

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना
ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW

वार्षिक प्रतिवेदन
ANNUAL REPORT 2017-18



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परियोजना समन्वयकर्ता
डा. एम.जी. नायक

PROJECT COORDINATOR
Dr. M.G. NAYAK



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प्राक्कथन

यह, अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की 34 वीं वार्षिक प्रतिवेदन है। यह प्रतिवेदन में अप्रैल – 2017 से मार्च - 2018 तक का शोध परिणाम और अन्य जानकारी को शामिल किया गया है।

परियोजना के अंतर्गत 14 केंद्र हैं, जैसे, भारत के पूर्वी तट में चार; बापट्ला (आंध्र प्रदेश), भुवनेश्वर (उड़ीसा), झारग्राम (प.बंगाल) और वृद्धाचलम् (तमिल नाडु); पश्चिम तट पर तीन केंद्र और एक उपकेंद्र जैसे, मडकत्तरा (केरळ), पिलिकोड उपकेंद्र (केरळ) तथा वेंगुर्ला केंद्र (महाराष्ट्र); नवसारी (गुजरात); मैदानी भाग में तीन केंद्र, एक चिंतामणि (कर्नाटका), दूसरा जगदलपुर (छत्तीसगड) तीसरा दारीसई (झारखण्ड) में स्थित हैं और इस परियोजना का अनुसंधान कार्यसूची को कार्यान्वयन करते हैं।

इस के अतिरिक्त 3 सहयोगी केंद्रों भी परियोजना के अंतर्गत कार्य कर रहे हैं। अरबावी (कर्नाटका), बारापानी (मेघालया) और गोवा में एक – एक केंद्र हैं।

विभिन्न अनुसंधान परियोजनाएँ, प्रमुख विषयानुसार जैसे जनन द्रव्य संग्रहण एवं फसल सुधार, फसल प्रबंधन और फसल संरक्षण जारी हैं। हर एक केन्द्र द्वारा दी गई परिणामों को संकलित कर यह प्रतिवेदन में प्रस्तुत किया गया है। इस प्रतिवेदन में दो प्रमुख अध्याय हैं, एक है, परियोजना और क्षेत्रीय तौर पर प्राप्त प्रायोगिक उपलब्धियों की तकनीकी जानकारी और दूसरा है इतिहास, कर्मचारियों की विवरा, वित्तीय प्रावधान, मौसम की आँकड़ें, शोध प्रकाशन से संबंधित संस्थानीय जानकारी।



[एम.जी. नायक]

प्रभारी निदेशक एवं परियोजना समन्वयकर्ता

स्थान : पुत्तूर

दिनांक : 31.07.2018

ABOUT THIS REPORT

This is the thirty fourth Annual Report of the All India Coordinated Research Project on Cashew. This report covers the research results and other information pertaining to the period from April 2017 to March 2018.

There are total fourteen centres i.e., four in the East Coast of India, namely, Bapatla (Andhra Pradesh); Bhubaneswar (Odisha); Jhargram (West Bengal) and Vridhachalam (Tamil Nadu), four centres in the West Coast, namely, Madakkathara (Kerala) and Pilicode (Kerala) (Sub centre); Vengurla (Maharashtra), Navsari (Gujarat) and one each in Plains Region, namely, Hogalagere (Karnataka), Jagdalpur (Chhattisgarh) and Darisai (Jharkhand) which are implementing the research programmes. Besides, three cooperating centres are also functioning under AICRP-Cashew one each in Arabhavi (Karnataka), Barapani (Meghalaya) and Goa.

There are various ongoing research projects under major theme areas such as Germplasm Conservation and Crop Improvement, Crop Management and Crop Protection. The results reported by each centre are compiled region-wise and theme-wise and presented in this report. This report consists of two major chapters i.e., Technical consisting of project wise and region wise experimental results from different centres and Organisation consisting of history, staff, budgetary provisions, functioning, meteorological data and research publications.



[M.G. NAYAK]

Puttur

Date : 31.07.2018

ACTING DIRECTOR & PROJECT COORDINATOR

CHAPTER 1 : TECHNICAL

परियोजना समन्वयकर्ता की रिपोर्ट

वर्तमान में काजू के अखिल भारतीय समन्वित अनुसंधान परियोजना के चौदह केंद्र हैं, जो देश के बारह काजू उगानेवाले विभिन्न राज्यों में स्थित हैं। इन सभी केंद्रों पर विभिन्न राज्य कृषि विश्वविद्यालयों और आयसीएआर के संस्थानों का प्रशासनीक नियंत्रण होता है। परियोजना का वर्ष 2017-18 का मूल बजट आबंटन रु. 407.57 लाख (भा.कृ.अ.प. का शेयर) था और कुल व्यय रु. 355.18 लाख (भा.कृ.अ.प. का शेयर) था।

निम्नलिखित विधियों से काजू की उत्पाद और उत्पादन क्षमता बढ़ाना इस परियोजना का लक्ष्य है:

1. उच्च उत्पादन के साथ रोग एवं कीट सहन/ निरोधी, अच्छे गिरी गुणवत्ता वाले और जैविक और अजैविक तनाव को सहने वाले किस्मों का विकास।
2. विभिन्न कृषि – मौसमी परिस्थितियों में काजू फसल के लिए कृषि प्रौद्योगिकी का मानकीकरण।
3. लागत प्रभावी, दक्ष पीडक एवं रोग प्रबंधन विधियों का विकास।

इन लक्ष्यों को पुरा करने के लिए प्रारंभित विविध परियोजनाओं से प्रतिवेदन अवधि में प्राप्त मुख्य परिणामों को विविध विभागों में प्रस्तुत किया गया है।

फसल सुधार

इस वर्ष के दौरान, परियोजना समन्वयकर्ता ने झारग्राम, होगलगेरे, वेंगुर्ला, गोवा, भुवनेश्वर, दारिसाई केन्द्रों को अनुसंधान कार्यक्रम पर चर्चा करने के लिए भेंट किया। पश्चिम बंगाल और झारकंड में जननद्रव्य सर्वेक्षण किया गया। झारग्राम से बहुत अच्छे फलने का एक नमूना और झारकंड में सेमिकार्पस अनाकार्डियम का एक नमूना संग्रह किया गया। निश्चित क्षेत्र के लिए लागू होने वाला काजू के नमूनों का अध्ययन करने के लिए सभी AICRP केन्द्रों में काजू का जननद्रव्य संग्रहण और मूल्यांकन जारी है। संकरण कार्य के लिए जरूरी पेरेंट चुनने के लिए उपज के गुणों को रिकार्ड किया जा रहा है। बापट्ला में पाँच, गोवा में तीन और भुवनेश्वर में एक नया किस्म का संग्रह किया गया। तुरा केन्द्र में एक “बारह मासी” नमूना पहचाना गया है। होगलगेरे केन्द्र में 104 किस्मों का रोपण किया गया है। भुवनेश्वर केन्द्र द्वारा 100 किस्मों का चरित्रवर्णन किया गया है। छे CNSL रहित नवीनतम किस्मों का अध्ययन वेंगुर्ला केन्द्र में जारी है।

बहु स्थानीय अध्ययन-III में बहुत सारे उत्कृष्ट संकरों को, जैसे BPP-8 (बापट्ला), H-14, H-32/4 (मडक्करा और वृधाचलम), H-675 (वेंगुर्ले) में पहचाना गया है। बहु स्थानीय अध्ययन, जहाँ विमोचित किस्मों का मूल्यांकन जारी है, मडक्करा-1 होगलगेरे में, BPP-8 दारिसाई में, “सुलभा” मडक्करा में, पिलिकोड में प्रियांका को आशाजनक पाया गया है। अगर संकरण और चयन को देखते हैं, तो बापट्ला में 200 से ज्यादा संकर नमूनों का मूल्यांकन जारी है और अनेक आशाजनक संकरों को पहचाना गया है। C2-6 भुवनेश्वर में पहचाना गया आशाजनक किस्म है। गोवा में 100 से ज्यादा संकरों का मूल्यांकन जारी में है। इस केन्द्र में 9 पेरेंटल कांबिनेशन का प्रयोग करते हुए 194 संकरों को उगाया गया है। पिलिकोड केन्द्र में PLD-57 को पेरेंट के तरह उपयोग करते हुए कुब्ज नमूनों को बनाया गया और उनका प्राथमिक मूल्यांकन जारी है। वेंगुर्ले में कुल 2756 संकरों में से, 58 संकरों का मूल्यांकन किया गया और उन में 18 संकरों को आगे का अध्ययन के लिए चयन किया गया। काजू फलों का चरित्रवर्णन से संबंधित जननद्रव्य संग्रह अध्ययन में 8/7, PLD-3, CARS-8, M103/7 जैसे अनेक किस्मों को आशाजनक पाया गया, जहाँ TSS, एसिडिटी, विटमिन-C गुण शामिल हैं।

फसल प्रबंधन

पोषक प्रबंधन अध्ययन में, होगलगेरे और भुवनेश्वर केन्द्र में, 100 RDF + 10 किलो FYM के

साथ प्रमुख पोषकों (3% Urea + 0.5% ZnSO₄ + 0.1% Boron + 0.3% MgSO₄) और सेकंडरी पोषकों के फोलियार स्प्रे औसत उपज के संबंध में बेहतरीन पाया गया। होगलगेरे, वृधाचलम और वेंगुर्ले केन्द्र में कुम्युलेटिव पान इवापोरेशन के 80 प्रतिशत सींचायी, रिप्रोडक्टिव मानदंडों के संबंध में बहुत अच्छा साबीत हुआ। अंतराल फसल के अध्ययन को अगर देखें तो विभिन्न केंद्रों में प्रयोगों का तिष्कर्ष हुआ है। नए अंतराल फसल जैसे क्रैसैन्तिमम्, चीना एस्टर, मेरिगोल्ड (बापट्ला में) और मिर्च, बैंगन, भेंडी, क्लस्टर बीन वृधाचलम में अध्ययन के लिए चयन किए गए हैं। जैविक काजू खेति का प्रबंधन में, सिफारिश की गई उर्वरक के साथ 10 किलो FYM, बापट्ला, दारिसाई, होगलगेरे, वेंगुर्ले और वृधाचलम में सबसे बेहतरीन फलितांश दिया मगर झारग्राम में FYM द्वारा 100%N देने से उच्चतम उपज मिला। मडकतरा और कनबरगी में FYM से 100% + बायोफर्टिलाइसर कनसोर्टियम आशाजनक फलितांश दिये हैं।

फसल संरक्षण

उक्त समय में भुवनेश्वर, जगदलपुर और मडकतरा में बहुत कम TMB की घटनाएँ दिखे हैं। काजू के फूलने और फलने के अवसर पर शूट टिप केटरपिल्लर, इन्फ्लोरसेन्स त्रिप्स और आपल और नट बोरर कीटों सबसे ज्यादा पाया गया। थियोमिथोक्सांम (0.2g/l), होगलगेरे और कनबरगी में TMB प्रबंधन में प्रभावी रहा। इसके बाद में लेम्बडा सैलोत्रिन का प्रदर्शन अच्छा रहा। मगर वेंगुर्ले में ब्युप्रोफेजिन प्रभावी था। जगदलपुर केन्द्र में लिफ केटरपिल्लर बीवेरिया बासिआना (5g/l) प्रभावी रहा। हर एक कीटनाशक स्प्रे के बाद प्राकृतिक शत्रुओं की जनसंख्या प्रकृति मकड़ियों, कोसिलेनिड्स, चींटियों और ब्राकोनिड में कमी आयी।

कांड और जड छेदक कीट द्वारा की जा रही पेड़ों का विघटनकारी क्षती से अच्छे फसल देनेवाली काजू पेड़ों की संख्या कम हो रही है। तथापि, अलग अलग AICRP केन्द्रों द्वारा लिए गए PEP प्रयोग से देखने में आया कि फिप्रोनिल स्वाबिंग (2ml/L) बापट्ला, होगलगेरे और वेंगुर्ले केन्द्र में प्रभावी रहा। तथापि, क्लोरोपेरीफोस (10ml/L) का इलाज भुवनेश्वर, जगदलपुर और वृधाचलम केन्द्रों में ज्यादा प्रभावी रहा और पीडा कम रहा। मडकतरा में नीम आइल सस्पेंशन @ 50ml/L अच्छा फलितांश दिया।

कीड़ों की पीडा के खिलाफ प्रतिरोध दिखानेवाले पेड़ों को डूंडने के लिए जनन द्रव्य संग्रह का अध्ययन किया जा रहा है। परंतु ऐसे कोई पेड़ दिखने में नहीं आया है जो फोलिएज पेस्ट के खिलाफ प्रतिरोध दिखाए। विभिन्न केन्द्र में यह देखने में आया कि वहाँ की तापमान और नमी, काजू की पेस्ट कॉम्प्लेक्स पर प्रभाव डालते हैं।

प्रौद्योगिकी हस्तांतरण

विभिन्न केन्द्रों में इस साल लगभग 3,95,490 काजू कलमों को बनाया गया और वितरण किया गया। केन्द्रों में कुल 43 प्रशिक्षण कार्यक्रम आयोजन किए गए, जैसे, गुणवत्ता रोपण सामग्री, फसल प्रबंधन, फसल सुरक्षा, काजू उत्पादन तंत्रज्ञान, फसल कटाई उपरांत प्रबंधन, काजू फलों का उपयोग और मौल्यवर्धन। आदिवासी किसानों को भी काजू उत्पादन तंत्रज्ञान और प्रदर्शन आयोजन किया गया। केन्द्र के वैज्ञानिकों ने दूरदर्शन और आकाश वाणी में काजू के बारे में आयोजित कार्यक्रम में भाग लिए और वक्तव्य भी दिए। काजू की खेति के बारे में प्रांतीय भाषा में फोल्डर बनाए गए और उन्हें किसानों को वितरण किए गए।

TSP कार्यक्रम के तहत केन्द्रों ने 13 प्रशिक्षण कार्यक्रम आयोजन किए और उनमें करीब 981 किसान भाग लिए। वर्ष में करीब आठ जागरूकता प्रदर्शन और समावेशों का आयोजन किया गया जिनमें करीब 410 प्रतिभागी उपस्थित थे। विभिन्न केन्द्रों के विज्ञानियों ने 46 हेक्टर में फ्रंटलाइन डेमोन्स्ट्रेशन भी शुरू किए हैं जिस से 103 किसानों को फायदा हुआ।

PROJECT CO-ORDINATOR'S REPORT

The AICRP on Cashew has presently fourteen centres, which are located in 12 cashew-growing states of the country and are under the administrative control of different State Agricultural Universities/ ICAR Institutes. The original budget allocation of the project for the year 2017-18 was Rs. 407.57 lakhs (ICAR Share) and the expenditure was Rs. 355.18 lakhs (ICAR Share).

The mandate of the project is to increase production and productivity of cashew through:

1. Evolving high yielding varieties with good kernel quality and tolerance to biotic and abiotic stresses.
2. Standardizing agro techniques for the crop under different agro-climatic conditions and
3. Evolving cost effective and efficient pest and disease management practices.

The salient findings during the period under report, in different projects are presented here.

CROP IMPROVEMENT :

During the year, the Project Coordinator had visited Bapatla, Bhubaneshwar, Hogalagere, Jhargram, Vengurle, Goa, Paria, Tura, Vridhachalam and Darisai centers for reviewing the on-going research programmes. Germplasm survey in West Bengal and Jharkhand was conducted and could identify and collect one profuse fruiting type in Jhargram and another *Semecarpus anacardium* accession in Jharkhand. Cashew germplasm accessions have been conserved and are being evaluated at all centres of AICRP-Cashew to assess their suitability for specific regions. The yield attributes are recorded to select promising accessions as parents in crossing programmes. At Bapatla centre five new accessions, at Goa three new accessions, and one new accession in Bhubaneshwar center have been collected. Baramasi type (fruiting throughout the year) has been identified at Tura center. At Hogalagere center, 104 accessions have been planted and established. 100 germplasm accessions have been characterized at Bhubaneshwar center. Further, a trial has been laid out with six CNSL free types in Vengurle center.

In Multilocation trial - III, many promising hybrids such as BPP-8 (Bapatla), H-14, H-32/4 at Madakkathara and Vridhachalam, H-675 at Vengurle have been identified. In Multilocation trial - V were released varieties of different centers are under evaluation, Madakkathara-1 at Hogalagere, BPP-8 at Darisai, Sulabha at Madakkathara, Priyanka at Pilicode have been found promising. As far as hybridization and selection is concerned, more than 200 hybrid progenies are under evaluation at Bapatla and many promising hybrids have been identified. C2-6 is a promising hybrid identified in Bhubaneshwar center. More than 100 hybrids are under evaluation in Goa centre. Further 194 hybrids have been produced with nine parental combinations in this centre. At Pilicode centre, dwarf hybrids using PLD-57 as parent are produced and are under preliminary evaluation. At Vengurle centre, out of 2756 hybrid progenies, 58 progenies were evaluated and 18 hybrids have been selected for further evaluation. With respect to characterization of germplasm for apple characters, many accessions such as 8/7, PLD-3, CARS-8, M103/7 have been found promising for apple characteristics such as TSS, acidity and Vitamin C.

CROP MANAGEMENT

In nutrient management experiment, application of 100% RDF+10 Kg FYM along with foliar spray of major nutrients (3% Urea + 0.5% ZnSO₄+0.1% Boron+0.3% Mg SO₄) and secondary nutrients was found to be significantly superior with respect to mean nut yield at Hogalagere and

Bhubaneswar centre. The irrigation treatment of 80% of cumulative pan evaporation found to be better in terms of reproductive parameters at Hogalagere, Vridhachalam and Vengurle centres. As for as intercropping experiment is concerned, the experiment is concluded at different centres of AICRP and new set of intercrops such as Crossandra, Chrysanthemum, China Aster, Marigold have been chosen at Bapatla centre and Chillies, Brinjal, Tomato, Bhendi, Cluster Bean have been selected at Vridhachalam. As for as organic management of cashew is concerned, recommended dose of fertilizer with 10 kg FYM has given best results in Bapatla, Darisai, Hogalagere, Vengurle and Vridhachalam centres. However, in Jhargram centre, 100% N as FYM gave the highest yield. In Madakkathara and Kanabargi centres, 100% N from FYM + Biofertilizer consortium have given promising results.

CROP PROTECTION

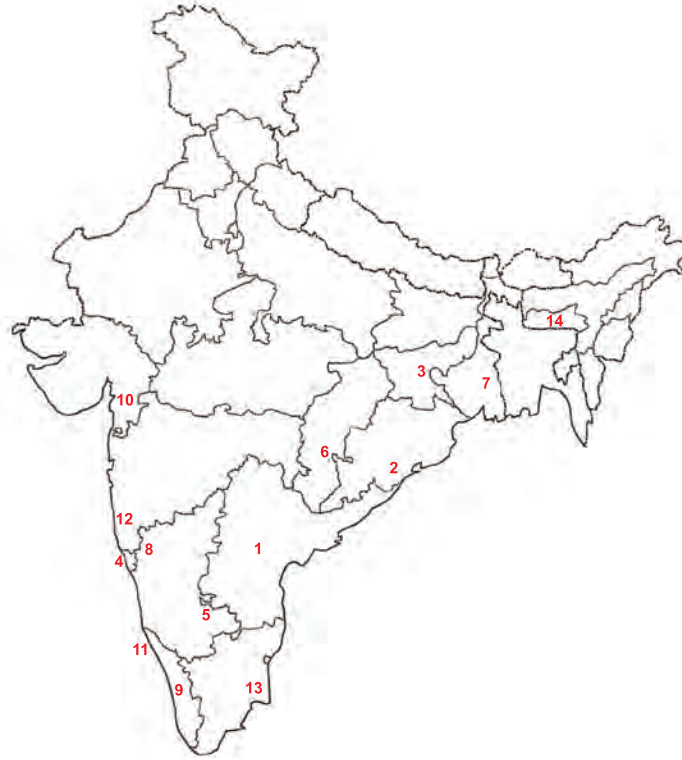
The incidence of TMB during the period under report was very less at Bhubaneswar, Jagdalpur and Madakkathara. Shoot tip caterpillar, Inflorescence thrips and apple and nut borers were the dominant pests observed during flushing, flowering and fruit setting in cashew. Thiomethoxam (0.2 g/l) was effective in managing TMB at Hogalagere and Kanabargi centres. This was followed by Lamda Cyhalothrin. However at Vengurle center, Buprofezin was effective. For leaf caterpillar *Beauveria Bassiana* (5g/l) was effective at Jagadalpur centre. The population trends of various natural enemies in respect of all the insecticides treatment gradually decimated the population of spiders, coccinellids, ants and braconid wasp after each round of insecticidal spray.

The lower tree population in all cashew growing tracts is due to destructive damage of yielding trees by cashew stem and root borers. However, post extraction prophylaxis (PEP) trials taken up by various AICRP-Cashew centres indicated that Fipronil swabbing (2ml/l) was found effective in Bapatla, Hogalagere and Vengurle centres. However Chlorpyrifos (10 ml/litre) could lead to better recovery, lower reinfestation in Bhubaneswar, Jagdalpur and Vridhachalam centres. At Madakkathara centre, neem oil suspension @ 50 ml/l gave better results. Screening of cashew germplasm for level of pest infestation is being done on a regular basis, but till date, none of the cashew accessions were noticed to exhibit pest tolerance to incidence of foliage pests. It is found in different centres that temperature and humidity are the major factors influencing the pest complex in cashew.

TRANSFER OF TECHNOLOGY

Around 395490 cashew grafts have been produced by different centres and distributed during the year. The centres have taken up 43 training programmes viz., quality planting material, crop management, crop protection, cashew production technology, post-harvest management, cashew apple utilization and Value addition and also conducted training and demonstration on cashew production technologies to the tribal farmers. The scientists of the centre have participated and given programmes on cashew in the Doordarshan and All India Radio. Folders on cashew cultivation and TMB control in cashew were prepared in local languages and distributed among the farmers.

Under TSP programme, the centres have conducted 13 training programmes in which about 981 farmers had participated. Around 8 nos. of awareness camps and exhibitions were taken up during the year in which about 410 participants were present. The scientists of the centre have also taken up front line demonstrations in around 46 ha in which 103 farmers were benefitted.

CENTRES OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW**HEADQUARTERS OF AICRP ON CASHEW**

ICAR - Directorate of Cashew Research, Puttur 574 202, Dakshina Kannada, Karnataka

AICRP on Cashew Centres:

1. Cashew Research Station, (Dr. YSRHU), Bapatla-522 101, Guntur District, Andhra Pradesh.
2. Cashew Research Station, (OUAT), Bhubaneswar-751 003, Odisha.
3. Zonal Research Station, (BAU), Darisai-832 304, Barakhursi, East Singhbhum Dist., Jharkhand.
4. ICAR-Central Coastal Agricultural Research Institute, Ela, Old Goa, Goa – 403 402.
5. Horticultural Research Station, (UHS), Hogalagere-563 138, Srinivasapura, Kolar Dist., Karnataka.
6. SG College of Agricultural and Research Station, (IGAU), Jagdalpur-494 005, Chattisgarh.
7. Regional Research Station, (BCKV), Jhargram - 721 507, Midnapore West District, West Bengal.
8. Horticultural Research Station, (UHS), Kanabargi – 590 016, Belagavi Dist., Karnataka.
9. Cashew Research Station, (KAU), Madakkathara - 680 651, Thrissur Dist., Kerala.
10. Agricultural Experimental Station (NAU), Paria-396 145, Valsad District, Gujarat.
11. Regional Agricultural Research Station, (KAU), Pilicode - 671 353, Kasaragod District, Kerala.
12. Regional Fruit Research Station, (Dr. BSKKV), Vengurla - 416 516, Sindhudurg Dist., Maharashtra.
13. Regional Research Station, (TNAU), Vridhachalam-606 001, Cuddalore District, Tamil Nadu.
14. ICAR Research Complex for North Eastern Hilly Regions, Tura-794 005, West Garo Hills Meghalaya.

EXECUTIVE SUMMARY

1. Germplasm survey in West Bengal and Jharkhand could identify and collect one profuse fruiting type in Jhargram and another *Semecarpus anacardium* accession in Jharkhand. A total of 9 new accessions have been collected by the AICRP centers. Baramasi type (fruiting throughout the year) has been located and collected by Tura centre.
2. Many promising hybrids such as BPP-8 (Bapatla), H-14, H-32/4 at Madakkathara and Vridhachalam, H-675 at Vengurle have been identified in multilocation trial-III. In Multilocation trial - V, Madakkathara-1 at Hogalagere, BPP-8 at Darisai, Sulabha at Madakkathara, Priyanka at Pilicode have been found promising. Accessions such as 8/7, PLD-3, CARS-8 M103/7 have been found promising for apple characteristics such as TSS, acidity and Vitamin C.
3. Application of 100% RDF+10 Kg FYM along with foliar spray of major nutrients (3% Urea + 0.5% ZnSO₄+0.1% Boran+0.3% Mg SO₄) and secondary nutrients was found to be significantly superior with respect to mean nut yield at Hogalagere and Bhubaneswar centre.
4. The irrigation treatment of 80% of cumulative pan evaporation found to be better in terms of reproductive parameters at Hogalagere, Vridhachalam and Vengurle centres.
5. With respect to organic management, recommended dose of fertilizer with 10 kg FYM has given best results in Bapatla, Darisai, Hogalagere, Vengurle and Vridhachalam centres. In Madakkathara and Kanabargi centres, 100% N from FYM + Biofertilizer consortium have given promising results.
6. The incidence of TMB was very less in Bhubaneswar, Jagdalpur and Madakkathara. Shoot tip caterpillar, Inflorescence thrips and apple and nut borers were the dominant pests observed during flushing, flowering and fruit setting in cashew. Thiomethoxam (0.2 g/l) was effective in managing TMB at Hogalagere and Kanabargi centres.
7. Post Extraction Prophylaxis (PEP) trials indicated that Fipronil swabbing (2ml/l) was found effective in Bapatla, Hogalagere and Vengurle centres. However Chlorpyrifos (10 ml/litre) could lead to better recovery, lower reinfestation of cashew stem and root borer in Bhubaneswar, Jagdalpur and Vridhachalam centres.
8. The centres have taken up 56 training programmes covering various aspects of cashew cultivation for stakeholders including tribal farmers.

Planting Material Produced :

A total of 395490 grafts were produced during 2017-18 and distributed to several government and non-government organizations as well as to cashew farmers. The centre wise production of cashew grafts is given below :

Centre	No. of grafts produced
Bapatla	50000
Bhubaneswar	20000
Jagdarpur	7000
Jhargram	3000
Madakkathara	103102
Pilicode	20000
Vengurle	155380
Vridhachalam	37008
TOTAL	395490



REPORT OF THE ANNUAL GROUP MEETING OF SCIENTISTS OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW-2017

The Annual Group Meeting (AGM) of Scientists of AICRP on Cashew is being organized at ICAR-Directorate of Cashew Research (DCR), Puttur from 21-12-2017 to 23-12-2017. The Inaugural function of the (AGM) was held on 21.12.2017 at 10.00 AM. Prof. K.V. Peter, Former Vice Chancellor, Kerala Agricultural University, Thrissur and Director, World Noni Research Foundation, Chennai inaugurated the AGM.

Dr. M. G. Nayak, Director (Acting) welcomed the dignitaries, delegates and other participants, followed by lightening the lamp by dignitaries. More than 75 delegates from Coordinating Centres of Cashew, Invitees, ICAR-DCR Staff, Press and Media persons had participated in the meeting. The Project Coordinator's report was presented by Dr. M.G. Nayak, Director (Acting) and highlighted the activities taken up by 14 AICRP Cashew Centers. The centers are maintaining 1710 accessions and 42 high yielding varieties have been released for commercial cultivation. Around 4.45 lakh cashew grafts were produced and supplied to farmers during 2016-17. He emphasized the importance of ultra high density planting system and canopy management in cashew. AICRP centers are also playing major role in transfer of technologies for cashew cultivation. More than 25 trainings were conducted on different aspects of cashew cultivation and also working towards empowering tribal farmers' livelihood.

The inaugural address was delivered by Prof. K.V. Peter and he suggested the scientists to focus more on scientific components in AICRP trails and also highlighted the importance of micro nutrients, water use efficiency, soil micro flora, bio fortification in cashew. He suggested entomologists to develop pheromones to manage two major pests such as CSRB and TMB. The Guest of Honour Dr. M.G. Bhat, Former Director, ICAR-DCR, Puttur, enlightened the importance of AICRP in dissemination of technologies from one state to other state. Efforts should be made to attain self sufficiency in cashew production to meet processing industries demand.

In his presidential speech Dr. P. Chowdappa, Director, ICAR-CPCRI, Kasargod, Kerala suggested the cashew scientists for identifying trait specific rootstocks in cashew especially for dwarfing. He appreciated the DCR for developing ultra density planting and suggested to promote and transfer to farmers' fields. He suggested for genome sequencing in cashew and to develop micro nutrients special, bio control agents to mitigate the problem of TMB and CSRB.

On this occasion three publications such as, 'Report on varietal screening of cashew apple for preparation of RTS and Jam' authored by Dr. Sobhana, A., Dr. Mohana, G.S. and Dr. M.G. Nayak; 'Ultra density planting in cashew' by M.G. Nayak and 'Weeds in Cashew plantations' by Mini Poduval were released by the dignitaries. The programme was also attended by Shri B.K. Ramesh, General Body Member of ICAR, Dr. HP Maheswarappa, Project Coordinator (Palms), Dr. K.S. Anand, Head, CPCRI-Research Station, Vittal. The inaugural function was signed off with a formal Vote of Thanks by Dr. Mohana, G.S. (Senior Scientist) and Scientist-In-charge of PC Cell.

Later the technical session on 'Crop Improvement' was held in the afternoon session. The discussions on Crop Management and Crop Protection was held on 22nd December 2017. An 'Interface of farmers, scientists, processors and officials from development departments' was held on 23rd December 2017 in which more than 100 farmers, Officers from the Horticulture Department of Karnataka State, Director of Research, UAHS, Shimoga, and officials of Karnataka Cashew Development Corporation, Kerala State Agency for Cashew Cultivation, Kollam participated besides the Scientists of AICRP and DCR, Puttur. The Plenary Session of AGM was held before concluding the group meeting.



Lighting of lamp by the dignitaries



Chief Guest Prof. K.V. Peter addressing the gathering



Release of publications by the dignitaries



EXPERIMENTAL RESULTS

I. CROP IMPROVEMENT

I. CROP IMPROVEMENT

Gen 1: Germplasm collection, conservation, evaluation, characterization and cataloguing

Centres: East Coast : Bhubaneshwar, Jhargram and Vridhachalam

West Coast : Goa, Paria, Pilicode and Vengurla

Plains / others : Darisai, Hogalagere, Kanabargi, Jagdalpur and Tura

The objectives of the project are:

- To evaluate the existing germplasm of cashew in different centres
- To collect local germplasm material with desirable characters such as high yield, cluster bearing habit, bold sized nuts, duration of flowering, off season flowering types from different cashew growing regions and,
- To establish clonal germplasm conservation blocks in different centres

During the current year, 16 germplasm accessions have been collected by different centres of AICRP on Cashew and are planted in the respective Regional Cashew Field Gene Banks (RCFGBs). The total number of accessions conserved so far is 1726 (Table 1.1)

Table 1.1 :Cashew germplasm holding in different centres

Centre	No. of accessions		
	Earlier existing	Collected during 2017-18	Existing
East Coast			
Bapatla	97	--	97
Bhubaneshwar	108	1	109
Jhargram	284	--	284
Vridhachalam	208	--	208
West Coast			
Goa	97	--	97
Madakkathara	142	--	142
Pilicode	87	7	94
Vengurla	365	--	365
Plains tract/others			
Barapani	59	3	62
Darisai	22	5	27
Hogalagere	110	--	110
Jagdalpur	72	--	72
Tura	59	--	59
Total	1710	16	1726

BAPATLA

During the year, five new germplasm lines were collected from the Rampa chodavaram area of East Godavari District, Andhra Pradesh. Particulars of the germplasm are mentioned here under.

- 1. Gangavaram-1:** Apples are red in colour, with big size (73 g). TSS is more than 12.5° Brix. The nuts are bold with nut weight of 11.0 g having highest shelling percentage.
- 2. Gangavaram-2:** The nuts are bold and big size having highest shelling percentage. The bark of the tree is very smooth. The bark splitting is absent. High yielding type.
- 3. Gangavaram-3:** The plants are dwarf in nature with intensive branching of habit. High yielding type. Nut weight is 8.55 g. Apple colour yellow with apple size of 50.0 g.
- 4. China Gaddada:** Nuts are bold with nut weight of 12.50 g showing extensive branching type. Apple colour is yellow.
- 5. Usiri Jonnala:** The nut weight is 14.3g. apple weight 60.4g with yellow colour. Plant is showing extensive branching type.

DARISAI

A total of 15 germplasm accessions (DSI 101 – 115) were evaluated. The accessions were planted during 2012, 2013, 2014 and 2015. The cumulative yield (kg/tree) in the 2nd year of harvest varied from 0.37 to 4.90 kgs. These will be further evaluated for their performance.

GOA

During the period, three cashew accessions, two from Batim village and one from Casrvane village of Pernem zone identified earlier were clonally collected by soft wood grafting for further evaluation. Further, during the early fruiting season of March 2018, four more accessions, namely Barsem-1/18, Barsem-2/18, Kushali-1/18 and Kushali-1/18 were identified from Barsem village, for their bold nut and higher yield features. A total of 97 germplasm accessions of cashew representing the following different groups is being maintained at Goa Centre.

- Jumbo nut types : 14 + 3= 17 accessions
- Bold ,, ,, : 40 accessions,
- Medium nut and high yielders : = 13 accessions
- Remaining 23: high yielders/ cluster bearers irrespective of nut size
- Dwarf canopy types : 3 accessions
- Very compact canopy type: 1 accession

HOGALAGERE

Vegetative growth parameters recorded on germplasm accessions revealed that, mean tree height was in the range of 0.78 to 2.6 m, stem girth ranged from 8.56 to 23.7cm and that of canopy area ranged from 0.7 to 22.9 m². Maximum plant height was recorded in HREC-16 (2.63m), maximum stem girth in HREC-20 (23.6cm) and that of the maximum canopy area in HREC-43 (22.8 m²).

Among the yield parameters recorded, nut weight ranged from 3.4 to 7.4 (g), shelling percentage ranged from 16.9 to 36.7 and that of the yield per plant from 22 to 538g (the plants were 2 years and 7 months old). The maximum nut weight was recorded in HREC-14 (7.4g), maximum

JAGDALPUR

Ten accessions collected from DCR, Puttur were planted during the year 1996-97. Among them, the mean annual nut yield/tree was highest in NRC-138 (11.20Kg), followed by NRC-137 (10.20Kg). The cumulative nut yield was highest in NRC-137 (108.85 Kg) with 18 harvests. Mean nut weight was found highest for NRC-138 (8.50 g) followed by NRC-140 and NRC-137. Shelling per cent was found highest in NRC-131 (29.50%).

JHARGRAM

This year due to a devastating hail storm the panicles were badly damaged, therefore the yield of the germplasm accessions was drastically reduced. However, the late varieties produced nuts as usual. The duration of flowering was maximum in JGM - 280 and JGM - 299 and minimum in JGM - 292. The highly cluster bearing types were JGM - 321 (17.5), JGM - 282 (11.5), JGM - 313 (9.3) and JGM - 287 (9.0).

The nut weight of the germplasms varied from 3.3 g to 8.2g, where largest was in JGM-288 and smallest was in JGM-287. Five germplasm accessions namely JGM-288, JGM-289, JGM-290, JGM-291 and JGM-302 had nut weight above 7g. The shelling percentage varied between 20.6% to 34.0%. The yield varied between 2.27 Kg to 10.98 kg/tree. The highest yielder was JGM - 313 followed by JGM - 296, JGM - 310, JGM - 282 and JGM - 289. Cumulative yield record showed that JGM - 282 was the highest yielder (67.89 kg/tree for 8 harvests) followed by JGM - 310 (51.24Kg/tree for 7 harvests).

VENGURLE

At present 313 cashew germplasm accessions are conserved in the gene bank. Since 2004, 1446 F₁ cashew progenies were developed and planted in the plots for further evaluation. During the year 2016-17, 86 hybrid nuts were developed from two cross combinations.

During the year 2016-17 growth observations of 24 types were recorded. Among the 14 types (planted during 2005 to 2011), RFRS 188 recorded the maximum height (7.30 m) while, RFRS 189 had the higher stem girth of 75.00 cm. The minimum flowering duration was observed in RFRS 195 (124 days).

Yield attributing data of 14 cashew germplasm showed that RFRS 188 had the maximum nut weight of 8.40 g. The highest apple weight (65.0 g) was recorded in RFRS 196. The highest shelling percentage (32.00%) was recorded in RFRS 185 and RFRS 186. The maximum annual nut yield (3.5 kg/tree) for the year 2016-17 was found in RFRS 192. Higher cumulative nut yield at 4th harvests (8.45 kg/tree) was observed in RFRS 195.



RFRS 195 (tender shell, kernel and testa)



RFRS -195 (CNSL free type, easy to open tender green shell and having bold tender kernel suitable for vegetable purpose)

Further, it is interesting to note that RFRS 195 was found CNSL free and green tender nut (about 30 days maturity) can easily be opened with bamboo stick. Hence, this tender cashew kernel can be used for vegetable purpose, which has more demand in the market as CNSL free green tender cashew kernel. For initiation of the trial on evaluation of CNSL free types, the scion sticks of five CNSL free types was collected from DCR, Puttur during June, 2017 and grafts were made. The grafts of RFRS 195 (CNSL free type) is also prepared and kept ready for planting. The grafts of all six CNSL free types will be planted in June, 2018. The details of the six CNSL free types are as follows.

Sr. No	Accession No.	IC No.	Original source of collection	work done for initiation of trial
1	NRC 116	249894	ARS, Ullal	The scion sticks of five CNSL free types were collected from DCR, Puttur on 29/6/2017 and grafts are prepared.
2	NRC 188	249966	CPCRI (RS), Vittal	
3	NRC 189	249967	CPCRI (RS), Vittal	
4	NRC 281	250059	RFRS, Vengurle	
5	NRC 285	250063	CRS, Karnataka	
6	RFRS 195	Under evaluation	RFRS, Vengurle (Dodamarg)	Grafts are prepared.

Gen. 3 Varietal Evaluation Trials 1. Multi Location Trial – III

Centres : *East Coast :* Bapatla and Vridhachalam
West Coast : Vengurla
Plains / others : Hogalagere

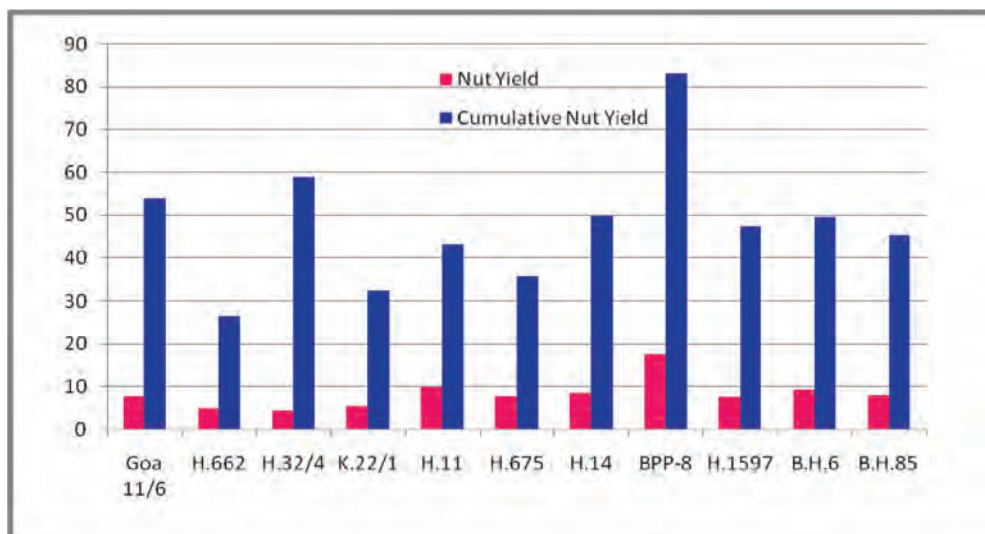
The objectives of the project are to evaluate promising hybrids identified and TMB tolerant accessions obtained from different sponsoring centres for their performance in different agro-ecological conditions.

Experimental Details :

Starting year : 2003, No. of entries : 10 + 1 (Local check)

Sponsoring centre	Promising hybrids	TMB tolerant type
CRS, Bhubaneswar	BH 6, BH 85	–
CRS, Madakkathara	H 1597	K 22-1
RFRS, Vengurla	H 662, H 675	–
RRS, Vridhachalam	–	H 11 & H 14
DCR, Puttur	H 32/4	Goa 11/6
Total	6	4
Replications – Three	Spacing 7.5 x 7.5 m	Plot size - 4 plants per plot

BAPATLA



Yield parameters of cashew genotypes in MLT-III at Bapatla Centre

Among the 11 genotypes evaluated, BPP-8 has recorded highest vegetative growth parameters, maximum canopy height, canopy spread, and canopy surface area in the four consecutive years during 2013-14, 2014-15, 2015-16 and 2016-17. With regard to annual nut yield (17.60kg/tree) and cumulative nut yield (83.06 kg/tree) also its performance is consistent in all the four years for annual harvests.

VENGURLE

No significant variation was observed among the different accessions in respect of growth parameters. Different hybrid/types significantly influenced the flowering, fruiting and yield parameters during the year 2016-17. However, the parameters such as number of laterals/m², number of panicles/m² and sex ratio were found non-significant.

The flowering duration ranged from 88.00 days to 99.67 days. Significantly maximum flowering duration was recorded in H-14 (99.67 days) and is at par with V-7 (94.67 days), BH.6 (94.00 days) and H. 32/4 (93.67 days). It is seen from the data presented in Table 1.2 that Vengurla-7 recorded significantly the maximum nut weight (8.57 g) and is at par with H-662 (8.27 g), BH 6 (8.20 g) and Goa 11/6 (7.47 g) while, significantly the maximum apple weight of 79.83 g was noted in BH-6 and superior over rest of the treatments. Whereas, significant maximum annual nut yield was recorded by H-675 (9.70 kg/tree) and is at par with H-662 (9.38 kg/tree) and both these treatments were significantly superior over rest of the treatments. Cumulative yield for first or initial 5 harvests (28.75 kg/tree) was recorded in H-662.

Table 1.2 : Yield parameters of cashew genotypes in MLT-III at Vengurle centre during the year 2016-17

Accession No.	Nut wt. (g)	Apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree)	Cum. yield (kg/tree) (For 5 th harvests)
BH 6	8.20	79.83	33.33	4.93	17.78
BH 85	6.93	53.33	33.00	8.53	18.41
H 1593	7.30	67.00	33.17	4.99	17.11
K-22-1	7.33	64.67	31.17	3.87	14.36
H. 662	8.27	66.67	29.67	9.38	28.75
H. 675	5.40	51.53	34.00	9.70	21.66
H. 11	6.00	38.67	31.00	5.69	14.92
H. 14	5.50	39.67	31.17	6.36	20.32
H. 32/4	7.00	69.67	25.83	5.07	16.83
Bhaskara	7.47	58.67	32.00	5.69	16.37
V-7	8.57	58.33	31.50	5.49	18.19
Mean	7.02	58.91	31.44	6.33	18.61
SEm±	0.38	3.29	0.42	0.28	-
CD @ 5%	1.12	9.72	1.24	0.81	-
CV %	9.36	9.68	2.31	7.54	-

VRIDHACHALAM

There was significant difference among genotypes for plant height. Maximum height was recorded by genotypes BH 6 followed by H 662. Significant variations were observed among the cashew types for flowering duration (72 to 87), number of panicles/ m² (11.4 to 20.8), mean number of nuts/ m² (16.8 to 30.8) as well as number of nuts/ panicle (3.0 to 6.3). The genotype H14 of Vridhachalam recorded the highest number of panicles/ m², mean number of nuts/ m² and number of nuts/ panicle.

The accessions H 1597, H 22-1, H11, H 14, H32/4, Goa 11/6 and VRI 3 recorded nut weight more than 7.0 g. Significant variation was observed for mean annual nut yield. The accession H14 of Vridhachalam centre recorded highest nut yield and cumulative yield.

Table 1.3 : Yield parameters of cashew genotypes in MLT-III at Vridhachalam Centre during the year 2017

Accession No.	Mean nut wt. (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 5 harvests)
BH 6	6.8	55.2	30.0	3.85	13.86
BH 85	6.7	45.4	29.6	4.56	17.16
H 1597	7.0	50.2	29.2	4.67	16.61
K 22-1	7.0	50.6	28.0	3.80	12.51
H 662	6.4	55.2	30.0	4.60	16.79
H 675	6.9	50.2	30.2	5.20	18.99
H 11	7.0	52.4	29.2	5.10	19.03
H 14	7.0	54.2	29.8	6.20	22.89
H 32/4	7.0	50.2	29.0	4.90	17.98
Goa 11/6	7.2	60.5	29.6	4.20	17.21
VRI3 (Local Check)	7.0	50.2	29.0	4.80	17.96
SEm ±	NS	1.6	NS	0.12	
CD at 5%		3.6		0.50	

2. Performance of Released Varieties (Multi Location Trial – V)

Centres: East Coast : Bapatla, Jhargram and Vridhachalam

West Coast : Paria and Pilicode

Plains / others : Hogalagere and Jagdalpur

The objective of this experiment is to evaluate the performance of released cashew varieties from various centres for their suitability to different agro-climatic regions.

Treatments :

Year of Initiation : 2006
No. of varieties : 25

SI. No.	Varieties	SI. No.	Varieties	SI. No.	Varieties
1	BPP-4	10	Dhana	19	NRCC Sel-2
2	BPP-6	11	Kanaka	20	Ullal-1
3	BPP-8	12	Priyanka	21	Ullal-3
4	Bhubaneswar-1	13	Amrutha	22	Ullal-4
5	Chintamani-1	14	Vengurla-1	23	UN-50
6	Jhargram-1	15	Vengurla-4	24	Goa-1
7	Madakkathara-1	16	Vengurla-6	25	Bhaskara
8	Madakkathara-2	17	Vengurla-7		
9	K-22-1	18	VRI-3		

HOGALAGERE

The growth parameters of varieties during 2016-17 showed tree height ranging from 0.41 to 1.80 m, stem girth varied from 3.5 to 15.7 cm, the maximum plant height and stem girth was noticed in VRI-3 (1.8m and 15.7cm). Among the yield parameters, nut weight 2.9 to 9.0g (max. BPP-4), yield per plant ranged from 54 to 770g (max. Madakkathara-2), apple weight was in the range of 15.8 to 49.6g (max. Amrutha-10) and shelling percentage varied from 17.6 to 36.0% (max. Kanaka).

**Table 1.4 : Yield parameters of cashew genotypes in MLT-V, during 2016-17
(Date of planting 02-01-2015)**

SI. No.	Variety	Flow ering Inten sity/ sq.m.	Fruits/ Panicle (No.s)	Nut weight (g)	Yield /plant (g)	Apple weight (g)	Shelling (%)	TMB tolerance
1	Chintamani-1	9.9	4.1	6.8	440	19.9	31.5	High
2	Madakkathara-1	8.5	3.3	6.1	563	25.0	32.8	Medium
3	Vengurla-1	9.6	2.9	2.9	95	15.8	0.0	High
4	Goa-1	8.7	3.0	5.1	81	30.5	17.6	High

5	Bhaskara	8.6	3.6	6.1	137	23.5	32.8	High
6	Ullal-3	9.8	2.9	7.1	445	17.2	31.0	Medium
7	BPP-6	11.3	3.8	4.3	260	40.3	27.9	Medium
8	Madakkathara-	8.3	2.6	6.1	770	31.4	32.8	Medium
9	Vengurla-6	8.4	3.8	6.7	306	21.8	31.3	High
10	Vengurla-7	9.6	2.7	8.7	160	26.7	33.3	High
11	NRCC-sel-2	11.2	3.4	7.5	522	49.6	33.3	Medium
12	Ullal-4	9.5	3.3	4.8	381	31	35.4	Medium
13	UN-50	12.7	3.3	6.9	539	37.6	30.4	Medium
14	Kanaka (H-	8.0	2.5	5	403	38.2	36.0	Medium
15	chintamani-2	7.9	3.9	5.4	238	23.3	33.3	High
16	Amrutha-10	12.0	3.9	5.4	546	49.6	35.2	Medium
17	VRI-3	6.4	2.6	5	54	21.8	33.3	Medium
18	BPP-4	10.1	3.7	9	233	47.6	32.2	High
19	Dhana	12.6	3.8	7.1	182	40.8	26.8	High

Note: The experimental plot is adjacent to the forest land and the plants are damaged by high wind speed and wild animals (Deer and wild boar during night times). The gap filling is being attended.

DARISAI

Among the 24 varieties planted, the yield ranged from 1.6kg / tree (Madakkathara-1) to 4.3kg/tree (Dhana) in the second year of harvesting. The cumulative yield was highest in Dhana variety (6.50kg/tree) and this was followed by BPP-8 (5.60kg/tree). These varieties will be evaluated further.



MLT-V at ZRS, Darisai centre during the year 2017

JHARGRAM

Among the 24 varieties studied under MLT- V, varieties were significantly different with respect to their tree height, no of panicles /m² and sex ratio. Data on growth parameters revealed non- significant results with respect to trunk girth, spread on both sides, canopy area and laterals /m². Tallest plants were with the variety Vengurla 6 (5.28m) followed by Vengurla 7 (5.09m), Goa – 1(5.09m) and Chintamani-1 (5.04m) and the shortest plants were in the variety VRI – 3 (3.69m). The plants suffered due to heavy hailstorm therefore, the panicles were totally damaged and there was no nut production.

PILICODE

Twenty released varieties with 10 plants each were planted during June 2008. The varieties differed among themselves for all the biometric characters studied.

Highest plant height was recorded in Madakkathara 2 which was on par with Ullal 1, V7, Ullal 1, and UN 50. Highest stem girth was reported in UN 50 which was statistically on par with Kanaka, Ullal 1, Ullal 4, Amrutha, Dhana and Madakkathara 2. Highest nut weight was recorded in Priyanka followed by NRCC sel -2, Amrutha and BPP 8. Heaviest apples were found in BPP 6 followed by BPP 8. Kanaka had the highest annual nut yield and Priyanka had the highest cumulative yield.

Table 1.5 : Yield parameters of cashew genotypes in MLT-V at Pilicode centre during 2016 (Year of planting 2008)

Accession No.	Nut wt (g)	Apple wt. (g)	Shelling %	Annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 3 Harvests)
BPP-8	9.70	92.50	24.32	3.80	14.63
Bhubaneswar-1	5.96	73.50	23.45	9.20	20.20
Madakkathara-1	5.12	47.50	26.94	2.00	8.75
Madakkathara-2	7.86	63.50	23.15	15.81	26.67
K-22-1	6.26	52.00	23.00	1.11	12.05
Dhana	8.02	61.50	26.44	0.88	4.55
Kanaka	7.86	60.00	24.44	35.03	45.54
Priyanka	10.92	62.25	25.23	23.73	50.41
Amrutha	9.60	63.00	25.83	8.13	23.62
Vengurla-4	7.45	53.00	24.45	1.00	3.17
Vengurla-7	8.36	48.75	16.73	0.90	5.67
VRI-3	6.07	52.00	23.00	1.43	4.12
NRCC Sel-2	10.10	85.50	26.53	0.88	3.75
Ullal-1	5.08	50.00	35.80	4.40	7.88
Ullal-3	7.12	53.00	32.86	2.98	8.90
Ullal-4	7.04	54.00	28.40	7.66	20.64
UN-50	7.68	62.50	21.89	1.71	5.84
Goa-1	6.40	57.50	23.99	3.16	5.85
Bhaskara	8.36	54.00	16.73	0.90	5.67
CD at 5 (%)	0.51	6.23	2.44	2.10	1.28
CV (%)	3.16	4.72	4.56	14.45	2.05

VRIDHACHALAM

Twenty five varieties were evaluated for morphological characters like plant height, girth, canopy spread etc. and yield characters.

The mean tree height ranged from 3.25 m (BPP-8) to 4.32 m (Ullal-4). The flowering duration varied with a mean flowering duration of 62 days to 86 days. The average nut weight, nuts/ panicle¹ and nuts/ m² showed significant variations among the cashew varieties. The average nut weight varied from 5.8 g to 7.8 g. Maximum nut weight of 7.8 g was recorded in Priyanka. The varieties BPP-4,



BPP-8, Madakkathara-2, Amrutha, Vengurla-4, Vengurla-7, VRI 3 and Ullal-4 recorded nut weight of 7.2 g. Apple weight varied from minimum of 51.2 g in BPP 6 to maximum of 70.0 in Priyanka. Shelling % ranged from 26.2 % (BPP-4) to 30.2 % (Vengurla-4). The mean annual nut yield plant⁻¹ (kg) varied from 3.75 kg (Bhubaneswar-1) to 8.10 kg (VRI-3) with cumulative nut yield of 14.10 kg (Bhubaneswar-1) to 25.97 kg (VRI 3) at sixth harvest.

Table 1.6 : Yield parameters of cashew genotypes in MLT-V at Vridhachalam centre during 2017 (Year of Planting - 2008)

Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 6 Harvests)
BPP-4	7.2	63.3	26.2	5.20	19.58
BPP-6	5.0	51.2	27.4	5.858	21.22
BPP-8	7.2	66.2	28.0	5.40	20.70
Bhubaneswar-1	6.6	56.7	26.8	3.75	14.10
Chintamani-1	6.0	66.6	27.0	3.90	15.24
Jhargram-1	5.8	53.3	28.2	3.95	14.94
Madakkathara-1	6.2	52.7	28.0	4.85	19.12
Madakkathara-2	7.2	60.4	29.2	4.90	18.32
K-22-1	6.6	59.4	30.0	5.25	19.49
Dhana	7.0	59.5	28.6	5.18	18.86
Kanaka	6.6	56.7	27.8	5.40	20.31
Priyanka	7.8	68.1	29.4	5.30	19.76
Amrutha	7.2	61.2	29.8	5.28	19.32
Vengurla-1	6.6	60.7	29.0	6.70	22.68
Vengurla-4	7.2	70.0	30.2	6.85	23.29
Vengurla-6	6.8	58.4	28.4	4.85	17.49
Vengurla-7	7.2	67.6	29.2	5.20	19.46
VRI-3	7.2	59.0	27.4	8.10	25.97
NRCC Sel-2	7.0	60.2	28.6	4.80	17.04
Ullal-1	6.8	53.0	29.2	4.15	16.29
Ullal-3	7.0	51.8	28.2	4.65	17.15
Ullal-4	7.2	59.0	28.0	5.70	19.77
UN-50	7.0	56.2	29.2	5.20	18.62
Goa-1	7.0	61.6	30.0	4.95	18.20
Bhaskara	6.8	62.5	28.6	6.50	21.84
SEm ±	0.09	1.40	0.17	0.09	
CD at 5%	0.24	2.94	0.42	0.24	

3. Multilocation Trial – VI (Special MLT)

Centres: *West Coast :* Paria
Plains / others: Darisai, Kanabargi and Tura

The objective of this experiment is to evaluate selected released varieties in new centres started during XI Plan (2009).

Experimental details:

Two rows each, of the cashew varieties (listed below) comprising of six plants per row.

Varieties :

NRCC Sel-2 Bhaskara BPP-8 Dhana VRI-3
VRI (CW) H-1 H 303 Vengurla-4 (Common check) Local Check *

* Local Check for new centres :

BAU Centre : BPP-8
Paria, Arabhavi & Tura : V-4

DARISAI

Table 1.7 : Yield parameters of cashew genotypes in MLT-VI at ZRS, Darisai, E. Singhbhum, BAU, Darisai Centre during the year 2017

Accession	Year of planting	Mean flowering duration (Days)	Mean apple wt. (gm)	Mean nut wt. (gm)	Mean nut yield 1st Year (kg/tree)	Cumulative Nut Yield (kg/plant) for two harvests
NRCC sel-1	2010	93	68.50	7.4	2.70	4.50
NRCC sel-2	2010	98	71.80	6.8	3.20	5.30
M44/3	2010	64	47.6	6.2	2.90	4.50
M15/4	2010	61	61.70	7.2	3.10	4.90
BPP3/33	2012	57	57.50	6.3	2.40	4.10
BPP10/19	2012	62	59.80	6.1	2.60	4.30
BPP30/1	2012	81	48.60	6.6	1.80	2.90
BPP3/28	2012	92	70.70	7.6	2.20	3.30
H303	2012	98	60.80	8.1	2.90	4.60
H255	2013	93	64.20	8.2	3.60	5.40
H367	2013	91	60.60	8.4	2.90	5.20
H68	2013	61	67.50	7.1	3.40	4.90
SEm±		2.58	3.56	0.3	0.23	0.47
CD(5%)		7.64	10.80	0.9	0.76	1.46

Gen.4. Hybridization and Selection

Centres: *East Coast :* Bapatla, Bhubaneshwar, Jhargram and Vridhachalam
West Coast : Goa, Pilicode and Vengurla
Plains / others: Hogalagere

The objective is to utilize the accessions with high yield and other desirable traits selected from the germplasm conserved at various AICRP centres as parents, to combine the desirable traits such as high yield, bold nut, cluster bearing habit, compact canopy, short flowering period, late synchronized flowering and high shelling percentage in single genotype.

BAPATLA

As a result of continuous crossing programme and systematic evaluation the BPP-1, BPP-2, BPP-8 and BPP-9 were released as hybrid varieties. T.No.10/19 and T.No. 30/1 were released as BPP-10 and BPP-11 during the year 2017.

Existing F1 progenies have been evaluated for the vegetative characters, duration of flowering, yield, nut weights etc.

Among the different hybrids evaluated, the mean plant height was found highest in H-390 (7.70m) followed by H-387 (7.20m). The mean stem girth was found highest in H-390 (106.0cm) followed by H-387 (91.0cm). The mean canopy spread was found highest in H-411 (10.50m) followed by H-390 (10.05m).

Table 1.8 : Yield parameters of some cashew hybrids at Bapatla Centre planted during 2007

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 5th harvest (2017)	Cum nut yield (kg/tree) (for 5 Harvests) 2013-17
H387	BPP-8X H 255	5.18	50.00	33.13	8.90	30.20
H403	PRIYANKAXTNO228	7.17	37.50	32.79	9.80	27.05
H410	T NO 228XBPP-8	5.47	50.00	26.20	10.80	40.15
H412	T NO 228XBPP-8	5.32	50.00	28.24	12.00	34.91
H420	BPP8 X PRIYANKA	12.74	41.00	19.48	5.40	13.65

The shelling percentage was found highest in H-388 (34.01) followed by H-387 (33.13). The mean annual nut yield was found highest in H-412 (12.00kg/tree) followed by H-410 (10.80kg/tree). The cumulative nut yield was found highest in H-410 (40.15kg/tree) followed by H-412 (34.91kg/tree) for 5 annual harvests. Among the different hybrids of 2008 evaluated, the mean plant height was found highest in H-437 (7.00m) followed by H-435 (6.70m). The mean stem girth was found maximum in H-437 (93.0cm) and H-429 (89.0cm). The mean canopy spread was recorded highest in H-436 (7.50m) followed by H-429 (6.95m).

Table 1.9 : Yield parameters of some cashew hybrids at Bapatla Centre planted during 2008

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 4 th harvest (2017)	Cum.yield (kg/tree) (for 4 Harvests) 2017
H 424	T.NO.228XBPP-8	6.33	32.60	25.40	1.80	4.60
H 427	TNO.10/19XBPP9	7.69	48.50	22.47	2.30	3.20
H 428	TNO.10/19XBPP9	4.83	63.40	26.54	4.40	9.80
H436	T.NO.228X T.NO.10/19	6.21	61.40	26.74	5.15	10.65
H 437	T.NO.228X T.NO.10/19	5.49	73.20	28.24	2.50	5.80

The mean nut weight was recorded highest in H-427 (7.69g) followed by H-424 (6.33g). The shelling percentage was recorded maximum in H-437 & H-425 (30.20) followed by H-426 (30.14). The mean annual nut yield per tree at 4th harvest was found maximum in H-436 (5.15 kg/tree) followed by H-428 (4.40kg/tree). The cumulative nut yield was found maximum in H-436 (10.65kg/tree) followed by H-428 (9.80kg/tree) for 4 annual harvests. Among the different hybrids of 2009 evaluated, the mean plant height was found highest in H-478 (5.65m) followed by H-445 (5.50m). The mean stem girth was recorded highest in H-445 (86.0cm) followed by H-464 (83.00 cm). The mean canopy spread was recorded highest in H-464 (9.30m) followed by H-445 (8.50m).

Table 1.10 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2009

Hybrid No.	Cross combination	Mean Nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 4 th harvest (2017)	Cum. yield (kg/tree) (for 4 Harvests) 2014-2017
H 461	VRI-3 XBPP-9	8.73	65.00	31.61	7.15	19.65
H 463	BPP-3xPRIYANKA	9.54	80.00	32.14	1.45	5.15
H 467	BPP-3xPRIYANKA	9.46	90.00	31.45	7.10	15.30
H 471	BPP-3xPRIYANKA	8.21	125.0	30.08	2.15	2.97
H 475	VRI-3XBPP-8	7.18	105.0	28.26	1.50	3.42
H 483	M15/4 X TNO.228	5.45	45.00	27.26	8.60	17.60
H 491	VRI-2 XBPP-8	8.92	45.00	27.83	7.60	13.30

The mean nut weight was recorded highest in H-463 (9.54g) followed by H-467 (9.46g). The shelling percentage was recorded maximum in H-465 (33.59) followed by H-468 (32.82). The mean annual nut yield was found highest in H-483 (8.60kg/tree) followed by H-491 (7.60kg/tree). The cumulative nut yield was maximum in H-461 (19.65 kg/tree) followed by H-483 (17.60kg/tree) for 4 annual harvests.

Among the different hybrids of 2010 evaluated, the mean plant height was found highest in H-547 (6.00m) followed by H-548 (5.90m). The mean canopy spread was found highest in H-559 & H-583 (7.35m) followed by H-539 (7.30m). The mean stem girth was recorded highest in H-516 (81.0cm) followed by H-546 (75.0cm).

Table 1.11 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2010

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 3 rd harvest (2017)	Cum. yield (kg/tree) (for three Harvests) 2015-2017
H 504	T.No.30/1 x M15/4	8.15	55.00	27.56	6.80	12.06
H 530	T.No. 30/1xPriyanka	10.37	100.00	20.34	13.65	15.75
H 534	T.No. 30/1xPriyanka	8.94	102.50	28.38	3.65	6.31
H 540	BPP-5XM15/4	6.07	67.50	39.58	1.58	5.23
H 557	BPP-3 X Priyanka	7.14	68.60	36.45	1.93	4.53
H 567	PriyankaX BPP-2	8.79	50.00	27.05	1.20	2.95
H 587	H-36x VRI-3	6.67	110.00	28.66	2.75	6.15

The mean nut weight was recorded highest in H-530 (10.37g) followed by H-534 (8.94g). The shelling percentage was recorded maximum in H-557 (39.58) followed by H-557 (36.45). The mean annual nut yield was found highest in H-530 (13.65kg) followed by H-504 (6.80kg). The cumulative nut yield recorded highest in H-530 (15.75) followed by H-504 (12.06) for 3 annual harvests.

Among the different hybrids of 2011, plant height was found highest in H-596 (5.50m) followed by H-642 (5.20m). The mean canopy spread was found highest in H-596 (8.05m) followed by H-641 (7.80m). The mean stem girth was recorded highest in H-596 & H-641 (75.00cm) followed by H-606, H-633 & H-642 (65.00cm).

Table 1.12 : Yield parameters of some cashew hybrids at Bapatla Centre planted during 2010

Hybrid No.	Cross combination	Mean nut wt. (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 1 st harvest (2017)	Cum. yield (kg/tree) (for one Harvest) 2016-17
H596	BPP-8 x BPP -9	4.16	35.00	40.12	9.25	9.25
H597	BPP-8 x BPP -9	6.02	50.00	30.12	2.83	2.83
H602	BPP-8 x BPP -9	7.54	95.00	31.20	0.40	0.40
H603	BPP-8 x BPP -9	5.31	42.50	31.30	2.20	2.20
H605	BPP-8 x T.No.40/1	4.69	50.00	34.50	4.50	4.50
H641	BPP-8 x Hy94-T4	6.00	50.00	29.69	5.05	5.05
H642	BPP-8 x Hy94-T4	9.40	102.50	23.88	9.70	9.70
H643	BPP-8 x Hy94-T4	8.81	75.00	21.20	1.90	1.90

The mean nut weight was recorded highest in H-642 (9.40 g) followed by H-643 (8.81 g). The mean apple weight was found highest in H-642 (102.50g) followed by H-602 (95.00g). The shelling percentage was recorded maximum in H-596 (40.12) followed by H-605 (34.50). The mean annual nut yield was found highest in H-642 (9.70 kg) followed by H-596 (9.25 kg). The cumulative nut yield recorded highest in H-642 (9.70 kg) followed by H-596 (9.25 kg) for one annual harvest. Among the different hybrids of 2011, plant height was found highest in H-657 (5.10m) followed by H-664 (4.20m). The mean canopy spread was found highest in H-686 (6.00m) followed by H-695 (6.85m). The mean stem girth was recorded highest in H-687 (66.00cm) followed by H-694 (60.00cm).

Table 1.13 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2011FS

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 1 st harvest (2017)
H648	T.No.71 x T.No.273	8.74	50.00	31.20	0.35
H658	T.No.228 x F.No.3	4.94	85.00	23.20	2.90
H662	BPP-5 x T.No.2/22	9.43	56.50	29.60	2.40
H673	F.No.3 x T.No.228	5.74	72.50	29.12	0.74
H686	ABT-3 x T.No.40/1	6.09	50.00	25.20	5.80
H695	BPP-8 x Ullal-3	4.35	47.50	32.58	17.80

The mean nut weight was recorded highest in H-662 (9.43 g) followed by H-648 (8.74 g). The mean apple weight was found highest in H-658 (85.00g) followed by H-673 (72.50g). The shelling percentage was recorded maximum in H-695 (32.58) followed by H-648 (31.20). The mean annual nut yield was found highest in H-695 (17.80 kg) followed by H-686 (5.80 kg). Among the different hybrids of 2012 evaluated, the mean plant height was found highest in H-709 (3.80m) followed by H-710 (3.70m). The mean canopy spread was found highest in H-708 (5.80m) followed by H-716 (5.65m). The mean stem girth was recorded highest in H-716 (59.00cm) followed by H-701 (55.00cm).

Table 1.14 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2012

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 1 st harvest (2017)
H705	Kankady x BLA39/4	7.45	80.00	29.26	0.60
H710	T.No.10/19xKankady	8.31	67.50	29.20	1.90
H711	T.No.10/19xKankady	5.81	62.50	31.20	0.75
H715	BPP-8 x Kankady	8.85	80.00	30.12	2.20
H716	BPP-8 x Kankady	7.24	62.50	31.81	3.60
H717	BPP-8 x Kankady	6.86	60.00	28.00	4.10
H718	BPP-8 x Kankady	6.55	62.50	26.20	3.80
H721	BPP-8 x Kankady	8.11	95.00	29.20	0.90

The mean nut weight was recorded highest in H-715 (8.85 g) followed by H-710 (8.31g). The mean apple weight was found highest in H-721 (95.00g) followed by H-705 & H-715 (80.00g). The shelling percentage was recorded maximum in H-716 (31.81) followed by H-711 (31.20). The mean annual nut yield was found highest in H-717 (4.10 kg) followed by H-718 (3.80 kg). Among the different hybrids of 2013 evaluated, the mean plant height was found highest in H-761 (3.50m) followed by H-729 & H-756 (3.10m). The mean canopy spread was found highest in H-761 (4.95m) followed by H-729 & H-757 (4.15m). The mean stem girth was recorded highest in H-761 (51.00cm) followed by H-757 (48.00cm).

Table 1.15 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2013

Hybrid No.	Cross combination	Mean nut wt(g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 1 st harvest (2017)
H726	T.No.30/1xKankady	8.81	40.00	26.92	5.40
H727	T.No.30/1xKankady	7.72	62.50	27.20	4.90
H729	T.No.30/1xKankady	7.13	45.00	24.56	5.00
H737	BPP-8x BLA- 39/4	5.48	50.00	32.44	2.80
H738	BPP-8x BLA- 39/4	5.50	42.50	31.20	2.90
H752	Hy 95-T4 x BPP-8	4.79	25.00	31.20	0.80
H755	Kankady x BPP-9	7.75	55.00	28.20	0.55
H757	Kankady x BPP-8	6.88	102.50	26.00	0.45
H758	Kankady x BPP-8	7.24	55.00	31.20	0.55

The mean nut weight was recorded highest in H-726 (8.81 g) followed by H-755 (7.75g). The mean apple weight was found highest in H-757 (102.50g) followed by H-727 (62.50g). The shelling percentage was recorded maximum in H-737 (32.44) followed by H-738, H-752 & H-758 (31.20). The mean annual nut yield was found highest in H-726 (5.40 kg) followed by H-729 (5.00 kg).

BHUBANESWAR

The cashew hybrids, parents and check varieties evaluated during the fruiting season 2016-17 revealed that the hybrid D-19 recorded maximum for the vegetative parameters like tree height (3.0m) and canopy spread (3.63 cm in E-W & 3.63cm in N-S) while trunk girth was recorded maximum in hybrid C2-6 (23.18cm).

Among the evaluated genotypes, nut weight was recorded maximum in parent Kankadi (10.76 g) while apple weight was maximum in parent VTH-711/4 (126.0g). Shelling % was recorded maximum in hybrid C-30 (33.86). Among the tested genotypes, significant maximum mean annual nut yield (kg plant⁻¹) was recorded in hybrid C2-6(2.05) at 1st harvest. Hybrid C2-6 was found to be significantly superior with respect to trunk girth, flowering laterals m⁻², flowering duration and mean annual nut yield among the tested cashew genotypes.

GOA

Hybridization work was continued during flowering season 2017-18, for producing the 7th set of hybrid progeny. A total of 317 hybrid seed nuts of the following parental combinations were produced from 2354 crosses and the nuts were collected for raising hybrid seedlings.

Details of hybrid seed nuts produced				
Sr. No.	Parents	Nos. of crosses	No. of seed nuts resulted	% success
1	Valpoi-7 X Tiswadi-3	564	59	10.4
2	Tiswadi-3 X Valpoi-7	114	11	9.6
3	10A X Tiswadi-3	196	17	8.6
4	Tiswadi-3 X 10A	157	17	10.8
5	Tiswadi-3 X V-4	229	43	18.7
6	V-4 X Tiswadi-3	185	22	11.8
7	Ganje-2 X Tiswadi-3	126	21	16.6
8	Tiswadi-3 X Ganje-2	35	4	11.4
9	39A X Valpoi-7	41	10	24.3
10	Valpoi-7 X 39A	225	74	32.8
11	8A X V4	14	5	35.7
12	Hybrid 31 X Tiswadi-3	123	21	17.0
13	tiswadi-3 X HYB- 31	27	2	7.4
16	Balli-1 X Tiswadi-3	169	1	0.5
17	GB-2A X Valpoi-2	149	10	6.7
		2354	317	11.0

JHARGRAM

The promising hybrids of the past years were clonally propagated and planted in a replicated trial during 2015 with the check variety BPP- 8. Yield Data could not be recorded due to heavy loss of crop due to devastating hail storm on March, 5th, 2017. Growth parameters revealed that the hybrids were significantly different with respect to their tree height and stem girth. H – 113 was the tallest plant and H- 41 was the shortest at the age of 2 years. The stem girth ranged from 4.41 to 12.5 cm.

PILICODE

The dwarf type PLD-57 was used for hybridization with ANK-1 and MDK-1 with the objective of obtaining hybrid progenies having dwarf stature, higher percentage of bisexual flowers, nut setting and high nut yield.

The mean of the growth characteristics of the hybrids produced during 2001 and 2003 are furnished in the Table 1.16. All the characteristics recorded found to vary significantly among the hybrids as well as parents and PLD 57 graft. MDK 1 was found to be tallest, followed by the hybrids

from the cross MDK 1 X PLD 57. The hybrid combination PLD 57 X ANK 1 and ANK 1 X PLD 57 had the canopy spread in both the directions. Higher number of flowering laterals per m² was observed in PLD 57 grafts. PLD 57 OP was the shortest with lowest canopy area. Higher fruit set per sq. m also observed in ANK 1 X PLD 57. The hybrids from the cross PLD 57 X ANK1 had the highest proportion of bisexual to male flowers.

Table 1.16 : Growth parameters of different cashew hybrids at Pilicode Centre during the year 2016-2017 planted during 2003

Cross combination	Tree ht. (m)	Stem girth (cm)	Canopy spread (m)		Canopy area (m ²)	No. of flowering laterals / m ²	Ratio of male : bisexual flowers	Nuts/ m ²	Mean annual nut yield (kg/tree)
			E-W	N-S					
PLD 57 graft	1.94	0.28	3.20	3.15	5.78	16.18	0.13	3.50	0.73
PLD 57 (OP)	2.80	0.55	4.00	5.00	11.48	7.90	0.14	1.97	0.55
PLD 57 X ANK 1	4.30	1.07	10.23	9.77	36.76	4.48	0.22	2.25	2.00
ANK 1 X PLD 57	4.18	1.07	10.55	10.22	36.57	5.13	0.15	6.74	1.60
MDK 1 X PLD 57	4.80	1.20	10.00	7.00	35.28	3.41	0.17	4.03	6.35
MDK 1	5.50	0.92	8.50	8.83	42.55	3.33	0.14	2.96	2.90
SEm±									-
CD at 5%	0.40	0.28	1.55	1.46	7.77	1.40	0.04	0.28	0.54
CV%	5.65	18.22	10.99	10.93	15.22	11.38	12.57	4.27	12.61

VENGURLE

On the basis of standard criteria viz., compact canopy, cluster bearing habit, nut weight (more than 8 g), shelling percentage (more than 28%) and high yield, 17 F₁ hybrid seedlings were screened initially as promising hybrids during the year 2016-17. It is observed that among the promising hybrids, H-2084 recorded maximum height (7.50 m), canopy spread (EW 10.40m & NS 9.50m) and maximum canopy area (77.56 m²). The highest stem girth (100.00 cm) was recorded in H- 2917.

With regard to yield attributes of promising hybrids (Table 1.17), H-3096 recorded maximum nut weight (16.10 g) and apple weight (140 g), while the maximum shelling percentage (33%) was observed in H-2872 and H-2873. The highest annual nut yield was recorded in H-2917 (6.330 kg/tree) followed by H-2084 (6.225 kg/tree). Cumulative yield for last 10 harvests was highest in H-2917 (27.62 kg/tree).

Table 1.17 : Yield parameters of different cashew hybrids at Vengurle Centre during the year 2015-16

Hybrid No.	Cross combination	Year of planting	Mean nut wt. (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) 10 th harvests
2084	J-15 x Kankadi	2004	10.70	60	28.00	6.225	25.61
2872	J-15 x Kankadi	2004	8.30	70	33.00	1.780	18.59
2873	J-15 x Kankadi	2004	9.40	70	33.00	1.480	24.16
2874	J-15 x Kankadi	2004	9.70	40	30.00	2.620	21.09
2876	J-15 x Kankadi	2004	9.00	50	28.50	2.810	12.75
2886	Taliparamba x B.T22	2004	9.70	50	30.00	1.590	11.31
2917	Nanoda x <i>A. microcarpum</i>	2004	9.60	90	30.00	6.330	27.62
2926	Nanoda x Kankadi	2004	10.50	70	26.00	2.600	12.27
3090	H-320 x B.T.22	2004	10.80	80	28.50	1.100	13.40
3043	Jawahar-1 x Kolgaon	2004	15.20	100	26.00	1.060	24.29
3059	CYT176 x B.T. 65	2004	8.80	80	32.00	2.280	17.27
3084	H-320 x B.T.1	2004	12.20	110	26.00	1.380	15.99
3096	H-320 x B.T.65	2004	16.10	140	27.50	1.000	16.33
3113	H-1598 x B.T.1	2004	9.20	120	32.00	1.675	12.66
3137	<i>A. microcarpum</i> x V-4	2004	9.80	80	32.00	3.300	14.40
3139	<i>A. microcarpum</i> x V-7	2004	11.70	90	32.22	1.680	14.16
3157	Hy-445 x B.T.10	2004	10.90	70	28.50	1.480	10.86

A total of 4058 F₁ cashew progenies planted at cashew farm, RFRS, Vengurle since 1999. The 2756 F₁ cashew progenies planted at 5m x 5m during 1999 to 2004 were evaluated. Out of these progenies, the best performing 58 hybrids were evaluated as promising hybrids as per the guidelines of DCR, Puttur.

VRIDHACHALAM

The hybrids planted during 2005, 2006 and 2008 were evaluated for characteristics namely high yield, cluster bearing, good fruit set, high percentage of bisexual flowers, bold nuts, dwarfness and easy peeling testa. Many promising hybrids were identified and data recorded. HC 1 resembled VRI 2 in terms of high yield but had an important advantageous character of easy peeling testa. HC 24 recorded good fruit set, high yield, bold nut (7.6 gms) along with easy peeling testa. HC 10, HC 25, HC 27 and HC 30 were cluster bearing with bold nuts. HC 10 was observed to have the typical characteristic of high yield even under water stress conditions. HC 23 and HC 25 had compact

canopy, cluster bearing and bold nuts. HC 17 and HC 23 showed a different type of intensive branching pattern occupying less space of spread.

Table 1.18 : Yield parameters of different cashew hybrids at Vridhachalam Centre

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield* (kg/tree)	Cum. Yield (kg/tree) (for 5/6/7 Harvests)	Total Number of Harvests
HC1	VRI2 X VRI 3	5.90	25.0	27.5	5.2	38.25	9
HC2	VRI 3 x VSK 2	6.25	31.0	26.5	4.4	29.70	9
HC3	VRI 3 x TK 1	6.50	35.5	24.5	4.2	21.85	9
HC 5	VRI 3 x VRI 2	7.00	40.5	27.5	6.9	37.25	9
HC6	VRI 3 x KGN 1	5.90	51.5	26.0	6.2	27.30	9
HC8	VRI 3 x PKP 1	6.20	48.2	26.0	6.4	27.70	9
HC10	VRI 3 x KK 1	7.40	31.2	28.5	12.2	52.30	8
HC 17	VRI 3 x AM 1	6.00	35.0	27.0	5.8	32.80	8
HC 22	VRI 3 X TK 1	7.20	50.5	28.5	5.9	28.45	7
HC 23	VRI 3 x AM 1	7.20	32.0	27.6	3.8	20.65	7
HC 24	VRI3XM 33/3	7.00	30.8	26.0	6.2	30.60	7
HC 25	VRI3XM 33/3	7.30	52.5	30.0	9.4	40.25	7
HC 27	VRI 3 X SL 1	7.80	50.5	31.5	6.2	35.05	7
HC 30	VRI 3 x PV 1	8.00	52.5	26.8	8.1	40.65	7
sd		0.76	11.4	2.23	0.76		
SEm ±		0.24	0.33	0.26	0.32		
CV%		9.80	24.5	5.2	75.2		

Gen.5: Characterization of germplasm for cashew apple

Centres: *East Coast :* Bapatla, Jhargram and Vridhachalam
West Coast : Goa and Pilicode
Plains / others : Jagdalpur

The objective of the experiment is to identify germplasm having preferred apple characters suitable for value addition.

BAPATLA

Among the 13 genotypes evaluated during the year 2016-17, the maximum mean annual nut yield per tree recorded in BPP-8 (6.42 kg) followed by Priyanka (6.20kg). The maximum apple weight was recorded in Priyanka (83.25 g) followed by BPP-8 (67.40 g). The maximum nut weight was recorded in Priyanka (9.30 g) followed by BPP-8 (7.28 g). The apple to nut ratio was highest in BLA 39/4 (12.12) followed by T.No. 8/7 (11.30). The juice recovery percentage was found maximum in BLA-39/4 (71.6%) followed by T.No.228 (68.60 %). Among the 13 genotypes the Total Soluble Solids (TSS) ranged from 9.6° Brix to 12.9° Brix. However, the highest TSS was recorded in Priyanka (12.70). The maximum vitamin C content was recorded in T.No. 8/7 (178.20 mg/100gm) followed by T. No. 3/4 and T. No. 18/3 (168.60mg/100gm). With regard to the tannin content the lowest was recorded in Priyanka (3.14mg/100g) followed by T.No.2/14 and T.No.18/3 (3.18mg/100gm). The acidity content was lowest in T.No.18/3 (0.43%) followed by T.No.8/7 (0.44%) and Priyanka (0.48%).

JAGDALPUR

Locally collected 10 genotypes were characterized for cashew apple. Apple weight ranged between 46.80 g to 103.80 g in CARS-4 and CARS-8 respectively. The maximum juice recovery was recorded in CARS-8 (77.50%). The vit C content varied between 208.2 to 267.6 mg/100 ml juice. TSS (°Brix) ranged from 10.20 to 16.40.

PILICODE

Highest apple weight was recorded in variety NRCC Sel 2. Apple to nut ratio was highest in the variety Ullal 1. Highest juice recovery in volume and percentage was obtained from NRCC Sel 2. Highest TSS was reported from Priyanka followed by Madakkathara 2. Lowest TSS was reported from Ullal 1. Highest acidity was reported from Kanaka and Priyanka variety. Sugar to acid ratio was highest in PLD 3 and lowest was in Kanaka.

VRIDHACHALAM

The characterization of germplasm for cashew apple was done in 20 germplasm accessions along with the three released varieties at Vridhachalam. The juice recovery of the accessions evaluated ranged from 49 % to 80 %. VRI 2 recorded the highest juice recovery of 80 %. Vitamin C content was more in VRI 3 and M103/7. The germplasm accessions NF 69, VRI2, VRI3, VRI (Cw)H1 recorded highest total sugars. TSS was highest in K 10/1, M 30/1 and A 5/3. Tannin content ranged between 0.05 - 0.10 g/ 100g.

Gen.6: Varietal Screening of Cashew Apple for preparation of RTS and Jam

Centres: *East Coast* : Vridhachalam
Plains / others : Jagdalpur and Hogalagere

The objective of this trial is to find out a suitable variety of cashew apple for preparation of RTS and Jam

HOGALAGERE

Cashew ready to serve (RTS) beverage was prepared from five varieties of cashew apples and was evaluated for the organoleptic properties. Teaching, non teaching staff and students of COH, Kolar were involved in preparation and evaluation of RTS. Among the varieties, Chintamani-1 recorded highest colour (3.80), texture (3.20) and overall acceptability (3.40) which was followed by V-4. The least score was obtained in V-3 (Table 1.19).

Cashew apple jam was prepared from five different cashew varieties apples. Evaluation of the product revealed that jam prepared from Chintamani-1 apples scored highest with respect to appearance, colour, flavor, taste and texture. The overall acceptability was also found to be best with C-1 (4.60) which was on par with V-4. The least score was obtained with UN-50 (3.00) (Table 1.20).

Table 1.19 : Sensory evaluation of different cashew varieties apple for preparation of RTS (Ready to Serve) during 2016-17

	Appearance	Colour	Flavour	Taste	Texture	Sweetness / Saltiness	Overall acceptability	TSS (° Brix)	Mean score	Overall Grade
Chintamani-1	3.4	3.8	3.2	3.2	3.2	3.4	3.4	72.8	3.37	Good
Un-50	3.2	3.4	3.0	3.2	3.2	3.2	3.3	73.7	3.21	Good
Vengurla-8	3.4	3.6	3.4	3.2	3.0	3.4	3.2	71.1	3.31	Good
Vengurla-3	3.2	3.2	2.6	2.8	2.6	3.0	2.8	71.7	2.89	Good
Vengurla-4	3.6	3.4	3.0	3.4	3.0	3.6	3.4	75.8	3.34	Good

Note: Scale for scoring, Excellent-5, Very good-4, Good-3, Fair-2, Poor-1.

Table 1.20 : Sensory evaluation of different cashew varieties apple for preparation of Jam during 2016-17

	Appearance	Colour	Flavour	Taste	Texture	Sweetness / Saltiness	Overall acceptability	TSS (° Brix)	Mean score	Overall Grade
Chintamani-1	4.6	4.4	4.4	4.4	3.2	4.4	4.6	15.6	6.06	very good
Un-50	3.0	3.0	3.0	2.2	2.8	3.4	3.0	15.9	4.79	good
Vengurla-8	3.4	3.4	3.0	3.0	3.2	3.2	3.4	15.3	4.96	good
Vengurla-3	3.8	3.4	3.0	3.0	2.6	3.4	3.8	15.4	5.11	good
Vengurla-4	4.6	4.2	4.2	4.2	3.2	4.2	4.6	14.5	5.79	very good

Note: Scale for scoring, Excellent-5, Very good-4, Good-3, Fair-2, Poor-1.

New trial formulated during AGM – 2017 at ICAR – DCR, Puttur

Evaluation of promising bold nut, bigger size apple and high yielding cashew genotypes

Centres: **East Coast :** Bapatla, Bhubaneswar, Jhargram and Vridhachalam
West Coast : Goa, Pilicode, Puttur, Madakkathara and Vengurla
Plains/others : Kanabargi and Jagdalpur

Objective : To evaluate the performance of promising bold nut bigger size apple and high yielding cashew genotypes at different AICRP-C Centres

Experimental details :

Total Number of genotypes : 17
 No. of replications : 2
 No. of plants per genotype : 4
 Spacing : 6m x 6m

Materials :

Sl. No.	Sponsoring centre	Cashew genotypes
1	CRS, Bapatla	H-218
2	CARS, Jagdalpur	CARS-8
3	CCARI, Goa	22/05, Tiswadi-3, Tudal-1
4	RFRS, Vengurle	H3041, H2084
5	CRS, Bhubaneswar	F-32, C-136, D-21, E-22, H-29
6	DCR, Puttur	H-125, H-126, H-130, NRC-301, NRC-493



II. CROP MANAGEMENT

II. CROP MANAGEMENT

Hort.1a : Nutrient Management for yield maximization in cashew

Centres: *East Coast* : Bhubaneshwar
Plains / others : Hogalagere

To objective of the experiment is to investigate the effect of nutrient management approaches on growth, yield and soil properties

Experimental Design : Randomized Block Design

No. of replications : 3

Treatments:

T₁ -100% RDF (500:250:250g NPK/Plant)

T₂ -100% RDF + FYM @ 10kg/Plant/Year

T₃ - T₂+ Foliar Spray of major nutrients (3% urea +0.5% H₃PO₄ +1% K₂SO₄)

T₄ - T₂ + Foliar Spray of Secondary and micro-nutrients (0.5% ZnSO₄ +0.1% Solubor +0.5% MgSO₄)

T₅ - T₃ +Foliar Spray of Secondary and micro-nutrients (0.5%ZnSO₄ +0.1% Solubor +0.5% MgSO₄)

T₆ - Control

BHUBANESWAR

The experiment was laid out during the year 2014 in Randomized Block Design with three replications. Cashew variety, Balabhadra was planted at a spacing of 7.0m x 7.0m. The crop was at initial stage of vegetative growth. First harvest was recorded from the year 2016-17 onwards.

Application of 100% RDF+10 Kg FYM along with foliar spray of major nutrients (3% Urea + 0.5% H₃PO₄+ 1% K₂SO₄), Secondary and micro-nutrients (0.5% ZnSo₄+0.1% Boron+0.5% Mg SO₄) (T₅) was found to be significantly superior with respect to mean nut yield (1.86 Kg/tree), Plant height (2.56m) and Stem girth (24.87cm) parameters over other treatments. This treatment was followed by T₃ which had mean nut yield of 1.70 Kg/tree. However, the control treatment (T₆) recorded least response with respect to all the growth and yield parameters (Table 2.1). The Tea Mosquito Bug infestation was low irrespective of the treatments.

Table 2.1 : Yield parameters of cashew at Bhubaneswar during 2016-17

Treatments	Treatment details	Apple Weight (gm)	Mean nut weight (gm)	Nut yield (kg/plant)	Tea Mosquito Bug infestation	Nut yield (kg/tree) for 1 st Harvest
T ₁	100% recommended dose of NPK fertilizer (RDF) i.e. 500:250:250g NPK/plant/year	45.95	6.75	1.38	Low	1.38
T ₂	100% RDF + 10kg FYM/plant/year	48.20	6.80	1.58	Low	1.58
T ₃	100% RDF + 10kg FYM/plant/year + Foliar spray of major nutrients (3% Urea + 0.5% H ₃ PO ₄ + 1% K ₂ SO ₄)	47.33	6.62	1.70	Low	1.70
T ₄	100% RDF + 10kg FYM/plant/year + Foliar spray of secondary and micro-nutrient 0.5% ZnSO ₄ +0.1% Solubor (Boron) + 0.5% MgSO ₄	50.85	7.06	1.62	Low	1.62
T ₅	100% RDF + 10kg FYM/plant/year + Foliar spray of major nutrients (3% Urea + 0.5% H ₃ PO ₄ + 1% K ₂ SO ₄) + Foliar spray of secondary and micro nutrient (0.5% ZnSO ₄ +0.1% Solubor(Boron) + 0.5% MgSO ₄)	53.85	7.26	1.86	Low	1.86
T ₆	Control	41.31	6.18	1.14	Low	1.14
	Mean	47.92	6.78	1.59	-	1.59
	SEM±	2.41	0.17	0.14	-	-
	CD at 5%	7.22	0.51	0.43	-	-
	CV (%)	10.05	4.98	18.14	-	-

HOGALAGERE

Plants treated with 100% RDF and 10kg FYM along with foliar spray of major nutrients (3% urea to 5% H₃PO₄+ 1 K₂SO₄) as well as secondary & micronutrients (0.5% ZnSO₄+0.1% Borax+0.5mg SO₄) (T₅), have shown higher growth and yield response in comparison to all other treatments. The growth and yield response was least in control plants compared to all other treatments. Plant height (2.91m), stem girth (14.78), nut weight (7.37g), nut yield (4.90 Kg/tree) and cumulative nut yield (9.6 Kg/tree) parameters were significantly higher in Treatment-T₅ compared to control plants and were statistically on par with other treatments (Table 2.2).

Table 2.2 : Cashew yield parameters as influenced by different nutrient treatments at HREC, Hogalagere during 2016-17

Treatments	Flowering duration (Days)	Apple weight (g)	Mean nut weight (g)	Nut yield (Kg/ plant)	Shell ing (%)	TMB Infestation	Cumulative yield (Kg/tree) (2 harvests)
T ₁	125	33.4	7.22	3.21	28.3	low	5.77
T ₂	127	32.3	7.25	3.50	27.7	low	6.75
T ₃	127	35.0	7.32	4.15	28.2	low	8.24
T ₄	126	36.8	7.34	4.20	29.7	low	8.00
T ₅	127	38.3	7.37	4.90	29.0	low	9.61
T ₆	126	32.1	6.94	2.99	28.4	low	4.67
S.EM _±	1.001	1.0686	0.1259	0.362	0.703	-	-
CD@5%	3.018	3.2204	0.3794	1.091	2.119	-	-
CV (%)	1.58	6.16	3.47	18.92	4.92	-	-

Hort. 2: Fertilizer application in high density cashew plantations

Centres: *East Coast* : Bapatla
Plains / others : Hogalagere

This trial envisages identification of optimum population density for cashew and suitable fertilizer doses at different high density plantings for specific regional variety.

Experiment Details :

Design	:	Split plot
Main plot : Plant density	:	S ₁ 200 plants/ha (10m x 5m) S ₂ 400 plants/ha (6m x 4m) S ₃ 600 plants/ha (5m x 4m)
Sub-plot : Fertilizer dose/ha	:	M ₁ 75 kg N, 25 kg P ₂ O ₅ , 25 kg K ₂ O M ₂ 150 kg N, 50 kg P ₂ O ₅ , 50 kg K ₂ O M ₃ 225 kg N, 75 kg P ₂ O ₅ , 75 kg K ₂ O
Fertilizers application level	:	1 st year : 1/5 th 2 nd year : 2/5 th 3 rd year : 3/5 th 4 th year : 4/5 th 5 th year : Full dose

BAPATLA

During the year 2016-17, results obtained from planting densities cum fertilizer trial it is evident that trees planted at closer densities i.e. 5m x 4m apart have given more plant height, canopy height, stem girth, canopy diameter, canopy spread area and flowering intensity. Annual nut yield per tree was highest 14.45kg/tree in 10 x 5m spaced trees when applied with fertilizer levels at 225:75:75 kg/ha [S₁M₃] which is followed by treatment S₁M₂ [10.89kg/tree]. Cumulative nut yield are also highest in S₁M₂ (77.30kg/tree) followed by S₁M₁ (76.50kg/tree). Results indicated that at closer densities vegetative parameters are at higher values and at wider densities yield are higher.

At different levels of spacing, the treatments differed significantly for mean stem girth, flowering intensity, number of nuts per panicle and the apple weight and for other characters their differences were non-significant.

At different levels of fertilizers, the treatments differed significantly for mean canopy diameter, mean number of nuts per panicle, nut weight and apple weight. For other characters, the differences were non-significant. As far as interaction between fertilizers and spacing is concerned, the treatments differed significantly for mean percentage of ground area covered by canopy, mean number of nuts/sq.m., nut weight and apple weight.

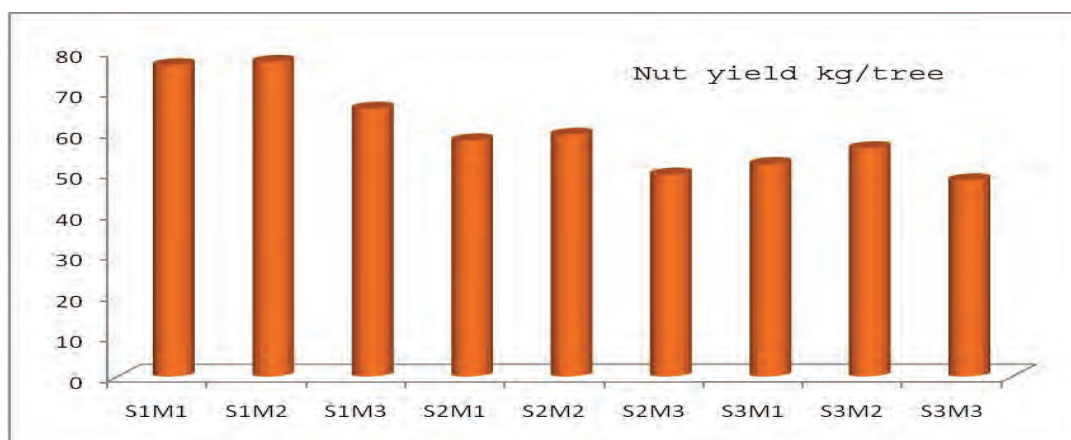
Table 2.3 : Effect of tree density and fertilizer levels on yield parameters of Cashew at Bapatla centre

Nut Yield/tree (kg)				
	M ₁	M ₂	M ₃	Mean
S ₁	9.17	10.89	14.45	11.50
S ₂	7.20	8.06	8.24	7.83
S ₃	7.10	8.40	6.40	7.30
Mean	7.82	9.12	9.70	
		CD(0.05)		SEm±
Spacings		0.21		0.05
Fertilizers		0.16		0.05
SpacingsX Fertilizers		0.30		0.09

The annual nut yield per tree was found to be significant at different levels of spacing and different doses of fertilizers. The maximum nut yield per tree was recorded in S₁ (11.50 kg/tree) followed by S₂ (7.83kg/tree). However, the maximum nut yield was recorded in M₃ (9.70kg/tree) followed by M₂ (9.12 kg/tree). The interaction between spacings and fertilizers was found to be significant. The highest interaction was recorded in S₁M₃ (14.45kg/tree) followed by S₁M₂ (10.89kg/tree).

Table 2.4 : Effect of tree density and fertilizer levels on yield parameters of Cashew at Bapatla centre

Cumulative nut Yield/tree (kg) for ten harvests				
	M ₁	M ₂	M ₃	Mean
S ₁	76.5	77.3	65.8	73.2
S ₂	58.0	59.4	49.6	55.7
S ₃	52.2	56.1	48.2	52.2
Mean	62.2	64.3	54.5	



Effect of tree density and fertilizer levels on yield of Cashew

HOGALAGERE

During the third year of planting, observations on vegetative and yield parameters were recorded in the experiment of fertilizer application in high density cashew plantations. Interaction of three spacings (S_1, S_2 & S_3) with three fertilizer levels (M_1, M_2 & M_3) were studied. Among different spacing and fertilizer interaction treatment, there were no significant differences and infestation of TMB was low in all the treatments.

Table 2.5 : Interaction effect of different spacing and fertilizer levels on growth of Cashew at Hogalagere during 2016-17

Treatments	Flowering duration (Days)	Apple weight (g)	Mean nut weight (g)	nut yield (Kg/plant)	nut yield (Q/ha.)	Shelling %	TMB Infestation	Cumulative yield (1 No. of harvest)
S_1M_1	107	33.8	6.25	1.05	2.10	29.4	low	1.05
S_1M_2	109	32.9	6.51	1.19	2.39	30.6	low	1.19
S_1M_3	109	32.5	6.30	1.20	2.41	30.5	low	1.20
S_2M_1	106	32.1	6.59	1.01	4.21	30.1	low	1.01
S_2M_2	108	33.0	6.93	1.05	4.39	29.4	low	1.05
S_2M_3	108	33.1	6.41	1.05	4.39	30.1	low	1.05
S_3M_1	105	33.8	6.71	0.98	4.88	30.0	low	0.98
S_3M_2	107	31.4	6.75	1.01	5.05	30.1	low	1.01
S_3M_3	107	32.4	6.73	1.00	5.00	30.2	low	1.00
S.E.M ₊	0.14	0.48	0.10	0.07	0.36	0.73	-	0.09
CD@5%	NS	NS	NS	NS	NS	NS	-	NS

Hort. 3: Drip irrigation trial

Centres : East Coast : Vridhachalam
 West Coast : Vengurla
 Plains / others : Hogalagere

The trial aims at studying the response of cashew to supplementary irrigation during flushing and flowering phases and to work out the critical stages of irrigation.

Experimental Details :

Treatments : 5

T1 : No Irrigation

T2 : Irrigation 20% of Cumulative Pan Evaporation (CPE).

T3 : Irrigation 40% of Cumulative Pan Evaporation (CPE).

T4 : Irrigation 60% of Cumulative Pan Evaporation (CPE).

T5 : Irrigation 80% of Cumulative Pan Evaporation (CPE).

Spacing = 7 x 7m

Variety = Chintamani : Chintamani-1
 Vengurla : Vengurla-7
 Vridhachalam : VRI-3

HOGALAGERE

Treatment with 80 per cent Cumulative Pan Evaporation (CPE) (T₅) recorded significantly higher plant height (3.22m) over other treatments. Treatments with 40, 60 and 80 CPE (T₃, T₄ & T₅) were on par with each other and were significantly higher than treatments with zero and 20 CPE (T₁ & T₂) with respect to canopy height, canopy spread and nut yield. The differences were insignificant in general with respect to flowering duration, apple weight, mean nut weight and shelling percentage.

Table 2.6 : The influence of different levels of drip irrigation on yield parameters of cashew at Hogalagere during 2016-17

Treatments	Flowering duration (Days)	Apple weight (g)	Mean nut weight (g)	Nut yield (Kg/plant)	Cumulative yield (Kg/plant) (2 harvests)	Shelling (%)	TMB Infestation
T ₁	120	31.8	6.97	2.50	3.83	28.6	Low
T ₂	124	32.0	7.07	3.00	5.32	28.3	Low
T ₃	126	33.5	7.13	3.83	6.80	27.0	Low
T ₄	125	33.0	7.24	4.00	7.47	28.6	Low
T ₅	123	35.9	7.26	4.40	8.56	27.4	Low
SEm±	2.728	0.546	0.088	0.257	0.276	0.468	-
CD@5%	8.222	1.645	0.265	0.774	0.833	1.409	-
CV	4.938	3.670	2.757	16.188	9.659	3.735	-

VENGURLE

The irrigation treatments did not significantly influence the vegetative growth attributes of cashew during 2016-17. The irrigation levels did not significantly affect the flowering and yield attributes however, the nut weight and annual nut yield were significantly influenced by irrigation levels during the year 2016-17 (Table).

The highest annual nut yield (11.06 kg/tree) was recorded under treatment T₅ (irrigation at 80% CPE) and it was found at par with treatments T₄ (10.64 kg/tree) and T₃ (9.83 kg/tree). The highest cumulative yield for last 14 harvests (78.06 kg/tree) was recorded under irrigation level at 80% CPE (T₅).

Table 2.7 : Effect of drip irrigation levels on growth parameters of cashew at Vengurle centre during the year 2016-17

Treatments	No. of flowering/panicles/m ²	Male : Bisexual flowers ratio	Nut wt. (g)	Apple wt. (g)	Annual nut yield (kg/tree)	Cum. yield (kg/tree) for 14 th harvest	Shelling (%)
T1 : No irrigation	17.35	0.13	9.35	77.00	7.53	55.17	31.00
T2 : Irrigation at 20% CPE	18.35	0.14	9.65	77.25	6.72	60.05	31.63
T3 : Irrigation at 40% CPE	18.43	0.13	9.63	81.25	9.83	64.13	31.13
T4 : Irrigation at 60% CPE	16.98	0.13	9.23	81.75	10.64	62.66	31.50
T5: Irrigation at 80% CPE	17.53	0.13	10.68	83.50	11.06	78.06	30.63
SEm ±	0.74	0.01	0.19	1.62	0.91	-	0.31
CD @ 5%	N.S	N.S	0.61	N.S	2.81	-	N.S
CV (%)	8.29	8.63	4.08	4.04	19.92	-	1.97

Hort.4: Expt. 2 High density planting – Observational trials

Centres : *East Coast* : Bapatla, Jhargram and Vridhachalam
Plains / others : Jagdalpur

The trial aims to identify the optimum population density for cashew to maximize the returns per unit area.

Experimental Details :

Planting of cashew at 4m x 4m under high density, with a control plot planted at 8m x 8m spacing with recommended fertilizer dosage.

BAPATLA

During the year 2016-17 maximum values were recorded in 4x4 m spacing with respect to the mean plant height (4.94m), mean canopy height (4.72m) and ground area coverage by canopy (150.6%), whereas 8x8m spacing recorded the highest mean trunk girth (82.69 cm), mean canopy spread (7.50 m) and mean canopy surface area (64.30m²). Flowering duration was recorded minimum in 4x4m spacing (97.0 days), whereas mean number of flowering laterals, mean number of nuts/m² and mean number of nuts per panicle was found highest in 8x8 m spacing (18.34, 16.35 and 1.97). The mean nut yield was recorded highest in 8x8 m spacing (2.56 kg/tree) and cumulative nut yield was also recorded highest in 8x8 m spacing (23.56 kg/tree) for ten annual harvests.

Table 2.8 :Yield and B: C ratio in high density trials at Bapatla Centre

Harvest	Yield (kg/ha)		Net returns (Rs/ha)		B:C ratio	
	(4m x 4m)	(8m x 8m)	(4m x 4m)	(8m x 8m)	(4m x 4m)	(8m x 8m)
1 st harvest	268.75	50.00	-8875.00	-3240.00	-0.35	-0.51
2 nd harvest	400.00	71.76	-1000.00	-1934.4	-0.04	-0.31
3 rd harvest	515.00	112.5	5350.00	-292.5	0.19	-0.04
4 th harvest	587.5	142.0	10062.50	2210.0	0.35	0.31
5 th harvest	2000.0	436.8	111875.00	23556.0	3.97	3.35
6 th harvest	1825	567.8	96500.00	31946.0	3.08	4.09
7 th harvest	1487.5	650.52	80312.5	40987.5	2.57	5.25
8 th harvest	1012.5	486.7	51000.00	18936.0	1.76	2.05
9 th harvest	662.50	605.28	28750	23422	0.43	1.42
10 th harvest	562.50	399.36	26250	19936	0.60	1.00

JHARGRAM

Table 2.9 : Growth parameters of cashew in normal and high density planting at Jhargram centre during the year 2016

Spacing	Mean tree height (m)	Mean stem girth (cm)	Mean canopy diameter (m)	Mean canopy surface area (m ²)	Ground coverage by canopy (%)
4m x 4m	3.8	40.4	3.8	16.4	71.9
8m x 8m	4.3	54.3	6.3	43.0	48.5

** Yield Data could not be recorded due to heavy loss of crop due to devastating hail storm

Maximum plant height, canopy spread, canopy area and flowering/m² were recorded in 8m x 8m spacing. The plants spaced at 4m x 4m covered 71.9 % allotted ground area by the canopy while the canopy of the plants spaced at 8m x 8m covered 48.5 % of the allotted ground area of 64 m². It means the plants spaced at 4m x 4m required heavy pruning for enough light penetration and air circulation in the canopy.

Hort.6 : Intercropping in Cashew

Centres: *East Coast* : Bapatla, Jhargram and Vridhachalam
West Coast : Madakkathara, Paria and Vengurla
Plains / others : Kanabargi and Darisai

The objectives of this trial are to identify compatible intercrops with cashew in the initial stages of orchard development, to study the economic benefits of inter-cropping system, and to work out a soil fertility management strategy for the intercropping system.

Experimental Details :

Main plot : 4
 Sub plots : 3
 F0 = No additional fertilizer to the intercrop
 F1 = Additional fertilizer to the intercrop as per the state recommendation
 F2 = 50% of additional fertilizer applied to the intercrop
 No. of replications : 3
 Design : Split plot

DARISAI

Table 2.10 : Yield and economics of cashew and intercrops Darisai, during the year 2017

Treatment Details	Mean Yield of inter crop	Mean Yield of cashew	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				B:C
	Q/ha	Q/ha	Cash ew	Inter-crop	Cashew + Intercrop	Cash ew	Inter-crop	Total	Net Profit	Ratio
T1	110.5	5.60	47,200	40,500	87,700	84,000	1,32,600	2,16,600	1,28,900	1.47
T2	225.40	6.24	47,200	48,800	93,600	91,200	1,25,400	2,19,000	1,23,000	1.31
T3	45.80	5.44	47,200	24,750	81,600	81,600	1,14,500	1,96,600	1,24,150	1.52
T4	56.70	5.82	47,200	36,650	83,850	89,300	1,13,400	2,02,700	1,18,850	1.42
T5	---	4.95	47,200	---	47,200	89,250	---	89,250	89,250	1.89

Treatment Details:-

- T1- Cashew (Var.V4) + Tomato (Var. swarn Samridhi)
- T2- Cashew (Var.V4) + Cabbage (Var. golden acre)
- T3- Cashew (Var.V4) + Frenchbean (Var. arka komal)
- T4- Cashew (Var.V4) + Pea (Var. arkel)
- T5- Cashew (Var.V4)

Selling Price :

Cashew Rs.150 /kg, Tomato Rs.12/kg, Cabbage Rs.10/kg, Frenchbean Rs.25/kg, Pea Rs.20/kg.

Conclusion : From the data, it appears that cashew alone is profitable and growing intercrops at the prevailing rates is not that economical.

JHARGRAM

Cashew Variety BPP - 8 spaced at 6m x 6m and cowpea, okra, pumpkin and brinjal were grown as intercrops under the 6 year old plantation leaving 2.0m space from the base of the cashew plants. The available space for intercrops was 41.61%. Cost - Benefit ratio revealed that at the age of 6 year vegetable crops are not remunerative under cashew plantation. The treatments were equivalent in terms of their response.

Table 2.11 : Yield and economics of cashew and intercrops in intercropping trial at Jhargram Centre during the year 2017

Treatment details	Yield of intercrop	Yield of cashew *	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				B:C Ratio
	Q/ha	Q/ha	Cashew	Inter-crop	Cashew + Intercrop	Cashew	Inter-crop	Total	Net	
Cashew + Cowpea	7.46	15.89	15000	7200	22200	174837	7455	182292	160092	7.21
Cashew + Okra	9.19	11.46		4400	19400	126065	9185	135250	115850	5.97
Cashew + pumpkin	18.28	10.66		3600	18600	117297	10970	128266	109666	5.90
Cashew + brinjal	8.17	10.85		6400	21400	119317	9798	129115	107715	5.03
Cashew alone		11.69				15000	128573	0	128573	113573

Price of intercrop

Cowpea : Rs.10/Kg
 Okra : Rs. 10/Kg
 Pumpkin : Rs. 6/Kg
 Brinjal : Rs. 12/Kg
 Cashew : Rs. 110 /Kg

Available area for intercropping (Age 5 years) : 41.61%
 Ground Coverage by canopy of cashew trees : 58.39%

KANABARGI

The trial was laid out for sixth year by planting six intercrops in the existing cashew plantation (Planted in the year 1992 and limb pruned) spaced at 6m x 6m apart at Horticultural Research & Extension Station, Kanabargi, Belgaum. Protective irrigation was given during longer dry spells. Intercrops included for the study were *Coleus (Plectranthus forskohlii)*, cowpea (*Vigna unguiculata*),

ginger (*Gingiber officinale*), ground nut (*Arachis hypogea*), sweet potato (*Ipomea batatas*) and turmeric (*Curcuma longa*) in a plot of 6 m x 4 m size.



Sweet Potato



Coleus



Turmeric

Table 2.12 : Yield of intercrops in cashew based intercropping system at Kanabargi

Intercrop	Estimated yield (q/ha)						Mean
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	
Coleus (Dry yield)	14.03 (5.05)*	13.50 (4.91)	12.18 (4.39)	10.55 (3.8)	8.38 (3.02)	7.5 (2.5)	11.02 (2.26)
Cowpea	9.54 (3.80)	11.28 (4.10)	10.83 (3.90)	9.99 (3.60)	8.89 (3.20)	6.56 (2.24)	9.52 (3.47)
Ginger (Fresh yield)	93.80 (30.17)	77.44 (28.16)	77.22 (27.80)	74.71 (26.90)	60.83 (21.90)	62.29 (21.98)	74.38 (26.15)
Ground nut	17.81 (6.27)	14.19 (5.16)	16.11 (5.80)	15.69 (5.65)	9.30 (3.35)	8.33 (2.8)	13.5 (4.84)
Sweet Potato	136.67 (49.20)	126.78 (46.10)	116.98 (42.11)	121.01 (43.60)	78.88 (28.40)	68.65 (23.53)	108.16 (38.82)
Turmeric (Processed)	23.75 (8.55)	22.05 (8.02)	21.25 (7.65)	21.94 (7.90)	18.61 (6.70)	18.75 (6.71)	21.06 (7.59)

Among the different inter crops used highest yield was obtained in sweet potato (108.16 q/ha) followed by ginger (74.38 q/ha). Minimum yield was recorded in cowpea (9.52 q/ha).

Table 2.13 : Yield and economics of cashew based intercropping system based on mean yield at Kanabargi.

Intercrop	Estimated yield (q/ha)	Cost of cultivation of intercrop (Rs/ha)	Total returns from intercrops (Rs./ha)	Net profit from intercrop (Rs./ha)
Coleus (Dry yield)	7.5	41805	90000	48195
Cowpea	6.56	15555	29520	13965
Ginger (Fresh yield)	62.29	99791	174412	74621
Ground nut	8.33	17500	33320	15820
Sweet Potato	68.65	35416	58352	22936
Turmeric (Processed)	18.75	101388	145312	43924

Coleus @ Rs. 12,000/q,
Ground nut @ RS. 4000/q,
(Rates as per APMC website)

Cow pea @Rs. 4500/q,
Sweet potato Rs. 850/q,

Ginger @Rs. 2800/q,
Turmeric @ Rs. 7750/q

Highest net profit from intercrops was recorded in Ginger (Rs. 74,621) followed by Coleus (Rs. 48,195) and Turmeric (Rs. 43,924) whereas minimum was recorded in cowpea (Rs.13, 965)

Table 2.14 :Mean cashew nut yield per tree as influenced by intercropping systems.

Intercropping system	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Mean
Cashew + Coleus	4.30	5.80	6.90	6.79	7.35	8.82	6.66
Cashew + Cowpea	4.60	6.00	7.10	7.18	7.44	8.86	6.86
Cashew + Ginger	4.40	5.90	7.00	6.88	7.06	8.51	6.63
Cashew + Ground nut	4.70	6.20	7.40	7.15	7.40	8.35	6.87
Cashew + Sweet potato	4.50	5.60	6.70	6.48	6.95	8.50	6.46
Cashew + Turmeric	4.70	6.10	7.30	6.88	7.15	9.25	6.90
Cashew alone	4.10	5.20	6.20	6.28	6.71	9.50	6.33
S.Em±	0.07	0.28	0.17	0.09	4.85	-	-
C.D. at 5%	0.22	NS	0.52	0.53	NS	NS	-

Mean cashew nut yield was significantly influenced by different intercrops. Highest cashew yield per plant was recorded when inter cropped with turmeric (6.90 kg/plant) followed by ground nut (6.87 kg/ plant) and cowpea (6.86kg/plant). Minimum yield was recorded in cashew alone (6.33 kg/plant).

Table 2.15 : Yield of cashew (Main crop) and economics of cashew based intercropping systems at Kanabargi

Intercropping system	Cashew nut yield (Mean)		Gross Expenditure (Main crop + Intercrop) (Rs/ha)	Gross income (Main crop + Intercrop) (Rs/ha)	Net Profit (Main crop + Intercrop) (Rs/ha)	Benefit Cost Ratio (BCR)
	Kg/tree	Q/ha (Estimated)				
Cashew + Coleus	8.83	2453.35	67305.00	396668.00	329363.00	4.89
Cashew + Cowpea	8.86	2463.08	41055.00	337405.00	296350.00	7.22
Cashew + Ginger	8.52	2367.17	125291.00	470308.00	345017.00	2.75
Cashew + Ground nut	8.35	2321.30	43000.00	323482.00	280482.00	6.52
Cashew + Sweet potato	8.50	2363.00	60916.00	353727.00	292811.00	4.81
Cashew + Turmeric	9.25	2571.50	126888.00	466749.00	339861.00	2.68
Cashew alone	9.50	2641.00	25500.00	330125.00	304625.00	11.95
C.D. at 5%	NS	NS	-	-	-	-

Net profit from main crop and intercrops was recorded from cashew + ginger intercrop (Rs. 345017) followed by cashew + turmeric inter crop (Rs. 339861). Minimum was recorded in cashew + groundnut intercrop (Rs. 280482).

Highest benefit to cost ratio was recorded in cashew alone (11.95) followed by cashew + cowpea intercrop (7.22) and cashew + ground nut (6.52) whereas minimum was recorded in Cashew + turmeric (2.68)

Conclusion

- In initial years of planting, to use open land effectively, it is profitable to grow intercrops like Ginger, Coleus and Turmeric.
- Further legumes like ground nut and cow pea can be grown to improve soil health and get additional income.

MADAKKATHARA

The influence of intercropping on the yield of main crop (cashew) was monitored. Cashew plants are at the early stage of bearing.



Patchouli (*Pogostemon cablin*)

Table 2.16 : Yield and economics of cashew and intercrops in intercropping trial at Madakkathara centre

Treatment details	Yield of intercrop	Yield of cashew	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				B :C Ratio
	Q/ha	Q/ha	Cashew	Inter-crop	Cashew + Intercrop	Cashew	Inter-crop	Total	Net	
<i>Asparagus racemosus</i>	3.10	3.40	37,000	33,330	70,330	54,400	6200	60,600	-	0.86
<i>Clitoria ternatea</i>	2.63	4.00	37,000	32,220	69,220	64,000	26,300	90,300	21,080	1.31
<i>Ayapana triplinervis</i>	3.64	4.60	37,000	32,250	69,250	73,600	6552	80,152	12,002	1.16
<i>Pogostemon cablin</i>	3.48	3.00	37,000	31,150	68150	48,000	13,920	61,920	-	0.91
<i>Ocimum sanctum</i>	1.10	3.00	37,000	32,210	69,210	48,000	2200	50,200	-	0.73
<i>Catharanthus roseus</i>	0.73	2.9	37,000	31,000	68,000	46,400	1460	47,860	-	0.70

The economic analysis of inter cropping in cashew with different medicinal plants revealed that *Clitoria ternatea* was economical followed by *Ayapana triplinervis*, with BC ratio 1.31 and 1.16 respectively. In all other medicinal plants, the BC ratio was less than one which indicates that they are not economical.

PARIA

The yield and economics of intercropping in cashew is presented in Table 2.17. The highest inter crop yield/ha (47.00 q/ha) was recorded in treatment cashew + spinach (T3) which was followed by treatment cashew + coriander (T1) and treatment cashew + fenugreek (T2) in gaining higher yield of intercrops. Highest net return of Rs. 86,789 ha⁻¹ was observed under the inter crop of coriander (T1) along with highest benefit:cost ratio of 2.89. It was followed by the inter crop of spinach (T3) with benefit:cost ratio of 2.75. The yield of cashew was found very low in almost all the treatments, which was due to pruning of low lying and out grow branches after harvest of last season i.e. 2015-16.

Table 2.17 : Yield and economics of cashew and intercrops in intercropping trial at Paria centre (2016-17).

Treat.	Yield of IC	Yield of cashew	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				B:C Ratio
	q/ha	q/ha	Cashew	IC	Cashew + IC	Cashew	IC	Total	Net	
T1: C + Coriander	45.00	1.62	10000	20000	30000	17789	99000	116789	86789	2.89
T2: C + Fenugreek	35.50	0.80	10000	20000	30000	8752	78100	86852	56851	1.89
T3: C + Spinach	47.00	0.82	10000	20000	30000	8980	103400	112380	82380	2.75
T4: C+ Amaranthus	8.50	0.34	10000	20000	30000	3775	21250	25025	-4974	-0.16
T5: Cashew alone	N.A.	0.81	10000	0	10000	8866	0	8866	-1134	-0.11

VENGURLE

The trial on intercropping with new sets of intercrops will be laid out in *Rabi* season, 2018. For initiation of said trial, the grafts of Vengurle-9 were already planted at 7 x 7m spacing in December, 2016. The details of the new sets of intercrops are as follows.

Design	:	R. B. D.
Replication	:	Four
Treatments	:	Five (5 different tuber crops) <i>T₁</i> Cashew + <i>Dolicus bean</i> (Wali) (<i>Lab lab purpureus</i>) <i>T₂</i> Cashew + Bhendi (<i>Abelmoschus esculentus</i>) <i>T₃</i> Cashew + Cowpea (<i>Vigna unguiculata</i>) <i>T₄</i> Cashew + Chilli (<i>Capsicum annum</i>) <i>T₅</i> Cashew + Brinjal (<i>Solanum melongena</i>) <i>T₆</i> Control (Cashew alone)
Sole intercrop	:	Sole intercrops will be planted near the experimental plot for comparison.
Year of start	:	The replicated trial on intercropping in cashew will be started in <i>Rabi</i> season, 2018
Cashew variety	:	Vengurle-9 planted in February, 2017
Cashew spacing	:	7 x 7 m
Package of practices	:	Recommended package of practices including recommended dose of fertilizers and plant protection will be followed for both main crop cashew and intercrops.

VRIDHACHALAM

High value transplantable Vegetable crops namely Chillies (PKM-1), Brinjal (Palur-2), and Tomato Hybrid (COTH-1) and direct sown vegetables namely bhendi hybrid (CoBh H1), and clusterbean (Pusa Navbahar) were sown as intercrops in cashew VRI-3 plot (year of planting 2013) in an area of 20 cents each during 2015-16 with good results.

The trial with same intercrops was repeated to find out the consistency of the intercrops giving more income to farmer during 2016-17 also. Sowing was done during the third week of January 2016. The results are as follows.

Table 2.18 : Yield and economics of cashew and intercrops in intercropping trial at Vridhachalam Centre - 2017

Treatment details	Yield of inter crop	Yield of cashew	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				C:B Ratio
	Q/ha	Q/ha	Cashew	Inter-Crop	Cashew + Inter crop	Cashew	Inter-crop	Total	Net	
Cashew + Chillies	45.80	4.5	12000	25000	37000	45000	45800	90800	53800	2.44
Cashew + Brinjal	50.50	4.5	12000	30000	42000	45000	50500	95500	53500	2.27
Cashew+Tomato Hybrid	65.40	4.5	12000	35000	47000	45000	65400	110400	63400	2.35
Cashew+ cluster bean	35.40	4.5	12000	18000	30000	45000	35400	80400	50400	2.68
Cashew+ bhendi	45.20	4.5	12000	18000	30000	45000	45200	90200	60200	3.01

Price: Chillies Rs. 10/Kg, Brinjal Rs. 10/Kg, Tomato Rs.10/kg, Cluster bean Rs. 10/Kg, Bhendi Rs. 10/Kg and Cashewnuts Rs. 100/Kg

The net return is higher in Cashew + Bhendi (Rs. 60200/ha) and the benefit to cost ratio is also high (3.01) in Cashew + Bhendi. All the vegetable intercrops are giving high returns (BC>2) in the initial cashew establishment periods. Though high value transplantable vegetables namely Hybrid tomato and brinjal gave high net return, the cost of cultivation is higher and BC ratio is low.

Hort. 7: Organic Management of Cashew

Centres : *East Coast :* Bhubaneswar, Jhargram and Vridhachalam
West Coast : Madakkathara and Vengurla
Plains / others : Hogalagere, Kanabargi and Jagdalpur

The objective of this trial is to evaluate and standardize an organic management schedule for cashew cultivation to optimize the returns and to work out economic feasibility of organic farming systems over conventional farming.

Treatments:

- T₁ - 100 % N as FYM
- T₂ - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g
- T₃ - 50 % N as FYM + Bio-fertilizers (200 g)
- T₄ - 100 % N as Vermicompost + Bio-fertilizers (200 g)
- T₅ - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)
- T₆ - *In situ* green manuring / green leaf manuring to meet 100 % N
- T₇ - 25 % N as FYM + Recycling of organic residue + *In situ* green manuring / green leaf manuring + Bio-fertilizers (200 g)
- T₈ - Recommended doses of fertilizer + 10 kg FYM (Control)

BHUBANESWAR

The experiment was laid out during the year 2007 in Randomized Block Design with three replications. Cashew variety H 2/16 (BPP-8) was planted at a spacing of 7m x 7m. Only farmyard manure was applied to all the plants during planting. There were significant variations among different treatments for different vegetative growth parameters under organic management at Bhubaneswar situation during 2016-17. Application of recommended dose of fertilizer (T₈) significantly produced maximum plant height (5.48m), canopy diameter (9.24m), canopy surface area (64.26m²) and ground coverage by canopy (122.82%) than rest of the treatments under study. Significant variations were observed among different treatments for nut yield and yield attributing parameters. Recommended doses of fertilizer + 10kg FYM (Control) T₈ recorded significantly highest number of panicles/m²(20.48) and nut yield of 1465.24 kg/ha).

The results of cumulative nut yield/tree at 8th harvest indicated highest nut yield in T₈ (22.48Kg/tree) followed by T₇ (22.48kg/tree) and T₂ (21.08kg/tree). The overall results observed during 2016-17 revealed the superiority of both T₈ and T₇ among the different organic sources towards cashew production.

Table 2.19 : Nut yield and yield attributing parameters of cashew under organic management at Bhubaneswar

Treatments	Mean no. of panicle s/ m ²	Mean nut weight (g)	Mean apple wt. (g)	Mean annual nut yield (kg/ha)	Cum. nut yield (Kg/tree) (8 harvests)
T ₁ - 100 % N as FYM	18.26	7.86	54.82	1024.86	17.52
T ₂ - 100 % N as FYM + Bio-fertilizers Consortium(BFC) (200 g)	19.35	8.22	61.76	1176.32	21.08
T ₃ - 50 % N as FYM + BFC (200 g)	17.51	7.92	54.18	1006.25	18.35
T ₄ - 100 % N as Vermicompost + BFC (200 g)	18.01	8.16	58.06	1102.56	18.62
T ₅ - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	18.56	7.98	53.18	1008.37	17.01
T ₆ - <i>In situ</i> green manuring / green leaf manuring to meet 100 % N	17.84	7.82	51.35	936.58	15.04
T ₇ - 25 % N as FYM + Recycling of organic residue + <i>In situ</i> green manuring / green leaf manuring + BFC (200 g)	19.52	8.24	60.25	1228.16	22.48
T ₈ - Recommended doses of fertilizer + 10 kg FYM (Control)	20.48	8.34	59.16	1465.24	29.15
Mean	18.69	8.07	56.60	1118.54	
SEm(±)	0.52	0.18	1.16	9.54	
CD at 5%	1.55	0.52	3.48	28.59	
CV(%)	4.79	3.76	3.55	1.48	

The data on economics of cashew under organic management revealed that the maximum net returns of Rs 98,410/- was obtained from treatment T₈ with recommended dose of fertilizers + 10kg FYM with B:C ratio of 3.05 and lowest in T₄ (1.62) with 100 % N as Vermicompost + Biofertilizer Consortium (200gm). The lowest benefit cost ratio is due to the high cost of vermicompost.

Shoot Tip caterpillar, inflorescence thrips, apple and nut borer were prominent pest observed during flushing, flowering and fruit setting in cashew. Incidence of tea mosquito bug was reported only in the treatment T₆, T₇ and T₈. The maximum incidence of tea mosquito bug (1.2), shoot tip caterpillar (8.4%), inflorescence thrips (47 population/inflorescence), apple and nut borer (8.5%) were recorded in the treatment T₈(Control) i.e. recommended doses of fertilizer + 10 kg FYM.

DARISAI

Table 2.20 : Yield parameters of cashew under organic management at Darisai, during 2017

Treatment	Mean flowering laterals/m ²	Mean nut wt(gm)	Mean apple wt(gm)	Mean annual nut yield kg/plant)	Cumulative nut Yield (kg/plant)for two harvest
T1 - 100 % N as FYM	17.76	7.20	56.30	2.10	4.10
T2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200g	20.54	7.70	59.70	2.75	4.40
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	18.86	7.40	56.25	2.60	4.00
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	16.30	7.70	61.80	1.90	3.90
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	18.30	7.85	63.30	1.95	3.95
T6 – In situ green manuring / green leaf manuring to meet 100 % N	19.50	7.6	57.50	2.20	3.70
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	20.85	6.9	54.80	2.90	4.50
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	22.65	8.27	65.7	3.20	4.90
SEm±	1.35	0.32	1.76	0.24	
CD(5%)	4.10	1.05	5.30	0.72	

The nut yield was highest in T₈ followed by T₇. However, they were not significantly different. Compared to other treatments, T₈ & T₇ gave highest nut yield as well as cumulative nut yield.

HOGALAGERE

Observations were recorded from the experimental plot which is in its third year of establishment. There was no significant difference among the eight treatments and TMB infestation recorded was low irrespective of the treatments.

Table 2.21 : The influence of different Organic manure sources on yield parameters of cashew at HREC, Hogalagere during 2016-17

Treatments	Flowering duration (Days)	Apple weight (g)	Mean nut weight (g)	Nut yield (Kg/plant)	Shelling %	TMB Infestation
T ₁ -100% N from locally available source (sheep manure)	104	32.2	6.38	0.85	29.7	Low
T ₂ -100% N as sheep manure + Bio fertilizer consortium (BFC) @ 200g/tree/year	102	32.5	6.25	1.10	30.7	Low
T ₃ -50% N as sheep manure + BFC @ 200g/tree/year + Rock phosphate	104	32.2	6.42	0.91	30.8	Low
T ₄ -100% N as Vermicompost + BFC @ 200g/tree/year	99	33.7	6.62	0.98	30.0	Low
T ₅ - Recycling of organic residue with the addition of 20% cowdung slurry (wt. Basis-20% weight of organic residue as cow dung slurry)	103	32.2	6.57	0.83	30.0	Low
T ₆ - In situ green manuring (retain litter + planting of Cowpea)	104	31.7	6.53	0.80	29.5	Low
T ₇ -25% as FYM + Recycling of organic residue + in situ green manuring/ green leaf manuring +BFC @200g/tree/year	102	33.8	6.58	1.19	30.6	Low
T ₈ -Recommended dose of fertilizer + 10 Kg FYM	105	34.3	6.33	1.29	30.7	Low
S.E.M±	1.971	0.924	0.164	0.165	1.054	-
CD@5%	5.980	2.802	0.496	0.500	3.196	-
CV (%)	3.321	4.876	4.384	28.724	6.033	-

JHARGRAM

There was no significant difference observed among the treatments in terms of their response on growth and yield parameters studied except number of nuts/m². Though plants were badly damaged by the hail storm during March, 2017, yet there was occurrence of second reproductive flush and the plants produced nuts. These resulted in low yield.

Table 2.22 : Yield parameters of cashew under organic management at Jhargram centre during the year 2016.

Treatment	Mean no. of panicles/ m ²	Mean no. of Nuts/ m ²	Mean nut weight (g)	Mean apple wt. (g)	Mean annual nut yield (kg/ha)	Cum. nut yield (Kg/tree) (for 8 harvests)
T1 - 100 % N as FYM	12.44	3.30	7.73	52.50	5.82	36.28
T2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	10.00	3.11	7.58	53.63	3.37	27.98
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	10.38	3.11	7.53	69.88	4.74	27.55
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	11.94	3.13	8.10	65.83	3.21	21.45
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	9.50	3.09	7.68	61.17	2.26	21.08
T6 – In situ green manuring / green leaf manuring to meet 100 % N	9.63	3.44	8.08	61.75	2.43	23.04
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	10.19	2.91	6.90	60.63	1.80	22.43
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	10.38	3.29	7.23	63.92	7.29	24.59
SEm ±	NS	3.21	NS	NS	NS	4.36
CD at 5%		6.68				9.06

KANABARGI

Highest tree height (4.83 m), trunk girth (16.83 cm), trunk height (1.06 cm) and canopy height (4.47 m) was recorded with 100% N from FYM+Bio fertilizer consortium (200g/tree/year). Similarly nut yield in kg/tree (12.72) and kg/ha (3537) was highest with 100% N from FYM+Bio fertilizer consortium (200g/tree/year) whereas least was recorded in In-situ green manuring (5.43kg/tree) and 1509.26 kg/ha (Table 2.23).

Table 2.23 :Vegetative and yield parameters of Cashew organic trial during the year 2016-17

Treatments	Tree height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height (m)	Canopy diameter (m)	Nut yield (kg/tree)	Nut yield (kg/ha)
100% N from FYM	3.11	10.77	1.01	2.68	3.49	9.87	2743.03
100% N from FYM+Bio fertilizer consortium (200g/tree/year)	4.83	16.83	1.11	4.47	4.17	12.72	3537.36
50% N from FYM+Bio fertilizer consortium (200g/tree/year)+rock phosphate	2.86	10.13	0.70	2.41	3.57	6.65	1847.50
100% N from vermi-compost + Bio fertilizer consortium (200g/tree/year)	2.75	9.68	0.61	2.28	3.85	7.73	2149.68
Recycling of organic residue with the addition of 20% cow dung slurry	2.90	10.00	0.79	2.46	3.84	8.28	2301.56
In situ green manuring	2.71	8.67	0.58	2.38	3.53	5.43	1509.26
25% N as FYM + recycling of organic residue + insitu green manuring	2.88	10.10	0.55	2.57	3.85	7.83	2176.09
Recommended dose of fertilizer	2.67	10.42	0.90	2.25	3.83	9.26	2573.26
Treatment Mean	3.09	10.82	0.78	2.69	3.77	8.47	2354.72
CD 5%	0.48	2.43	0.37	0.45	NS	2.72	755.14
S.Em±	0.16	0.81	0.12	0.15	NS	0.90	251.52

S- Significant

NS-Non Significant

MADAKKATHARA

Statistical analysis of the data recorded showed significant variations among the treatments with respect to growth parameters viz., trunk girth, canopy surface area, canopy diameter and ground coverage by canopy. The data on yield parameters are given in Table 2.24. The treatments did not vary significantly for yield characters except annual nut yield. Highest annual nut yield was recorded in T2 (6.27kg/ha) followed by T8 (6.26kg/ha). The maximum cumulative yield was recorded in T3 (16.57kg), followed by T7 (16.13kg). However, highest B: C ratio (4.42) was observed in T8 with recommended dose of

Table 2.24 : Yield parameters of cashew under organic management at Madakkathara centre during 2016-17

Treatment	Duration of flowering (days)	Mean flowering laterals/panicles m ²	Mean nut weight (g)	Mean apple weight (g)	Mean annual nut yield (kg/tree)	Cumulative nut yield (kg/tree) four harvests)	B C Ratio
	Mean						
T1 - 100 % N as FYM	113.33	8.33	7.533	75	4.69	14.61	2.81
T2 - 100 % N as FYM + Bio-fertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB) 200 g	109.00	8.66	7.1	69	6.27	15.87	3.62
T3 - 50 % N as FYM + Biofertilizers (200 g)	104.00	7.33	7.733	68	5.53	16.57	3.57
T4 - 100 % N as Vermicompost + Bio- fertilizers (200 g)	101.00	7.66	7.967	71.667	5.25	15.80	1.61
T5- Recycling of organic residue with the addition of 20 % cow dung slurry (20.0% weight of organic residue as cow dung)	106.66	6.00	7.033	65.667	5.37	15.61	4.03
T6 – In situ green manuring / green leaf manuring to meet 100 % N	107.33	6.66	6.7	68.667	4.65	15.45	2.95
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Biofertilizers (200 g)	118.00	6.66	8.367	77.667	5.97	16.13	4.14
T8 – Recommended doses of fertilizer + 10 kg FYM (Control)	112.66	7.67	7.267	47.667	6.26	15.54	4.42
CD @ 5%	NS	NS	NS	NS	1.91		
SE(m±)	-	-	-	-	0.63		

VENGURLE

It is revealed that there was no significant differences among the treatments in respect of growth attributes. The organic treatments did not significantly affect the flowering attributes such as flowering duration (days) and number of panicle/m².

The studied treatments significantly influenced the yield attributes. The treatment T₆ recorded highest nut weight of 10.10 g and it was on par with the treatments T₄, whereas the highest apple weight (85.83 g) was recorded in T₄ and it was on par with treatments T₆.

The annual nut yield was recorded maximum (1698.64 kg/ha) with T₂. It was on par with treatment T₈ and treatment T₄ while, the lowest yield of 743.24 kg/ha was obtained in T₇. The highest cumulative yield for last 6 harvests was recorded in treatment T₈ (33.98 kg/tree).

Table 2.25 : Effect of tree density and fertilizer levels on yield parameters of cashew at Vengurle centre during the year 2016-17

Treatment	Duration of flowering (days)		Flow. panicl. /m ²	Nut wt. (g)	Apple wt. (g)	Annu. nut yield (kg/ha)	Cum. nut yield (kg/tree) 6 harvests)
	Range	Mean					
T1 100 % N as FYM	79-116	98.67	16.58	9.50	81.67	1004.36	21.00
T2 100% N as FYM + Biofertilizers consortium (BCF) (200g/tree)	82-107	98.33	16.58	9.07	79.17	1698.64	28.50
T3 50% N as FYM + BCF (200g/tree) + Rock phosphate	83-98	92.67	17.92	9.43	78.33	859.52	20.73
T4 100% N as Vermicompost + BCF (200g/tree)	89-112	99.00	18.00	9.83	85.83	1382.44	26.48
T5 Recycling of organic residue with the addition of 20 % cow dung slurry (20% weight of organic residue as cow dung slurry)	82-113	95.67	17.42	9.10	71.67	762.96	14.82
T6 <i>In situ</i> green manuring /green leaf manuring to meet 100% (Retain litter +planting cowpea)	78-116	100.00	17.17	10.10	82.50	866.32	23.40
T7 25% N as FYM + Recycling of organic residues + <i>In situ</i> green manuring/green leaf manuring + BCF (200g/tree)	79-108	94.33	17.42	9.20	68.33	743.24	20.79
T8 Recommended dose of fertilizer + 10 kg FYM (Control)	81-112	97.00	18.92	9.13	78.50	1390.60	33.98
Mean	-	96.96	17.50	9.42	78.25	1088.51	23.71
SEm ±	-	2.64	0.75	0.22	2.17	193.67	-
CD @ 5%	-	NS	NS	0.65	6.57	587.42	-
CV (%)	-	4.71	7.39	3.96	4.79	30.82	-

VRIDHACHALAM

Inorganic fertilizer treatment (T₈) recorded the highest values for mean canopy diameter, mean surface area, mean flowering laterals per m², nut yield and cumulative yield followed by T₇, with 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g).

Table 2.26 : Growth parameters of cashew under organic management at Vridhachalam centre

Treatment	Mean tree height (m)	Mean stem girth (cm)	Mean canopy diameter (m)	Mean canopy surface area (m ²)	Ground coverage by canopy (%)
T1 - 100 % N as Locally available source (FYM)	5.20	56.2	6.55	60.77	33.68
T2 - 100 % N as FYM + Bio-fertilizers consortium(200 g/tree/year)	5.10	55.4	6.52	60.22	33.37
T3 - 50 % N as FYM + Bio-fertilizers Consortium (200 g) + Rock phosphate	5.02	54.2	6.75	64.54	35.77
T4 - 100 % N as Vermicompost + Bio-fertilizers consortium (200 g/tree/year)	5.04	56.4	6.82	65.89	36.51
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20 % weight of organic residue as cow dung slurry)	5.08	53.4	7.25	74.46	41.26
T6 - In situ green manuring / green leaf manuring to meet 100 % N	5.25	57.8	7.10	71.41	39.57
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers consortium (200 g/tree/year)	5.30	60.2	7.20	73.43	40.69
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	5.50	62.4	7.45	78.62	43.57
CD @ 5%	0.302	2.515	0.314	1.627	3.724
SEm±	0.096	1.153	0.176	0.824	1.755
CV %	3.40	3.25	3.24	3.75	3.24

Table 2.27 : Yield parameters of cashew under organic management at Vridhachalam

Treatment	Duration of flowering (days)		Mean flowering laterals/panicles per m ²	Mean nut weight (g)	Mean apple wt. (g)	Mean annual nut yield (kg/ha)*	Cum. nut yield (Kg/tree) (8 hvts)
	Range	Mean					
T1 - 100 % N as FYM	60-70	65	19.0	6.9	55.2	1100	32.65
T2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	59-71	65	18.0	6.9	55.0	1040	31.88
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	63-69	66	17.0	6.8	56.2	1060	30.80
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	61-71	66	16.5	6.8	55.4	1200	35.75
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	61-69	65	16.0	6.8	57.4	1120	33.95
T6 - In situ green manuring / green leaf manuring to meet 100 % N	62-70	66	19.4	6.9	55.6	1150	32.85
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	60-70	65	19.4	6.9	55.8	1240	37.45
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	64-72	68	20.8	7.1	58.0	1760	44.55
CD @ 5%		3.85	1.042	0.401	3.425	0.302	0.812
SEm±		1.821	0.503	0.192	1.385	0.132	0.344
CV %		3.30	3.421	3.25	3.413	3.321	3.402

Inorganic fertilizer treatment (T8) recorded the highest values for mean canopy diameter, mean surface area, mean flowering laterals per m², nut yield and cumulative yield followed by T 7 with 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers consortium (200 g).

Table 2.28 : Cost benefit ratio of cashew under organic management at Vridhachalam

Treatment	Materials required	Cost of Material	Cost of Cultivation	Mean annual nut yield (kg/ha)*	Income @Rs.100/ Kg of raw nuts	BC ratio
T1 - 100 % N as FYM	FYM 40 tonnes	20000	35000	1100	110000	1:3.14
T2 - 100 % N as FYM + Bio-fertilizers (Azotobacter + Azospirillum + PSB) 200 g	40 T FYM and Biofertilizers	24000	39000	1040	104000	1:2.67
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	20 T FYM & Biofertilizers	14000	29000	1060	106000	1:3.66
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	10 T Vermicompost	50000	65000	1200	120000	1:1.85
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	Organic residue collection and labour cost	15000	30000	1120	112000	1:3.73
T6 - In situ green manuring / green leaf manuring to meet 100 % N	Growing cost of green manure 3 seasons	20000	35000	1150	115000	1:3.29
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	FYM 10 tonnes + Growing cost of green manure	20000	35000	1240	124000	1:3.54
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	Urea 440 Kg SSP 150 Kg Potash 80 Kg FYM 2 T	5000	20000	1760	176000	1:8.8

The cost benefit ratio is higher (1:8.8) in T8 with recommended dose of fertilizers and lower in T4 (1:1.85) with 100 per cent Nitrogen given in the form of vermicompost. The lower benefit cost ratio was due to high cost of vermicompost.

Hort.8 : Spacing cum fertilizer trial

Centres : Plains / others : Darisai, Kanabargi, Paria and Tura

The objective of this trial is to arrive at an appropriate spacing and fertilizer doses for maximizing returns from cashew.

DARISAI



Table 2.29 : Yield parameters of cashew under spacing cum fertilizer trial at ZRS, Darisai, E. Singhbhum, BAU, Ranchi centre during the year 2017

Treatment	Mean flowering lateral/ (m ²)	Mean nut wt. (gm)	Mean apple wt. (gm)	Mean nut yield (kg/tree)	Cumulative Yield for two harvests Kg/plant
S1M1	20.30	7.14	65.2	2.1	3.2
S1M2	27.30	7.69	67.3	2.7	4.1
S1M3	21.30	7.3	64.1	2.6	3.25
S2M1	28.30	7.4	54.7	2.8	4.8
S2M2	36.30	7.8	60.7	3.4	5.6
S2M3	32.30	6.8	63.9	3.2	5.3
S3M1	26.30	6.6	50.56	2.4	3.6
S3M2	31.30	7.1	58.74	2.8	4.6
S3M3	29.30	7.6	59.64	3.1	3.8
SEm _±	2.46	0.18	3.20	0.24	0.29
CD(5%)	7.40	0.55	9.65	0.67	0.85

The treatments differed significantly for many characters including mean nut yield (kg/tree). The mean nut yield (kg/tree) was highest in the treatment S2M2 followed by S2M3.

KANABARGI

Significant difference was found among the spacing levels with respect to tree height, trunk girth, canopy diameter which was highest recorded in spacing (8m x 8m). While nut yield in kg/ha was highest with the spacing (6.5 m x 6.5 m) and the spacing (10 m x 5 m) giving 816.44 kg/ha and 729.38 kg/ha respectively.

With respect to fertilizer levels, there was significant difference for all the parameters studied which was highest with fertilizer level of 3 (117:29:29g NPK/plant/year) recording plant height (3.42m), trunk girth (11.30 cm), trunk height (0.85 m) and nut yield (4.13 kg/tree) compared to other treatments (Table).

Nut yield in kg/tree was highest with S_2F_3 (4.28 kg/tree) which was on par with S_3F_3 (4.20 kg/tree) and S_1F_2 (4.03 kg/tree) and nut yield in kg/ha was highest and also par with S_3F_3 (991.80 kg/ha) and S_2F_3 (856.58 kg/tree) (Table).

Table 2.30 : Vegetative and yield parameters in cashew as influenced by spacing cum fertilizer interaction effect during the year 2016-17

Sl. No.	Treatments	Tree height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height (m)	Canopy diameter (m)	Nut yield kg/tree	Nut yield kg/ha
1	S_1F_1	3.37	12.12	1.03	2.41	4.36	3.40	530.09
2	S_1F_2	3.08	11.79	1.17	2.41	3.94	4.03	627.99
3	S_1F_3	3.50	12.17	1.19	2.64	4.54	3.91	610.50
4	S_2F_1	3.21	11.14	0.95	2.51	3.90	3.36	671.89
5	S_2F_2	3.06	10.68	1.36	2.37	3.62	3.30	659.67
6	S_2F_3	3.58	12.82	0.99	2.75	4.57	4.28	856.58
7	S_3F_1	3.24	11.21	1.03	2.58	4.23	2.61	616.09
8	S_3F_2	3.19	10.86	1.06	2.50	4.05	3.56	841.42
9	S_3F_3	3.19	11.74	0.87	2.31	4.11	4.20	991.80
Mean		3.27	11.61	1.07	2.50	4.15	3.63	711.78
CD 5%		0.34	1.12	0.51	0.33	0.59	0.91	164.08
S.Em±		0.11	0.37	0.17	0.11	0.20	0.30	54.33

PARIA

The results on effect of different levels of spacing and fertilizers on growth and yield of cashew at Paria (2016-17) revealed that all the growth as well as yield parameters were observed to be non-significant at individual as well as interaction level.

Hort.9 : Evaluation of production potential of newly developed cashew variety Jhargram-2 at different spacing

Centres: *East Coast* : Jhargram
West Coast : Paria
Plains / others : Darisai

The objective of this trial is to arrive at appropriate spacing for Jhargram-2 at different centres

JHARGRAM

Table 2.31 : Growth parameters of Bidhan Jhargram - 2 under Spacing trial at Jhargram centre during 2017.

Treatment	Mean tree height (m)	Mean stem girth (cm)	Mean canopy diameter (m)	Mean canopy surface area (m ²)	Ground coverage by canopy (%)
T ₁ – 10m x 10m	2.76	29.20	3.46	15.57	9.47
T ₂ - 8m x 8m	3.08	28.80	3.88	20.25	18.58
T ₃ - 7m x 5m	2.82	31.40	4.07	20.72	37.53
T ₄ - 4m x 4m	3.11	26.40	3.64	19.51	65.81
SEm ±	0.09	NS	NS	NS	6.68
CD at 5%	0.19				13.90
CV%	4.46				28.76

** Yield Data could not be recorded due to heavy loss of crop due to devastating hail storm on March, 5th, 2017

The records on growth parameters depicted that the treatments were significantly different with respect to tree height and ground coverage. The plants under 4m x4m were the tallest followed by 8m x 8m. In three years, canopies of the plants spaced at 4m x4m had covered 65.81% of the allotted ground area while plants with 10m x 10m spacing only 9.47 % area had been covered by the canopy. It means that plants under 4mx4m spacing needed heavy pruning from the initial years for proper flowering and fruiting.



III. CROP PROTECTION

III. CROP PROTECTION

Ent. 1: Chemical Control of pest complex in cashew Expt. 3. Evaluation of insecticides for control of TMB and other insect pests

Centres : *East Coast* : Bapatla, Bhubaneshwar, Jhargram and Vridhachalam
West Coast : Madakkathara, Vengurla and Paria
Plains / others : Hogalagere, Kanabargi and Jagdalpur

The project aims at identifying the effective insecticide amongst the newer synthetic insecticides in comparison with recommended spray schedule, which are safer as well as economically feasible for managing the insect pests of cashew.

Treatment details:

T1- Thiamethoxam (0.1 and 0.2 ml/L)
T2- Carbosulfan (2 ml/L)
T3- Buprofezin (2 ml/L)
T4- *Beauveria bassiana* WP (1g/L)
T5- *Beauveria bassiana* WP (5 g/L)
T6- L-cyhalothrin (0.6 ml/L)
T7- Untreated check

BAPATLA

Table 3.1 : Efficacy of different insecticides against pest complex in Cashew at Bapatla centre

	Treatment	Leaf and blossom webber damaged shoots (%)		Shoot tip caterpillar damaged shoots (%)		Apple and Nut Borer damage (%)	Leaf miner Damage (%)	
		Before spray	30 days after 3 rd spray	Before spray	30 days after 3 rd spray	30 days after 3 rd spray	Before spray	30 days after 3 rd spray
T ₁	Thiamethoxam 25 WG (0.1 g/l)	24.87 (29.85)	14.52 ^{cd} (22.26)	26.76 (31.11)	21.99 ^e (27.83)	20.38 ^{cd} (26.81)	15.68 (23.28)	13.65 ^{bc} (21.63)
T ₂	Thiamethoxam 25 WG (0.2 g/l)	26.39 (30.86)	13.22 ^{bc} (21.04)	27.54 (31.51)	17.73 ^{cd} (24.52)	18.86 ^c (25.65)	15.06 (22.45)	11.34 ^b (19.63)
T ₃	Carbosulfan 25 EC (2 ml/l)	25.19 (30.07)	12.36 ^{bc} (20.55)	28.57 (32.20)	15.21 ^b (22.61)	18.29 ^c (25.24)	16.47 (23.72)	10.41 ^b (18.77)
T ₄	Buprofezin 25 SC (2 ml/l)	26.21 (30.77)	15.70 ^{cd} (23.29)	30.06 (33.14)	21.70 ^{de} (27.55)	23.57 ^d (29.03)	14.99 (22.58)	16.53 ^c (23.93)
T ₅	<i>Beauveria bassiana</i> WP (1 g/l) IIHR Product	29.90 (33.08)	21.12 ^e (27.26)	33.29 (35.12)	25.21 ^e (30.04)	20.97 ^{cd} (27.22)	15.71 (23.29)	17.07 ^{cd} (24.37)
T ₆	<i>Beauveria bassiana</i> WP (5 g/l) IIHR Product	28.26 (32.07)	18.60 ^{cd} (25.46)	34.21 (35.74)	23.27 ^e (28.79)	17.08 ^c (24.37)	14.73 (22.52)	16.13 ^c (23.60)
T ₇	λ – Cyhalothrin 5 EC (0.6 ml/l)	25.67 (30.33)	6.18 ^a (14.26)	26.93 (31.11)	9.43 ^a (17.78)	5.72 ^a (13.78)	16.17 (23.65)	2.59 ^a (9.02)
T ₈	Monocrotophos	27.25	10.22 ^b	32.16	13.04 ^{ab}	11.21 ^b	17.47	4.06 ^a

	36 SL (1.6 ml/l) at flushing, Chlorpyrifos 20EC (2.0 ml/l) at flowering and Profenofos 50 EC (1 ml/l) at fruit & nut development stage.	(31.43)	(18.60)	(34.50)	(20.65)	(19.52)	(24.65)	(11.52)
T ₉	Untreated check	28.30 (32.09)	27.63 ^f (31.69)	34.22 (35.76)	36.12 ^f (36.90)	29.79 ^e (32.95)	15.59 (23.19)	20.71 ^d (27.02)
	CD (0.05)	NS	3.45	NS	3.05	3.25	N.S.	2.95
	SEm±	0.74	1.18	1.62	1.04	1.11	1.57	1.01

Figures in parentheses are arc sin transformed values

Figures followed by same alphabet (s) are not differing significantly at 5% level.

During the year 2016-17, the activity of different important foliage, flower and nut feeding pests of cashew was medium. Treatment T₇ (λ -Cyhalothrin 0.6 ml/l) was found to be effective in controlling the Leaf and Blossom Webber followed by the treatment T₈ (Monocrotophos 36 SL (1.6 ml/l) at flushing, Chlorpyrifos 20 EC (2.0 ml/l) at flowering and Profenofos 50 EC (1 ml/l) at fruit & nut development stage).

With regard to Shoot tip caterpillar, T₇ (λ -Cyhalothrin 0.6 ml/l) was found to be more effective compared to rest of the treatments and was on par with the treatment T₈ (Monocrotophos 36 SL (1.6 ml/l) at flushing, Chlorpyrifos 20 EC (2.0 ml/l) at flowering and Profenofos 50 EC (1 ml/l) at fruit & nut development stage).

The treatment T₇ (λ -Cyhalothrin 0.6 ml/l) offered better control against Apple and nut borer damage followed by T₈ (Monocrotophos 36 SL (1.6 ml/l) at flushing, Chlorpyrifos 20 EC (2.0 ml/l) at flowering and Profenofos 50 EC (1 ml/l) at fruit & nut development stage).

With regard to leaf miner the treatment T₇ (λ -Cyhalothrin 0.6 ml/l) and T₈ (Monocrotophos 36 SL (1.6 ml/l) at flushing, Chlorpyrifos 20 EC (2.0 ml/l) at flowering and Profenofos 50 EC (1 ml/l) at fruit & nut development stage) was found to be effective in reducing the pest population and damage on leaf.

Population of ants and spiders were maximum in untreated check. However, among the treated plots the treatment T₅ (*Beauveria bassiana* WP @ 1 g/l), the treatment T₄ (Buprofezin 25 SC @ 2 ml/l) and T₆ (*Beauveria bassiana* WP @ 5 g/l) recorded maximum population of ants and spiders at 30 days after 3rd spray.

BHUBANESWAR

Shoot tip caterpillar (STC), leaf miner, red banded foliage thrips, inflorescence thrips (yellow and black) and apple and nut borer were predominant pests observed during flushing, flowering and fruiting period in cashew. The incidence of TMB occurred for a short period (2nd week of March) in very low intensity. Significant control of TMB and other pests were made through insecticide application as compared to untreated control.

The intensity of damage made by TMB varied from 1.03 to 1.22 (0-4 scale) over the treatments and was found non significant before application of insecticides. Among the treatments, the least incidence 0.89 was observed in T6 followed by 0.98 in T2 and were at par at 15 days after spray. However, the T6 was found most effective (0.49) while the damage level varied between 1.17 – 1.55 among the insecticides at 30 days after spray and the untreated control tree recorded 1.98 damage score.

The incidence of shoot tip caterpillar varied from 6.12 to 6.78 per cent damaged shoot before insecticide application and was found non significant among the treatments. The percent damaged shoot varied between 3.82 and 6.16 among the insecticidal treatments at 7 days after spray, the lowest being observed in T6. The STC incidence was further reduced at 15 days after spray in treatments T6 (1.11), T2 (1.87) and T5 (2.4) % damaged shoot. Incidence of leaf miner varied from 18.67 to 23.2 per cent damaged leaf before spray and was non significant. Damaged leaf by leaf folder was the lowest in treatment T6 (1.41 %) closely followed by T1, T2 and T5 while untreated control recorded 21.39 per cent damaged leaf at 15 days after 3rd spray.

Population of red banded foliage thrips (*Selenothrips rubrocinctus*) was comparatively higher during the year under report varying from 51.75-62.88 per leaf before spray. Most of the insecticides were found effective against the thrips as compared to untreated control. However, T6, T1 and T2 were found most effective in controlling red banded thrips observed in 7 and 15 days after application.

Population of inflorescence thrips varied from 5.34 – 6.51 per inflorescence before the insecticidal treatment and was non significant. Lowest population of IT was observed in T1 (0.89) closely followed by T2 and T6 and were at par as compared to 8.84 per inflorescence in case of untreated control.

Significant variation in Apple and nut borer incidence was found among the insecticidal treatments, the most effective being T7 (0.97) followed by T5 and T2. The untreated check recorded 7.68% damaged fruits.

Cashew nut yield per tree varied from 2.25 – 3.52 kg / tree in the treated plot as compared to 1.92 kg/tree in the untreated control. Highest cashewnut yield was recorded from T6 (3.52 kg / tree). Treatments viz. T1, T2 and T6 produced significantly higher yield among the insecticides with 55.21 to 83.33 % yield increase over the control. Spider population varied from 1.49- 4.77 among the treatments and were significantly different.

Highest spider population was recorded in T4 (4.77 per inflorescence) which was at par with control. Treatments T3 and T5 also had higher population of spider per inflorescence. With respect to coccinellid predators, highest population per laterals was observed in T4 (2.18) followed by T5 (1.76) and T3 (1.52). The population of these predatory class were minimum in all the synthetic group of insecticide (T2 and T6).

Table 3.2: Effect of Insecticides against insect pest complex in cashew*

Treatments	Dose ml/gm per l of water	STC (BS) **	STC (7DAS)	STC (15 DAS)	LM (BS) (% DL)	LM (15DAS) %DL)
T1 Thiamethoxam	0.2gm/l	6.45 (2.53)	3.9 (1.97)	3.84 (1.96)	20.72 (4.54)	2.73 (1.62)
T2 Carbosulfan	2ml/l	6.12 (2.47)	3.84 (1.86)	1.87 (1.36)	23.2 (4.81)	2.63 (1.61)
T3 Buprofezin	2ml/l	6.33 (2.51)	6.16 (2.48)	8.34 (2.87)	20.85 (4.55)	6.91 (2.62)
T4 B. bassiana	1g/l	6.78 (2.6)	5.94 (2.44)	4.97 (2.23)	20.14 (4.48)	6.31 (2.5)
T5(B. bassiana)	5g/l	6.25 (2.5)	3.85 (1.96)	2.4 (1.54)	21.24 (4.61)	2.82 (1.66)
T6 L. Cyhathrin-Profenophos	0.6ml/l	6.35 (2.52)	3.82 (1.95)	1.1 (1.03)	21.0 (4.57)	1.41 (1.18)
T7 Untreated control	-	6.58 (2.56)	6.97 (2.64)	8.92 (2.99)	18.67 (4.56)	21.39 (4.62)
	SEm(±)	NS	0.05	0.1	NS	0.14
	CD(0.05)		0.14	0.29		0.40

* mean of 4 replications, ** Value in parentheses are square root transformed values
STC- Shoot Tip Caterpillar, LM- Leaf Miner

Table 3.3 : Effect of insecticide on yield and natural enemies

Treatment	Yield (kg/tree)	Yield over control	Spider	Coccinellid
T1 (Thiamethoxam) 0.2g/l	2.98	55.21	2.67 (1.63)	1.31 (1.1)
T2 (Carbosulfan) 2ml/l	3.15	64.06	1.49 (1.21)	0.64 (0.76)
T3 (Buprofezin) 2g/l	2.41	25.52	3.44 (1.85)	1.52 (1.21)
T4 (B. bassiana) 1g/l	2.25	17.19	4.77 (2.18)	2.18 (1.45)
T5 (B. bassiana) 5g/l	2.41	25.52	4.05 (2.01)	1.76 (1.31)
T6 (L. Cyhathrin) 0.6g/l-Profenophos	3.52	83.33	1.7 (1.29)	0.93 (0.95)
T9 (Untreated Control)	1.92	55.21	4.66 (2.16)	3.16 (1.78)
	SEm(±)	0.15	0.07	0.12
	CD(0.05)	0.44	0.22	0.35

* mean of 4 replications, ** Value in parentheses are square root transformed values

HOGALAGERE

The population of tea mosquito bug (TMB) on shoots and panicles ranged between 1.21 to 1.63 and 1.20 to 1.60, respectively before spraying the insecticides. The TMB damage at 7 days and 15 days after the spray ranged from 0.55 to 1.47 and 0.13 to 1.59 on young shoots and 1.18 to 1.56 and 0.62 to 1.37 on panicles (Table 3.4). In both cases, the damage on shoots and panicles at 7 days and 15 days after each spray was significantly reduced in the treatment sprayed with Thiamethoxam 25 WG (0.2g/l) in all the sprays. This was followed by Lambda cyhalothrin 5 EC (0.6ml/l) and Carbosulfan 25EC (2ml/l) in all the three sprays. Whereas, the treatment with IIHR strain of *Beauvaria bassiana* (1 & 5 g/l) and Buprofezin (2 ml/l) were found least effective in controlling the TMB. The maximum nut yield was recorded in the treatment Thiamethoxam 25 WG (0.2g/l) (8.12 kg/tree) followed by Lambda cyhalothrin 5 EC (0.6ml/l) (7.38 kg/tree) (Table 3.4). The minimum yield was recorded in IIHR strain of *Beauvaria bassiana* (1 & 5 g/l) and Buprofezin (2 ml/l) treatments. The results on efficacy of different treatments against apple and nut borer, thrips and aphids indicated similar trend in management of these pests on cashew and recording enhanced nut yield (Table 3.5). However the maximum spider and predatory coccinellid population was recorded in treatment *Beauvaria bassiana* (1 & 5 g/l) followed by Buprofezin (2ml/l) treatments (Table 3.5) as compared to remaining treatments.

Table 3.4 : Efficacy of different insecticides against Tea Mosquito Bug (TMB) incidence in cashew at HREC, Hogalagere centre during 2016-17

Treatments	TMB incidence on 52 leader shoots/panicles at different days after spray (DAS)						Mean	Nut yield (Kg/tree)
	On shoots			On Inflorescence				
	BS	7	15	BS	7	15		
T ₁ Thiamethoxam 25WG (0.1 g/l)	1.47	0.70	0.70	1.47	1.56	0.77	1.11	5.50
T ₂ Thiamethoxam 25 WG (0.2 g/l)	1.21	0.72	0.13	1.30	1.19	0.72	0.88	8.12
T ₃ Carbosulfan 25 EC (2 ml/l)	1.37	0.74	0.42	1.37	1.31	0.88	1.01	6.54
T ₄ Buprofezin 25 SC (2 ml/l)	1.30	0.78	0.57	1.40	1.32	0.85	1.04	6.27
T ₅ <i>Beauvaria bassiana</i> (IIHR strain) (1 g/l)	1.45	0.70	0.70	1.45	1.41	0.71	1.07	5.07
T ₆ <i>Beauvaria bassiana</i> (IIHR strain) (5 g/l)	1.63	0.77	0.76	1.60	1.53	0.76	1.18	5.77
T ₇ L - Cyhalothrin 5EC @ 0.6ml/l)	1.50	0.55	0.33	1.34	1.37	0.62	0.95	7.38
T ₈ Untreated control	1.54	1.47	1.59	1.20	1.18	1.37	1.39	4.87
SE.m	0.13	0.05	0.05	0.11	0.09	0.05	-	0.41
CD at 5%	0.38	0.15	0.14	0.33	0.28	0.15	-	1.23
CV (%)	17.73	12.35	14.25	15.83	13.53	11.57	-	13.22

* TMB – Tea Mosquito Bug, BS-Before spray, DAS- Days after spray

Table 3.5 : Efficacy of different insecticides against pest complex in cashew at HREC Hogalagere centre during 2016-17

Treatment		Incidence of different pests on 52 leader shoots / inflorescence					
		Apple and nut borer		Thrips		Aphid	
		BS	15 DAS	BS	15 DAS	BS	15 DAS
T ₁	Thiamethoxam 25WG (0.1 g/l)	2.29	1.91	1.56	0.99	1.56	0.86
T ₂	Thiamethoxam 25 WG (0.2 g/l)	2.87	1.10	1.78	0.32	1.34	0.31
T ₃	Carbosulfan 25 EC (2 ml/l)	2.45	1.34	1.45	0.63	1.91	0.63
T ₄	Buprofezin 25 SC (2 ml/l)	2.26	1.57	1.19	0.64	1.98	0.78
T ₅	<i>Beauveria bassiana</i> (1 g/l)	2.25	1.90	1.45	1.25	1.49	0.77
T ₆	<i>Beauveria bassiana</i> (5 g/l)	2.27	1.62	1.08	0.76	1.79	0.80
T ₇	L - Cyhalothrin 5 EC @ 0.6ml/l)	2.16	1.32	1.40	0.60	0.99	0.32
T ₈	Untreated control	2.33	2.38	1.79	1.84	1.28	1.46
	SEm±	0.15	0.11	0.10	0.07	0.09	0.05
	CD at 5%	0.44	0.32	0.30	0.21	0.27	0.16
	CV (%)	12.45	12.85	13.79	15.84	11.78	14.54

JAGDALPUR

Table 3.6 : Efficacy of different insecticides against pest complex in cashew at Jagdalpur centre during the year 2016-17.

Treatments	Panicle TMB damage score	
	Before spray	30 days after 3 rd spray
T-1: Thiamethoxam (0.1 ml/l)	0.10 (1.05) ^d	0.63 (1.27) ^a
T-2: Thiamethoxam (0.2ml/l)	0.21 (1.10) ^e	0.58 (1.25) ^a
T-3: Carbosulfan (2 ml/l)	0.15 (1.07) ^d	0.85 (1.35) ^b
T-4: Buprofezin (2ml/l)	0.07 (1.03) ^{bc}	1.08 (1.44) ^d
T-5: Beauveria bassiana (1g/l)	0.00 (1.00) ^a	0.82 (1.34) ^b
T-6: Beauveria bassiana (5g/l)	0.12 (1.05) ^d	1.02 (1.41) ^c
T-7: L-cyhalothrin (0.6ml/l)	0.05 (1.02) ^b	0.60 (1.26) ^a
T-8: Untreated check	0.09 (1.04) ^{cd}	1.25 (1.49) ^e
	CD at 5%	0.01
	SEm ±	0.006
	CV(%)	1.17

The results on the efficacy of insecticides against TMB on 30 days after 3rd spray is given in Table. Infestation of TMB was nil in all the treatments during shoot stage due to low population pressure of TMB. After that, population increased gradually causing damage to the plant at panicle stage. Pretreatment infestation was minimum in treatment T5 (*Beauveria bassiana* @ 1g/l) followed by T7 (L-cyhalothrin @0.6ml/l) and T4 (Buprofezin @ 2ml/l). At 30 days after 3rd spray, treatment T2 (Thiamethoxam 0.2 ml/l) received minimum damage of 0.58 score and was on par with T7 (L-cyhalothrin 0.6ml/l) and T1(Thiamethoxam 0.1 ml/l) with the damage score of 0.60 and 0.63, respectively. Treatments T3 (Carbosulfan 2ml/l) and T5 (*Beauveria bassiana* 1g/l) were at par with each other and found best in second order. All the treatments were superior over control.

For leaf caterpillar damage, pre-treatment population was at par among treatments. At 30 days after 3rd spray, significantly minimum damage of 4.97 per cent was recorded in treatment T6 (*Beauveria bassiana* @ 5g/l) which was significantly superior over all the treatments. Treatment T7 (L-cyhalothrin) was second best treatment in terms of controlling leaf caterpillar. All the treatments were significantly superior over control. In leaf folder damage, pretreatment population was also at par among treatments. At 30 days after 3rd spray, treatment T6 (*Beauveria bassiana* @ 5g/l) gave minimum damage with 9.84 per cent and was significantly superior over all the treatments. Treatments T1, T2, T3 and T4 were at par with each other and superior over control.

In Leaf miner damage, significant difference was recorded among treatments during pretreatment observation. Significant minimum incidence of 4.19 per cent recorded when crop was treated with T4 (Buprofezin 2ml/l) which was on par with T2 (Thiamethoxam 0.2ml/l) with 4.81 per cent at 30 days after 3rd spray. Treatment T3 and T6 were the next best insecticides giving the minimum incidence. All the treatments were significant superior over untreated control. In nut thrips damage, there was significant difference among the treatments during pretreatment observation. At 30 days after 3rd spray, treatment T2 (Thiamethoxam 0.2ml/l) having significant minimum damage with 0.49 score which was on par with T7 (L-cyhalothrin 0.6ml/l) with 0.50 score. All the treatments were significantly superior over control.

Population of natural enemies was also recorded at 30 days after 3rd spray. Population of all natural enemies was higher in untreated trees. Among the treatments, spider found maximum in number with 0.95 spider/tree in T2 (Thiamethoxam 0.2 ml/l) which was statistically at par with T7 (L-cyhalothrin 0.6ml/l) with 0.77 spider/tree. The lady bird beetle population was significantly maximum (0.16 number/tree) in T6 (*Beauveria bassiana* 5g/l) over all the treatments. Treatments T1 (Thiamethoxam 0.1 ml/l), T2 (Thiamethoxam 0.2 ml/l), T4 (Buprofezin 2ml/l) and T5 (*Beauveria bassiana* 1g/l) received significantly maximum population of *Brumus* sp. with 0.21, 0.14, 0.13 and 0.13 number/tree, respectively.

JHARGRAM

Table 3.7 :Efficacy of insecticides against pest complex in cashew at Jhargram

Treatment	Before spray		After first spray		After second spray	
	LBW	LM	LBW	LM	LBW	LM
Thiamethoxam 0.1g/L	12.22 (20.45)	7.25 (15.61) ^b	8.84 (12.62) ^{bc}	3.41 (10.63) ^b	2.96 (9.66) ^b	2.04 (8.20) ^{bc}
Thiamethoxam 0.2 g/L	12.10 (20.35)	7.40 (15.78) ^b	4.27 (11.87) ^{bc}	2.76 (9.52) ^{bc}	1.40 (5.46) ^b	1.18 (6.23) ^c
Carbosulfan @2 ml/L	12.35 (20.57)	7.25 (15.60) ^b	4.37 (12.02) ^{bc}	3.69 (10.94) ^b	1.77 (7.56) ^b	1.87 (7.74) ^{bc}
Buprofezin @2ml/L	12.20 (20.43)	7.37 (15.74) ^b	3.91 (11.29) ^{bc}	2.68 (9.40) ^{bc}	1.55 (6.88) ^b	2.02 (8.07) ^{bc}
<i>Beauveria bassiana</i> @1g/L	12.18 (20.41)	7.32 (15.68) ^b	6.12 (14.26) ^{bc}	3.90 (11.36) ^b	3.34 (10.19) ^b	2.73 (9.48) ^b
<i>Beauveria bassiana</i> @5g/L	12.33 (20.55)	7.72 (16.12) ^b	4.91 (12.75) ^{bc}	3.03 (10.01) ^{bc}	1.97 (8.02) ^b	1.10 (6.02) ^c
Lamda cyhalothrin @0.6ml/L	12.26 (20.49)	7.99 (16.41) ^b	2.94 (9.82) ^c	2.05 (8.14) ^c	0.00 (0.00) ^c	0.38 (3.29) ^d
Untreated Control	12.11 (20.35)	13.04 (21.15) ^a	14.57 (22.41) ^a	12.20 (20.42) ^a	10.37 (18.70) ^a	9.33 (17.69) ^a
	0.88	1.49	3.88	2.94	6.61	2.34

Figure in the parentheses are arc sin transformed values.

• LBW – Leaf and Blossom Webber, LM – Leaf Miner

All the insecticidal treatments were found to be superior to the untreated check. T7 (L-cyhalothrin 0.6ml/litre) treatment was recorded as most effective against the leaf and blossom webber followed by the rest of the treatments and also found statistically at par after 30 days of 1st and 2nd round of spray. The result revealed that minimum leaf miner infestation was noticed in T7 treatment i.e. lambda cyhalothrin @ 0.6ml/lit followed by T2, T4 and T6 treatment while T1, T3 and T5 treatments were least effective after 30 days of 1st spray and almost same trend was noticed after 2nd round of spray.

KANABARGI

The population of tea mosquito bug (TMB) on shoots and panicle ranged between 1.32 to 1.71 and 1.30 to 1.61, respectively at before spraying the insecticides, the TMB damage at 7 and 7days and 15 days after the spray ranged from 0.52 to 1.65 and 0.35 to 1.80 on shoots and 0.71 to 1.83 and 0.65 to 1.58 on inflorescence were recorded. In both the cases the damage on shoots and inflorescence were reduced due to spray at 7 and 15 days interval.

Table 3.8 : Efficacy of different insecticides against tea mosquito bug incidence in cashew during 2016-17

Treatments		TMB damage on 52 leader shoots / inflorescences at diff. days after spray						Mean damage	Nut yield (Kg/tree)
		On shoots			On Inflorescences				
		BS	7	15	BS	7	15		
T ₁	Thiamethoxam 25WG (0.1 g/l)	1.71	0.87	0.84	1.61	1.82	0.81	1.09	5.43
T ₂	Thiamethoxam 25 WG (0.2 g/l)	1.54	0.52	0.35	1.42	0.71	0.65	0.55	7.49
T ₃	Carbosulfan 25 EC (2 ml/l)	1.33	0.75	0.46	1.51	1.50	0.94	0.91	6.46
T ₄	Buprofezin 25 SC (2 ml/l)	1.32	0.70	0.61	1.44	1.15	0.89	0.83	6.34
T ₅	<i>Beauveria bassiana</i> (1 g/l)	1.60	0.61	0.59	1.40	1.83	0.80	0.95	5.25
T ₆	<i>Beauveria bassiana</i> (5 g/l)	1.46	0.69	0.65	1.55	1.62	0.77	0.93	5.59
T ₇	L - Cyhalothrin 5 EC @ 0.6ml/l)	1.51	0.82	0.13	1.30	1.42	0.67	0.76	6.62
T ₈	Untreated control	1.4	1.65	1.80	1.38	1.33	1.58	1.59	4.81
	CD at 5%	NS	1.14	0.64	NS	0.86	0.82	-	0.25

MADAKKATHARA

Tea mosquito bug damage

Tea mosquito bug intensity was very low during the season. The spray was imposed only once during the flowering period. At seventh day after second spray, the damage on shoot was practically nil in all the treatments as evidenced from the score value (Table 3.9). However, all the treatments were significantly superior to control. At 15th day of second spray, same trend was observed with the exception that thiamethoxam @ 0.1 g/l was also on par with control.

On panicle, at seventh day after second spray, all the treatments except carbosulfan were significantly superior to control. At 15th day, the damage score was nil in both *Beauveria bassiana* @5g/l (ICAR-IIHR formulation), carbosulfan and KAU POP. The damage score in the remaining treatments were comparatively less and they were superior to control.

Insect pests other than tea mosquito bug

Insect pests other than tea mosquito were practically absent during the season and hence the data were not included in the report.

Influence on natural enemies

The data on the effect of insecticides on natural enemies indicated decline in population of black ant in all the trees that received insecticide treatments. There observed no significant variation in red ant population. However, control treatment harboured significantly high red ant population during second spray. Spider activity was observed in all the trees which received insecticide sprays as well as in unsprayed there was no significant difference among treatments.

Table 3.9 : Efficacy of different insecticides against tea mosquito bug incidence in cashew at Madakkathara centre during the year 2016-17 (Second spray)

Treatments		On shoots			On panicles		
		Before spray	7 days after spray	15 days after spray	Before spray	7 days after spray	15 days after spray
T1	Thiamethoxam (0.1g/l)	0.000 (0.707)	0.000 (0.707) ^b	0.036 (0.732) ^a	0.182 (0.816)	0.022 (0.721) ^b	0.025 (0.724) ^b
T2	Thiamethoxam (0.2g/l)	0.000 (0.707)	0.000 (0.707) ^b	0.000 (0.707) ^b	0.218 (0.841)	0.000 (0.707) ^b	0.011 (0.715) ^{bc}
T3	Carbosulfan (2ml/l)	0.013 (0.715)	0.000 (0.707) ^b	0.000 (0.707) ^b	0.302 (0.878)	0.052 (0.742) ^a	0.000 (0.707) ^c
T4	Buprofezin (2ml/l)	0.034 (0.731)	0.009 (0.713) ^b	0.009 (0.713) ^b	0.160 (0.804)	0.000 (0.707) ^b	0.019 (0.719) ^{bc}
T5	<i>Beauveria bassiana</i> WP (1g/l) (ICAR-IIHR formulation)	0.000 (0.707)	0.000 (0.707) ^b	0.000 (0.707) ^b	0.038 (0.733)	0.000 (0.707) ^b	0.006 (0.711) ^{bc}
T6	<i>Beauveria bassiana</i> WP (5g/l) (ICAR-IIHR formulation)	0.025 (0.724)	0.005 (0.710) ^b	0.000 (0.707) ^b	0.198 (0.829)	0.000 (0.707) ^b	0.000 (0.707) ^c
T7	L-cyhalothrin (0.6 ml/l)	0.000 (0.707)	0.000 (0.707) ^b	0.000 (0.707) ^b	0.316 (0.888)	0.000 (0.707) ^b	0.020 (0.720) ^{bc}
T8	POP, KAU	0.086 (0.760)	0.000 (0.707) ^b	0.007 (0.712) ^b	0.081 (0.761)	0.000 (0.707) ^b	0.000 (0.707) ^c
T9	Untreated check	0.071 (0.753)	0.055 (0.744) ^a	0.039 (0.734) ^a	0.185 (0.820)	0.058 (0.746) ^a	0.071 (0.755) ^a
	Mean	0.025	0.008	0.010	0.187	0.015	0.017
	SEm ±	0.022	0.006	0.007	0.065	0.017	0.009
	CD at 5%	NS	0.15	0.015	0.190	0.015	0.015
	CV%	6.09	1.69	1.98	16	4.76	2.71

Figures are adjusted mean of four replicates, Figures in paraenthesis are $\sqrt{x} + 0.5$ values
Means followed by common alphabets are not significantly different among themselves

PARIA

The population of Tea Mosquito Bug (TMB) on shoots and panicles ranged between 1.54 to 1.72 and 1.47 to 1.69, respectively before spraying the insecticides. The TMB damage score at 7 days and 15 days after the spray were ranged from 0.87 to 1.90 and 0.19 to 2.10 on shoots and 0.72 to 1.88 and 0.16 to 2.07 on panicles were recorded. All the treatments were observed to be significantly superior over the control for reducing the TMB population on shoots and panicles after spraying in insecticides. Among the insecticidal treatments, T4 (Buprofezin) was observed to be superior for the management of TMB on shoots and panicles followed by Carbosulfan application 15 days after spray. Whereas, the treatment with *Beauveria bassiana* (1 g/L) was found least effective in controlling the TMB.

Table 3.10 : Efficacy of different insecticides against tea mosquito bug incidence in cashew at Paria centre during the year 2016-17

Treatments		On shoots (%)			On panicles (%)		
		Before spray	7 days after spray	15 days after spray	Before spray	7 days after spray	15 days after spray
T1	Thiamethoxam 25% WG 1g/10 lit	1.67	1.53	1.18	1.60	1.40	1.09
T2	Thiamethoxam 25% WG 2g/10 lit	1.54	1.30	0.98	1.53	1.19	0.72
T3	Carbosulfan 25% EC 20ml/10 lit	1.58	0.87	0.21	1.69	0.81	0.23
T4	Buprofezin 25% SC 20 ml/10 lit	1.72	0.90	0.19	1.47	0.72	0.16
T5	<i>Beauveria bassiana</i> 10 g/10 lit	1.64	1.55	1.29	1.58	1.41	1.15
T6	<i>Beauveria bassiana</i> 50 gm/10 lit	1.63	1.36	0.92	1.56	1.26	0.83
T7	L-Cyhalothrin 5% EC 6 ml /10 lit	1.61	1.16	0.50	1.57	1.01	0.49
T8	Untreated control	1.60	1.90	2.10	1.61	1.88	2.07
	SEm ±	0.0391	0.0382	0.0624	0.0497	0.0346	0.0662
	CD at 5%	NS	0.12	0.19	NS	0.12	0.22
	CV(%)	4.18	5.00	11.74	4.46	4.05	11.12

The result on efficacy of different treatments against thrips indicated that all the insecticidal treatments significantly reduced the incidence of thrips over the control in cashew. In nut thrips damage, minimum damage was observed in Buprofezin (T4) with 0.18 nut thrips damage score after 3rd spray followed by the Carbosulfan. The maximum nut yield was recorded in the treatment Buprofezin followed by Carbosulfan. The minimum yield was recorded in *Beauveria bassiana* (1g/l) and Thiamethoxam treatments.

The populations of natural enemies were recorded before 3rd spray and 30th days after spraying. Maximum populations of spider and lady bird beetle within the treated trees were recorded in *Beauveria bassiana* (T6). However the maximum populations of ants were recorded in untreated control and it was at par with *Beauveria bassiana* (1 & 5 g/l).

VENGURLE

Table 3.11 : Efficacy of different insecticides against tea mosquito bug incidence in cashew at Vengurle centre during the year 2016-17

Treatments		On shoots		On panicles	
		Before spray	15 days after spray	Before spray	15 days after spray
T ₁	Thiamethoxam	0.120	0.096	0.182	0.134
T ₂	Thiamethoxam	0.148	0.149	0.173	0.178
T ₃	Carbosulfan	0.178	0.120	0.192	0.129
T ₄	Buprofezin	0.125	0.048	0.187	0.048

T ₅	<i>Beauveria bassiana</i> 1g/lit	0.139	0.158	0.178	0.178
T ₆	<i>Beauveria bassiana</i> 5g/lit	0.153	0.149	0.163	0.192
T ₇	L-cyhalothrin	0.139	0.071	0.187	0.081
T ₈	Untreated check	0.149	0.206	0.178	0.264
	SEm ±	0.011	0.011	0.006	0.008
	CD at 5%	NS	0.032	NS	0.024
	CV(%)	15.99	17.33	6.90	10.90

During the year 2016-17 the data presented in Table 3.11 showed that all the insecticidal treatment reduce the incidence of tea mosquito bug over control. Among the insecticide tested, the treatment T₄ Buprofezin recorded significantly lowest incidence of tea mosquito bug on shoot and panicle and superior over rest of the treatments. The treatment T₇ (L-cyhalothrin) found second best treatment for management of tea mosquito bug on shoot and panicle.

In case of thrips, all the insecticidal treatment reduces the incidence of thrips over control. Among the insecticide tested the treatment T₂ (Thiamethoxam) recorded the lowest incidence of thrips thirty days after third spray and significantly superior over rest of the treatments.

VRIDHACHALAM

Three round spray schedule of chemical insecticides was followed at flushing, flowering and fruit formation stages. Whereas for the entomopathogenic fungal treatment spore formulation supplied by ICAR-IIHR, Bangalore was sprayed during flushing to fruiting at the interval of 15 days. Totally five round of sprays were imposed with maximum spray suspension used per tree at 10 lit./each spray.

The data on the pest incidence for each treatment was recorded from randomly selected fresh 52 leader shoots of each tree at four sides (East, West, North, South) on 7, 15 and 30 days after each spray and the pest infestations were recorded. Observations were recorded on the infestation of TMB (damage in 0-4 scale) on flushes, TMB population (adults and nymphs), leaf miner (% infestation), leaf folder (% infestation), Leaf and blossom webber (% infestation), apple and nut borer damage (% infestation). Natural enemies population viz., Spiders, ants, coccinellids and cotesia were also recorded.

The results of evaluation of insecticides against TMB revealed that after first, second and third spraying, the efficacy of different insecticides was on par with untreated control (Table). The pre-treatment damage score of TMB was non-significant in all treatments including the untreated control. Gradual reduction of fresh infestation was observed two weeks after each round of spray. After first spray, the damage score was low (0.425) in T6 (Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays), followed by T7 (Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays) and T1 (Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays) which was at par each other. It was followed by T2 (Carbosulfan 25 EC @ 2 ml/lit. all the three sprays) and T3 (Buprofezin 25 % SC @ 2 ml/lit. all the three sprays) which was at par with each other, followed by T5 (*Beauveria bassiana* WP @ 5 g/lit.) and T4 (*Beauveria bassiana* WP @ 1 g/lit.) ranging between 0.425 and 1.275 as against 2.275 in the

After the second spray, the damage score ranged between 0.375 and 0.975 in different treatments as against an increased damage score of 3.25 in untreated control. Thirty days after third spray, the damage score decreased and ranged between 0.003 and 0.60 in various treatments as against an increased score of 3.475 in control (Table 3.12). The overall efficacy ranked in the order against the incidence of TMB and its population at Vridhachalam are as follows; T6 (Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays) > T7 (Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays) > T1 (Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays) > T2 (Carbosulfan 25 EC @ 2 ml/lit. all the three sprays) > T3 (Buprofezin 25 % SC @ 2 ml/lit. all the three sprays) > T5 (*Beauveria bassiana* WP @ 5 g/lit.) > T4 (*Beauveria bassiana* WP @ 1 g/lit.) However, all the insecticides were statistically on par to control the pest. Reduction of fresh infestation was observed when fourth and fifth spraying was given to the treated trees of T5 (*Beauveria bassiana* WP @ 5 g/lit.), T4 (*Beauveria bassiana* WP @ 1 g/lit.). The efficacy of different insecticides was at par, but statistically superior over untreated control.

Table 3.12: Efficacy of insecticides on TMB population / 52 leader shoot at Vrindhachalam

Treatment	Pre-Treatment Count /52 leader shoots	Post-treatment count (Mean TMB population/52 leader shoots)						Pre-Treatment Count /52 leader shoots	Post-treatment count (Mean TMB population/52 leader shoots)					
		I Spray			II Spray				II Spray			III Spray		
		7 DAS	15 DAS	30 DAS	7 DAS	15 DAS	30 DAS		7 DAS	15 DAS	30 DAS	7 DAS	15 DAS	30 DAS
T1	2.175 (1.781)	0.45 (1.204)	0.06 (1.03)	0.035 (1.017)	2.375 (1.837)	0.525 (1.233)	0.078 (1.038)	0.043 (1.021)	2.588 (1.894)	0.008 (1.004)	0.007 (1.004)	0.004 (1.002)		
T2	2.1 (1.761)	0.65 (1.284)	0.325 (1.151)	0.06 (1.03)	2.275 (1.809)	0.713 (1.308)	0.143 (1.069)	0.074 (1.036)	2.663 (1.914)	0.15 (1.069)	0.016 (1.008)	0.01 (1.005)		
T3	2.2 (1.789)	0.75 (1.322)	0.475 (1.213)	0.07 (1.034)	2.413 (1.847)	0.808 (1.344)	0.475 (1.214)	0.238 (1.111)	2.7 (1.922)	0.065 (1.032)	0.04 (1.02)	0.025 (1.012)		
T4	2.225 (1.796)	0.775 (1.332)	0.475 (1.214)	0.08 (1.039)	2.425 (1.85)	1.075 (1.44)	0.765 (1.327)	0.425 (1.193)	2.525 (1.876)	0.100 (1.049)	0.053 (1.026)	0.043 (1.021)		
T5	2.2 (1.789)	0.75 (1.322)	0.588 (1.26)	0.068 (1.033)	2.375 (1.836)	1.225 (1.491)	0.568 (1.251)	0.375 (1.172)	2.475 (1.863)	0.123 (1.059)	0.071 (1.035)	0.043 (1.021)		
T6	2.275 (1.809)	0.275 (1.128)	0.035 (1.017)	0.024 (1.012)	2.475 (1.863)	0.375 (1.172)	0.048 (1.023)	0.011 (1.006)	2.525 (1.876)	0.003 (1.001)	0.002 (1.001)	0.001 (1.000)		
T7	2.225 (1.796)	0.500 (1.224)	0.063 (1.031)	0.038 (1.019)	2.250 (1.802)	0.500 (1.22)	0.075 (1.03)	0.035 (1.017)	2.575 (1.89)	0.006 (1.003)	0.005 (1.002)	0.004 (1.002)		
T8	2.15 (1.775)	2.200 (1.789)	2.300 (1.816)	2.500 (1.871)	2.425 (1.851)	2.550 (1.884)	2.600 (1.897)	2.650 (1.91)	2.625 (1.903)	2.715 (1.927)	2.73 (1.931)	2.875 (1.968)		
CD at 5%	NS	0.097	0.122	0.053	NS	0.16	0.146	0.114	NS	0.160	0.126	0.029		
SEm ±	0.055	0.033	0.041	0.018	0.084	0.054	0.049	0.038	0.117	0.054	0.043	0.01		
CV (%)	5.01	8.276	15.28	9.885	7.063	11.114	16.663	15.951	9.036	27.307	23.261	5.299		

PTC - Pre Treatment Count; DAS - Days After Spraying

Values in the parentheses are $\sqrt{x + 0.5}$ transformed values

Table 3.13 : Efficacy of insecticides against foliar pests at Vrindhachalam

Treatment	(Mean of four observations)																		
	Mean damage after 3 rd spray																		
	TMB Damage %		Leaf Miner %		Leaf and Blossom Webber %		Apple and Nut Borer %		Leaf Thrips Population (Nos.)		Yield (Kg per tree)								
	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	
T1 Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	3.35 (10.541)	2.025 (8.106)	4.6 (12.375)	1.475 (6.972)	3.405 (10.625)	0.688 (4.721)	1.075 (5.945)	0.078 (1.502)	9.063 (3.171)	0.5 (1.222)									5.975
T2 Carbosulfan 25 EC @ 2 ml/lit. all the three sprays	3.55 (10.855)	2.063 (8.205)	4.625 (12.413)	1.6 (7.255)	3.518 (10.802)	0.65 (4.58)	1.125 (6.079)	0.026 (0.768)	8.75 (3.118)	0.575 (1.255)									6.025
T3 Buprofezin 25 % SC @ 2 ml/lit. all the three sprays	3.563 (10.87)	2.2 (8.469)	4.55 (12.303)	1.725 (7.532)	3.315 (10.481)	0.838 (5.204)	1.1 (6.009)	0.018 (0.751)	8.65 (3.103)	0.55 (1.244)									5.625
T4 <i>Beauveria bassiana</i> WP @ 1 g/lit.	3.688 (11.065)	2.038 (8.142)	4.475 (12.201)	1.825 (7.748)	3.4 (10.61)	0.713 (4.807)	1.075 (5.939)	0.028 (0.928)	9.000 (3.159)	0.525 (1.234)									5.475
T5 <i>Beauveria bassiana</i> WP @ 5 g/lit.	3.475 (10.735)	2.05 (8.178)	4.55 (12.311)	1.85 (7.812)	3.553 (10.852)	0.538 (4.046)	1.000 (5.737)	0.025 (0.901)	9.250 (3.2)	0.6 (1.265)									5.600
T6 Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	3.525 (10.81)	1.613 (7.186)	4.75 (12.583)	0.798 (5.098)	3.403 (10.616)	0.535 (4.046)	0.95 (5.585)	0.001 (0.181)	8.813 (3.13)	0.275 (1.126)									6.313
T7 Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays	3.35 (10.541)	1.925 (7.897)	4.688 (12.494)	1.275 (6.477)	3.475 (10.733)	0.683 (4.626)	1.025 (5.807)	0.003 (0.285)	9.25 (3.199)	0.55 (1.244)									5.538
T8 Untreated control	3.4 (10.617)	3.6 (10.933)	4.715 (12.535)	4.76 (12.596)	3.383 (10.589)	3.425 (10.654)	1.125 (6.071)	1.263 (6.446)	8.875 (3.14)	9.075 (3.172)									4.238
CD (0.05)	NS	0.355	NS	0.192	NS	0.154	NS	0.056	NS	0.368									
SE(m)	0.095	0.12	0.101	0.065	0.097	0.052	0.054	0.019	0.42	0.124									
CV (%)	5.426	10.961	4.39	6.764	5.635	10.308	10.228	20.862	9.37	15.712									

PTC- Pre Treatment Count; DAS: Days after Spraying

Values in the parentheses are arc sine $\sqrt{\text{per cent transformed values for per cent damage and } \sqrt{x + 0.5}}$ transformed values for population numbers.

The population trend of TMB and other foliar feeding insects was recorded. Thirty days after 3rd spray, all the insecticides effective in controlling TMB populations to zero as against 2.8 bugs/ 52 leader shoots observed in untreated control. Furthermore, the per cent damage of leaf miner, leaf folder, leaf and blossom webber and nut borer was very low in all insecticides treated trees as compared to untreated trees.

The population trends of various natural enemies in respect of all the insecticides treatment gradually decimated the population of spiders, coccinellids, ants and braconid wasp after each round of insecticidal spray. In unprotected trees, the activity of weaver ants and *Cotesia* wasps were predominant among different forms of natural enemies.

The mean population of natural enemies was considerably reduced in sprayed trees, but in unsprayed trees higher number of natural enemies were observed throughout the season.

Ent. 2: Control of cashew stem and root borer Expt. 2. Curative control trial

Centres: *East Coast :* Bapatla, Bhubaneshwar, Jhargram and Vridhachalam
West Coast : Madakkathara and Vengurla
Plains / others : Hogalagere and Jagdalpur

The objective of this trial is to evaluate different pesticides and neem products for their efficacy in curative control of the cashew stem and root borer incidence after extraction of pest stages.

Treatment details:

T1 - Fipronil swabbing – 2 ml/L
T2 - Neem oil swabbing 5 % suspension
T3 - Imidachloprid – Swabbing and drenching – 2 ml/ L
T4 - Chlorpyrifos (10 ml/L)
T5 - Treated check (only removal of grubs)
T6 - Untreated check

BAPATLA

During the year, among the insecticides evaluated as post extraction prophylaxis, Imidacloprid (Swabbing and drenching) @ 2ml/l have offered protection to the tune of 87.50 % trees without re-infestation followed by Chloropyrifos 10 ml/l (Treated check) with 83.78 % trees without re-infestation. The other treatments Fipronil swabbing 2 ml/l and neem oil 5% (swabbing) has offered 70.00 and 61.90 percent protection without re-infestation and are superior over the control treatment which recorded 37.50 % trees without re-infestation. Preferential zone of attack is collar +root in 46.88 percent of trees (60/128) followed by stem in 20.31 percent of trees (26/128).

Table 3.14 : Efficacy of insecticides as Post extraction prophylaxies (PEP) against cashew stem and root borer at Bapatla centre

Trt No	Treatment	Total No. of trees treated	No. of trees reinfested	% trees with Reinfestation	% trees without Reinfestation
1.	Fipronil Swabbing (2 ml/l)	30	9	30.00	70.00
2.	Neem oil Swabbing (5%)	21	8	38.10	61.90
3.	Imidacloprid (2 ml/l) (Swabbing and Drenching)	24	3	12.50	87.50
4.	Chlorpyrifos (10 ml/l) (Treated Check)	37	6	16.22	83.78
5.	Untreated check (only removal of CSRB grubs)	16	10	62.50	37.50

BHUBANESWAR

The PEP treatment carried out during 2016-17 in CRS, Bhubaneswar covered a total of 127 nos CSRB affected trees. Among the CSRB species only *Plocaederus ferrugineus* L was detected affecting cashew plants. Maximum recovery (82.6%) of plant was observed in case of chlorpyrifos swabbing (10 ml/l) followed by fipronil swabbing (2ml/l) (80.95%). In case of control i.e. mechanical extraction of CSRB grub only, 50.0 per cent of the plant were recovered from reinfestation. In case of stem girth less than 60cm, reinfestation of treated trees was 37.04 per cent. With the increase in stem girth i.e. above 60 cm reinfestation of CSRB was found to be higher. Plants of 80-100 cm diameter were reinfested more (63.15%) in comparison to other groups. In plants of age group below 5 year percentage reinfestation of CSRB was nil and plants of age group 5-10 years and 10-15 years showed 40-50 per cent of reinfestation. Plants of more than 15 years were however more vulnerable to borer attack. Plants of collar+stem+root zone of damage were more prone to attack of CSRB (42.4 % reinfestation) followed by stem (36.4%) and C+S zone (34.5%). Yellowing of canopy showed 51.85 per cent reinfestation while not yellowing showed 34.7% of reattack by the pest. The per cent re-infestation was nil in less than 25 per cent bark damage. With the increase in damage to bark the re-infestation by the pest also increased gradually, highest being observed in >75% damage in bark (74% reinfestation).

Table 3.15 : Efficacy of post extraction prophylaxis treatment (PEP) at Bhubaneswar

Treatment	No of trees treated	No. of trees without reinfestation	Recovery (%)
1) Fipronil swabbing (2ml/l)	21	14	66.7
2) Neem oil swabbing (5% suspension)	20	11	55.0
3) Imidacloprid- Swabbing & drenching 2ml/l	22	16	72.7
4) Chlorpyrifos (10ml/l)	23	19	82.6
5) Treated check (only removal of grub)	20	10	50.0
6) Untreated check	21	0	0.0
Total	127	70	Mean: 54.5

HOGALAGERE

Infestation and reinfestation of the CSRБ grubs were observed in the trees treated with the insecticides. The treatment with Fipronil swabbing (2ml/l) during Oct.-Nov., Jan.-Feb. and April - May and Chlorpyrifos (0.2%) were found most effective treatments against grubs of CSRБ with 87.4% and 78.4% trees without re-infestation, respectively. However, the other treatments also maintained their superiority in suppressing the population over control. In treated check, where only grubs extraction was adopted, it was observed that 33.9 % trees could recover (Table 3.16).

Table 3.16 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRБ) at HREC, Hogalagere during 2016-17

Sl. No.	Treatment	No. of trees treated	No. of trees without reinfestation	% Recovery from reinfestation
1	Fipronil swabbing @ 2ml/l (during Oct.-Nov., Jan.- Feb. and April - May)	17	15	87.4
2	Neem oil swabbing 5% suspension	14	7	48.9
3	Imidacloprid 17.8 SL @ 2ml/l as swabbing and drenching	7	5	74.7
4	Chlorpyrifos 20 EC(0.2%) @ 10ml/l	14	11	78.4
5	Treated check - only removal of CSRБ grubs	10	4	33.9
6	Untreated control	6	2	37.4
	Total	67	43	-

The incidence of cashew stem and root borer was monitored randomly at fortnightly interval in neglected cashew gardens. Trees with 60-100 cm stem girth showed maximum damage (95.5%) and with respect to age of trees, more than 15 years old trees were highly prone to CSRБ damage (85.7%). The zone of CSRБ attack was noticed maximum at collar + stem (73.3%) and canopy yellowing of trees was observed in 85.9 per cent of treated trees. The plants with less than 25% bark circumference damage recorded 55.5 per cent recovery of the infested trees.

JAGDALPUR

The result revealed that treatment T4 (Chlorpyrifos@10ml/l) led to maximum recovery of 72.22 per cent trees without re-infestations followed by treatment T1 (Fipronil swabbing@2ml/l) with 66.67 per cent trees without re-infestations.

Table 3.17 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Jagdalpur centre during the year 2016-17

Treatment	Total number of trees treated	No. of trees re-infested	No. of trees without reinfestation / persistent attack	% trees without reinfestation / persistent attack
T1 : Fipronil swabbing (2ml/l)	18	6	12	66.67
T2 : Neem oil swabbing (5%)	18	11	7	38.89
T3 : Imidacloprid (2 ml/l)	18	10	8	44.44
T4 : Chlorpyriphos (10ml/l)	18	5	13	72.22
T5: Treated check (only removal of CSRB grubs)	18	12	6	33.33
T6 : Untreated check	18	14	4	22.22
Total	108	58	50	

The physical parameters of different treated trees were also recorded. In case of stem girth less than 60 cm, reinfestation of treated tree was less. With the increase in stem girth i.e. above 60 cm, reinfestation of CSRB was found to be higher.

Below 10 years old trees were free from the attack of CSRB. While, plants of age more than 15 years showed 50.55 per cent reinfestation. Preferential zones of attack of re-infestations by cashew stem and root bores in the tree was C + R zone with 65 per cent followed by C+S and C zones with 50.00 and 41.30 per cent re-infested trees, respectively. The canopy of cashew trees infested by CSRB was yellowed. Trees with 26-50 per cent bark circumference damage had maximum reinfestation with 63.64 per cent followed by 51-75 per cent bark circumference damage (41.17% reinfestation).

JHARGRAM

Chlorpyriphos (0.2%) was found to be most effective treatment with maximum recovery of 93.96% followed by trees treated with Fipronil (2ml/l). In case of treated check where only grubs were removed showed 57.42% of recovery. The experimental result revealed that using chlorpyriphos @ 10 ml/lit after removal of grubs could protect the plants from further infestation.

Table 3.18 : Efficacy of post extraction prophylaxis (PEP) against CSRB at Jhargram

Treatment	% of trees without reinfestation/persistent attack
Fipronil swabbing (2 ml/l)	91.64
Neem oil swabbing @5% suspension	68.29
Imidacloprid swabbing and drenching @ 2ml/l	71.09
Chlorpyriphos @ 10 ml/lit	93.96
Treated check (only removal of grubs)	57.42

Trees with stem girth 60-80 cm showed maximum re-infestation (%) followed by the trees having stem girth <60 cm (%). Out of the total trees maximum infestation was observed at stem part followed by collar + stem + root region. Trees infested at stem + collar + root showed 100% re-infestation. Maximum recovery was observed on trees less than 25% and 25-50% bark circumference damage. 100% re-infestation was observed when bark circumference damage was more than 50% and those trees also showed canopy yellowing.

MADAKKATHARA

Among the insecticides tested for post extraction prophylaxis, swabbing neem oil soap suspension @ 50 ml/l resulted in recovery of 90% of treated trees followed with chlorpyrifos with 85% of trees recovered. Fipronil swabbing resulted in recovery of 75% of treated trees and same was the case with imidachloprid. Grub removal only resulted in recovery of 40% of trees.

No definite pattern of influence of physical parameters has been observed with respect to per cent recovery. However, only 64 per cent of treated trees have been recovered after post extraction prophylaxis among trees with more than 75 per cent bark circumference damage compared to 87% recovery with bark circumference damage less than 25 per cent.

Table 3.19 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Madakkathara centre during the year 2016-17

Treatment	Total number of trees treated	No. of trees without reinfestation / persistent attack	% trees without reinfestation / persistent attack
Fipronil swabbing 2ml/l	20	15	75
Neem oil swabbing 5% (50ml/l)	20	18	90
Imidachloprid swabbing and drenching 2ml/l	20	15	75
Chlorpyrifos drenching 10 ml/l	20	17	85
Treated check-grub removal only	20	8	40

VENGURLE

Table 3.20 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Vengurle centre during the year 2016-17

Treatment	Total number of trees treated	No. of trees without reinfestation / persistent attack	% trees without reinfestation / persistent attack
Fipronil swabbing 2ml/lit	20	18	90
Neem oil swabbing 5%	20	13	65
Imidachloprid swabbing and dranching 2ml/lit	20	15	75
Chlorpyrifos 10ml/lit	20	16	80

Treated check (only removal of grub)	20	9	45
Untreated check	20	5	25

The results indicated that the treatment T₁ (Fipronil swabbing 2ml/lit) recorded 90.00 per cent trees without reinfestation followed by treatment T₄ Chlorpyriphos (0.2%) 80.00 per cent trees without reinfestation. Reinfestation was more in Control (T₆) 25.00 percent trees.

During the year 2016-17 total 120 trees are treated for cashew stem and root borer management. The data on the physical parameter of infested tree and uninfested trees was recorded. The tree having the stem girth >100 cm recorded more prone to CSRB damage. Trees having age more than 15 years were more prone to CSRB infestation. Whereas the trees having the age <10 year recorded less infestation. In case of zone of attack, the collar+ stem recorded more infestation whereas it was minimum in collar + root.

VRIDHACHALAM

Maximum recovery of 60.0% was observed in chlorpyriphos 20 EC @10 ml/lit. of water as swabbing and drenching of CSRB infested trees as against mere recovery of 6.66 in treated check (only removal of CSRB grubs). Treatments with Fipronil 5% SC swabbing @ 2ml/lit. and Imidachloprid 17.8 SL Swabbing and Drenching @ 2ml/lit. lead to 55.00 and 52.00% recovery respectively as against nil recovery in untreated check. The overall results indicate that chlorpyriphos recorded maximum recovery, followed by Fipronil and Imidachloprid which are at par in reducing the CSRB infestation, with an average cost of protection of Rs.80/-, Rs.89/- and Rs. 92/- respectively.

Table 3.21 : Efficacy of certain insecticides as curative control against CSRB at Vridhachalam

Treatment		No. of trees treated	No. of trees without reinfestation from CSRB	Mean % recovery of trees from CSRB	Frequency of treatment	Cost of treatment /tree
T ₁	Fipronil 5% SC Swabbing@ 2ml/lit.	20	11	55.00 ^b	3	89.00
T ₂	Neem Oil suspension 5% Suspension Swabbing and Drenching	22	7	31.82 ^c	3	75.00
T ₃	Imidachloprid 17.8 SL Swabbing and Drenching @ 2ml/lit.	25	13	52.00 ^b	3	92.00
T ₄	Chlorpyriphos 20 EC @ 10ml / lit. Swabbing and Drenching	25	15	60.00 ^a	3	80.00

T ₅	Treated check (only removal of CSRB grubs followed).	15	01	6.66 ^d	3	48.00
T ₆	Untreated check.	20	-	-	-	-
	Total	107	47			

Observations recorded in the physical parameters of treated cashew trees under Post Extraction Prophylaxis (PEP) curative trial revealed that the cashew trees having 80-100 cm of stem girth (86.36%) were more prone to the attack of CSRB infestation. Comparing the age of the cashew infested trees, more than 15 year old cashew trees (83.33%) were more susceptible to attack of CSRB. Preferential zone of attack of re-infestations by CSRB in the trees were Collar + Root zone followed by Collar + Stem +Root and Collar + Stem with 75.75, 78.57 and 52.00 per cent re-infested trees respectively. Yellowing of canopy showed 94.64 per cent re-infestation. Trees with less than 25 per cent bark circumference damage had maximum re-infestation with 42.37 per cent followed by 51-75 per cent bark circumference damage (30.00% re-infestation). This implies that early detection of borer infestation and simultaneous prophylaxis treatment on a community basis is very important to mitigate persistent attack of cashew stem and root borer.

Ent. 3: Influence of biotic and abiotic factors on the incidence of pest complex of cashew

Centres: *East Coast* : Bapatla, Bhubaneshwar, Jhargram and Vridhachalam
West Coast : Madakkathara, Paria and Vengurla
Plains / others : Hogalagere, Kanabargi and Jagdalpur

The objective of the project is to investigate the population dynamics of pests of regional importance and to correlate it to prevalent weather parameters.

BAPATLA

During 2016-2017, the relation between the percent pest damage (Y) and weather variables such as Max.Temp (X_1), Min.Temp. (X_2), Relative Humidity (m) (X_3), Relative Humidity (e) (X_4) and Rainfall (X_5) was worked out by subjecting the data collected over 22 standard weeks to Multiple Linear Regression Analysis.

Leaf miner incidence showed significant negative correlation with Max.Temp (X_1) and Relative Humidity (m) (X_3). With regard to leaf folder damaged leaves results revealed that Max.Temp (X_1), RH (m) (X_3) and Rain Fall (X_5) have significant negative correlation and all weather variables together accounted for 54.56 percent variation in percent leaf damage by leaf folder ($R^2=0.5456$).

Table 3.22 : Influence of abiotic factors on the activity of pest complex of cashew at Bapatla centre

Variable	Leaf and blossom webber	Leaf miner	Leaf Folder	Shoot Tip Caterpillar	Apple and Nut borer
X_1 -Maximum Temp	-0.157	-0.973	-0.853*	-0.863	1.656
X_2 -Minimum Temp	0.176	0.295	0.500*	-0.191	-0.878
X_3 -RH (m)	0.069	-0.296*	-0.211*	0.319	0.173
X_4 -RH (e)	-0.122	0.074	0.010	-0.295	0.096
X_5 -Rain fall	-0.015	-0.140	-0.109*	-0.012	0.059
R^2 Value	0.1022	0.3278	0.5456	0.6219	0.1226
% Variation	10.22	32.78	54.56	62.19	12.26

BHUBANESWAR

The rainy season started from 1st fortnight of July continued upto 1st fortnight of November. There was well distribution of rainfall during July-September and post monsoon rainfall was observed during October and 1st fortnight of November. The total of 915.9 mm rainfall was received during the period of observation. Highest rainfall was received during 1st fortnight of August. However, there was occurrence of rain during 1st fortnight of March (45.4 mm) and 2nd fortnight of April (29.2 mm).

The maximum temperature ranged between 27.11°C to 37.17°C with highest temperature of 37.17°C was experienced during 2nd fortnight of April. Similarly the minimum temperature ranged between 13.65°C to 25.98°C with lowest temperature of 13.65°C occurred during 2nd fortnight of December. Sunshine hour, varied from 2.5 to 8.09. Lowest sunshine hour was observed during 1st fortnight of September while it was highest during 2nd fortnight of April. On an average the sunshine hour remained more than 5.0 from October 2016 to April 2017.

Seasonal incidence and correlation with weather parameters:

Vegetative phase:

Observations taken during the vegetative growth phase (July to November) revealed the incidence of shoot tip caterpillar, leaf miner, leaf folder, leaf webber and other foliage feeding pests which includes leaf eating beetle, ashy weevil, cow bug and mealy bug.

The incidence of shoot tip caterpillar (STC) was observed between 2nd fortnights of August to 2nd fortnight of November. Highest incidence of 22.91 percent damage shoot was observed during 2nd fortnight of October. Higher damage incidence was observed during September, October and November months. No incidence of TC was observed during December. Leaf miner infestation was observed between 2nd fortnights of August to 1st fortnight of November. Highest infestation (30.43 5 damaged leaf) was observed during 1st fortnight of October. Leaf miner population disappeared during 2nd fortnight of November.

Incidence of leaf folder was observed between 1st fortnight of September to 1st fortnight of November. Highest incidence of 25.53 percent leaf damage was recorded during 2nd fortnight of October. Leaf Webber infestation was observed between 1st fortnight of September and 1st fortnight of November. Initially 0.82 per lateral was observed during 1st fortnight of September which gradually increased up to 3.7 per lateral during 1st fortnight of November. The population disappeared during 2nd fortnight of November. Infestation of foliage thrips was observed during 1st fortnight of November with population 2 3.4 per leaf. The population of foliage thrips then decreased to 8.4 per leaf during 2nd fortnight of December. The population of other insect pests was observed unevenly during the vegetative phase of established plantation.

Reproductive phase:

The seasonal incidence of insect pests of Cashew during reproductive phase (December to May 2017) revealed the attack of shoot tip caterpillar, leaf miner, leaf folder, leaf and flowering thrips, Tea Mosquito Bug and other foliage feeding pests which includes leaf eating beetle, ashy weevil, cow bug and mealy bug.

TMB incidence was observed between 1st fortnight of February and 2nd fortnight of April. The TMB infestation was very low in the cashew plantation and caused very less damage to the plant. The infestation of STC commenced during 2nd fortnight of February with 4.76 per cent damaged shoot. Maximum incidence of 15.0 per cent shoot damage occurred during 2nd fortnight of March. The population gradually declined and disappeared after wards.

Leaf miner infestation started during 2nd fortnight of January with 19.05 percent leaf damage which increased to highest 23.68 percent and during 1st fortnight of February. Then it gradually decreased and 5.88 percent leaf damage was observed during 2nd fortnight of March. Leaf folder infestation was observed during 1st fortnight of March with 13.95 percent leaf damage. Then it increased to 16.28 percent leaf damage in the next fortnight and then decreased to 7.31 per cent leaf damage during 1st fortnight of April.

The population of red banded foliage thrips increased to maximum during February, March and April. Highest population was observed during 2nd fortnight of March with 77.5 nos. per leaf. Then it decreased gradually and a population of 35.5 per leaf was observed during 2nd fortnight of April. Flowering thrips were present in the inflorescence during the flowering and fruiting period of established plantation. Other insect pests like ashy weevil, leaf beetle were present during the observation. Their number was very less and ranged between 1.2 to 2.5.

Table 3.23 : Correlation with weather parameters during vegetative phase in established plantation

Factors	STC	LM	LF	LW	Leaf Thrips	Others
Temp (max)	0.76	0.40	0.76	0.52	-0.47	0.026
Temp (min)	0.65	0.60	0.70*	0.40	-0.74*	-0.20
RH (morning)	0.37	0.44	0.23	0.19	-0.18	-0.16
RH (even.)	0.68	0.68	0.71*	0.41	-0.76*	-0.17
Rainfall	0.49	0.59	0.48	0.14	-0.7*	-0.26
BSH	0.37	-0.56	-0.42	-0.18	0.59*	0.16
R²	0.76	0.81	0.74	0.79	0.75	0.31

Incidence of leaf folder showed significant positive correlation with temp min. ($r=0.7046$) and RH (even.) ($r=0.7169$). Incidence of leaf thrips had significant negative correlations with temp (min) ($r=0.743$), RH (even.) ($r=0.768$), rainfall ($r=0.7$) and significant positive correlation with BSH ($r=0.5935$). All the above factors contribute 75.54% for the incidence of leaf miner. ($R^2=0.7554$).

Table 3.24 : Correlation with weather parameters during reproductive phase

Factors	TMB	STC	LM	LF	Leaf Thrips	Flower Thrips	Others
Temp (max)	0.59	0.63	-0.08	0.19	0.60	0.42	0.63
Temp (min)	0.8706*	0.8449*	-0.55	0.52	0.7673*	0.7286*	0.8359*
RH (morning)	-0.51	-0.36	0.8373*	-0.14	-0.03	-0.24	-0.16
RH (even.)	0.7233*	0.61	-0.70	0.13	0.34	0.38	0.30
Rainfall	0.52	0.42	-0.32	0.33	0.25	0.41	-0.02
BSH	0.13	0.36	0.37	-0.06	0.39	0.06	0.47
R²	1.00	0.96	1.00	0.99	0.86	0.98	0.96

Tea Mosquito Bug incidence showed significant positive correlation with temp min ($r=0.8706$), and RH ($r=0.7233$). The results revealed that, the incidence of STC was positive and significantly correlated with temp (min.) ($r=0.8449$). RH (morning) showed significant positive correlation with leaf miner incidence. Temp (min.) showed significant positive correlation with the leaf folder incidence ($r=0.8359$). Incidence of flower thrips showed significant positive correlation with Temp (max.) ($r=0.7286$).

HOGALAGERE

A total of five species of insect pests infesting and breeding on cashew and two species of their natural enemies were recorded at varied intensity in maidan parts of Karnataka. Among them, tea mosquito bug and cashew stem and root borer were found to be the major insect pests in the region (Table 3.25).

Table 3.25 :Influence of abiotic factors on the activity of pest complex of cashew during 2016-17

Sl. No.	Common Name	Scientific name	Month of Occurrence	Intensity
	Insect pests			
1	Tea mosquito	<i>Helopeltis antonii</i> Family: Miridae Order: Hemiptera	October - March	Moderate to high
2	Stem and root borer	<i>Plocaederus ferrugineus</i> Family: Cerambycidae Order: Coleoptera	Throughout the year	Moderate
3	Inflorescence thrips	<i>Rhynchothrips raoensis</i> Family: Thripidae Order: Thysanoptera	March - April	Low
4	Fruit and nut borer	<i>Thylecoptila panerosema</i> Family: Pyralidae Order: Lepidoptera	April - May	Low to moderate
5	Aphids	<i>Toxoptera odinae</i> Family: Aphidae Order: Hemiptera	November – May	Low
	Predators	Host pest		
1	<i>Oxyopes sweta</i>	<i>Helopeltis antonii</i> Order: Araneae	Oct - Mar.	Low to moderate
2	<i>Menochilus sexmaculatus</i>	<i>Toxoptera odinae</i> Family: Coccinellidae Order: Coleoptera	Feb.-May	Low to moderate

The correlation between the pest incidence and weather parameters revealed that minimum temperature (+0.84) showed significantly positive correlation with the activity of TMB. Whereas CSRB population indicated significantly positive correlation with morning relative humidity (+0.58). The activity of CSRB was observed throughout the year but its peak activity was noticed during December, April and May. Apple and nut borer had significantly positive correlation with maximum temperature and evening relative humidity (+0.92 & +0.93) and significantly negative correlation (-0.68) with morning relative humidity. The infestation of thrips showed significantly positive correlation with maximum temperature and evening relative humidity (+0.85 & +0.92) respectively. The aphid infestation had a positive correlation with maximum temperature and evening relative humidity (+0.13 & +0.44) whereas the rest of the parameters had negative correlation.

Variation with respect to various pest incidences is evident over years of observations and even with the occurrence of natural enemies of pests. However, correlation of pests with the weather parameters seems to be consistent over years (Table 3.26).

Table 3.26 : Correlation of weather parameters and different insect pests recorded on cashew during 2016-17

Weather Parameters	TMB	CSRB	ANB	Thrips	Aphids
X1 - Maximum Temp	- 0.14	- 0.24	+ 0.92*	+ 0.85*	+ 0.13
X2 - Minimum Temp	+ 0.84 *	+ 0.07	- 0.49	- 0.22	- 0.52
X3 - RH (m)	+ 0.22	+ 0.58*	- 0.68*	- 0.71*	- 0.15
X4 - RH (e)	- 0.59*	- 0.34	+ 0.93*	+ 0.92*	+ 0.44
X5 - Rain fall	+ 0.37	+ 0.37	- 0.34	- 0.66*	- 0.67*
X6 - No. of rainy days	- 0.28	+ 0.47	- 0.37	- 0.66*	- 0.71*

* Significant at 0.05 level (r=0.5324)

TMB -Tea mosquito bug; CSRB - Cashew stem & root borer; ANB - Apple & nut borer

JAGDALPUR

Maximum incidence of pest was observed during new growth of flush and flowering. In case of leaf folder and leaf caterpillar, significant positive correlation was recorded with relative humidity (morning) while, significant negative correlation was recorded with maximum temperature. Rainfall significantly negatively influenced the leaf folder population with the correlation coefficient value of -0.599. In case of leaf caterpillar, rate of evaporation indicated significant negative correlation of $r = -0.598$. Leaf miner population was significant negatively influenced with minimum temperature ($r = -0.546$) and rate of evaporation ($r = -0.677$). Whereas, relative humidity (morning) was significant positively influenced the leaf miner population. Significant positive correlation ($r = 0.581$) was observed between panicle TMB and relative humidity (evening). Population of nut and apple thrips was significant and positively influenced by maximum temperature while, relative humidity (morning) influenced them in a significant negative pattern. None of the abiotic parameters had influenced the mealy bug population.

Table 3.27 : Influence of abiotic factors on the activity of pest complex of cashew at Jagdalpur centre during the year 2016-17

Weather Parameters	Leaf miner	Shoot TMB	Panicle TMB	Leaf folder	Leaf caterpillar
X1 - Maximum Temp	0.44	-0.19	0.17	-0.847**	-0.775**
X2 - Minimum Temp	-0.546*	0.46	-0.01	-0.45	-0.48
X3 - RH (m)	0.682*	0.42	-0.06	0.658*	0.582*
X4 - RH (e)	0.15	-0.12	0.581*	-0.01	0.09
X5 - Rain fall	-0.38	0.19	-0.16	-0.599*	-0.38
X6 - No. of rainy days	-0.33	0.20	-0.15	-0.03	0.39
X7 - Bright sunshine hours	-0.17	-0.16	0.43	0.03	-0.01
X8 - Wind velocity	-0.47	0.33	0.07	-0.45	-0.49
X9 - Rate of evaporation	-0.677*	-0.40	0.22	-0.02	-0.598*

Table 3.28 : Influence of abiotic factors on the activity of pest complex of cashew at Jagdalpur centre during the year 2016-17

Weather Parameters	Nut thrips	Apple thrips	Mealy bugs
X1 - Maximum Temp	0.62*	0.62*	-0.04
X2 - Minimum Temp	0.28	-0.01	-0.11
X3 - RH (m)	-0.56*	-0.55*	0.31
X4 - RH (e)	-0.22	-0.38	0.31
X5 - Rain fall	0.31	-0.03	-0.33
X6 - No. of rainy days	0.37	-0.02	-0.33
X7 - Bright sunshine hours	0.30	0.42	-0.41
X8 - Wind velocity	0.34	0.07	-0.14
X9 - Rate of evaporation	0.44	0.20	-0.28

JHARGRAM

There was no tea mosquito bug infestation observed during 2016-17. CSRB showed significant positive correlation with rainfall and rainy days while Leaf Miner showed significant positive correlation with RH.

Table 3.29 : Correlation of weather parameters with pest complex of cashew at Jhargram

Weather parameter	CSRB	LM	LBW
Temp (Max.)	0.23	-0.32	-0.40
Temp (Min.)	0.57	0.02	-0.13
RH (Max.)	0.54	0.61*	0.38
Rainfall	0.85**	0.54	0.25
No. of rainy days	0.95**	0.48	0.17

MADAKKATHARA

The correlation analysis between tea mosquito bug damage and second previous week weather factors revealed that morning and evening relative humidity had a significant negative correlation with the damage by tea mosquito bug, whereas significant positive correlation was not established with any of the weather parameters. However during last year, minimum temperature, relative humidity and rainy days had a significant negative correlation whereas significant positive correlation was established with bright sunshine hours and wind velocity. Insect pests other than tea mosquito bug were absent during the reporting year and the data was not sufficient for correlation studies.

Natural enemies

Natural enemies recorded in cashew ecosystem were given in Table 3.30. The common natural enemies were red ant, black ant and spiders.

Table 3.30 : List of Natural enemies recorded in Cashew ecosystem

Natural enemy	Order	Family	Genus	Species
Red ants	Hymenoptera	Formicidae	Oecophylla	<i>O. smaragdina</i>
Black ants	Hymenoptera	Formicidae	Crematogaster	<i>C. wroughconi</i>
Spiders	Araneae	Oxyopidae	Oxyopes	<i>O. shweta</i>
	Araneae	Tetragnathidae	Tetragnatha	-
	Araneae	Thomisidae	Thomisus	-

Seasonal occurrence of insect pest and natural enemies

Monitoring of pests and natural enemies of cashew throughout the season from April 2016 to March 2017 showed sporadic nature of tea mosquito bug in the months of April and May of 2016 and January-February months of 2017. The tea mosquito population was not there from June to September period. Though red ants were observed, throughout the year, the population was high during April-May months of 2016 and February-March months of 2017.

An overview of incidence of leaf miner during 2016-17 season showed the occurrence of infestation only during the months of September-October coinciding with flushing stage of the crop with a maximum of 9.5 per cent infestation in September month. In the case of apple and nut borer, whose incidence is expressed as per cent infestation, attack was mostly limited to the months of November to March. However, the infestation was negligible and was to the tune of less than one per cent. Bioecological observations on thrips revealed the presence of the pest only during February to May period and were negligible with a maximum score of 0.156 during February month. With regard to other natural enemies, though the presence of spiders was observed throughout the year, high population was recorded during the month of May 2016 and from July to September 2017. Black ant population was high during March month.

Table 3.31 : Influence of abiotic factors on the activity of pest complex of cashew at Madakkathara centre during the year 2016-17

Weather Parameters	Tea mosquito bug			
	Anakkayam-1	Madakkathara-1	Kanaka	Dhana
X1 - Maximum Temp	0.02	0.28	0.14	-0.10
X2 - Minimum Temp	-0.26	-0.29	-0.31	-0.27
X3 - RH (m)	-0.30	-0.48*	-0.33	-0.08
X4 - RH (e)	-0.27	-0.42*	-0.29	-0.13
X5 - Rainfall	-0.21	-0.23	-0.23	-0.16
X6 - No. of rainy days	-0.29	-0.38	-0.32	-0.20
X7 - Bright sunshine hours	0.23	0.38	0.28	0.04
X8 - Wind velocity	0.31	0.38	0.17	0.15
X9 - Rate of evaporation	-0.12	-0.11	-0.15	-0.14

*= r at 5 % level of significance, **= r at 1% level of significance

PARIA

The TMB incidence showed positive significant correlation with morning relative humidity while, negative correlation with other weather parameters. Morning relative humidity had positive significant correlation with the activity of thrips.

Table 3.32 : Influence of abiotic factors on the activity of pest complex of cashew at Paria centre during the year 2016-17

Weather Parameters	TMB	Thrips
X1 - Maximum Temp	-0.64*	-0.52*
X2 - Minimum Temp	-0.76*	-0.69*
X3 - RH (m)	0.79*	0.62*
X4 - RH (e)	-0.11	-0.02
X5 - Bright sunshine hours	-0.43*	-0.24
X6 - Wind velocity	-0.45*	-0.26
X7 - Rate of evaporation	-0.69*	-0.72*

*= significant at 5%

VENGURLE

The data from table revealed that in the year 2016-17 the TMB incidence shows negative significant correlation with minimum temperature ($r=-0.582$). The incidence of thrips showed negative significant correlation with minimum temperature ($r=-0.629$). The incidence of Apple and Nut borer showed negative significant correlation with minimum temperature ($r=-0.747$).

Table 3.33 : Influence of abiotic factors on the activity of pest complex of cashew at Vengurle centre during the year 2016-17

Weather Parameters	TMB	THRIPS	ABN
X1 - Maximum Temp	0.56	0.54	0.50
X2 - Minimum Temp	-0.58*	-0.62*	-0.74*
X3 - RH (m)	-0.09	-0.09	-0.17
X4 - RH (e)	-0.56	-0.55	-0.56
X5 - Rainfall	-0.35	-0.35	-0.38

* - Significant at 5% level of significance. $r = 0.576$ at 5% level of significance

VRIDHACHALAM

The incidence of cashew pests and natural enemies were recorded at weekly intervals from ten randomly selected cashew trees from 52 leader shoots of each tree from all the four sides at Regional Research Station, Vridhachalam. These cashew trees were grown under unprotected condition. The seasonal incidence and correlation coefficient of insect-pests in Cuddalore district are presented in Table 3.34 and 3.35.

The incidence of TMB was confined to flushing through fruiting season. Its activity was observed from first week of February 2017 to third week of April 2017. Maximum TMB damage was observed during the second week of March with mean damage score ranging between 1.6 and 2.46.

Nut borer activity during non-bearing periods could not be traced out. Cashew leaf miner was found from August to March with a maximum of 3.23 % leaf damage during first fortnight of August 2017. Cashew leaf folder was also observed from August 2016 - March 2017 with 3.8% to 7.9% leaf damage observed in young plantations. Maximum damage was noticed during August 2016 and also in August 2017, whereas leaf and blossom webber damage was observed maximum during June 2016 and August 2017. Cashew Leaf thrips population (8.03) was noticed in March 2017. Leaf folder damage (7.9%) was observed during June - 2017. However, shoot tip caterpillar was observed during January to February - 2017. The CSRB damage was prevailing throughout the season but maximum was recorded during August 2017 (32%).

It was observed that the TMB population has significant positive correlation with sunshine hours whereas significant negative correlation with rainy days. Leaf thrips population was significantly positively correlated with sunshine hours. Shoot tip caterpillar damage was significantly negatively correlated with minimum temperature. Whereas CSRB damage was significantly positively correlated with rainy days.

Table 3.34 : Correlation coefficient (r) for abiotic factors and insect pests of cashew at Vridhachalam

Weather Parameters	TMB Population (Y1)	Leaf and blossom webber (% damage) (Y2)	Leaf miner (% damage) (Y3)	Leaf thrips Population (Y4)	Apple and nut borer (%damage) (Y5)	Leaf folder (%damage) (Y6)	Shoot tip caterpillar (%damage) (Y7)	CSRB (% damage) (Y8)
Maximum temperature (°C) (X1)	0.53 ^{NS}	0.35 ^{NS}	0.24 ^{NS}	0.26 ^{NS}	-0.11 ^{NS}	-0.01 ^{NS}	-0.28 ^{NS}	0.02 ^{NS}
Minimum temperature (°C) (X2)	0.46 ^{NS}	0.56 ^{NS}	0.57 ^{NS}	0.21 ^{NS}	-0.06 ^{NS}	0.38 ^{NS}	-0.67*	0.14 ^{NS}
Relative Humidity (%) (X3)	-0.33 ^{NS}	-0.19 ^{NS}	-0.25 ^{NS}	-0.03 ^{NS}	-0.47 ^{NS}	-0.13 ^{NS}	0.36 ^{NS}	-0.01 ^{NS}
Rainfall (X4)	-0.40 ^{NS}	0.16 ^{NS}	0.31 ^{NS}	-0.49 ^{NS}	-0.50 ^{NS}	0.32 ^{NS}	0.23 ^{NS}	0.58 ^{NS}
Rainy days (X5)	-0.66*	0.51 ^{NS}	0.37 ^{NS}	-0.56 ^{NS}	-0.01 ^{NS}	0.49 ^{NS}	-0.34 ^{NS}	0.77 ^S
Wind speed (Km/hr.) (X6)	-0.28 ^{NS}	-0.48 ^{NS}	-0.58 ^{NS}	-0.15 ^{NS}	0.48 ^{NS}	-0.36 ^{NS}	0.48 ^{NS}	-0.32 ^{NS}
sunshine (hours) (X7)	0.76*	0.24 ^{NS}	0.32 ^{NS}	0.67*	-0.47 ^{NS}	0.06 ^{NS}	0.17 ^{NS}	-0.25 ^{NS}

*significant at 5% level

Table 3.35 : Correlation coefficient (r) for abiotic factors and population of natural enemies on cashew at Vridhachalam

Weather Parameters	Spiders (Y9)	Ants (Y10)	Coccinellids (Y11)	Braconids (Y12)	Wasp (Y13)
Maximum temperature (°C) (X1)	-0.06 ^{NS}	-0.12 ^{NS}	-0.36 ^{NS}	0.02 ^{NS}	0.05 ^{NS}
Minimum temperature (°C) (X2)	-0.02 ^{NS}	-0.37 ^{NS}	-0.28 ^{NS}	0.17 ^{NS}	0.38 ^{NS}
Relative Humidity (%) (X3)	0.24 ^{NS}	0.40 ^{NS}	-0.02 ^{NS}	-0.25 ^{NS}	0.05 ^{NS}
Rainfall (X4)	-0.15 ^{NS}	-0.29 ^{NS}	0.37 ^{NS}	0.07 ^{NS}	0.07 ^{NS}
Rainy days (X5)	-0.22 ^{NS}	0.09 ^{NS}	0.23 ^{NS}	-0.05 ^{NS}	0.36 ^{NS}
Wind speed (Km/hr.) (X6)	0.027 ^{NS}	0.40 ^{NS}	0.15 ^{NS}	-0.07 ^{NS}	-0.70*
sunshine (hours) (X7)	0.12 ^{NS}	-0.26 ^{NS}	-0.51 ^{NS}	-0.06 ^{NS}	0.40 ^{NS}

*significant at 5% level

Ent 4 : Screening of germplasm to locate tolerant / resistant types to major pests of the region

Centres : *East Coast* : Bapatla, Bhubaneshwar, Jhargram and Vridhachalam
West Coast : Madakkathara and Vengurla
Plains / others : Hogalagere and Jagdalpur

The objective of this project is to identify germplasm accessions tolerant / resistant to the major pests of the region.

BAPATLA

During the year 2016-17, the 40 accessions were screened to identify the tolerant lines against the pests of cashew.

Table 3.36 : Screening of cashew germplasm to locate tolerance / resistance to major pests of the region at Bapatla centre.

Infestation by	Min. Damage recorded	Germplasm	Max. Damage recorded	Germplasm
Leaf and blossom webber	1.39	T.No.12/1	8.68	Ch.gudem
Leaf miner	1.36	Vetapalem	9.01	ABT-3
Shoot tip caterpillar	1.80	T.No.277	9.24	ABT-3
Leaf folder	1.28	Hy 94-T4	5.12	T.No.233
Apple and nut borer	0.37	T.No.7/12	10.09	T.No.2/3

BHUBANESWAR

Extent of damage by Leaf miner ranged between 0.5 and 1.5 per cent damage leaf in all the accessions. Minimum incidence of shoot tip borer (0.5-1% damaged shoot) was observed in all the accession. Mixed population of Yellow and Black Thrips incidence was recorded 0.5 – 5/panicle among the 23 germplasms during the year under report. TMB incidence was very low during the year and almost all germplasm were not having the TMB incidence excepting in OC 105, OC 125 and OC 126 with 0-0.5 incidence level.

Table 3.37 : Reaction of germplasm accessions against insect pests in Bhubaneswar during 2016-17

Pest	Accessions	Min. damage	Accessions	Max. damage
LM	100 Nos (all)	0.5-1.0%		
STC	100 Nos (all)	0.5-1.0%		
IT	OC1, OC12, OC14, OC22, OC31, OC49, OC50, OC51, OC52, OC56, OC92, OC96, OC 99, OC109, OC114, OC117, OC119, OC122, OC123, OC128, OC129, OC137 and OC143,	0.5-1/ panicle	Rest of the accession	8-10/ panicle
TMB	97 Nos	0	OC 105, OC 125 and OC 126	0-0.5

HOGALAGERE

The reactions of MLT-1992 and MLT-2002 entries maintained at HREC, Hogalagere & ARS, Chintamani were observed for susceptibility/resistant or tolerance to infestation of TMB. The data indicated that none of the yielding accessions/entries have shown resistant reactions to TMB infestation (Table 3.38 & 3.39).

Table 3.38 : Screening of MLT-II (MLT-1992) entries for tolerant/resistant to the major pests of the region at HREC, Hogalagere during 2016-17

Centre	Entry	Mean damage on 52 leader shoots			Thrips
		TMB	Leaf miner	Apple & nut borer	
Vengurla	H-68	1.04	1.14	1.33	0.95
	H-367	0.72	1.19	0.98	0.76
	H-303(V-9)	0.92	0.84	0.68	1.09
	H-255	1.14	0.71	0.71	1.27
	H-320	1.05	1.28	1.07	0.94
Vridhachalam	M-4/3	0.81	1.00	1.10	1.37
	M-15/4	0.79	1.01	1.14	1.09
NRCC, Puttur	NRCC-1	0.78	0.87	0.66	1.02
	NRCC-2	1.21	1.13	0.65	0.85
Bapatla	TN-30/1	0.88	0.60	0.62	0.79
	TN-3/33	1.21	0.80	0.79	0.87
	TN-10/19	1.30	0.89	1.03	0.94
	TN-3/28	0.69	0.70	0.74	1.16
Ullal	Ullal-1	1.06	0.71	0.69	1.34

Table 3.39 : Screening of MLT-III (MLT-2002) entries for tolerant/resistant to the major pests of the region at HREC, Hogalagere during 2016-17

Centre	Entry	Mean damage on 52 leader shoots		
		TMB	Leaf miner	Apple & nut borer
Bhubaneswar	BH-6	1.20	0.73	1.12
	BH-85	0.71	0.70	0.82
Madakkathara	H-1593	1.19	1.10	0.72
	K-22-1	1.04	0.92	1.31
Vengurla	H-662	1.05	0.90	0.79
	H-675	1.01	0.73	1.22
Puttur	H-32/4	0.75	0.91	1.10
	Goa-11/6	0.68	0.60	0.92
Vridhachalam	H-11	0.69	1.24	1.13
	H-14	0.92	1.06	1.33
Chintamani	Chintamani-1	0.89	0.79	1.08

JAGDALPUR

Thirty six germplasm were screened against major and minor insect pests of cashew presented in Table 3.40. It was observed that the incidence of TMB was less during this year. At panicle stage, 23 germplasm were free from the attack of TMB and remaining germplasm were received less than one damage score. Leaf miner incidence varied from 1.19 per cent in CARS-8 to 33.34 in NRC-190. Minimum leaf folder infestation was recorded in NRC-191 (22.05%) and maximum in NRC-137 (33.84%). Damage of leaf caterpillar ranged from 23.73 to 40.83 per cent in the germplasm. Germplasm, T-10/19 and Hy-367 received minimum nut thrips damage score with 0.17 score while, germplasm CARS-10 having maximum damage score of 0.64. in case of apple thrips damage, Hy-367 and CARS-6 were free from the attack of thrips while, NRC-130 having maximum damage score of 0.49.

Table 3.40 : Screening of cashew germplasm to locate tolerance / resistance to major pests of the region at Jagdalpur centre during the year 2016-17

Infestation by	Min. damage recorded (range)	Germplasm accession	Max. damage recorded (range)	Germplasm accession
Leaf miner	1.19	CARS-8	33.34	NRC-190
Shoot tip caterpillar				
Leaf and blossom webber				
Leaf folder	22.05	NRC-191	33.84	NRC-137
Leaf caterpillar	23.73	V-3/28	40.83	V-3/33
Leaf beetle				
Apple and nut borer				
Leaf thrips				
Nut thrips DS	0.17	T-10/19, Hy-367 (2)	0.64	CARS-10
Apple thrips DS	0.00	Hy-367 & CARS-6 (2)	0.49	NRC-130
Shoot TMB				
TMB on panicle (%)	0.00	T-10/19, SEL – 2, V - 3/33, V - 30/1, VRI – 1, VRI – 2, NRC – 131, NRC– 136, NRC – 37, NRC – 138, NRC – 140, NRC – 190, NRC– 191, NRC– 192, NRC – 193, AAKHANE, VTH - 711/4, CARS - 3, CARS - 4, CARS – 5, CARS - 6, CARS- 9, CARS - 10 (23)	0.78	CARS-8

JHARGRAM

Almost all the accessions screened were infested by leaf miner and leaf and blossom webber. Three accessions viz., H-10, H-114 and H-122 were recorded less infested by the leaf miner while rest of the accessions were susceptible to the insect (Table 3.41).

Table 3.41 : Screening of cashew germplasm to locate tolerance/resistance to major insect pests in Jhargram

Pest	Accessions	Min. damage	Accessions	Max. Damage
Leaf miner	H-10, 114,122	0-5%	H-9,H-12,H-126,H-132,H-144,H-154,H-157,H-115,H-21,H-133,H-23,H-159,H-161,H-110,H-117,H-134,H-150,H-111,H-120,H-136,H-146,H-173,H-174,H-121,H-41,H-137,H-55,H-178,H-57,H-179,H-180,H-130,H-139,H-147,H-65,H-158,H-162,H-87,H-119,H-28,H-30,H-170,H-36,H-37,H-39,H-58, H-59, H-112	6-22%
Leaf & blossom webber	H-114, H-132, H-154, H-157, H-158, H-159, H-161, H-150, H-29, H-170, H- 37, H-39, H-146, H-174, H-121,H- 41, H-137, H-112, H-122, H-139, H-14, H-55, H-59, H-111, H-120, H-134, H-133, H-23, H-126, H-9	0-5%	H-12,H-144,H-115,H-21,H-133,H-110,H-117,H-136,H-146,H-173,H-174,H-121,H-41,H-137,H-178,H-57,H-179,H-180,H-130,H-147,H-65, H-162,H-87,H-119,H-28,H-30,H-36,H-58, H-59	6-16%

MADAKKATHARA

The insect pest infestation on fourteen accessions has been maintained in the germplasm collection. Tea mosquito bug infestation was very low ranged from 0.001 in ARL-1 to 0.099 in Ummannur. The other insect pests were not observed during the period. Leaf miner infestation was absent in all accessions. In the previous year, the leaf miner infestation was absent in all the accessions except K-1, K-3, Mannar, Kottukkal and Ummannur and a maximum of 5.15 per cent was observed in K-1 and minimum in K-3 (0.67%). Thrips infestation was absent during this year. During last year, thrips infestation was absent in K-2, K-3, Kottukkal and ARL-2.

Apple and nut borer incidence was negligible in all accessions during the reporting year. During last year, the infestation was within the range of 1.5 to 3.0 per cent with highest damage in Mannar.

Table 3.42 : Screening of cashew germplasm to locate tolerance / resistance to major pests of the region at Madakkatahra centre during the year 2015-16.

Infestation by	Min. damage recorded (range)	Germplasm	Max. damage recorded (range)	Germplasm
Tea mosquito bug	0-0.05	ARL-1, ARL-2, K-2, ODR, Pathannur	0.05-0.1	K-1, K-3, Kunjithai, Kottukkal, Mannur, K-5, Peechi, Kainoor, Ummannur.

VENGURLE

During the year 2016-17, the accession No. NRCC-2 recorded lowest TMB incidence (0.086) whereas, it was maximum in the variety 30/1 (0.18). In case of thrips the accession No. NRCC-2 (0.07) recorded lowest TMB infestation whereas it was maximum in variety V-7 (0.178).

Table 3.43 : Screening of cashew germplasm to locate tolerance/resistance to major pests of the region at Vengurle centre during the year 2016-17

Infestation by	Min. damage recorded (range)	Germplasm	Max. damage recorded (range)	Germplasm
Tea Mosquito Bug	0.09	NRCC-2	0.18	30/1
Flower thrips	0.07	NRCC-2	0.18	V-7

VRIDHACHALAM

The data pertaining to reaction of different accessions indicate that all the MLT entries and hybrids are prone for TMB infestation in varying degree of susceptibility. The damage score for TMB infestations in various MLT entries ranged from 1.2-3.8 (Table 3.44). The score was low in ME 20/1 with mean damage score of 1.2. In other cashew entries, the mean damage score ranged between 1.6 and 3.8. So, none of the cashew entries have shown resistant reaction to TMB infestation under field condition.

Table 3.44 : Screening of MLT entries against major pests of cashew at Vridhachalam

MLT entries	TMB (mean damage score 0-4 scale in 52 leader shoots)	Leaf & blossom webber (% shoot damaged / 52 leader shoots)	Leaf miner (% of mined leaves on five laterals)	Inflorescence caterpillars (% of damaged panicle out of 52 panicles)	Leaf thrips (Population No./52 leader shoots)	Apple & Nut borer (% of apples damaged /52 panicles)
H 1598	2.1	2.6	1.3	No incidence	No incidence	No incidence
H 1600	2.0	3.4	1.1			
H 1608	2.2	3.2	1.4			
H 1610	2.4	3.3	2.0			
H 129	2.6	3.6	2.0			
H 40	3.4	1.6	2.6			
H 2/15	2.6	3.2	1.1			
H 2/16	3.8	2.4	2.0			
H 33/3	1.6	2.7	3.0			
H 44/3	2.0	2.4	1.4			
M 26/2	2.6	3.2	3.5			
ME 20/1	1.2	2.3	1.3			
VTH 30/4	2.8	3.2	1.3			
VTH 59/2	3.1	3.2	1.0			
V 2	2.8	2.4	1.0			
V 3	3.2	2.4	3.2			
V 4	3.2	2.6	2.5			
V 5	2.0	2.8	2.5			

Screening of F₁ hybrids revealed that all the cross combinations were susceptible to TMB infestation. However, the damage score was low (1.4) in H 10, H14 and H 16 followed by H 13 and H15, H17 with a mean damage score of 2.3 and 3.0 respectively (Table 3.45).

Table 3.45 : Screening of F₁ hybrids for tolerance to cashew pests at Vridhachalam

Hybrid Number	Cross combination	TMB mean damage score 0-4 scale in 52 leader shoots	Leaf & blossom webber % shoot damaged / 52 leader shoots	Inflorescence caterpillars (% of damaged panicle out of 52 panicles)	Leaf miner (% of mined leaves) on five laterals	Apple & Nut borer (% of apples damaged /52 panicles)
H 10	M 10/4 x M 26/1	1.4	3.0	2.3	1.6	No incidence
H 11	M 10/4 x M 45/4	3.0	3.6	3.0	1.3	
H 12	M 10/4 x M 75/3	2.8	3.6	2.6	0.0	
H 13	M 26/2 x M 26/1	2.3	3.3	2.3	1.0	
H 14	M 26/2 x M 45/4	1.4	4.8	2.6	1.0	
H 15	M 26/2 x M 75/3	2.3	4.6	2.6	1.8	
H 16	M 44/3 x M 26/1	1.4	4.8	2.3	2.3	
H 17	M 44/3 x M 45/1	2.5	4.6	2.6	2.0	

However, none of the cashew entries have shown immune or resistant reaction to TMB and other foliar feeding insects.



CHAPTER II : ORGANISATION

1. INTRODUCTION

The All India Coordinated Spices and Cashew nut Improvement Project (AICS & CIP) was started during the fourth five year Plan in 1971. The AIC & CIP had five centres (four University Centres and one ICAR Institute based centres) identified for conducting research on cashew. These centres were located at Bapatla (Andhra Pradesh), Vridhachalam (Tamil Nadu), Anakkayam (Kerala) (Later shifted to Madakkathara), Vengurla (Maharashtra) and CPCRI, Regional Station, Vittal (Karnataka). During the fifth Plan period, one centre at Bhubaneswar (Orissa) and in sixth plan period two centres one at Jhargram (West Bengal) and another at Chintamani (Karnataka) were added. During VIII Plan period one centre at Jagdalpur (Chhattisgarh) and a sub Centre at Pilicode (Kerala) was started. During the period of XI plan, two new centres were added – one in Paria in Gujarat in 2009 and another in Darisai in Jharkhand in 2010. Further three co-operating centres are also functioning under AICRP-Cashew at Arabhavi, Barapani and Goa since 2009.

The Headquarters of the project was located at Central Plantation Crops Research Institute, Kasaragod. During the Seventh Plan period, the project was bifurcated into:

1. All India Coordinated Cashew Improvement Project and
2. All India Coordinated Spices Improvement Project.

The headquarters of the independent cashew project was shifted to National Research Centre for Cashew, Puttur in 1986. Presently, there are ten coordinating Centres and one sub Centre, four in the East Coast viz., Bapatla, Bhubaneswar, Jhargram, Vridhachalam, four in the West Coast viz., Pilicode, Madakkathara, Vengurla, Paria and three centres, one each in the plains region at Hogalagere in Karnataka, at Jagdalpur in Chhattisgarh and at Darisai in Jharkhand and three co-operating centres.

The objective of the Project is to increase production and productivity through:

1. Evolving high yielding varieties with good kernel quality and tolerance to biotic and abiotic stresses.
2. Standardizing agro techniques for the crop under different agro-climatic conditions;
3. Evolving cost effective and efficient pest and disease management practices.

2. GENERAL CHARACTERISTICS OF CENTRES OF AICRP ON CASHEW

The ten coordinating centres and one sub centre as well as three co-operating centres are located in the East Coast, West Coast and Plains Region (plateau region) of the country.

The centres of the East Coast are located at Bapatla, Bhubaneshwar, Jhargram and Vridhachalam. This zone receives low to medium rainfall ranging from 800 mm to 2000 mm annually and is distributed over a period of 7-8 months from June to January. The soil is mainly sandy, red sandy loam, red loam and laterite. Bapatla centre is situated at an elevation of 54.9 m from mean sea level (MSL) with 40° 54' latitude and 80° 28' longitude. At Bapatla the annual average rainfall is 1167 mm and the temperature ranges from 17.3 to 37.8° C; the soil is sandy soil with low organic matter, medium N, low P₂O₅ and K₂O. Average Water Holding Capacity (AWC) of soil is 100 mm and the climate is sub humid (dry). At Bhubaneshwar average rainfall is 1550 mm and the temperature ranges from 14.3 to 37.1° C. The soil is red soil, red loamy and laterite. The climate is sub humid (dry), AWC 100 mm. The Jhargram centre is located 87° longitude and 78.8° latitude. At Jhargram average rainfall is 1622 mm and the temperature ranges from 11.3 to 39.4° C. The soil is red, laterite, shallow depth gravels, low in organic matter, N and high in P₂O₅ and K₂O. The climate is sub humid (dry), AWC 200 mm. At Vridhachalam average rainfall is 1215 mm and the temperature ranges from 18.7 to 35.7° C, the soil is red laterite, low in organic matter and N, medium in P₂O₅ and high in K₂O. The climate is semi arid (dry), AWC 125 mm.

The centres in the West Coast are located at Madakkathara, Pilicode, Vengurla and Paria and a cooperating centre at Goa. This zone receives rainfall ranging from 2800 mm to 3800 mm annually and is distributed over a period of 7-9 months from April/June to December. The soil is typically sandy, sandy loam, sandy clay loam and laterite (oxisol). Madakkathara receives an average rainfall of 3550 mm and the temperature ranges from 22.0 to 36.2° C, the soil is laterite (oxisol), medium in N, low in P and medium in K contents. The climate is per humid and AWC is 150 mm. At Vengurla average rainfall is 2916 mm and the temperature ranges from 17.4 to 32.9° C. Centre is situated at an elevation of 90m above MSL; the soil is sandy loam to sandy clay loam with high organic matter, N, K and low in P. The climate is humid and AWC is 150 mm. Paria centre is characterized by black loamy soil and receives an average annual rainfall of 2200mm and temperature ranged from 18.5° C to 33.0° C with a mean RH of 70.22 percent.

Maidan tract characterized by even land has Chintamani, Darisai, Jagdalpur centres and Co-operating centre at Arabhavi in this region. Chintamani comes under Region III (Southern dry region), Eastern dry zone (zone V) of Karnataka and receives average rainfall of 789 mm and the temperature ranges from 13.9 to 34.5° C. Centre is situated at an elevation of 300m above MSL, the soil is red sandy loam, deficient in N, medium in P₂O₅ and high in K₂O. The climate is semi arid (dry), AWC is 150 mm. Darisai Centre has well drained loamy soil and receives about 1200 mm of rain during June to October. Jagdalpur is located at 17° 45' to 20° 34' N and 80° 15'to 82° 15' E longitude with altitude ranging from 550 m to 850 m above MSL with average annual rainfall ranging from 1200-1400 mm. The maximum and minimum temperatures are 41° C and 6° C, respectively. Texturally soils are sandy loam to silty loam, with very poor moisture retaining capacity having shallow depth with poor organic matter (0.05%) and pH value (5.5 - 6.5) about normal. Arabhavi centre is situated in North transitional zone (zone-8) of Karnataka and soils are texturally red sandy loams and having medium to deep soil depth. The average annual rainfall is 1200 mm. A cooperating centre in Barapani / Tura in Meghalaya region is characterized by hilly terrain and has deep black loamy soils. The average rainfall ranges between 2500 – 4000 mm spread out durind the months of June to November. The cooperating centre at Goa is characterized by lateritic soils with shallow to medium depth. The centre is situated at altitude of 25-40m above the MSL. This centre receives rainfall ranging from 2800 mm to 3800 mm spread out during June to December.

3. TRANSFER OF TECHNOLOGY

BAPATLA

The scientists of the centre have organized one day training programme on Cashew at Rastakuntubai, Viziayanagaram Dist on 12.04.2017 and 3 days training programme for farmers on “Advanced Cashew Production Technology” at PCMA Hall, Palasa, Srikakulam District from 23.01.2018 to 25.01.2018 and delivered talks on Cashew Production Technology, Crop Protection and Post-Harvest Management. They have also organized the one day district level farmers training programme on “Advanced Cashew Production Technology” at Alluri Seetha Rama Raju Memorial library, Koyyuru, Visakhapatnam District on 17.03.2018.

Organized a training programme on Cashew Apple Utilization and Value addition to the women (25 Nos.) Self Help Groups on 22nd to 24th March, 2018 held at Cashew Research Station, Bapatla.

BHUBANESWAR

The scientists of the centre participated in State level exhibition on Agricultural Biodiversity organized on 1st April, 2018 at OUAT, Bhubaneswar campus. They also participated and imparted training to farm women on cashew apple utilization at Barunia and Solar of Jajpur district, organized by OSCDC Ltd. Govt. of Odisha from 16th to 17th of May, 2017 and on 7th June, 2017 at Pitapali, Khurda. Training was imparted to the farmers and officers of Nagaland on “Advances in production and processing of cashew nut” sponsored by Central Institute of Horticulture, Nagaland at Bhubaneswar on 24th-25th March, 2017. Scientists participated and imparted training to cashew growers of Khunta, Mayurbhanj in a District Level training on 3rd January, 2018 and at Dhenkanal organized by OSCDC Ltd. under MIDH programme.

The officials participated and imparted training at District Level Seminar on Cashew at Koraput on 30th November, 2017 organized by OSCDC Ltd. under MIDH programme. Dr P.K. Panda, Horticulturist presented the paper “Importance of quality planting material in augmenting production and processing in cashew” at the DCCD sponsored MIDH Scheme - “National Conference on Cashew” 12-13th February, 2018 at Bhubaneswar. Organized one day training programme on “Scientific cashew cultivation” under TSP at village Similisahi, GP: Nuagaon, Dist. Nayagarha on 28th March, 2018. The scientists of the centre have participated in Doordarshan Programme on Pallishree (Regional Agriculture Programme) on 6th June, 2018 and discussed the topic “Kajuphasalara roga poka o tahara niyantrana on Krishi Darshan on the topic “Kaju Phasalara Jatna” on 02.02.2018 and delivered the topic “Kaju Bagichara Jatna” in All India Radio programme on 18.03.2018.

JAGDALPUR

The scientist of the centre have conducted one day training programme on 'Production technologies, Plant Protection and Processing of cashew nut' on 19th March 2018 in which about 120 farmers had participated. Participated in National Conference on "Encashing Technological Innovation for Production and Processing of Cashew" on 12-13th Feb. 2018 at Bhubaneswar, Odisha by DCCD, Kerala.

JHARGRAM

The scientist of the centre has conducted one training programme on cashew and two exposure visits in which about 50 farmers had participated. The scientist had attended three training programmes as experts in which about 100 farmers had participated.

MADAKKATHARA

A state level training on cashew production technology was held at Karshaka Bhavanam, KAU, Vellanikkara from 20.2.2018 to 22.2.2018 in which about 50 farmers had participated. District level seminar on cashew was held on 28.2.2018 in which about 150 farmers had participated. Field day was conducted at Iritty, Kannur on 16.3.2018 were about 225 participants were involved. Training on cashew apple processing was also conducted during 27.3.2018 and 28.3.2018 for 50 farmers at CRS, Madakkathara. The scientists of the centre had also participated in the seminars / workshops and symposia. Awareness programme was conducted at Pazhavallam Tribal, Colony, Thrissur and a briefing was done on scope and importance of cashew, cultivation tips and cashew apple processing.

Two day training programme on cashew production technology, quality planting material production, plant protection as well as cashew apple utilization was organized at Cashew Research Station, Madakkathara for 33 tribal people on 19th and 20th March 2018. The beneficiaries were from three colonies, viz., Marottichal Tribal Colony, Valloor Tribal Colony and Pazhavallam Tribal Colony of Thrissur district. Training on the below mentioned aspects were given.

- Cashew production technology including intercropping
- Production of quality planting material in cashew – soft wood grafting technique.
- Scion bank and establishment of small scale nursery.
- Important pests of cashew and their control.
- Demonstration of plant protection measures.
- Cashew apple utilization
- Value added products from cashew apple.

PARIA

The scientists of the centre organized one training programme for farmers in collaboration with ATMA, Valsad on scientific cashew cultivation at Mandva village of Kaprada Taluka. A total of 318 farmers had participated. During the training, farmers were given information about scientific cultivation of cashew as well as insect control in cashew. One product 'Novel Organic Liquid Fertilizer' had been given as kit to participants. Folders on cashew cultivation and TMB control in cashew (both in vernacular language) were also provided.

PILICODE

The scientists of the centre have conducted training programme on “Scientific cashew cultivation” on 2nd February 2018 at Ayithara in which around 90 farmers had participated. Farmers district level training on cashew varieties for about 150 farmers was conducted on 28.2.2018 at Iritty. Under TSP programme 2 trainings was given to 50 farmers from 2.3.2018 to 3.3.2018 at RARS, Pilicode and for 50 farmers during 5.3.2018 to 6.3.2018.

TURA

The scientist of the centre had conducted 3 training programmes on grafting methods and rejuvenation programme. Under AICRP-C and KVK programme, the cashew variety V-4 and Priyanka was distributed to the farmers for cashew area expansion in their field. Front line demonstration on cashew rejuvenation was taken up under KVK programme.

VENGURLE

The scientists of the centre have conducted 8 training programmes on crop protection for 565 participants on crop management aspect for 57 participants and on cashew fertilizer management for 62 participants. Training on insect pest of cashew and their management was given to 47 participants. The scientists have conducted 3 day training programme on cashew production technology from 7.2.2018 to 9.2.2018 in which 50 farmers had participated. Two days training programme from 15.2.2018 to 16.2.2018 was conducted on cashew cultivation and pest management for about 87 participants under RKVY program. A district level workshop on cashew was also conducted on 23.2.2018 for about 150 participants. Training on cashew apple utilization for about 125 participants was organized from 12.3.2018 to 20.3.2018. A Horticulture fair cum field day on cashew was conducted on 21.3.2018 in which about 100 farmers had participated. The scientists have conducted two training for 100 participants.

VRIDHACHALAM

The scientists of the centre have conducted District level seminar on cashew on 21.3.2018 to the farmers of cuddalore district. Under TSP conducted training and demonstration on cashew production technologies to the tribal farmers of Kalvarayan hills on 23.3.2018. The centre has conducted training and demonstration on improved production techniques and cashew apple utilization to unemployed women from 26.03.18 to 28.03.18.

4. RESEARCH PUBLICATIONS

BAPATLA

Technical Bulletin :

“Jeedimamidi-Samagra Yajamanya Paddathulu” in telugu sponsored by Directorate of Cashew nut and Cocoa Development, Cochin.

Popular Article :

Umamaheswarar Rao, K., Vimala, B. and Nagendra Reddy, B. “Andhra Pradesh Emerging as a new cashew hub”; Cashew Week, an initiative of Casheweinfo.com volume 18; Issue: 34. Pp-22-25.

Vimala, B., Umamaheswara Rao, K. and Nagendra Reddy, B. “Jeedimamidi pandu viluva aadharitha utpathulu”; Annadata, May 2017.

Umamaheswara Rao, K., Nagendra Reddy, B. and Vimala B. “Jeedimamidi antla tayarilo melakuvalu”; Annadata, August 2017. Pp. 46-48.

Nagendra Reddy, B., Umamaheswarara Rao, K. and Vimala, B. “Jeedimamidi ni aasinche kandam tolachu purugu - Nivarana”, Annadata, November 2017. Pp. 56-57.

BHUBANESWAR

Research publications

- Sethi, K., Pradhan, K., Mohapatra, K. C., Tripathy, P. and Saroj, P. L. 2017. Stability analysis for nut yield and component traits in cashew. *Indian Journal of Horticulture*. 74(1):11-15.
- Toppo, S., Sethi, K., Tripathy, P. and Mukherjee, S.K. 2017. Evaluation of Cashew (*Anacardium occidentale* L.) Germplasm for Nut Parameters. *Trends in Biosciences*, 10 (37):7766-7769
- Toppo, S., Sethi, K., Tripathy, P. and Mukherjee, S.K. 2017. Evaluation of Cashew Germplasm for Physico-Chemical Parameters and RTS Preparation. *Trends in Biosciences*, 10 (5): 1261-1265.
- Mohapatra, M., Dash, D. K., Tripathy, P., Sethi, K., Mukherjee, S. K. and Das, A. K. 2016. Performance of some cashew (*Anacardium occidentale* L.) selections for nut yield. *International Journal of Farm Sciences*, 6(3): 1-7

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- Panda, P.K., Sethi, K. and Mukherjee, S.K. (2017). Effect of organic inputs on growth and yield of cashew (*Anacardium occidentale* L.). In: International Conference on "Organic Farming for Sustainable Agriculture". 02-03rd June, OUAT, Bhubaneswar. Pp: 07.
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- Mukherjee, S.K., Panda, P.K., Sethi, K., 2018. Importance of quality planting materials in augmenting production and processing in cashew" at the DCCD sponsored MIDH Scheme- "National Conference on Cashew" 12-13th February, 2018 at Bhubaneswar. Pp. 38-42.

Popular Article

- Panda, P. K., Sethi, K. and Mukherjee, S. K. 2016. "Unnata Pranalire Lanka Amba Chasa". Chasira Sansara, April-June 2017. 52(3):8-12.

Leaflets

- Panda, P. K., Sethi, K. and Mukherjee, S. K. 2017. Lanka Amba Chasa-Lagaeba tharu amala paryanta. (In Odia)
- Mukherjee, S. K., Panda, P. K., and Sethi, K. 2018. Baignyanika Pranalire Lanka Amba Chasa (In Odia).

JHARGRAM

- Anamika Kar and Mini Poduval. 2018. Varietal Screening of cashew against different insect pests at Red and laterite zone of West Bengal. *Green Farming*. Vol. 9 (1) : 161 - 64

PARIA

Research papers presented at International and National Seminar/Symposia

- Shakti Arbat, Makati, J.P. and Shah, N.I. 2016. Varietal evaluation of cashew apple for RTS beverage preparation. Poster paper presentation in national seminar on 'Strategies for Development of Cashew' jointly organized by Dr. BSKKV, Dapoli; DCCD, Kochi and NABARD at Regional Fruit research Station, Vengurle from 19th to 20th Feb., 2016.

Popular Article

Makati, J.P. and Parmar, S.G. 2016. 'Suka meva kajuni rajyama ubharatee jatee khetee'. In 'Agro Sandesh' dated 18/07/2016, Pp.05.

Folder

Patel, R.C., Sharma, D.K., Makati, J.P. and Parmar, S.G. 2016. Folder in vernacular language 'Daxin gujaratma kajuni vaigyanik kheti'. Published by Research Scientist (Hort.), AES, NAU, Paria. Publication no. 62/2015-16.

PILICODE

Research papers presented at International and National Seminar/Symposia

Meera Manjusha, A. V., Rethesh, P. K., Kavya, P. Padmanabhan and Suresh, P.R., 2018, Early growth performance of cashew on the hard lateritic soil under different planting methods, organic manures and bioinoculants, Kerala Science congress from 28th to 30th January 2018 at Thalassery.

Meera Manjusha, A. V., Rethesh, P. K. and Suresh, P. R., 2017, Seed priming studies in Cashew. S3O18A621, Book of Abstracts, International Symposium on Horticulture: Priorities and emerging trends, 4-8 September 2017, Bengaluru, India. Pp.57

Meera Manjusha A. V., Rethesh, P. K. and Suresh, P. R. 2017, Seed priming studies in Cashew: Influence on softwood grafting S3P32A622, Book of Abstracts, International Symposium on Horticulture: Priorities and emerging trends, 4-8 September 2017, Bengaluru, India. Pp.326

MADAKKATHARA

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Sobhana, A. and Mini, C. 2018. Entrepreneurship ventures in cashew processing. In: *Entrepreneurship and Skill development in Horticultural Processing*. (Eds. Sudheer, K.P. and Indira, P.): 140-159.

VENGURLA

Gajbhiye, R.C., Salvi, V.G., Pawar, S.N., and Salvi, S.P. 2017. Effect of value added briquettes on flowering, fruiting and yield of cashew cv. Vengurla-7. *Multilogic in Science J.* (International Peer Reviewed Journal) 2277-7601. 7(23): 271-273



- Gajbhiye, R.C., Pawar, S.N., and Haladavnekar, P.C., 2017. Effect of supplementary irrigation with reference to growth and yield of cashew under South Konkan region of Maharashtra. *J. Indian Society of Coastal Agriculture Research* 0972-1584. 35(1): 51-55
- Salvi, B. R., Gawankar, M.S., Gajbhiye, R.C., Kadam, D.S., Dalvi, N.V., Khanvilkar, M.H., Zote, V.K., Pawar, S.N., Salvi, S.P., Haladankar, P.M. and Sawratkar, S.M. 2017. Technology developed for productivity enhancement in cashew under Konkan region - A review. *The Cashew and Cocoa Journal* No. KERENG/2012/49318. 6(3): 14-28
- Gajbhiye, R.C., Salvi, V.G., Salvi, S.P. and Pawar, S.N. 2017. Response of different value added briquettes with reference to yield attributes and nutrient status of cashew in Konkan region of Maharashtra. *J. Indian Society of Coastal Agriculture Research* 0972-1584. 35(1): 35-39.
- Gajbhiye, R.C., and Haladavnekar, P.C. 2017. Cashew Scenario in Maharashtra: An Overview. *Cashew Week Journal* (An initiative of Cahewinfo.com). 18(34): 42-45.
- Vaishali Zote K., Salvi, S.P., Haldavnekar, P.C., Narangalkar, A.L., 2017. Susceptibility of cashew variety to tea mosquito bug (*Helopiltis antonii* sign) In Konkan Region of Maharashtra. *Multilogic in science* 2277-7601. XIX.

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6. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2017-18

Allocation

(Rs. in lakhs)

Centre	Details of sanctioned provision					ICAR share
	Pay and Allowances	TA	Recurring contingency	Non-Recurring contingency	Grand Total	
Bapatla	38.64	1.20	12.00	0.00	51.84	38.88
Bhubaneshwar	50.00	1.20	13.00	0.00	64.20	48.15
Hogalagere	26.25	1.20	10.00	0.00	37.45	28.08
Darisai	12.37	0.40	7.00	0.00	19.77	14.83
Jagdapur	16.75	0.77	8.00	0.00	25.52	19.14
Jhargram	13.45	0.67	8.00	0.00	22.12	16.59
Madakkathara	50.00	1.00	12.33	0.00	63.33	47.50
Paria	16.45	0.70	8.00	0.00	25.15	18.86
Pilicode	12.85	0.40	8.00	0.00	21.25	15.94
Vengurla	46.00	1.20	10.00	0.00	57.20	42.90
Vridhachalam	50.00	1.20	12.00	0.00	63.20	47.40
KRCCH, Arabhavi	0.00	0.40	7.00	0.00	7.40	5.55
ICAR Res. Compl. For Goa, Goa	0.00	0.00	9.33	0.00	9.33	7.00
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	6.00	0.00	6.00	4.50
Provision for TA for PC Cell	0.00	0.00	0.00	0.00	0.00	0.00
Provision for RC for PC Cell	0.00	0.00	5.67	0.00	5.67	4.25
Total	332.76	10.34	136.33	0.00	479.43	359.57
ICAR Share	249.57	7.75	102.25	0.00	359.57	
Provision for NEH						39.00
Provision for TSP						9.00
GRAND TOTAL						407.57

Actual Expenditure

(Rs. in lakhs)

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	41.42	0.92	9.40	0.00	51.74	38.81
Bhubaneshwar	54.11	0.34	9.00	0.00	63.45	47.59
Hogalagere	23.40	1.20	10.00	0.00	34.60	25.95
Darisai	15.15	0.36	2.95	0.00	18.46	13.85
Jagdapur	18.98	0.74	8.00	0.00	27.72	20.79
Jhargram	12.98	0.28	6.59	0.00	19.85	14.89
Madakkathara	57.64	0.38	12.33	0.00	70.35	52.76
Paria	14.99	0.49	3.50	0.00	18.98	14.23
Pilicode	12.86	0.31	7.21	0.00	20.38	15.28
Vengurla	44.29	0.11	9.90	0.00	54.30	40.72
Vridhachalam	48.16	1.20	12.00	0.00	61.36	46.02
KRCCH, Arabhavi	0.00	0.24	3.55	0.00	3.79	2.84
ICAR Res. Compl. For Goa, Goa	0.00	0.00	9.29	0.00	9.29	6.97
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	1.64	0.00	1.64	1.23
Provision for RC for PC Cell	0.00	0.00	5.67	0.00	5.67	4.25
Total	343.98	6.57	111.03	0.00	461.58	346.18
ICAR Share	257.98	4.93	83.27	0.00		
Provision for NEH						0.00
Provision for TSP						9.00
					GRAND TOTAL	355.18

7. METEOROLOGICAL DATA OF DIFFERENT CENTRES FOR THE YEAR

BAPATLA

Month	Temperature (°C)		Mean RH (%)		Rainfall (mm)	No. of rainy days
	Max.	Min.	Max.	Min.		
April	35.5	26.8	72	71	-	-
May	37.6	27.0	69	63	232.0	8
June	35.1	25.5	78	68	187.5	14
July	34.5	24.2	79	64	115.9	6
August	35.7	25.7	69	56	128.9	8
September	32.5	26.2	86	67	302.7	11
October	33.9	23.0	78	63	25.7	3
November	32.4	20.5	82	62	-	-
December	30.7	18.5	86	64	33.4	4
January	30.7	18.2	89	62	-	-
February	31.8	19.1	86	62	-	-
March	33.5	24.1	78	70	-	-
Total					1026.1	

BHUBANESWAR

Months	Temperature (°C)		R.H (%)		Rainfall (mm)	No. of rainy days	BSH
	Max.	Max.	Max	Min			
June	35.36	26.55	86.8	59.7	122	15	3.58
July	31.86	25.91	92.25	77.80	445.9	24	2.1
August	32.78	25.80	90.77	75.09	391.7	26	4.77
September	33.61	25.70	92.03	70.6	244.4	14	4.62
October	32.22	24.30	93.48	68.64	204.5	8	5.76
November	29.57	18.83	88.73	54.73	55.2	4	
December	28.05	14.34	92.06	47.45	36.3	1	6.87
January	28.23	11.93	92.35	34.19	-	-	7.60
February	33.61	15.94	91.42	29.25	-	-	8.35
March	36.81	22.13	91.67	34.06	-	-	6.52
Total					1500		

DARISAI

Month	Temperature (°C)		Humidity (%)		Rainfall (mm)
	Max.	Min.	Max.	Min.	
April	42.55	23.32	71	32	21.3
May	38.30	23.10	76	50	134.6
June	35.30	24.67	81	66	112.6
July	30.60	24.38	86	76	189.8
August	31.25	23.82	89	78	399.8
September	31.26	24.03	92	78	370.7
October	31.47	19.61	88	64	5.2
November	29.38	12.35	89	53	0.0
December	31.8	5.7	87	43	0.0
Jan	27.01	8.9	87	52	0.0
Feb	31.28	12.43	83	45	0.0
Mar	34.41	16.84	83	44	26.0
Total					1260

HOGALAGERE

Month	Temperature (°C)		R.H (%)		No. of rainy (days)	Rainfall received (mm)
	Max.	Min.	Morn.	Even.		
April	39.0	20.70	82.00	19.00	1	28.00
May	36.8	18.80	94.00	28.00	1	16.20
June	32.70	20.03	94.00	50.00	3	67.90
July	28.42	20.73	92.19	63.58	10	223.2
August	28.66	20.73	91.26	59.71	3	56.60
September	28.07	20.62	91.97	60.33	3	13.20
October	30.10	18.32	90.32	39.81	0	2.00
November	29.29	15.79	93.17	36.97	1	2.90
December	26.73	15.04	93.90	46.84	5	57.80
January	27.02	14.85	94.45	43.97	2	9.40
February	29.93	13.79	92.00	27.14	0	0.00
March	33.05	19.11	91.68	30.10	3	34.40
Total						511.6

JAGDALPUR

Month	Temperature (°C)		Relative Humidity (%)		Vapour Pressure		Wind Vel. (Kmph)	Evaporation (mm)	Bright Sunshine hours	Rainfall (mm)
	Max.	Min.	I	II	I	II				
April	38.3	24.8	73.7	28.5	20.5	15.4	5.4	7.4	6.7	3.6
May	37.5	25.7	67.2	33.2	18.1	14.5	6.5	7.8	6.3	47.0
June	33.4	24.4	85.7	60.9	20.9	20.3	5.9	4.9	4.2	296.2
July	29.1	23.2	91.9	77.0	21.5	21.8	7.0	2.9	2.1	481.2
August	29.3	23.8	90.0	70.6	21.0	21.1	6.1	3.3	3.6	335.9
September	29.6	23.4	93.3	75.4	21.1	21.2	4.7	3.1	3.5	308.6
October	30.0	19.4	95.6	52.4	17.3	15.3	3.1	3.4	6.3	182.0
November	29.6	13.5	96.5	32.2	11.9	9.4	2.6	3.4	7.8	0.0
December	28.9	10.0	94.2	30.8	9.3	8.6	2.5	3.2	6.8	0.0
January	24.3	9.4	94.0	29.0	8.9	7.9	2.6	3.3	7.7	0.0
February	32.7	11.7	88.0	23.0	10.2	7.7	2.9	4.8	8.5	0.0
March	35.1	17.5	80.0	26.0	14.2	9.9	4.4	6.0	8.4	11.9
Total									1666.4	

JHARGRAM

Month	Temperature (°C)		Relative Humidity (%)	Max. Wind velocity (mph)	Cloud cover (%)	Rainfall (mm)	Rainy days	Average Pressure (mb)	Sun shine hours
	Maximum	Minimum							
April	47	27	48	16.6	6	6.8	8	1006	351
May	36	27	68	11.9	11	203.5	18	1004	377
June	34	27	75	9.6	30	136.9	27	1000.1	316.5
July	36	28	72	11.2	53	395.9	30	1000.8	232
August	35	28	72	10.1	44	183.4	27	1002.6	276.5
September	34	27	72	8.9	35	90.3	19	1005.8	239
October	32	25	73	8.1	26	185.5	18	1008.5	268.5
November	29	20	56	7.2	15	16.4	6	1013.4	246.5
December	28	18	46	7.2	10	12.1	2	1015.5	215.5
January	27	15	32	7.6	0	0	0	1014.1	93
February	27	15	34	8.1	7	0.8	1	1013.8	83.5
March	38	25	34	6.4	7	0	0	1010.3	316.8
Total						1231.6			

MADAKKATHARA

Month & Year	Temperature (°C)		Relative Humidity (%)	Sunshine hours (h)	Rainfall (mm)	Rainy days (No.)
	Max.	Min.	Average			
Apr	35.72	25.8	70	46.62	9.5	4
May	33.88	24.93	75.88	32.12	23.13	11
June	30.53	23.5	87	13.3	152	23
July	30.82	22.92	84.6	22.02	92.62	24
Aug	30.1	23.3	86.5	21.15	101.48	16
Sept	31.48	22.93	84.5	28.5	99.73	16
Oct	31.94	22.4	80.2	36.26	42.42	12
Nov	32.73	21.7	73	43.13	10.13	5
Dec	32.65	21.05	62.75	54.08	0	0
Jan	33.62	20.84	50.4	58.66	0	0
Feb	36.15	22.8	48.75	66.26	1.3	1
Mar	36.7	24.02	57.6	56.14	6.64	2
Total					538.95	

PARIA

Month	Temperature (°C)		RH		Wind velocity	Rainfall	Sunshine hours	Evaporation
	Max.	Min.	Mor.	Eve.				
April	35.96	19.19	69.72	46.32	3.33	0.0	9.50	6.86
May	36.10	24.61	74.59	54.05	6.67	0.0	9.77	7.55
June	34.41	26.30	81.63	68.52	7.75	161.6	6.80	5.74
July	29.73	23.75	95.21	88.37	5.51	997.3	1.13	1.97
August	29.77	24.19	93.55	84.50	6.85	974.2	2.45	2.74
September	29.80	22.81	94.52	80.43	2.87	499.9	4.05	2.81
October	32.79	19.12	87.70	61.34	1.97	39.6	7.32	3.06
November	34.75	12.04	74.69	32.57	1.16	0.0	9.13	3.54
December	33.81	10.88	86.96	33.46	1.27	0.0	9.27	3.27
January	32.16	9.36	87.29	37.32	1.55	0.0	8.87	3.10
February	34.38	11.57	81.26	37.84	1.92	0.0	9.43	4.60
March	35.75	14.11	75.42	38.04	2.58	0.0	9.46	5.86
Total						2672.6		

PILICODE

Month & year	Temperature (°C)		Relative humidity (%)	Rainfall (Monthly cumu. mm)	No. of rainy days	Bright Sunshine hours
	Maximum	Minimum				
April	33.1	24.6	76	28.8	3	3.4
May	32.8	23.6	74	124	10	3.7
June	28.3	22.2	89	1137.4	30	1.0
July	28.0	22.4	86	746.6	31	0.9
August	29.1	22.8	88	663.6	24	1.1
September	29.8	23.0	86	697.1	18	1.8
October	30.4	22.3	83	181.2	13	1.4
November	31.6	21.5	79	23.2	4	1.8
December	31.5	20.1	77	37.0	3	6.2
January	30.9	20.1	75	0	0	8.2
February	31.7	21.1	76	1.6	1	8.6
March	32.6	23.6	77	36.9	3	7.2
Total				3677.4		

VENGURLA

Month	Temperature (°C)		Humidity (%)		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	Forenoon	Afternoon		
April	33.856	23.398	84.74	62.17	0	0
May	34.89	26.088	76.82	64.75	15.6	5
June	30.523	23.963	90.07	83.75	1257.8	24
July	29.092	23.244	92.20	86.65	1273	30
August	30.638	23.225	89.68	79.60	341.6	28
September	30.225	23.23	91.86	80.14	312.6	24
October	31.584	22.286	88.17	74.17	101	8
November	34.63	17.518	88.60	61.10	6.4	2
December	34.513	17.305	91.95	63.12	0	0
January	33.645	16.288	83.35	59.96	0	0
February	35.25	18.038	86.57	59.65	0	0
March	35.278	19.928	87.07	54.60	0	0
Total					3308	

VRIDHACHALAM

Month	Temperature (°C)		RH (%)	Rainfall (mm)	No. of rainy days	Wind speed	Sunshine hours
	Max.	Min.					
April	47	27	48	6.8	8	16.6	351
May	36	27	68	203.5	18	11.9	377
June	34	27	75	136.9	27	9.6	316.5
July	36	28	72	395.9	30	11.2	232
August	35	28	72	183.4	27	10.1	276.5
September	34	27	72	90.3	19	8.9	239
October	32	25	73	185.5	18	8.1	268.5
November	29	20	56	16.4	6	7.2	246.5
December	28	18	46	12.1	2	7.2	215.5
January	27	15	32	0	0	7.6	93
February	27	15	34	0.8	1	8.1	83.5
March	38	25	34	0	0	6.4	316.8
Total				1231.6			

8. LIST OF DCR PUBLICATIONS

Sl. No.	Publication	Price Rs.
1	Cashew Production Technology (Revised)	60.00
2	Softwood grafting and nursery management in cashew (Revised)	45.00
3	Annotated Bibliography on Cashew (1985-1994)	75.00
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	Germplasm accessions – I	165.00
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15	Status of Cashew Germplasm Collection in India (Booklet)	*
16	Compendium of Concluded Research Projects (1986-2001)	*
17	Cashew nutritive value Revised (Brochure)	*
18	Insect pests of cashew	*

* Free of cost

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Address your enquiries to the Director, ICAR - Directorate of Cashew Research (DCR), Puttur – 574 202, Dakshina Kannada, Karnataka.



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