Karnataka

Fig. 153. View of SCSP trainees with Ms. Shobha Karandlaje, State Minister of Agriculture and Farmer Welfare (GOI) during Kisan Mela at ICAR-CPCRI, Kidu, Karnataka

Empowerment of unemployed youth

Four specialized skill development training programs were conducted at ICAR-CPCRI, Kasaragod, on the key areas: Coconut Value Addition, Basic Computer Applications and Office Automation, E-office Management Skills, Laboratory Techniques, Coconut Agro-techniques, Cropping System Models, Planting Material Production, and Irrigation Management.A total of 52 unemployed youths from Scheduled Caste communities benefited from these training programmes (Fig. 154-156). Among the participants, six successfully found stable daily wage employment in the plantation sector after completing the training.

Fig. 154. SCSP trainee receiving certificate from the Director, CPCRI, Dr. K.B. Hebbar

Fig. 155. View of SCSP trainees with Dr. Sanjay Kumar, Chairman, ASRB New Delhi & Dr. Vishwanath, Dean, IARI, New Delhi

Fig. 156. SCSP skill development training at ICAR-CPCRI, Kasaragod, inaugurated by Sri Raviraj, District Development Officer for SC/ST

Awareness training on scientific production of coconut and arecanut along with seedling distribution

ICAR-CPCRI in collaboration with ICAR-KVK, Dakshina Kannada and Karnataka State Rural Livelihood Promotion Society (KSRLPS), Bangalore organized comprehensive capacity development programme on "Scientific Coconut production-cum-Seedling Distribution Programme" under SCSP in Sulia taluk on 26 July 2024, ICAR-KVK, Mangalore on 08 November 2024, DATC Belthangady on 17 August 2024, Ramkuni Gram Panchyath, Kadaba Taluk on 23 August 2024, Bantwal taluk on 02 December 2024, Mohitnagar on 30 August 2024 and Panathady panchayath of Kasaragod on 10 October 2024 and Kayamkulam on 05 September 2024. A total of 6241 coconut and 4250 arecanut saplings were provided to 1208SC farmers selected from Dakshina Kannada district of Karnataka, Kasaragod and Alappuzha district of Kerala and Mohitnagar of West Bengal (Fig. 157).

Fig. 157. Training-cum-seedling distribution at ICAR-CPCRI, Mohitnagar, Dakshina Kannada and Panathady panchayath of Kasaragod

Fig. 158. Glimpses of training the SCSP participants

SC honey entreprenur trained at ICAR-CPCRI take part in three day Kalpa Agri-tech Expo

Sri Ramchandran from Puduyod of Badiadka village of Kasaragod district, a trainee of SCSP of the institute displayed honey and its value added products produced from indian honey bee (*Apis cerana indica)* and stingless bee, beeswax, bee hives and its accessaries for the sales to the farmers and visitors during Kalpa Agri Expo held during 03 January 2025 to 05 January 2025 at ICAR – CPCRI, Kasaragod (Fig. 159 & 160). The trainees are getting regular technical guidance for scientific bee keeping in coconut and arecanut eco-system for effectively branding their honey product in local market and popularizing their products along with providing platform for trainees to share their knowledge on the bee keeping in planation system during exhibitions and trainings. This success story of Sri Ramchandran will inspire the unemployed youths of Scheduled caste communities to take part in the honey bee business mode to improve their livelihood of the communities.

Fig. 159. Dr. Sanjay Kumar Singh, DDG, Horticulture along with Dr. K.B. Hebbar, ICAR – CPCRI, Kasaragod visited the stall

Fig. 160. Sri.Ramachandran, SCSP trainee displayed honey products during Kalpa Agri Expo held at ICAR-CPCRI, Kasaragod

Fig. No. 161. Laboratory and skill training to the SC youth at CPCRI, Regional Station, Vittal

Upskilling of SCSP farmers

A training program on Upskilling and Entrepreneurship Development Programme for Schedule Caste youths was conducted at ICAR Central Plantation Crops Research Institute, Regional Station, Kayamkulam, from 02 January to 1 February 2024 as part of the Scheduled Caste Sub Plan. Participants with entrepreneurship potential were selected from Kandalloor, Oachira, Krishnapuram panchayaths and Kayamkulam municipality.

Empowered about 90 SCSP trainees on the mass production of bioagents used in pest suppression during the one-day upskilling programme held on 20 February 2024. Farm inputs were also distributed to the SCSP farmers as part of technology familiarization and field level adoption.

'Skill Development Program- Nursery worker/ owner' training under SCSP was organized during March 2024 at CPCRI, RS, Vittal, Karnataka. Eight trainees including 6 boys and 2 girls benefitted from the training. They gained expertise in nursery raising of plantation crops and spices.

Another training on preparation of biocontrol agents was organized from 1 -31 March 2024 at ICAR-CPCRI, RS,

Vittal under SCSP scheme. Local unemployed rural women from the SC/ST community have participated.

Valedictory programme of skill development training programme under SCSP/TSP

The valedictory function of skill development training programme under SCSP/TSP was organized on 26 March 2024 at ICAR – CPCRI, Kasaragod. The training was conducted during 01 August 2023 to 31 March 2024 for the benefit of 19 Scheduled Caste and Scheduled Tribe community's youths to upgrade their skills and expertise in scientific cultivation of coconut and entrepreneurship development. Certificates were distributed by Director, ICAR – CPCRI, Kasaragod, to the participants (Fig. 162).

Fig. 162. Dr. K.B. Hebbar, Director delivering certificates to successful trainees

Fig. 163. SCSP skill trainees with experts at ICAR – CPCRI Kasaragod

Programmes under SCSP and TSP at RC, Mohitnagar

One hundred numbers of coconut seedlings were distributed to 50 beneficiaries belonging to scheduled caste community on 11 January 2024 at Daspara, Jalpaiguri.

Knapsack sprayers (25 numbers) were distributed to 25 beneficiaries belonging to Scheduled caste community on 11 March 2024 at RC, Mohitnagar.

Piglets were distributed to 60 beneficiaries belonging to the tribal community on 12 March 2024 at Nathuahat, Jalpaiguri.

Apiary skill training under SCSP activity

Skill training on Apiary was imparted to eleven SC beneficiaries belonging to Badiadka and Muliyar Panchayats at KVK Kasaragod. A total of 52 units of bee boxes with colonies (including 27 units of melliponiculture units) and tool kits were distributed.

Exposure visits and off campus training were imparted subsequently to equip the trainees on handling of colonies and their maintenance. After 2 months around 3-4 Kgs of honey is extracted from ideally maintained colonies. Also, the beneficiaries have further started dividing the colonies for upscaling the same.

Fig. 164. Dr. K.B. Hebbar, Director distributing lambs to SCSP beneficiaries

Community Development Programme under Scheduled Tribe Sub Plan organized by ICAR-CPCRI, Regional Station, Kayamkulam

Under the Tribal Sub Plan (TSP) scheme of ICAR-CPCRI, Regional Station, Kayamkulam, three tribal settlements—Pottamavu in Thiruvananthapuram district and Kocharippa and Idappana in Kollam district—were selected for a Community Development Programme (Fig. 165-168). The initiative began with a comprehensive transect walk through these villages to assess local resources and identify challenges faced by the farming community. These settlements collectively house around 250 families. Based on the insights gathered about the

challenges faced by farmers, as well as their crop preferences and suitability, a comprehensive development program was designed. This program includes training, demonstrations, and the provision of essential inputs to improve livelihood security. Training sessions covered scientific cultivation techniques for crops such as coconut, arecanut, tuber crops, spices, and mushrooms, as well as arecanut nursery management. The program witnessed enthusiastic participation from farmers, women, and youth, who displayed a strong interest in adopting advanced agricultural practices. Farmers were provided with planting materials, including coconut and arecanut seedlings, clove and nutmeg clones, black pepper cuttings, turmeric rhizomes, vegetable seeds, grow bags, and poultry chicks. Additionally, essential farm tools, such as spades, were distributed. Beneficiaries are maintaining these resources using scientific methods learned during training. Once these crops mature and begin yielding, they are expected to provide a sustainable source of additional income, significantly improving the livelihoods of the community.

SCSP activities conducted by ICAR-CPCRI, Regional Station, Kayamkulam

Sl. No.	Programme	Target group	No. of beneficiaries
1	Transect walk at Pottamavu, Edappana and Kocharippa tribal settlements to plan developmental programs	Farmers, youth and women	50
2	Training on 'Mushroom cultivation' at Pottamavu	Tribal women and youth	25
3	Training on 'Cultivation practices of tuber crops' at Pottamavu	Tribal farmers	40
4	Field visits at Pottamavu	Tribal farmers	30
5	Field visits at Pottamavu and Idappana	Tribal farmers	30
6	Training on the cultivation practices of spice crops at Pottamavu	Tribal farmers	200
7	Distribution of 200 nutmeg grafts and 1250 black pepper rooted cuttings at Pottamavu and Idappana	Tribal farmers	200
8	Training on 'Arecanut nursery management' at Kocharippa	Tribal youth	20
9	Establishment of arecanut nurseries by sowing 10000 seed nuts at Kocharippa, and Pottamavu	Tribal youth	20
10	Training on 'Scientific coconut cultivation' at Pottamavu	Tribal farmers	100
11	Distribution of 300 coconut seedlings and 500 poultry chicks at Kocharippa, Edappana, and Pottamavu	Tribal farmers	100
12	Training-cum-farmer scientist interaction at Kocharippa and Pottamavu tribal settlements	Tribal farmers	250
13	Distribution of 500 clove seedlings and farm tools like spade at Kocharippa, Idappana and Pottamavu	Tribal farmers	100
14	Training on scientific coconut cultivation at Kocharippa	Tribal farmers	250
15	Distribution of 2500 Kg turmeric planting materials in Kocharippa, Idappana and Pottamavu settlements	Tribal farmers	250

Fig. 165. Distribution of coconut seedlings

Fig. 167. Farmer Scientist interaction

Fig. 166. Training on mushroom cultivation

Fig. 168. Transect walk

SCSP programme at Kollam

Identified 150 beneficiaries belonging to Scheduled Caste were provided improved breeds of poultry birds (10 each), fruit plants (mango, jack, and sapota grafts, and curry leaf and bush pepper plants) and vegetable seed kit (comprising of six types of vegetable seeds, bio pesticide Nanma, yellow sticky trap, and micronutrient mix sampoorna) under the Scheduled Caste Sub Plan (SCSP) Programme of the KVK in a function organized at Bharanikkavu panchayat community hall on 05 March 2024. About 100 farmers participated in the programme and availed the benefits. The interventions are intended to enhance the nutritional security of the scheduled caste families in the area.

Livelihood enhancement of SC communities through backyard poultry

ICAR-KVK, Kasaragod initiated a programme under SCSP scheme for the Livelihood enhancement of SC communities through backyard poultry. Ninety six-layer chick breed "Gramasree" were distributed to 19 SC families in Badiadka Panchayat of Kasaragod on 5 February 2024. Along with distribution, a technical training was organised on scientific rearing of layer chicks by veterinary surgeon, Badiadka.

Training on arecanut cultivation for farmers of West Bengal under SCSP

Training cum planting material distribution programme on 'Scientific cultivation of arecanut for better growth and yield under SCSP was conducted on 5 July 2024 at ICAR CPCRI, Research Centre, Mohitnagar, West Bengal. A total of 60 farmers belongs to Scheduled Caste community of different block ofJalpaiguri districts participated in this programme. After the training programme, arecanut seedlings weredistributed to farmers by Dr. K.B. Hebbar, Director.

A total of 4200 arecanut seedlings and 210 coconut seedlings were distributed at ICAR-CPCRI, RC, Mohitnagar to 210 farmers belonging to SC community. Another 1000 arecanut seedlings and 50 coconut seedlings were distributed to 50 ST farmers. A training on 'Scientific arecanut

cultivation' was conducted as off campus training at Dhupguri block for farmers of the SC community on 30 August 2024. A total of 150 farmers attended the training programme.

Fig. 169. MGR-Coconut seedling distribution under SCSP

Training on scientific arecanut cultivation at Lower Dibang Valley, Arunachal Pradesh

A one day training cum demonstration and distribution of arecanut seedling was conducted at Balek Village under the NEH programme on 01 July 2024 organized by ICAR – CPCRI, Kasaragod, Kerala in collaboration with KVK, Balek and Department of Agriculture, Assam.

The farmers were trained and demonstrated on scientific cultivation practices of Arecanut by Dr. L.S. Singh (Scientist ICAR – CPCRI) Kahikuchi, Guwahati, Assam. 5000 Arecanut seedling were distributed to 75 farmers from various villages of the district who participated in the programme. ZPC Tony Borang, DHO Kuru Ama, Director Dr. K.B. Hebbar, Principal Scientist Dr. C. Thamban, Dr. K. Samsudeen, Principal Scientists (ICAR-CPCRI) and Senior Scientist and Head (KVK, Balek) Dr. Deepanjali Deori was were present during the programme (Fig. 170).

Fig. 170. Dr. K.B. Hebbar Director, ICAR-CPCRI Kasaragod distributing arecanut seedlings to farmers

State level workshop cum training on Scientific Arecanut Cultivation Technologies

A state-level workshop on "Scientific Areca Nut Cultivation Technologies" was held at the College of Agriculture, Pasighat, funded by ICAR-CPCRI, Kasaragod, Kerala, under the Tribal Sub Plan (TSP). The program, benefited 100 farmers from districts like East Siang, Siang, Upper Siang, and Lower Siang, who were trained in modern Arecanut cultivation and provided 20,000 saplings.

MLA Oken Tayeng, the Chief Guest, appreciated the initiative to empower farmers and improve their livelihoods. Dean Dr. B.N. Hazarika urged farmers to adopt multi-cropping with Arecanut alongside black pepper, cocoa, and banana to boost income. Experts, including Dr. Hebbar K.B., Dr. Samsudeen K., Dr. Thambam, C., Dr. A.K. Tripathi, Dr. Anok Uchoi, and Dr. Senpon Ngomle shared insights and encouraged farmers to leverage the training for sustainable agriculture.

Celebration of World Bee Day

Under the SCSP programme of KVK around 11 farmers/ youths have been trained in Apiculture and provided with bee boxes with colonies and tool kits. With this successful intervention they have been able to reap the first harvest of honey. Commemorating the day the potential beekeepers were given a platform to sell the first harvest of honey at KVK. Shri Vishwanath of Karadka village sold around 11 Kgs of Honey. An awareness programme was organized on marking the day highlighting the theme "Bee engaged with youth". Vegetable kits and seedlings of papaya and drumstick was provided to foster diverse agricultural systems like vegetable cultivation with reliance to organic farming practices to facilitate increased pollination (Fig. 171). Significance of bees for improving food quality and quantity to benefit both human population and ecosystem was focus of World Bee Day.

Fig. 171. Distribution of seedlings and vegetable seed kits to KVK beneficiaries

XX

Swachh Bharat Abhiyan

Swachhata Hi Sewa

Kasaragod

The Swachhata Hi Seva 2024 cleanliness campaign with the theme of 'Swabhav Swachhata Sanskar Swachhata (Cleanliness of nature-Cleanliness of culture)', was launched at the ICAR-CPCRI on 17 September 2024 to 02 October 2024 by Shri. Rajmohan Unnithan, the Honourable Member of Parliament, Kasaragod. He highlighted the importance of swachhata initiative. Shri N.A. Nellikunnu, Hon'ble MLA, Kasaragod, emphasized the need to honour the sanitaryworkers and the need to initiate cleanliness at household level under Safai mitra Suraksha programme. A talk on effective waste management at household level was delivered on the occasion by Mr. H. Krishna, Coordinator, Malinya Mukta Nava Keralam Campaign, Suchithwa Mission, Kasaragod. The sanitary workers of the institute were honoured by thechief guest. Earlier Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI administered the swachhata pledge to all the staff members. Different programmes viz., awareness class on"Effective waste management at household level', Ek ped maa ke naam' plantation drives, swachhata run, swachhata samvad on "Role of agricultural input dealers in SHG campaign", swachhata ki pathshaala, mega cleanliness drives at Bekal and CPCRI Beach (Fig. 168), swachhatalakshit ekayi (cleanliness drives at offices & institutional buildings, religious places), time bound transformation of difficult & dirty spots (black spots) generally neglected garbage points, safai mitra suraksha shivirs (honouring, health check up and talk on social welfare linkages etc. were organized (Fig. 166).

Dr. K.B. Hebbar, Director, felicitated sanitation workers of Haritha Karma Sena, Suchithwa Mission, Mogral Puthur Panchayat, Kasaragod. On the occasion, the 40 sanitation workers of the institute were distributed with umbrellas. The fund raised by the staff for the medical treatment of wife one of the sanitation workers, Mr Sivadasan was handed over.

A new bio-waste management (composting) unit at Hill Block was also inaugurated. At the end, as part of shramadan, the two black spots identified were cleaned by all the staff of the institute (Fig. 167).

Suchitwa Mission has declared the Institute as a green institute with and awarded with an 'A' grade Green Protocol Certificate. Shri Inbasekar K., IAS, District Collector handed over the certificate to the Dr. K.B. Hebbar, Director, ICAR-CPCRI on the occasion of Swachhata Diwas (Fig. 169-170).

Kidu

The Swachhata Hi Seva 2024 campaign at ICAR-CPCRI, RC, Kidu was inaugurated by Dr. K.B. Hebbar, Director of ICAR-CPCRI, Kasaragod on 18 September 2024. Three Safai Karmi workers from Bilinele grama panchayat were identified and honoured with Safai Mitra Samman. About 50 students from five schools and all the staff members of RC Kidu participated in swachhata programmes and competitions including poster making (on theme Ek Ped Maa ke Naam), quiz, singing and essay writing on the key aspects of Swachhata Hi Seva programme.

Kayamkulam

Swachhta Hi Sewa 2024 campaign of ICAR-CPCRI, Regional Station, Kayamkulam commenced on 17 September 2024 with Swachhta Pledge administered by Dr. Regi J. Thomas, Head. 'Swachhata Samvad' on 'role of agricultural input

dealers in SHS campaign', 'Ek Ped Maa Ke Naam' programme, essay competition for school students, Swachhta run, 'Waste to art' competition and cleaning of the campus were part of the Swachhta Hi Sewa 2024 campaign.

Mohitnagar

At Research Centre, Mohitnagar, Swachhta Pledge was taken by all the staff. Other activities included office cleaning, locality cleaning, skit, extempore speech and drawing competition for school children. A total of 60 forest trees have been planted within the campus under the programme 'Ek ped maa ke naam'.

KVK Alappuzha

'Swachhta Hi Seva' campaign was organised by the KVK, Alappuzha from 15 September to 2 October, 2024. Awareness programs on cleanliness and the relevance of hygienic circumstances for a healthy life were organised for farmers, farm women, rural youth, and students in the campus and off-campus mode in the NICRA village and other operational areas.

Swachhatha Pakhwada

Vittal

Swachhatha Pakhwada was celebrated in the RS, Vittal from 16 to 31 December with various activities including Kisan Diwas celebrations, farmers training, cleaning drive, planting of tree saplings in the farm etc.

'Swachhta Pakhwada' was organised by the KVK from 16 to 31 December 2024.

Fig. 172. Felicitation of Sanitation workers of ICAR-CPCRI, Kasaragod

Fig. 173. Inauguration of composting Collection of compost from the composting yard

Fig. 174. Mega cleanliness activities at Bekal and CPCRI Beach

Fig. 175. Handing over 'A' grade Green Protocol Unit: certificate award by Shri Inbasekar K., IAS, District Collector, Kasaragod

Fig. 176. Swachhata Hi Seva Celebration at Kasaragod

Fig. 177. Swachhatha Pakhwada celebration administering oath to staff at Kasaragod

Fig. 178. Inauguration of the programme by Dr. K.B. Hebbar, Director, ICAR-CPCRI at Kidu

XXI

Women's Cell Activities

A general body meeting of women members held at ICAR-CPCRI Kasaragod on 5 July 2024 for discussing the betterment of working atmosphere at the institute. About 40 members were participated in the meeting.

A quarterly meeting was also conducted in the institute on 25 September 2024 to discuss various women cell activities and feasibility of arranging a Pot Luck lunch, various awareness programmes accordingly. Almost 35 women were present in the meeting.

Women group visit

Two women groups from Jnana Vana Dharmasthala Mandir visited ICAR-CPCRI, Kasaragod on 19 June 2024 and 27 June 2024 with 85 members.

EDP for Farm Women

A Women Entrepreneurship Development Programme was conducted on 21 August 2024, on homemade chocolate making, at ICAR-CPCRI, Kahikuchi.

Three Entrepreneurship Development programs and training on scientific cultivation of inter crops for women SHGs were organized in Devikulangara, Pathiyoor and Arattupuzha panchayats during November and December 2024.

XXII

Other Important Events

National Science Day

As part of the National Science Day 2024, a workshop on the theme: 'Climate Change in Plantation Sector' was conducted at ICAR-CPCRI, Regional Station, Kayamkulam on 28 February 2024.

The workshop was inaugurated by Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI, Kasaragod (Fig. 179 & 180). In his inaugural address, he highlighted the way in which innovative thoughts translate into useful technologies for the betterment of humanity. He described the role of science, technology and innovation in the progress of the nation .

Fig. 179. Director inaugurating National Science Day programme at Kayamkulam

Fig. 180. A view of the delegates of the National Science Day

International Yoga Day

'International Yoga Day' was celebrated on 21 June 2024 at ICARCPCRI, Regional Station, Vittal. Shri Sajeev K.N., LDC, was the yoga instructor. Dr. M. K. Rajesh, Head of the Station, highlighted that the 'International Yoga Day' was a day dedicated to embracing the timeless practice of yoga, which has transcended borders and united people across the globe. It is a holistic approach to life that promotes harmony between the mind, body, and spirit. A total of 21 staff performed different yoga asanas.

An awareness programme on 'Yogic Food' for Self and Society was conducted at KVK Kasaragod with aim of empowering women through yoga. Basic yoga asanas were demonstrated by the faculty of KVK. Around 25 participants attended the programme (Fig. 181).

World Environmental Day

World Environmental Day was celebrated at ICAR CPCRI, Kasaragod on 5 June 2024 on the theme 'Land restoration, desertification and drought resilience' (Fig. 182 & 183). The programme was organised under the chairmanship of Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI. The Chief Guest Shri Ananth Hegde Ashisara, former chairman of the Western Ghats Task Force, talked about various kinds of ecosystems, including the coastal ecosystem, river valley, wetland, deemed forests and plantations, and tradition, culture, and gestures of gifting tree

Fig. 181. Yoga performance by KVK Staffs

seedlings during important occasions to promote biodiversity conservation.

Shri Prakash Mesta, Marine Ecologist, stressed upon the importance of documentation of traditional forms of agriculture, with more than 4000 years history that can serve as a resource document for the younger generations.

A tree-planting programme was held as a part of the celebration in the main office campus. An MoU on 'Kalpa organic gold-Coconut leaf vermi composting' was signed between Prathik Solanki and ICAR-CPCRI on the occasion.

Painting competition was held school children from Kendriya Vidyalaya No.1, ICAR-CPCRI, Kasargod prizes were distributed by Chief Guest to the winners of the competition.

An awareness programme was conducted under the slogan "Our land, Our future" wherein 350 fruit and forest plant seedlings procured through Social Forestry Department and vegetable seed kits was distributed to 40 farmer participants by ICAR-KVK, Kasaragod.

Fig. 182. Shri Ananth Hegde Ashisara, planting evergreen sapling

Fig. 183. Shri Ananth Hegde Ashisara, former chairman of the Western Ghats Task Force addressing the meeting.

Fig. 184. Fruit tree sapling distribution to women farmers

World Coconut Day 2024

Kasaragod

World Coconut Day was celebrated at ICAR-CPCRI, Kasaragod on 2 September 2024 with the theme "Coconut for a circular economy building: partnership for maximum value." Chief guest Sri P. Prasad, Agriculture Minister, Kerala, emphasized the need for circular agriculture to boost sustainability and praised coconut milk as a superior plant-based milk (Fig. 185). He highlighted the importance of coconut-based secondary agriculture for entrepreneurial growth and called for solutions to

combat pests like the rhinoceros beetle and red palm weevil.

Dr. S.K. Singh, DDG (Hort. Sci.), ICAR, who presided over the function, highlighted the coconut sector's potential for zero waste and continuous employment. Dr. K. Balachandra Hebbar, Director, CPCRI, presented the recent advancements, made by the Institute, including two newly released coconut varieties (Kalpa Suvarna and Kalpa Vajra), pest management technologies, and drone-based innovations. The Director also handover a cheque of Rs. 3,66,000/- collected from the Staff to the Minister Sri P. Prasad for the Kerala CM's Distress Relief Fund for Wayanad.

Successful farmers and entrepreneurs were honoured, and MoUs were signed for technology transfers, including varieties and products. Two products, viz., "Kalpa Bliz – Flavored Coconut Mylk" by ICAR-CPCRI and "Zila," an aerated coconut water by an entrepreneur from Uppala, Kasaragod were launched on the occasion. Publications on coconut farming innovations were also released.

Dr. Rajesh Kannan Megalingam emphasized integrating AI in the coconut sector, and Dr. B. Augustine Jerard highlighted coconut's role in achieving UN Sustainable Development Goals. The event concluded with a stakeholder-scientist interaction session attended by over 400 participants.

Fig. 185. Sri. P. Prasad, Hon'ble Minister for Agriculture inaugurating the function

Fig. 186. Release of coconut milk " Kalpa Bliz"

Fig. 187. Release of publication

Kayamkulam

A farmers' technological conclave on the theme: 'Scientific health management in coconut' was conducted at ICAR-CPCRI, Regional Station, Kayamkulam on 2 September 2024 as part of World Coconut Day (Fig. 188 & 189). More than 50 farmers participated in the seminar. In his presidential address, Dr. Regi J. Thomas, Head,

Fig. 188. Inaugurating the function by Dr. CPR Nair, Former Head of ICAR-CPCRI, RS, Kayamkulam

Fig. 189. Dr. CPR Nair, addressing the delegates

sensitised the participants about various technologies developed at the station and emphasized on the one-health concept for the welfare of the mankind. The seminar was inaugurated by Dr. C.P.R. Nair, Former Head of ICAR-CPCRI, RS, Kayamkulam. Mrs. Sanju Susan Mathew, Project Director, ATMA Alappuzha, was the special guest of the event. Mr. M. Abdulla, CEO of Nata Nutrico, was the special invitee of the programme.

Kahikuchi

Training cum input distribution programme was conducted on 2 September 2024 at ICAR-CPCRI, RC, Kahikuchi, Guwahati to celebrate World Coconut Day. About 40 farmers from Hajo, Rangia, Dhankhanda and Madhukushi Kamrup (Rural) district of Assam participated in the programme. Dr. Alpana Das, Principal Scientist and Scientist In-charge of the Centre, highlighted the importance of coconut cultivation in North East India. The programme involved demonstration of coconut climbing device and distribution of coconut climbing machine to participating farmers.

Fig. 190. Distribution of coconut climbing device to farmers

Fig. 191. Dr. Alpana Das, Principal Scientist delivering speech on World Coconut Day

Fig. 192. Demonstration of coconut climbing device

Mohitnagar

A training on 'Coconut cultivation for tribal farmers' was conducted on 2 September 2024 at Jalpaiguri block as off farm training programme. A total of 50 farmers attended the programme.

Independence Day

Independence Day was celebrated at ICAR-CPCRI Kasaragod and its subordinate offices on 15 August 2024 (Fig. 193).

Fig. 193. Flag hoisting by Director at ICAR-CPCRI Kasaragod

World Soil Day

ICAR-CPCRI, Kasaragod, celebrated *World Soil Day* 2024 with the theme "Caring for Soils: Measure, Monitor, and Manage" on 5 December 2024 (Fig. 194). Dr. K. Balachandra Hebbar, Director, ICAR-CPCRI, presided over the program and highlighted the importance of soil health and its sustainable management in his opening remarks. The chief guest of the function, Dr. Anil Kumar K.S., former principal scientist, ICAR-NBSS & LUP, Bangalore, gave a thoughtful presentation on the geographical landscape of India, the area under cultivation, and water availability for agriculture. His words provided valuable insights to both farmers and students. Dr. Anil Kumar handed over soil health cards to 12 farmers.

About 30 persons, including officials, farmers from Kerala, Karnataka, and Tamil Nadu participated in the program.

A drawing competition on the theme of Soil Day was conducted for the students of KV 1 and the staff of CPCRI, and prizes were distributed to the winners of the competition.

World Soil Day was also celebrated with farmers on 5 December, 2024, in collaboration with the Department of Agriculture at the Kanjikuzhy Panchayat Community Hall. Soil health cards were distributed to 25 farmers. Around 90 farmers participated.

Fig. 194. World Soil day Celebrated in Kasaragod

World Microbiome Day

World Microbiome Day 2024 on the theme : "Feed Your Microbes: How Diet Shapes Your Gut Microbiome" was celebrated at ICAR-CPCRI on 27 June 2024, with an expert talk titled "Feed Your Gut Microbes Right and Be Healthy," delivered by Prof. Yogesh Shreepad Shouche, Deputy Director, SKAN-RT, Bengaluru. The talk was attended by 27 participants in person, and around 100 people joined online. The participants represented 18 ICAR Institutes and SAUs.

XXIII

Budget and Expenditure

The Budget and Expenditure for the period from April 1, 2024 to March 31, 2025

(Rs. in lakh)

Head	Budget	Expenditure
Recuring		
Salary	3214.23	3214.23
Pension	4498.35	4498.35
Total (A)	**7712.58**	**7712.58**
Non- Recuring		
ONEH General	1050.00	1050.00
ONEH Capital	142.00	142.00
NEH General	200.00	200.00
NEH Capital	25.00	25.00
SCSP	110.00	110.00
TSP	35.00	35.00
Total (B)	**1562.00**	**1562.00**
Grand Total (A+B)	**9274.58**	**9274.58**

XXIV

Weather Data - 2024

Headquarters, Kasaragod

Month	Temp.		RH (%)		Wind velocity (km/h)	Sunshine (h/day)	Evaporation (mm)	Rainfall (mm)	Rainy days
	Max (°C)	Min (°C)	FN	AN					
January	31.79	22.77	83.71	61.96	0.20	10	3.8	27.2	7
February	33.76	23.28	82.25	59.39	0.14	10.1	4.0	0	0
March	33.68	24.94	86.94	64.89	0.21	9.7	3.8	0.2	1
April	34.50	26.43	80.61	62.50	0.19	8.3	3.6	13.2	2
May	32.87	25.74	86.68	69.21	0.21	7	3.5	348.6	14
June	29.77	24.17	89.68	68.33	0.22	5.4	3.2	862.8	28
July	29.57	24.91	89.29	85.65	0.37	0.14	2.15	1099.3	28
August	30.37	24.48	88.16	82.16	0.36	2.95	4.36	552.63	26
September	30.65	24.1	88.16	81.6	0.22	3.62	3.30	440.6	22
October	31.74	24.27	83.77	74.10	0.32	5.08	3.46	152.2	10
November	33.25	23.39	79.8	65.33	0.27	7.29	3.51	159.3	6
December	33.09	22.75	84.19	62.94	-	5.98	3.01	183	4

Regional Station, Vittal

Month	Temp.		RH (%)		Wind velocity (km/h)	Sunshine (h/day)	Evaporation (mm)	Rainfall (mm)	Rainy days
	Max (°C)	Min (°C)	FN	AN					
January	34.10	19.20	92.00	50.00	2.20	6.4	2.7	34.00	2
February	35.15	21.83	91.29	47.11	1.86	8.29	3.32	0.00	0
March	37.35	24.81	91.90	49.04	2.44	7.03	4.30	0.00	0
April	37.67	25.13	91.72	48.54	2.55	4.78	5.21	0.00	0
May	36.52	24.86	89.42	64.09	2.23	2.70	4.39	248.4	6
June	30.07	21.28	92.87	75.93	2.92	1.49	3.02	751.6	23
July	28.44	22.15	91.42	86.39	2.22	0.90	4.38	1545.7	28
August	30.56	21.89	91.58	78.45	1.98	2.67	4.65	634.2	20
September	30.97	21.72	90.52	73.46	2.29	1.96	2.87	287.8	12
October	32.65	21.55	91.06	69.14	1.50	2.67	2.64	239.1	12
November	34.10	20.67	92.73	66.97	1.36	5.82	2.37	186.4	6
December	33.50	20.40	95.79	57.02	1.70	5.12	4.02	116.6	3

Regional Station, Kayamkulam

Month	Temp.		RH (%)		Wind velocity (km/h)	Sunshine (h/day)	Evaporation (mm)	Rainfall (mm)	Rainy days
	Max (°C)	Min (°C)	FN	AN					
January	36.8	32.6	77.4	66.1	0.91	7.0	3.9	50.2	2
February	35.6	23.3	92.7	55.6	0.04	9.6	4.3	0.0	0
March	36.1	24.6	93.4	58.2	0.1	9.1	4.3	5.9	1
April	36.2	24.6	95.1	63.3	1.27	9.2	3.8	129.0	9
May	35.9	26.2	98.9	67.4	0.89	7.8	3.5	652.5	19
June	33.5	25.7	96.2	67.1	0.86	8.4	3.7	372.4	21
July	32.1	24.7	95.8	66.4	1.19	8.0	3.6	393.7	19
August	34.3	24.6	94.5	67.2	1.2	8.4	4.0	163.3	14
September	35.3	24.7	93.0	65.7	1.46	7.9	3.8	206.7	19
October	35.6	24.6	94.1	72.5	1.41	7.7	3.8	268.9	13
November	36	24.6	96.6	66.9	1.06	9.0	4.0	174.8	13
December	37.8	25.0	96.3	72.3	1.14	9.5	4.4	77.0	4

Research Centre, Kidu

Month	Temp.		RH (%)		Wind velocity (km/h)	Sunshine (h/day)	Evaporation (mm)	Rainfall (mm)	Rainy days
	Max (°C)	Min (°C)	FN	AN					
January	35.16	19.00	82.65	57.42	0.02	5.82	1.91	37.60	4
February	37.74	24.10	76.82	40.78	0.05	9.14	2.50	0.00	0
March	39.64	28.20	73.96	42.93	0.47	7.56	3.14	16.00	1
April	40.45	31.37	72.33	45.57	0.51	7.99	3.37	33.00	4
May	39.5	30.14	84.12	65.12	0.22	4.42	1.99	444.0	21
June	35.8	25.42	92	85.13	0.14	1.64	1.12	693.1	28
July	28.62	24.1	98.8	93.45	0.18	0.39	1.06	1495.2	31
August	31.5	24.8	95.51	84.58	0.07	1.48	1.15	8.34	30
September	34.1	26.2	94.23	82.27	0.1	1.61	1.41	593.3	28
October	34.5	29.8	94.78	80.19	0.11	1.64	1.43	364.4	23
November	36.1	30.6	92.23	80.37	0.05	6.65	1.59	68.5	4
December	33.67	21.1	89.84	63.49	0.09	7.14	1.67	107.4	8

राजभाषा कार्यान्वयन रिपोर्ट 2024

हिंदी पखवाड़ा समारोह

कासरगोड

भा.कृ.अ.प.-के.रो.फ.अ.सं., कासरगोड में निदेशक डॉ. के. बालचंद्र हेब्बार की अध्यक्षता में 12 सितंबर 2024 को हिंदी पखवाड़े का उद्घाटन किया गया। निदेशक ने कर्मचारियों को राजभाषा दिशा-निर्देशों के अनुसार हिंदी का प्रयोग बढ़ाने के लिए आधुनिक डिजिटल तकनीकों का उपयोग करने के लिए आमंत्रित किया। मुख्य अतिथि डॉ. वी. मुरलीधर नाइक, पूर्व विभागाध्यक्ष, यूनिवर्सिटी कॉलेज, मंगलूरु ने एकीकृत भाषा के रूप में हिंदी की भूमिका पर जोर दिया।

वैज्ञानिक डॉ. शमीना बेगम ने सकारात्मक सोच पर ध्यान केंद्रित करते हुए व्यक्तित्व विकास पर बात की। राजभाषा के प्रयोग को बढ़ावा देने के लिए विभिन्न गतिविधियों जैसे चित्र देखें और नाम लिखें, शब्द निर्माण, हिंदी कविता पाठ, स्मरण परीक्षण, मौके पर बोलें, अंताक्षरी, अनुवाद, हिंदी टाइपिंग आदि का आयोजन किया गया। प्रतियोगिता में लगभग 30 लोगों ने भाग लिया। 27 सितंबर 2024 को समापन समारोह में मुख्य अतिथि श्रीमती शैलजा ताइकांडी ने कर्मचारियों के हिंदी प्रयोग की प्रशंसा की।

चित्र.195 यूनिवर्सिटी कॉलेज, मंगलूरु के पूर्व विभागाध्यक्ष डॉ. वी. मुरलीधर नाइक को स्मृति चिन्ह भेंट करते हुए

चित्र.196 समापन समारोह में मुख्य अतिथि डॉ. शैलजा थायकंडी संबोधित करती हुईं

कायंकुलम

भा.कृ.अ.प.-के.रो.फ.अ.सं., क्षेत्रीय स्टेशन कायंकुलम में 17 से 24 सितंबर 2024 तक हिंदी सप्ताह मनाया गया। कर्मचारियों के लिए हिंदी गीत, हिंदी श्रुतलेख, हिंदी अनुवाद, स्मृति परीक्षण, कविता पाठ और सरकारी संचार में अधिकतम हिंदी शब्दों का प्रयोग जैसी विभिन्न प्रतियोगिताएं आयोजित की गईं तथा कुशल सहायक कर्मचारियों के लिए नामकरण चित्र और हिंदी हस्तलेख प्रतियोगिता आयोजित की गई। हिंदी सप्ताह का समापन समारोह 26 सितंबर 2024 को डॉ. अब्दुल हारिस की अध्यक्षता में आयोजित किया गया। डॉ. पूर्णिमा आर, एसोसिएट प्रोफेसर, एस.डी. कॉलेज, अलपुझा मुख्य अतिथि थीं। उन्होंने हिंदी के प्रयोग के महत्व और हिंदी सप्ताह मनाने की आवश्यकता पर प्रकाश डाला।

किदु

भा.कृ.अ.प.-के.रो.फ.अ.सं., अनुसंधान केंद्र, किदु में हिंदी पखवाड़े का उद्घाटन भा.कृ.अ.प.-के.रो.फ.अ.सं. कासरगोड के निदेशक डॉ. के.बी. हेब्बर ने किया। अपने उद्घाटन भाषण में डॉ. के.बी. हेब्बर ने हिंदी भाषा के महत्व पर प्रकाश डाला और प्रतिभागियों को अपने आधिकारिक संचार में हिंदी को शामिल करने के लिए प्रोत्साहित किया। कार्यक्रम में कर्मचारियों और स्कूली बच्चों के लिए हिंदी प्रतियोगिताओं की एक श्रृंखला आयोजित की गई। पांच स्थानीय स्कूलों के लगभग 48 छात्रों और अनुसंधान केंद्र किडू के कर्मचारियों ने पोस्टर मेकिंग, क्विज़, गायन, भाषण और निबंध लेखन सहित प्रतियोगिताओं में भाग लिया।

चित्र.197 श्री राम अवतार पाराशर (सीएफ और एओ), भा.कृ.अ.प.-के.रो.फ.अ.सं. किडू में प्रतिनिधियों को संबोधित करते हुए

मोहितनगर

मोहितनगर में 14 से 20 सितम्बर 2024 तक हिन्दी सप्ताह मनाया गया।

राजभाषा कार्यान्वयन निरीक्षण

इस वर्ष के दौरान, राजभाषा कार्यान्वयन पर उच्च अधिकारियों द्वारा दो निरीक्षण किए गए। श्री निर्मल कुमार दुबे, उप निदेशक (कार्यान्वयन), क्षेत्रीय कार्यान्वयन कार्यालय (दक्षिण-पश्चिम), कोच्चि, गृह मंत्रालय, ने निरीक्षण किया और सुधार के सुझाव दिए। डॉ. एस.के. सिंह, माननीय उप महानिदेशक (बागवानी विज्ञान), भा.कृ.अ.प., नई दिल्ली ने भी 5 जनवरी 2025 को भा.कृ.अ.प.-के.रो.फ.अ.सं., कासरगोड में राजभाषा कार्यान्वयन का प्रगामी प्रयोग से संबंधित निरीक्षण किया।

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

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