ISO 9001:2008 Certified

ISSN 0972 - 2645

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना

ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW

वार्षिक प्रतिवेदन

ANNUAL REPORT

2018 -19

भा.कृ.अनु.प. – काजू अनुसंधान निदेशालय

दर्बे पोस्ट, पुत्तूर – 574 202, दक्षिण कन्नड, कर्नाटक

I.C.A.R. - DIRECTORATE OF CASHEW RESEARCH

Darbe P.O., Puttur - 574 202

Dakshina Kannada, Karnataka

ISSN 0972 - 2645

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना

ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW

वार्षिक प्रतिवेदन

ANNUAL REPORT

2018-19

परियोजना समन्वयकर्ता

डॉ. एम.जी. नायक

PROJECT COORDINATOR

Dr. M.G. Nayak

भा.कृ.अनु.प. – काजू अनुसंधान निदेशालय

दर्बे पोस्ट, पुत्तूर – 574 202, दक्षिण कन्नड, कर्नाटक

ICAR - DIRECTORATE OF CASHEW RESEARCH

Darbe P.O., Puttur - 574 202, Dakshina Kannada, Karnataka

Correct citation

Annual Report 2018-19. All India Coordinated Research Project on Cashew
Directorate of Cashew Research, Puttur, Pages 182
ISSN 0972 – 2645

Published by

Dr. M.G. Nayak
Director (Acting)
ICAR - Directorate of Cashew Research, Puttur
Phone : (08251) 231530; EPABX : (08251) 230902, 236490
FAX : 08251 – 234350
E-mail : director.dcr@icar.gov.in dircajures@gmail.com, cashewresputr@gmail.com
Grams : CAJUKENDRA, PUTTUR

DCR Website: http://www.cashew.icar.gov.in

July 2019

Edited by

Dr. Mohana G.S. & Dr. M.G. Nayak

Word-processed by

Mrs. Reshma K

Hindi Translation by

Mr. P.G. Bhat

Printed at

Codeword Process and Printers
C - 18, Yeyyadi, Mangaluru– 575 008
Tel. No. : 0824-2214618, 9900100818
E-mail : codeword.process@gmail.com

Cover & Back Page

NRC-137 (BPP-3) and NRC-138 (NRCC-Sel-1), promising germplasm accessions for Bastar Plateau region of Chhattisgarh

CONTENTS

प्राक्कथन

ABOUT THIS REPORT

INTRODUCTION

CHAPTER- I : TECHNICAL

परियोजना समन्वयकर्ता की रिपोर्ट 1

Project Coordinator's Report 3

AICRP Cashew Centres 5

Executive Summary 6

Report of AGM – 2018 of AICRP-Cashew 7

EXPERIMENTAL RESULTS

I. CROP IMPROVEMENT

Gen.1. Germplasm collection, conservation, evaluation, characterization and cataloguing 13

Gen.1a Evaluation of germplasm accession for CNSL content 19

Gen.3 Varietal Evaluation Trials

1. Multi Location Trial – III 23
2. Performance of Released Varieties (Multi Location Trial – V) 26
3. Multilocation Trial – VI (Special MLT) 34

Gen.4. Hybridization and Selection 36

Gen.4a Rapid Polyclonal Hybrid Evaluation Trial 54

Gen.5. Characterization of germplasm for cashew apple 55

Gen.6. Varietal Screening of cashew apple for preparation of RTS and Jam 59

Gen.7. Evaluation of promising bold nut, bigger size apple and high yielding cashew genotypes 60

II. CROP MANAGEMENT

Hort.1a. Nutrient Management for yield maximization in cashew. 63

Hort.2. Fertilizer application in high density cashew plantations 66

Hort.3. Drip irrigation trial 68

Hort.4. Expt.2. High density planting-Observational trial 70

Hort.6. Intercropping in cashew 73

Hort.7. Organic management of cashew 78

Hort.8. Spacing cum fertilizer trial 89

Hort.9. Evaluation of production potential of newly developed cashew variety Jhargram-2 at different spacing 92

Hort.10. Ultra High Density Planting (UHDP) in cashew 94

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 99

Ent. 2. Control of cashew stem and root borer

Expt.2. Curative control trial 117

Ent.3. Influence of Biotic and Abiotic factors on the incidence of pest complex in cashew 128

Ent.4. Screening of germplasm to locate tolerant/ resistant types to major insect pests of the region 140

CHAPTER-II : ORGANISATION

1. General characteristics of centres of AICRP on cashew 151
2. Transfer of technology 152
3. Research Publications 156
4. Staff position 160
5. Budgetary provision and actual expenditure during 2018-19 164
6. Meteorological data of different centres for the year 166
7. List of DCR Publications 172

प्राक्कथन

यह, अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की 35 वीं वार्षिक प्रतिवेदन है । यह प्रतिवेदन में अप्रेल – 2018 से मार्च – 2019 तक का शोध परिणाम और अन्य जानकारी को शामिल किया गया है।

परियोजना के अंतर्गत 14 केंद्र हैं, जो, जैसे, भारत के पूर्वी तट में चार; बापट्ला (आंध्र प्रदेश), भुवनेश्वर (उड़ीसा), झारग्राम (पश्चिम बंगाल) और वृद्धाचलम् (तमिल नाडु); पश्चिम तट पर तीन केंद्र और एक उपकेंद्र जैसे, माडकत्तरा (केरळ), पिलिकोड उपकेंद्र (केरळ) तथा वेंगुर्ला केंद्र (महाराष्ट्र); नवसारी (गुजरात); मैदानी भाग में तीन केंद्र, एक चिंतामणि (कर्नाटका), दूसरा जगदलपुर (छत्तीसगड), तीसरा दारीसाई (झारखण्ड) में स्थित हैं और इस परियोजना के अनुसंधान कार्यसूची का 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 प्ररियोजनाएँ, 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 तकनिकी जानकारी और दूसरा है इतिहास, कर्मचारियों की विवरा, वित्तीय प्रावधान, मौसम के आँकडें, शोध प्रकाशन से संबंधित संस्थानीय जानकारी।

(एम.जी. नायक)
प्रभारी निदेशक एवं परियोजना समन्वयकर्ता

स्थान : पुत्तूर
दिनांक : 31.07.2019

ABOUT THIS REPORT

This is the thirty fifth 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 2018 to March 2019.

There are a total of fourteen centres ie., four in the East Coast of India, namely, Bapatla (Andhra Pradesh); Bhubaneshwar (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, 3 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 ie., 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]
DIRECTOR & PROJECT COORDINATOR (ACTING)

Puttur
Dated : 31.07.2019

INTRODUCTION

The All India Coordinated Spices and Cashewnut 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 (Chattisgarh) 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.

CHAPTER I - 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 स्थीत हैं। इन सभी केन्द्रों पर विभिन्न राज्य कृषि विश्वविद्यायलों और आयसीएआर के संस्थानों का प्रशासनीक नियंत्रण होता है। परियोजना का वर्ष 2018-19 का मूल बजट आबंटन रु. 373.35 लाख (भा.कृ.अ.प. का शेयर) था।

निम्नलिखित विधियों से काजू की उत्पाद और उत्पादन क्षमता बढाना 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।

इस वर्ष, QRT टीम के साथ परियोजना समन्वयकर्ता और प्रभार विज्ञानी, पीसी सेल AICRP काजू के सभी केन्द्रों का दौरा किया और कार्यों का समीक्षा किया है। इन केन्द्रों द्वारा की गई कार्यों का विवरण नीचे दिया गया है।

फसल सुधार

जहाँ तक जनन द्रव्य किस्मों का विचार है, इस वर्ष के दौरान 15 नया किस्मों को उनके उपज और उपज के लिए कारण गुणों के आधार पर अलग अलग केन्द्रों द्वारा संग्रहण, किया गया हैं। 125 किस्मों का चरित्रवर्णन और मूल्यांकन जारी है। वेंगुर्ला और आस पास में सब्जी तैयार करने के लिए काजू की कोमल गिरियों का ज्यादा मांग है। इसे ध्यान में रखते हुए CNSL से मुक्त काजू किस्मों को पहचान ने के लिए RFRS वेंगुर्ला में CNSL मुक्त किस्मों को डूंडने का प्रयोग शुरु किया गया है। अत्युत्तम हाईब्रिडों का मूल्यांकन करने का बहुस्थानीय ट्राइल-III में वेंगुर्ला में हाइब्रिड एच-662 (34.76 किलो, पाँचवी कटाई) और वृधाचलम केन्द्र में H-14 हाइब्रिड (22.62 किलो, पाँचवी कटाई) उच्चतम संचयी उपज दिखाए।

विमोचित किस्मों का प्रदर्शन का ट्राइल में, दारीसाई बापट्ला में बीपीपी-8, होगलगेरे में सेलेक्षन-2, झारग्राम में भुवनेश्वर-1, पिलिकोड में प्रियांका, वृधाचलम में वीआरआई-3 ने बेहतर साबीत हुआ। हाइब्रिडाइजेशन और चयन ट्राइल में, गोवा में 18 और भुवनेश्वर में 16 नया संयोजन का प्रयोग किया गया। बापट्ला केन्द्र में 14 हाइब्रिड आशाजनक रहा, गोवा में दो और वृधाचलम में एक हाइब्रिडों का प्रदर्शन सिसिलेवार रहा। हाइब्रिडों में जननद्रव्य किस्मों का आशाजनक गुण लाने का उद्देश्य रखनेवाली रापिड क्लोनल् हाइब्रिड मूल्यांकन ट्राइल, भुवनेश्वर, वेंगुर्ला और मडक्कतरा केन्द्रों में आरंभ किया गया है। आशाजनक बोल्ड नट और अधिक उपज देनेवाले किस्मों का मूल्यांकन करने का नई ट्राइल आरंभ करने के लिए, पहचान की गई किस्मों का सयान स्टिक भुवनेश्वर, जगदलपुर, गोवा, बापट्ला और वेंगुर्ला से डी.सी.आर., पुत्तूर को दिया गया है और जब इनके ग्रफ्ट बनते हैं, उन्हें रोपण का मौसम में वितरण किया जाएगा।

फसल प्रबंधन

उच्चतम उपज पाने के लिए आयोजित पोषक प्रबंधन ट्राईल में, सिफरिश की गई मात्रा में उर्वरक और एफ.वाई.एम. डालना, प्रमुख और लघु पोषकांशों का फोलियार स्प्रे भुवनेश्वर और होगलगेरे में

अत्युत्तम परिणाम दिया। बूँद बूँद सिंचायी ट्राइल में, 80% कुमुलेटिव पान इवापोरेशन में सींचायी करना होगलगेरे केन्द्र में बहुत अच्छा साबित हुआ। उच्च घनत्व रोपण पर्यवेक्षण ट्राइल में, यह देखने में आया कि उच्च घनत्व रोपण में (4मी x 4 मी) बीसी रेशियो समय के साथ कम होते जा रही थी और सामान्य घनत्व रोपण में यह रेशियों समय के साथ बढ़ रही थी। अंतर फसल प्रबंधन ट्राइल में, बापटला में अंतर फसल चैना एस्टर, दारीसाई में टोमेटो, झारग्राम में क्लस्टर बीन, मडक्कतरा में अमरांतस और वृधाचलम में भिंडि अत्यंत ज्यादा निवल प्रतिफल दिया। जैविक काजू खेती प्रबंधन ट्राइल में, वर्मिकॉपोस्ट द्वारा 100% नाइट्रोजन और बायो फटिंलैजर देने से बापटला केन्द्र में सर्वादिक गिरी उपज रिकार्ड किया गया। जब कि, सिफारिश की गई मात्रा 10 किली FYM का उपचार भुवनेश्वर, दारिसाई, वृधाचलम और होगलगेरे में उच्चतम बेनिफिट रेशियो दिया।

मगर, वेंगुर्ला केन्द्र में वर्मिकॉपोस्ट द्वारा 100% नाइट्रोजन और बायो फर्टिलैजर देने से सबसे ज्यादा निवल लाभ मिला। इस साल से, डीसीआर – पुत्तूर में मानकीकरण की गई अल्ट्रा हाइडेंसिटि रोपण का प्रयोग वेंगुर्ला केन्द्र में आरंभ किया गया है।

फसल संरक्षण

काजू फसल दो प्रमुख कीडों से बाधित है, टी.एम.बी. और सी.एस.आर.बी.। बापट्ला, भुवनेश्वर, वृधाचलम, जगदलपुर और मडक्कत्तरा में टी.एम.बी. शूट टिप् केटरपिल्लर, एपल और नट् बोरर, लीफ मैनर के खिलाफ लामडा–साइलोत्रिन (0.6 ml/L) अन्य कीटनाशकों से भी ज्यादा प्रभावी रहा। जब की होगलगेरे केन्द्र में थियोमिथोक्सांम् (0.2g/l) प्रभावी पाया गया। वेंगुर्ला केन्द्र में लामडा साइलोत्रिन और ब्युप्रोफेजिन प्रभावी साबीत हुआ। जहाँ तक सी.एस.आर.बी. का सवाल है क्लोरोपैरीफोस (10ml/L) भुवनेश्वर, वृधाचलन और जगदलपुर में प्रभावी साबीत हुआ। जब कि, इमिडाक्लोप्रिड (2ml/L) बापट्ला केन्द्र में प्रभावी रहा। होगलगेरे, मडक्कतरा और वेंगुर्ला केन्द्रों में फिप्रोनिल सबसे अच्छा प्रदर्शन दिया। शूट टिप क्याटपिल्लर का प्रभाव भुवनेश्वर में मौसम के पारामिटर के साथ सकारात्मक संबंध दिखाया। जब कि टी.एम.बी. की प्रभाव न्यूनतम तापमान के साथ वेंगुर्ला, मडक्कतरा, होगलगेरे और वृधाचलम केन्द्रों में नकारात्मक संबंध दिखाया। बापट्ला, भुवनेश्वर, होगलगेरे, जगदलपुर केन्द्रों में बहुत सारे जननद्रव्य किस्मों को कीडों के खिलाफ स्क्रीन किया गया और कुछ आशादायक किस्मों को पहचाना गया है।

प्रौध्योगिकी हस्तांतरण

AICRP के समन्वयन केन्द्रों ने प्रौद्योकिकि हस्तांतरण गतिविधियों में भी जुडे है और वर्ष 2018–19 के दौरान 3,61,491 काजू कलमों को उत्पादन किये हैं, जिन्हें किसानों को, सरकारी संघटनों को और गैर सरकारी संस्थाओं को वितरण किया गया है। नया नया उत्पादन प्रौद्योगिकियों को, तकनिकी मार्गदर्शन के साथ, प्रसार करने के लिए अलग अलग केन्द्रों द्वारा 'प्रदर्शन खेती' आरंभ किया गया है। यह उल्लेखनीय है कि AICRP काजू केन्द्रों ने काजू खेती और प्रबंधन के बारे में जानकारी देने के लिए 49 प्रशिक्षण और जागृति कार्यक्रम आयोजन किए हैं। इन में 1000 से ज्यादा किसान भाग लिए हैं।

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 2018-19 was Rs. 373.35 lakhs (ICAR Share) and the expenditure was Rs. 358.75 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.

The Project Coordinator and the Scientist in charge, PC cell have visited all centres of AICRP cashew along with the QRT team and reviewed the progress of those centres during the year. The salient achievements of the centres are outlined here section wise.

Crop Improvement:

As for as cashew germplasm accessions are concerned, during the year, 15 new accessions for yield and yield attributing characters have been collected by different centers. Further, 125 accessions are in various stages of characterization and evaluation. A new trial on CNSL free accessions (6) has been initiated at RFRS, Vengurle with the aim of identifying best CNSL free accession for local market where demand is high for tender nuts for use in curry preparation. In the multilocation trial –III which aims at evaluation of promising hybrids, H-662 showed highest cumulative yield (34.76 kgs in fifth harvest) at Vengurle center and H14 at Vridhachalam center (22.62 kgs in fifth harvest).

In the trial on performance of released varieties, BPP-8 at Darisai, Bapatla, NRCC Selection-2 at Hogalagere, Bhubaneswar-1 at Jhargram, Priyanka at Pilicode, VRI-3 at Vridhachalam were found to be better. In the trial on hybridization and selection, 16 new hybrid combinations were tried at Bhubaneswar and 18 at Goa. Further, 14 hybrids seems to be promising at Bapatla center, two hybrids showed consistent performance at Goa, one at Vridhachalam. In addition to these, evaluation of 18 promising hybrids has been initiated at Vengurle. Further, rapid clonal hybrid evaluation trial which aims at bringing desirable characters from promising germplasm accessions has been initiated at Bhubaneswar, Madakkathara and Vengurle centers. For initiation of new trial on evaluation of promising bold nut and high yielding

genotypes, the scion sticks of identified accessions from Bhubaneswar, Jagdalpur, Goa, Bapatla and Vengurle have been supplied to ICAR-DCR and grafts will be distributed during the planting season.

Crop Management

In the trial on nutrient management for yield maximization in cashew, recommended dose of fertilizers with FYM and foliar spray of major and minor nutrients gave best results in Bubhaneshwar and in Hogalagere. In drip irrigation trial, irrigation at 80% cumulative pan evaporation was found to be the best in Hogalagere center. In the high density planting – observation trial, it was found that BC ratio goes on decreasing as the years advance in high density (4m x 4 m) and the reverse is true in case of normal planting (8 m x 8m) . The intercrop China aster at Bapatla, Tomato at Darisai, cluster bean at Jhargram, amaranthus at Madakkathara, Bhendi at Vridhachalam centers gave highest net returns in the intercropping experiment. In organic management trial, 100% N as vermicompost and biofertilizers gave highest nut yield in Bapatla center. Whereas recommended dose of fertilizer with 10 kg FYM gave highest benefit ratio in Bhubaneswar, Darisai, Vridhachalam and Hogalagere. However, in Vengurle center, 100% N as vermicompost and biofertilizer combination gave highest net returns. Further, a new trial on ultra high density planting which was standardized at ICAR-DCR, Puttur has been initiated at Vengurle this year.

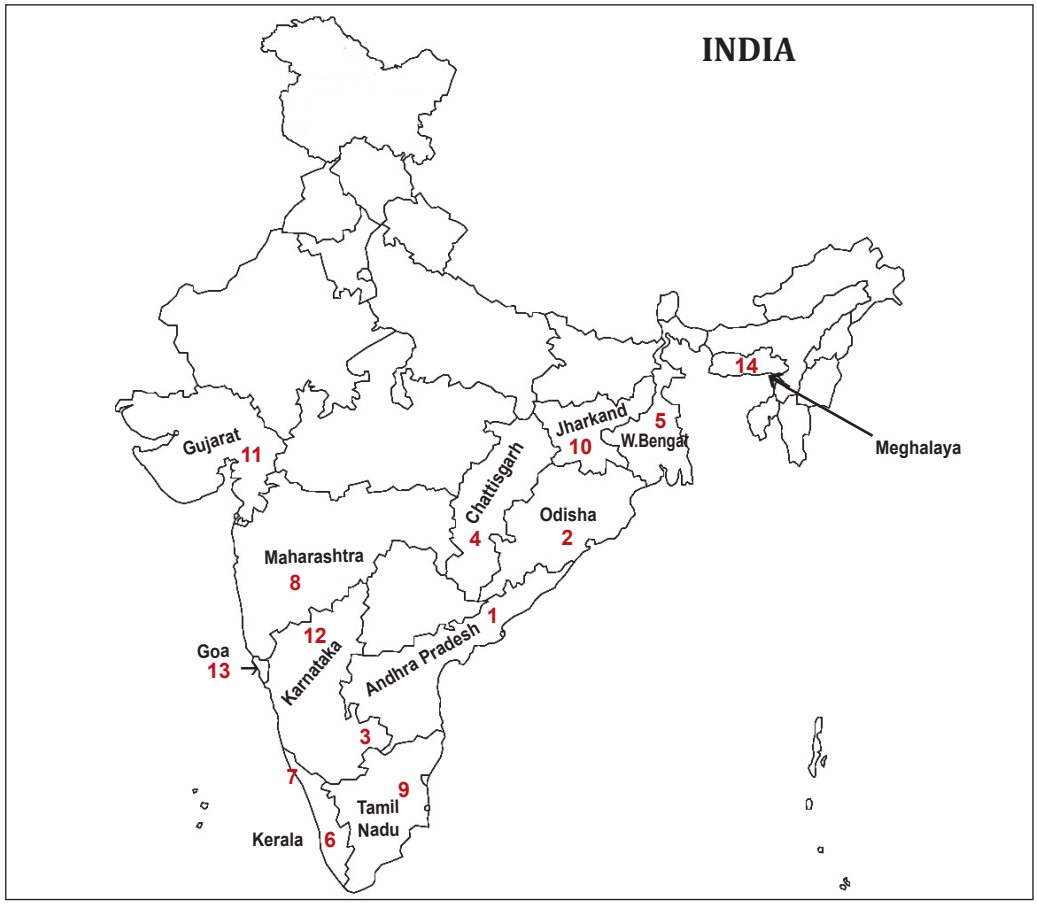
Crop Protection

Cashew is affected with two major pests i.e. TMB and CSRB. Lamda-Cyhalothrin (0.6 ml/litre) found to be more effective compared to other insecticides against TMB, Shoot tip caterpillar, Apple and nut borer, leaf miner in Bapatla, Bhubaneswar, Vridhachalam Jagdalpur and Madakkathara. However, Thiomethoxam (0.2g/l) was found to be effective in Hogalagere center. In Vengurle center, Lambda-Cyhalothrin and Buprofezin found to be effective. As for as CSRB is concerned, Chloropyriphos (10ml/l) was found to be effective in Bhubaneswar, Vridhachalam and Jagdalpur. However, Imidachloprid (2ml/l) was effective in Bapatla center. In Hogalagere, Madakkathara and Vengurle centers, Fipronil gave the best results. The incidence of Shoot tip caterpillar was positively correlated with weather parameters at Bhubaneswar. However, TMB incidence was negatively correlated with minimum temperature in Vengurle, Madakkathara, Hogalagere and Vridhachalam centers. Many germplasm accessions were screened against pests at Bapatla, Bhubaneswar, Hogalagere, Jagdalpur and some promising accessions are identified.

Transfer of Technology

The coordinating centres of AICRP are also involved in transfer of technology activities and have produced 3,61,491 cashew grafts during 2018-19 which were distributed to cashew farmers, government and non-government organizations. Frontline demonstration plots have been laid out by different centres to disseminate the recent production techniques with backup of necessary technical guidance. It is worth mentioning that the Centres of AICRP on Cashew have conducted 49 training and awareness programs on different aspect of cashew cultivation and management practices in which more than 1000 farmers have participated.

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

- 27 new germplasm accessions for yield and yield attributing characters have been collected by different centres and 125 accessions are in various stages of characterization and evaluation.
- A new trial on CNSL free accessions (6) has been initiated at RFRS, Vengurle with the aim of identifying best CNSL free accession for local market.
- In the multi-location trial–III, H-662 showed highest cumulative yield of five harvests (34.76 kgs) at Vengurle center and H14 at Vridhachalam center (22.62 kgs).
- In the trial on nutrient management for yield maximization in cashew, recommended dose of fertilizers with FYM and foliar spray of major and minor nutrients gave best results in Bhubaneswar and in Hogalagere.
- In the high density planting trials, it was found that BC ratio goes on decreasing as the years advance in high density (4m x 4m) and it has increased in normal density planting (8 m x 8m).
- The intercrop china aster at Bapatla, tomato at Darisai, cluster bean at Jhargram, amaranthus at Madakkathara, bhendi at Vridhachalam centers gave highest net returns in the intercropping experiment.
- Lamda-Cyhalothrin (0.6 ml/litre) found to be more effective compared to other insecticides against TMB, Shoot tip caterpillar, Apple and nut borer, leaf miner in Bapatla, Bhubaneswar, Vridhachalam Jagdalpur and Madakkathara.
- For CSRB management, chloropyriphos (10ml/l) was found to be effective in Bhubaneswar, Vridhachalam and Jagdalpur.
- AICRP - Cashew centres have produced 3,61,491 no. of cashew grafts during 2018-19.
- The centres have conducted 49 training and awareness programs on different aspect of cashew cultivation and management practices.

Planting Material Produced :

A total of 3,61,491 no. of grafts were produced during 2018-19 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	90000
Bhubaneswar	22000
Jagdalpur	8000
Jhargram	792
Madakkathara	121365
Pilicode	15000
Vengurle	60798
Vridhachalam	43536
TOTAL	**361491**

REPORT OF THE ANNUAL GROUP MEETING OF SCIENTISTS OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW-2018

The first day of the AGM-2018 witnessed the opening ceremony with the lighting of holy lamp by Prof. S. Pashupalak, the Hon'ble Vice- Chancellor, OUAT, ADG (Hort.) Dr. W.S. Dhillon, Director (Acting), DCR, Puttur, Dr. M.G. Nayak and Dean of Research of OUAT, Dr. L. M Garnayak. Welcome address was delivered by Dean of Research, OUAT. Dr. M.G. Nayak, Director (Acting), DCR, Puttur, presented project co-ordinator's report and provided a general view of the issues and challenges pertaining to cashew research and development. He stated that there are 1726 germplasm of cashew being maintained and promising types have been used for hybridization programmes, 43 high yielding cashew varieties have been released in AICRP system. He focused on some important points like high density planting, canopy management for harvesting solar energy, promotion of intercrops in new plantations and management of CSRB and TMB.

Honorable Vice-Chancellor OUAT Professor Dr. S. Pashupalak in his presidential address mentioned cashew is a prominent cash crop and focused on public-private partnership for market intervention. In Odisha, nut quality is on par with national level, however farmers are not getting good price for rawnuts. He also stated that low yield in Odhisa is due to lack of nutrition, old and senile orchard and lack of pruning practices. He also focused on development of varieties with tolerance to pests, suitable for high density planting and with good processing qualities. Chief guest address was given by Dr. W.S.Dhillion, ADG I (Horticulture) ICAR. He stated cashew is a very important cash crop; out of total export of horticultural crops one third is contributed by cashew. He further opined that, horticulture progressed tremendously, In 2012 horticulture production was suppressed for first time food grain production and it is 300 million tonnes with 2.7% growth rate and maximum share in agricultural GDP is contributed by horticulture. He focused on value addition aspects and the post-harvest losses is estimated to be around 20-25% in horticultural crops i.e., 60 million tones accounting for 1 lakh crore rupees. He suggested five approaches for increasing productivity under fruit crops including cashew.

1. Providing quality planting material to the farmers as 40 crore planting material is required and presently 5 crores is being produced
2. Rootstock improvement programme for identification of tolerant type to CSRB,TMB, water and salt tolerance and resistance
3. Promotion of HDP to increase productivity and also by adopting new training systems like Y- trellising and use of growth retardants etc.
4. Transfer of technology need to be intensified as only 17% of technology is disseminated to the farmers at present
5. Generation of innovative ideas by students and practical approach through research guidance, RAWE and other activities

Dr. S.K. Mukherjee, in-charge AICRP-Cashew, CRS, Bhubaneswar, proposed the vote of thanks.

The dignitaries released the following publications & website :

1. AES, Paria

   Three folders have been published by Paria in vernacular language.

- Management of Tea mosquito bug in cashew by Dr. S.G. Parmer and Dr. J.P. Makati.
- Scientific farming in cashew by Dr. J.P. Makati.
- Management of cashew stem and root borer in cashew by Dr. S. G. Parmer, Dr. J.P. Makati and Dr. D.K. Sharma

2. CRS, Madakkathara
   - Good agricultural practices in Cashew (In Malayalam) by Dr. A. Shobana, Dr. M.S. Smitha, P.S. Sarath and T. Reshma
3. CRS, Bhubaneswar
   - Minimal descriptor of cashew germplasm accessions by Dr. K. Sethi, Dr. S.K. Mukherjee, Dr. P. Tripathey, Dr. P.K. Panda.
   - Insect pests of cashew and their control (In Odia language) by Dr. S.K. Mukherjee, Dr. P.K. Panda and Dr. K. Sethi.
   - Hi-tech cashew cultivation: An option to enhance the production by Dr. P.K. Panda, Dr. K. Sethi and Dr. S.K. Mukherjee.
4. Status export on cashew published by ICAR-DCR, Puttur.
5. AICRP-Cashew website was launched in this occasion which covers the details on history, mandates, research centres, achievements etc. This website is designed by Mr. Muthuraju and Dr. G.S. Mohana at ICAR-DCR, Puttur.

EXPERIMENTAL RESULTS

I. CROP IMPROVEMENT

I. CROP IMPROVEMENT

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

Centres: East Coast : Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast : Goa, Madakkathara, Paria, Pilicode and Vengurla

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

The objectives of the project are:

(a) To evaluate the existing germplasm of cashew in different centres

(b) 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,

(c) To establish clonal germplasm conservation blocks in different centres

During the current year, 27 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 1557 (Table. 1.1).

Table 1.1 : Cashew germplasm holding in different centres

Centre	No. of accessions		
	Earlier existing	Collected during 2018-19	Existing
East Coast			
Bapatla	104	7	111
Bhubaneshwar	109	3	112
Jhargram	164	--	164
Vridhachalam	208	--	208
West Coast			
Goa	97	7	104

Madakkathara	142	--	142
Pilicode	94	5	99
Vengurla	346	--	346
Plains tract/others			
Darisai	18	5	23
Hogalagere	110	--	104
Jagdalpur	82	--	82
Kanabargi	3	--	3
Tura	59	--	59
Total	**1536**	**27**	**1557**

BHUBANESWAR

During the fruiting season of 2017-18, three cashew germplasm accessions were collected and included in germplasm conservation block of the centre. With addition of these 3 new accessions, the total number of germplasm collections have been increased to 112, out of which 37 are primary and 71 are secondary collections. Three hybrids developed by the centre are also included in germplasm conservation block.

The newly collected germplasm accessions were collected from village Ranasighpur, Khurda for having desirable traits like cluster bearing and high nut yield.

Evaluation of Germplasm

The results revealed that accession OC-166 has higher nut weight (8.6g) while nut yield was higher in accession OC-163 (4.53 kg/ plant at fourth harvest). Mean apple weight (62.0g) and shelling (30.9%) were recorded in accessions OC-169.

Among the evaluated germplasm, two accessions DSI-103 (9.03 Kg nut /plant) & DSI-107 (9.24 Kg nut / plant) were identified for higher nut yield. It was observed that flowering season in different germplasm ranged from 2nd week of November to 2nd week of April with maximum mean flowering duration of 125 days, in accession DSI-107 & minimum of 76 days in accession DSI-105. Mean nut weight was recorded maximum in accession DSI-107 (8.90gm), followed by accession DSI-111 (8.80gm), the cumulative yield was maximum in accession DSI-107 (9.24 Kg/plant) followed by accession DSI-103 (9.03 Kg/ plant) of three harvests.

GOA

Five new accession viz. Durga-1/18, Barsem-1/18, Barsem-3/18, Karvem-1/18 and Karvem-2/18 were identified for their higher nut yield and bold nut features. Two accessions viz. Arla Keri-1/8 and Barsem-2/18 were identified for their cluster bearing habit irrespective of their nut size. The characteristic features of nuts and apples of the accessions and their mother trees are presented here.

Table 1.2 : Cashew accession newly collected during 2017-18

Sl. No.	Accession	Location	Approx. age (yrs.)	Nut Wt (g)	Shelling %	Nut yld (Kg/tree)	Apple wt. (g) & Colour	TSS (°B)
1	Durga-1/18	Priol	55-60	9.37	32.23	35-38	82.5 Yellow	12.4
2	Arla keri 1/18	Arla-Kerim 15° 25'43"N 74° 00'42.3"E	45-50	6.88	30.42	40-42	52.5 Yellow	11.2
3	Barsem 1/18	Barsem 15° 4'42.15"N 74° 1'55.94"E	35	7.68	30.52	35-40	69.85 Red	12.0
4	Barsem 2/18	Barsem 15° 4'42.15"N 74° 1'55.94"E	15	6.88	31.25	8-10	51.5 Red	11.9
5	Barsem 3/18	Barsem 15° 4'42.29"N 74° 1'55.65"E	15	11.86	28.88	12 -15	118.42 Reddish orange	12.6
6	Karvem 1/18	Karvem 15° 1'41.51"N 74° 6'41.10"E	25	8.36	30.32	27-30.	109.25 Yellow,	11.8
7	Karvem 2/18	Karvem 15° 1'41.82"N 74° 6'40.76"E	25	9.99	28.62	25-30	139.53 Yellow	11.6

With addition of these seven new accessions to the earlier Germplasm of 97 accessions, a total of 104 germplasm accessions of cashew representing the different groups are being maintained at Goa Centre.

b) Characterization of selected local bold nut cashew genotypes:

The results on characterization of 14 genotypes revealed that the accession Valpoi-2 showed vigorous growth with maximum tree height of 5.1m with collar girth of 74 cm and mean canopy spread of 12.56 m^2 followed by Mayem-1 with corresponding values of 5.0 m, 58 cm and 14.34m^2 respectively.

Tudal-1 recorded the highest nut yield of 5.53 kg/tree with mean nut weight of 8.27g and apple weight of 81.42g, followed by Bardez-8/98 with 5.33 kg/tree as compared to 4.19 kg/tree of raw nut yield in check (Goa-1). Valpoi-2, Tiswadi-3 and FMGDI-1 continued to record higher nut weight in the range of 11.83g-14.69 g. Bardez 8/98 and Tiswadi-7 recorded the mean nut weight of less than 8g but were on par with check (7.33g). All other accessions recorded the mean nut weight in between 8.02g (BKL-2 and Mayem-1) and 9.13g (Tudal-3). Shelling percentage significantly varied from 27.61 (Bardez-9) to 31.43% (Mayem-1) as compared of 30.36% in Check variety. Among the accessions, apple weight varied from 61.6.g in Mayem-1 to 98.46 in Tiswadi-3.

Table 1.3 : Performance of local bold nut Cashew genotype.

Sl.No.	Genotype	Flowering year	Nut yield (Kg/tree)	Mean Nut Wt. (g)	Shelling (%)	Mean apple Wt (g)	TSS (%)
1	Valpoi-1	2012	3.96	8.83	29.04	73.13	12.28
2	Valpoi-2	2012	3.37	14.69	28.31	90.68	10.31
3	Valpoi-3	2012	-	8.85	28.01	88.58	11.27
4	Bardez-8/98	2011	5.33	7.08	29.92	63.49	11.76
5	Bardez-9	2011	3.89	9.11	27.61	91.52	12.64
6	Tiswadi-3	2012	3.86	12.73	29.18	98.46	10.17
7	Tiswadi-7	2011	2.64	7.26	30.46	71.32	10.16
8	Tudal-1	2011	5.53	8.27	28.73	81.42	11.59
9	Tudal-3	2011	3.55	9.13	28.42	79.04	11.66
10	Mayem-1	2011	3.98	8.02	31.43	61.60	11.19
11	BKL-1	2011	2.03	8.96	28.19	73.96	11.24
12	BKL-2	2011	1.22	8.02	28.64	73.43	11.96
13	FMGDI-1	2011	3.71	11.83	28.89	84.68	11.66
14	Goa-1 (check)	2011	4.19	7.330	30.36	70.79	10.40
	SEm ±		0.24	0.16	0.24	2.02	0.26
	CD (5%)		0.76	0.49	0.73	6.06	0.81
	CV (%)		20.15	3.32	1.49	4.62	4.30

HOGALAGERE

Layout of the germplasm experiment has been completed at HREC, Hogalagere and planting was taken up in two stages (during September 2014 and during December 2016). Results presented here are from the plants of first stage planting and the remaining plants are in establishing stage. So far 104 accessions have been collected and planted.

a. Evaluation:

The mean tree height ranged from 1.9 to 3.7m, trunk girth ranged from 24.5 to 47.0cm and that of canopy area ranged from 3.8 to 15.2 m^2 in different accessions. Highest plant height was recorded in HREC-23 (3.7m), Maximum stem girth in HREC-23 (47.0cm) and that of the maximum canopy area was noticed in HREC-14 (15.2 m^2) and HREC-23 (13.7 m^2).

Observations on yield attributes revealed that weight of nuts ranged from 4.4 to 12.3 (g) and that of the nut yield from 0.13 to 4.84 (kg/tree). The highest nut weight recorded was in HREC-11 (12.3g) and highest nut yield recorded was in HREC-27 (4.84 kg/tree) in fourth harvest and the maximum shelling per centage was noticed in HREC-16 (30.9%).

The high speed winds (59.5km/hr) during April-2018 have damaged cashew plants in the experimental plots (Plate 1).

Plate 1. High speed winds have affected old and young plants in experimental plots of cashew

JAGDALPUR

The centre has 82 Cashew germplasm in conservation block.

JHARGRAM

At present the center is maintaining 29 primary germplasm accessions, 78 secondary germplasm accessions and 57 varieties, therefore, a total of 164 germplasm accessions.

This year the centre has collected 3 germplasms from the farmers'orchard located in the Jhargram district. The germplasm collected were having more than 9.0 gm nut weight, high shelling percentage and moderate yield. So they were found promising and were collected and added to the gene bank of AICRP on Cashew, RRS, BCKV, Jhargram.

1. BCKV / 2018/1 : The tree is upright compact with intensive branching habbit. The age of the plant was 7 years. The trunk bark type was smooth. Apples were yellow, cylindrical with big size (77 g). Nuts were bold (9.5g) and there were 7 nuts/ panicle. The shelling percentage was 30.12%. The estimated yield is 0.13kg/m^2. There was no TMB or CSRB incidence.

2. BCKV / 2018/2 : The tree is upright compact with intensive branching habbit. The age of the plant was 5 years. The trunk bark type was smooth. Apples were yellow, cylindrical with big size (67 g). Nuts were bold (9.0 g) and there were 5 nuts/panicle. The shelling percentage was 32.2 %. The estimated yield is 0.06 kg/m^2. There was no TMB or CSRB incidence recorded.

3. BCKV / 2018/3 : The tree is upright compact with intensive branching habbit. The age of the plant was 32 years. The trunk bark type was rough. Apples were yellow, pyriform with big size (68 g). Nuts were bold (9.2 g) and there were 6 nuts/panicle. The shelling percentage was 31.0 % with estimated yield of 0.18 kg/m^2. There was no TMB or CSRB incidence.

VENGURLA

There are 346 cashew germplasm accessions conserved in the gene bank. The 10 cashew accessions planted during 2005 were evaluated, characterized as per descriptor during 2018. Growth observations of all 14 types were recorded during the year 2017-18. Among the 14 types, the maximum height (4.85m), stem girth of 56.50cm, EW canopy spread (5.53m), NS canopy spread (5.67m), canopy area (25.98m^2) and number of laterals/m^2 (31.0/m^2) was recorded in RFRS 195.

Among fourteen cashew accessions planted during 2007-2016, ten accessions planted during 2014 to 2016 were young and yet to start flowering and fruiting and only 4 accessions have flowered and yielded fruits.

Among the 4 types, the maximum flowering duration (122.5 days), number of nuts per sq. m. (24.5/m^2) and number of nuts per panicle (4.7) were recorded in RFRS 195. The highest sex ratio of 0.21 was observed in RFRS 195 and RFRS 198.

Yield attributing data of 4 cashew germplasm accessions showed that RFRS-197 had the maximum nut weight of 8.0g. The higher apple weight (67.0g) was recorded in RFRS-196. The higher shelling percentage (30.5%) was recorded in RFRS-198. The maximum annual nut yield (2.3 kg/tree) and cumulative nut yield at 5th harvests (10.75 kg/tree) was recorded in RFRS-195 for the year 2017-18.

Gen.1a : Evaluation of germplasm accession for CNSL content

Objective	:	To evaluate the performance of CNSL free germplasm accessions
Design	:	RBD
Replication	:	Four (4)
Treatment	:	Six (6) CNSL free cashew types
Treatment Details	:	T_1 : NRC-116 T_2 : NRC-188 T_3 : NRC-189 T_4 : NRC-281 T_5 : NRC-285 T_6 : RFRS-195
Spacing	:	5 x 5 m
Year of planting	:	1st July, 2018

For initiation of the said trial at AICRP-Cashew, Vengurle centre, the scion sticks of five CNSL free types were collected from ICAR-DCR, Puttur during June, 2017 and grafts were made. Similarly the grafts of RFRS-195 (CNSL free type of Vengurle centre) were also prepared. The replicated trial of all six CNSL free types initiated at Vengurle centre during July, 2018. The care and maintenance of the planted grafts is in progress. The vegetative growth observations of the trial will be recorded in June, 2019.

Data on initial soil properties of the experimental plot revealed that the soil of the experimental site is lateritic clay loam in texture and moderately acidic (pH 5.29) in reaction and showed safe limit of electrical conductivity (0.13dSm^{-1}) for plant growth. Soil high in organic carbon content (1.85%), medium in available nitrogen content (362.17kg ha^{-1}) and available phosphorus content (20.18kg ha^{-1}). It showed very high content of available potassium (420.7kg ha^{-1}). As far as the micronutrients in soil were concerned, it indicated sufficient range of available Iron (3.27 ppm), Manganese (1.80 ppm), Copper (0.93 ppm) and Zinc (0.16 ppm) content.

CONCLUDED EXPERIMENT

Gen 1. Germplasm evaluation of ICAR - DCR accessions

Experimental details:	No. of accession	:	10
	Replication	:	Unreplicated
	No. of plants/ treatments	:	06
	Source of collection	:	DCR (NRCC), Puttur

The experiment was carried out at the S.G. College of Agriculture and Research Station, Jagdalpur, Chhattisgarh, India during 1996-97 to 2016-17. Ten DCR accessions viz., NRC-130, NRC-131, NRC-136, NRC-137, NRC-138, NRC-140, NRC-190, NRC-191, NRC-192 and NRC-193 were collected from DCR, Puttur. The germplasm accessions were planted at a spacing of 7.5 m X 7.5 m under unreplicated trial. There were 6 plants per germplasm. All the plants were given the same agronomic practices. The observations on growth viz., mean tree height (m), mean stem girth (cm), canopy spread, canopy area and flowering duration; and yield attributes viz., number of flowering laterals / m^2, mean number of nuts/panicle, mean nut weight (g), mean apple weight (g), shelling %, mean annual nut yield c(kg/tree) and cumulative (yield/tree) were recorded. Meteorological data had also been recorded during the period.

Results

It is evident from the data presented in Table-B that during 2016-17, the mean annual nut yield/ tree was highest for NRC- 138 (11.20Kg), followed by NRC-137 (10.20Kg). The cumulative nut yield was highest in NRC-137 (108.85Kg) in 18 harvests. Mean nut weight was found highest for NRC-138 (8.50g) followed by NRC-140 and NRC-137. Shelling per cent was found highest in NRC-131 (29.50%). The average annual nut yield was also recorded maximum in NRC-138 (9.64 kg/tree) and NRC-137 (9.10 kg/tree).

Conclusion: Comparing all the parameters studied it was clear that NRC-138 (NRCC Sel.-1) and NRC-137 (BPP-3) are promising germplasm for Bastar Plateau region of Chhattisgarh.

Table A : Growth and yield characters of DCR entries during 2016-17 at Jagdalpur Centre

Accession	Mean tree height (m)	Number of flowering laterals / m^2	Mean number of nuts/panicle	Mean nut weight (g)	Mean apple weight (g)	Shelling %	Cum. yield (kg/tree) (For 18 Harvests)
NRC- 130	5.70	14.25	3.40	7.60	70.20	25.40	63.18
NRC- 131	7.60	12.25	4.20	7.70	50.60	29.50	55.43
NRC- 136	6.70	12.75	4.80	6.30	59.50	27.50	53.15
NRC- 137	8.20	15.50	6.20	7.90	51.40	29.10	108.85
NRC- 138	8.50	17.75	5.80	8.50	65.20	28.50	101.88
NRC- 140	5.90	12.50	3.10	8.40	104.40	28.10	61.05
NRC- 190	6.50	11.75	3.50	7.50	60.20	24.80	47.45
NRC- 191	6.80	15.50	4.80	8.00	56.20	29.30	83.06
NRC - 192	7.80	11.25	3.20	7.40	64.30	26.80	52.70
NRC - 193	6.20	14.75	5.20	7.30	58.80	28.40	82.97

Table B : Mean annual nut yield (kg/tree) of DCR entries from 2012-13 to 2016-17 at Jagdalpur Centre

Accession	2012-13	2013-14	2014-15	2015-16	2016-17	Average
NRC-130	5.80	6.40	5.30	7.50	7.80	6.56
NRC-131	4.10	5.20	4.80	6.30	6.20	5.32
NRC-136	4.30	4.90	4.30	6.10	6.40	5.20
NRC-137	8.60	9.20	7.80	9.70	10.20	9.10
NRC-138	8.90	9.50	8.20	10.40	11.20	9.64
NRC-140	4.20	5.30	4.50	6.80	7.20	5.60
NRC-190	4.00	4.90	4.20	5.90	6.10	5.02
NRC-191	7.25	8.40	7.30	8.30	9.20	8.09
NRC-192	4.50	5.60	4.60	6.20	6.50	5.48
NRC-193	6.80	7.80	6.50	7.80	8.10	7.40

2. 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 evaluation of 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

HOGALAGERE

This experiment has been laid out at HREC, Hogalagere in the beginning of 2017. The plants are less than two years old and are in establishing stage in the experimental plot.

VENGURLE

The experiment was replanted during December 2008. Significant variation was observed among the different accessions in respect of growth parameters. The maximum height was recorded in H-662 (4.41m) and at par with V-7 (4.18m), H-675 (4.13m), K-22-1 (4.12m), B.H. 85 & Goa 11/6 (3.92 m). Whereas, the maximum stem girth recorded in V-7 (57.94 cm) and at par with all the accessions except H-11 (40.89 cm). The maximum EW spread was recorded in B.H. 6 (5.67 m) and the maximum NS spread noted in H-675 (5.87 m). The maximum canopy area (26.04 m^2) was recorded in the H-675.

There was no significant difference for flowering and fruiting parameters during the year 2017-18.

It is evident from the data presented in Table 1.4 that Vengurla-7 recorded significantly the higher nut weight (9.90 g) and at par with BH 6 (9.03 g) while; significantly the higher apple weight of 78.00 g noted in BH-6 and superior over rest of the entries. The highest shelling percentage (33.83%) was recorded in BH-85 and at par with BH-6 & H-1593 (33.17%) and V-7 (32.0%). Whereas, significantly the higher annual nut yield (6.01 kg/tree) and cumulative yield of 6 harvests (34.76 kg/tree) was recorded in H-662 and was superior over rest of the entries.

Table 1.4 : Yield parameters of cashew genotypes in MLT-III at Vengurle centre during the year 2017-18

Accession No.	Mean nut wt. (g)	Mean apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree)	Cum. Yield (kg/tree (For 6th harvests)
BH 6	9.03	78.00	33.17	2.48	20.26
BH 85	7.37	57.00	33.83	2.88	21.29
H 1593	7.56	64.00	33.17	1.34	18.45
K-22-1	7.13	63.00	30.00	1.18	15.54
H-662	8.33	69.33	30.83	6.01	34.76
H-675	5.27	56.00	31.83	4.19	25.85
H-11	6.53	44.00	29.50	2.09	17.01
H-14	6.20	38.67	31.33	3.06	23.38
H-32/14	7.43	70.00	26.23	1.30	18.13
Goa 11/6	8.00	63.33	29.83	1.32	17.69
V-7	9.90	67.67	32.00	1.20	19.39
SEm±	0.33	2.57	0.63	0.44	-
CD @ 5%	0.98	7.57	1.85	1.30	-
CV (%)	7.69	7.29	3.49	31.01	-

VRIDHACHALAM

The trial was relaid during 2008. There were significant differences among the genotypes for plant height. More height was recorded in genotypes BH 6 followed by H 662. The stem girth was more in H 675. Significantly higher mean canopy area was observed in H662 followed by H 32/4. Significant variations were observed among the cashew types for flowering duration (70 to 88), number of panicles/ m^2 (11.2 to 20.9), mean number of nuts/ m^2 (14.7 to 28.6) as well as number of nuts/ panicle (2.8 to 6.0). The genotype H14 of Vridhachalam recorded the higher number of panicles/ m^2, mean number of nuts/ m^2 and number of nuts/ panicle.

The accessions, H 1597, H 22-1, H 11, H 14, H 32/4, 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 at Vridhachalam recorded higher nut yield and cumulative yield.

Table 1.5 : Yield parameters of cashew genotypes in MLT-III at Vridhachalam Centre during 2018

Accession No.	Mean nut wt. (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 7 Harvests)
BH 6	6.9	55.0	30.1	3.64	17.50
BH 85	6.8	**45.5**	29.6	4.32	21.48
H 1597	7.1	50.3	29.2	4.28	20.89
K 22-1	7.1	50.5	**28.3**	**3.64**	**16.15**
H 662	6.5	54.9	30.1	4.41	21.10
H 675	6.9	50.3	30.2	5.02	24.01
H 11	7.0	52.1	29.4	4.96	23.99
H 14	7.0	54.4	29.7	**6.03**	**28.92**
H 32/4	7.0	50.5	29.2	4.75	22.73
Goa 11/6	7.3	**60.8**	29.5	4.03	21.24
VRI3 (Local Check)	7.0	50.4	29.2	4.61	22.57
SEm ±	NS	1.5	NS	0.12	
CD at 5%		3.4		0.48	

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

Centres: East Coast : Bapatla, Jhargram and Vridhachalam

West Coast : Madakkathara, 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

Sl. No.	Varieties	Sl. No.	Varieties	Sl. 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		

BAPATLA

Table 1.6 : Yield parameters of cashew genotypes in MLT-V at Bapatla Centre

Sl. No.	Variety/ Genotype	Nut weight (g) weight (g)	Apple	Shelling (%)	Nut Yield /tree (kg) (Harvest No.1)
1.	BPP 4	5.24	34.17	31.12	2.07
2.	BPP 6	6.41	41.67	17.59	1.20

3.	BPP 8	8.45	61.10	25.26	2.29
4.	BBSR -1	3.86	35.00	32.36	1.35
5.	Chintamani-1	4.56	25.00	31.28	1.54
6.	Jhargram-1	5.08	35.67	28.51	1.01
7.	Madakathara-1	4.37	39.60	18.65	1.53
8.	Madakathara-2	5.13	39.17	15.39	1.69
9.	K-22-1	6.70	50.70	30.79	1.62
10.	Dhana	7.38	51.10	25.63	1.21
11.	Kanaka	5.93	**73.33**	30.48	1.37
12.	Priyanka	**9.96**	**74.17**	23.13	1.77
13.	Amrutha	6.28	63.33	31.27	1.27
14.	Vengurla -1	5.87	64.17	29.22	1.33
15.	Vengurla -4	7.10	48.60	31.70	1.83
16.	Vengurla -6	**9.50**	58.60	25.12	1.43
17.	Vengurla -7	**8.62**	58.70	20.38	1.03
18.	VRI-3	6.96	40.10	30.20	1.50
19.	NRCC Sel. 2	7.53	64.17	29.39	1.07
20.	Ullal 1	3.87	15.00	27.70	1.58
21.	Ullal 3	7.52	37.77	28.40	1.43
22.	Ullal 4	5.25	20.00	30.70	1.10
23.	UN 50	7.92	60.00	25.06	0.97
24.	Goa 1	6.58	65.00	31.37	1.98
25.	Bhaskara	6.91	42.50	29.25	1.25
	CD@5%	1.04	14.68	4.28	0.67
	SEm ±	0.36	5.15	1.50	0.24

With respect to mean nut weight, mean apple weight, shelling percentage and mean annual nut yield per tree, the treatments are found to be significant. Among the 25 released varieties, the mean nut weight was found maximum in Priyanka (9.96 g) followed by Vengurla 6 (9.50g), Vengurla -4 (8.62g) and BPP-8 (8.45g). The maximum mean annual nut yield per tree during the year was recorded in BPP-8 (2.29 kg) followed by BPP 4 (2.07 kg) and Goa 1 (1.98 kg). With regard to the mean apple weight, the highest was recorded in Priyanka (74.17g) followed by Kanaka (73.33g). The shelling percentage was recorded higher in BBSR -1 (32.36) followed by Vengurla-4 (31.70).

DARISAI

Table 1.7 : Yield parameters of cashew genotypes in MLT-V at Darisai Centre during the year 2017-18

Accession	Year of planting	Mean Nut wt. (g)	Mean Apple Wt.(g)	No. of laterals /m²	Duration of Flowering Days	Yield (kg/ tree)	Cumulative Yield (Three Harvests)
BH6	2011	7.20	68.90	19.70	97.4	3.74	8.69
BH85	2011	6.90	56.40	14.30	110.6	3.56	6.16
H1597	2011	7.40	59.70	21.30	94.6	3.87	8.85
H662	2011	6.90	69.40	17.60	93.3	3.34	7.96
H675	2011	4.60	61.20	12.20	98.20	3.85	7.04
H11	2011	5.38	67.40	15.40	123.40	3.91	8.42
H14	2011	4.70	60.40	12.80	92.20	4.24	7.26
H32/4	2011	6.50	57.70	14.30	83.60	3.52	7.59
GOA11/6	2011	5.95	70.30	10.50	114.60	2.42	6.38
BPP-4	2011	6.40	37.40	17.60	89.60	2.97	8.25
BPP-6	2012	5.90	39.80	23.25	94.20	4.62	9.46
BPP-8	2012	7.70	67.50	31.40	112.6	4.18	10.34
DHANA	2012	8.10	66.40	27.54	110.8	2.53	9.68
MADAKKATHARA-1	2012	7.40	38.60	9.70	87.40	1.87	4.51
MADAKKATHARA-2	2012	7.20	47.40	11.20	109.60	1.54	5.72
KANAKA	2012	9.90	53.20	16.40	112.70	2.97	7.73
VENGURLA-1	2012	8.20	57.60	14.70	92.80	2.47	7.42
PRIYANKA	2012	11.40	74.50	24.70	87.60	2.64	9.13
ULLAL-1	2013	7.00	41.30	13.10	126.7	1.32	6.93
GOA-1	2013	6.90	48.60	11.60	110.6	2.75	5.72
BHASKAR	2013	7.90	47.30	12.80	119.60	2.69	6.54
VRI-3	2013	6.00	57.40	29.86	83.90	3.96	9.92
K22-1	2013	7.90	105.30	12.40	127.40	1.98	6.05
JHARGRAM-2	2014	5.30	44.20	13.60	94.60	2.53	5.72
SEm±		1.19	12.54	2.24	4.86	0.19	0.48
CD(5%)		3.54	37.74	6.78	14.84	0.54	1.45
CV(%)		12.86	14.76	13.47	16.18	13.32	13.54

The cumulative yield of variety BPP-8 (10.34 Kg/plant), planted in the year 2012 recorded maximum yield, followed by Dhana (9.68 Kg/plant), BPP-6 (9.46 Kg/plant) & Priyanka (9.13 Kg/ plant), on the basis of three harvests. Duration of flowering ranged from 127.40 days in K22-1 to 83.60 days in H32/4. Mean apple weight recorded 44.20 gm in Jhargram-2 to 105.30 gm in K22-1. Mean nut weight was highest in Priyanka (11.40 gm), followed by Kanaka (9.90 gm).

HOGALAGERE

The growth parameters of varieties during 2017-18 showed tree height ranging from 1.4 to 3.2m, trunk girth varied from 14.7 to 38.0cm, the maximum plant height was noticed in VRI-3 (3.2m) and stem girth in BPP-6 (38.0cm). The canopy spread of the varieties ranged from 2.4 to 11.7 m^2 with maximum in NRCC-Sel-2 and flowering duration ranged from 31 to 82 days with maximum in BPP-6. Among the yield parameters, per cent flowering intensity per square meter ranged from 57 to 90 (max. VRI-3), fruits per panicle ranged from 5.0 to 9.5 No.s (max. Chintamani-2), nut weight 5.4 to 11.6g (max. Vengurla-7), yield per plant ranged from 1.1 to 4.8kg (NRCC- Sel-2), apple weight was in the range of 28.2 to 89.3g (max. Goa-1) maximum shelling percentage was noticed in BPP-6 (36.5%) (Table 1.8).

Table 1.8 : Yield parameters of cashew genotypes in MLT-V, during 2018-19 (Date of planting 02-01-2015)

Sl. No.	Variety	Fl.Int./sq.m (%)	Fruits/ Panicle (No.s)	Nut weight (g)	Yield / plant (kg)	Shelling (%)	Apple weight (g)
1	Chintamani-1	79	7.0	8.0	2.5	31.8	38.1
2	Madakathara-1	81	5.5	7.1	1.1	27.6	73.7
3	Vengurla-1	86	6.5	5.4	3.1	35.2	46.5
4	Goa-1	81	8.0	7.0	2.8	34.5	89.3
5	Bhaskara	80	5.3	7.1	2.1	29.5	63.9
6	Ullal-3	72	7.0	8.7	3.1	34.0	44.8
7	BPP-6	76	6.3	5.8	1.4	36.5	45.6
8	Madakkathara-2	76	7.0	7.2	4.2	33.9	61.5
9	Vengurla-6	76	7.0	7.9	1.5	31.2	64.0
10	Vengurla-7	71	5.5	11.6	1.8	33.9	36.1
11	K-22-1	84	8.0	8.2	1.5	33.0	38.2
12	NRCC-sel-2	85	6.0	7.1	4.8	31.8	47.8
13	Ullal-1	57	5.3	7.7	1.3	30.7	41.6
14	Ullal-4	76	6.3	7.8	1.1	34.7	86.5
15	UN-50	75	5.0	10.5	1.4	34.7	60.1
16	Kanaka (H-1598)	87	7.0	6.3	1.8	36.2	55.1
17	Jhargram -1	84	6.0	5.7	1.3	35.6	45.7
18	Chintamani-2	83	9.5	5.8	4.1	34.3	35.2
19	Amrutha-10	87	5.7	5.7	3.3	34.9	47.8
20	VRI-3	90	6.0	6.1	1.8	34.4	28.2
21	BPP-4	77	5.0	8.7	1.5	33.0	33.2
22	Dhana	85	5.5	8.3	3.7	28.3	48.3

JAGDALPUR

The grafts of the entries to be used in experiment is prepared and procured from different centre's. The experiment will be conducted this year in the Block number 2 of SG College of Agriculture and Research Station, Jagdalpur.

JHARGRAM

It was observed that significant variations were persisting among the varieties with respect to different parameters under study. Plant height varied from 4.09m to 5.88m. Taller plants were seen in Vengurla-7 variety (5.88m) followed by BPP-6 (5.66m) and Goa-1 (5.60m). The less height plants were found in Jhargram-1 and VRI-3 varieties. The varieties were on par with respect to trunk girth, East-West and North-South canopy spread and Canopy area.

The varieties were significantly different with respect to Flowering /m^2. Maximum flowering was noticed among the varieties namely Jhargram-1 (19.16/m^2), NRCC-2 (18.5/m^2) and Bhubaneswar-1 (15.19/m^2) while minimum numbers were in BPP-6 (3.94/m^2). Other varieties were on par with respect to flowering /m^2. The sex ratio in the inflorescence was varied between 0.02 to 0.63. Maximum numbers of hermaphrodite flowers were recorded in UN-50 (0.63) followed by Priyanka (0.55) and Jhargram -1 (0.52) while male flowers were maximum in Chintamani-1, Madakkathara-II, Amrutha and BPP- 6. Bhubaneswar-I produced maximum nuts/ m^2 (61.75 nuts/m^2) while other varieties were on par with respect to nuts /m^2. Chintamani-1 had highest number of nuts/panicle (14.69) followed by Bhubaneswar-1 (11.44) and BPP- 4 (10.25).

Except Priyanka all other varieties were on par with respect to apple weight. Priyanka had exceptionally big apples (103.2 g). Shelling per cent varied from (23.55 to 35.44). Except Dhana, Priyanka and Chintamani-1 all other varieties had more than 28% shelling recovery and maximum was in Ullal- 4 followed by Bhubaneswar-1. At the age of 8 years the yield of the varieties were recorded in the range of (2.92-13.54 Kg/tree).

Higher yield was with Bhubaneswar-1 (13.54 Kg/ tree). The varieties produced more than 8 kg yield /tree were Bhubaneswar-1, Vengurla-4, NRCC-2, Chintamani-1, Bhaskara, Ullal-3, Vengurla-7, Goa-1 and BPP- 8. Cumulative yield was maximum in Bhubaneswar-1 (28.2 Kg/tree) followed by NRCC-2 (27.68 Kg/tree), Bhaskara (23.62 Kg/tree), Ullal-3 (22.87 Kg/tree) and Vengurla-7 (22.47 Kg/tree). Therefore, if the main four yield characters i.e. nut weight, shelling percent, yield/tree and cumulative yield/tree were considered for recommending varieties for the red and laterite zone of West Bengal, it was observed that during 2017-18 the varieties NRCC-2, Bhaskara, Ullal-3, Vengurla-7, BPP- 8 and Amrutha were found promising varieties for this region.

Table 1.9 : Yield parameters of cashew genotypes in MLT-V at Jhargram centre during 2017-18 (Year of Planting: 2010)

Varieties	Nut wt. (g)	Mean Apple Wt. (g)	Shelling %	Mean Annual Nut Yield (kg/tree)	Cum. Yield (kg/tree) (for 5 Harvests)
Bhaskara	6.95	66.98	33.88	9.62	23.62
Madakkathara-II	6.25	75.55	31.22	6.51	16.19
Bhubaneswar-1	4.85	37.70	34.55	13.54	28.20
K-22-1	5.90	35.38	33.49	7.87	18.35
Chintamani -1	5.68	44.05	23.55	9.63	19.43
Ullal-4	5.50	68.70	35.44	7.20	21.99
Vengurla-7	7.73	75.53	33.05	9.00	22.47
VRI-3	5.42	45.75	33.81	4.32	15.48
BPP-6	5.10	61.53	29.90	4.93	13.16
Amrutha	6.33	68.73	30.95	5.84	19.23
Vengurla-4	5.45	48.88	28.80	10.91	21.98
Goa-1	5.65	50.08	32.33	8.90	15.53
Madakathara-I	5.30	50.93	34.47	2.92	11.57
Priyanka	7.95	103.20	26.19	5.89	16.28
BPP-8	6.46	65.95	31.85	8.26	19.62
Kanaka	4.88	73.95	31.29	4.11	13.98
Vengurla-1	4.73	64.58	31.74	5.92	14.53
Vengurla-6	5.40	62.58	31.12	6.81	15.51
Ullal-3	6.78	57.53	32.26	9.17	22.87
Dhana	7.03	61.20	26.74	7.04	15.01
BPP-4	4.40	53.50	30.93	7.67	17.43
UN-50	7.65	64.23	29.75	6.68	15.81
Jhargram-1	5.50	60.80	32.73	7.80	16.63
NRCC Sel-2	6.35	47.88	30.33	10.08	27.68
SEm±	0.16	3.35	0.99	1.53	
CD at 5%	0.37	7.89	2.34	3.61	
CV(%)	5.25	11.12	6.37	4.69	

MADAKKATHARA

The varieties differed among themselves for all the biometric characters studied. The differences in plant height were statistically insignificant. Higher collar girth was reported in Kanaka which was statistically on par with Madakkathara 2. Canopy spread in both EW and NS directions showed statistically insignificant differences. Higher canopy area was observed with Madakkathara 1 which was statistically on par with Ullal 4.Varieties like Ullal 4, Ullal 1, V 7 and Madakkathara 2 fared better than the other varieties included in the trial. The varieties BPP 6, Vengurla 4 and Goa 1 had poor biometric growth parameters compared with other varieties in the trial. Higher number of flowering panicles

was observed in K-22-1 (18.00). Higher number of branches that did not have a panicle was noticed in BPP 8 (7.00) and Ullal 1 (6.13), while the least was in Vengurla 7 (1.25).

Higher proportion of bisexual flowers to male flowers was noted in Madakkathara 1 (0.20), and Ullal 3 (0.19) while least was observed in Bhubaneswar-1 and Ullal-1 (0.06). Seed set/sq.m was highest in K-22-1 (21.25). Higher nut weight was recorded in Priyanka followed by, Amrutha and BPP 8. Heaviest apples were found in BPP 6 followed by BPP 8. Highest shelling percentage was reported with Madakkathara 1, Ullal 1, BPP 8 and NRCC sel 2. Madakkathara 2 had the highest annual nut yield which was followed by Ullal 4 and Priyanka and Kanaka had the higher cumulative yield. This was followed by Madakkathara 2. Least cumulative yield was reported from VRI 3 and BPP 6.

Table 1.10 : Yield parameters of cashew genotypes in MLT-V at Pilicode centre during 2018-19 (2008 planted)

Accession No.	Nut Wt (g)	Apple wt. (g)	Shelling %	Annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 6 Harvests)
BPP-4	-	-	-	-	-
BPP-6	9.70	-	29.93	3.80	5.56
BPP-8	9.08	92.50	33.50	3.80	22.23
Bhubaneswar-1	5.96	73.50	29.02	9.20	38.05
Chintamani-1	-	-	-	-	-
Jhargram-1	-	-	-	-	-
Madakkathara-1	5.05	47.50	34.45	7.17	17.92
Madakkathara-2	7.86	63.50	28.91	15.81	49.02
K-22-1	6.26	52.00	27.89	1.11	14.27
Dhana	8.02	61.50	30.94	0.88	6.31
Kanaka	7.86	60.00	29.86	9.40	64.35
Priyanka	10.92	62.25	30.88	7.02	64.45
Amrutha	9.60	63.00	30.43	8.13	33.78
Vengurla-1	-	-	-	-	-
Vengurla-4	7.51	53.00	31.77	1.13	6.50
Vengurla-6	-	-	-	-	-
Vengurla-7	8.33	48.75	30.49	4.90	11.47
VRI-3	9.02	52.00	28.50	0.80	5.72
NRCC Sel-2	8.29	85.50	33.54	1.19	6.15
Ullal-1	5.19	50.00	34.30	7.70	16.86
Ullal-3	8.09	53.00	30.41	5.92	17.79
Ullal-4	7.71	54.00	32.06	13.26	39.75
UN-50	7.68	62.50	28.07	1.71	9.26
Goa-1	5.81	57.50	29.09	1.76	10.77
Bhaskara	7.80	54.00	31.15	4.58	17.81
CD at 5%	**0.60**	**6.23**	**1.36**	**2.20**	
CV (%)	**3.64**	**4.72**	**2.10**	**19.29**	

VRIDHACHALAM

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

The mean tree height ranges from 3.28 m (BPP-8) to 4.46m (Ullal-4). The canopy spread (both N-S and E-W direction) as well as mean canopy area showed significant variations among the varieties. The canopy spread in E-W direction ranges from 3.93m (Vengurla 6) to 5.63m (Ullal-4) and in N-S direction from 5.13m (NRCC Sel-2) to 6.21 m (Jhargram-1). Higher canopy area was recorded with the varieties such as Ullal 4, Vengurla-1 and UN 50. The flowering duration varied with a mean flowering duration of 63 days to 86 days. VRI-3 recorded higher number of panicle/m^2 and mean number of nuts/m^2. The number of nuts/ panicle varied from 3.1 in BPP 4 to to 11.8 in Ullal 4.

The average nut weight, nuts/panicle and nuts/m^2 showed significant variations among the cashew varieties. The average nut weight varies from 5.9 g to 8.2 g. Maximum nut weight of 8.2 g was recorded by Priyanka. The varieties BPP-4, BPP-8, Madakkathara-2, Vengurla-4, Vengurla-7, VRI 3, NRCC Sel-2 and Ullal-4 recorded nut weight of 7.3 g.

Apple weight varied from 51.4 g in BPP 6 to maximum of 70.3 g in Vengurla 4. Shelling ranged from 26.1% (BPP-4) to 30.3% (Vengurla-4). Nut yield/ tree recorded significant differences among the varieties. The mean annual nut yield per plant varied from 3.50 kg (Bhubaneswar 1) to 7.95 kg (VRI-3) with cumulative nut yield of 13.80 kg (Bhubaneswar 1) to 25.75 kg (VRI 3) in six harvests.

Table 1.11 : Yield parameters of cashew genotypes in MLT-V at Vridhachalam centre during 2018

Accession No.	Mean nut wt. (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 7 Harvests)
BPP-4	7.3	63.6	26.1	4.90	24.48
BPP-6	5.2	51.4	27.2	5.25	26.47
BPP-8	7.3	66.3	28.0	5.10	25.80
Bhubaneswar-1	6.8	56.8	27.1	3.50	17.60
Chintamani-1	6.2	66.2	26.9	3.70	18.94
Jhargram-1	5.9	53.6	28.0	3.75	18.69
Madakkathara-1	6.4	52.4	27.8	4.55	23.67
Madakkathara-2	7.3	60.7	29.1	4.70	23.02
K-22-1	6.5	59.1	30.1	5.05	24.54
Dhana	7.2	59.6	28.4	5.02	23.88
Kanaka	6.8	56.3	27.7	5.25	25.56
Priyanka	8.2	67.8	29.2	5.10	24.86
Amrutha	7.2	60.6	29.9	5.08	24.40
Vengurla-1	6.8	60.4	29.1	6.40	27.08
Vengurla-4	7.3	70.3	30.3	6.45	29.74
Vengurla-6	6.9	58.1	28.1	4.65	22.14
Vengurla-7	7.3	66.9	28.9	5.00	24.46
VRI-3	7.3	58.7	27.2	7.95	33.92
NRCC Sel-2	7.3	59.8	28.5	4.55	21.59
Ullal-1	6.9	53.2	29.3	4.50	20.79
Ullal-3	7.2	51.7	28.4	4.45	21.60
Ullal-4	7.3	59.2	27.8	5.30	25.07
UN-50	7.2	56.4	29.0	5.05	23.67
Goa-1	7.2	61.1	28.8	4.75	22.95
Bhaskara	7.0	62.8	28.5	6.20	28.04
SEm ±	0.11	1.41	0.17	0.08	
CD at 5%	0.25	2.95	0.43	0.21	

Gen.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 :**

Darisai : BPP-8

Paria, Kanabargi & Tura : V-4

DARISAI

Table 1.12 : Yield parameters of cashew genotypes in MLT-VI at Darisai Centre during the year 2017-18

Accession	Year of planting	Flowering duration (Days)	Apple wt. (gm)	Nut wt (g)	Nut yield (kg/tree)	Cumulative Nut Yield (kg/plant)
NRCC sel-1	2010	98.65	68.85	6.40	2.90	7.40
NRCC sel-2	2010	109.86	63.70	7.10	3.65	8.95
M44/3	2010	94.65	39.65	5.90	4.08	8.58
M15/4	**2010**	**101.25**	**78.60**	**7.30**	**4.30**	**9.20**
BPP3/33	2012	98.60	58.40	6.60	3.50	7.90
BPP10/19	2012	94.30	52.80	6.20	2.90	7.20
BPP30/1	2012	91.20	46.20	6.60	2.25	5.15
BPP3/28	2012	87.40	69.40	7.50	3.60	6.90
H303	2012	106.74	65.20	8.20	3.60	8.20
H255	**2013**	**104.85**	**68.60**	**5.70**	**3.75**	**9.15**
H367	2013	95.20	98.70	6.70	3.40	8.60
H68	**2013**	**96.40**	**67.60**	**5.10**	**4.10**	**9.00**
SEm±	--	2.61	3.78	0.33	0.12	0.23
CD (5%)	--	7.96	11.24	0.98	0.34	0.62
CV (%)	--	14.62	16.76	13.86	12.38	12.56

The mean flowering duration in variety BPP3/28 to NRCC Sel-2 ranged from 87.40 days to 109.86 days. The variety H303, (106.74 days) & the variety H255 (104.85 days) are significantly at par. The mean apple weight of variety H367 (98.70 gm) are significantly superior to all other varieties tested. The mean nut weight of H303 recorded the higher nut weight (8.20 gm) followed by BPP3/28. The maximum nut yield was recorded in variety M15/4 (4.30 Kg) followed by 4.10 Kg in var.H68 in third harvest.

KANABARGI

The significant difference was recorded in plant height. VRI-3 (2.82 m) had more height which was followed by Dhana and Bhaskara. Less height was recorded in VRI-H-1. While significant difference with respect to trunk girth was highest in Bhaskara (11.13 cm), followed by NRCC-Sel-2 and least recorded in Bhaskara. While no significant difference was found with respect to trunk height, canopy height and tree spread.

TURA

Among the cashew genotypes highest plant height was recorded in Bhaskara (3.80 m) followed by VRI (CW)H-1 (3.43 m) and Dhana (3.33 m), while lower in VRI-3 (2.27 m). Plant spread (NS x EW) was recorded highest in Dhana (4.40 m x 4.77 m), while lowest in H-303 followed by BPP-8. The maximum plants survival was recorded in Dhana (50 per cent) followed by Bhaskara (33.3 per cent).

Gen.4. Hybridization and Selection

Centres: East Coast : Bapatla, Bhubaneswar, 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 and T.No.10/19 and T.No. 30/1 is released as BPP-10 and BPP-11. Existing F1 progenies have been evaluated for the vegetative characters, duration of flowering, yield, nut weights etc and the data is presented in the Table here under.

Table 1.13 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2010

Hybrid No.	Cross combination	Nut wt. (g)	Apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree) 4th harvest (2018)	Cum. yield (kg/tree) (for four harvests) 2015-2018
H 498	T.No.30/1 x M15/4	6.34	44.40	29.10	2.80	7.90
H 499	T.No.30/1 x M15/4	6.03	37.50	31.20	4.20	10.58
H 500	T.No.30/1 x M15/4	6.20	52.00	30.20	3.00	6.94
H 501	T.No.30/1 x M15/4	7.55	51.50	30.60	1.20	4.04
H 502	T.No.30/1 x M15/4	6.34	55.00	28.60	4.00	10.19
H504	T.No.30/1 x M15/4	7.56	52.50	27.49	7.40	19.46
H505	M15/4xT.No.228	7.34	57.50	26.80	1.00	4.40
H 507	M15/4xT.No.228	6.18	59.50	28.60	1.00	2.41
H508	M15/4xT.No.228	6.12	64.50	30.10	0.50	1.74
H 509	M15/4xT.No.228	6.34	49.40	31.25	2.60	7.80
H510	M15/4xT.No.228	5.12	58.50	31.30	1.30	5.55

H 511	M15/4xT.No.228	5.24	54.50	28.20	0.50	3.55
H 512	M15/4xT.No.228	5.44	40.00	21.76	3.50	10.80
H 514	M15/4xT.No.228	4.98	35.00	30.16	1.50	4.64
H 515	M15/4xT.No.228	5.50	51.50	28.78	2.00	6.10
H 516	BPP-5xBPP-8	7.34	34.50	27.46	1.00	4.30
H 517	BPP-5xBPP-8	6.90	69.50	26.28	1.20	5.15
H 518	BPP-5xBPP-8	8.20	58.00	27.20	3.40	9.06
H 519	BPP-5xBPP-8	6.80	49.20	28.36	2.80	8.99
H 520	BPP-5xBPP-8	7.02	67.00	28.96	1.00	5.36
H 521	BPP-5xBPP-8	5.08	39.50	25.66	1.40	5.44
H 522	BPP-5xBPP-8	6.24	72.75	30.20	1.20	5.97
H 523	BPP-5xBPP-8	6.16	65.65	31.60	3.40	9.92
H524	BPP-5xBPP-8	6.34	49.60	28.56	1.80	5.60
H 525	BPP-5xBPP-8	6.55	62.70	28.26	4.40	13.36
H 526	T.No. 30/1xPriyanka	5.95	39.50	28.48	2.00	6.65
H 527	T.No. 30/1xPriyanka	6.88	49.60	21.50	3.00	10.20
H 528	T.No. 30/1xPriyanka	7.40	51.40	22.88	3.40	10.80
H 529	T.No. 30/1xPriyanka	7.23	45.00	22.97	3.65	9.46
H 530	T.No. 30/1xPriyanka	10.22	98.00	22.34	14.20	29.95
H 531	T.No. 30/1xPriyanka	7.22	78.50	20.59	4.20	12.80
H 532	T.No. 30/1xPriyanka	7.12	52.50	27.55	4.40	12.50
H 533	T.No. 30/1xPriyanka	6.44	72.50	28.34	1.00	5.40
H 534	T.No. 30/1xPriyanka	8.84	101.50	28.66	3.90	10.21
H 535	BPP-5xM15/4	6.44	64.50	26.48	1.50	5.83
H 536	BPP-5xM15/4	7.55	71.50	26.56	2.50	7.98
H 537	BPP-5xM15/4	5.75	72.50	31.56	3.20	9.70
H 538	BPP-5xM15/4	6.50	54.50	31.60	1.80	6.70
H 539	BPP-5xM15/4	9.50	98.50	28.34	3.20	9.67
H 540	BPP-5xM15/4	6.04	64.50	34.34	2.00	7.23
H 541	BPP-5xM15/4	6.44	58.50	29.20	3.10	8.33
H 542	BPP-5xM15/4	6.20	44.50	28.20	1.20	4.70
H 543	BPP-5xH-320	6.60	43.50	29.60	1.40	4.10
H 544	BPP-5xH-320	5.82	74.50	30.40	1.80	6.20
H 545	BPP-5xH-320	5.40	54.50	32.40	5.20	9.32
H 546	BPP-5x H-320	5.96	52.50	30.14	4.60	11.39
H 547	BPP-5xH-320	6.10	52.00	30.12	5.20	12.74
H 548	BPP-5xH-320	7.20	79.50	31.33	4.00	12.10

H 549	BPP-5 x H-320	7.05	47.50	30.25	3.20	8.56
H 550	BPP-5 x H-320	5.15	51.00	28.55	2.80	6.73
H 551	BPP-5 x H-320	7.28	47.50	20.64	1.30	5.82
H 552	BPP-5 x H-320	7.10	52.50	28.44	1.70	6.17
H 553	BPP-3 x Priyanka	7.25	50.80	26.16	2.30	8.73
H 554	BPP-3 x Priyanka	7.90	49.40	27.34	5.30	15.35
H 555	BPP-3 x Priyanka	4.50	44.50	32.84	5.40	14.98
H 556	BPP-3 x Priyanka	9.40	74.50	34.73	4.90	12.06
H 557	BPP-3 x Priyanka	7.10	65.70	31.45	2.20	6.73
H 558	BPP-3 x Priyanka	7.43	50.00	22.07	4.40	11.35
H 559	BPP-3 x Priyanka	6.46	59.00	31.24	3.50	11.11
H 560	BPP-3 x Priyanka	5.74	59.00	30.18	2.20	6.18
H 561	BPP-3 x Priyanka	4.25	61.40	28.26	2.75	7.80
H 562	Priyanka x BPP-2	7.53	57.50	21.67	2.20	5.60
H 563	Priyanka x BPP-2	6.13	62.50	28.45	1.00	3.40
H 564	Priyanka x BPP-2	6.73	52.50	19.89	3.00	9.56
H 565	Priyanka x BPP-2	6.14	59.00	31.24	2.50	7.75
H 566	Priyanka x BPP-2	7.34	75.00	26.24	1.20	4.30
H 567	Priyanka x BPP-2	8.44	53.00	26.14	1.40	4.35
H 568	Priyanka x BPP-2	8.00	92.00	29.58	1.30	4.90
H 569	VRI-2 x BPP-8	6.40	61.00	28.34	1.20	3.21
H 570	VRI-2 x BPP-8	6.45	54.00	27.58	1.20	3.07
H 571	VRI-2 x BPP-8	6.56	67.00	22.61	4.00	8.96
H 572	VRI-2 x BPP-8	6.85	62.00	28.88	3.00	8.15
H 573	VRI-2 x BPP-8	6.25	35.00	28.34	3.00	8.50
H 574	VRI-2 x BPP-8	6.35	63.00	28.26	1.45	6.80
H 575	VRI-2 x BPP-8	5.65	64.50	28.24	4.00	10.90
H 577	VRI-2 x BPP-8	5.22	49.00	29.24	3.00	8.11
H 578	VRI-2 x BPP-8	5.60	43.00	29.26	2.50	7.45
H 579	VRI-3 x BPP-8	4.65	81.00	28.26	3.50	10.15
H 580	VRI-3 x BPP-8	5.89	51.00	28.77	1.00	5.52
H 581	VRI-3 x BPP-8	5.23	76.00	28.56	4.80	13.07
H 582	VRI-3 x BPP-8	5.95	43.00	30.12	3.80	11.09
H 583	VRI-3 x BPP-8	5.25	78.00	31.12	2.90	8.16
H 584	VRI-3 x BPP-9	6.30	47.50	28.26	1.00	5.52
H 585	H-36x VRI-3	5.60	79.00	31.45	4.85	13.05
H 586	H-36x VRI-3	5.95	79.00	28.10	2.60	8.74
H 587	H-36x VRI-3	6.50	105.00	28.66	3.00	9.15
H 588	H-36x VRI-3	6.80	49.00	28.43	0.80	4.45

The mean nut weight was recorded more in H-530 (10.22g) followed by H-556 (9.40g). The mean apple weight was found more in H-587 (105.0g) followed by H-534 (101.50g). The shelling percentage was recorded more in H-540 (34.34) followed by H-523 (31.60). The mean annual nut yield was found more in H-530 (14.20kg/tree) followed by H-504 (7.40kg/tree). The cumulative nut yield recorded more in H-530 (29.95kg/tree) followed by H-504 (19.46kg/tree) for 4 annual harvests.

Table 1.14 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2011

Hybrid No.	Cross combination	Nut wt. (g)	Apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree) 3rd harvest (2018)	Cum. yield (kg/tree) (for three harvests) 2016-18
H589	BPP-8 x Vengurla-2	5.84	54.50	27.88	2.40	4.60
H590	BPP-8 x Vengurla-2	5.65	47.50	27.25	5.25	10.30
H591	BPP-8 x Vengurla-2	5.60	64.00	26.44	6.70	13.00
H592	BPP-8 x Vengurla-2	5.15	52.50	15.46	3.40	6.50
H593	BPP-8 x Vengurla-2	4.48	76.00	24.20	1.50	2.75
H594	BPP-8 x Vengurla-2	5.23	75.00	26.25	1.80	3.30
H595	BPP-8 x Vengurla-2	5.54	79.00	27.14	3.00	5.55
H596	BPP-8 x BPP -9	4.14	50.00	36.12	6.25	15.50
H597	BPP-8 x BPP -9	6.10	49.00	30.12	2.80	5.63
H598	BPP-8 x BPP -9	5.70	45.00	31.44	3.90	8.80
H599	BPP-8 x BPP -9	5.20	47.00	30.16	3.30	7.65
H600	BPP-8 x BPP -9	5.90	51.00	29.60	1.00	1.70
H601	BPP-8 x BPP -9	6.50	60.00	28.20	1.20	2.15
H602	BPP-8 x BPP -9	5.90	97.00	31.54	0.80	1.20
H603	BPP-8 x BPP -9	4.29	75.00	22.03	2.40	4.60
H604	BPP-8 x T.No.40/1	5.18	75.00	29.75	4.00	7.65
H605	BPP-8 x T.No.40/1	5.05	25.00	14.82	5.20	9.70
H606	BPP-8 x T.No.40/1	5.42	58.00	30.20	2.00	3.80
H607	BPP-8 x T.No.40/1	6.15	48.00	28.20	1.00	1.70
H608	BPP-8 x T.No.40/1	6.76	49.00	28.60	1.00	1.55
H609	BPP-8 x T.No.40/1	6.80	61.50	28.20	1.00	1.80
H610	BPP-8 x T.No.40/1	6.91	61.50	28.30	1.25	1.65
H611	BPP-8 x T.No.40/1	7.01	58.00	27.70	3.20	4.25
H612	BPP-8 x T.No.40/1	5.40	34.50	26.80	5.20	8.30
H613	BPP-8 x Vengurla-5	5.55	54.50	30.10	4.20	9.20

H614	BPP-8 x Vengurla-5	5.40	49.50	30.70	2.30	6.40
H615	BPP-8 x Vengurla-5	5.50	52.50	31.20	1.20	3.20
H616	BPP-8 x Vengurla-5	6.70	39.50	20.98	0.60	1.55
H617	BPP-8 x Vengurla-5	6.85	41.50	24.60	0.80	1.20
H618	BPP-8 x Vengurla-5	6.80	43.40	25.56	1.20	1.80
H619	BPP-8 x Vengurla-5	6.10	49.50	26.70	1.20	1.85
H620	BPP-8 x Vengurla-5	8.03	55.00	24.27	5.00	9.40
H621	BPP-8 x Vengurla-5	7.53	45.00	23.17	7.00	13.70
H622	BPP-8 x Vengurla-4	5.70	56.50	28.40	6.30	12.45
H623	BPP-8 x Vengurla-4	6.54	77.00	29.40	9.00	17.60
H624	BPP-8 x Vengurla-4	5.04	67.00	26.20	1.20	2.20
H625	BPP-8 x Vengurla-4	5.15	68.00	30.40	1.50	2.30
H626	BPP-8 x Vengurla-4	4.40	54.50	28.60	4.00	8.20
H627	BPP-8 x Vengurla-4	5.60	77.00	28.90	0.50	1.00
H628	BPP-8 x Vengurla-4	5.44	84.50	26.70	0.60	1.15
H629	BPP-8 x Vengurla-4	5.89	49.50	24.44	2.30	4.50
H630	BPP-8 x Vengurla-4	5.15	55.00	30.15	6.30	12.65
H631	BPP-8 x Hy94-T4	5.34	27.50	27.60	6.40	13.20
H632	BPP-8 x Hy94-T4	4.20	68.50	28.44	6.80	14.00
H633	BPP-8 x Hy94-T4	6.74	41.50	27.31	4.80	9.85
H634	BPP-8 x Hy94-T4	3.76	44.50	27.25	4.20	8.40
H635	BPP-8 x Hy94-T4	4.34	47.00	27.54	0.50	1.00
H636	BPP-8 x Hy94-T4	4.92	35.00	14.95	4.15	9.00
H637	BPP-8 x Hy94-T4	6.72	43.50	27.55	1.80	3.57
H638	BPP-8 x Hy94-T4	7.50	86.00	25.65	2.60	5.00
H639	BPP-8 x Hy94-T4	5.98	87.50	26.20	0.75	1.25
H640	BPP-8 x Hy94-T4	7.44	62.00	28.40	2.30	4.50
H641	BPP-8 x Hy94-T4	5.80	84.00	29.84	5.10	10.15
H642	BPP-8 x Hy94-T4	9.28	100.50	24.14	6.50	16.20
H643	BPP-8 x Hy94-T4	8.48	54.00	22.20	2.20	4.10
H644	BPP-8 x Hy94-T4	6.58	74.00	20.10	1.60	3.10
H645	BPP-8 x Hy94-T4	6.20	49.50	26.34	0.80	1.80
H646	BPP-8 x Hy94-T4	6.55	54.00	28.44	0.80	1.55

The mean nut weight was recorded more in H-642 (9.28 g) followed by H-643 (8.48 g). The mean apple weight was found more in H-642 (100.50g) followed by H-602 (97.00g). The shelling percentage was recorded maximum in H-596 (36.12) followed by H-698 (31.44). The mean annual nut yield was found highest in H-632 (6.80 kg/tree) followed by H-642 (6.50 kg/tree). The cumulative nut yield recorded more in H-623 (17.60 kg/tree) followed by H-642 (16.20 kg/tree) for three annual harvests.

Table 1.15 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2011

Hybrid No.	Cross combination	Nut wt. (g)	Apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree) 2nd harvest (2018)	Cum. yield (kg/tree) (for two harvests) 2018
H647	T.No.2/22 x BPP-5	5.44	49.50	26.30	0.60	1.10
H648	T.No.71 x T.No.273	8.34	54.30	30.20	0.38	0.73
H649	BPP-9 x T.No.2/22	7.44	38.40	26.40	1.80	3.30
H650	BPP-9 x T.No.2/22	5.80	44.50	26.80	1.00	2.40
H651	BPP-9 x T.No.2/22	5.80	33.50	28.80	1.80	3.80
H652	T.No.228 x T.No. 71	5.56	52.50	30.14	1.60	3.10
H653	T.No.228 x BPP-9	4.54	47.50	29.80	4.80	9.80
H654	BPP-8 x T.No.2/22	7.15	44.50	26.80	3.60	7.00
H655	T.No.2/22 x BPP-5	5.14	40.00	22.10	3.40	6.60
H656	T.No.228 x Priyanka	6.22	31.50	26.14	3.00	6.00
H657	T.No.228 x Priyanka	6.34	38.40	24.24	3.00	5.80
H658	T.No.228 x F.No.3	4.80	89.00	23.15	2.90	5.80
H659	BPP-5 x T.No.2/22	7.40	73.00	25.10	1.00	2.00
H660	BPP-5 x T.No.2/22	8.40	58.00	28.40	3.60	7.30
H661	BPP-5 x T.No.2/22	8.33	51.50	29.42	3.50	7.30
H662	BPP-5 x T.No.2/22	9.23	59.50	30.60	2.40	4.80
H663	T.No.228 x Priyanka	6.50	47.50	29.50	4.60	9.30
H664	Priyanka x T.No.30/1	5.28	35.50	26.50	3.00	6.00
H665	BPP-8 x Priyanka	7.02	42.00	26.70	2.80	5.80
H666	T.No.273 x T.No. 71	5.38	49.00	28.20	2.00	4.00
H667	T.No.273 x T.No. 71	6.12	43.00	28.40	1.40	3.00
H668	T.No. 71 x T.No.273	6.28	44.00	27.86	1.60	3.20
H669	T.No. 71 x T.No.273	6.15	44.50	25.86	1.50	2.94
H670	F.No.5 x T.No.40	5.10	39.50	27.34	1.10	2.20
H671	F.No.5 x T.No.40	6.40	72.50	27.14	1.05	2.10
H672	F.No.3 x T.No.228	5.14	33.50	28.34	1.00	2.00
H673	F.No.3 x T.No.228	5.35	74.50	28.84	1.00	1.74
H674	T.No.30/1 x BPP-8	6.44	63.00	30.12	0.80	1.40
H675	T.No.30/1 x BPP-8	4.90	39.70	21.40	0.60	1.30

H676	T.No.228 x F.No.5	5.50	37.00	30.12	0.75	2.10
H677	T.No.228 x F.No.5	5.20	43.00	30.24	1.50	1.85
H678	BPP-8 x BPP-3	5.35	33.00	27.70	1.00	1.90
H679	BPP-8 x BPP-3	3.54	45.50	23.50	1.80	3.40
H680	Kavali x T.No.40/1	4.70	51.50	28.40	1.80	3.35
H681	R.K.Bhai x T.No.40/1	5.65	46.50	27.40	1.80	3.50
H682	R.K.Bhai x T.No.40/1	4.28	48.95	26.80	1.60	3.20
H683	R.K.Bhai x T.No.40/1	4.56	49.75	25.40	1.80	3.45
H684	ABT-3 x T.No.40/1	5.44	51.75	24.24	1.85	3.35
H685	ABT-3 x T.No.40/1	6.15	49.50	24.50	1.60	2.20
H686	ABT-3 x T.No.40/1	6.10	52.50	24.20	1.20	7.00
H687	BPP-6 x Sel-2	6.34	53.30	24.12	5.40	6.90
H688	BPP-6 x Sel-1	6.25	64.50	26.10	1.00	1.90
H689	BPP-8 x BPP-4	6.26	62.00	25.10	0.80	1.50
H690	BPP-8 x Ullal -4	6.12	58.00	24.34	0.60	1.55
H691	BPP-8 x Ullal-5	4.88	57.50	26.14	1.00	2.15
H692	T.No.228 x BPP-8	6.45	64.25	27.24	1.25	3.75
H693	BPP-8 x T.No.228	4.84	50.15	27.10	2.50	6.60
H694	BPP-8 x T.No.228	4.86	52.98	26.88	4.20	8.00
H695	BPP-8 x Ullal-3	4.33	50.50	31.34	13.90	31.70
H696	BPP-8 x Ullal-3	5.20	51.50	24.33	1.00	1.55
H697	BPP-6 x NRCC-1	6.98	50.50	24.28	1.25	2.00
H698	T.No. 228 x BPP-8	8.20	49.50	24.34	1.00	1.70
H699	Priyanka x T.No.10/19	4.45	64.50	28.20	0.80	1.30

Among the hybrids the mean nut weight was recorded highest in H-662 (9.23 g) followed by H-648 (8.40 g). The mean apple weight was found highest in H-658 (89.00g) followed by H-673 (74.50g). The shelling percentage was recorded maximum in H-695 (31.34) followed by H-648 (30.20). The mean annual nut yield was found highest in H-695 (13.90 kg) followed by H-653 (4.80 kg). The cumulative nut yield recorded highest in H-695 (31.70 kg) followed by H-653 (9.80 kg) for two annual harvests.

Table 1.16 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2012

Hybrid No.	Cross combination	Nut wt (g)	Apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree) 2nd harvest (2018)	Cum. yield (kg/tree) (for two harvests) 2017-2018
H700	Kankady x BLA39/4	5.15	64.00	24.20	0.80	1.40
H701	Kankady x BLA39/4	5.36	63.50	28.16	2.80	5.40
H702	Kankady x BLA39/4	6.84	54.50	28.24	1.80	2.94
H703	Kankady x BLA39/4	5.84	68.50	30.10	1.60	3.04
H704	Kankady x BLA39/4	6.15	59.00	28.20	1.40	2.70
H705	Kankady x BLA39/4	7.44	78.00	28.24	0.80	1.40
H706	Kankady x BLA39/4	6.04	35.00	24.30	1.80	4.35
H707	T.No.10/19 x Kankady	6.30	54.50	25.86	0.50	1.05
H708	T.No.10/19 x Kankady	6.35	56.00	26.80	0.40	1.05
H709	T.No.10/19 x Kankady	8.15	64.00	27.50	0.85	1.60
H710	T.No.10/19 x Kankady	8.25	69.50	28.50	1.90	3.80
H711	T.No.10/19xKankady	6.10	60.50	31.10	0.60	1.35
H712	Kankady x T.No.10/19	6.60	64.50	30.56	0.80	1.70
H713	Kankady x T.No.10/19	7.45	52.00	27.34	1.30	2.70
H714	Kankady x T.No.10/19	7.89	71.50	21.34	1.60	3.40
H715	BPP-8 x Kankady	8.46	81.40	30.20	2.00	4.20
H716	BPP-8 x Kankady	8.28	50.00	22.89	3.40	7.00
H717	BPP-8 x Kankady	7.28	63.50	19.09	3.30	7.40
H718	BPP-8 x Kankady	6.44	62.25	26.34	3.00	6.80
H719	BPP-8 x Kankady	5.72	49.75	24.34	0.40	1.05
H720	BPP-8 x Kankady	6.92	74.50	22.88	0.50	1.00
H721	BPP-8 x Kankady	8.25	84.50	28.24	0.60	1.50
H722	Kankady x T.No.10/19	7.24	74.50	28.24	1.20	2.60

Among the evaluated, the mean nut weight was recorded highest in H-715 (8.46 g) followed by H-716 (8.28g). The mean apple weight was found highest in H-721 (84.50g) followed by H-715 (81.40g). The shelling percentage was recorded maximum in H-711 (31.10) followed by H-715 (30.20). The mean annual nut yield was found highest in H-716 (3.40 kg) followed by H-717 (3.30 kg). The cumulative nut yield recorded highest in H-717 (7.40 kg) followed by H-716 (7.00 kg) for two annual harvests.

Table 1.17 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2013

Hybrid No.	Cross combination	Nut wt (g)	Apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree) 2nd harvest (2018)	Cum. yield (kg/tree) (for two harvests) 2018
H723	T.No.30/1xKankady	5.60	51.20	28.24	2.00	4.30
H724	T.No.30/1xKankady	5.23	51.50	25.80	2.20	4.40
H725	T.No.30/1xKankady	6.10	49.50	27.80	3.00	6.40
H726	T.No.30/1xKankady	8.78	41.00	27.00	4.80	10.20
H727	T.No.30/1xKankady	7.30	61.50	27.20	4.00	8.90
H728	T.No.30/1xKankady	6.06	50.50	27.40	2.30	5.30
H729	T.No.30/1xKankady	7.10	45.60	26.30	4.50	9.50
H730	T.No.30/1xKankady	5.98	52.30	24.50	0.80	1.80
H731	BPP-8x BLA- 39/4	6.20	47.80	23.40	1.40	3.20
H732	BPP-8x BLA- 39/4	6.60	49.50	27.80	1.20	2.64
H733	BPP-8x BLA- 39/4	5.60	36.00	26.40	0.60	1.20
H734	BPP-8x BLA- 39/4	6.10	53.00	23.40	4.20	9.10
H735	BPP-8x BLA- 39/4	5.45	38.00	24.28	2.80	5.80
H736	BPP-8x BLA- 39/4	6.50	41.00	29.20	2.20	4.60
H737	BPP-8x BLA- 39/4	5.20	49.00	28.20	2.60	5.40
H738	BPP-8x BLA- 39/4	5.35	12.50	31.54	2.40	5.30
H739	BLA- 39/4 x BPP-8	5.70	41.50	30.80	2.20	5.00
H740	BLA- 39/4 x BPP-8	5.10	40.50	28.80	3.00	6.40
H741	BLA- 39/4 x BPP-8	5.38	28.50	24.56	1.70	3.42
H742	BLA- 39/4 x BPP-8	6.00	28.50	26.56	1.40	3.00
H743	BLA- 39/4 x BPP-8	6.14	31.00	24.48	1.40	3.10
H744	BLA- 39/4 x BPP-8	6.20	31.00	26.44	1.00	2.00
H745	BLA- 39/4 x BPP-8	5.10	36.50	24.30	1.20	2.00
H746	Hy95-T4x T.No.30/1	5.00	26.00	26.80	1.00	1.60
H747	Hy95-T4x T.No.30/1	3.90	19.50	31.28	0.80	1.30
H748	Hy95-T4 xT.No.30/1	5.29	45.00	28.00	0.40	0.90
H749	Hy95-T4x T.No.30/1	4.25	24.00	28.20	0.50	1.00
H750	Hy95-T4x T.No.30/1	5.24	44.00	26.54	0.60	1.20
H751	Hy95-T4x T.No.30/1	6.06	42.30	27.28	0.65	1.00
H752	Hy 95-T4 x BPP-8	4.80	24.50	28.40	0.70	1.50
H753	Hy 95-T4 x BPP-8	6.10	46.50	30.20	0.40	0.90
H754	Hy 95-T4 x BPP-8	5.10	49.50	30.10	0.55	1.15

H755	Kankady x BPP-9	7.65	54.00	28.40	0.45	1.00
H756	Kankady x BPP-9	5.10	34.50	27.20	0.80	1.25
H757	Kankady x BPP-8	6.70	101.50	27.50	1.00	1.45
H758	Kankady x BPP-8	7.10	54.00	25.44	0.90	1.45
H759	Kankady x BPP-8	5.90	49.00	30.20	0.55	1.05
H760	Kankady x BPP-8	7.11	50.00	30.18	0.60	1.00
H761	Kankady x BPP-8	5.10	51.00	21.88	0.55	1.00
H762	Kankady x BPP-8	5.04	25.00	26.28	0.50	0.95

Among the hybrids, the mean nut weight was recorded highest in H-726 (8.78 g) followed by H-755 (7.65g). The mean apple weight was found highest in H-757 (101.50g) followed by H-727 (61.50g). The shelling percentage was recorded maximum in H-738 (31.54) followed by H-747 (31.28). The mean annual nut yield was found highest in H-726 (4.80 kg) followed by H-729 (4.50 kg). The cumulative nut yield recorded highest in H-726 (10.20 kg) followed by H-729 (9.50kg) for two annual harvests.

BHUBANESWAR

During the fruiting season 2017-18, 16 numbers of cross combination were selected for the hybridization programme, with the objective to evolve dwarf, bold nut, cluster bearing and high yield cashew genotypes. The parents were selected based on D2 value and the standard procedure was followed for the hybridization programme as described in the "Experimental Manual on Cashew" published by DCR, Puttur. The details of the hybridization programme of 2017-18 fruiting season are presented in Table 1.18.

Table 1.18 : Details of hybridization program during 2017-18

Sl. No.	Cross combination	No. of flowers pollinated	No. of nuts harvested	% fruit set	No. of seeds germinated	% germination	No. of plants in the main field
1	VRI-3 x Dhana	104	5	4.81	5	100.00	5
2	Dhana x VRI-3	56	3	5.36	2	66.67	2
3	Dhana x K22-1	77	2	2.60	2	100.00	2
4	Bhaskara x Priyanka	85	5	5.88	3	60.00	3
5	BPP-4 x Priyanka	98	9	9.18	9	100.00	9
6	Priyanka x BPP-4	84	2	2.38	1	50.00	1
7	H-14 x BPP-8	77	7	9.09	7	100.00	7
8	H-675 x BPP-8	92	9	9.78	9	100.00	9
9	H-675 x BH-6	77	12	15.58	9	75.00	9
10	K-22-1 x H1597	60	3	5.00	3	100.00	3
11	H-675 x H-662	88	10	11.36	10	100.00	10
12	Bhubaneswar-1 x Dhana	68	6	8.82	5	83.33	5
13	RP-2 x Dhana	69	7	10.14	6	85.71	6
14	RP-2 x H-367	71	12	16.90	12	100.00	12
15	RP-2 x Kankadi	60	3	5.00	3	100.00	3
16	RP-2 x VTH-711/4	61	2	3.28	2	100.00	2
	Total	**1227**	**97**	**-**	**88**	**-**	**88**

A total 1227 numbers of bisexual flowers were pollinated during the fruiting season 2018-19 and percentage fruit set ranged from 2.38 (Priyanka x BPP-4) to 16.90 (RP-2 x H-367). All total 97 matured nuts were harvested and were taken for raising seedlings. Total 88 nuts recorded germination of different cross combinations. Seedlings obtained from 88 seed nuts were planted in the main field observing a spacing of 4m x 4m.

Evaluation of hybrids:

The cashew genotypes evaluated during the fruiting season 2017-18 revealed that the genotype, D-19 recorded maximum for the vegetative parameters like tree height (3.9 m) and trunk girth (35.6 cm) while canopy spread was recorded maximum in genotype Dhana (4.73 cm in E-W & 5.05 cm in N-S). Genotype, Kankadi recorded maximum canopy area (43.98m^2) among the tested genotypes.

The results on flowering and yield attributing parameters revealed significant differences among the hybrids. The flowering period ranged from 4th week of January to 1st week of May. The Mean duration of flowering ranged from minimum 63 days (RP-2) to maximum 78.5days (B-27 & Kankadi). Number of flowering laterals/m^2 was recorded significantly maximum in genotype D-19 (28.68) followed by BH-105 (25.43) and RP-1 (25.25). Genotype, M-44/3 recorded superiority for ratio of male to bisexual flowers (0.6) while nuts/m^2 (55.06) and nuts/panicle recorded maximum in RP-2 (14.5).

It was revealed that among the evaluated hybrids, nut weight (17.5g) as well as apple weight (126.0g) were recorded maximum in genotype, VTH-711/4 while shelling was recorded maximum in genotype, RP-2 (34.35%). The mean annual nut yield was recorded maximum for the genotype C2-6 (3.9 kg/plant) followed by genotype D-19 (3.61kg/plant) which were statistically at par. The lowest yield was recorded in genotype Kankadi (0.21 kg/plant). Similarly cumulative nut yield was recorded maximum in genotype C2-6 followed by D-19 for 2nd harvest.

Table 1.19 : Yield parameters of different cashew hybrids at Bhubaneswar Centre during the year 2017-18

Hybrid No.	Cross combination	Nut wt. (g)	Apple wt. (g)	Shelling %	Annual nut yield (kg/tree) (for 2nd harvest	Cum. yield (kg/tree) (for 2nd harvests)
B-27	RP-1 x VTH-711/4	7.75	55.92	32.32	2.82	3.92
C-30	RP-2 x Kankady	6.32	44.45	33.41	2.96	4.25
D-19	M-44/3 x VTH-711/4	6.75	44.25	32.65	3.61	5.17
C2-6	RP-2 x Kankady	7.95	39.20	31.61	3.90	5.95
BH-105	RP-1 x VTH-711/4	7.85	59.00	32.59	1.95	3.37
BBSR-1		5.82	34.19	33.24	3.23	4.68
RP-1		4.52	24.65	33.78	3.01	4.18
RP-2		4.50	28.70	34.35	3.12	4.51
M-44/3		5.60	35.60	31.725	2.89	4.06
Kankadi		16.41	121.50	22.85	0.21	0.41
VTH-711/4		17.50	126.00	30.38	0.25	0.55
NRCC Sel.-2		8.10	47.90	33.81	2.07	3.12
H-320		7.42	47.17	30.17	1.50	2.35
Dhana		8.32	57.70	28.06	3.22	4.50
BPP-8		7.95	61.30	30.67	2.55	3.95

GOA

a) Performance of 1st set of Hybrids (7th harvest)

Among the hybrids, raw nut yield varied from 0.3 kg/tree (H-13/05) to 18.22 kg/tree (H-31/05) with mean nut weight of 7.4g and shelling of 28% in the former, and 4.99g nut weight and 35.95% of shelling in the latter respectively. Other hybrids such as H-27/05 (12.6kg/tree, 8.05g nut weight and 31.83% shelling) and H-21/05 (10.32 kg./tree, 8.28g nut weight and 32.18% shelling) recorded consistent performance.

Table 1.20 : Performance of 1st set of hybrids

S No.	Hybrid	Av. Nut Wt. (g)				Nut yield (kg/tree)				Shelling (%)			
		2014-15	2015-16	2016-17	2017-18	2014-15	2015-16	2016-17	2017-18	2014-15	2015-16	2016-17	2017-18
1	H- 5/05	7.8	7.35	7.62	9.9	1.65	1.45	3.12	1.875	28.22	28.00	28.35	32.41
2	H- 14/05	8.12	8.2	8.10	8.4	1.81	3.28	4.24	3.227	28.00	27.55	27.88	29.39
3	H- 11/05	7.80	7.21	7.42	7.56	4.41	4.90	6.42	2.77	28.86	28.35	28.22	31.97
4	H- 12/05	7.82	8.0	7.90	8.14	5.85	8.25	8.42	2.97	29.45	29.80	28.89	28.73
5	H- 13/05	7.91	7.55	7.76	7.4	0.89	1.85	3.25	0.3	27.92	27.50	28.00	28.00
6	H- 21/05	8.6	8.2	8.32	8.28	6.7	8.55	9.27	10.32	29.15	28.86	29.02	32.18
7	H- 22/05	9.02	9.65	9.24	10.0	2.87	5.68	6.25	1.17	29.21	28.76	29.78	32.64
8	H- 23/05	7.9	7.85	7.78	8.85	2.02	4.05	5.87	0.35	28.86	28.24	28.08	34.19
9	H- 27/05	7.56	7.90	7.85	8.05	3.35	5.35	6.84	12.6	28.55	28.42	27.86	31.83
10	H- 29/05	7.60	7.85	7.70	-*	1.55	2.85	3.33	-*	28.00	28.22	28.58	-*
11	H- 30/05	7.62	7.85	7.59	7.14	1.01	2.35	3.52	2.92	27.68	27.22	27.66	29.78
12	H- 31/05	7.22	6.85	7.32	4.99	14.56	12.45	8.86	18.22	29.02	29.24	28.85	35.94

* died due to CSRB

b) Performance of Second set of hybrids

Seven hybrid seedlings from among 32 of 2nd set of hybrids, started flowering and fruiting during the season, of which, hybrid genotypes namely HB-N2/07, HB-27/07, HB-28/07 and HB-29/07 recorded nut yield in the range of 1-2 kg/tree with mean nut weight ranging from 7.01 to 9.33g. Two hybrids (HB-30/07 and HB-N1/07) had the mean nut weight of 10g each (Table 1.21).

Table 1.21 : Nut yield and nut weight trend of 2nd set of hybrid progeny

Sr. No.	Hybrids	Parental combination	Av. Nut wt. (g)	Nut yield (kg/tree)
1	HB-4/07	KN2/98 X GNJ 2	6.02	0.75
2	HB- N1/0	TIS-3 X V4	10.00	0.30
3	HB- N2/07	V-4 X Tis-3	7.60	1.17
4	HB-27/07	Valpoi-7 X Tis-3	7.93	1.33
5	HB-28/07	Tis-3 X Valpoi-7	7.01	2.17
6	HB-29/07	Tiswadi 3 X Balli-2	9.33	1.52
7	HB-30/07	Tiswadi 3 X KN2/98	10.00	0.10

c). Hybridization work: Hybridization work was continued during flowering season 2017-18, for producing the 7th set of hybrid progeny. Eight parents having higher nut yield and/or cluster bearing traits were used for crossing with parents having jumbo nut size. In all, 2773 crosses involving 18 parental combinations were effected with an average nut set of 14.53%, while, percent success of crossing which resulted into the maturity of hybrid seed nut varied from 7.4% to 35.73%. Higher level of nut set was observed in parental combinations namely "Hybrid 31xTiswadi-3", "39AxValpoi-7", "Valpoi-7x 39A" and "8AxV4" with percent nut set success of 20.32, 24.39, 33.77 and 35.71 respectively (Table 1.23).

Table 1.22 : Parents involved in crossing 2017-18

High Yielding parents (> 15kg/tree)		Bold nut parents (> 9.8g Av. Wt)	
Accessions	**Characteristic feature**	**Accessions**	**Characteristic feature**
KN-2/98	High yield, medium bold nut & cluster bearing	Valpoi-2	Bold nut
Valpoi-7	High yielding, medium bold nut	Tiswadi-3 (Goa cashew-2)	Bold nut, Mod. yielder
10 A	High yielding, medium bold nut	8A	Bold nut, Cluster bearing
Ganje-2	High yielding, medium bold nut	39A	High yielding, medium bold nut
HB-31/05	High yielding, small nut, cluster bearing		
Balli-1	High yielding, medium bold nut, cluster bearing		
GB-2A	High yielding, small nut, dwarf statured		

Table 1.23 : Details of crossing work 2017-18

Sr. No.	Parents	Nos. of crosses	No. of seed nuts resulted	% success
1	Valpoi-7 x Tiswadi-3	564	59	10.46
2	Tiswadi-3 x Valpoi-7	114	15	13.15
3	10A x Tiswadi-3	196	23	11.73
4	Tiswadi-3 x 10A	157	17	10.82
5	Tiswadi-3 x V-4	229	43	18.77
6	V-4 x Tiswadi-3	185	25	13.51
7	Ganje-2 x Tiswadi-3	126	23	18.25
8	Tiswadi-3 x Ganje-2	35	3	8.57
9	39A x Valpoi-7	41	10	24.39
10	Valpoi-7 x 39A	225	76	33.77
11	8A x V4	14	5	35.71
12	Hybrid 31 x Tiswadi-3	123	25	20.32

13	tiswadi-3 x HYB- 31	27	2	7.40
14	KN2 x valpoi-2	330	26	7.87
15	vaipoi-2 x KN-2	79	7	8.86
16	Balli-1 x Tiswadi-3	169	24	14.20
17	GB-2A x Valpoi-2	149	19	12.75
18	Valpoi-2 x Barsem-1	10	1	10
		2773	**403**	**14.53**

A total of 403 hybrid seed nuts of twelve parental combinations were produced and the nuts were sown for raising seedlings.

JHARGRAM

The hybrids were on par with respect to plant height, spread on both side i.e East – West and North – South and canopy area, while there was no significant difference among the hybrids with respect to trunk girth.

The intensity of flowering per square meter of canopy area ranged from 9.75 to 18.25. Maximum density in flowering was recorded in H-139, while other hybrids were on par with respect to flowering/ m^2. The intensity of nut bearing per square meter of canopy area ranged between 3.75 to 23.13, but it was observed that the hybrids were on par with respect to nuts/m^2. Maximum number of nuts/ panicle was observed in case of H-126 (6.88 nuts/ panicle) while except H-139 all other hybrids were on par with respect to nuts/panicle. Significant variation was noticed among the hybrids with respect to nut weight, apple weight. Highest nut weight was recorded with H-139 (7.63 g) followed by H-121 (6.76 g) and the check variety BPP- 8 (6.63 g). Biggest size apple was found in H-139 (86 g) which was on par with H-113 (63.85 g). Smallest apple was recorded with H-121 (31.78 g). Except H-126, all other hybrids had more than 30% shelling recovery and the highest was recorded in H-35 (33.67%). It was the first year of harvest and all the hybrids were on par with respect to yield/ tree.

Table 1.24 : Yield parameters of different cashew hybrids at Jhargram Centre during the year 2017-18

Hybrid No.	Cross combination	Year of planting	Nut wt (g)	Apple wt. (g)	Shelling %	Annual nut yield (kg/tree)
H-121	H- 2/15x Red Hazari	2015	6.76	31.78	31.04	0.80
H-132	H- 2/15x Red Hazari	2015	6.30	47.18	30.94	1.16
H-139	KGN – 1 x BLA – 39 - 4	2015	7.63	86.00	28.46	0.30
H-33	Local x 2/9 Dicherla	2015	6.27	47.00	31.34	0.69
H-113	H- 2/15x Red Hazari	2015	5.70	63.85	33.25	0.93
H-35	Local x 2/9 Dicherla	2015	5.15	46.94	33.67	1.07
H-126	H- 2/15x Red Hazari	2015	5.52	50.85	28.18	0.80
H-37	Local x 2/9 Dicherla	2015	5.50	33.50	30.77	0.98
H-41	Local x 2/9 Dicherla	2015	6.45	42.50	32.56	0.42
BPP- 8		2015	6.63	62.00	30.14	0.91
SEm ±			0.07	3.10	0.58	0.15
C.D. at 5%			0.20	9.00	1.68	0.42
CV %			2.25	12.12	3.72	6.29

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 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 unit area was observed in PLD 57 grafts. PLD 57 OP was the shortest with lowest canopy area. Higher seed 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 1.25 : Yield parameters of different cashew hybrids at Pilicode Centre during the year 2017-18

Cross combination	Annual nut yield (kg/tree)
PLD 57 graft	0.73
PLD 57 (OP)	0.55
PLD 57 x ANK 1	2.00
ANK 1 x PLD 57	1.60
MDK 1 x PLD 57	6.35
MDK 1	2.90

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 seen that among the promising hybrids, H-2876 recorded maximum height (7.60 m), EW canopy spread (7.90 m) and canopy area (42.29 m^2) while, NS canopy spread (6.90m) was noted maximum in H-3084. The highest stem girth (102.00 cm) was recorded in H-2917. Further, the minimum flowering duration (86.0 days) recorded in H-2917 while, maximum number of flowering laterals (34/m^2) was recorded in H-3113. The highest sex ratio (0.20), nut/m^2 (31.0) and numbers of nuts/panicle (6.5) were noticed in H-3096.

With regards to yield attributes of promising hybrids, the maximum nut weight recorded by H-3043 (16.7g) and followed by H-3096 (16.0 g). The highest apple weight of 120g and 110g was recorded in H-3096 and H-3043, respectively. While, the maximum shelling percentage (32.00%) was observed in H-2872 and H-3137. The highest annual nut yield was recorded in H-3096 (3.0 kg/tree). Cumulative yield for last 11 harvests was noted highest in H-2917 (28.81 kg/tree).

Table 1.26 : Yield parameters of different cashew hybrids at Vengurle centre during the year 2017-18

Hybrid No.	Cross combination	Year of planting	Nut wt. (g)	Apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree)	Cum. yield (kg/tree) 11th harvests
2872	J-15 x Kankadi	2004	9.1	40.0	32.0	0.940	19.53
2873	J-15 x Kankadi	2004	9.0	50.0	31.0	1.825	25.98
2874	J-15 x Kankadi	2004	9.0	60.0	31.0	0.250	21.34
2876	J-15 x Kankadi	2004	9.2	60.0	29.0	0.315	13.06
2886	Taliparamba x B.T22	2004	9.5	60.0	29.5	0.290	11.6

2917	Nanoda x *A. microcarpum*	2004	10.5	80.0	31.7	1.190	28.81
2926	Nanoda x Kankadi	2004	10.5	70.0	30.0	0.580	12.85
3090	H-320 x B.T.22	2004	12.0	90.0	28.0	2.680	16.08
3043	Jawahar-1 x Kolgaon	2004	16.7	110.0	25.0	1.375	25.66
3059	CYT176 x B.T. 65	2004	10.3	80.0	31.5	2.980	20.25
3084	H-320 x B.T.1	2004	13.2	100.0	30.0	0.780	16.77
3096	H-320 x B.T.65	2004	16.0	120.0	28.0	3.000	19.33
3103	M-26/2 x B.T.1	2004	10.2	60.0	31.7	1.530	12.66
3113	H-1598 x B.T.1	2004	11.1	80.0	31.0	0.440	13.1
3137	*A.microcarpum* x V-4	2004	9.9	70.0	32.0	0.390	14.79
3139	*A. microcarpum* x V-7	2004	11.2	70.0	31.5	0.215	14.37
3157	Hy-445 x B.T.10	2004	10.5	80.0	26.7	1.155	12.01

Total 4058 number of F_1 cashew progenies planted at cashew farm, RFRS, Vengurle since 1999. The 2756 F_1 cashew progenies planted at 5m x 5m during 1999 to 2004 were evaluated during 2015. Out of these F_1 progenies, the best performing 58 hybrids were evaluated as promising hybrids as per the guidelines of DCR, Puttur. Out of these 58 F_1 hybrids, replicated trial of the top performing 18 hybrids initiated at AICRP-Cashew Vengurle centre during July, 2016. The detail of the trial is as follows.

Expt. Gen. 4	:	Performance of new set of promising hybrids under Konkan conditions			
Objectives	:	1) To evaluate the performance of new set of promising hybrids			
Design	:	RBD			
Replication	:	3			
Treatment	:	18			
Treatment details	:	**Hybrid No.**	**Cross Combination**	**Hybrid No.**	**Cross Combination**
		T_1 - H-735	V-2 x B.T.65	T_{10} - H-1016	M 26/2 x B.T.65
		T_2 - H-778	M 44/3 x B.T.22	T_{11} - H-1039	M 26/2 x B.T.65
		T_3 - H-801	V-5 x B.T.1	T_{12} - H-1155	V-5 x B.T.65
		T_4 - H-883	V-4 x Hy. 2/16	T_{13} - H-1174	M 26/2 x B.T.1
		T_5 - H-939	V-4 x Hy. 2/16	T_{14} - H-2005	V-8 x Priyanka
		T_6 - H-991	M 26/2 x B.T.65	T_{15} - H-1675	V-4 x Hy.2/16
		T_7 - H-969	V-4 x Hy. 2/16	T_{16} - H-1187	M 26/2 x B.T.1
		T_8 - H-958	V-4 x Hy. 2/16	T_{17} - H-1306	Hy-2/16 x V-4
		T_9 - H-992	M 26/2 x B.T.65	T_{18}-V-9 (Check)	V-4 x M-10-4
Spacing	:	7m x 7m			
Year of planting	:	July, 2016			
Plant unit/ replication	:	3			
Total plants	:	162			

The growth of all the grafts is satisfactory. The first year (2017-18) vegetative growth parameters of new set of promising hybrid recorded and presented in Table 1.27. Data revealed that there was non-significant result with respect to height (m), girth (cm), and EW spread (m). However, different promising hybrid significantly influenced the NS spread (m) and mean spread (m). H-1039 recorded significantly maximum NS spread (1.76m) and at par with H-1187 (1.58m), H-1174, H-778 & H-992 (1.33m), H-1306 (1.29m), H-2005 (1.10m) and H-939 (1.04m). Whereas, significantly the highest mean spread recorded in H-1039 (1.71m) and at par with H-1187 (1.52m), H-1174 (1.33m), H-778 (1.29m), H-992 (1.25m), H-2005 (1.09m) and H-969 (1.05m).

Table 1.27 : Growth parameters of new set of promising hybrid during 2017-18

Hybrid No.	Height (m)	Girth (cm)	Spread EW (m)	Spread NS (m)	Mean spread (m)
H-735	0.77	6.11	0.53	0.51	0.52
H-778	1.72	12.78	1.23	**1.33**	**1.29**
H-801	0.79	5.40	0.44	0.49	0.47
H-883	1.15	10.67	0.88	0.94	0.91
H-939	1.14	9.78	0.82	1.04	0.94
H-991	1.01	7.00	0.77	0.81	0.80
H-969	1.10	9.22	0.94	0.93	1.05
H-958	0.97	8.67	0.76	0.90	0.83
H-992	1.21	10.22	1.16	1.33	1.25
H-1016	0.60	4.44	0.43	0.51	0.47
H-1039	1.70	14.22	1.66	1.76	1.71
H-1155	1.03	5.53	0.76	0.85	0.80
H-1174	1.36	11.22	1.32	1.33	1.33
H-2005	1.20	9.11	1.07	1.10	1.09
H-1675	0.62	4.33	0.35	0.32	0.34
H-1187	1.54	12.90	1.46	1.58	1.52
H-1306	1.22	9.11	1.10	1.29	1.19
V-9 (Check)	1.19	9.56	0.83	0.80	0.81
SEm ±	0.25	2.20	0.26	0.27	0.26
CD at 5%	N.S.	N.S.	N.S.	0.78	0.76

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 22 and HC 25 had compact canopy, cluster bearing and bold nuts. HC 17 and HC 22 showed a different type of intensive branching pattern occupying less space of spread.

Table 1.28 : 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)	Total Number of Harvests
HC1	VRI2 X VRI 3	5.90	25.0	27.5	5.2	43.45	9
HC2	VRI 3 x VSK 2	6.25	31.0	26.5	4.4	34.10	9
HC3	VRI 3 x TK 1	6.50	35.5	24.5	4.2	26.05	9
HC 5	VRI 3 x VRI 2	7.00	40.5	27.5	6.9	44.15	9
HC6	VRI 3 x KGN 1	5.90	51.5	26.0	6.2	33.50	9
HC8	VRI 3 x PKP 1	6.20	48.2	26.0	6.4	34.10	9
HC10	VRI 3 x KK 1	7.40	31.2	28.5	12.2	64.50	8
HC 17	VRI 3 x AM 1	6.00	35.0	27.0	5.8	38.60	8
HC 22	VRI 3 X TK 1	7.20	50.5	28.5	5.9	34.35	7
HC 23	VRI 3 x AM 1	7.20	32.0	27.6	3.8	24.45	7
HC 24	VRI3XM 33/3	7.00	30.8	26.0	6.2	36.80	7
HC 25	VRI3XM 33/3	7.30	52.5	30.0	9.4	49.65	7
HC 27	VRI 3 X SL 1	7.80	50.5	31.5	6.2	41.25	7
HC 30	VRI 3 x PV 1	8.00	52.5	26.8	8.1	48.75	7
SEm ±		0.24	0.33	0.26	0.32		
CV(%)		9.80	24.5	5.2	75.2		

Gen.4a : Rapid Polyclonal Hybrid Evaluation Trial

Centres: East Coast : Bapatla, Bhubaneswar and Vridhachalam

West Coast : Madakkathara and Vengurla

The objective of the experiment is to identify best performing hybrid among the five released hybrids with bold nut and higher yield.

Experimental Design : Randomized Block Design

No. of replications : 3

No. of hybrids : 5

Spacing : 3m x 2m

Date of planting : 13/10/2017

Details of hybrids:

Sr. No.	Accession No.	Original source of collection
1	C2-6	CRS, Bhubaneshwar
2	H-12/05	ICAR Research Complex for Goa
3	H-2917	RFRS, Vengurla
4	VRI (cw) H1	CRS, Vridhachalam
5	H-504	CRS, Bapatla

BHUBANESWAR

The experiment was laid out during the year, 2017 involving five hybrids viz. C2-6 (BH-26), H-504, H12/05, H2917 and VRI (cw) H1 which were planted following a spacing of 3m x 2m. Five grafts per each hybrid were planted following all recommended package of practices. The plants are now in vegetative stage.

MADAKKATHARA

The trial was initiated during 2017 and it is in progress.

VENGURLE

For initiation of the trial at Vengurle centre, the scion sticks of high yielding hybrids viz., C2-6 (Bhubaneswar), H-12/05 (Goa), H-2917 (Vengurla), VRI (cw) H1 (Vridhachalam) were collected and grafts prepared during July-August, 2017. However, the scion sticks of H-504 (Bapatla) were not available. The grafts of all high yielding hybrids are planted in 3m x 2m spacing @ 5 grafts/hybrids in July, 2018 and the growth of all the grafts are satisfactory.

VRIDHACHALAM

The trial was initiated during September 2018.

Gen.5: Characterization of germplasm for cashew apple

Centres: East Coast : Bapatla and Vridhachalam

West Coast : 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 2017-18, the maximum mean annual nut yield per tree was recorded in BPP-8 (8.30 kg) followed by BLA 39/4 (6.90kg). The maximum nut weight was recorded in Priyanka (9.50 g) followed by BPP-8 (7.80 g). The maximum apple weight was recorded in Priyanka (99.50 g) followed by BPP-8 (64.00 g). The apple nut ratio was highest in T.No.8/7 (11.89) followed by T.No. 2/14 (11.78). The juice recovery percentage was found maximum in BLA-39/4 (73.20%) followed by T.No.228 (71.20 %).

Table 1.29 : Physical parameters of cashew germplasm for cashew apple

S. No.	Germplasm	Nut wt (g)	Apple wt (g)	Yield / tree (kg)	Apple nut ratio	Juice recovery (%)	Colour of the apple
1.	Priyanka	9.50	99.50	5.20	10.47	68.20	Red Yellow
2.	T.No: 2/14	4.26	50.20	4.20	11.78	60.20	Yellow
3.	T.No.17/5	4.18	36.20	4.28	8.66	57.60	Yellow
4.	T.No. 5/1	4.90	38.40	3.96	7.83	62.00	Yellow
5.	BLA. 139/1	4.92	36.00	4.20	7.31	58.60	Yellow
6.	BLA. 39/4	4.02	36.80	6.90	9.15	73.20	Yellow
7.	T.No. 3/4	4.28	42.00	3.80	9.81	64.80	Yellow
8.	T.No. 8/7	3.70	47.33	4.10	11.89	56.20	Yellow
9.	T.No. 18/3	4.80	51.00	3.70	10.62	58.20	Yellow
10.	Hy 95-T4	5.60	38.00	5.80	6.78	65.00	Yellow
11.	T.No. 12/1	4.30	42.00	3.60	9.76	60.00	Yellow
12.	T.No. 228	4.20	35.60	5.20	8.47	71.20	Red Yellow
13.	BPP-8	7.80	64.00	8.30	8.14	69.40	Yellow
	SEm±	0.32	3.80	0.34	0.89	3.71	
	CD @ 5%	0.11	1.29	0.12	0.30	1.26	

Table 1.30 : Chemical parameters of cashew germplasm for cashew apple

S.No.	Germplasm	TSS (° Brix)	Vitamin-C (mg/100 g)	Tannins (mg/100 g)	Acidity (%)
1.	Priyanka	12.60	134.50	3.11	**0.46**
2.	T.No. 2/14	10.70	141.20	**3.16**	0.57
3.	T.No.17/5	11.20	150.80	3.26	0.56
4.	T.No. 5/1	9.50	140.60	3.66	1.06
5.	BLA. 139/1	10.60	154.20	3.78	1.18
6.	BLA. 39/4	10.40	154.30	3.44	0.75
7.	T.No. 3/4	12.00	172.20	3.42	0.83
8.	T.No. 8/7	**11.50**	**176.20**	3.18	**0.43**
9.	T.No. 18/3	11.70	**169.60**	3.20	**0.42**
10.	Hy 95-T4	**10.80**	162.00	3.39	0.54
11.	T.No. 12/1	10.80	125.00	3.42	0.67
12.	T.No. 228	10.50	131.00	3.41	0.79
13.	BPP-8	11.20	142.20	3.25	0.48
	SEm±	0.97	6.53	0.34	0.11
	CD at (5%)	0.34	2.22	0.12	0.04

Among the 13 genotypes, the Total Soluble Solids was ranged from 9.60 Brix to 12.90 Brix. However, the highest TSS was recorded in Priyanka (12.60). The maximum vitamin C content was recorded in T.No. 8/7 (176.20 mg/100gm) followed by T. No. 18/3 (169.60mg/100gm). With regard to the tannin content the lowest was recorded in Priyanka (3.11mg/100g) followed by T.No.2/14 (3.16mg/100gm). The acidity content was lowest in T.No.18/3 (0.42%) followed by T.No.8/7 (0.43%) and Priyanka (0.46%).

JAGDALPUR

Locally collected 10 genotypes were characterized for cashew apple. Apple weight ranged between 44.60 g to 107.20 g in CARS-4 and CARS-8 respectively. The maximum juice recovery was recorded in CARS-8 (80.20 %). The highest fruit TSS was recorded in CARS-3 (16.20°Brix) whereas maximum acidity in CARS-9 (0.65 %). The vitamin C content varies between 212.2 to 263.4 mg/100 ml juice and total sugar ranged between 9.80 to 17.80 %.

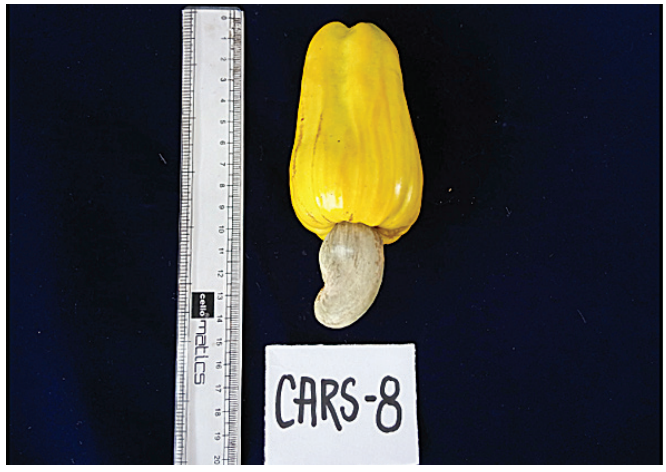


Table 1.31 : Physical characteristics

Germplasm accession	Age of tree (Year)	Yield/ tree (kg) (2017-18)	Apple wt. (g)	Nut wt. (g)	Apple nut ratio	Juice recovery (%)	Colour of apple
CARS-1	34	11.60	65.40	6.40	10.21	64.20	Red
CARS-2	34	9.80	62.80	7.80	8.05	65.50	Yellow
CARS-3	21	8.20	70.20	7.20	9.75	71.40	Red
CARS-4	21	6.40	44.60	6.50	6.86	60.20	Yellow
CARS-5	21	9.20	78.20	7.50	10.42	62.80	Yellow
CARS-6	21	8.50	70.80	7.20	9.83	70.20	Red
CARS-8	21	9.75	107.20	12.20	8.78	80.20	Yellow
CARS-9	21	8.40	85.40	9.80	8.71	65.80	Red
CARS-10	21	10.70	80.20	10.50	7.63	75.10	Yellow
CARS-11	21	9.85	92.20	8.10	11.38	70.40	Red

Table 1.32 : Chemical parameters

Germplasm	TSS (°Brix)	Acidity (mg/100ml)	Vitamin C (mg/ml)	Total sugar
CARS-1	12.10	0.34	223.5	10.10
CARS-2	14.40	0.25	244.6	13.30
CARS-3	16.20	0.36	263.4	17.80
CARS-4	14.30	0.40	224.5	10.90
CARS-5	10.40	0.47	231.2	15.20
CARS-6	11.60	0.50	234.6	11.50
CARS-8	12.80	0.42	243.6	13.10
CARS-9	10.10	0.65	212.2	9.80
CARS-10	13.00	0.37	246.8	13.90
CARS-11	14.80	0.48	217.5	11.40

PILICODE

Highest apple weight was recorded in variety VTH 30/4. Apple to nut ratio was highest in the variety BPP 6. Highest juice recovery in volume and Percentage was obtained from VTH 30/4. Highest TSS was reported from PLD 4 followed by BPP 6. Lowest TSS was reported from VTH 30/4. Highest acidity was reported from Madakkathara 1. Sugar Acid ratio was highest in KGN 1 and PLD 4. Lowest was in Madakkathara 1.

Table 1.33 : Physical characters

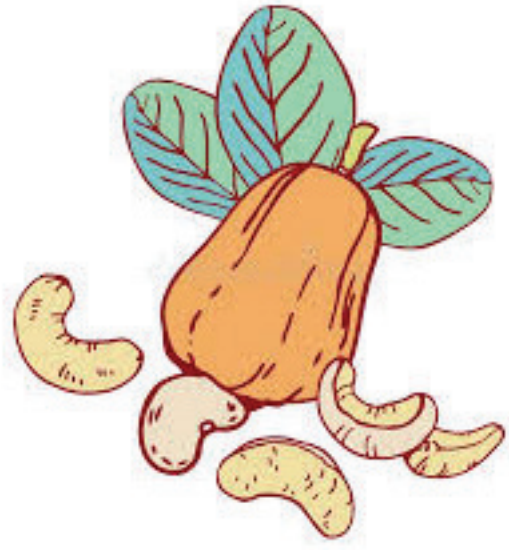
Germplasm details	Apple weight (g)	Apple nut ratio	Juice recovery		Colour of apple
			Quantity (ml)	%	
PLD 15	68.90	9.99	43.30	62.85 (52.44)	Orange Red
PLD 13	73.70	8.53	61.50	83.45 (65.99)	Yellowish Orange
VTH 30/4	139.60	13.70	100.00	71.63 (57.81)	Yellowish orange
V2	71.60	11.37	68.60	95.81 (78.19)	Red
KGN 1	102.90	8.95	63.30	61.52 (51.65)	Red
BPP 6	105.00	18.10	50.00	47.62 (43.64)	Yellow
AMRUTHA	100.00	8.33	32.50	32.50 (34.75)	Light Red
PLD 12	72.10	5.55	70.00	97.09 (80.17)	Yellow
Madakkathara 1	44.00	6.03	37.20	84.55 (66.85)	Yellow
PLD 4	77.00	10.55	40.00	51.95 (46.12)	Yellow
CD at 5%	0.46	0.11	0.54	0.55	
CV%	0.24	0.48	0.42	0.43	

Figures in parentheses are arcsine transformed values

Table 1.34 : Biochemical characters

Germplasm details	TSS	Acidity %	Sugar acid Ratio	Tannin %	Tannin mg/ml
PLD 15	14.15	0.26	54.03	0.10 (1.80)	9.95
PLD 13	12.50	0.27	46.66	0.13 (2.09)	13.30
VTH 30/4	11.80	0.24	48.57	0.13 (2.09)	13.30
V2	12.90	0.40	32.58	0.12 (1.96)	11.60
KGN 1	12.50	0.21	60.07	0.13 (2.08)	13.30
BPP 6	15.70	0.45	34.58	0.25 (2.86)	24.90
AMRUTHA	14.60	0.45	32.58	0.17 (2.34)	16.64
PLD 12	12.50	0.32	39.07	0.12 (1.95)	11.65
Madakkathara 1	13.00	0.59	22.11	0.15 (2.21)	14.970
PLD 4	16.20	0.28	57.85	0.12 (1.95)	11.640
CD at 5%	0.41	0.02	5.91	0.07	0.76
CV%	1.32	2.89	6.21	1.27	2.40

Figures in parentheses arcsine transformed values



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

JAGDALPUR

Among the 10 cashew varieties tested for preparation of jam, Vengurla-4 and NRCC Sel-2 recorded higher scores for taste, colour, flavour and total acceptability. Lower scores were recorded for varieties BPP-1, BPP-4 and VRI-3 during 2017-18. For overall acceptability Vengurla-4 is preferred for jam preparation.

Table 1.35 : Organoleptic evaluation of jam prepared from different varieties of cashew

Variety	Taste	Colour	Flavour	Total acceptability
Vengurla-4	8.5	8.2	8.2	8.4
Vengurla-7	7.4	7.2	7.2	7.2
Vengurla-9	7.6	7.8	7.5	7.4
BPP-1	6.4	6.5	6.3	6.5
BPP-4	6.7	6.5	6.5	6.5
BPP-8	6.8	6.6	6.6	6.7
Priyanka	7.5	7.8	7.5	7.2
VRI-3	6.5	6.5	6.6	6.4
NRCC Sel-1	7.4	7.3	7.2	7.2
NRCC Sel-2	**8.0**	**8.0**	**8.1**	**7.8**

Gen.7. 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, CARS-10
3	CCARI, Goa	HB-22/05, Tiswadi-3, Tudal-1
4	RFRS, Vengurle	H3043, H2873
5	CRS, Bhubaneswar	C-136, D-21, E-22
6	DCR, Puttur	H-126, H-130, NRC-301, NRC-493, Priyanka, Vengurla-7

II. CROP MANAGEMENT

II. CROP MANAGEMENT

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

Centres: East Coast : Bhubaneswar
Plains / others : Hogalagere

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:

T_1 - 100% RDF (500:250:250g NPK/Plant)

T_2 - 100% RDF + FYM @ 10kg/Plant/Year

T_3 - T_2 + Foliar Spray of major nutrients (3% urea + 0.5% H_3PO_4 +1% K_2SO_4)

T_4 - T_2 + Foliar Spray of Secondary and micro-nutrients (0.5% $ZnSO_4$ +0.1% Solubor +0.5% $MgSO_4$)

T_5 - T_3 + Foliar Spray of Secondary and micro-nutrients (0.5%$ZnSO_4$ +0.1% Solubor +0.5% $MgSO_4$)

T_6 - Control

BHUBANESWAR

The experiment was laid out during the year 2014 in Randomized Block Design with four replications. Cashew variety, Balabhadra was planted at a spacing of 7.0m x 7.0m. First harvesting has been recorded from the year 2016-17 onwards.

Higher growth and yield response was observed in the treatment (T_5) i.e. 100% RDF+10 Kg FYM along with foliar spray of major nutrients (3% Urea + 0.5% H_3PO_4+ 1% K_2SO_4), Secondary and micro-nutrients (0.5% $ZnSO_4$+0.1% Boron+0.5% $MgSO_4$) in comparison with all other treatments. Treatment (T_5) was found to be significantly superior with respect to nut yield (2.70Kg/plant), plant height (3.58m) and trunk girth (31.25cm) over other treatments followed by T_3 which had nut yield (2.66Kg/plant) and then T_4 (2.64Kg/plant). Least mean nut yield was observed in T_6 treatment (2.39Kg/plant). However, the control treatment i.e.T_6 recorded least response with respect to all the growth and yield parameters. The incidence of Tea Mosquito Bug infestation was low irrespective of the treatments.

Table 2.1 : Yield parameters of cashew at Bhubaneswar during 2017-18

Treatment details		Apple weight (gm)	Nut weight (gm)	Nut yield (kg/ plant)	Cum. nut yield (kg/plant) for 2nd harvest
T_1	100% recommended dose of NPK fertilizer (RDF) i.e. 500:250:250g NPK/plant/year	51.25	6.79	2.46	3.84
T_2	100% RDF + 10kg FYM/ plant/year	50.45	6.87	2.59	4.17
T_3	100% RDF + 10kg FYM/plant/ year + Foliar spray of major nutrients (3% Urea + 0.5% H_3PO_4 +1% K_2SO_4)	51.71	7.04	2.66	4.36
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% $MgSO_4$	53.83	7.24	2.64	4.26
T_5	100% RDF + 10kg FYM/plant/year + Foliar spray of major nutrients (3% Urea + 0.5% H_3PO_4 +1% K_2SO_4) + Foliar spray of secondary and micro-nutrient 0.5% $ZnSO_4$+0.1% Solubor (Boron) + 0.5% $MgSO_4$	54.83	7.35	2.70	4.56
T_6	Control	48.43	6.39	2.39	3.53
	Mean	51.74	6.95	2.57	
	SEm±	0.78	0.04	0.16	
	CD at 5%	2.36	0.14	0.47	
	CV%	3.02	1.29	12.14	

HOGALAGERE

During the year 2017-18, the plants were fed with 100% RDF + 10 kg FYM along with foliar spray of major nutrients (3% urea + 0.5 % H_3PO_4+1% K_2SO_4), secondary and micronutrients (0.5% $ZnSO_4$+ 0.1% solubor as boron source + 0.5% $MgSO_4$) (T_5) and was found to perform significantly in vegetative traits like stem girth (16.12cm), canopy height (1.85m), plant height (3.34m) excluding T_4 (3.21m) and T_3 (3.20m), while other vegetative attributing traits such as canopy surface area (m_2), ground area covered by plant canopy (%), mean canopy diameter (m) and canopy spread (m) were numerically superior in T_5. Whereas yield and yield attributing parameters were found significantly in T_5 treatment plants such as flowering duration (130 days), apple weight (42.33 g), shelling percentage (31.50%) except T_3 (31.40%), cumulative yield of 3 season harvest (19.38 kg per plant) and mean nut weight (7.53g) except T_4 (7.38g) and T_3 (7.29g). However, the control treatment-6 (T_6) was recorded least response with respect to all the vegetative and yield attributes. The Tea Mosquito Bug (TMB) infestation was low among all the treatments (Table 2.2).

Table 2.2 : Influence of nutrient management approaches on vegetative parameters of cashew at HREC, Hogalagere during 2018-19

Treatments	Flowering duration (Days)	Apple weight (g)	Nut weight (g)	Nut yield (kg/ plant)	Shelling (%)	Cumulative yield (Kg/tree) (3 No. of harvests)
T_1	124	35.85	7.05	8.91	30.50	14.68
T_2	124	36.28	7.15	9.05	30.70	15.80
T_3	127	37.75	7.29	9.22	31.40	17.46
T_4	127	39.31	7.38	9.35	30.90	17.35
T_5	130	42.33	7.53	9.78	31.50	19.38
T_6	122	34.58	6.73	7.74	30.02	12.41
SEm±	0.9025	0.5125	0.1117	0.5358	0.1965	0.6180
CD@5%	2.7199	1.5446	0.3365	1.6146	0.5921	1.8625
CV	1.4364	2.7201	3.1076	11.8978	1.2743	7.6395

Hort.2: Fertilizer application in high density cashew plantations

Centres: East Coast : Bapatla

West Coast : Madakkathara

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_2O_5, 25 kg K_2O
		M_2 150 kg N, 50 kg P_2O_5, 50 kg K_2O
		M_3 225 kg N, 75 kg P_2O_5, 75 kg K_2O
Fertilizers application level	:	1st year : 1/5th
		2nd year : 2/5th
		3rd year : 3/5th
		4th year : 4/5th
		5th year : Full dose

HOGALAGERE

During the year of 2017-18, the fertilizer application in high density cashew plantation was studied, here 3 spacing combination with 3 level dose of fertilizer treatments were investigated, among the spacing and fertilizer level interaction treatments, there were no significant difference and irrespective of treatments the tea mosquito bug (TMB) infestation was low.

Table 2.3 : Effect of spacing, fertilizers and Interaction of different spacing and fertilizer levels on yield contributing traits of cashew at Hogalagere during 2018-19

Treatments	Flowering duration (Days)	Apple weight (g)	Mean nut weight (g)	Nut yield (Kg/plant)	Shelling %	Cumulative yield (2 No. of harvest) (Kg/plant)
S_1M_1	110	35.24	6.68	2.61	29.80	3.66
S_1M_2	110	34.86	6.82	2.68	30.50	3.87
S_1M_3	113	34.96	6.83	2.72	30.46	3.92
S_2M_1	110	34.66	6.72	2.45	30.25	3.46
S_2M_2	111	34.95	6.74	2.52	29.50	3.58
S_2M_3	110	35.07	6.73	2.49	30.00	3.54
S_3M_1	110	35.18	6.89	2.30	30.20	3.28
S_3M_2	112	34.63	6.88	2.38	30.25	3.39
S_3M_3	113	34.70	6.89	2.37	30.05	3.37
Mean	111.00	34.92	6.80	2.50	30.11	3.56
			SEm±			
Spacing	0.36	0.23	0.04	0.04	0.31	0.06
Fertilizers	0.42	0.36	0.03	0.05	0.27	0.05
Spacing x Fertilizers	0.69	0.56	0.05	0.08	0.49	0.10
			CD@5%			
Spacing	NS	NS	NS	0.17	NS	0.23
Fertilizers	NS	NS	NS	NS	NS	NS
Spacing x Fertilizers	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

T_1 : No Irrigation

T_2 : Irrigation 20% of Cumulative Pan Evaporation (CPE).

T_3 : Irrigation 40% of Cumulative Pan Evaporation (CPE).

T_4 : Irrigation 60% of Cumulative Pan Evaporation (CPE).

T_5 : Irrigation 80% of Cumulative Pan Evaporation (CPE).

Spacing = 7 x 7m

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

HOGALAGERE

The drip irrigation trial experiment was studied with five levels of irrigation based on cumulative pan evaporation (CPE) during the year 2017-18. Among the different five levels of irrigation treatments, T5 i.e., 80% cumulative pan evaporation was found significantly superior over other treatments. Vegetative parameters like plant height (3.57m), stem girth (15.78 cm), mean canopy diameter (4.50m) were on par with T4 (4.28m). The mean canopy surface area (44.96m2), ground area coverage by plant canopy (24.87%) was found significantly varying in trees given with irrigation of 80% cumulative pan evaporation (T5). Mean nut weight of other treatments were on par with T5 except T1-No irrigation (6.97g) and the TMB infestation was also low irrespective of all the treatments.

Table 2.4 : The influence of different levels of drip irrigation on yield parameters of cashew at HREC, Hogalagere during 2018-19

Treatments	Flowering duration (Days)	Apple weight (g)	Nut weight (g)	Nut yield (Kg/ plant)	Shelling (%)	Cumulative yield (Kg/plant) (3 harvests)
T_1	123	37.37	6.97	7.30	30.50	11.13
T_2	125	37.64	7.05	8.00	30.55	13.32
T_3	127	38.41	7.23	8.40	30.50	15.19
T_4	129	39.74	7.25	9.10	31.00	16.56
T_5	130	39.79	7.30	10.80	31.10	19.36
SEm±	0.73	0.56	0.12	0.34	0.26	--
CD@5%	2.25	1.73	0.38	1.07	0.82	--
CV	1.15	2.91	3.46	7.99	1.73	--

JAGDALPUR

This experiment was laid out at Upland Research Station, Lamker (Dist. Bastar) in the new plantation of Vengurla-4 variety during August 2018. The treatments of different levels of irrigation will be imposed and the observations will be made in the ensuing years. Due to stony soil texture and slopy land, the drip pipes will be laid after two years of plantation since alternate day watering is required during summers and rate of evapo-traspiration is higher.

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

Centres : East Coas : 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

As per the recommendations of AGM held at Vridhachalam limb pruning was done in 4x4 m spacing upto 1m height on 10.09.2017.

Note:

1. All the limb pruned plants shown emergence of new shoots within a month.
2. Control measures were taken for CSRB by spraying of Chloripyriphos

During the year 2017-18 values were recorded in 8x8 m spacing with respect to the mean plant height (5.18m), mean canopy height (4.91m), mean trunk girth (95.28 cm), mean canopy spread (8.85 m), mean canopy surface area (81.86m^2) and ground area coverage by canopy (52.14%) .

Flowering duration was recorded 112.0 days in 8x8m spacing, whereas mean number of flowering laterals, mean number of nuts/m^2 and mean number of nuts per panicle was found 19.50, 18.32 and 2.00 in 8x8 m spacing.

Table 2.5 : Yield parameters of cashew in normal and high density planting at Bapatla centre

Spacing	Nut weight (g)	Apple weight (g)	Nut yield (Kg/ha)	Mean nut yield kg/tree (Harvest No.11)	CNY (kg/tree) (2008-2018)
8m x 8m	5.60	60.00	686.40	4.40	27.96

The mean nut yield was recorded highest in 8x8 m spacing (4.40 kg/tree) and cumulative nut yield was also recorded highest in 8x8 m spacing (27.96 kg/tree) for eleven annual harvests.

Table 2.6 : 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)
1st harvest	268.75	50.00	-8875.00	-3240.00	-0.35	-0.51
2nd harvest	400.00	71.76	-1000.00	-1934.4	-0.04	-0.31
3rd harvest	515.00	112.50	5350.00	-292.5	0.19	-0.04
4th harvest	587.50	142.00	10062.50	2210.0	0.35	0.31
5th harvest	2000.0	436.80	111875.00	23556.0	3.97	3.35
6th harvest	1825	567.80	96500.00	31946.0	3.08	4.09
7th harvest	1487.5	650.52	80312.5	40987.5	2.57	5.25
8th harvest	1012.5	486.70	51000.00	18936.0	1.76	2.05
9th harvest	662.50	605.28	28750	23422	0.43	1.42
10th harvest	562.50	399.36	26250	19936	0.60	1.00
11th harvest	-	686.40	-	48640	-	2.43

JAGDALPUR

The experiment was laid out at Upland Research Station, Lamker (Dist. Bastar) during 2017 with variety Vengurla-4 consisting of two spacing i.e., 4x4m and 8x8m (control). The data on morphological and vegetative characters were collected from the experimental plants are presented. Tree height, canopy height and number of leaves per shoot were reported higher in 8 x 8 m spacing whereas trunk diameter below grafting point, trunk diameter above grafting point, canopy diameter between rows, number of terminal shoots per tree, Length of terminal shoot, number of leaves per shoot, number of leaves infested from leaf miner and number of leaves infested with TMB were reported higher in 4 x 4 m spacing.

Table 2.7 : Tree and canopy characters under different spacing

Spacing	Tree height (m)	Trunk diameter below grafting point (mm)	Trunk diameter above grafting point (mm)	Canopy diameter into rows (m)	Canopy diameter between rows (m)	Canopy height (m)
8 x 8	1.41	29.16	24.55	1.10	0.93	0.94
4 x 4	1.37	33.37	27.27	1.10	1.07	0.83

Table 2.8 : Shoot characters and pest infestation under different spacing

Spacing	Number of terminal shoots per tree	Length of terminal shoot (cm)	Number of leaves per shoot	Number of leaves infested from leaf miner	Number of leaves infested from TMB
8 x 8	9.00	29.00	262.00	26.00	5.00
4 x 4	14.00	33.50	247.50	36.00	7.00

JHARGRAM

The plants under 4m x 4m spacing were limb pruned after the hail storm on 5th March, 2017. And data was taken after 6 months of pruning. The plants spaced at 8m x 8m were not damaged much due to the hail storm therefore, not pruned.

Maximum plant height, trunk girth, canopy spread, canopy area, ground coverage and flowering /m² were recorded in 8m x 8m spacing. During 2017-18 yield /tree as well as yield /ha were highest in plants spaced at 8m x 8m. It was seen that upto 4th harvests the yield per unit area (Yield/ha) was maximum in case of trees spaced at 4m x 4m (1365.8 kg/ha). But after the limb pruning the yield /ha was reduced in case of trees spaced at 4m x 4m and on 5th harvest the unit area yield was maximum in 8m x 8m spaced plot (1976.79 kg/ha).

Table 2.9 : Growth parameters of cashew in normal and high density planting at Jhargram centre during the year 2017-18

Spacing	Mean tree height (m)	Mean stem girth (cm)	Mean canopy diameter (m)	Mean canopy surface area (m²)	Ground coverage by canopy (%)
4m x 4m	2.06	45.6	2.15	8.10	32.15
8m x 8m	4.68	63.00	6.87	51.07	56.86

Table 2.10 : Yield parameters of cashew in normal and high density planting at Jhargram centre during the year 2017-18

Spacing	Duration of flowering (days)	No. of panicles/m²	Nut weight (g)	Apple wt. (g)	Annual nut yield		Cum. nut yield (Kg/tree) (for 5hvts)
					(Kg/tree)	(Kg/ha)	
4m x 4m	64	5.25	7.89	75.69	0.58	362.50	7.84
8m x 8m	65	10.94	7.91	76.90	12.67	1976.79	26.91

Table 2.11 : Yield and B:C ratio in high density trials at Jhargram centre during the year 2017-18

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)
1st harvest	1056.3	416.5	55604.5	24580.4	3.0	5.4
2nd harvest	693.8	184.1	30229.5	8309.6	1.6	1.8
3rd harvest	750.0	497.6	34167.0	30258.8	1.9	6.6
4th harvest	1365.8	653.3	77272.3	41154.6	4.2	9.0
5th harvest	362.5	1976.79	41749	307241	2.57	15.61

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.

BAPATLA

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

Among the different intercrops studied during the initial years of cashew the treatment T_3 (Cashew + Marigold) recorded maximum yield of intercrop 2344 kg/ha and was superior over rest of the treatments and this was followed by T_1 (Cashew + China aster) of 969 kg/ha and T_4 (Cashew + Crossandra) recorded the lowest yield (39 kg/ha).

Further the economics of growing intercrops, it is seen from the data that growing China Aster as inter crop in cashew orchard gave higher net profit of Rs.1,05,430/- with BC ratio of 2.34 followed by Marigold Rs.86,380/- with BC ratio of 2.16 and the lowest net profit was obtained in Crossandra Rs. 48,600/- with BC ratio 1.08.

Table 2.12 : Yield and economics of cashew and inter crops in intercropping trail at Bapatla centre

Treatment details	Yield of intercrop (Kg/ Plot)	Yield of cashew (Kg/ tree)	Cost of cultivation (Rs./ha)			Returns (Rs./ha)				BC ratio
			Cashew	Inter crop	Total	Cashew	Inter crop	Total	Net	
T_1 Cashew + China Aster	6.20	5.30	20000	25000	45000	82600	67830	150430	105430	2.34
T_2 Cashew + Marigold	15.00	5.10	20000	20000	40000	79500	46880	126380	86380	2.16
T3 Cashew + Chrysanthemum	6.00	5.00	20000	25000	45000	78000	31240	109240	64240	1.43
T4 Cashew + Crossandra	0.25	5.00	20000	25000	45000	78000	15600	93600	48600	1.08
T_5 Cashew Alone	-	4.00	20000	---	20000	62400	-----	42400	42400	2.12
C.D.@5%	1.40	0.32								
S.Em±	0.45	0.10								

Sale Price (Rs/Kg)

Raw Cashew Nuts : 100.00 Chrysanthemum : 40.00 Marigold : 20.00

China aster : 70.00 Crossandra : 400.00

DARISAI

Treatment Details:-

- T_1- Cashew (Var.V4) + Tomato (Var. Swarn Samridhi)
- T_2- Cashew (Var.V4) + Cabbage (Var. Golden acre)
- T_3- Cashew (Var.V4) + Frenchbean (Var. Arka komal)
- T_4- Cashew (Var.V4) + Pea (Var. Arkel)
- T_5- Cashew (Var.V4)

Table 2.13 : Yield and economics of cashew and intercrops in intercropping trial at Darisai Centre during the year 2017-18

Treatment Details	Mean Yield of intercrop	Mean 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 Profit	
Variety: V4										
T_1	102.84	6.54	47200	40500	87700	98100	205680	303780	216080	2.46
T_2	204.56	7.36	47200	48800	93600	110400	204560	314960	221360	2.36
T_3	41.28	6.49	47200	24750	81600	97350	103200	200550	118950	1.45
T_4	51.32	6.78	47200	36650	83850	101700	153960	255660	171810	2.04
T_5	---	8.14	47200	---	47200	122100	---	122100	74900	1.58

Cashew (Var. V-4 + Tomato) recorded highest B:C ratio 2.46 followed by cashew (Var. V-4 + Cabbage) 2.36.

JHARGRAM

Cashew Variety BPP - 8 spaced at 4m x 4m and cowpea, okra, cluster bean and pumpkin were grown as intercrops with the newly planted plantation leaving 0.5 m space from the base of the cashew plants.

The available space for intercrops was 75%. Benefit to cost ratio revealed that cluster bean was the most profitable crop at the initial stages of high density cashew plantation followed by pumpkin. The return from cowpea and okra cultivation within the high density plantation did not meet fully the initial establishment cost of cashew with intercrop. Therefore, the benefit to cost ratio were negative for those two crops, even then it is better to grow intercrops instead of growing cashew as a sole crop as revealed from the experiment.

Table 2.14 : Yield and economics of cashew and intercrops in intercropping trial at Jhargram Centre during the year 2017-18

Treatment details	Yield of intercrop Q/ha	Yield of cashew* Q/ha	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				B:C Ratio
			Cashew	Inter-crop	Cashew + Intercrop	Cashew	Intercrop	Total	Net	
Cashew + Cowpea	21.97	--	53961	33,452	87,413	--	43,931	43,931	- 43,482	- 0.49
Cashew + Okra	25.27	--		36800	90761	--	50,534	50,534	- 40,227	- 0.44
Cashew + Pumpkin	169.62	--		11130	65091	--	1,18,732	1,18,732	53,641	0.82
Cashew + Cluster Bean	62.32	--		32410	86371	--	1,86,956	1,86,955	1,00,584	1.16
Cashew alone	--	--		--	53961	--			- 53,961	- 1.00

Available area for intercropping (Age 1 year) : 75%

Price of intercrop : Cowpea : Rs.20/Kg; Okra : Rs. 20/Kg; Pumpkin : Rs. 7/Kg; Cluster Bean : Rs. 30/Kg

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 at Horticultural Research & Extension Station, Kanabargi, Belgaum. Protective irrigation was given during longer dry spells. Intercrops included for the study were China aster, Gaillardia, Chrysanthemum, Cabbage, Cauliflower, Knol khol in a plot of 6 m x 4 m size.

MADAKKATHARA

Table 2.15 : Yield and economics of intercrops in cashew at Madakkathara centre during the year 2017-18

Treatment details	Yield of intercrop (Q/ha)	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)		B: C
		Cashew	Inter-crop	Cashew + Intercrop	Inter-crop	net	
Bhindi	9.65	21000	43000	64000	28950	-	-0.45
Cowpea	3.55	21000	48000	69000	15975	-	-0.23
Brinjal	15.30	21000	41000	62000	38250	-	-0.62
Tomato	31.30	21000	46000	67000	93900	-	1.40
Amaranthus	18.50	21000	38000	59000	111000	52000	1.88
Chilli	3.33	21000	43500	64500	19980	-	-0.31

Six vegetable crops viz. bhindi, cowpea, brinjal, tomato, amaranthus and chilli, were raised as inter crops in the interspace of three-year-old cashew trees. Economic analysis revealed that cultivation of amaranthus gave highest B:C ratio (1.88). There was no yield in cashew since it was in the third year of growth.

VENGURLE

Design : R. B. D.

Replication : Five

Treatments : Five

T_1 Cashew + Dolicus bean (Wali) (Lab lab purpureus)
T_2 Cashew + Bhendi (Abelmoschus esculentus)
T_3 Cashew + Cowpea (Vigna unguiculata)
T_4 Cashew + Chilli (Capsicum annum)
T_5 Cashew + Brinjal (Solanum melongena)
T_6 Control (Cashew alone)

Sole intercrop : Sole intercrops will be planted near the experimental plot for comparison.

Year of start : Rabi season, 2018

Cashew variety : Vengurle-9 (planted in December, 2016)

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.

As per the decision taken in the AGM-2017, the trial with new sets of intercrops is laid out in Rabi season, 2018 at AICRP-Cashew, Vengurle centre. The grafts of Vengurle-9 already planted at 7m x 7m during December, 2016. Recording of yield observation of both (main & inter-crops) are in progress.

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 2016-17.

The trial with same intercrops was repeated to find out the consistency of the intercrops giving more income to farmers during 2017-18. Sowing was done during the third week of January 2018. The results are as follows.

Table 2.16 : Yield and economics of cashew and intercrops in intercropping trial at Vridhachalam Centre during 2018

Treatment details	Yield of inter crop	Yield of cashew	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				BC Ratio
	Q/ha	Q/ha	Cashew	Inter-Crop	Cashew + Inter crop	Cashew	Inter-crop	Total	Net	
Cashew + Chillies	37.20	4.3	13000	28000	41000	64500	37200	101700	53800	2.48
Cashew + Brinjal	40.34	4.3	13000	25000	48000	64500	40340	104840	53500	2.18
Cashew + Tomato Hybrid	47.08	4.3	13000	32000	45000	64500	47080	111580	63400	2.48
Cashew + Cluster bean	32.86	4.3	13000	24000	37000	64500	32860	97360	50400	2.63
Cashew + Bhendi	43.98	4.3	13000	24000	37000	64500	43980	108480	71480	2.93

Price: Chillies Rs. 10/Kg, Brinjal Rs. 10/Kg, Tomato Rs.10/kg, Cluster bean Rs. 10/Kg, Bhendi Rs. 10/Kg and Cashewnut Rs. 150/Kg

The net return is higher in Cashew + Bhendi (Rs. 71480/ha) and the benefit cost ratio is also high (2.93) 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 : Bapatla, 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:

T_1 - 100% N as FYM

T_2 - 100% N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g

T_3 - 50% N as FYM + Bio-fertilizers (200 g)

T_4 - 100% N as Vermicompost + Bio-fertilizers (200 g)

T_5 - Recycling of organic residue with the addition of 20% cow dung slurry (20.0% weight of organic residue as cow dung)

T_6 - *In situ* green manuring / green leaf manuring to meet 100 % N

T_7 - 25% N as FYM + Recycling of organic residue + *In situ* green manuring / green leaf manuring + Bio-fertilizers (200 g)

T_8 - Recommended doses of fertilizer + 10 kg FYM (control)

BAPATLA

Among the treatments, there was no significant difference was observed with respect to growth parameters.

Table 2.17 : Yield parameters of cashew in organic management at Bapatla Centre

Sl.No.	Variety/ Genotype	Nut weight (g)	Apple weight (g)	Shelling (%)	Nut yield /tree (kg) (1st harvest) 2018
1.	T_1	8.54	59.17	18.21	2.92
2.	T_2	10.08	70.57	27.15	2.75
3.	T_3	7.82	65.53	29.80	2.72
4.	T_4	8.40	60.13	25.01	3.05
5.	T_5	9.26	65.00	26.33	2.35
6.	T_6	9.14	67.93	21.91	2.25
7.	T_7	7.47	65.33	30.08	2.33
8.	T_8	8.66	64.70	24.44	2.86
	CD@5%	1.08	N.S.	4.90	0.23
	SEm ±	0.35	3.03	1.60	0.07

The nut weight, shelling percentage and annual nut yield per tree were found to be significant and mean apple weight was found to be non significant. Among the treatments, the mean nut weight was found maximum in T_2 (10.08 g) followed by T_5 (9.26g) and T_6 (9.14g). The maximum mean annual nut yield per tree during the year was recorded in T_4 (3.05 kg) followed by T_1 (2.92 kg) and T_8 (2.86 kg). The shelling percentage was recorded highest in T_7 (30.08) followed by T_3 (29.80).

BHUBANESWAR

The experiment was laid out during the year 2007 in Randomized Block Design with three replications and eight treatments of different organic sources on Cashew variety H 2/16 (BPP-8) at a spacing of 7m x 7m.

Among the different treatments, application of recommended dose of fertilizer + 10kg FYM (T_8) significantly recorded superior plant height (6.02m), canopy diameter (9.86m), canopy surface area (70.24m^2) and ground coverage by canopy (134.61%) compared to all other treatments under study. Significantly highest stem girth of 79.60cm was recorded with application of 100%N as FYM + Bio-fertilizers Consortium 200g (T_2) closely followed by T_1, T_8 and T_7.

The various organic treatments had significantly influenced the nut yield and yield attributing parameters. Recommended doses of fertilizer + 10kg FYM (Control) T_8 recorded significantly highest number of panicles/m^2 (23.16), average nut weight (8.34g) and nut yield of 1702.68 kg/ha. Significantly, the maximum apple weight (61.86g) was recorded in treatment T_2 (100 % N as FYM + Bio-fertilizers Consortium) and it was at par with treatment T_7 (60.87g) and T_4 (60.71g). The results on cumulative nut yield/tree over 9th harvest revealed wide variations from 20.16 kg in T_6 to maximum of 37.14Kg in T_8.

Table 2.18 : Nut yield and yield attributing parameters of cashew under organic management at Bhubaneswar

Treatments	No. of panicles/	Nut weight m^2	Apple wt. (g) (g)	Annual nut yield (kg/ha)	Cum. nut yield (Kg/tree) (9^{th} No. of hvts)
T_1 - 100% N as FYM	20.04	7.81	56.24	1161.44	22.72
T_2 - 100% N as FYM + Bio-fertilizers Consortium (BFC) (200 g)	22.74	8.26	61.86	1356.52	27.73
T_3 - 50% N as FYM + BFC (200 g)	19.75	7.95	55.12	1118.36	23.83
T_4 - 100% N as Vermicompost + BFC (200g)	20.86	8.20	60.71	1265.21	24.82
T_5 - Recycling of organic residue with the addition of 20% cow dung slurry (20.0% weight of organic residue as cow dung)	20.12	8.01	52.51	1086.17	22.33
T_6 - *In situ* green manuring / green leaf manuring to meet 100% N	18.17	7.88	52.10	1044.85	20.16
T_7 - 25% N as FYM + Recycling of organic residue + *In situ* green manuring / green leaf manuring + BFC (200 g)	21.68	8.30	60.87	1501.34	29.84
T_8 - Recommended doses of fertilizer + 10 kg FYM (Control)	23.16	8.42	59.08	1702.68	37.14
Mean	20.82	8.10	57.31	1279.57	
SEm±	0.81	0.14	1.02	34.83	
CD @ 5%	2.47	0.41	3.08	105.64	
CV (%)	6.78	2.92	3.07	4.71	

Maximum net returns of Rs 1,20,148 /- per hectare was obtained from the treatment T_8 with recommended dose of fertilizers + 10kg FYM with B:C ratio of 3.40 and lowest in T_4 (1.78) with 100 % N as Vermicompost + Bio-fertilizer Consortium (200gm). The lowest benefit cost ratio is due to the high cost of vermicompost. The overall results observed during 2017-18 revealed the superiority of T_7 (25 % N as FYM + Recycling of organic residue + *In situ* green manuring / green leaf manuring + Bio-fertilizers Consortium) among the different organic sources towards cashew production.

Table 2.19 : Effects of organic inputs on gross return, net return and B:C ratio in cashew

Treatments	Cost of cultivation	Gross return (Rs/ha)	Net return (Rs/ha)	Benefit:Cost ratio (Rs/ha)
T_1 - 100% N as FYM	60,160.00	1,39,372.80	79,212.80	2.32
T_2 - 100% N as FYM + Bio-fertilizers Consortium (BFC) 200 g	64,780.00	1,62,782.40	98,002.40	2.51
T_3 - 50% N as FYM + BFC (200 g)	52,050.00	1,34,203.20	82,153.20	2.58
T_4 - 100% N as Vermicompost + BFC (200 g)	84,865.00	1,51,825.20	66,960.20	1.78
T_5- Recycling of organic residue with the addition of 20% cow dung slurry (20. % weight of organic residue as cow dung)	60,080.00	1,30,340.40	70,260.40	2.17
T_6 - *In situ* green manuring / green leaf manuring to meet 100% N	55,840.00	1,25,382.00	69,542.00	2.25
T_7 - 25% N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + BFC (200 g)	64,830.00	1,80,160.80	1,15,330.80	2.78
T_8 - Recommended doses of fertilizer + 10 kg FYM (Control)	50,120.00	1,70,268.00	1,20,148.00	3.40

During flushing, flowering and fruit setting in cashew, incidence of shoot tip caterpillar, inflorescence thrips and apple and nut borer were found prominent. Incidence of tea mosquito bug was reported only in the treatment T_6, T_7 and T_8. Maximum incidence of tea mosquito bug (1.8), shoot tip caterpillar (7.8%), inflorescence thrips (5.1 population/inflorescence), apple and nut borer (9.2%) were observed in the treatment T_8 (Control) i.e. recommended doses of fertilizer + 10 kg FYM.

Table 2.20 : Yield parameters of cashew under organic management at Darisai centre during the year 2017-18

Treatment	Flowering laterals/m²	Nut wt.(gm)	Apple wt. (gm)	Annual nut yield (kg/plant)	Cumulative nut Yield (kg/plant) for three harvests
T_1 - 100 % N as FYM	19.20	7.40	49.93	3.55	7.65
T_2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	19.65	7.65	46.45	3.85	8.25
T_3 - 50 % N as FYM + Bio-fertilizers (200 g)	10.35	7.15	53.68	2.70	6.70

T_4 -	100 % N as Vermicompost + Bio-fertilizers (200 g)	18.65	7.47	50.20	3.70	7.60
T_5 -	Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	13.45	6.85	52.65	2.30	6.25
T_6 -	*In situ* green manuring / green leaf manuring to meet 100 % N	21.60	7.10	52.15	3.50	7.20
T_7 -	25 % N as FYM + Recycling of organic residue + *In situ* green manuring / green leaf manuring + Bio-fertilizers (200 g)	22.70	7.85	56.45	3.80	8.70
T_8 -	Recommended doses of fertilizer + 10 kg FYM (Control)	26.85	8.30	59.08	4.30	9.20
	SEm±	1.27	0.25	1.91	0.19	--
	CD(5%)	3.84	0.74	5.78	0.56	--
	CV (%)	14.47	12.38	16.64	13.37	--

DARISAI

Recommended dose of fertilizer (N 500 gm, P_2O_5 250 gm & K_2O 250 gm) + 10 Kg FYM (Control) recorded the maximum nut yield / plant (4.30 Kg) followed by T_2 (3.85 Kg) where 100% N + Bio-fertilizer 200gm/plant was applied. On the basis of cumulative yield (3 harvests) T_8 (Control) was significantly superior to all other organic treatments.

HOGALAGERE

During the year 2017-18, fourth year of organic management of cashew, the growth and yield parameters were recorded. The combination of treatments includes organic, bio-fertilizers, naturally available rock phosphate, *in-situ* green manuring, recommended dose of fertilizers and FYM. Under this experiment eight treatments were imposed and plants were fed with 25% N as FYM + Recycling of organic residue + *In-situ* green manuring/green leaf manuring + BFC @ 200 g /tree/year i.e., T_7 was significantly elevated higher values in stem girth (13.84 cm) except T_8 (13.60 cm), canopy height (1.40 m) but on par with T_8 (1.35m) and T_6 (1.19m), mean nut weight (6.92 g) exclude T_8 (6.81 g), nut yield (3.28 kg/plant) except T_8 (3.23 kg/plant). However the cumulative nut yield (two season harvest) was significantly higher in T_8 (4.51 kg/plant) but on par with T_7 (4.47 kg/plant) and the TMB infestation was low in all the eight treatments of experiment.

Table 2.21 : Influence of organic manures, bio-fertilizers and other organic sources on yield parameters of cashew at Hogalagere Centre during 2018-19

Treatments	Flowering duration (Days)	Apple weight (g)	Mean nut weight (g)	Nut yield (Kg/plant)	Shelling %	Cumulative yield (2nd harvest)
T_1	111	33.32	6.53	2.39	30.10	3.24
T_2	112	33.65	6.70	2.80	30.10	3.90
T_3	113	33.26	6.57	2.52	31.00	3.43

T_4	114	33.74	6.65	2.68	31.15	3.66
T_5	112	32.92	6.48	2.28	30.00	3.11
T_6	114	32.88	6.46	2.20	29.90	2.99
T_7	116	35.45	6.92	3.28	31.10	4.47
T_8	118	36.18	6.81	3.23	31.10	4.51
SEm±	0.74	0.67	0.07	0.09	0.28	
CD@5%	2.26	2.04	0.22	0.28	0.85	
CV	1.13	0.42	1.93	5.99	1.59	

JHARGRAM

There was no significant difference observed among the treatments in terms of their response on growth and yield parameters studied.

Table 2.22 : Yield parameters of cashew under organic management at Jhargram centre during the year 2017-18

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/tree)	Cum. nut yield (Kg/tree) (6^{th}. hvts)
T_1 - 100 % N as FYM	7.33	14.25	7.48	76.90	7.57	43.85
T_2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	9.00	15.42	7.27	81.78	8.01	35.99
T_3 - 50 % N as FYM + Bio-fertilizers (200 g)	12.75	17.42	7.37	70.54	8.71	36.26
T_4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	10.42	23.00	7.27	79.13	11.48	32.93
T_5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	9.83	17.42	7.50	83.37	7.75	28.83
T_6 - In situ green manuring / green leaf manuring to meet 100 % N	10.92	17.83	7.00	67.36	7.27	30.31
T_7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	9.00	19.92	7.67	82.57	8.82	31.25
T_8 - Recommended doses of fertilizer + 10 kg FYM (Control)	9.58	23.42	7.13	79.87	13.64	38.23
CD at 5%	NS	NS	NS	NS	NS	

KANABARGI

Highest tree height (4.84m) and canopy height (4.49 m) was with 100% N from FYM+Bio fertilizer consortium (200g/tree/year).No significant difference was with respect to trunk girth and canopy diameter among all the treatments. Similarly nut yield 20.50 kg/tree (5694.29 kg/ha) was highest with 100% N from FYM+Bio fertilizer consortium (200g/tree/year) which was on par with 100% N from FYM 18.68 kg/ tree (5188.74 kg/ha).

Table 2.23: Vegetative and yield parameters of Cashew organic trial at Kanabargi

Sl.No.	Treatments	Tree height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height (m)	Canopy diameter (m)	Nut yield (kg/tree)
1	100% N from FYM	3.32	14.72	0.67	2.72	3.92	18.68
2	100% N from FYM+Bio fertilizer consortium (200g/tree/year)	4.84	16.89	1.09	4.49	4.59	20.50
3	50% N from FYM+Bio fertilizer consortium (200g/tree/year) + rock phosphate	3.28	15.33	0.71	2.57	4.18	11.42
4	100% N from vermi-compost + Bio fertilizer consortium (200g/tree/year)	2.91	15.09	0.88	2.29	4.10	13.97
5	Recycling of organic residue with the addition of 20% cow dung slurry	3.00	14.93	1.89	2.57	3.98	16.85
6	*In situ* green manuring	2.91	13.69	0.63	2.43	3.62	11.26
7	25% N as FYM + recycling of organic residue + insitu green manuring	2.96	16.21	0.74	2.59	4.37	13.65
8	Recommended dose of fertilizer	3.08	15.20	0.83	2.48	4.22	18.45
	Mean	3.29	15.26	0.93	2.77	4.12	15.60
	SEm±	0.15	1.58	0.07	0.17	0.35	1.70
	CD 5%	0.47	4.79	0.21	0.51	1.06	5.16

S- Significant NS-Non significant

MADAKKATHARA

Statistical analysis of the data indicated that there was no significant difference among the treatments with respect to any of the growth parameters studied. Severe infestation of tea mosquito bug occurred in the plots which could not be controlled. Hence the flowering details and yield details could not be recorded during the year 2017-18.

VENGURLE

Data pertaining to vegetative growth parameters during the period under reporting was recorded and presented here. It is revealed from the data that there was significant difference among the various treatments in respect of growth attributes. The maximum height (4.95m), stem girth (65.17cm), canopy diameter (4.93m) and ground coverage by canopy (39.00%) was recorded in

T_6 (*In situ* green manuring/green leaf manuring to meet 100% - Retain litter + planting cowpea). The maximum canopy surface area (38.00 m^2) recorded in treatment T_8 (RDF + 10 kg FYM - Control). The various organic treatments did not significantly affect the flowering attributes such as flowering duration (days) and number of panicle/m^2 during the year 2017-18.

The different treatments significantly influenced the yield attributes of cashew cv. Vengurla-4 under organic management during the year 2017-18. The treatment T_4 (100% N as Vermicompost + BCF) recorded significantly the highest nut weight of 10.50 g and on par with the treatments T_5 (10.23g), T8 (10.03g), T_6 (10.00g) and T_7 (9.93g). Whereas, significantly the highest apple weight (88.50 g) was recorded in T_4 (100% N as Vermicompost + BCF) and on par with treatments T_8 - RDF + 10 kg FYM-Control (88.33 g), T_2 - 100% N as FYM + BCF (85.00 g) and T_3 - 50% N as FYM + BCF + Rock phosphate (75.00 g).

The annual nut yield of cashew cv. Vengurla-4 under organic management was recorded significantly highest 1366.12 kg/ha with application of 100% N as Vermicompost + BCF (T_4) and it was superior over rest of the treatments including control. While, the lowest yield of 486.88 kg/ha was obtained by recycling of organic residue with the addition of 20% cow dung slurry (T_5). The highest cumulative yield for last 7 harvests recorded in treatment T_8 (39.37 kg/tree) followed by T_4 (33.31kg/tree).

Table 2.24 : Yield parameters of cashew under organic management at Vengurle centre during the year 2017-18

Treatment		Duration of flowering (days)		Flow. panicle / m^2	Nut wt. (g)	Apple wt. (g)	Nut yield (kg/ha)	Cum. nut yield (kg/tree) 7 harvests)
		Range	Mean					
T1	100 % N as FYM	90-94	91.40	18.87	9.30	69.10	549.44	23.75
T2	100% N as FYM + Biofertilizers consortium (BCF) (200g/tree)	92-95	93.70	20.10	9.67	85.00	805.80	32.53
T3	50% N as FYM + BCF (200g/tree) + Rock phosphate	90-93	91.47	19.60	9.90	75.00	547.40	23.47
T4	100% N as Vermicompost + BCF (200g/tree)	90-95	92.50	21.07	10.50	88.50	1366.12	33.31
T5	Recycling of organic residue with the addition of 20 % cow dung slurry (20% weight of organic residue as cow dung slurry)	89-96	93.27	19.83	10.23	63.33	486.88	17.25
T6	*In situ* green manuring /green leaf manuring to meet 100% (Retain litter + planting cowpea)	91-93	92.17	18.30	10.00	66.67	563.04	26.21
T7	25% N as FYM + Recycling of organic residues + *In situ* green manuring/green leaf manuring + BCF (200g/tree)	91.98	94.30	18.60	9.93	63.33	497.76	23.28
T8	Recommended dose of fertilizer + 10 kg FYM (Control)	92-99	95.30	22.77	10.03	88.33	1079.16	39.37
SEm ±		-	1.43	1.64	0.19	6.31	45.07	-
CD @ 5%		-	N.S.	N.S.	0.58	19.14	136.70	-
CV (%)		-	2.67	14.29	3.33	14.59	10.59	-

The data on economics of cashew under organic management (Table 2.25) revealed that the maximum net returns of Rs. 1,65,858/- was obtained from treatment T4 (100% N as Vermicompost + BCF) with C:B ratio of 1:5.25.

Table 2.25 : Yield and economics of cashew under organic management at Vengurle Centre

Treatment details		Yield of cashew (kg/ha)	Cost of Cultivation (Rs./ha)	Returns (Rs./ha)		C:B Ratio
				Total	Net	
T_1	100 % N as FYM	549.44	114000	82416	-31584	1:0.72
T_2	100% N as FYM + BCF (200g/tree)	805.80	117060	120870	3810	1:1.03
T_3	50% N as FYM + BCF (200g/tree) + Rock phosphate	547.40	76260	82110	5850	1:1.08
T_4	100% N as Vermicompost + BCF (200g/tree)	1366.12	39060	204918	165858	1:5.25
T_5	Recycling of organic residue with the addition of 20 % cow dung slurry (20% weight of organic residue as cow dung slurry)	486.88	42120	73032	30912	1:1.73
T_6	*In situ* green manuring /green leaf manuring to meet 100% (Retain litter + planting cowpea)	563.04	40080	84456	44376	1:2.11
T_7	25% N as FYM + Recycling of organic residues + *In situ* green manuring/green leaf manuring + BCF (200g/tree)	497.76	59460	74664	15204	1:1.25
T_8	Recommended dose of fertilizer + 10 kg FYM (Control)	1079.16	42467	161874	119407	1:3.81

Note : Rate of cashew raw nut @ Rs. 150/- per kg

The treatment-wise soil nutrient status after harvest of crop was estimated during 2017-18 and results are non-significant for all the characters.

The data on leaf nutrient status of cashew under organic management was estimated during 2017-18. It is evident from the data that different treatments had significantly affect on the leaf phosphorus content however, results are non-significant for leaf nitrogen and potassium content. Application of 100 % N as FYM (T_1) recorded significantly the highest leaf phosphorus content (1.61%) and at par with T_5 (1.24%) and T_2 (1.22%). The leaf nitrogen content ranged from 1.43% (T_6) to 1.76% (T_8) while, the leaf potassium content vary from 9.06% (T_4) to 14.42% (T_5).

The data on soil microbial population was analyzed during the year 2017-18. It is evident from data that the microbial population (CFU) particularly Rhizopus, Matarizium and Verticilium were observed. The highest total microbial count i.e. colony forming unit (CFU) at six dilution (15x106) recorded in treatment T_6 (*In situ* green manuring/green leaf manuring to meet 100% - Retain litter + planting cowpea) followed by T_4 - 100% N as Vermicompost + BCF (10x106) while, the lowest total microbial count (3x106) observed in treatment T_8 (RDF+10 kg FYM). The maximum CFU of Rhizopus and Verticilium were observed in treatment T_6 (6x106 & 5x106), respectively. Whereas, the maximum CFU (7x106) of Matarizium noted in T_1 - 100 % N as FYM.

VRIDHACHALAM

Inorganic fertilizer treatment (T_8) recorded the highest values for mean canopy diameter, mean surface area, mean flowering laterals per m^2, 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 2.26 : Yield parameters of cashew under organic management at Vridhachalam

Treatment	Duration of flowering (days)		Flow. panicle / m^2	Nut wt. (g)	Apple wt. (g)	Nut yield (kg/ha)	Cum. nut yield (kg/tree) 7 harvests)
	Range	Mean					
T1 - 100 % N as FYM	60-69	65	18.5	6.9	55.5	1082	31.85
T2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	59-70	66	17.8	6.8	55.3	1016	30.98
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	63-67	65	17..0	6.8	56.4	1045	30.10
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	68-71	69	16.6	6.9	55.8	1177	34.95
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	66-72	68	16.4	6.8	57.7	1091	33.25
T6 - *In situ* green manuring / green leaf manuring to meet 100 % N	63-69	66	19.7	6.8	55.9	1126	32.05
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	65-69	67	19.4	7.0	56.0	1222	36.74
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	65-71	69	21.0	7.2	58.2	1741	43.35
CD @ 5%		3.87	1.04	0.40	3.42	0.30	
SEm±		1.82	0.50	0.19	1.38	0.13	
CV (%)		3.31	3.42	3.26	3.41	3.32	

Table 2.27 : Benefit cost ratio of cashew under organic management at Vridhachalam Center

Treatment	Materials required	Cost of Material	Cost of Cultivation	Annual nut yield (kg/ha)*	Income @Rs.100/Kg of raw nuts	BC ratio \
T_1 - 100 % N as FYM	FYM 40 tonnes	21000	38000	1082	108200	2.84
T_2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	40 T FYM and Biofertilizers	25000	42000	1016	101600	2.42

T_3 - 50 % N as FYM + Bio-fertilizers (200 g)	20 T FYM & Biofertilizers	15000	42000	1045	104500	2.49
T_4 - 100 % N as Vermi-compost + Bio-fertilizers (200 g)	10 T Vermi-compost	52000	67000	1177	117700	1.76
T_5 - 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	16000	53000	1091	109100	2.06
T_6 - In situ green manuring / green leaf manuring to meet 100 % N	Growing cost of green manure 3 seasons	22000	52000	1126	112600	2.17
T_7 - 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	22000	52000	1222	122200	2.35
T_8 - Recommended doses of fertilizer + 10 kg FYM (Control)	Urea 440 Kg SSP 150 Kg Potash 80 Kg FYM 2 T	8000	35000	1741	174100	4.97

The benefit cost ratio is high (4.97) in T_8 with recommended dose of fertilizers and lowest in T_4 (1.76) with 100 per cent Nitrogen given in the form of vermicompost. The lower benefit cost ratio is 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.

KANABARGI

Year of planting : 2012

Design : Split plot

Replication : Three

Spacing : S1- 8m x 8m
S2- 10m x 5m
S3- 6.5m x 6.5 m

Fertilizer : F1- 52:13:13 g NPK/plant /year
F2- 78: 20:20 g NPK/plant/year
F3- 117: 29: 29g NPK/plant/year

Number of plant per replication : 5

Significant difference was found among the spacing levels with respect to canopy diameter (5.17 m) while nut yield was highest i.e. 1536 kg/ha in the spacing 6.5 m x 6.5 m, 1137 kg/ha in the spacing 10 m x 5 m and 966 kg/ha in 8m x 8m spacing.

Table 2.28 : Vegetative and yield parameters in cashew as influenced by three spacing levels during the year 2017-18

Sl.No.	Treatments	Tree height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height (m)	Canopy diameter (m)	Nut yield kg/tree
1	Spacing 1 (8m x 8m)	3.74	16.29	0.92	2.82	5.17	6.20
2	Spacing 2 (10m x 5m)	3.53	16.15	0.81	2.73	4.97	5.69
3	Spacing 3 (6.5 x 6.5m)	3.50	16.15	0.84	2.66	4.76	6.46
4	Treatment Mean	3.59	16.20	0.86	2.74	4.97	6.11
	S.Em±	0.10	0.41	0.05	0.10	0.11	0.18
	CD @ 5%	0.29	1.21	0.16	0.28	0.31	0.53

Significant difference was found among the fertilizer levels with respect to trunk height (0.98 m) and canopy diameter (5.10 m) recorded in fertilizer level (117:29:29 g NPK/ plant/year) while nut yield of 1385 kg/ha was highest with fertilizer level (117:29:29 g NPK/ plant/year) followed by 1205 kg/ha and 1045 kg/ha in fertilizer level (78:20:20g NPK/ plant/year) and (52:13:13g NPK/ plant/year) respectively.

Table 2.29 : Vegetative and yield parameters in cashew as influenced by three fertilizer levels during the year 2017-18

Sl. No.	Treatments	Tree height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height (m)	Canopy diameter (m)	Nut yield (kg/tree)
1	Fertilizer 1 (52:13:13g NPK/plant/year)	3.64	16.23	0.80	2.84	5.07	5.29
2	Fertilizer 2 (78:20:20g NPK/plant/year)	3.43	15.45	0.79	2.64	4.73	6.08
3	Fertilizer 3 (117:29:29g NPK/plant/year)	3.71	16.90	0.98	2.73	5.10	6.97
4	Treatment Mean	3.59	16.20	0.86	2.74	4.97	6.11
	SEm±	0.10	0.41	0.05	0.10	0.11	0.18
	CD @ 5%	0.29	1.21	0.16	0.28	0.31	0.53

Spacing cum fertilizer interaction effect showed that the trunk height S_1F_3 (1.22 m) recorded highest followed by S_2F_2 (0.92m) and S_1F_2 (0.68 m) which showed lowest plant height. Canopy diameter was highest in S_1F_2 which was on par with S_3F_2 and the least was recorded in S_3F_3. While nut yield in kg/ tree was highest with S_3F_3 (7.31 kg/tree) which was on par with S_1F_3 (6.89 kg/tree) and nut yield in kg/ha was highest and on par with S_3F_3 (1739 kg/ha) and S_3F_2 (1561 kg/tree) (Table 2.30).

Table 2.30 : Vegetative and yield parameters in cashew as influenced by spacing cum fertilizer interaction effect during the year 2017-18

Sl.No.	Treatments	Tree height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height (m)	Canopy diameter (m)	Nut yield (kg/tree)
1	S_1F_1	3.80	17.08	0.87	2.94	5.22	5.37
2	S_1F_2	3.75	15.17	0.68	3.07	4.87	6.33
3	S_1F_3	3.68	16.62	1.22	2.46	5.42	6.89
4	S_2F_1	3.60	15.95	0.78	2.82	5.20	5.01
5	S_2F_2	3.42	15.91	0.92	2.50	4.86	5.34
6	S_2F_3	3.58	16.58	0.72	2.86	4.84	6.71
7	S_3F_1	3.52	15.67	0.77	2.75	4.80	5.50
8	S_3F_2	3.11	15.28	0.77	2.35	4.45	6.56
9	S_3F_3	3.88	17.50	0.99	2.89	5.03	7.31
Treatment Mean		3.59	16.20	0.86	2.74	4.97	6.11
SEm±		0.17	0.72	0.09	0.16	0.19	0.32
CD @ 5%		0.50	2.09	0.27	0.48	0.54	0.93

PARIA

The results on effect of different levels of spacing and fertilizers on growth and yield of cashew at Paria (2017-18) are presented here. This year was fourth year of fruiting. All the growth as well as yield parameters were observed to be non-significant at individual as well as interaction level.

Table 2.31 : Effect of different levels of spacing and fertilizers on growth and yield of cashew at Paria (2017-18)

Treatments	Trunk girth (m)			Mean of Spacing	SEm/ CD at 5%	Plant height (m)			Mean of Spacing	SEm/ CD at 5%
	F_1	F_2	F_3			F_1	F_2	F_3		
S_1	0.61	0.53	0.57	0.57	0.06 / NS	4.38	3.67	4.10	4.05	0.46 / NS
S_2	0.61	0.66	0.48	0.58		4.60	5.18	3.47	4.42	
S_3	0.48	0.57	0.49	0.51		4.85	4.82	4.00	4.56	
Mean of Ferti.	0.57	0.58	0.51			4.61	4.56	3.86		
SEm±/ CD at 5%	0.06 / NS					0.40 / NS				
	Interaction effect:					Interaction effect:				
SEm±/ CD at 5%	0.10 / NS					0.69 / NS				
CV (%)	29.77					27.51				

Treatments	Mean canopy area (m)			Mean of Spacing	SEm/ CD at 5%	Canopy volume (m^3)			Mean of Spacing	SEm/ CD at 5%
	F_1	F_2	F_3			F_1	F_2	F_3		
S1	5.46	4.94	5.10	5.17	0.64/ NS	71.36	68.55	72.36	70.36	17.28 / NS
S2	6.01	7.07	4.47	5.85		87.10	143.10	58.48	96.23	
S3	4.46	5.60	4.64	4.90		50.15	82.38	46.19	59.57	
Mean of Ferti.	5.31	5.87	4.74			69.54	98.01	59.01		
SEm±/ CD at 5%	0.53 / NS					15.89 / NS				
Interaction effect:						**Interaction effect:**				
SEm±/ CD at 5%	0.93 / NS					27.53/ NS				
CV (%)	30.21					63.13				

Treatments	Nuts/plant			Mean of Spacing	SEm/ CD at 5%	Nut yield (q/ha)			Mean of Spacing	SEm/ CD at 5%
	F_1	F_2	F_3			F_1	F_2	F_3		
S1	99.50	48.83	32.33	60.22	23.12 / NS	3.00	1.47	0.98	1.82	0.62 / NS
S2	65.50	46.00	78.33	63.28		1.18	0.82	1.39	1.13	
S3	19.33	57.50	19.67	32.17		0.23	0.68	0.23	0.38	
Mean of Ferti.	61.44	50.78	43.44			1.47	0.99	0.87		
SEm±/ CD at 5%	14.53/ NS					0.30 / NS				
Interaction effect:						**Interaction effect:**				
SEm±/ CD at 5%	25.17/NS					0.52/NS				
CV%	84.23					81.27				

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 2.32 : Yield parameters of Bidhan Jhargram - 2 under Spacing trial at Jhargram centre during the year 2017 - 18

Treatment	No. of panicles/ m^2	No. of nuts/ m^2	Nut weight (g)	Annual nut yield (kg/tree)	Yield /unit area (Q/ha)
T_1 – 10m x 10m	13.79	23.88	8.55	2.97	2.97
T_2 - 8m x 8m	14.46	21.69	8.22	2.75	4.29
T_3 - 7m x 5m	14.63	21.94	8.18	1.90	5.42
T_4 - 4m x 4m	17.96	26.94	8.80	2.32	14.49
SEm ±	NS	NS	NS	NS	1.26
CD at 5%					2.68
CV (%)	29.53	18.90	4.78	3.41	3.05

There are 4 different spacing i.e. 10m x 10m, 8m x 8m, 7m x 5m and 4m x 4m. There are 6 replications and 4 plants/ replication. Observations were recorded on growth and yield characters. The plants were pruned differently according to the spacing. The plants spaced at 10m x 10m and 8m x 8m were pruned to remove the lower branches upto 1m and to maintain the shape and balance of the plants. The plants spaced at 7m x 5m were pruned to keep 2m gap in between the branches of the adjoining trees and also to keep 1m of the trunk free from branches. The plants spaced at 4m x 4m were pruned to reduce the height of the plants to 2m and to reduce the length of the side branches to keep 2m free space in between the adjoining trees and also to keep 0.75m of the trunk free from branches. Pruning was conducted during the month of July, 2017. The growth parameters

were recorded during December, 2017 and yield characters were observed during January to May, 2018.

The records on growth parameters depicted that the treatments were significantly different with respect to tree height, canopy area and ground coverage. The plants under 10m x 10m, 8m x 8m and 7m x 5m were on par with respect to plant height while the plants spaced at 4m x 4m were shortest. After pruning in 5 months time the canopies of the plants spaced at 4m x4m had covered 38.34% area which is the maximum, while plants under 10m x10m spacing covered only 7.46% area on the ground by the canopy and it was the minimum. It means plants under 4m x 4m spacing needed heavy pruning every year from the initial years itself for proper flowering and fruiting. It was the first year harvest and no significant variation was noticed among the four spacing treatments with respect to parameters like panicles/m^2, nuts/m^2, nut weight and yield/tree. Significant difference was recorded in case of yield/ha and it was highest in the plot where plants were spaced at 4m x 4m (14.49q/ha) while in other spacing treatments yield /ha data was on par.

Hort. 10 : Ultra High Density Planting (UHDP) in cashew

Centres: East Coast : Bapatla, Jhargram and Vridhachalam

West Coast : Madakkathara, Paria and Vengurla

Objectives : To identify the suitable variety for ultra high density planting. To study the economic feasibility of ultra high density compared to normal planting density in cashew.

Date of planting	:	2018
Design	:	Split plot
Replication	:	3
Treatment details	:	**Main Plot: Spacing** S_1: 2.5m x 2.5m S_2: 3m x 3m S_3: 8m x 8m (Control) **Sub plot: Varieties** V_1: VRI-3 V_2: Ullal-1 V_3: Local ruling variety
No. of plants/ treatment/ repl. for UHDP	:	6 plants for UHDP and 3 for normal plating
Operation to be performed after planting	:	1) Removal of side sprouts up to 1.5' – 2.0' on main stem 2) Terminal bud knifed off at 1 m height from ground level
Development of framework of primary branches	:	✦ 3-5 major branches be allowed in different directions and later the pruning of secondary & territory branch after completion of fruiting season.

- ✦ Yearly to be repeated.
- ✦ 1% Bordeaux spray after pruning.
- ✦ Regular pest control measures to be followed.

Manuring : Half of the dosage of regular spaced plants sufficient for the UHD plantation can be given in two splits. Recommended dose should be given at least 2 months before flushing and flowering.

Irrigation : Depending on the locality, water requirement may be decided for the initial establishment. Subsequently need based irrigation to be given after flowering depending on the availability of the water and varieties planted.

Observation to be recorded :

1) Yield & Yield attributes
2) Earliness & delay in flowering & fruiting
3) Pest & disease problems
4) Requirement of manure
5) Associated problems
6) Advantages
7) Quality of the produce
8) Precocity to be measured
9) Deblossoming in the first year need not be taken up
10) Yield need to be recorded from first year itself
11) Expenditure on establishment and maintenance need to be recorded.
12) Cost benefit ratio to be worked out besides recording routine growth & other observations.

MADAKKATHARA

There were four spacings (2.5m, 3.0m, 3.5m and 8.0 m) and three varieties (VRI-3, NRCC Sel-2 and Poornima) and the experiment was laid out in split plot design with 12 treatments and four replications. The data on the effect of spacing and varieties on growth parameters are presented here. Statistical analysis of data revealed that spacing did not significantly influence the growth character except canopy spread. Plants with a spacing of 3.5 m x 3.5m had the maximum canopy spread which was significantly different from 2.5m and 8.0m spacings.

The plant height and canopy spread were significantly influenced by varieties whereas trunk girth and trunk height were not found significant among the varieties. VRI-3 and Poornima were on par with respect to plant height and canopy spread and NRCC Sel-2 had the minimum height and canopy spread. Significant difference was not found among any of the character, when the interaction effect of varieties and spacing was studied.

Table 2.34 : Effect of spacing and varieties on growth parameters under ultra high density planting in cashew during the year 2017-18

Treatments	Height (cm)	Girth (cm)	Canopy spread (E-W)(cm)	Canopy spread (N-S)(cm)	Trunk height (cm)
S_1	78.02	7.37	63.51	65.54	29.63
S_2	81.65	8.07	72.26	71.29	29.42
S_3	86.82	8.09	81.20	80.95	23.97
S_4	68.74	6.72	58.35	55.33	24.13
Mean	78.81	7.56	68.83	68.28	26.79
SEm±	5.18	0.73	4.30	4.08	1.49
CD@5%	NS	NS	15.18	14.38	NS
V_1	86.70	7.94	78.64	75.52	28.27
V_2	67.53	6.92	50.38	48.46	26.76
V_3	82.19	7.83	77.48	80.85	25.34
Mean	78.81	7.56	68.83	68.28	26.79
SEm±	3.25	0.68	3.48	4.76	1.33
CD@5%	9.82	NS	10.52	14.41	NS
S_1V_1	82.72	8.09	69.33	68.11	34.14
S_1V_2	63.25	6.44	48.08	42.67	27.50
S_1V3	88.08	7.58	73.13	85.83	27.24
S_2V_1	92.17	8.05	84.00	81.25	29.33
S_2V_2	73.61	7.79	56.61	57.61	30.67
S_2V_3	79.17	8.37	76.17	75.00	28.25
S_3V_1	103.03	8.77	93.81	90.67	26.03
S_3V_2	77.61	7.39	59.86	53.22	25.50
S_3V_3	79.83	8.12	89.94	98.97	20.39
S_4V_1	68.88	6.87	67.40	62.05	23.57
S_4V_2	55.67	6.07	36.97	40.33	23.36
S_4V_3	81.67	7.24	70.67	63.61	25.47
Mean	78.81	7.57	68.83	68.28	26.79
SEm±	8.97	0.73	7.45	7.06	2.57
CD@5%	NS	NS	NS	NS	NS
CV (%)	14.27	14.81	17.51	24.16	17.20

VENGURLE

The trial is initiated at AICRP-cashew Vengurle centre in July, 2018. The growth of all the grafts is satisfactory. The care and maintenance of the planted grafts are in progress.

Data on initial soil properties of the experimental plot revealed that the soil of the experimental site is lateritic clay loam in texture and moderately acidic (pH 5.07) in reaction and showed safe limit of electrical conductivity (0.07dSm-1) for plant growth. Soil high in organic carbon content, low in available nitrogen content (216.3 kg/ha) and available phosphorus content medium (13.56 kg/ha). It showed very high content of available potassium (737.9 kg/ha). As far as the micronutrients in soil were concerned, it indicated sufficient range of available Iron (2.86 ppm), Manganese (1.47 ppm), Copper (0.92 ppm) and Zinc (0.17 ppm) content.

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, Bhubaneswar, 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:

T_1- Thiamethoxam (0.1 and 0.2 ml /L)

T_2- Carbosulfan (2 ml/L)

T_3- Buprofezin (2 ml/L)

T_4- *Beauveria bassiana* WP (1g/L)

T_5- *Beauveria bassiana* WP (5 g/L)

T_6- L-cyhalothrin (0.6 ml/L)

T_7- Untreated check

BAPATLA

Table 3.1 : Efficacy of different insecticides against pest complex in cashew (2017-18)

Treatment		Leaf and blossom webber damaged hoots (%)		Shoot tip caterpillar damaged shoots (%)	
		Before spray	30 days after 1st spray	Before spray	30 days after 1st spray
T_1	Thiamethoxam 25 WG (0.1 g/l)			4.50 (12.17)	7.15^{bc} (15.33)
T_2	Thiamethoxam 25 WG (0.2 g/l)			3.95 (11.45)	5.6^{8c} (13.67)

T_3	Carbosulfan 25 EC (2 ml/l)	**Pest incidence was low during the season**	5.18 (13.06)	5.23^{c} (13.13)
T_4	Buprofezin 25 SC (2 ml/l)		4.13 (11.71)	7.58^{bc} (15.79)
T_5	*Beauveriabassiana*WP (1 g/l)		4.13 (11.70)	8.23^{b} (16.64)
T_6	*Beauveriabassiana*WP (5 g/l)		5.55 13.45)	6.30^{bc} (14.47)
T_7	L - Cyhalothrin 5 EC (0.6 ml/l)		5.83 (13.95)	2.33^{d} (8.65)
T_8	Monocrotophos 36 SL (1.6 ml/l) at flushing, Chlorpyriphos 20EC (2.0 ml/l) at flowering and Profenofos 50 EC (1 ml/l) at fruit & nut development stage.		5.33 (13.26)	3.15^{d} (10.21)
T_9	Untreated check		5.13 (13.02)	12.20^{a} (20.41)
	CD (0.05)		NS	2.90
	SEm±		0.69	0.99
	CV		10.91	13.87

Figures in parentheses are arc sin transformed values
Figures followed by same alphabet (s) are not differing significantly at 5% level.

During the year 2017-18, the activity of different important foliage, flower and nut feeding pests of cashew was medium to low during the season. During this season the incidence of leaf and blossom webber was very low (almost zero) in all treatments. With regard to Shoot tip caterpillar, treatment T_7 (L-Cyhalothrin 0.6ml/l) and treatment T_8 (Monocrotophos 36 SL (1.6ml/l) at flushing, Chlorpyriphos 20 EC (2.0ml/l) at flowering and Profenofos 50 EC (1ml/l) at fruit & nut development stage) were found to be more effective in managing the pest compared to rest of the treatments.

The treatment T_7 (L-Cyhalothrin 0.6 ml/l) offered better control against apple and nut borer damage and on par with the treatment T_8 (Monocrotophos 36 SL (1.6ml/l) at flushing, Chlorpyriphos 20 EC (2.0ml/l) at flowering and Profenofos 50 EC (1ml/l) at fruit & nut development stage). With regard to leaf miner the treatment T_7 (L-Cyhalothrin 0.6 ml/l) was found to be effective in reducing the pest population and damage on leaf followed by treatment T_8 (Monocrotophos 36 SL (1.6ml/l) at flushing, Chlorpyriphos 20 EC (2.0ml/l) at flowering and profenofos 50 EC (1ml/l) at fruit & nut development stage).

Table 3.2 : Influence of different insecticides on natural enemies in cashew (2017-18)

	Treatment	Mean no. of Spiders per 52 inflorescence at 30 days after 1stspray
T_1	Thiamethoxam 25 WG (0.1 g/l)	10.00^{bc} (3.14)
T_2	Thiamethoxam 25 WG (0.2 g/l)	8.25^{c} (2.87)
T_3	Carbosulfan 25 EC (2 ml/l)	8.25^{c} (2.85)
T_4	Buprofezin 25 SC (2 ml/l)	11.00^{ab} (3.31)

T_5	*Beauveriabassiana* WP (1 g/l)	15.00[a] (3.85)
T_6	*Beauveriabassiana* WP (5 g/l)	12.25[ab] (3.49)
T_7	L-Cyhalothrin 5 EC (0.6 ml/l)	5.25[d] (2.25)
T_8	Monocrotophos 36 SL (1.6 ml/l) at flushing, Chlorpyriphos 20 EC (2.0 ml/l) at flowering and Profenofos 50 EC (1 ml/l) at fruit & nut development stage.	5.00[d] (2.20)
T_9	Untreated check	15.00[a] (3.85)
	CD (0.05)	0.59
	SEm±	0.19
	CV	12.81

Figures in parentheses are sq.root transformed values

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

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 TMB and other pests were made through insecticide application as compared to untreated control.

The intensity of damage made by TMB varied form 0.9 to 1.13 (0-4 scale) over the treatments and was found non significant before application of insecticides. Among the treatments the least incidence (0.70) was observed in (T_6) followed by 0.78 in T_2 and were at par at 15 days after spray. The incidence of shoot tip caterpillar varied from 5.77 to 6.65 per cent damaged shoot before insecticide application and was found non significant among the treatments. The damage shoot per cent varied between 1.86 and 6.19 among the insecticidal treatments at 15 days after spray, the lowest being observed in T_6. Incidence of leaf miner varied from 15.32 to 18.64 per cent damaged leaf before spray and was non significant. Damaged leaf by folder was the lowest in treatment T_6 (1.40%) closely followed by T_1, T_2 and T_5 while untreated control recorded 16.88 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 T_6, T_1 and T_2 were found most effective in controlling red banded thrips observed in 7 and 15 days after application.

Cashew nut yield per tree varied from 3.07 – 4.62 kg / tree in the treated plot as compared to 2.07 kg/tree in the untreated control. Highest cashewnut yield was recorded from T_6 (5.20 kg / tree). Treatments viz. T_1, T_2 and T_6 produced significantly higher yield among the insecticides. Spider population varied from 1.94-3.18 among the treatments and were significantly different. Highest spider population was recorded in T_5 (3.18 per inflorescence) which was at par with control. Treatments T_3 and T_5 also had higher population of spider per inflorescence.

Table 3.3 : Efficacy of insecticide against TMB at Bhubaneswar

Treatment	Dose (g/ml per l)	BS	15 DAS
T_1 (Thiamethoxam)	0.2gm/l	0.91 (0.94)	0.87 (0.93)
T_2 (Carbosulfan)	2ml/l	0.90 (0.95)	0.78 (0.88)
T_3 (Buprofezin)	2g/l	0.99 (0.99)	0.84 (0.91)
T_4 (B. bassiana)	1g/l	1.13 (1.02)	1.31 (1.02)
T_5 (B. bassiana)	5g/l	1.05 (1.00)	1.05 (1.03)
T_6 (L-Cyhalothrin-Profenophos)	0.6ml/l	1.02 (1.04)	0.76 (0.87)
T_7 Untreated Control	-	1.13 (1.02)	1.28 (1.13)
SEm±		NS	0.03
CD (0.05)			0.09

* mean of 4 replications, ** Value in parentheses are square root transformed values
TMB- Tea Mosquito Bug (*Helopeltis antonii*)

Table 3.4 : Effect of Insecticides against insect pest complex in cashew*

Treatments	Dose ml/gm per l of water	STC (BS) **	STC (15 DAS)	LM (BS) (% DL)	LM (15DAS) %DL)	Red banded thrips No/leaf)	
						1DBS	15DAS
T_1 Thiamethoxam	0.2gm/l	6.40 (2.52)	2.89 (1.62)	18.64 (4.31)	1.84 (1.35)	52.83	3.24 (11.56)
T_2 Carbosulfan	2ml/l	6.36 (2.51)	1.86 (1.43)	15.32 (3.91)	2.43 (1.56)	48.72	4.32 (11.61)
T_3 Buprofezin	2g/l	6.65 (2.57)	6.19 (2.47)	16.72 (4.08)	4.26 (2.24)	52.22	28.02 (38.04)
T_4 B. *bassiana*	1g/l	6.47 (2.54)	5.36 (2.30)	16.75 (4.48)	6.19 (2.49)	54.32	48.24 (7.15)
T_5 B. *bassiana*	5g/l	5.77 (2.4)	3.74 (1.91)	15.32 (3.91)	2.48 (1.56)	60.28	32.80 (5.98)
T_6 L-Cyhalothrin-Profenophos	0.6ml/l	6.35 (2.52)	2.32 (1.58)	15.40 (3.92)	1.40 (1.18)	60.22	1.48 (6.83)
T_7 Untreated control	-	6.53 (2.55)	7.71 (2.77)	16.35 (4.04)	16.88 (4.10)	61.42	68.23 (5 .33)
	SEm±	NS	0.1	NS	0.05	SEm±	2.02
	CD (0.05)		0.29		0.15	CD(0.05)	6.12

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

Table 3.5 : Effect of insecticide on yield and natural enemies

Treatment	Yield (kg/tree)	Cost of Insecticide Application per tree (in Rs.)	Benefit over control (kg)	Benefit: cost (Cost of raw cashewnut @150/- per kg)	Spider	Coccinelid
T_1 Thiamethoxam 0.2g/l	3.07	125/-	1.0	1.20	2.15 (1.46)	1.27 (1.1)
T_2 Carbosulfan 2ml/l	4.62	160/-	2.55	1.33	1.97 (1.40)	0.66 (0.76)
T_3 Buprofezin 2g/l	3.52	170/-	1.45	0.30	2.50 (1.58)	1.55 (1.23)
T_4 B. *bassiana* 1g/l	3.33	150/-	1.26	0.25	3.03 (1.73)	2.05 (1.43)
T_5 B. *bassiana* 5g/l	4.20	350/-	2.13	0.91	3.18 (1.77)	1.66 (1.28)
T_6 L-Cyhalothrin 0.6g/l-Profenophos	5.2	200/-	3.13	2.35	1.94 (1.38)	0.97 (0.96)
T_9 Untreated Control	2.07			0	3.95 (1.98)	3.27 (1.79)
SEm±	0.21				0.04	0.13
CD (0.05)	0.62				0.12	0.38

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

HOGALAGERE

The tea mosquito bug (TMB) damage on cashew shoots and panicles ranged between 1.75 to 2.35 and 1.73 to 2.32, respectively before spraying the insecticides. The TMB damage at 7 days and 15 days after the spray were ranged from 0.69 to 2.30 and 0.13 to 2.60 on young shoots and 0.49 to 1.93 and 0.22 to 2.36 on panicles were recorded. 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 three 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* (at 1 & 5g/l) and Buprofezin (2ml/l) were found least effective in controlling the TMB. The maximum cashew nut yield was recorded in treatment Thiamethoxam 25 WG (0.2g/l) (8.37kg/tree), followed by Lambda cyhalothrin 5 EC (0.6ml/l) (8.19kg/tree) (Table 3.6). The minimum nut yield was recorded in IIHR strain of *Beauvaria bassiana* (1 & 5g/l), Carbosulfan 25 EC (2ml/l) and Buprofezin (2ml/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. However the maximum spider and predatory coccinellid population was recorded in treatment *Beauvaria bassiana* (at 1& 5g/l) followed by Buprofezin (2ml/l) treatments (Table 3.7) as compared to remaining treatments.

Table 3.6 : Efficacy of different insecticides against Tea Mosquito Bug (TMB) incidence in cashew at Hogalagere centre during 2018-19

Treatments		TMB incidence on 20 leader shoots/panicles at diff. days after spray (DAS)						Mean	Cashew Nut yield (Kg/tree)
		On shoots			On Inflorescence				
		BS	7	15	BS	7	15		
T_1	Thiamethoxam 25WG (0.1g/l)	2.14	0.96	0.69	2.16	1.06	0.76	1.30	4.91
T_2	Thiamethoxam 25 WG (0.2g/l)	1.75	0.81	0.13	1.89	0.49	0.22	0.88	8.37
T_3	Carbosulfan 25 EC (2ml/l)	1.95	0.91	0.43	2.00	1.01	0.69	1.16	6.43
T_4	Buprofezin 25 SC (2ml/l)	1.89	0.99	0.57	2.00	1.23	0.66	1.22	6.53
T_5	*Beauvaria bassiana* (IIHR strain) (1g/l)	2.10	0.88	0.71	2.11	1.73	0.70	1.37	4.98
T_6	*Beauvaria bassiana* (IIHR strain) (5g/l)	2.35	0.98	0.76	2.32	1.91	0.77	1.51	5.77
T_7	L - Cyhalothrin 5 EC @ 0.6ml/l)	2.15	0.69	0.33	1.95	0.72	0.30	1.02	8.19
T_8	Untreated control	2.25	2.30	2.60	1.73	1.93	2.36	2.20	4.46
	SEm±	0.18	0.07	0.05	0.16	0.11	0.05	-	0.59
	CD at 5%	0.54	0.22	0.15	0.48	0.34	0.14	-	1.77
	CV (%)	17.41	13.49	12.45	15.85	17.75	11.50	-	18.93

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

Table 3.7 : Efficacy of different insecticides against pest complex in cashew at HREC Hogalagere centre during 2018-19

Treatment		Incidence of diff. pests on 20 leader shoots / inflorescence						Incidence of diff. predators on 20 leader shoots / inflorescence			
		Apple and nut borer		Thrips		Aphid		*Oxypes sweta*		*Menochilus sexmaculatus*	
		BS	15 DAS	BS	15 DAS	BS	15 DAS	BS	15 DAS	BS	15 DAS
T_1	Thiamethoxam 25WG (0.1g/l)	2.27	1.19	1.59	0.99	1.60	0.80	3.08	1.64	2.37	1.13
T_2	Thiamethoxam 25 WG (0.2g/l)	2.19	0.72	1.80	0.34	1.36	0.31	2.75	1.21	2.77	1.79
T_3	Carbosulfan 25 EC (2ml/l)	2.51	1.12	1.50	0.63	1.96	0.63	2.63	1.57	2.28	1.33
T_4	Buprofezin 25 SC (2ml/l)	2.17	1.32	1.24	0.67	2.06	1.79	2.44	2.18	2.69	2.42
T_5	*Beauvaria bassiana* (1g/l)	2.18	1.88	1.53	1.29	1.58	1.38	2.44	2.27	2.32	2.25
T_6	*Beauvaria bassiana* (5g/l)	2.09	1.64	1.09	1.77	1.86	1.41	2.49	2.40	2.36	2.38
T_7	L - Cyhalothrin 5 EC @ 0.6ml/l)	2.12	0.81	1.44	0.41	1.03	0.32	2.54	1.71	2.51	1.99
T_8	Untreated control	2.30	2.45	1.84	1.96	1.29	1.42	2.50	3.00	2.30	3.02
	SEm±	0.16	0.11	0.12	0.07	0.09	0.06	0.16	0.12	0.16	0.11
	CD at 5%	0.48	0.33	0.35	0.22	0.28	0.18	0.49	0.35	0.49	0.33
	CV (%)	14.25	15.89	15.54	14.44	11.85	12.11	12.44	11.63	13.28	10.62

JAGDALPUR

Table 3.8 : Efficacy of different insecticides against pest complex in cashew at Jagdalpur centre during the year 2017-18

Treatments	Shoot TMB damage score		Panicle TMB damage score	
	Before spray	15 DAS	Before spray	15 DAS
T_1: Thiamethoxam 25 WG (0.1g/l)	0.09 (1.04)	0.00 (1.00)	0.38 (1.17)	0.22 (1.10)
T_2: Thiamethoxam 25 WG (0.2g/l)	0.03 (1.01)	0.03 (1.01)	0.30 (1.14)	0.10 (1.05)
T_3 : Carbosulfan 25 EC (2ml/l)	0.09 (1.04)	0.03 (1.01)	0.51 (1.22)	0.39 (1.18)
T_4: Buprofezin 25 SC (2ml/l)	0.09 (1.04)	0.00 (1.00)	0.79 (1.33)	0.11 (1.05)
T_5: *Beauveria bassiana* (1g/l)	0.09 (1.04)	0.003(1.01)	0.53 (1.23)	0.25 (1.11)
T_6: *Beauveria bassiana* (5g/l)	0.00 (1.00)	0.00 (1.00)	0.39 (1.18)	0.18 (1.09)
T_7: L-Cyhalothrin 5EC (0.6ml/l)	0.00 (1.00)	0.006(1.03)	0.32 (1.14)	0.09 (1.04)
T_8: Untreated check	0.09 (1.04)	0.12 (1.06)	0.54 (1.23)	0.73 (1.31)
CD at 5%	NS	NS	NS	0.13
SEm ±				0.04
CV(%)				8.01

*Figure in the parentheses shows square root transformed values

Infestation of TMB was least in all the treatments during the shoot stage due to low population pressure. After that, the population increased gradually causing damage to the plant at panicle stage. Before spraying of insecticide the TMB damaged score ranged from 0.30 to 0.79. The TMB damage at 15 days after the spray ranged from 0.09 to 0.73. The damage on the panicle stage at 15 days after the spray was significantly reduced in all treatments. The minimum damage (0.09) was recorded in L-cyhalothrin 5 EC (0.6ml/l) which was at par with thiamethoxam 25 WG (0.2g/l) and buprofenzin 25 SC (2ml/l) i.e., 0.10 and 0.11, respectively. Whereas, the rest treatment *Beauveria bassiana* (1 and 5g/l) and carbosulfan (2ml/l) were found least effective in controlling the TMB. All the treatments were found to be superior over control.

Table 3.9 : Efficacy of different insecticides against pest complex in cashew at Jagdalpur centre during the year 2017-18

Treatment	Leaf caterpillar damage (%)		Leaf folder damage (%)		Leaf minor damage (%)		Thrips damage score on nuts	
	Before spray	15 DAS	Before spray	15 DAS	Before spray	15 DAS	Before spray	15 DAS
T_1: Thiamethoxam 25 WG (0.1g/l)	28.90 (32.46)	13.61 (21.63)	24.44 (29.57)	10.71 (19.06)	11.24 (19.38)	7.26 (15.52)	0.92 (1.38)	0.49 (1.22)
T_2: Thiamethoxam 25 WG (0.2g/l)	29.66 (32.98)	10.70 (19.08)	22.60 (28.34)	8.93 (17.38)	12.75 (20.82)	6.44 (14.73)	0.73 (1.31)	0.15 (1.07)
T_3 : Carbosulfan 25 EC (2ml/l)	31.39 (34.04)	12.13 (20.36)	24.54 (29.66)	10.58 (18.97)	15.00 (22.73)	8.26 (16.68)	0.70 (1.30)	0.31 (1.14)

T_4: Buprofezin 25 SC (2ml/l)	30.09 (33.11)	9.78 (18.21)	24.99 (29.96)	8.59 (17.03)	15.77 (23.34)	5.49 (13.96)	1.04 (1.43)	0.19 (1.09)
T_5: *Beauveria bassiana* (1g/l)	27.24 (31.34)	13.28 (21.36)	24.97 (29.91)	13.26 (21.34)	14.83 (22.39)	9.26 (17.65)	0.97 (1.40)	0.55 (1.24)
T_6: *Beauveria bassiana* (5g/l)	28.51 (32.26)	12.67 (20.84)	25.08 (30.01)	12.75 (20.90)	12.81 (20.90)	7.73 (16.12)	0.99 (1.41)	0.28 (1.13)
T_7:L-cyhalothrin 5EC (0.6ml/l)	29.84 (33.09)	8.96 (17.40)	29.40 (32.78)	7.68 (16.06)	12.51 (20.68)	7.06 (15.39)	0.89 (1.37)	0.17 (1.08)
T_8: Untreated check	27.28 (31.45)	29.77 (33.04)	24.70 (29.72)	30.48 (33.46)	13.05 (21.09)	14.61 (22.44)	0.72 (1.37)	1.03 (1.42)
CD at 5%	NS	1.01	NS	1.62	NS	2.55	NS	0.07
SEm ±	-	0.34	-	0.55		0.86		0.02
CV%	-	3.17	-	5.32		10.42		3.97

*Figure in the parentheses shows arc sin transformed values

Data from table shows that the per centage leaf damage from leaf caterpillar before insecticidal spray was ranged from 27.28 - 31.39. At 15 days after spray, minimum per cent leaf damage (8.96%) from leaf caterpillar was recorded in treatment L-cyhalothrin 5 EC (0.6 ml/l) which was at par with buprofenzin (25 SC @ 2 ml/l) 9.78 percent followed by thiamethoxam (25 WG @ 0.2 g/l) 10.70 per cent. All the insecticidal treatments were significantly superior over untreated control.

The data presented revealed that the pre treatment leaf folder damage percent ranged from 22.60 to 29.40. At 15 days after spray least per cent damage (7.68) was recorded in treatment L-cyhalothrin 5 EC (0.6ml/l) which was at par with buprofenzin (25 SC @ 2ml/l) and thiamethoxam (25 WG@ 0.2g/l) 8.59, 8.93 percent, respectively. All the treatments were significantly superior over untreated control.

Perusal of data presented on efficacy of different insecticides against pest complex in cashew revealed that before insecticidal spray the leaf miner damage (%) ranged from 11.24 to 15.77. At 15 days after spray the leaf miner damage in all the treatments were found significantly superior to

untreated control. The significant minimum incidence (5.49 %) was recorded in treated with (Buprofezin @ 2ml/l), which was on par with thiamethoxam (0.2 g/l), L-cyhalothrin (0.6ml/l) and *Beauveria bassiana* (5 g/l) with 6.44, 7.06 and 7.73 per cent at 30 days after 3rd spray respectively.

There were no significant differences observed before spray. However, thrips damage score on nuts showed significant difference among the treatments during post treatment observation. At 15 days after spray treatment thiamethoxam (0.2ml/l) having significant minimum damage with 0.15 score which was on par with L-cyhalothrin @0.6 ml/l and buprofenzin @ 2ml/l with 0.17 and 0.19 score respectively.

Table 3.10 : Influence of different insecticides on natural enemies and pollinators in cashew at Jagdalpur centre during the year 2017-18

Treatment	Spiders (*Oxypus* sp)	LBB (*Menochilus sexmaculata*)	Brumus (*Brumus* sp.)
	15 DAS	15 DAS	15 DAS
T_1:Thiamethoxam 25 WG (0.1 g/l)	0.57 (1.25)	0.18 (1.08)	0.24 (1.11)
T_2:Thiamethoxam 25 WG (0.2 g/l)	0.52 (1.23)	0.09 (1.04)	0.09 (1.04)
T_3 : Carbosulfan 25 EC (2 ml/l)	0.50 (1.22)	0.11 (1.05)	0.13 (1.06)
T_4: Buprofezin 25 SC (2ml/l)	0.52 (1.23)	0.10 (1.05)	0.09 (1.04)
T_5: *Beauveria bassiana* (1g/l)	0.62 (1.27)	0.22 (1.10)	0.28 (1.13)
T_6: *Beauveria bassiana* (5g/l)	0.47 (1.21)	0.21 (1.10)	0.17 (1.08)
T_7: L-cyhalothrin 5EC (0.6ml/l)	0.23 (1.11)	0.08 (1.04)	0.10 (1.05)
T_8: Untreated check	1.12 (1.45)	0.40 (1.18)	0.45 (1.20)
CD at 5%	0.13	0.06	0.01
SEm ±	0.04	0.02	0.03
CV (%)	7.06	3.98	6.20

*Figure in the parentheses shows square root transformed values.

Population of natural enemies was recorded at 15 days after spray. Population of all natural enemies was higher in untreated trees. Among the treatments, spider population was maximum in treatment T_5 (*Beauveria bassiana* @ 1g/l) with 0.62 spider/tree which was statistically at par with T_1, T_2, T_3, T_4 and T_6 with 0.57, 0.52, 0.50, 0.52 and 0.47 spider /tree. The lady bird beetle population was significantly maximum (0.22) in treatment T_5 (*Beauveria bassiana* @1g/l) and the lowest in T_7 (L-cyhalothrin 5EC @ 0.6ml/l) with 0.08/tree. The highest *Brumus* sp. population was found in T_5 (*Beauveria bassiana* @1g/l) with 0.28 Brumus /tree followed by T_1, T_6 and T_3 with 0.24, 0.17 and 0.13 Brumus /tree, respectively.

MADAKKATHARA

Tea mosquito bug damage

On laterals: Trial conducted in the midseason variety Priyanka.The second round spray was done during last week of December 2017 coinciding with flower initiation and tea mosquito bug population build-up. At seventh day after spray all treatments except Carbosulfan 2ml/l and Buprofezin 2ml/l were superior and on par with POP. At 15th day of second spray, Thiamethoxam @ 0.1g/l and 0.2g /l Lambda cyhalothrin @ 0.6 ml/l were on par with POP. At 30th day Thiamethoxam @ 0.1g/l and 0.2g/l, Carbosulfan 2ml/l and *Beauveria bassiana* @ 1g/l and 5g/l and Lambda cyhalothrin @ 0.6 ml/ were

significantly superior to control and on par with POP and Buprofezin 2ml/l was inferior to all treatments.

On 7th day after third spray except *Beauveria bassiana* 0.5gm/ml all treatments were superior to Control. On 15th day except Buprofezin 2ml/l all treatments were superior and on par with POP. On 30th day all treatments except Carbosulfan 2ml/l were superior to control.

On inflorescence: Moderate damage recorded on inflorescence before the second round spray. On 7th day all treatments except Buprofezin 2ml/ and Carbosulfan 2ml/l were superior on par with POP. On 15th day all treatments except Buprofezin 2ml and Carbosulfan 2ml/l were superior to control. The treatments, Thiamethoxam 0.1g and 0.2g, *Beauveria bassiana* and Lambda cyhalothrin@0.6 ml/l were close to POP. On 30th day all treatments except Buprofezin 2ml and Carbosulfan 2ml/l were superior to control and *Beauveria bassiana* 5g/l was on par with POP.

On 7th day after third round spray all treatments except Buprofezin 2ml were superior to control and Thiamethoxam @ 0.2g/l was on par with POP. On 15th day except Carbosulfan 2ml/l, Buprofezin 2ml and *Beauveria bassiana* 0.5g/l were superior to control. On 30th day all treatments except Thaimethoxam 0.1gm/l, Carbosulfan 2ml/l, Buprofezin 2ml/l and *Beauveria bassiana* 0.5g/l were superior and on par with POP.

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. No significant variation was observed in red ant population. Spider population showed a reduction in chemical treatments.

Table 3.11: Efficacy of different Insecticides against Tea Mosquito Bug Incidence in cashew at Madakkathara centre during the year 2017-18 (Second Spray)

Treatments		Laterals				Panicle			
		Before spray	Days after			Before spray	Days after		
			7th day	15th day	30th day		7th day	15th day	30th day
T_1	Thiamethoxam (0.1g/l)	0.256 (0.867)^{b}	0.041 (0.735)^{b}	0.060 (0.748)^{bcd}	0.112 (0.782)^{bc}	0.872 (1.170)^{a}	0.055 (0.745)^{c}	0.202 (0.837)^{bcd}	0.213 (0.844)^{c}
T_2	Thiamethoxam (0.2g/l)	0.492 (0.994)^{ab}	0.031 (0.728)^{b}	0.011 (0.715)^{cd}	0.065 (0.751)^{bc}	0.849 (1.157)^{a}	0.040 (0.735)^{c}	0.096 (0.771)^{cd}	0.139 (0.799)^{c}
T_3	Carbosulfan (2ml/l)	0.511 (1.005)^{ab}	0.333 (0.906)^{a}	0.132 (0.795)^{bc}	0.158 (0.811)^{bc}	0.709 (1.097)^{a}	0.427 (0.962)^{b}	0.710 (1.095)^{a}	0.435 (0.966)^{ab}
T_4	Buprofezin (2ml/l)	0.413 (0.955)^{ab}	0.435 (0.964)^{a}	0.153 (0.804)^{b}	0.202 (0.833)^{ab}	0.735 (1.106)^{a}	0.457 (0.970)^{b}	0.710 (1.099)^{a}	0.547 (1.023)^{a}
T_5	*Beauveria bassiana* WP (0.5 g/l)	0.464 (0.980)^{ab}	0.089 (0.767)^{b}	0.407 (0.951)^{a}	0.217 (0.845)^{ab}	0.992 (1.215)^{a}	0.145 (0.800)^{c}	0.419 (0.958)^{b}	0.291 (0.889)^{bc}
T_6	*Beauveria bassiana* WP (1g/l)	0.456 (0.973)^{ab}	0.068 (0.753)^{b}	0.329 (0.910)^{a}	0.154 (0.807)^{bc}	0.486 (0.988)^{a}	0.152 (0.807)^{c}	0.321 (0.904)^{bc}	0.250 (0.863)^{bc}
T_7	*Beauveria bassiana* WP (5g/l)	0.723 (1.100)^{a}	0.049 (0.741)^{b}	0.149 (0.806)^{b}	0.124 (0.789)^{bc}	0.932 (1.187)^{a}	0.069 (0.755)^{c}	0.215 (0.846)^{bcd}	0.217 (0.846)^{c}

T_8	L-cyhalothrin (0.6 ml/l)	0.389 (0.914)^{ab}	0.049 (0.741)^{b}	0.062 (0.749)^{bcd}	0.116 (0.785)^{bc}	0.872 (1.167)^{a}	0.049 (0.741)^{c}	0.157 (0.810)^{cd}	0.317 (0.900)^{bc}
T_9	POP, Kerala	0.345 (0.917)^{ab}	0.019 (0.721)^{b}	0.004 (0.710)^{d}	0.026 (0.725)^{c}	0.920 (1.184)^{a}	0.027 (0.727)^{c}	0.035 (0.732)^{d}	0.107 (0.778)^{c}
T_{10}	Untreated check	0.330 (0.903)^{ab}	0.451 (0.972)^{a}	0.443 (0.970)^{a}	0.369 (0.931)^{a}	0.871 (1.168)^{a}	0.896 (1.181)^{a}	0.713 (1.097)^{a}	0.549 (1.023)^{a}
	Mean	0.438	0.156	0.175	0.154	0.824	0.232	0.358	0.307
	SEm ±	0.060	0.034	0.022	0.030	0.068	0.038	0.039	0.034
	CD at 5%	0.179	0.109	0.077	0.094	0.203	0.108	0.121	0.109
	CV%	10.85	7.38	4.85	6.54	10.31	7.75	7.41	6.71

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

Table 3.12 : Efficacy of different Insectcides against Tea Mosquito Bug Incidence in cashew at Madakkathara centre during the year 2017-18 (Third spray)

Treatments		Incidence of TMB (Tea Mosquito Bug) mean damage score for 52 leader shoots (0-4 scale) of pre treatment and third spraying.						
		Laterals			Panicle			Nut Yield (Kg/Tree)
		Days after			Days after			
		7th day	15th day	30th day	7th day	15th day	30th day	
T_1	Thiamethoxam (0.1g/l)	0.009 (0.713)^{c}	0.000 (0.707)^{b}	0.000 (0.707)^{b}	0.100 (0.773)^{ab}	0.096 (0.772)^{bcd}	0.121 (0.788)^{cd}	2.392 (2.718)^{ab}
T_2	Thiamethoxam (0.2g/l)	0.000 (0.707)^{c}	0.000 (0.707)^{b}	0.000 (0.707)^{b}	0.061 (0.749)^{b}	0.031 (0.728)^{d}	0.035 (0.731)^{de}	2.750 (2.781)^{ab}
T_3	Carbosulfan (2ml/l)	0.052 (0.743)^{bc}	0.014 (0.717)^{b}	0.017 (0.719)^{ab}	0.137 (0.796)^{ab}	0.127 (0.792)^{bc}	0.249 (0.865)^{b}	1.170 (2.480)^{b}
T_4	Buprofezin (2ml/l)	0.031 (0.728)^{c}	0.054 (0.744)^{a}	0.000 (0.707)^{b}	0.285 (0.886)^{a}	0.399 (0.947)^{a}	0.262 (0.872)^{b}	1.987 (2.621)^{ab}
T_5	*Beauveria bassiana* WP (.5g/l)	0.139 (0.798)^{ab}	0.000 (0.707)^{b}	0.000 (0.707)^{b}	0.131 (0.795)^{ab}	0.171 (0.818)^{b}	0.269 (0.875)^{bc}	3.703 (2.950)^{ab}
T_6	*Beauveria bassiana* WP (1g/l)	0.093 (0.768)^{abc}	0.000 (0.707)^{b}	0.000 (0.707)^{b}	0.127 (0.789)^{ab}	0.068 (0.753)^{cd}	0.200 (0.835)^{de}	4.180 (3.024)^{a}
T_7	*Beauveria bassiana* (5g/l)	0.052 (0.742)^{bc}	0.000 (0.707)^{b}	0.000 (0.707)^{b}	0.106 (0.778)^{ab}	0.047 (0.739)^{cd}	0.102 (0.775)^{de}	4.593 (3.059)^{a}
T_8	L-cyhalothrin (0.6 ml/l)	0.023 (0.723)^{c}	0.000 (0.707)^{b}	0.000 (0.707)^{b}	0.107 (0.779)^{ab}	0.055 (0.744)^{cd}	0.074 (0.758)^{de}	2.137 (2.668)^{ab}
T_9	POP, Kerala	0.000 (0.707)^{c}	0.000 (0.707)^{b}	0.000 (0.707)^{b}	0.037 (0.733)^{b}	0.031 (0.728)^{d}	0.025 (0.724)^{e}	4.812 (3.132)^{a}
T_{10}	Untreated check	0.150 (0.806)^{a}	0.071 (0.755)^{a}	0.028 (0.726)^{a}	0.301 (0.886)^{a}	0.369 (0.931)^{a}	0.521 (1.009)^{a}	2.917 (2.811)^{ab}
	Mean	0.055	0.014	0.004	0.139	0.139	0.186	3.064
	SEm ±	0.018	0.008	0.007	0.038	0.016	0.022	0.156
	CD at 5%	0.054	0.017	0.017	0.109	0.054	0.054	0.464
	CV (%)	4.26	2.10	1.63	8.30	3.53	4.52	9.54

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

Table 3.13: Influence of different insecticides on natural enemies and pollinators in cashew at Madakkathara centre during the year 2017-18

Treatment		Black ant		Spiders (*Oxyopes shweta,Tetragnatha* spp.*Thomisus* spp.)		Red ants (*Oecophylla smaragdina*)	
		Before spray	30 days after 3rd spray	Before spray	30 days after 3rd spray	Before spray	30 days after 3rd spray
T_1	Thiamethoxam (0.1g/l)	3.50	1.83	1.00	1.50	0.00	2.17
T_2	Thiamethoxam (0.2g/l)	2.83	2.33	1.50	0.83	0.33	1.50
T_3	Carbosulfan (2ml/l)	3.33	2.33	2.00	0.83	0.00	0.88
T_4	Buprofezin (2ml/l)	3.5	2.17	2.00	1.17	0.00	1.34
T_5	*Beauveria bassiana* WP (.5g/l) (ICAR-IIHR formulation)	2.17	1.83	1.33	1.17	2.00	0.70
T_6	*Beauveria bassiana* WP (1g/l) (ICAR-IIHR formulation)	3.17	2.50	1.33	1.33	0.00	0.70
T_7	*Beauveria bassiana* WP (5g/l) (ICAR-IIHR formulation)	1.67	1.50	1.83	0.83	1.83	0.70
T_8	L-cyhalothrin (0.6 ml/l)	2.17	1.00	0.50	0.17	0.00	0.70
T_9	POP, KAU	4.17	0.33	1.67	0.00	0.33	0.70
T_{10}	Untreated check	2.33	2.00	2.17	1.50	0.00	0.70

Figures are adjusted mean of four replicates

VENGURLE

Table 3.14 : Efficacy of different insecticides against tea mosquito bug incidence in cashew at Vengurle centre during the year 2017-18

Treatments		On shoots		On panicles	
		Pre count	15 days after spray	Pre count	15 days after spray
T_1	Thiamethoxam (0.1g/lit)	0.158	0.117	0.183	0.170
T_2	Thiamethoxam (0.2g/lit)	0.163	0.148	0.173	0.187
T_3	Carbosulfan (2ml/l)	0.163	0.139	0.173	0.209
T_4	Buprofezin (2ml/l)	0.163	0.098	0.173	0.141
T_5	Beauveria bassiana (1g/lit)	0.144	0.146	0.168	0.196
T_6	Beauveria bassiana (5g/lit)	0.144	0.151	0.163	0.136
T_7	L-cyhalothrin (0.6ml/lit)	0.153	0.149	0.163	0.134
T_8	Untreated check	0.125	0.254	0.163	0.259
	SEm ±	0.014	0.013	0.010	0.012
	CD at 5%	NS	0.037	NS	0.036
	CV (%)	18.22	16.85	16.90	13.79

During the year 2017-18 the data showed that all the insecticidal treatments reduced the incidence of tea mosquito bug over control. Among the insecticide tested, the treatment T_4 Buprofezin recorded significantly least incidence of tea mosquito bug on shoot (0.098) and on panicle, the treatment T_7 L-cyhalothrin recorded least incidence of tea mosquito bug (0.134).

Table 3.15 : Efficacy of different insecticides against thrips incidence in cashew at Vengurle centre during the year 2017-18

Treatments		Before spray	30 days after spray
T_1	Thiamethoxam (0.1g/lit)	0.163	0.153
T_2	Thiamethoxam (0.2g/lit)	0.165	0.096
T_3	Carbosulfan (2ml/l)	0.165	0.114
T_4	Buprofezin (2ml/l)	0.173	0.120
T_5	Beauveria bassiana (1g/lit)	0.156	0.151
T_6	Beauveria bassiana (5g/lit)	0.165	0.136
T_7	L-cyhalothrin (0.6ml/lit)	0.158	0.139
T_8	Untreated check	0.137	0.216
	SEm ±	0.014	0.008
	CD at 5%	NS	0.023
	CV (%)	13.14	11.29

In case of thrips, all the insecticidal treatment reduces the incidence of thrips over control. Among the insecticide tested, the treatment T_2 (Thiamethoxam) recorded the least incidence of thrips thirty days after third spray and significantly effective over rest of the treatments.

VRIDHACHALAM

Experimental details

Design : RBD
Treatment : Eight
Variety : VRI-3
No. of trees/treatment : Two
Replication : Four
Year of Planting : 2005

Treatments

The following treatments were imposed as per approved technical programme.

T_1 : Thiamethoxam 25 WG @ 0.1g/lit. all the three sprays
T_2 : Carbosulfan 25 EC @ 2 g/lit. all the three sprays
T_3 : Buprofezin 25% SC @ 2 ml/lit. all the three sprays
T_4 : *Beauveria bassiana* WP @ 1 g/lit.
T_5 : *Beauveria bassiana* WP @ 5 g/lit.
T_6 : Lambda-Cyhalothrin 5 EC - (0.6ml/lit) all the three sprays
T_7 : Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays
T_8 : Untreated control

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. Maximum spray suspension used per tree was 10 lit. / 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 on pest infestations were taken. 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 at par, but statistically superior over untreated control. The pre-treatment damage score of TMB was non-significant in all treatments including the untreated control. The overall efficacy ranked in the order against the incidence of TMB and its population at Vridhachalam are as follows: T_7 (Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays) > T_8 (Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays) > T_1 (Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays) > T_2 (Carbosulfan 25 EC @ 2 ml/lit. all the three sprays) > T_3 (Buprofezin 25 % SC @ 2 ml/lit. all the three sprays) >T_6 (*Beauveria bassiana* WP @ 5 g/lit.) > T_5 *(Beauveria bassiana* WP @ 2 g/lit.) > T_4 (*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 T_6 (*Beauveria bassiana* WP @ 5 g/lit.), T5 (*Beauveria bassiana* WP @ 2 g/lit.) and T4 (*Beauveria bassiana* WP @ 1 g/lit.). The efficacy of different insecticides was at par, but statistically superior over untreated control.

Table 3.16 : Effect of insecticides on the incidence of TMB at Vridhachalam

(Mean of four replications)

Treatment		Pre-treatment damage score (0-4)	Post treatment mean damage score (0-4)			Pre-treatment damage score (0-4)	Post treatment mean damage score (0-4)			Pre-treatment damage score (0-4)	Post treatment mean damage score (0-4)		
			I Spray				II Spray				III Spray		
			7 DAS	15 DAS	30 DAS		7 DAS	15 DAS	30 DAS		7 DAS	15 DAS	30 DAS
T_1	Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	1.850 (1.688)	0.550 (1.245)	0.325 (1.150)	0.150 (1.072)	3.050 (2.012)	0.500 (1.224)	0.375 (1.172)	0.253 (1.119)	3.600 (2.145)	0.275 (1.129)	0.0975 (1.048)	0.0085 (1.004)
T_2	Carbosulfan 25 EC @ 2 ml/lit. all the three sprays	1.900 (1.703)	0.850 (1.360)	0.650 (1.284)	0.550 (1.245)	3.000 (2.000)	0.825 (1.351)	0.550 (1.245)	0.445 (1.202)	3.525 (2.127)	0.400 (1.183)	0.2250 (1.106)	0.2750 (1.129)
T_3	Buprofezin 25 % SC @ 2 ml/lit. all the three sprays	1.925 (1.710)	1.000 (1.414)	0.975 (1.405)	0.750 (1.323)	2.950 (1.987)	0.975 (1.405)	0.775 (1.332)	0.688 (1.299)	3.500 (2.121)	0.650 (1.284)	0.4000 (1.183)	0.4000 (1.182)
T_4	*Beauveria bassiana* WP @1 g/lit.	1.850 (1.688)	1.575 (1.605)	1.450 (1.565)	1.200 (1.483)	3.025 (2.006)	1.275 (1.508)	1.075 (1.440)	0.800 (1.341)	3.525 (2.126)	0.900 (1.378)	0.6375 (1.280)	0.6750 (1.294)
T_5	*Beauveria bassiana* WP @ 2 g/lit.	1.900 (1.703)	1.500 (1.581)	1.325 (1.525)	1.100 (1.449)	3.075 (2.019)	1.200 (1.483)	0.950 (1.396)	0.500 (1.224)	3.625 (2.150)	0.850 (1.360)	0.5750 (1.255)	0.6500 (1.284)
T_6	*Beauveria bassiana* WP @ 5 g/lit.	1.850 (1.688)	1.300 (1.516)	1.225 (1.491)	1.075 (1.440)	2.950 (1.987)	1.175 (1.475)	0.900 (1.378)	0.475 (1.214)	3.525 (2.127)	0.850 (1.360)	0.5250 (1.235)	0.6000 (1.265)
T_7	Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	1.850 (1.688)	0.275 (1.129)	0.150 (1.072)	0.095 (1.046)	2.975 (1.994)	0.325 (1.151)	0.225 (1.106)	0.045 (1.022)	3.450 (2.109)	0.125 (1.060)	0.0080 (1.004)	0.0023 (1.001)
T_8	Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays	1.850 (1.688)	0.525 (1.235)	0.300 (1.140)	0.150 (1.072)	3.000 (2.000)	0.450 (1.204)	0.325 (1.151)	0.238 (1.112)	3.450 (2.109)	0.250 (1.118)	0.1000 (1.049)	0.0080 (1.004)
T_9	Untreated control	1.925 (1.710)	2.450 (1.857)	2.800 (1.949)	3.050 (2.012)	3.125 (2.031)	3.525 (2.127)	3.675 (2.162)	3.700 (2.168)	3.500 (2.121)	3.575 (2.139)	3.600 (2.145)	3.6500 (2.156)
CD @ 0.05		NS	0.043	0.061	0.038	NS	0.040	0.037	0.028	NS	0.039	0.033	0.031
SEm ±		0.015	0.015	0.021	0.013	0.016	0.013	0.013	0.009	0.021	0.013	0.011	0.011

DAS - Days After Spraying

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

Table 3.17 : Efficacy of insecticides on TMB population / 52 leader shoots at Vridhachalam

(Mean of four replications)

	Treatment	Pre-treatment Count /52 leader shoots	Post treatment count (Mean TMB population/52 leader shoots) I Spray			Pre-treatment Count /52 leader shoots	Post treatment count (Mean TMB population/52 leader shoots) II Spray			Pre-treatment Count /52 leader shoots	Post treatment count (Mean TMB population/52 leader shoots) III Spray		
			7 DAS	15 DAS	30 DAS		7 DAS	15 DAS	30 DAS		7 DAS	15 DAS	30 DAS
T_1	Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	2.075 (1.753)	0.675 (1.294)	0.068 (1.033)	0.050 (1.025)	2.550 (1.884)	0.500 (1.224)	0.048 (1.023)	0.050 (1.025)	2.925 (1.981)	0.008 (1.004)	0.006 (1.003)	0.003 (1.002)
T_2	Carbosulfan 25 EC @ 2 ml/lit. all the three sprays	2.025 (1.739)	0.800 (1.341)	0.375 (1.172)	0.075 (1.037)	2.600 (1.897)	0.788 (1.337)	0.475 (1.211)	0.084 (1.041)	2.950 (1.987)	0.048 (1.023)	0.024 (1.012)	0.018 (1.009)
T_3	Buprofezin25 % SC @ 2 ml/lit. all the three sprays	2.050 (1.746)	0.925 (1.387)	0.550 (1.245)	0.083 (1.040)	2.525 (1.877)	0.858 (1.363)	0.575 (1.255)	0.313 (1.145)	2.875 (1.968)	0.080 (1.039)	0.048 (1.023)	0.030 (1.015)
T_4	*Beauveria bassiana* WP @ 1 g/lit.	2.075 (1.754)	1.213 (1.487)	0.725 (1.313)	0.125 (1.060)	2.575 (1.891)	1.300 (1.516)	0.915 (1.384)	0.650 (1.284)	2.850 (1.962)	0.200 (1.095)	0.225 (1.107)	0.068 (1.033)
T_5	*Beauveria bassiana* WP @ 2 g/lit.	2.050 (1.746)	1.175 (1.475)	0.675 (1.294)	0.095 (1.046)	2.625 (1.904)	1.250 (1.500)	0.683 (1.297)	0.638 (1.279)	2.975 (1.994)	0.175 (1.083)	0.125 (1.060)	0.060 (1.030)
T_6	*Beauveria bassiana* WP @ 5 g/lit.	2.100 (1.761)	1.075 (1.440)	0.650 (1.284)	0.090 (1.044)	2.600 (1.897)	1.150 (1.466)	0.665 (1.297)	0.525 (1.234)	2.925 (1.981)	0.125 (1.060)	0.089 (1.043)	0.055 (1.027)
T_7	Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	2.050 (1.746)	0.375 (1.172)	0.043 (1.021)	0.039 (1.019)	2.625 (1.904)	0.325 (1.151)	0.025 (1.012)	0.011 (1.006)	2.925 (1.981)	0.003 (1.001)	0.002 (1.001)	0.001 (1.000)
T_8	Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays	2.100 (1.761)	0.625 (1.275)	0.065 (1.032)	0.048 (1.023)	2.525 (1.877)	0.450 (1.204)	0.043 (1.027)	0.025 (1.012)	2.975 (1.994)	0.007 (1.003)	0.005 (1.003)	0.003 (1.001)
T_9	Untreated control	2.075 (1.754)	2.150 (1.775)	2.375 (1.837)	2.450 (1.857)	2.600 (1.897)	2.750 (1.936)	2.825 (1.955)	2.925 (1.981)	2.975 (1.994)	3.125 (2.031)	3.250 (2.061)	3.400 (2.097)
	CD @ 0.05	NS	0.042	0.026	0.019	NS	0.036	0.062	0.042	NS	0.031	0.018	0.014
	SEm ±	0.010	0.014	0.009	0.006	0.015	0.012	0.021	0.014	0.007	0.011	0.006	0.005

PTC - Pre Treatment Count; DAS - Days After Spraying

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

Table 3.18 : Efficacy of insecticides against foliar pests at Vridhachalam

(Mean of four observations)

Treatment		Mean damage after 3rd 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	
T_1	Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	3.625 (10.966)	2.100 (8.328)	4.675 (12.481)	1.450 (6.908)	3.475 (10.738)	0.863 (5.326)	1.250 (6.402)	0.002 (0.252)	8.625 (3.102)	0.375 (1.172)	6.025 (2.650)
T_2	Carbosulfan 25 EC @ 2 ml/lit. all the three spray	3.725 (11.116)	2.363 (8.836)	4.625 (12.413)	1.550 (7.148)	3.400 (10.621)	0.800 (5.126)	1.450 (6.908)	0.025 (0.894)	8.575 (3.094)	0.450 (1.204)	5.825 (2.612)
T_3	Buprofezin25 % SC @ 2 ml/lit. all the three sprays	3.550 (10.855)	2.425 (8.953)	4.725 (12.549)	1.775 (7.653)	3.500 (10.778)	0.988 (5.697)	1.475 (6.970)	0.033 (1.023)	8.525 (3.086)	0.550 (1.244)	5.725 (2.593)
T_4	*Beauveria bassiana* WP @ 1 g/lit.	3.625 (10.969)	2.763 (9.562)	4.725 (12.549)	2.075 (8.277)	3.475 (10.739)	1.413 (6.804)	1.500 (7.030)	0.073 (1.542)	8.525 (3.086)	0.775 (1.332)	5.413 (2.532)
T_5	*Beauveria bassiana* WP @ 2 g/lit.	3.500 (10.778)	2.675 (9.408)	4.700 (12.515)	1.763 (7.625)	3.550 (10.856)	1.250 (6.410)	1.500 (7.028)	0.058 (1.372)	8.575 (3.094)	0.725 (1.313)	5.475 (2.545)
T_6	*Beauveria bassiana* WP @ 5 g/lit.	3.650 (11.008)	2.550 (9.184)	4.750 (12.583)	1.850 (7.813)	3.550 (10.856)	1.013 (5.765)	1.475 (6.970)	0.040 (1.136)	8.725 (3.118)	0.675 (1.294)	5.650 (2.579)
T_7	Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	3.650 (11.008)	1.538 (7.078)	4.775 (12.617)	0.773 (5.040)	3.525 (10.816)	0.760 (4.986)	1.525 (7.088)	0.001 (0.181)	8.600 (3.098)	0.175 (1.082)	6.625 (2.761)
T_8	Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays	3.600 (10.930)	2.050 (8.228)	4.650 (12.448)	1.150 (6.152)	3.475 (10.738)	0.883 (5.382)	1.700 (7.486)	0.003 (0.299)	8.700 (3.114)	0.400 (1.183)	6.350 (2.711)
T_9	Untreated control	3.725 (11.123)	3.850 (11.311)	4.700 (12.515)	4.835 (12.697)	3.500 (10.738)	3.700 (11.085)	1.600 (7.257)	1.738 (7.569)	8.675 (3.110)	9.075 (3.174)	4.450 (2.334)
	CD @ 0.05	NS	0.509	NS	0.233	NS	0.472	0.469	0.184	NS	0.063	0.025
	SEm ±	0.146	0.173	0.055	0.079	0.065	0.164	0.160	0.063	0.010	0.021	0.009

PTC - Pre Treatment Count; DAS: Days After Spraying

Values in the parentheses are arc sine $\sqrt{}$ per cent transformed values for per cent damage $\sqrt{x+0.5}$ and 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 were effective in controlling TMB populations to zero as against 3.4 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.

Table 3.19 : Effect of insecticide sprays on natural enemies at Vridhachalam

Treatment		Mean number of natural enemies / pollinators in 52 inflorescence 30 days after 3rd spray			
		Spiders	Ants	Coccinellids	Cotesia
T_1	Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	2.875 (1.968)	4.250 (2.288)	2.500 (1.868)	3.550 (2.131)
T_2	Carbosulfan 25 EC @ 2 ml/lit. all the three sprays	3.125 (2.030)	4.625 (2.370)	2.625 (1.896)	3.750 (2.177)
T_3	Buprofezin 25% SC @ 2 ml/lit. all the three sprays	3.375 (2.087)	4.750 (2.396)	2.750 (1.931)	3.875 (2.202)
T_4	*Beauveria bassiana* WP @ 1 g/lit.	2.250 (1.801)	4.875 (2.421)	3.625 (2.150)	4.000 (2.230)
T_5	*Beauveria bassiana* WP @ 2 g/lit.	1.875 (1.694)	5.125 (2.473)	3.250 (2.061)	3.750 (2.171)
T_6	*Beauveria bassiana* WP @ 5 g/lit.	1.750 (1.657)	4.875 (2.419)	2.875 (1.961)	4.000 (2.230)
T_7	Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	1.625 (1.615)	3.625 (2.148)	1.750 (1.650)	2.950 (1.984)
T_8	Thiamethoxam 25 WG @ 0.2g/ lit. all the three sprays	3.125 (2.027)	4.125 (2.261)	2.125 (1.764)	3.050 (2.003)
T_9	Untreated control	4.875 (2.419)	7.750 (2.957)	5.750 (2.596)	10.313 (3.363)
	CD @ 0.05	0.183	0.184	0.218	0.255
	SEm ±	0.062	0.063	0.074	0.087

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

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, Bhubaneswar, 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 - Chlorpyriphos (10 ml/L)

T5 - Treated check (only removal of grubs)

T6 - Untreated check

BAPATLA

The treatments 1-5 indicated above were applied sequentially as and when infested trees were observed. The treatments were applied on the tree trunk and exposed roots after removal of the grubs and cocoons from the infested trees to the extent possible and observation on re-infestation were recorded at monthly intervals.

During 2017-18, among the insecticides evaluated as post extraction prophylaxis, Imidacloprid (swabbing and drenching) @ 2ml/l have offered protection to the tune of 82.60 % trees without re-infestation followed by Fipronil Swabbing 2 ml/l with 73.90 % trees without re-infestation. The other treatments Chlorpyriphos 10 ml/l (treated check) and neem oil 5% (swabbing) has offered 69.6 and 60.90 percent protection without re-infestation and are superior over the control treatment which recorded 39.10 % trees without re-infestation. Preferential zone of attack is stem + collar + root in 30.40 percent of trees (35/115) followed by color+root in 22.60 percent of trees (26/115).

Table 3.20 : Efficacy of insecticides as Post Extraction Prophylaxies (PEP) against cashew stem and root borer at Bapatla centre

Sl. No.	Treatment	Total number of trees treated	No. of trees re-infested	% trees with Re-infestation	% trees without Re-infestation
1.	Fipronil Swabbing (2 ml/l)	23	6	26.1	73.9
2.	Neem oil Swabbing (5%)	23	9	39.1	60.9
3.	Imidacloprid (2 ml/l) (Swabbing and Drenching)	23	4	17.4	82.6
4.	Chlorpyriphos (10 ml/l) (Treated Check)	23	7	30.4	69.6
5.	Untreated check (only removal of CSRB grubs)	23	14	60.9	39.1

Table 3.21 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at Bapatla

Physical parameters		Total trees treated	No. of trees infested after PEP	% out of total trees	No. of trees not reinfested after PEP	% out of total trees
Stem girth	< 60 cm	6	0	0.0	6	100.0
	60-80cm	32	12	37.5	20	62.5
	80-100 cm	57	20	35.1	37	64.9
	>100 cm	20	8	40.0	12	60.0
Total		**115**	**40**	**34.8**	**75**	**65.2**
Age of the tree	< 10 years	10	1	10.0	9	90.0
	10-15 years	25	4	16.0	21	84.0
	>15years	80	35	43.8	45	56.2
Total		**115**	**40**	**34.8**	**75**	**65.2**
Zone of attack	C + R	26	7	26.9	19	73.1
	C + S	20	9	45.0	11	55.0
	R	1	0	0.0	1	100.0
	S	19	3	15.8	16	84.2
	C	14	3	21.4	11	78.6
	C + S + R	35	18	51.4	17	48.6
Total		**115**	**40**	**34.8**	**75**	**65.2**
Yellowing of canopy	Canopy yellowing	8	7	87.5	1	12.5
	Canopy not yellowing	107	33	30.8	74	69.2
Total		**115**	**40**	**34.8**	**75**	**65.2**
% of bark circumference damaged	<25	45	6	13.3	39	86.7
	26-50	37	13	35.1	24	64.9
	51-75	21	12	57.1	9	42.9
	>75	12	9	75.0	3	25.0
Total		**115**	**40**	**34.8**	**75**	**65.2**

BHUBANESWAR

The PEP treatment carried out during 2017-18 in CRS, Bhubaneswar covered a total of 133 nos CSRB affected trees. Among the CSRB species only *Plocaderus ferrugineus* L. was detected affecting cashew plants. Maximum recovery (76.0%) of plant was observed in case chlorpyriphos swabbing (10 ml/l) followed by fipronil swabbing (2ml/l) (75%). In case control i.e. mechanical extraction of CSRB grub only, 38.0 per cent of the plant were recovered from reinfestation. In case of stem girth less than 60cm, reinfestation of treated trees was 40 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 (68.42%) in comparison to other groups. In plants of age group below 5 year percentage there was no reinfestation of CSRB and plants of age group 5-10 years and 10-15 years showed 50.0 and 40.59 per cent of reinfestation. Plants of more than 15 years were however more vulnerable to borer attack. Plants of collar+root+stem of damage were more prone to attack of CSRB (55.55% reinfestation) followed by Root and C+S zone (50%). Yellowing of canopy showed 51.85 per cent reinfestation while not yellowing showed 34.7 % of reattack by the pest. In less than 25 % bark damage the recovery was 100 %. In 25-50 % damage in bark circumference the recovery was less i.e 66.7%.

Table 3.22 : 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)	20	15	11.3
2) Neem oil swabbing (5% suspension)	22	12	9.0
3) Imidacloprid- Swabbing & drenching 2ml/l	23	17	12.8
4) Chlorpyriphos (10ml/l)	25	19	14.3
5) Treated check (only removal of grub)	21	8	06.00
6) Untreated check	22	0	0.0
Total	133	71	Mean: 53.4

Table 3.23 : Physical parameter of CSRB treated tree

Parameters		No. of trees treated	No. of trees reinfested	% reinfested	No. of trees not reinfested	% of trees not reinfested
Stem girth (cm)	< 60 cm	3	0	0	3	4.23
60-80 cm	49	28	45.16	21	29.59	
80-100 cm	74	32	51.61	42	59.15	
>100 cm	7	2	3.23	5	7.04	
Total:	133	62	100	71	10	
Age of tree (yrs)	<5	0	0	0	0	0
5-10	26	7	11.29	19	26.76	
10-15	60	41	66.12	19	26.76	
>15	47	14	22.58	33	46.46	
Total	133	62	100	71	100	

Two way Table (Stem Girth Vs Age of Tree)	Age of Tree					
		<5 years	5-10 Years	10-15 Years	>15 Years	Total
Stem Girth	<60cm	0	3	0	0	**3**
	60-80 cm	0	23	24	2	**49**
	80-100 cm	0	0	36	38	**74**
	>100 cm	0	0	0	7	**7**
	Total:	**0**	**26**	**60**	**47**	**133**
Zone of attack	C+R	16	8	50.0	8	50.0
	C+S	60	24	40.0	36	65.
	R	8	4	50.0	4	60.0
	S	13	6	46.15	7	53.84
	C+S+R	36	20	55.55	16	44.44
	Total	**133**	**62**	**46.61**	**71**	**53.39**
Yellowing of canopy	Yellowed	28	17	51.85	11	39.28
	Not yellowed	105	45	34.7	60	57.14
	Total	**133**	**62**	**44.88**	**71**	**55.12**
% bark circumference damage	<25	29	0	0	29	100
	26-50	32	8	26.67	20	66.67
	51-75	21	12	66.67	6	33.33
	>75	50	37	74.0	17	34.0
	Total	**133**	**62**	**44.88**	**71**	**62.20**

HOGALAGERE

The re-infestation of CSRB were observed in the trees treated with different insecticide treatments during Oct.-Nov., Jan.- Feb. and April – May months. The treatment Fipronil 5% SC (2ml/l) and Chlorpyriphos 20EC (0.2%) swabbing were found most effective treatments against grubs of CSRB with 83.0% and 77.0% trees without re-infestation, respectively. However, the other treatments also maintained their superiority in suppressing the damage by CSRB over untreated control. In treated check, where only grubs extraction was adopted and neem oil 5% suspension swabbing, recorded 38.0% and 46% trees respectively, could be recovered from the re-infestation.

Table 3.24: Efficacy of insecticides as Post Extraction Prophylaxis (PEP) against Cash Stem and Root Borer (CSRB) at HREC, Hogalagere during 2018-19

Sl. No.	Treatment	No. of trees treated	No. of trees without re-infestation	% Recovery from re-infestation
1	Fipronil 5%SC (2ml/l) swabbing (during Oct.-Nov., Jan.- Feb. and April - May)	10	8	83
2	Neem oil swabbing 5% suspension	10	5	46
3	Imidacloprid 17.8 SL @ 2ml/l as swabbing and drenching	10	7	71
4	Chlorpyriphos 20 EC(0.2%) @ 10ml/l	10	8	77
5	Treated check - only removal of CSRB grubs	10	4	38
6	Untreated control	10	3	30
	Total	**60**	**35**	

The incidence of cashew stem and root borer was monitored randomly at fortnightly interval in neglected cashew gardens. The trees with 60-100cm stem girth showed maximum infestation of CSRB (70.00%) and with respect to age of trees, more than 15 years old trees were highly prone to attack of CSRB (80.0%). The zone of CSRB attack was noticed maximum at collar + stem (70.00%) and yellowing of tree canopy was observed in 60.00 per cent of infested trees. The trees with less than 25% bark circumference damage was found to be 55.50% recovery from CSRB damage.

Table 3.25 : Physical parameters of treated cashew trees under Post Extraction Prophylaxis (PEP) trial at HREC, Hogalagere during 2018-19

Physical parameters		No. plants observed after PEP	No. plants re-infested after PEP	% CSRB Preference
Stem girth	< 60 cm	10	3	30
	60-100 cm	10	7	70
	> 100 cm	10	4	40
Total		**N=30**	**N=14**	**-**
Age of the tree	<10 years	10	2	20
	10-15 years	10	3	30
	>15 years	10	8	80
Total		**N=30**	**N=13**	**-**
Zone of attack	C + R	10	2	20
	C + S	10	7	70
	C + S + R	10	5	50
Total		**N=30**	**N=14**	**-**
% of bark circumference damaged	< 25	10	6	60
	26-50	10	3	30
	51-75	10	2	20
	>75	10	1	10
Total		**N=40**	**N=12**	**-**
Yellowing of canopy	Yellowing	10	6	60%
	Not yellowing	10	2	20%
Total		**N=20**	**N=8**	**-**

JAGDALPUR

Table 3.26 : Efficacy of insecticides as Post Extraction Prophylaxis (PEP) against cashew stem and root borer (CSRB) at Jagdalpur centre during the year 2017-18

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	7	11	61.11
T2 : Neem oil swabbing (5%)	18	12	6	33.33

T3 : Imidacloprid (2 ml/l)	18	8	10	55.55
T4 : Chlorpyriphos (10 ml/l)	18	5	12	66.67
T5: Treated check (only removal of CSRB grubs)	18	13	5	27.78
T6 : Untreated check	18	14	4	22.22
Total	**108**	**59**	**49**	**45.37**

The result on efficacy of insecticides (PEP) against cashew stem and root borer (CSRB) revealed that treatment T_4 (Chlorpyriphos @10 ml/l) lead to maximum recovery of 66.67 per cent trees without re-infestations followed by treatment T_1 (Fipronil swabbing @2 ml/l) with 61.11 per cent trees without re-infestations and minimum without re-infestations were recorded in T_5 (Treated check) with 27.78 per cent.

Table 3.27 : Physical parameters of treated cashew trees under Post Extraction Prophylaxis (PEP) trial at Jagdalpur centre during the year 2017-18

Physical parameters		No. of trees treated	No. of trees infested after PEP	% of trees reinfested	No. of trees not reinfested after PEP	% of trees not reinfested
Stem girth	< 60 cm	18	4	22.22	14	77.78
	60-100 cm	69	27	39.13	42	60.87
	> 100 cm	21	13	61.90	8	38.09
Total		**108**	**44**	**40.74**	**64**	**59.26**
Age of the tree	<10 years	0	0	0	0	0.00
	10-15 years	19	8	42.10	11	57.89
	>15 years	89	47	51.68	42	47.19
Total		**108**	**55**	**50.93**	**53**	**49.07**
Zone of attack	C	48	22	45.83	26	54.17
	C+R	18	10	55.55	8	44.44
	C+S	15	7	46.67	8	53.33
	R	4	1	25.00	3	75.00
	S	6	2	33.33	4	66.67
	S+R	5	2	40.00	3	60.00
	C+S+R	12	4	33.33	8	66.67
Total		**108**	**48**	**44.44**	**60**	**55.55**
Yellowing of canopy	Canopy yellowing	15	6	40.00	9	60.00
	Canopy not yellowing	93	35	37.63	58	62.36
Total		**108**	**41**	**37.96**	**67**	**62.03**
% of bark circumference damaged	< 25	20	6	28.57	15	71.42
	26-50	58	33	56.90	20	36.36
	51-75	11	4	36.36	10	58.82
	>75	6	2	33.33	11	73.33
Total		**108**	**52**		**56**	

The physical parameters of different treated trees were recorded and details are given here. 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 51.68 per cent reinfestation. Preferential zones of attack of re-infestations by cashew stem and root bores in the tree was C + R zone with 55.55 per cent followed by C+S and Collar zones with 46.67 and 45.83 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 re-infestation with 56.90 per cent followed by 51-75 per cent bark circumference damage (36.36% re-infestation).

MADAKKATHARA

Among the insecticides tested for post extraction prophylaxis, swabbing and drenching of imidachloprid resulted in recovery of 75% treated trees. And Fipronil swabbing resulted in recovery of 80% trees. Application of healer and sealer

resulted in 60% recovery. Removal of grub resulted in recovery of 50% of treated trees.

Eighty nine percent recovery obtained in trees with fifty percent circumference damage as area increases recovery reduced progressively. Complete recovery was obtained in trees with stem girth below 60 cm and as stem girth increased the recovery reduced to 60-70 percent. If the infestation extends from collar region to root the recovery reduces from 90% to 44% and if in addition it affect the stem also, the recovery reduces to 37%.

Table 3.28 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Madakkathara centre during the year 2017-18

Treatment	Total number of trees treated	No. of trees without reinfestation / persistent attack	% trees without reinfestation / persistent attack
Fipronil swabbing 2ml/l	20	16	80%
Neem oil swabbing 5% (50ml/l)	20	13	65%
imidachloprid swabbing and drenching 2ml/l	20	15	75%
Chlorpyriphos drenching 10 ml/l	20	18	90%
Healer cum Sealer	20	12	60%
Treated check-grub removal only	20	10	50%

Table 3.29 : Physical parameters of treated cashew trees under post extraction prophylaxis trial at Madakkathara Centre during the year 2017-18.

Physical parameters		No. of trees infested after PEP	% out of total trees	No. of trees not re-infested after PEP	% out of total trees
Stem girth	< 60 cm	0	0	2	100
	60-100 cm	5	35.71%	9	64.29%
	> 100 cm	31	29.81%	73	70.19%
Total		**36**		**84**	
Age of the tree	<10 years	-	-	-	-
	10-15 years	2	12.5%	14	87.5%
	>15 years	34	32.69%	70	67.30%
Total		**36**		**84**	
Zone of attack	C + R	9	18%	41	82%
	C + S	5	55.56%	4	44.44%
	C	2	9.52%	19	90.48%
	C + S + R	17	62.96%	10	37.04%
	S	0	0	2	100%
	R	3	27.27%	8	72.73%
Total		**36**		**84**	
Yellowing of canopy	Yellowing	1	25%	3	75%
	no yellowing	35	30.17%	81	69.83%
Total		**36**		**84**	
% of bark circumference damaged	< 25	5	10.42%	43	89.58%
	26-50	4	11.43%	31	88.57%
	51-75	4	36.36%	7	63.64%
	>75	23	88..46%	3	11.54%
Total		**36**		**84**	

VENGURLE

Year of experimentation	:	2017-18
Design	:	CRD
Treatments	:	The experiment was conducted with following six treatments
		T1 - Fipronil swabbing 2ml/lit
		T2 - Neem oil swabbing 5%
		T3 - Imidachloprid swabbing and dranching 2ml/lit
		T4 - Chlorpyriphos 10ml/lit
		T5 - Treated check (only removal of grub)
		T6 - Untreated check

Table 3.30 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Vengurle centre during the year 2017-18

Treatment	Total number of trees treated	No. of trees without reinfestation / persistent attack	% trees without reinfestation/ persistent attack
Fipronil swabbing 2ml/lit	20	19	95
Neem oil swabbing 5%	20	15	75
Imidachloprid swabbing and dranching 2ml/lit	20	16	80
Chlorpyriphos 10ml/lit	20	18	90
Treated check (only removal of grub)	20	10	50
Untreated check	20	5	25

The results indicated that the treatment T_1 (Fipronil swabbing 2ml/lit) recorded 95.00 per cent trees without reinfestation followed by treatment T_4 Chlorpyriphos (0.2%) 90.00 per cent trees without reinfestation. Reinfestation was more in Control (T_6) 25.00 percent trees.

Table 3.31 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at Vengurle Centre during the year 2017-18

Physical parameters		No. of trees infested after PEP	% out of total trees	No. of trees not reinfested after PEP	% out of total trees
Stem girth	< 60 cm	7	5.83	25	21.67
	60-100 cm	10	8.33	40	33.33
	> 100 cm	20	16.67	7	14.17
Total		**37**	**30.83**	**83**	**69.17**
Age of the tree	<10 years	7	5.83	26	21.67
	10-15 years	15	12.5	45	37.5
	>15 years	15	12.5	12	10.0
Total		**37**	**30.83**	**83**	**69.17**
Zone of attack	C + R	9	7.5	53	44.17
	C + S	18	15.0	16	13.33
	C + S + R	10	8.33	14	11.67
Total		**37**	**30.83**	**83**	**69.17**
Yellowing of canopy	Canopy yellowing	2	1.67	-	-
	Canopy not yellowing	35	29.16	83	69.17
Total		**37**	**30.83**	**83**	**69.17**
% of bark circumference damaged	< 25	2	1.67	55	45.83
	26-50	10	8.33	20	16.67
	51-75	10	8.33	3	2.50
	>75	15	12.5	5	4.17
Total		**37**	**30.83**	**83**	**69.17**

During the year 2017-18 total 120 tree were treated for cashew stem and root borer management. The tree having the stem girth >100 cm were more prone to CSRB damage. Regarding age of tree, the tree with more than 15 year of age were more prone to CSRB infestation. Whereas, the tree having the age of 10-15 year recorded less infestation of cashew stem and root borer. In case of zone of attack the collar+ stem recorded more infestation of stem and root borer where as it was minimum in collar + root. Bark circumference damaged the bark removed >75 percent showed more number of tree infested where as the bark removed >25 percent showed more tree without re-infestation after the removal of grub.

VRIDHACHALAM

Higher recovery of 70.58% was observed in chlorpyriphos 20 EC @10 ml/lit. of water as swabbing and drenching of CSRB infested trees as against mere recovery of 5.55 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 51.61 and 46.15% recovery respectively as against nil recovery in untreated check. The overall results indicate that chlorpyriphos recorded higher recovery, followed by Fipronil and Imidachloprid which are at par in reducing the CSRB infestation, with an average cost of protection of Rs.85/-, Rs.93/- and Rs.96/- respectively.

Table 3.32 : 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	31	16	51.61[b]	3	93.00
T_2	Neem Oil suspension 5% Suspension Swabbing and Drenching	24	8	33.33[c]	3	77.00
T_3	Imidachloprid 17.8 SL Swabbing and Drenching @ 2ml/lit	26	12	46.15[b]	3	96.00
T_4	Chlorpyriphos 20 EC @ 10ml / lit. Swabbing and Drenching	34	24	70.58[a]	3	85.00
T_5	Treated check (only removal of CSRB grubs followed)	18	1	5.55[d]	3	50.00
T_6	Untreated check	23	-	-	-	-
	Total	**156**	**61**			

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 (83.33%) were more prone to the attack of CSRB infestation. Comparing the age of the cashew infested trees, more than 15 - year old cashew trees (69.33%) 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 73.92, 70.27 and 61.77 per cent re- infested trees respectively. Yellowing of canopy showed 91.54 per cent re-infestation. Trees with less than 25 per cent bark circumference damage had maximum re-infestation with 71.62 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.

Table 3.33 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) curative trial observed at Vridhachalam

Physical Parameters		Total no. of trees treated	No.of trees reinfested	% of trees reinfested	No. of trees not reinfested	% of trees not reinfested
Stem girth	< 60 cm	12	4	33.33	8	66.66
	60-80 cm	69	45	65.22	24	34.78
	80-100 cm	36	30	83.33	6	16.67
	>100 cm	39	16	41.03	23	58.97
Total		**156**	**95**		**61**	
Age of the tree	< 10 years	0	0			
	10-15 years	81	43	53.09	38	34.57
	>15 years	75	52	69.33	23	30.67
Total		**156**	**95**		**61**	
Zone of attack	Collar+Root	46	34	73.92	12	26.09
	Collar+Stem	34	21	61.77	13	38.24
	Root	8	0	0	8	100.00
	Stem	13	7	53.85	6	46.15
	Collar	14	7	50.00	7	50.00
	Stem+Root	4	0	0	4	100.00
	Collar+Stem+Root	37	26	70.27	11	29.73
Total		**156**	**95**		**61**	
Yellowing of canopy	Canopy yellowing	71	65	91.54	6	8.45
	Canopy not yellowing	85	30	35.29	55	58.82
Total		**156**	**95**		**61**	
% of bark circumference damaged	< 25	74	53	71.62	21	28.38
	26-50	59	35	59.32	24	40.68
	51-75	23	7	30.00	16	69.57
	> 75	0	0	0	0	0
Total		**156**	**95**		**61**	

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

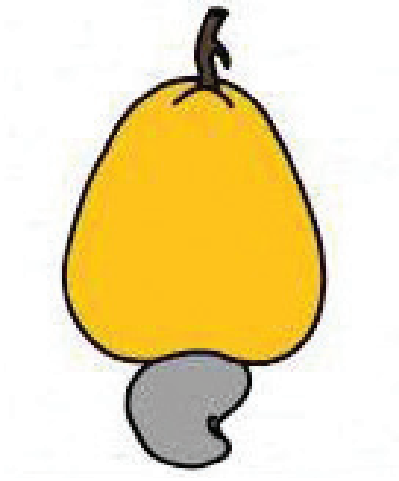
Centres:

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

Trees were selected randomly in the cashew plantations visited in the surrounding areas of Bapatla and in certain villages of Prakasam and the different pests occurring and their intensities were recorded. Collection of pest infested samples at weekly intervals and maintaining in the laboratory for observation of emergence of parasitoids. The data on pest incidence from 12 selected and unprotected trees in Cashew Research Station, Bapatla was recorded at weekly intervals from 52 leader shoots of each tree from all the four sides.

During 2017-18 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 28 standard weeks to Multiple Linear Regression Analysis. Relationship of per cent leaf and blossom webber damaged shoots with selected weather variables was subjected to multiple regression analysis. Results revealed that all weather variables together in question accounted for 23.11 per cent variation in per cent shoot damage by leaf and blossom webber (R^2 = 0.2311). However none of the variables was found to influence the damage by LBW independently. Relationship of per cent leaf damage caused by leaf miner with selected weather variables was subjected to multiple regression analysis. Results revealed that none of the variables were found to influence the damage by LBW independently.

With regard to leaf folder damaged leaves with selected weather variables was subjected to multiple regression analysis. Results revealed that all weather variables together in question accounted for 38.58 per cent variation in per cent leaf damage by leaf folder (R^2 = 0.3858). However none of the variables was found to influence the damage by leaf folder independently. Shoot tip caterpillar population showed significant positive correlation with Relative Humidity (m) (X_3) and remaining weather variables were found to influence the damage by shoot tip caterpillar independently and all five independent

variables have accounted for 31.76 percent of total variation in percent shoot damage by shoot tip caterpillar (R^2=0.3176).

Finally, with regard to Apple and nut borer all five independent variables have accounted for 46.28% of total variation in percent nut damage by Apple and nut borer (ANB) (R^2=0.4628). The data indicated that none of the variables were found to influence the damage by apple and nut borer independently.

Table 3.34 : 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	-0.12	-0.12	-0.79	0.68	1.58
X_2-Minimum Temp	0.02	0.02	0.28	-0.16	-0.32
X_3-RH (m)	0.00	0.02	0.04	0.16*	0.13
X_4-RH (e)	0.02	-0.03	-0.06	0.01	0.23
X_5-Rain fall	0.01	0.00	0.03	-0.02	0.02
R^2 Value	0.23	0.31	0.39	0.32	0.46
% Variation	23.11	31.02	38.58	31.76	46.28

BHUBANESWAR

The weather data collected during the crop period i.e. vegetative phase and reproductive phase of Cashew presented here. The rainy season started from 1st fortnight of July continued end of 2nd fortnight of October. There was well distribution of rainfall during July-October. The total of 590 mm rainfall was received during the period of observation. Highest rainfall was received during 1st fortnight August. However, there was occurrence of rain during April 2018 (45.4 mm) and 2nd fortnight of April (12.5 mm).

The maximum temperature ranged between 23.3°C to 37.1°C with highest temperature of 37.1°C was experienced during 2nd fortnight of March 2018. Similarly the minimum temperature ranged between 11.8°C to 32.5°C and tempature remained in the month of December and January. With respect to sunshine hours, it varied from 2.05 to 7.8. Minimum sunshine hour was observed during 1st fortnight of February while it was maximum during November to February (more than 7.5).

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 December. Highest incidence of 16.4 percent damage shoot was observed during 1st fortnight of November. Leaf miner infestation was observed between 2nd fortnights of August to 2nd fortnight of November. Highest infestation (16.1% damaged leaf) was observed during 2nd fortnight of October. Incidence of leaf folder was observed between 2nd fortnight of August to 2nd fortnight of November. Highest incidence of 15.5 percent leaf damage was recorded during October. Infestation of foliage thrips (Red banded thrips) was commenced from 1st fortnight of November and maximum 22.5

thrips per leaf was observed in vegetative phase. The population of foliage thrips then decreased to 8.5 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 in the month of March and April 2018. The TMB infestation was very low (1.5 – 1.9) 0-4 scale during the period.

The infestation of STC commenced during 2nd fortnight of February and continued April 2nd fortnight. Maximum incidence of 12.3 per cent shoot damage occurred during 2nd fortnight of April. The population gradually declined and disappeared after wards. Leaf miner infestation started during 2nd fortnight of January with 14.05 percent leaf damage and maximum 16.0 percent and during 1st fortnight of February. Leaf folder infestation was observed during 1st fortnight of March and April with maximum 14.5% damaged leaf.

The population of red banded thrips continued upto end of April and maximum 70 per leaf observed during March 18. Flowering thrips (yellow and black) occurred in the flowering and fruiting period with average 7.3 thrips per inflorescence. Other insect pests like ashy weevil, leaf beetle were during the observation. The predatory population viz., coccinelid beetle and spiders were present in both vegetative and reproductive phases.

Table 3.35 : Pest Distribution in Cashew Plantation, 2017-18 at Bhubaneswar

	THRIPS										
PERIOD	STC	LM	LF	LW	FOLIAGE (Red Banded)	FLOWERING	TMB	OTHERS	ANT	COCCINELIDS	SPIDER
(VEGETATIVE PHASE)											
JULY-I	0	0	0	0	0	0	0	0	0	0	0
JULY-II	0	0	0	0	0	0	0	0	0	0	0
AUG-I	0	0	0	0	0	0	0	1.1	0	0	0
AUG-II	8.6	6.54	6.33	0	0	0	0	0	0	0	0
SEPT-I	9.4	12.15	10.23	0.62	0	0	0	1.8	0	2.3	0
SEPT-II	10.7	16.4	12.19	0.3	0	0	0	1.6	0	1.4	1.5
OCT-I	10.3	24.5	13.24	1.2	0	0	0	1.5	0	2.0	2.2
OCT-II	14.5	16.08	15.52	2.33	0	0	0	2.5	0	2.2	1.4
NOV-I	16.4	13.78	11.43	2.7	07.4	0	0	2.0	0	2.0	1.4
NOV-II	6.7	6.4	7.6	0	22.5	0	0	1.2	0	2.6	2.4
DEC-I	2.5	0	0	0	12.2	0	0	1.3	0	1.3	2.7
DEC-II	0	0	0	0	8.6	0	0	0	1.2	0.3	1.7
(REPRODUCTIVE PHASE)											
JAN-I	0	0	0	0	7.5	2.4	0	0	1.3	1.4	1.3
JAN-II	0	14.05	0	0	5.3	2.7	0	0	1.2	1.2	0.5
FEB-I	0	16.68	0	0	22.6	2.2	0	1.7	1.8	0.8	0.7
FEB-II	4.50	15.77	0	0	65.63	2.5	0	1.3	1.6	1.7	0.5
MAR-I	8.5	5.38	11.55	0	65.6	5.6	1.5	1.5	1.8	2.5	1.7
MAR-II	12.3	4.86	14.26	0	70.5	7.3	1.6	1.5	3.4	2.7	2.3
APRIL-I	7.55	0	6.32	0	45.4	2.2	1.9	1.7	3.8	3.4	3.2
APRIL-II	3.30	0	0	0	32.5	0	1.6	1.5	3.3	2.2	2.2

Table 3.36 : Correlation with weather parameters at Bhubaneswar

Weather Parameters	STC	LM	LF	Red banded thrips	TMB	COCCINELIDS
Temperature (Max)	0.39	0.07	0.13	0.391	0.83*	0.21
Temperature (Min)	0.46	0.02	0.30	-0.21	-0.03	-0.16
RH (morn)	0.05	0.21	0.12	-0.37	-0.49	-0.36
RH (even)	0.23	-0.00	0.19	-0.67	0.77*	-0.40
Rain Fall (mm)	0.20	0.07	-0.00	-0.58*	0.54	-0.57*
BSH	-0.38	0.54*	0.03	0.03	0.99	0.32
R	**0.76**	**0.81**	**0.74**	**0.75**	**0.75**	**0.80**

STC- Shoot tip caterpillar, LM-Leaf Miner, LF- Leaf folder, TMB- Tea Mosquito bug

Shoot tip caterpillar incidence positively correlated with all the weather parameters except BSH but none of the correlation was found significant. Similarly leaf miner was positively correlated with all the weather parameters excepting RH (evening). Leaf folders incidence was also positively correlated with all the weather factors. In case of red banded thrips the incidence was negatively correlated with temperature (minimum), RH (morning and evening) and rainfall. TMB incidence was observed for a very short period. It was significantly correlated with Temperature Maximum, RH even and BSH.

HOGALAGERE

A total of six 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. Presently apple and nut borer are also noticed in the region.

Table 3.37: Influence of abiotic factors on the activity of pest complex of cashew during 2018-19 at Hogalagere

Sl. No.	Common Name	Month of Occurrence	Intensity
	Insect pests		
1	Tea mosquito	October - March	Moderate to high
2	Stem and root borer	Throughout the year	Moderate
3	Inflorescence thrips	March - April	Low
4	Fruit and nut borer	April - May	Low to moderate
5	Aphids	November – May	Low
6	Mealy bug	March - May	Low
	Predators		
1	*Oxypes sweta*	Oct - Mar.	Low to moderate
2	*Menochilus sexmaculatus*	Feb.-May	Low to moderate

The correlation between pest incidence and weather parameters revealed that morning relative humidity (+0.45) and evening relative humidity (+0.21) had a positive correlation with the activity of TMB, but highly significant negative correlation was established with maximum temperature (-0.74) and significant negative correlation with minimum temperature (-0.61). The activity of CSRB was observed throughout the year but its peak activity was noticed during December, April and May. The morning relative humidity (+0.46) and evening relative humidity (+0.41) had positive correlation with the incidence of the pest and negative correlation was noticed with rest of the parameters.

Apple and nut borer had significant positive correlation with maximum temperature and evening relative humidity (+0.59 & +0.56) and negative correlation with rest of the weather parameters. The infestation of thrips showed significant positive correlation with maximum temperature (+0.58) and highly significant negative correlation with minimum temperature (-0.86), number of rainy days (-0.73) and significant negative correlation with rainfall (-0.62). The aphid infestation had a positive correlation with maximum temperature (+0.40) and highly significant negative correlation with rainfall (-0.98), number of rainy days (-0.67) and significant negative correlation with minimum temperature (-0.54).

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

Table 3.38: Correlation of weather parameters and different insect pests recorded on cashew during 2018-19

Weather Parameters	Correlation coefficient ('r' values)				
	TMB	CSRB	ANB	Thrips	Aphids
X_1 - Maximum Temp	-0.74**	-0.47	+0.59*	+0.58*	+0.40
X_2 - Minimum Temp	-0.61*	-0.04	+0.56*	-0.86**	-0.54*
X_3 - RH (m)	+0.45	+0.46	-0.06	-0.48	-0.39
X_4 - RH (e)	+0.21	+0.41	-0.03	-0.18	-0.41
X_5 - Rainfall	-0.08	-0.10	+0.24	-0.62*	-0.98**
X_6 - No. of rainy days	-0.15	-0.14	+0.28	-0.73**	-0.67**

* Significant at 0.05 level
TMB -Tea mosquito bug; CSRB - Cashew stem & root borer; ANB - Apple & nut borer

JAGDALPUR

Table 3.39: Influence of abiotic factors on the activity of pest complex of cashew at Jagdalpur centre during the year 2017-18

Weather Parameters	Shoot TMB	Panicle TMB	Leaf folder	Leaf caterpillar	Leaf miner	Thrips D.L. score
X_1 - Maximum Temp	**0.622**	-0.076	-0.132	-0.534	-0.167	0.250
X_2 - Minimum Temp	0.304	0.548	0.028	**-0.710**	**-0.696**	**-0.641**
X_3 - RH (m)	-0.750	0.308	-0.187	0.346	**0.637**	**-0.700**
X_4 - RH (e)	-0.155	**0.887**	-0.099	**-0.577**	-0.300	**-0.649**
X_5 - Rainfall	-0.188	0.932	0.048	-0.467	-0.300	0.033
X_6 - Wind velocity	0.510	0.245	0.103	**-0.553**	-0.567	-0.422

Maximum incidence of the pest was observed during new growth of flush and flowering. The maximum significant positive correlation (r = 0.622) was observed between shoot TMB and maximum temperature while, a significant negative correlation was recorded between relative humidity evening (r = -0.750) and shoot TMB. In case of leaf caterpillar, significant negative correlation (r = - 0.710) was recorded with minimum temperature and relative humidity (evening) with (r = - 0.577). Leaf folder showed negative correlation with maximum temperature (-0.132), relative humidity (m) (-0.187)

and relative humidity (e) (-0.099), similarly positive correlation showed with wind velocity (0.103). Leaf miner population showed significant negative correlation with minimum temperature (r = -0.696). Where, relative humidity (morning) was significant positively (r = 0.637) influenced the leaf minor population. Population of thrips leaf damage score was significant negative influence correlation with minimum temperature (r = - 0.641), morning relative humidity (r = -0.700) and evening relative humidity (-0.649).

MADAKKATHARA

Natural enemies recorded in cashew ecosystem are given here under. The common natural enemies were red ant, black ant and spiders. The pollination observed was mainly by honey bee.

TMB infestation on shoots

TMB Adult

CSRB Adult

Seasonal occurrence of insect pest and natural enemies

Monitoring of pests and natural enemies of cashew throughout the season from April 2017 to March 2018 was done.

Table 3.40: Seasonal occurrence of pests at Madakkathara centre during 2017-18

Season	Tea mosquito bug (damage score)	Leaf miner (%infestation)	Apple & nut Borer (% infestation)	Caterpillar (% infestation)	Thrips (damage score)
April	0.00	0.00	0.00	0.00	0.00
May	0.00	0.00	0.00	0.00	0.00
June	0.00	0.00	0.00	0.14	0.00
July	0.00	0.00	0.00	0.25	0.00
August	0.01	0.00	0.00	0.00	0.00
September	0.00	0.00	0.00	0.00	0.00
October	0.00	0.00	0.00	0.00	0.00
November	0.05	0.13	0.00	0.00	0.01
December	0.50	0.37	0.00	0.00	0.04
January	0.27	0.09	0.04	0.00	0.11
February	0.06	0.00	0.00	0.00	0.07
March	0.02	0.00	0.00	0.03	0.05

The tea mosquito bug population suddenly increased in the month of November and reached peak in December and during this period there was decline in red ant population. Following the flushing stage negligible incidence of leaf miner recorded from November to January. In January, slight damage of apple and nut borer Thylcoptila paurosema recorded. Bio ecological observations on thrips revealed it present only during October to March and were negligible with a maximum score of 0.116, during the month of January.

The red ant population was high during April-June and tea mosquito bug population appeared from June to August. Red ant was present throughout with peaks in the months of May, June and October. Black ant also found throughout the season with peaks in June and July. Spider population reached peak in July.The activity of stingless honey bee was high in December.

Table 3.41: Seasonal occurrence of natural enemies at Madakkathara centre during 2017-18

Season	Red ant	Black ant	Spider
April	25.00	6.66	0.09
May	39.16	5.47	0.44
June	34.27	8.69	0.25
July	3.25	6.47	2.06
August	26.60	3.53	1.93
September	0.03	3.75	1.25
October	14.06	2.25	1.28
November	0.65	2.27	0.6
December	1.03	2.13	0.53
January	0.21	1.19	0.63
February	0.00	1.63	0.63
March	0.69	1.84	0.69

Influence of abiotic factors

The correlation analysis between tea mosquito bug damage and second previous week weather factors revealed strong negative correlation with minimum temperature, RH (morning) and rate of evaporation in all varieties. The number of raining days showed positive correlation with Tea mosquito damage.

Table 3.42: Influence of abiotic factors on the activity of pest complex of cashew at Madakkathara centre during the year 2017-18

Weather Parameters	Tea mosquito bug			
Varieties	Anakkayam-1	Madakkathara-1	Kanaka	Dhana
X_1 - Maximum Temp	0.04	0.14	0.13	0.07
X_2 - Minimum Temp	-0.61*	-0.63*	-0.55*	-0.49**
X_3 - RH (m)	-0.43**	-0.60*	-0.57*	-0.39
X_4 - RH (e)	-0.36	-0.51*	-0.47**	-0.34
X_5 - Rainfall	0.34	0.42**	0.35	0.24
X_6 - No. of rainy days	0.51*	0.59*	0.46**	0.32
X_7 - Bright sunshine hours	0.28	0.38	0.30	0.19
X_8 - Wind velocity	-0.29	-0.37	-0.37	-0.31
X_9 - Rate of evaporation	-0.42**	-0.53*	-0.52*	-0.44**

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

Weather Parameters	Tea mosquito bug			
Varieties	Anakkayam-1	Madakkathara-1	Kanaka	Dhana
X_1 - Maximum Temp	0.04	0.14	0.13	0.07
X_2 - Minimum Temp	-0.61*	-0.63*	-0.55*	-0.49**
X_3 - RH (m)	-0.43**	-0.60*	-0.57*	-0.39
X_4 - RH (e)	-0.36	-0.51*	-0.47**	-0.34
X_5 - Rain fall	0.34	0.42**	0.35	0.24
X_6 - No. of rainy days	0.51*	0.59*	0.46**	0.32
X_7 - Bright sunshine hours	0.28	0.38	0.30	0.19
X_8 - Wind velocity	-0.29	-0.37	-0.37	-0.31
X_9 - Rate of evaporation	-0.42**	-0.53*	-0.52*	-0.44**

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

Regression analysis between abiotic biotic factors and weather parameters are given in Table. As independent variables are highly correlated, simple regression is performed.

Table 3.43 : Regression analysis between Biotic factors and Weather parameters during 2017-18 at Madakkathara

Weather Parameters	TMB	THRIPS
X_1 - Maximum Temp	**-0.26***	0.06
X_2 - Minimum Temp	-0.22	**0.01****
X_3 - RH (m)	**-0.02***	**0.03***
X_4 - RH (e)	**-0.01****	0.43
X_5 - RH (avg)	**-0.03***	0.00
X_6 - Rainfall	-0.00	0.61
X_7 - No. of rainy days	-0.09	0.25
X_8 - Bright sunshine hours	0.08	0.33
X_9 - Wind velocity	0.11	0.85
X_{10} - Rate of evaporation	0.13	0.75

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

Sl. No.	Biotic factors	Regression equation	R^2
1.	TMB population	$Y=10.77+(-0.2)x_1+(-0.03)x_2+0.08x_3+(-0.0016)x_4+(-0.015)x_5+(-0.022)x_6+(-0.99)x_7+(0.066)x_8+(0.12)x_9+(0.13)x_{10}$	0.50
2.	Thrips	$Y=0.59+0.000921+(-0.01046)x_2+-0.00518x_3+(0.0015)x_4+(-0.00.51)x_5+(-0.0016)x_7+(-0.13)x_8+(-0.009)x_9+(-0.005)x_{10}$	0.48

PARIA

There was very low incidence of insect-pest observed during the season of cashew. So, the population of the insect-pest could not be correlated with weather parameters and thus the experiment could not be summarised.

VENGURLE

The data revealed that in the year 2017-18 the TMB incidence shows negative significant correlation with minimum temperature (r=-0.708) and negative correlation with evening humidity and rainfall (-0.346) (-0.251) respectively. The incidence of TMB shows positive correlation with maximum temperature and morning humidity (r=0.019) (0.281) respectively.

The incidence of thrips showed negative significant correlation with minimum temperature (r=-0.826) and negative correlation with evening humidity and rain fall (r=0.483), (r=0.344) respectively and positive correlation with maximum temperature and morning humidity (r=0.210), (0.143) respectively.

In the year 2017-18 the incidence of Apple and Nut borer showed negative correlation with minimum temperature evening and morning humidity and rain fall (r=0.457), (r=0.107), (-0.315), (-0.177) respectively and positive correlation with maximum temperature (r=0.267).

Table 3.44 : Influence of abiotic factors on the activity of pest complex of cashew at Vengurle centre during the year 2017-18

Weather Parameters	TMB	THRIPS	ABN
X_1 - Maximum Temp	0.01	0.21	0.26
X_2 - Minimum Temp	-0.70*	-0.82*	-0.45
X_3 - RH (m)	0.28	0.14	-0.10
X_4 - RH (e)	-0.34	-0.48	-0.31
X_5 - Rain fall	-0.25	-0.34	-0.17

* - Significant at 5% level of significance
r = 0.57 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.

During the year (from June 2017 to September 2018), the relation between the 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) and the natural enemies viz., population of spiders (Y9), ants (Y10), coccinellids (Y11), braconids (Y12) and wasp (Y13) and weather variables such as Minimum temperature (°C) (X1), Maximum temperature (°C) (X2), Relative Humidity (Morning%) (X3), Relative Humidity (Evening %) (X4), Rainfall (X5), Rainy days (X6), Wind speed (Km/hr) (X7) and sunshine (hours) (X8). The seasonal incidence and correlation coefficient of insect- pests in Cuddalore district are presented in Table.

The incidence of TMB was confined from flushing to fruiting season. Its activity was observed from first week of February 2018 to third week of April 2018. Maximum TMB damage was observed during the second week of March with mean damage score ranging between 1.7 and 3.8. 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 2.8% leaf damage during first fortnight of February 2018. Cashew leaf folder was also observed from August 2017 - March 2018 with 3.1% to 6.6% leaf damage observed in young plantations. Maximum damage was noticed during August 2018. Whereas, Leaf and blossom webber damage was observed maximum during June 2017 and 2018.Cashew Leaf thrips population (8.8) was noticed in April 2018.Leaf folder damage (6.6%) was observed during August - 2017 and 6.35% during August-2018. However, shoot tip caterpillar was observed during January to February - 2018. The CSRB damage (31-35%) was prevailing throughout the season but maximum was recorded during July to August 2018.

Table 3.45 : 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)
Minimum temperature (°C) (X_1)	0.20	0.57*	0.65**	- 0.10	- 0.27	0.39	- 0.61*	0.53**
Maximum temperature (°C) (X_2)	0.52*	0.60*	0..61*	0.37	0.20	0.34	- 0.37	0.64**
Relative Humidity (Morning %) (X_3)	0.11	- 0.54*	- 0.74**	0.35	0.40	- 0.30	0.42	- 0.55*
Relative Humidity (Evening %) (X_4)	- 0.77**	- 0.08	- 0.15	- 0.61*	- 0.37	0.15	0.26	- 0.16
Rainfall (X_5)	- 0.74**	-0.04	0.03	- 0.63**	- 0.35	0.06	- 0.34	- 0.19
Rainy days (X_6)	- 0.68**	0.07	0.05	- 0.61*	- 0.39	0.18	- 0.35	- 0.1
Wind speed (Km/hr.) (X_7)	0.21	- 0.48	- 0.26	0.00	0.00	0.00	0.16	- 0.27
sunshine (hours) (X_8)	0.60**	0.27	0.22	0.76	0.60*	- 0.17	0.05	0.11

*significant at 1% level; **significant at 5% level

Table 3.46 : 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)
Minimum temperature (°C) (X1)	0.30	-0.14	0.00	-0.03	0.12
Maximum temperature (°C) (X2)	0.36	-0.33	-0.29	-0.15	0.11
Relative Humidity (Morning %) (X3)	-0.24	0.12	0.02	-0.26	-0.06
Relative Humidity (Evening %) (X4)	-0.18	0.61*	0.46	0.23	0.12
Rainfall (X5)	-0.12	-0.50*	0.62**	0.41	0.18
Rainy days (X6)	-0.15	0.38	0.52*	0.34	0.22
Wind speed (Km/hr.) (X7)	-0.44	-0.22	-0.15	-0.09	-0.42
sunshine (hours) (X8)	0.08	-0.37	-0.69	-0.27	0.07

*significant at 1% level; **significant at 5% level

Correlation studies revealed that sunshine (hours) and maximum temperature (°C) were significant and positively correlated with the TMB population. Relative Humidity (Evening %), Rainfall and Rainy days were significant and negatively correlated with TMB population. Rainfall had significant negatively correlated with Leaf and blossom webber (LBW) per cent damage. The incidence of Leaf and blossom webber, Leaf Miner (LM) and Cashew stem and root borer (CSRB) were significantly positively correlated with minimum temperature while incidence of shoot tip caterpillar was negatively correlated to it. Maximum temperature had positive significant correlation with incidence of Tea mosquito bug population, Leaf and blossom webber per cent damage, Leaf Miner per cent damage and Cashew stem and root borer per cent damage. The population of LBW, LM and CSRB significantly decreased with morning RH whereas that of TMB and leaf thrips decreased significantly with evening RH.

Population of apple and nut borer was significantly and positively correlated with sunshine hours. With reference to the influence of weather factors with the occurrence of natural enemies, rainfall and rainy days were found to be significantly increasing the coccinellid population, whereas, rainfall and wind speed were significant and negatively correlated with the population of ants.

Based on the regression analysis by taking pest population, damage per cent and population of natural enemies (Y) as a dependent variable and weather parameters (X) as independent variables following equations were fitted for season June 2017 to September 2018. The regression equation indicated that a decrease in 1°C of maximum temperature reduced the TMB population by 0.1 per 52 Leader shoots. Similarly, evening Relative humidity, Rainfall also reduced TMB population by 0.1 and 0.002, respectively per 52 Leader shoots. But, increase in 1 km/hr of wind speed decreases the TMB population. Increase in Rainfall reduces the Leaf and blossom webber damage to 0.01%. Increase in rainy days decreased Leaf miner damage and the leaf thrips population (1 No.). Decrease in sun shine hours decreases apple and nut borer infestation to 0.1% and the CSRB damage to 5%.

The multiple regression equations were developed for predicting the pests and natural enemies of cashew by using regression models. by using regression models and the coefficient of determination (R2) indicated that pests observed viz., 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) were predicted to an extent of 93, 67, 76, 91, 82, 66, 62 and 74 per cent respectively. Similarly, for the natural enemies viz., population of spiders (Y9), ants (Y10), coccinellids (Y11), braconids (Y12) and wasp (Y13) were predicted to an extent of 38, 56, 84, 48 and 35 per cent respectively.

Table 3.47 : Regression analysis between pests of cashew and weather parameters during June - 2017 and September - 2018 at Vridhachalam

S. No.	Biotic factors	Regression equation	R^2
1.	TMB Population (Y_1)	Y1= -5.33 + 0.1 (X1)+ (-0.1) (X2) +(0.1) (X3)+(- 0.1) (X4) + (-0.002)X5)+(- 0.1) (X6) + 0.2 (X7) + (-0.02) (X8)	0.93**
2.	Leaf and blossom webber (% damage) (Y_2)	Y2= -42.80 + 0.2 (X1) + 1.0 (X2) +(- 0.05) (X3) + 0.2 (X4) + (-0.01) (X5)+0.1 (X6) +(- 1.0) (X7) +1.0 (X8)	0.67
3.	Leaf miner (% damage) (Y_3)	Y3= 0.83+ 0.03 (X1) + 0.4 (X2) + (-0.3) (X3) +0.1 (X4) + 0.01 (X5) + (-0.03) (X6) +0.4 (X7) + 0.4 (X8)	0.76
4.	Leaf thrips Population (Y_4)	Y4= -25.73 + (-1) (X1) +1 (X2) + 0.3 (X3) +(- 0.2) (X4) + 0.003 (X5) +(-0.04) (X6) + 0.1 (X7) + 0.4 (X8)	0.91**
5.	Apple and nut borer (% damage) (Y_5)	Y5= -25.86 +(-2) (X1) + 2 (X2) + 0.2 (X3) + 0.1 (X4) + 0.02 (X5) + 0.1 (X6) + 0.4 (X7) +(-0.1) (X8)	0.82**
6.	Leaf folder (% damage) (Y_6)	Y6= -36.74 +(- 2) (X1) + 2 (X2)+(- 0.03) (X3) + 0.1 (X4) + (- 0.0004) (X5) + 0.5 (X6) +1 (X7) + (-2) (X8)	0.66
7.	Shoot tip caterpillar (% damage) (Y_7)	Y7= 19.51 +(0.02) (X1) +(- 1) (X2)+(- 0.1) (X3) +0.1 (X4)+ (- 0.01) (X5) + (-0.1) (X6) +0.01 (X7) + 0.2 (X8)	0.62
8.	CSRB (% damage) (Y_8)	Y8= -44.79 +(- 6) (X1) + 8 (X2) +(- 1) (X3) +0.1 (X4) + (0.01) (X5) + 0.5 (X6) + 1 (X7) +(- 5) (X8)	0.74

*significant at 1% level; **significant at 5% level

Minimum temperature (°C) (X1), Maximum temperature (°C) (X2), Relative Humidity (Morning %) (X3), Relative Humidity (Evening %) (X4), Rainfall (X5), Rainy days (X6), Wind speed (Km/hr.) (X7) and Sunshine (hours) (X8)

Table 3.4 : Regression analysis between natural enemies of cashew and weather parameters during June - 2017 and September - 2018 at Vridhachalam

S. No.	Biotic factors	Regression equation	R^2
1.	Spiders (Y9)	Y9= (-1.34) +(- 0.03) (X1) +(0.2) (X2) + 0.04 (X3) +(- 0.01) (X4)+ (- 0.002) (X5) + 0.01 (X6)+(- 0.3) (X7) + (-0.2) (X8)	0.38
2.	Ants (Y10)	Y10= -22.31 + 1 (X1) + (-0.4) (X2) + 0.2 (X3) + 0.2 (X4) + 0.01 (X5) + (-0.1) (X6) +(- 1) (X7) +0.3 (X8)	
3.	Coccinellids (Y11)	Y11= -2.54 + (-0.2) (X1) + 0.3 (X2)+0.04 (X3) + (-0.01) (X4) + 0.002 (X5) +(0.1) (X6) + (-0.2) (X7) +(- 0.4) (X8)	0.84*
4.	Braconids (Y12)	Y12= -4.55 + (-0.05) (X1) +0.1 (X2) + 0.04 (X3) +(- 0.003) (X4) + 0.001 (X5) +0.02 (X6) + (-0.1) (X7) + (- 0.1) (X8)	0.48
5.	Wasp(Y13)	Y(13)= -9.59 + 0.1 (X1) +0.1 (X2) + 0.1 (X3) + 0.02 (X4) + (- 0.0001) (X5) + 0.1 (X6) +(- 0.4) (X7) + 0.1 (X8)	0.35

*significant at 1% level; **significant at 5% level

Minimum temperature (°C) (X1), Maximum temperature (°C) (X2), Relative Humidity (Morning %) (X3), Relative Humidity (Evening %) (X4), Rainfall (X5), Rainy days (X6), Wind speed (Km/hr.) (X7) and Sunshine (hours) (X8)

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

Centres:

East Coast : 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, among the 39 accessions screened to identify the tolerant lines against the pests of cashew, BLA 139-1 has recorded with highest incidence of leaf and blossom webber (2.04%) and remaining entries recorded with the lowest incidence (0.00-1.24%). The accession ABT-3 has recorded with the highest incidence of leaf miner (9.00%) and Hy 94-T4 has recorded with the lowest incidence (0.64%). With regard to the incidence of leaf folder, the ABT-3 has recorded with the highest incidence (2.94%) and Hy-94-T4, ASRPT and T.No. 129 were observed no incidence during this season (0.00%). The accession has recorded with the highest incidence of Shoot tip caterpillar (2.60%) and M 15/4 and T.No. 71 observed no incidence during this season (0.00%). The accession line BLA 139-1 has recorded with highest incidence of Apple and nut borer (22.00%) and T.No. 1/1,T.No-7/12 and Hy 94-T4 observed no incidence during this season (0.00%).

Table 3.49 : Screening of cashew germplasm to locate tolerance / resistance to major pests of the region (2017-18)

Infestation by	Min. Damage recorded	Germplasm recorded	Max. Damage	Germplasm
Leaf and blossom webber	0 - 1.24	All entries	2.04	BLA 139-1
Leaf miner	0.64	Hy 94-T_4	9.00	ABT-3
Shoot tip caterpillar	0.00	M 15/4 and T.No. 71	2.60	ASRPT
Leaf folder	0.00	Hy-94-T_4, ASRPT and T.No. 129	2.94	ABT-3
Apple and nut borer	0.00	T.No. 1/1, T.No. 7/12 and Hy 94-T_4	22.00	BLA 139-1

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 22 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 3.50: Reaction of germplasm accessions against insect pests in Bhubaneswar (2017-18)

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, OC14, OC22, OC31, OC49, OC50, OC51, OC52, OC56, 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

Germplasm Evaluation Pool Data

2013-14	2014-15	2015-16	2016-17
LM (0.5-1.0%) All 100 Acc	**LM** (0.5-1.0%) - All 100 Acc	**LM** (0.5-1.0%) All 100 Acc	**LM** (0.5-1.0%) All 100 Acc
STC (0.5-1.0) OC 31, OC 37, OC130 and OC 133	**STC** (0.5-1.0) OC 31, OC 37, OC 133, OC 140	**STC** (0.5-1.0) OC 31, OC 36, OC 37, OC 133, OC 142	**STC** (0.5-1.0) OC 1, OC 12, OC 14, OC 22, OC 31
IT (0.5-1.0/panicle) OC 6, OC 21, OC 92, OC 109, OC 117, OC 122 and OC 137	**IT** (0.5-1.0/panicle) OC 6, OC 21, OC 31, OC 37, OC 92, OC 109, OC 117, OC 122 and OC 137	**IT** (0.5-1.0/panicle) OC 31, OC 36, OC 37, OC 55, OC 91, OC 109, OC 122 and OC 137	**IT** (0.5-1.0/panicle) OC 49, OC 50, OC 51, OC 52, OC 56, OC 92, OC 109, OC 114, OC 122, OC 123, OC 128 OC 129 and OC 137

Evaluation over the years with consistent results

LM: 0.5-1.0% incidence in all the acc.

STC: 0.5-1.0 : OC 31, OC 37, OC 133

IT: OC 21, OC 31, OC 37, OC 117, OC 122 and OC 137

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 or tolerant reactions to TMB and any other pests infestation.

Table 3.51 : Screening of MLT-II (MLT-1992) entries for tolerant/resistant to the major pests of the region at HREC, Hogalagere during 2018-19.

Sl. No.	Centre	Entry	Mean % damage on 20 leader shoots (0-4 scale)			
			TMB	Leaf miner	Apple & nut borer	Thrips
1	Vengurle	H-68	1.33	1.30	1.55	0.91
2		H-367	0.90	1.37	1.13	0.73
3		H-303(V-9)	1.18	0.96	0.80	1.04
4		H-255	1.47	0.84	0.84	1.24
5		H-320	1.32	1.52	1.24	0.91
6	Vridhachalam	M-4/3	1.05	1.17	1.31	1.31
7		M-15/4	1.01	1.17	1.35	1.08
8	NRCC, Puttur	NRCC-1	0.99	1.02	0.79	1.00
9		NRCC-2	1.51	1.31	0.78	0.84
10	Bapatla	TN-30/1	1.10	0.69	0.72	0.77
11		TN-3/33	1.55	0.92	0.92	0.83
12		TN-10/19	1.63	1.04	1.21	0.93
13		TN-3/28	0.87	0.79	0.87	1.15
14	Ullal	Ullal-1	1.37	0.85	0.83	1.28

Table 3.52 : Screening of MLT-III (MLT-2002) entries for tolerant/resistant to the major pests of the region at HREC, Hogalagere during 2018-19.

Sl. No.	Centre	Entry	Mean % damage on 20 leader shoots (0-4 scale)		
			TMB	Leaf miner	Apple & nut borer
1	Bhubaneshwar	BH-6	1.54	0.86	1.35
2		BH-85	0.92	0.80	0.96
3	Madakkathara	H-1593	1.51	1.24	0.85
4		K-22-1	1.35	1.10	1.55
5	Vengurle	H-662	1.33	1.05	0.92
6		H-675	1.28	0.87	1.41
7	Puttur	H-32/4	0.95	1.04	1.28
8		Goa-11/6	0.86	0.72	1.07
9	Vridhachalam	H-11	0.89	1.40	1.31
10		H-14	1.18	1.22	1.59
11	Chintamani	Chintamani-1	1.16	0.95	1.29

JAGDALPUR

Table 3.53: Screening of cashew germplasm to locate tolerance/resistance to major pests of the region at Jagdalpur centre during the year 2017-18

Infestation by	Min. damage recorded range)	Germplasm	Max. damage recorded (range)	Germplasm
Shoot TMB	0.00	T-10/19, SEL - 2, V - 3/33, V - 30/1, NRC - 131, NR - 136, NRC - 37, NRC - 138, NRC - 140, NRC - 190 NRC - 191, NRC - 192, AAKHANE, VTH - 711/4, CARS - 3, CARS - 4, CARS - 5, CARS - 6, CARS - 9, CARS - 10 **(20)**	0.68	NRC – 190
Panicle TMB	0.00	VRI – 1, VRI – 2 **(2)**	0.98	CARS-8
Leaf miner (%)	4.23	CARS-8	19.46	NRC – 193
Leaf folder (%)	3.85	NRC-191	23.67	NRC-137
Leaf caterpillar (%)	6.49	V-3/28	25.72	V-3/33
Leaf thrips	0.12	Hy-367 & CARS-6 **(2)**	1.09	NRC-130
Nut thrips DS	0.17	T-10/19, Hy-367 **(2)**	0.89	CARS-10

Thirty-six germplasm accessions were screened against major and minor insect pests of cashew. The incidence of TMB at shoot and panicle stage was less during this year, 22 germplasm were free from the attack of TMB and remaining germplasm was received <1 damage score. Leaf miner incidence was minimum of 4.23 per cent in CARS-8 and maximum of 19.46 per cent in NRC-193. Minimum leaf folder infestation was recorded in NRC-191 (3.85%) and maximum in NRC-137 (23.67%). Damage of leaf caterpillar ranged from 6.49 to 25.72 per cent in the germplasm. Leaf thrips infestation was recorded in Hy-367 and CARS-6 with 0.12 damaged score while, NRC-130 having maximum damage score of 1.09. Germplasm, T-10/19 and Hy-367 received minimum nut thrips damage score with 0.17 score while, germplasm CARS-10 having maximum 0.89 damage score.

VENGURLE

During the year, the accession No. 10/19 recorded lowest TMB incidence (0.08) whereas, it was maximum in the variety Hy- 320 (0.16). In case of thrips the accession No. Hy-303 (0.05) recorded lowest TMB infestation whereas it was maximum in variety V-7 (0.143).

Table 3.54 : Screening of cashew germplasm to locate tolerance/resistance to major pests of the region at Vengurle centre during the year 2017-18

Infestation by	Min. damage recorded (range)	Germplasm	Max. damage recorded (range)	Germplasm
Tea Mosquito Bug	0.08	10/19	0.16	Hy- 320
Flower thrips	0.05	Hy- 303	0.14	V-7

The data for 11 year of screening showed that all the accessions were found susceptible to tea mosquito bug damage. From the mean of 11 year it is observed that the Hy-303 recorded lowest incidence of tea mosquito bug (0.12) followed by the variety Vengurla-3 (0.12). The accession No. 3/33 recorded the highest incidence of tea mosquito bug (0.21) followed by the variety NRCC Sel-1 (0.21). From the above study it is concluded that none of the germplasm found tolerant or resistant's to tea mosquito bug all the accessions were found susceptible to tea mosquito bug damage only the degree of infestation vary.

Table 3.55 : Screening of cashew germplasm to identify tolerance/resistance to tea mosquito bug at Vengurle centre during the year 2007-08 to 2017-18

Varieties	Mean TMB incidence (0-4 scale)											Mean
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	
Vengurla - 1	0.16	0.14	0.23	0.18	0.14	0.06	0.21	0.07	0.18	0.11	0.08	0.14
Vengurla - 2	0.11	0.09	0.19	0.23	0.09	0.03	0.20	0.15	0.19	0.12	0.09	0.14
Vengurla - 3	0.11	0.08	0.19	0.20	0.11	0.01	0.17	0.11	0.17	0.11	0.09	0.12
Vengurla - 4	0.14	0.08	0.30	0.25	0.26	0.26	0.15	0.18	0.21	0.10	0.09	0.18
Vengurla - 5	0.14	0.08	0.23	0.23	0.15	0.15	0.15	0.09	0.19	0.55	0.09	0.18
Vengurla - 6	0.12	0.08	0.18	0.20	0.12	0.18	0.16	0.08	0.20	0.12	0.11	0.14
Vengurla - 7	0.13	0.08	0.29	0.18	0.11	0.22	0.16	0.06	0.25	0.10	0.09	0.15
Vengurla - 8	0.16	0.08	0.44	0.20	0.17	0.23	0.27	0.11	0.15	0.11	0.14	0.19
Hy - 320	0.14	0.10	0.23	0.20	0.11	0.20	0.15	0.07	0.18	0.09	0.16	0.15
Hy - 303	0.16	0.09	0.08	0.22	0.10	0.07	0.13	0.09	0.19	0.10	0.10	0.12
Acc. No. M - 44/3	0.17	0.08	0.34	0.19	0.15	0.12	0.25	0.11	0.19	0.12	0.08	0.15
Acc. No 30/1	0.16	0.09	0.16	0.19	0.15	0.22	0.14	0.07	0.24	0.18	0.09	0.15
Acc. No 10/19	0.10	0.09	0.30	0.24	0.13	0.13	0.20	0.10	0.19	0.10	0.08	0.15
Acc. No 3/28	0.18	0.09	0.25	0.24	0.11	0.06	0.25	0.08	0.23	0.12	0.16	0.16
Acc. No 15/4	0.14	0.09	0.25	0.24	0.18	0.07	0.10	0.64	0.17	0.09	0.10	0.19
Acc. No 3/33	0.14	0.09	0.34	0.23	0.28	0.31	0.11	0.56	0.13	0.10	0.09	0.21
NRCC Selection - 1	0.14	0.07	0.42	0.20	0.10	0.10	0.10	0.83	0.17	0.09	0.11	0.21
NRCC Selection - 2	0.13	0.06	0.34	0.22	0.13	0.07	0.26	0.105	0.24	0.10	0.09	0.16

VRIDHACHALAM

Screening of the cashew accessions available at Regional Research Station, Vridhachalam was made to locate the tolerant/ resistant/ susceptible cashew types against TMB and other foliar feeding insects viz., leaf and blossom webber, Leaf miner, Infloresence caterpillar, Leaf thrips and apple and nut borer pests. 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 infestation in various MLT entries ranged from 1.1-3.6. The score was low in ME 20/1 with mean damage score of 1.1. In other cashew entries, the mean damage score ranged between 1.8 and 3.6. So, none of the cashew entries have shown immune or resistant reactions to TMB infestation under field condition.

Table 3.56 : 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	0.0	0.0	0.0
H 1600	2.0	3.3	1.1	0.0	0.0	0.0
H 1608	2.2	3.1	1.4	0.0	0.0	0.0
H 1610	2.5	3.3	2.1	0.0	0.0	0.0
H 129	2.7	3.4	2.1	0.0	0.0	0.0
H 40	3.6	1.9	2.8	0.0	0.0	0.0
H 2/15	2.7	3.1	1.1	0.0	0.0	0.0
H 2/16	3.6	2.4	2.2	0.0	0.0	0.0
H 33/3	1.8	2.7	2.9	0.0	0.0	0.0
H 44/3	2.0	2.4	1.4	0.0	0.0	0.0
M 26/2	2.7	2.8	3.5	0.0	0.0	0.0
ME 20/1	1.1	2.3	1.4	0.0	0.0	0.0
VTH 30/4	2.9	3.2	1.3	0.0	0.0	0.0
VTH 59/2	3.1	3.2	1.0	0.0	0.0	0.0
V 2	2.9	2.4	1.0	0.0	0.0	0.0
V 3	3.1	2.4	3.0	0.0	0.0	0.0
V 4	3.1	2.9	2.3	0.0	0.0	0.0
V 5	1.8	3.0	2.6	0.0	0.0	0.0

Screening of F1 hybrids revealed that all the cross combinations were susceptible to TMB infestation. However, the damage score was low (1.9) in H 10, H 14 and H 16 followed by H 17 and H 13, H 15 with a mean damage score of 2.2 and 2.4 respectively.

Table 3.57: Screening of F_1 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	1.9	3.0	2.3	1.6	0.0
H 11	M 10/4 x M 45/4	2.8	3.6	3.0	1.3	0.0
H 12	M 10/4 x M 75/3	2.6	3.6	2.6	0.0	0.0
H 13	M 26/2 x M 26/1	2.4	3.3	2.3	1.0	0.0
H 14	M 26/2 x M 45/4	1.9	4.8	2.6	1.0	0.0
H 15	M 26/2 x M 75/3	2.4	4.6	2.6	1.8	0.0
H 16	M 44/3 x M 26/1	1.9	4.8	2.3	2.3	0.0
H 17	M 44/3 x M 45/1	2.2	4.6	2.6	2.0	0.0

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

CHAPTER II - ORGANISATION

1. 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 P_2O_5 and K_2O. 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 P_2O_5 and K_2O. 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 P_2O_5 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 ranges 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 P_2O_5 and high in K_2O. 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 during 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.

2. TRANSFER OF TECHNOLOGY

BAPATLA

Training programme on cashew apple value addition was conducted for unemployed women of Karlapalem on 24.04.2018. The scientist of the centre have also organized the District level seminar on cashew at Rastakuntabai, Parvathipuram on 25.04.2018 and training programme on cashew apple utilization for unemployed women on 02.05.2018. A District level farmers training programme on cashew was organized at Koyyuru, Visakhapatnam Dist., Andhra Pradesh on 25.3.2019 in which around 150 farmers had participated. The scientists have also organized three days farmers training programme on "Advanced Cashew Production Technology" at TTDC, Etcherla and Pathapatnam villages of Srikakulam District from 26.03.2019 to 28.03.2019.

The Scientist of the Centre have attended the Phone in Live programme in Pasidi Pantalu on the topic "Jeedi Mamidi Sagu- Melakuvalu" at Doora Darshan Kendra, Vijayawada on 06.08.2018 and also had Radio talk on the topic "Jeedi Mamidi Yajamanya Paddathulu" at All India Radio, Vijayawada on 28.01.2019

Under TSP programme the scientists have organized training programme on cashew at Miliyaputti, Srikakulam Dist. on 08.05.2018. Dr. B. Nagendra Reddy, Scientist (Ento) organized one District level training programme on Advanced production technology of cashew at Gurugumilli village, Buttayagudem Mandal, West Godavari on 19.05.2018 in which around 100 tribal farmers had participated.

The centre has organized awareness programme on Cashew production technology at Gurugumilli (v), Buttayagudem (Mn) of West Godavari Dist on 04.10.2018.

The Scientists of the Centre attended National Conference on Cashew: "Productivity Enhancement and Value Addition for Doubling Farmer's Income" at Vijayawada on 22nd – 23rd Feb, 2019 and Sri. K. Umamaheswara Rao, Scientist (Hort) presented the paper on "Innovative Strategy in Augmenting Quality Planting Material Production". Dr. B. Nagendra Reddy, Scientist (Ento), Cashew Research Station, Bapatla, attended the Divisional Workshop on Mango and Cashew at Kakinada, East Godavari dist. on 16.03.2019 organized by Department of Horticulture, East Godavari and delivered the lecture on Integrated Pest Management in Cashew.

The scientist of the centre have participated in Doordarshan "Live Phone-in Programme" in Pasidi Pantalu on the topic "Jeedi Mamidi Sagu-Melakuvalu" on 06.08.2018 at Vijayawada and also delivered a radio talk on the topic "Jeedi Mamidi Yajamanya Paddathulu" in All India Radio Programme on 28.01.2019 at Vijayawada.

Organized the District level seminar on cashew at Koyyuru, Vishakhapatnam district on 25th March, 2019

Organized district level seminar on cashew at Guuurugumilli, West Godavari, on 19.05.2018

BHUBANESWAR

The officials participated and imparted 7 District Level Seminar on Cashew under MIDH Scheme organized by OSCDC Ltd., Bhubaneswar at Khatuahata, Dhenkanal District on 21.12.2018, at Chhatia, Jaipur District on 29.01.2019; at Karanjia, Mayurbhanj District on 30.01.2019; at Pallahara, Angul District on 8.2.2019; at Harichandanpur, Keonjhar District on 16.2.2019; at Rambha Ganjam District on 19.2.2019 and at Khunta Baripada, Mayurbhanj District on 27.2.2019. Two skill development training programme was organized by PFDC, OUAT, Bhubaneswar and AICRP on MAP and Betelvine, OUAT, Bhubaneswar on 23.2.2019 and 24.2.2019.

The scientists of the centre have participated in Doordarshan "Live Phone-in Programme" on Krishi Darshan on the topic "Kaju Phasalara Jatna" on 15.02.2019 and also delivered the topic "Adhika Amala Pain Baula Samayare Kaju Bagichara Jatna" in Kisan Vani, All India Radio Programme on 23.01.2019.

HOGALAGERE

The scientists of the centre had organized cashew field day on 19th April 2018 in the field of cashew farmer Mr. Nagaraj, Kala Nayakana Halli, Jangamkote Hobli and Hosakote Taluk. The centre had taken up demonstration of cashew pruning in 2 acres of cashew plantation at Shettimadamangala, Chintamani Taluk. The scientists of AICRP on Cashew, HREC, Hogalagere had visited the farmers cashew field on 27-10-2018 and suggested the recommended soil reclamation and management aspects for recovery of cashew plants in degraded soils in Veerapura village of Sidlaghatta Taluk Chikkaballapur district. The centre had exhibited

cashew production technologies in Krishi Mela organised by University of Agricultural Sciences Bengaluru for 4 days between 15th to 18th November 2018, 3 days from 23 to 25th Dec. 2018 in Thotagarika Mela organised by University of Horticultural Sciences Bagalkot and at National Horticulture Fair at IIHR, Bengaluru during 23-25th January 2019. The scientist had attended crop seminar cum interaction on Integrated pest management in Cashew and Mango at Mango Development Centre, Madikere cross.

JAGDALPUR

The centre produced 8000 grafts of varieties Vengurla-4, Vengurla-7, Indira Kaju-1 and NRCC Sel. 2 for distribution to the farmers of Bakawand, Bastar and Jagdalpur blocks of Dist. Bastar. Year round graft production has been initated with the use of College facilities and mist chamber, however grafts success was recorded less during winters i.e. December to February.

Plantation of cashew with co-ordination of watershed development agencies of Department of Agriculture and Department of Panchayanti Raj has been formulated from last three years. Plantations were done in Satlawand, Kaudawand, Mooli villages of Bakawand block in around 50 acres.

The Centre has conducted "One day Training programme on Cashew" on 19th March, 2018 at S.G. College of Agriculture and Research Station, Jagdalpur sponsored by DCR, Puttur in which about 120 farmers had attended. Training of tribal womens and women self help group is conducted many times for processing of raw cashew nuts for livelihood development under DMF (District Mining Fund) and Zila panchayat funds. Two groups of village Marlenga and Rajnagar are trained and they are processings 50 quintals of raw nut every year.

A project has been proposed during the year to Zila Panchayat, Bastar and a grant of 2.50 lakhs has been released for the training. Under this project two villages Marlenga and Rajnagar were selected for distribution of machines, simultaneously tribal women's who formed SHGs were trained for boiling raw cashewnuts, cutting of nuts, shelling, packaging and marketing of the produce.

JHARGRAM

Two trainings "Preparation of cashew apple syrup and cashew apple jam" on 21st April 2018 and "Training on preparation of processed food products from various horticultural crops" on 10th June 2018 was organized at Lalgod, Jhargram district where 20 women participated from the women SHG groups in each training. Training on pruning of cashew trees was provided to the farmers by the Centre. Demonstration of pruning of cashew plants in the cashew orchards of Binpur, Jhargram Dist. was provided to the farmers by the trained personnels of the centre. Further, training on softwood grafting of cashew was organized at Lalgod, Jhargram district on 25th Sept. 2018 wherein 20 women participated and benefitted.

The Scientist of the Centre participated in "Mati Utsav, 2019 " held during 22 – 24th February by putting a stall and provided information on " Scope of Horticulture in the backward areas of West Bengal". Fertilizer /Pesticide Dealers (40 Nos.) of different districts of West Medinipur District of West Bengal visited cashew Orchards of AICRP on Cashew, RRS, BCKV, Jhargram on 27.03.19 organized by the District Agriculture Department.

During the year, about 792 no. of grafts were distributed to 8 farmers and around 2500 scion sticks was provided to the nurserymen for area expansion. Around 13 individual farmers were also provided technical knowledge on cashew cultivation. During January and February 2019, each batch of 30 nos. of SC farmers of different districts of West Bengal visited cashew nursery for first hand knowledge on cashew grafting technique. The cashew production technology was also uploaded in the internet for the benefit of the viewers.

MADAKKATHARA

The Scientist of the centre had participated in the "National Conference on Cashew" held on 22.2.2019 to 23.3.2019 at Vijayawada, Andhra

Pradesh. Training programme on Cashew apple utilization was organised from 12.6.2018 to 13.6.2018; 20.6.2018 to 21.6.2018; 22.3.2019 and 26.3.2019 at CRS, Madakkathara; and at HD Farm, Malampuzha on 23.3.2019 and at Krishibhavan, Vettilappara on 24.3.2019 in which around 200 unemployed women had participated.

A District level seminar on cashew was organised at Chithara, Kollam on 23.1.2019 for about 100 nos. of trainees. Training on Cashew Production Technology for 50 trainees was conducted at Karshaka Bhavanam, Vellanikkara from 12/02/2019 to 14/02/2019 and at CRS, Madakkathara on 27.2.2019. The Centre has also conducted "Horticulture Fair" and "Farm Day Programme" on 27.2.2019 in which 50 peoples had participated. The scientists had participated in the exhibition in connection with VAIGA-KUM 2018 at Thekkinkadu Maidanam, Thrissur from 27.12.2018 to 30.12.2018.

PILICODE

The Scientist of the centre had participated in the "National Conference on Cashew" organised by DCCD, Kochi held on 21.2.2019 to 23.3.2019 at Vijayawada, Andhra Pradesh and Swadeshi Science Congress held at NIIST, Thiruvanathapuram from 7-9th November 2018 .

The Scientist of the centre had been the resource person in two trainings were the farm womens were given training on cashew apple utilization held at RARS, Pilicode from 15.2.2019 to 16.2.2019 and from 27.2.2019 to 28.2.2019 in which 50 farmers had participated in each training. Training on cashew production technology was also given at Ponmala, Kudiyanmala on 5.3.2019 in which 100 farmers had participated. Classes for Farmers on Cashew Propagation and Cashew apple utilization was taken up at KVK, Kannur during 1.6.2018 and 21.6.2018 in which 30 farmers had participated in each session.

VENGURLE

The scientist of the centre had conducted 5 Fruit processing training under ATMA at RFRS, Vengurle during 15th Dec. 2018 to 9th Jan. 2019; 30th Jan. 2019 to 11th Feb. 2019; 6th to 8th March 2019; 21st to 23rd March 2019 and 23rd to 25th March 2019 in which 25 farmers attended in each training. Scientists Farmers Forum on Cashew and Mango was organized by DSAO, Sindhudurg at Mangoan, Kudal during 16th Nov. 2018 in which about 200 invitees had participated. DCCD sponsored "Three days training programme on Cashew" was also conducted at RFRS, Vengurle from 11th to 13th March 2019 in which 50 members had participated. Five training programmes on "Cashew Apple Utilization for Unemployed Women" was conducted at RFRS, Vengurle from 12th to 16th March 2019 sponsored by DCCD.

Three training programmes on cashew along with 10 demonstration on a) Care and maintenance of newly planted grafts b) fertilizer application c) training d) pruning e) rejuvenation f) drip irrigation g) soil and water conservation technique on 12/03/2019 h) Spraying of insecticides for insect-pest control i) CSRB management and j) cashew nut processing on 13/03/2019 h) Spraying of insecticides for insect-pest control i) CSRB management and j) cashew nut processing on 13/03/2019 for about 50 farmers were conducted at RFRS, Vengurle from 11th to 13th March 2019 sponsored by DCCD.

A Horticulture fair cum field day on cashew along with demonstration with CSRB management was conducted at Adeli, Tal. Vengurla, Dist. Sindhudurg on 18th March, 2019 in which 100 people had participated.

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.

3. RESEARCH PUBLICATIONS

BAPATLA

Umamaheswara Rao. K, Nagendra Reddy. B and Dhanumjaya Rao. K. "Innovative Strategy in Augmenting Quality Planting Material Production", published in Souvenir of National Conference on Cashew: "Productivity Enhancement and Value Addition for Doubling Farmer's Income" at Vijayawada on 22nd – 23rd Feb, 2019.

BHUBANESWAR

Extension Bulletins/ Booklets /Leaflets

Sethi, K., Mukherjee,S.K, Tripathy P. and Panda,P.K. 2018. *Minimal descriptor of cashew germplasm accessions.* Published by AICRP on Cashew, OUAT, Bhubaneswar, Pp.36

Panda, P.K.,Sethi, K. and Mukherjee, S.K. 2018. *Hi-Tech cashew cultivation : an option to enhance the production.* Published by AICRP on Cashew, OUAT, Bhubaneswar, Pp.4

Mukherjee, S.K, Panda, P.K. and Sethi, K. 2018. *Insect pests of cashew and their Control (In Odia*). Published by AICRP on Cashew, OUAT, Bhubaneswar, Pp.4

List of publications:

Research publications

Chandrasekhar,M., Sethi, K. Tripathy, P. Mukherjee, S. K. Panda, P.K. and Roy, A.2018. Performance of released cashew (*Anacardium occidentale* L.) varieties under hot and humid climatic zone of Odisha. *Indian Journal of Agriculture and Research,* 52(2):152-156.

Jena C.,Panda, P. K. and Karna A. K. 2018.Effect of growth promoting substances on flowering behaviour of cashew cv.BPP-8 grown in the coastal region of Odisha. *International Journal of Chemical Studies,*6(6):908-911.

Jena Chinmaya, Panda P.K., Karna A.K., Panda R.K. and Sethi K. 2018.Studies on growth promoting substances on physio-chemical parameter of cashew (*Anacardium occidentale* L.).Chemical Science Review and Letters,7 (28):966-970.

Mohapatra, M., Dash, D.K., Tripathy, P. Sethi, K. and Roy, A.2018. Studies on Variability, Heritability and Genetic Advance in Cashew (*Anacardium occidentale* L.). Trends in Biosciences, 11 (2):120-125.

Mohapatra, M., Dash, D.K.,Tripathy, P.Sethi, K. Dash, M. and Roy, A.2018. Character association and path coefficient analysis for nut yield and component traits in Cashew (*Anacardium occidentale* L.). Indian Agriculturist, 62 (1):53-62.

Roy, A. Dora, D. K., Sethi, K, Sahu, S. Dash, D.K. and Parida, A. 2018. Studies on biometric parameters of cashew in *Bhubaneswar condition. International Journal Current Microbiology and Applied Science*, 7(12):365-370.

Roy, A. Dora, D.K., Sethi, K, Sahu, S. Dash, D. K.and Parida, A. 2018. Studies on variability of different cashew landrace in Bhubaneswar. *International Journal Current Microbiology and Applied Science,* 7 (12):433-438.

Awards and Recognition

Panda, P.K., Gopikrishna K, Sethi, K. and Mukherjee, S.K.2019. Oral Presentation Award : Nutrient management for yield maximization in cashew (*Anacardium occidentale* L.).: "8th Indian Horticulture Congress-2019" 17th-21st January, 2019 at IGKV, Raipur. Chattisgarh.

Research papers presented at International and National Seminar/Symposia

Mukherjee S.K and Nayak S.P.2018. Screening of cashew germplasm on the incidence of Red banded thrips (*Selenothrips rubrocinctus* Giard). In : 5th National Symposium on "New Dimension in Plant Protection - A step towards

food and nutritional security and environmental safety" 27th-28th October, 2018 at OUAT, Bhubaneswar.Pp79.

Panda P.K., Gopikrishna K., Sethi K. and Mukherjee S.K. 2019. Nutrient management for yield maximization in cashew (*Anacardium occidentale* L.). In: "8th Indian Horticulture Congress-2019", 17th – 21st January, 2019 at IGKV, Raipur. Chattisgarh.Pp:96

JAGDALPUR

Sahu, K.R., Shukla, B.C. and Saxena, R.R. 2018. Effect of climatic factors on diversity of lepidopteran insect pests on cashew in Chhattisgarh. *International Journal of Agriculture Sciences.* 10(9): 5897-5900.

Paikra, M.S. and Gupta, A. K. 2018. Status of cashew research and development in Chhattisgarh, In: M. G. Nayak and G. S. Mohanna, Status of cashew research and development in India; A state perspective, pp. 8-16.

JHARGRAM

Subhendu J., Mini Poduval, Goalm M., Arindam S. and Raju D. 2018. Diseases of cashew and their management. In: Diseases on Vegetables and Fruits: Current Status and their management by P.C. Trivedi, Published by Aavishkar Publishers (2018) ISBN 10 : 8179105733 ISBN 13: 9788179105733.

PILICODE

M.V. Sajeev, P.L. Saroj and Meera Manjusha, A.V., 2018. Impact of production technologies on area and productivity of cashew in North Kerala. *Ind. J. Ext. Edn.,* 54: 100-107

Meera Manjusha A. V., Retheesh P. K. and Megha K.G., Preliminary investigations on heat tolerance of cashew genotypes. Book of Abstracts, 28th Swadeshi Science Congress held at NIIST Thiruvannthapuram from 7-9th November, 2018

MADAKKATHARA

Conference proceedings/ Abstracts

Sobhana A. 2018. Management of hidden hunger by Cashew apple products. In *Zero Hunger-Policies and Perspectives* (Ed. Peter, K.V.). Brillion Publishing, Karol Bag, New Delhi, 311-330.

Sobhana, A. 2018. Boosting cashew production in Kerala. *The Cashew and Cocoa Journal* VII (3): 12-17.

Sobhana, A. 2018. Innovative technologies for processing of cashew apple on commercial scale. *The Cashew and Cocoa Journal.* 3(2): 67-74.

Jalaja S. Menon, Hariprasad C, Berin Pathrose, Manoj M.K aand Satheesan N.V. 2019. Alternate host plants to sustain Red ant population for biological control of Tea Mosquito Bugs in cashew plantation – A case study. *National Conference on Cashew,* 22-23rd February 2019, Directorate of Cashew and Cocoa Development, Vijayawada, Andhra Pradesh.

Jalaja S. Menon, Hariprasad C, Sobhana A.2019. Dynmaics of cashew apple production from Cashew Research Station, Madakkathara, Kerala. *National Conference on Cashew,* 22-23rd February 2019, Directorate of Cashew and Cocoa Development, Vijayawada, Andhra Pradesh.

Books/Book Chapter/ Reports/Technical Bulletin/ Leaflets

Sobhana, A., Smitha, M.S., Sharath, P.S., and Reshma, T. 2018. *Kashumaavinte uthama krishireethikal.* Kerala Agricultural University Press, Mannuthy, Thrissur, 18p.

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.

Research papers

Jalaja S. Menon, Hariprasad C, Berin Pathrose, Manoj M.K and Satheesan N.V. 2019. Alternate host plants to sustain Red ant population for biological control of Tea Mosquito Bugs in cashew plantation – A case study. *The Cashew and Cocoa Journal.* VIII (1), January- March 2019.

Popular articles

Jalaja S. Menon. 2019. Puliyurumbine aavahich kashumaavu karshakan. *Mathrubhumi Daily.* February 2019.

Jalaja S. Menon. 2019. Parakkoothathiloru Kashumaavu thopp, puliyurumbugal kaavalaal. *Krishijaagaran.* March 2019.

VENGURLA

Research papers

R. C. Gajbhiye, S. N. Pawar, S. P. Salvi, V. K. Zote and P. C. Haldavanekar. 2018. Performance of different cashew (*Anacardium occidentale* L.) genotypes under Konkan region of Maharashtra. International J. of Chemical Studies Vol. 6(5): 1939-1942.

R. C. Gajbhiye, R. Gavit, B. R. Salvi, R. S. Varadkar, V. K. Patil, A. D. Rane, A. A. K. Dosani, P. M. Haladankar and T. Bhattacharyya, July 2018. Cashworthy Companion of Konkan Farmers: Cashewnut. *Advanced Agricultural Research & Technology Journal* (ISASaT) 2(2): 175-184

R. C. Gajbhiye, V. K. Zote, P. C. Haldawanekar, S. N. Pawar and S. P. Salvi, Oct. 2018. Performance of different tuber crops in well grown cashew orchard under Konkan Conditions of Maharashtra. Multilogic in Science J. (*International Peer Reviewed Journal*) 8(27): 224-228

V. K. Zote, R. C. Gajbhiye, S. P. Salvi and P. C. Haldavanekar, 2018. Efficacy and evaluation of Solomon 300 OD (betacyfluthrin 90% + imidacloprid 210%) for management of insect pest in cashew. *Journal of Entomology and Zoology Studies.* 6(4):81-83

N. M. Kanade, R. C. Gajbhiye, C. D. Pawar, M. C. Kasture and P. C. Haldavanekar. 2018. Efficacy and evaluation of Solomon 300 OD (betacyfluthrin 90% + imidacloprid 210%) for management of insect pest in cashew. *International J. of Chemical Studies* 6(3): 1305-1310

Conference/Symposium/Seminar Publication

Sr. No.	Name of Authors	Title of published Papers	Year	Place of organization
1.	R. C. Gajbhiye, S. N. Pawar and P. C. Haldavanekar	Effect of Supplementary Irrigation with Reference to Growth and Yield of Cashew under South Konkan Region of Maharashtra	28th Sept. to 1st Oct. 2018	12th National Symposium on Coastal Agriculture: Boosting Production Potential under Stressed Environment organized by Indian Society of Coastal Agricultural Research, ICAR CSSRI, Regional Research Station Canning Town (West Bengal)

2.	R. C. Gajbhiye, S. P. Salvi, S. N. Pawar and P. C. Haldavanekar	Response of Cashew cv. Vengurla-4 under Organic Management	28th Sept. to 1st Oct. 2018	-do-
3.	R. C. Gajbhiye, S. N. Pawar, S. V. Deshmukh, S. P. Salvi, and P. C. Haldavanekar	Effect of Different Value Added Briquettes on Soil Nutrient Status and Yield of Cashew in Konkan Region of Maharashtra	28th Sept. to 1st Oct. 2018	-do-
4.	R. C. Gajbhiye and P. C. Haldavanekar	Cashew Graft Production Technology- Best Practice from Indian State of Maharashtra	08th to 10th Nov., 2018	Cashew Technology Handbook 2018 SIETTA-ACA Annual Cashew Conference & Expo 2018, Abidjan, pp. 18-24
5.	V. K. Zote, S. P. Salvi, P. C. Haldavanekar and A. L. Narangalkar	Efficacy of Insecticide for the Management of Cashew Apple and Nut Borer	28th Sept. to 1st Oct. 2018	12th National Symposium on Coastal Agriculture: Boosting Production Potential under Stressed Environment organized by Indian Society of Coastal Agricultural Research, ICAR-CSSRI, Regional Research Station Canning Town (West Bengal)
6.	V. K. Zote, R. C. Gajbhiye, S. P. Salvi and P. C. Haldavanekar	Feeding Potential of Common Species of Spiders in Cashew	28th Sept. to 1st Oct. 2018	-do-
7.	S. V. Deshmukh, R. C. Gajbhiye and P. C. Haldavanekar	Nutrient Status and Fertility Capability Grouping of Soils of Sindhudurg District, Maharashtra	28th Sept. to 1st Oct. 2018	-do-
8.	A. Y. Munj, V. K. Zote, R. A. Raut and P. C. Haldavanekar	Population Dynamics and Natural Enemies of Mango Hopper- A Review	28th Sept. to 1st Oct. 2018	-do-

Book published

Sr. No.	Name of the author/s	Name of Book (with ISBN No. if any)	Publisher	Published year
1.	Book chapters writtern by AICRP-Cashew Scientists, RFRS, Vengurle and Horticulture Dept., Dapoli staff of DBSKKV, Dapoli	Advances in Cashew Production Technology ISBN No. 978-81-937464-5-5	Director of Extension Education, DBSKKV, Dapoli	2018

VRIDHACHALAM

Jaya Prabhavathi, S., S. Velmurugan, S. Vincent and P. Nainar. 2018. Efficacy of different insecticides against foliage pests on cashew. In: International Conference on Biocontrol and sustainable insect pest management, Jan 29-31, 2018 held at AC&RI, Killikulam, p. 380-382. ISBN: 978-93-81102-46-6

Jagadeesan, R., S. Velmurugan, S. Jaya Prabhavathi and R. Ushakumari. 2018. Malarum maruthuvamum. In: FARM FEST 2018, p. 84-88 (In Tamil)

4. STAFF POSITION

HEADQUARTERS

Directorate of Cashew Research
Darbe PO, PUTTUR-574 202, DK, KARNATAKA

Phone No. : 08251-231530, 233490 (R) and 230992 (R)
EPABX : 08251-230902, 236490 Fax No. : 08251-234350
E-mail : cashewresputr@gmail.com, director.dcr@icar.gov.in, dircajures@gmail.com,
Website : http://www.cashew.res.in

Project Coordinator	:	Dr. M.G. Nayak
Scientist-in-charge	:	Dr. Mohana G.S.
Secretarial Assistance	:	Smt. Reshma K.

PROJECT CENTRES

Cashew Research Station, (Dr. Y.S.R. Horticultural University), Bapatla, 522 101, Guntur District, Andhra Pradesh.

Phone No. : 08643 – 225304 Fax No. : 08643 – 225304
E-mail : cashewresbapt@gmail.com, headcrs_bapatla@drysrhu.edu.in

Horticulturist	:	Dr. K. Dhanumjaya Rao (from 9.1.2019) Smt. B. Vimala (Upto 8.1.2019)
Asstt. Horticulturist	:	Sri. K. Uma Maheshwara Rao
Asstt. Entomologist	:	Dr. B. Nagendra Reddy
Sr. Technical Assistant	:	Contractual Basis
Jr. Technical Assistant	:	Sri. G. Samuel
Grafter	:	Sri. V. Kantha Rao (Upto 30.4.2018)

Cashew Research Station, (Orissa University of Agriculture and Technology), Bhubaneswar 751 003, Orissa.

Phone No. : 0674-2397383 Fax No. : 0674-2397780
E-mail : cashewresbhub@gmail.com, aicrpcashew_bbsr@yahoo.co.in

Horticulturist	:	Dr. P.K. Panda
Jr. Horticulturist	:	Mrs. Kabita Sethi
Jr. Entomologist	:	Dr. S.K. Mukherjee

Sr. Technical Assistant : Mrs Supriti Bhuyan (From 18.6.2018)

Jr. Technical Assistant : Vacant

Grafter : Sri. D. Almango

Horticulture Research Station, (University of Horticultural Sciences), Hogalagere-563 125, Srinivaspura Taluk, Kolar District, Karnataka.

Phone No. : 08157 - 245022

E-mail : cashewreshogl@gmail.com, hrshogalagere@gmail.com

Horticulturist : Vacant

Jr. Horticulturist : Mr. B.N. Rajendra

Jr. Entomologist : Dr. N. Aswathanarayana Reddy

Sr. Technical Assistant : Mr. B. Subramanyam

Sr. Technical Assistant : Mr. M. Ramesh

Grafter : On Contractual Basis

Zonal Research Station, (Birsa Agricultural University), Darisai, East Singhbhum Dist., Jharkhand

Phone No. : 0651-2450060

Fax No. : 0651-2450060

E-mail : cashewresdari@gmail.com

Horticulturist : Dr. Pawan Kumar Jha

SG College of Agricultural and Research Station, (Indira Gandhi Agricultural University), Jagdalpur 494 005, Bastar District, Chattisgarh

Phone No. : 07782-229360, 229150

Fax No. : 07782-229360

E-mail : cashewresjagd@gmail.com
zars_igau@rediffmail.com

Jr. Horticulturist : Dr. M.S. Paikra (Upto 1.10.2018)
Mr. Vikas Ramteke

Jr. Entomologist : Mr. N.C. Mandawi (Upto 4.9.2018)
Dr. Y.S. Nirala (From 5.9.2018)

Jr. Technical Assistant : Contractual Basis

Grafter : Mr. Jagdeo

Regional Research Station, (Bidhan Chandra Krishi Vishwa Vidyalaya), Jhargram 721 507, Midnapore West District, West Bengal

Phone No. : 03221-205500

E-mail : cashewresjhar@gmail.com, poduvalmini@gmail.com

Horticulturist	:	Dr. Mini Poduval
Jr. Horticulturist	:	Vacant
Jr. Entomologist	:	Vacant
Sr. Technical Assistant	:	Vacant
Jr. Technical Assistant	:	Vacant
Grafter	:	Vacant

Cashew Research Station, (Kerala Agricultural University), Madakkathara 680 651, Thrissur District, Kerala

Phone No.	:	0487-2370339
Fax No.	:	0487-2370019
E-mail	:	cashewresmadk@gmail.com, crsmadakkathara@kau.in
Horticulturist	:	Dr. Jalaja S. Menon (From 15.12.2018)
		Dr. A. Sobhana
Jr. Breeder	:	Dr. Asna A.C. (From 1.3.2019)
Jr. Entomologist	:	Sri. Satheesan N.V.
Sr. Technical Assistant	:	Vacant
Jr. Technical Assistant	:	Mr. M.K. Manoj
Grafter	:	Vacant

Agricultural Experimental Station, (Navsari Agricultural University), Paria, Pardi Taluk, Valsad-396 145, Gujarat

Phone No.	:	0260 2337227	Fax No.	:	0260 2337227
E-mail	:	cashewrespari@gmail.com, aesparia@nau.in			
Horticulturist	:	Dr. S.K. Desai			
Jr. Entomologist	:	Mr. S.G. Parmar			
Jr. Technical Assistant	:	Mr. N.M. Talavia			
Grafter	:	Vacant			

Regional Agricultural Research Station, (KAU), Pilicode 671 353, Kasaragod District, Kerala.

Phone No.	:	0467-2260450	FAX No	:	0467-2260554
E-mail	:	cashewpili@gmail.com, adrrarspil@rediffmail.com			
Jr. Horticulturist	:	Dr. Meera Manjusha A.V.			
Jr. Technical Assistant	:	Contractural Basis			

Regional Agricultural Research Station, (Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth), Vengurla 416 516, Sindhudurg District, Maharashtra.

Phone No.	:	02366-262234	Fax No.	:	02366-262234
E-mail	:	cashewresveng@gmail.com, adrrfrsvengurle@yahoo.com			

Horticulturist : Dr. R.C. Gajbhiye

Jr. Breeder : Dr. R.T. Bhingarde

Jr. Entomologist : Mrs. V.K. Zote

Sr. Technical Assistant : Mr. S.P. Salvi

Jr. Technical Assistant : Mr. A.L. Patekar

Regional Research Station, (Tamil Nadu Agricultural University), Vridhachalam 606 001, Cuddalore District, Tamil Nadu.

Phone No. : 04143-238231 Fax No. : 04143-238120

E-mail : cashewresvrid@gmail.com, arsvri@tnau.ac.in, rrsvri@tnau.ac.in

Horticulturist : Dr. R. Jagadeesan

Jr. Horticulturist : Dr. S. Velmurugan

Jr. Entomologist : Dr. S. Jaya Prabhavathi

Sr. Technical Assistant : Ms. T. Sangeetha

Jr. Technical Assistant : Ms. L. Murugeswari

Grafter : Mr. S. Manivasagam

KRC College of Horticulture, University of Horticulture Sciences, Arabhavi-591 310, Gokak Taluk, Belgaum Dist., Karnataka

Phone : 08332 – 284 502 (O) Fax No. : 08332 – 284684

Email : rudratp@gmail.com, dikrccha@yahoo.co.in

Horticulturist : Dr. Naveen M. Puttaswamy

ICAR Research Complex for NEH Region, Umiam – 793 103, Barapani, Meghalaya

Horticulturist : Dr. A.S. Singh

Phone : 03651 - 222535

E-mail : director@icarneh.ernet.in; kvkwestgarohills2019@gmail.com

ICAR Research Complex for Goa, Ela, Old Goa, Goa – 403 402

Phone : 0832 - 2284678 / 2284679 (O)

E-mail : director@icargoa.res.in

Horticulturist : Dr. A.R. Desai

5. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2018-19

Allocation **(Rs. in lakhs)**

Centre	Details of sanctioned provision					
	Pay and Allowances	TA	Recurring contingency	Non-Recurring contingency	Grand Total	ICAR share
Bapatla	44.20	1.68	11.39	1.00	58.27	43.70
Bhubaneshwar	39.22	1.68	11.00	1.00	52.90	39.68
Hogalagere	26.67	1.68	8.23	2.25	38.83	29.12
Darisai	16.00	0.59	5.88	0.00	22.47	16.85
Jagdalpur	17.26	1.04	7.08	0.80	26.18	19.64
Jhargram	14.50	1.04	10.71	1.00	27.25	20.44
Madakkathara	48.57	1.68	9.69	1.00	60.94	45.70
Paria	25.40	1.04	7.08	0.95	34.47	25.85
Pilicode	12.90	0.59	2.85	1.02	17.36	13.02
Vengurla	46.00	1.68	11.64	1.60	60.92	45.69
Vridhachalam	46.95	1.68	10.60	1.00	60.23	45.17
KRCCH, Arabhavi	0.00	0.59	2.64	0.00	3.23	2.42
ICAR Res. Compl. For Goa, Goa	0.00	0.00	5.00	0.00	5.00	3.75
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	2.17	0.00	2.17	1.63
Provision for PC Cell	0.00	0.00	0.00	1.71	1.71	1.28
Provision for RC for PC Cell	0.00	0.00	5.88	0.00	5.88	4.41
Total	**337.67**	**14.97**	**111.84**	**13.33**	**477.81**	**358.35**
ICAR Share	**253.25**	**11.22**	**83.88**	**10.00**	**358.35**	
Provision for SCSP						15.00
					GRAND TOTAL	**373.35**

Actual Expenditure **(Rs. in lakhs)**

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	45.69	0.78	12.95	1.00	60.42	45.31
Bhubaneshwar	41.48	0.27	10.00	0.00	51.75	38.81
Hogalagere	25.19	0.99	4.69	0	30.87	23.15
Darisai	15.15	0.36	2.95	0.00	18.46	13.85
Jagdalpur	17.95	1.30	9.58	0.80	29.63	22.22
Jhargram	14.37	0.81	10.30	0.29	25.77	19.32
Madakkathara	60.35	0.74	7.60	0.99	69.68	52.26
Paria	25.66	0.14	7.07	0.94	33.81	25.36
Pilicode	12.77	0.59	2.48	0.52	16.36	12.27
Vengurla	49.77	0.54	11.64	1.43	63.38	47.54
Vridhachalam	46.30	1.48	10.66	1.00	59.44	44.58
KRCCH, Arabhavi	0.00	0.23	3.50	0.00	3.73	2.80
ICAR Res. Compl. For Goa, Goa	0.00	0.00	5.69	0.00	5.69	4.27
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	1.76	0.00	1.76	1.32
Provision for RC for PC Cell	0.00	0.00	5.88	1.71	7.59	5.69
Total	**354.68**	**8.23**	**106.75**	**8.68**	**478.34**	**358.75**
ICAR Share	**266.01**	**6.17**	**80.06**	**6.51**	**358.75**	
Provision for SCSP						0.00
					GRAND TOTAL	**358.75**

6. METEOROLOGICAL DATA OF DIFFERENT CENTRES FOR THE YEAR

BAPATLA

Month	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days
			(Max)	(Min)		
April	35.2	27.0	73	73	-	-
May	38.5	27.9	65	58	8.4	3
June	37.1	26.3	71	57	103.9	9
July	35.8	25.6	73	57	88.5	12
August	33.7	24.6	82	70	291.5	16
September	33.5	25.6	81	75	239.2	10
October	33.5	25.6	81	75	121	6
November	31.5	21.7	84	69	32.5	2
December	30.5	17.6	86	59	-	-
January	30.1	17.4	88	60	-	-
February	31.4	18.0	84	53	-	-
March	33.3	21.7	83	64	1.2	1
Total					**886.2**	**59**

BHUBANESWAR

Months	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days	BSH
	Max.	Min.	Max.	Min.			
April	36.9	26.1	88	49	29.2	1	7.5
May	38.8	27.2	82	46	43.1	3	8.5
June	35.2	26.5	87	59	122.0	15	3.8
July	31.9	25.9	92	78	445.9	24	2.0
August	32.9	25.8	91	76	377.0	24	4.9
September	33.6	25.7	92	70	245.2	14	4.7
October	32.2	24.3	93	69	204.5	9	6.0
November	29.6	18.7	89	56	55.2	4	7.1
December	28.2	14.4	92	48	36.3	1	7.0
January	28.0	12.0	92	35	0.0	0	7.3
February	33.7	15.9	91	29	0.0	0	8.4
March	36.9	22.2	92	33	0.0	0	6.6
Total					**1558.4**	**95**	

DARISAI

Month	Rainfall (mm)	Temperature (°C)		Humidity %	
		Maximum	Minimum	Maximum	Minimum
January	0.0	27.01	8.9	87	52
February	0.0	31.28	12.43	83	45
March	26.0	34.41	16.84	83	44
April	2.4	38.4	22.5	75.3	36.9
May	219.0	40.1	25.4	76.5	42.9
June	183.5	38.5	26.8	76.2	51.8
July	513.4	33.5	25.2	89.1	79.3
August	207.0	31.2	25.3	89.4	77.1
September	122.6	32.2	24.7	89.2	70.6
October	60.7	25.9	20.1	89.9	61.8
November	13.8	28.2	14.9	87.7	57.6
December	2.0	26.1	8.3	85.8	47.5
Total	**1350.40**				

HOGALAGERE

Month	Temp (°C)		R.H (%)		No. of rainy (days)	Rainfall received (mm)	Normal rainfall (mm)
	Max.	Mini.	Morn.	Even.			
April	35.73	21.51	84.73	35.73	5	27.0	27.40
May	33.72	21.67	90.19	33.72	10	111.1	69.20
June	30.30	21.56	89.30	30.30	4	47.7	60.60
July	29.94	21.17	88.7	29.94	5	30.48	74.70
August	29.08	21.28	89.97	29.08	7	68.3	96.90
September	28.48	20.76	90	28.48	10	146.2	150.60
October	28.15	19.89	95	28.15	11	230.5	126.20
November	26.57	18.27	95.27	26.57	4	21.2	61.90
December	26.48	16.12	95.84	26.48	1	3.2	16.30
January	27.84	13.95	94.8	27.84	0	0.0	2.10
February	29.71	14.41	91.86	29.71	1	4.3	6.50
March	32.45	17.75	88.03	32.45	2	26.3	11.60
Total						**716.28**	**704.00**

JAGDALPUR

Month	Temp (°C)		Relative Humidity (%)		Wind Vel. (Kmph)	Bright Sunshine hours	Rainfall (mm)	Rainy days
	Max.	Min.	I	II				
April	39.14	21.16	66.77	21.07	5.49	7.43	5.80	1
May	38.82	23.43	69.29	33.32	5.69	7.30	57.60	4
June	32.02	23.23	88.10	71.90	6.00	2.62	380.60	16
July	29.12	22.76	92.26	74.06	6.65	1.74	416.80	15
August	29.58	22.69	95.03	79.87	4.23	2.24	329.40	20
September	31.34	22.65	93.10	69.43	3.12	4.67	239.00	14
October	30.79	20.70	96.16	62.35	2.32	5.33	235.90	11
November	28.92	14.05	95.77	45.90	2.77	6.50	0.00	0
December	28.51	8.01	96.06	31.52	2.13	8.31	0.00	0
January	28.51	8.12	94.32	26.16	1.94	8.57	0.00	0
February	31.49	12.28	89.39	26.96	2.45	8.02	2.00	0
March	35.43	17.42	83.03	26.55	3.02	5.99	3.20	0
Total							**1670.3**	**81**

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	43	27	48	26.6	6	6.8	8	1006.0	18
May	36	27	68	19.8	11	203.5	18	1004.0	12
June	34	27	75	18.4	23	136.9	27	1000.1	3
July	36	28	72	18.0	53	395.9	30	1000.8	1
August	35	28	72	16.2	44	183.4	27	1002.6	2
September	34	27	72	14.4	35	90.3	19	1005.8	15
October	32	25	73	14.0	26	185.5	18	1008.5	14
November	29	20	56	12.6	15	16.4	6	1013.4	24
December	28	18	46	12.6	10	12.1	2	1015.5	29
January	27	15	32	13.0	0	0.0	0	1014.1	31
February	32	21	34	13.0	7	0.8	1	1013.8	27
March	38	25	34	19.1	7	0.6	2	1010.0	29
Total						**1232.2**	**158**		

MADAKKATHARA

Month	Temperature (°C)		Relative Humidity (%)	Sunshine hours (h)	Rainfall (mm)	Rainy days (No.)
	Max.	Min.	Average			
April	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
August	30.1	23.3	86.5	21.15	101.48	16
September	31.48	22.93	84.5	28.5	99.73	16
October	31.94	22.4	80.2	36.26	42.42	12
November	32.73	21.7	73	43.13	10.13	5
December	32.65	21.05	62.75	54.08	0	0
January	33.62	20.84	50.4	58.66	0	0
February	36.15	22.8	48.75	66.26	1.3	1
March	36.7	24.02	57.6	56.14	6.64	2
Total					**538.95**	

PARIA

Month	Max. Temp. (°C)	Min. Temp. (°C)	Mor. RH	Eve. RH	Wind velocity	Rainfall	Sunshine hours	Evaporation
April	37.18	18.15	74.25	43.16	3.96	0.0	9.97	6.73
May	36.43	23.79	75.73	51.90	5.79	1.0	10.35	6.89
June	33.65	24.58	86.44	71.31	5.74	677.2	6.47	4.60
July	30.12	23.96	95.33	93.37	6.68	1156.5	3.05	3.83
August	30.79	23.92	90.90	80.60	5.11	237.7	4.56	3.94
September	33.25	22.99	88.16	73.17	2.98	20.3	6.12	4.29
October	35.21	20.55	83.26	60.28	1.35	89.2	8.32	4.37
November	34.77	15.19	82.55	40.60	1.01	0.0	8.66	3.09
December	30.94	16.15	83.80	72.47	1.27	75.0	7.20	2.39
January	32.68	16.58	83.92	82.40	1.25	0.0	8.50	2.14
February	35.16	16.79	89.15	92.59	1.66	0.0	8.62	2.50
March	36.60	21.39	79.76	78.72	1.88	0.0	8.05	4.70
Total						**2256.9**		

PILICODE

Month	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**	**140**	

TURA

Month	Temperature (°C)		Relative humidity (%)		Rainfall (Monthly cumu. mm)
	Maximum	Minimum	Maximum	Minimum	
April	33	15	89	49	414.2
May	33	15	88	45	481.2
June	34	15	89	51	332.2
July	33	16	87	58	682
August	34	15	91	58	643.6
September	34	17	88	56	1111.6
October	34	16	89	52	565.4
November	31	16	90	62	3
December	29	15	89	68	2
January	28	13	91	71	0
February	26	11	80	65	0
March	27	14	79	54	0
Total					**4235.2**

VENGURLA

Month	Temperature (°C)		Humidity (%)		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	Forenoon	Afternoon		
April	35.05	23.45	74.39	63.83	00	00
May	32.21	25.81	79.93	69.00	171.8	7
June	32.50	25.33	89.53	77.92	808.2	28
July	31.96	24.66	88.09	78.65	780.8	35
August	32.66	23.98	91.43	79.34	00	00
September	33.01	23.74	90.39	76.28	77.2	7
October	34.79	23.24	87.17	70.23	7.4	5
November	36.03	19.01	83.28	57.07	00	00
December	34.14	17.74	88.73	58.68	27.4	2
January	33.43	16.61	89.23	66.51	00	00
February	34.90	17.18	84.14	60.57	00	00
March	35.18	21.07	82.93	61.25	00	00
Total					**1872.8**	**84**

VRIDHACHALAM

Month	Temperature (°C)		RH (%)	Rainfall (mm)	No. of rainy days	Sunshine hours
	Max.	Min.				
April	37.3	26.6	72.0	0	0	8.5
May	37.0	27.7	70.0	18.6	01	7.2
June	37.3	27.1	69.0	103.0	05	6.7
July	37.2	26.8	70.0	44.6	04	6.1
August	35.3	25.9	79.0	166.8	07	5.2
September	34.9	25.9	76.0	238	07	4.6
October	33.6	24.6	75.0	100.4	07	5.2
November	30.7	24.4	76.0	208	13	3.3
December	30.2	21.9	82.0	163	03	2.9
January	32.1	20.1	84.1	26.2	2.0	4.1
February	34.0	20.4	76.4	0	0	8.6
March	37.0	24.2	74.7	9.2	1.0	8.0
Total				**1077.8**	**50**	

7. 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
4	Catalogue of Minimum Descriptors of Cashew	
	Germplasm accessions – I	165.00
	Germplasm accessions –II	125.00
	Germplasm accessions –III	128.00
	Germplasm accessions –IV	--
	Germplasm accessions –V	--
5	Database on Cashewnut Processing in India (2003)	100.00
6	Directory of Cashewnut Processing Industries in India (2003)	100.00
7	Process Catalogue on Development of an economically viable on-farm Cashewnut Processing	45.00
8	Annotated Bibliography on Cashew (1995-2007)	205.00
9	Soil and water management in cashew plantations	30.00
10	Biochemical characterization of released varieties of Cashew	85.00
11	Pruning and canopy architecturing in cashew	40.00
12	Development of dual mode dryer for raw cashewnuts	90.00
13	Alternate energy utilization of cashew shell cake for thermal application	90.00
14	Cashew Cultivation Practices (Pamphlet)	*
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

Price indicated above does not include postage.

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

* * *

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch