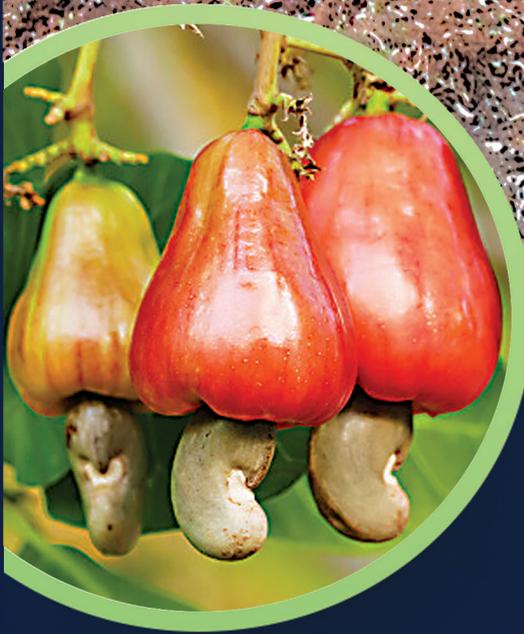


# अखिल भारतीय समन्वित काजू अनुसंधान परियोजना ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW

AICRP ON CAHSEW



## वार्षिक प्रतिवेदन ANNUAL REPORT 2019



भा.कृ.अनु.प. - काजू अनुसंधान निदेशालय  
दर्बे पोस्ट, पुत्तूर - 574 202, दक्षिण कन्नड, कर्नाटक

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

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वार्षिक प्रतिवेदन  
ANNUAL REPORT  
2019

परियोजना समन्वयकर्ता  
डॉ. एम.जी. नायक

PROJECT COORDINATOR  
Dr. M.G. Nayak



भा.कृ.अनु.प. - काजू अनुसंधान निदेशालय  
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# CONTENTS

प्राक्कथन	(v)	Hort.3. Drip irrigation trial	58
ABOUT THIS REPORT	(vi)	Hort.4. Expt.2. High density planting - (Observational trial)	61
INTRODUCTION	(vii)	Hort.6. Intercropping in cashew	64
<b>CHAPTER- I : TECHNICAL</b>		Hort.7. Organic management of cashew	68
परियोजना समन्वयकर्ता की रिपोर्ट	1	Hort.8. Spacing cum fertilizer trial	78
Project Coordinator's Report	3	Hort.9. Evaluation of production potential of newly developed cashew variety	82
AICRP Cashew Centres	5	Hort.11. Ultra high density planting in cashew	84
Executive Summary	6		
Report of AGM-2019 of AICRP-Cashew	7		
<b>EXPERIMENTAL RESULTS</b>		<b>III. CROP PROTECTION</b>	
<b>I. CROP IMPROVEMENT</b>		Ent.1. Chemical control of pest complex in cashew	
Gen.1 Germplasm collection, conservation, evaluation, characterization and cataloguing	13	Expt.3. Evaluation of insecticides for control of TMB and other insect pests	89
Gen. 1a Evaluation of Cashew nut and shell liquid (CNSL) free germplasm accessions	22	Ent.2. Control of cashew stem and root borer	
Gen.3. Varietal Evaluation Trials		Expt.2. Curative control trial	104
Expt.1. Multilocation Trial-III	23	Ent.3. Influence of Biotic and Abiotic factors on the incidence of pest complex in cashew	116
2. Performance of released varieties (MLT-V)	24	Ent.4. Screening of germplasm to locate tolerant/ resistant types to major insect pests of the region	125
3. Special Multilocation trial (MLT-VI)	31		
Gen.4. Hybridization and Selection	34	<b>CHAPTER II : ORGANISATION</b>	
Gen. 4a Rapid polyclonal hybrid evaluation trial	43	1. General characteristics of centres of AICRP on cashew	137
Gen.5. Characterization of germplasm for cashew apple	44	2. Transfer of technology	138
Gen.6. Varietal Screening of cashew apple for preparation of RTS and Jam	47	3. Publications	142
Gen.7. Evaluation of promising bold nut, bigger apple types and high yielding cashew Genotypes	49	4. Staff position	144
<b>II. CROP MANAGEMENT</b>		5. Budgetary provision and actual expenditure during 2019-20	148
Hort.1a. Nutrient Management for yield maximization in cashew	53	6. Meteorological data of different centres for the year	150
Hort.2. Fertilizer application in high density cashew plantations	56		



# प्राक्कथन

यह, अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की 36 वीं वार्षिक प्रतिवेदन है। यह प्रतिवेदन में अप्रैल - 2019 से मार्च - 2020 तक का शोध परिणाम और अन्य जानकारी को शामिल किया गया है।

परियोजना के अंतर्गत 14 केंद्र हैं, जैसे, भारत के पूर्वी तट में चार; बापट्ला (आंध्र प्रदेश), भुवनेश्वर (उड़ीसा), झारग्राम (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 तकनीकी जानकारी और दूसरा है इतिहास, कर्मचारियों की विवर, वित्तीय प्रावधान, मौसम के आँकड़ें, शोध प्रकाशन से संबंधित संस्थानीय जानकारी।



( एम.जी. नायक )

प्रभारी निदेशक एवं परियोजना समन्वयकर्ता

स्थान : पुत्तूर

दिनांक : 30.06.2020

# ABOUT THIS REPORT

This is the thirty sixth 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 2019 to March 2020.

There are a total of fourteen centres ie., four in the East Coast of India, namely, Bapatla (Andhra Pradesh); Bhubaneswar (Odisha); Jhargram (West Bengal) and Vridhachalam (Tamil Nadu), four centres in the West Coast, namely, Madakkathara (Kerala) and Pilicode (Kerala) (Sub centre); Vengurla (Maharashtra), Navsari (Gujarat) and one each in Plains Region, namely, Hogalagere (Karnataka), Jagdalpur (Chhattisgarh) and Darisai (Jharkhand) which are implementing the research programmes. Besides, 3 cooperating centres are also functioning under AICRP-Cashew one each in Kanabargi (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 : 30.06.2020

# 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 (Chhattisgarh) and a sub Centre at Pilicode (Kerala) were 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 Headquarter 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 headquarter of the independent cashew project was shifted to National Research Centre for Cashew, Puttur in 1986. Presently, there are ten coordinating Centres, one sub Centre and three co-operating centres. The ten co-ordinating centres are ; 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.

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 स्थित हैं। इन सभी केंद्रों पर विभिन्न राज्य कृषि विश्वविद्यालयों और आयसीएआर के संस्थानों का प्रशासनीक नियंत्रण होता है। परियोजना का वर्ष 2019-20 का मूल बजट आबंटन रु. 408.38 लाख (भा.कृ.अ.प. का शेयर) था और कुल व्यय रु. 386.23 लाख (भा.कृ.अ.प. का शेयर) था।

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

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

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

## फसल सुधार

कुल 1557 जननद्रव्य किस्मों को विभिन्न केंद्रों में संरक्षण किया गया है। जहाँ तक जननद्रव्य संग्रह का विचार है, इस वर्ष, 27 नये किस्मों को उनके उपज और उपज के लिए कारण गुणों के आधार पर अलग अलग केंद्रों में संग्रह किया गया। 110 किस्मों का चरित्रवर्णन और मूल्यांकन जारी है। इस वर्ष वापट्ला, भुवनेश्वर, झारग्राम, वृधाचलम, गोवा, मडक्कतरा, पिलिकोड,

वेंगुर्ले, जगदलपुर और कनबर्गि केंद्रों में बोलड नट, बडा फल, उच्च उपज देनेवाले काजू जीनोटाइप का मूल्यांकन का एक नया प्रयोग शुरुवात किया गया है। उत्तम हाइब्रिडों का मूल्यांकन का बहुस्थानीय ट्राइल-III में वेंगुर्ला में H-662 (37.82 किलों, सातवीं कटाई में) और वृधाचलम में H-14 उच्चतम संचयी उपज दिखाए। विमोचित किस्मों का प्रदर्शन अध्ययन करने का एक प्रयोग में, दारिसाई में BPP-8, होगलगेरे में उल्लाल-4, झारग्राम में वेंगुर्ला-7, पिलिकोड में प्रियांका, वृधाचलम में VRI-3 अत्युत्तम साबीत हुआ।

हाइब्रिडाइजेशन और चयन के ट्राइल में, भुवनेश्वर में 12 और गोवा में 17 नए संकरण संयोजनों का प्रयोग किया गया। और बापट्ला केंद्र में 12 हाइब्रिड्स आशाजनक लगता है, भुवनेश्वर में एक और गोवा में दो हाइब्रिड्स का प्रदर्शन सिसिलेवार रहा। उसके साथ साथ, वेंगुर्ला में 18 आशाजनक हाइब्रिडों का मूल्यांकन जारी है। इसके अलावा, भुवनेश्वर, मडक्कतरा, वृधाचलम और वेंगुर्ला में आशाजनक जननद्रव्य किस्मों से अच्छे गुणों को बाहर लाने के लिए रापिड क्लोनल हाइब्रिड मल्टिप्लिकेशन का काम जारी में हैं।

## फसल प्रबंधन

उच्चतम उपज पाने के लिए आयोजित पोषक प्रबंधन ट्राइल में, सिफरिश की गई मात्रा में उर्वरक डालना, प्रमुख और लघु पोषकांशों का फोलियार स्प्रे भुवनेश्वर और होगलगेरे में अत्युत्तम परिणाम दिया। बूँद बूँद सिंचायी ट्राइल में 80% क्युम्युलेटिव पान इवोपेरेशन में करना होगलगेरे केन्द्र में बहुत अच्छा सबित हुआ। उच्च घनत्व रोपण पर्यवेक्षण ट्राइल में यह देखने में आया कि उच्च घनत्व रोपण में (4मी. x 4 मी.) बी सी रेशियो समय के साथ कम होते जा रही थी जब की सामान्य घनत्व रोपण में यह रेशियो बढ़ रही थी। अंतर फसल प्रबंधन ट्राइल में, अंतर फसल क्रोसांडा बापट्ला में, परिया में कोरियंडर, वृधाचलम में भिंडि, वेंगुर्ला में अमरांतस अत्यंत ज्यादा निव्वल लाभ दिया। जैविक काजू खेती प्रबंधन ट्राइल

में, वर्मिकॉपोस्ट और बायोफार्टिलाइसर द्वारा शत प्रतिशत नाइट्रोजन देने से बापटला केन्द्र में सर्वाधिक गिरी उपज पाया गया। जब कि, सिफारिश की गई मात्रा 10 किलों FYM का उपचार भुवनेश्वर, दारिसाई, वृधाचलम और होगलगरे में उच्चतम बेनिफिट रेशियो दिया। मगर, वेंगुर्ला केन्द्र में वर्मिकॉपोस्ट और बायोफार्टिलाइसर का कांबिनेशन द्वारा दी गई 100% नाइट्रोजन से सबसे अधिक निव्वल लाभ मिला। और बापटला, भुवनेश्वर, झारग्राम, मडक्कतरा और वेंगुर्ला केन्द्रों में अल्ट्रा हाइडेन्सीटि ट्राइल चालू है।

### फसल संरक्षण

बापटला, भुवनेश्वर, वृधाचलम, जगदलपुर और मडक्कतरा में टी.एम.बी. शूट टिप क्याटरपिल्लर, एपल और नट् बोरर, लीफ मैनर् के खिलाफ लामडा-साइलोत्रिन (0.6 ml/L) अन्य कीटनाशकों से भी ज्यादा प्रभावी रहा। जब की होगलगरे केन्द्र में थियोमिथोक्सांम् (0.2g/l) और परिया केन्द्र में कार्बोसलफान प्रभावी था। जहाँ तक काजू कांड और जड छेदक (CSRB) का विचार है, क्लोरोफाइरोफास (10ml/L) को भुवनेश्वर, वृधाचलम और इमिडाक्लोप्रिड (2ml/L) प्रभावी पाया गया। होगलगरे और वेंगुर्ला केन्द्रों में फिप्रोनिल् सबसे अच्छा प्रदर्शन दिया। इस वर्ष के दौरान परिया, पिलिकोड, बापटला, भुवनेश्वर, होगलगरे, मडक्कतरा, जगदलपुर, वेंगुर्ला और वृधाचलम केन्द्रों में चाय मच्चर प्रबंधन के बारे में, क्षेत्र विशिष्ट वनस्पतियों के आधार पर, एक नए ट्राइल आरंभ किया गया है।

### तकनीकी हस्तांतरण

AICRP के समन्वयन केन्द्रों ने प्रौद्योगिकि हस्तांतरण गतिविधियों में भी जुड़े हैं और वर्ष 2019-20 के दौरान 5.54 लाख 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, तकनीकी मार्गदर्शन के साथ, प्रसार करने के लिए अलग अलग केन्द्रों द्वारा 'प्रदर्शन खेती' आरंभ किया गया है। यह उल्लेखनीय है कि AICRP काजू केन्द्रों न काजू खेती और प्रबंधन के बारे में जानकारी देने के लिए 93 प्रशिक्षण और जागृति कार्यक्रम आयोजन किए हैं। इन में 5724 से ज्यादा किसान भाग लिए हैं। इस वर्ष के दौरान AICRP केन्द्रों ने SCSP योजना के अंतर्गत 18 कार्यक्रम आयोजन किया और SC जनांग के किसानों को छोटे छोटे कृषि यंत्रों को वितरण किया।

किसानों को विविध काजू उत्पादन तकनिक जैसे पौधों का प्रसात, रोपण, काजू आरचर्ड का पालन, काजू के कीट और रोग प्रबंधन और काजू फलों और बीजों का प्रसंस्करण के बारे में प्रशिक्षण दिया गया। केन्द्र के वैज्ञानिकों ने "रेडियो टाक" दिये ओर दूरदर्शन केन्द्र में "लाइव् फोन् इन कार्यक्रम" में भाग लिए, जहाँ किसानों को काजू उत्पादन के विभिन्न तकनिकों के बारे में सूचना दिया गया और सुझाव भी दी गई।

# PROJECT CO-ORDINATOR'S REPORT

There are 14 AICRP – cashew centers in the country which come under administrative control of state agricultural universities/ICAR institutes. ICAR-Directorate of Cashew Research is the Project Coordinating cell which takes care of technical, financial and monitoring aspects of AICRP- Cashew centers. The original budget allocation of the project for the year 2019-20 was Rs. 408.38 lakhs (ICAR Share) and the expenditure was Rs.386.23 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 progress of the centers has been reviewed by the Project Coordinator and the Scientist in charge, PC cell, who have visited the centers of AICRP cashew. The salient achievements of the centres are outlined here section wise.

## CROP IMPROVEMENT

The total germplasm accessions conserved at various centers are 1557. As for as evaluation of germplasm accessions are concerned, during the year, 27 new accessions for yield and yield attributing characters have been collected by different centers. Further, 110 accessions are in various stages of characterization and evaluation. A new trial on evaluation of promising bold nut, bigger size apple types and high yielding cashew

genotypes was initiated at Bapatla, Bhubaneshwar, Jhargram, Vridhachalam, Goa, Madakkathara, Pilicode, Vengurla, Jagdalpur and Kanabargi centers during the year. In the multi-location trial– III which aims at evaluation of promising hybrids, H-662 showed highest cumulative yield (37.82 kgs in 7th harvest) at Vengurla center and H14 at Vridhachalam center. In the trial on performance of released varieties, BPP-8 at Darisai, Ullal-4 at Hogalagere, Vengurla-7 at Jhargram, Priyanka at Pilicode, VRI-3 at Vridhachalam were found to be superior.

In the trial on hybridization and selection, 12 new hybrid combinations were tried at Bhubaneshwar and 17 at Goa. Further, 12 hybrids seems to be promising at Bapatla center, one at Bhubaneshwar, two hybrids showed consistent performance at Goa. In addition to these, evaluation of 18 promising hybrids is under progress at Vengurla. Further, rapid clonal hybrid evaluation trial which aims at bringing desirable characters from promising germplasm accessions is under progress at Bhubaneshwar, Madakkathara, Vridhachalam and Vengurla centers.

## CROP MANAGEMENT

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 4m) and the reverse is true in case of normal planting (8m x 8m). 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 Bhubaneshwar and in Hogalagere. In drip irrigation trial, irrigation at 80% cumulative pan evaporation was found to be the best in Hogalagere center.

The intercrop Crossandra at Bapatla, Tomato at Darisai, Pumpkin at Jhargram, Amaranthus at Madakkathara, Coriander at Paria, Bhendi at Vridhachalam, Yardlong bean at Vengurla 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 Bhubaneshwar, Darisai, Vridhachalam and Hogalagere. However, in Vengurla center, 100% N as vermicompost and biofertilizer combination gave highest net returns. Further, the trial on ultra high density planting is under progress in Bapatla, Bhubaneshwar, Jhargram, Madakkathara and Vengurla centers.

### **CROP PROTECTION**

L-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, Bhubaneshwar, Vridhachalam, Jagdalpur and Madakkathara. However, Thiomethoxam (0.2g/l) was found to be effective in Hogalagere center and Carbosulfan in Paria center. As for as CSRB is concerned, Chloropyrifos (10ml/l) was found to be effective in Bhubaneshwar, Vridhachalam and Jagdalpur. However, Imidachloprid (2ml/l) was effective in Bapatla center and neem oil swabbing in Madakkathara center. In Hogalagere, and Vengurla centers, Fipronil gave the best results. During the year, a new trial to manage TMB has

been initiated with region specific botanicals at Paria, Pilicode, Bapatla, Bhubaneshwar, Hogalagere, Madakkathara, Jagdalpur, Vengurla and Vridhachalam

### **TRANSFER OF TECHNOLOGY**

During the year 2019-20, the AICRP-Cashew Centres have produced more than 5.54 lakh cashew grafts 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. The Centres of AICRP on Cashew have conducted 93 training programmes on different aspect of cashew cultivation and management practices in which around 5724 farmers have participated. During the year, the Centres of AICRP on Cashew have also conducted 18 training programmes under SCSP Scheme as well as distributed small farm equipments for benefitting the farmers of the SC community.

The farmers were trained on various aspects of cashew cultivation such as propagation methods, planting technique, maintenance of cashew orchards, management of pest and diseases of cashew crops and processing of cashew apple and nut. The Scientists of the centers have delivered radio talks and attended "Live-Phone-in Programme" at Doordarshan Kendra wherein various aspects of cashew cultivation and suitable suggestions were provided to the farmers.

## 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

- The total germplasm accessions conserved at various AICRP centers are 1557. A total of 27 new accessions have been collected by different centers.
- A new trial on evaluation of promising bold nut, bigger apple types and high yielding cashew genotypes was initiated at Bapatla, Bhubaneswar, Jhargram, Vridhachalam, Goa, Madakkathara, Pilicode, Vengurla, Jagdalpur and Kanabargi centers.
- Recommended dose of fertilizers with FYM and foliar spray of major and minor nutrients gave best results in Bhubaneswar and in Hogalagere. 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 intercrops Crossandra at Bapatla, Tomato at Darisai, Pumpkin at Jhargram, Amaranthus at Madakkathara, Coriander at Paria, Bhendi at Vridhachalam and Yardlong bean at Vengurla centers gave highest net returns.
- 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.
- L-Cyhalothrin (0.6 ml/litre) was found to be more effective against TMB, Shoot tip caterpillar, apple and nut borer, leaf miner in Bapatla, Bhubaneswar, Vridhachalam Jagdalpur and Madakkathara. For CSRB, Chloropyriphos (10ml/litre) was found to be effective in Bhubaneswar, Vridhachalam and Jagdalpur.
- A new trial to manage TMB has been initiated with region specific botanicals at Paria, Pilicode, Bapatla, Bhubaneswar, Hogalagere, Madakkathara, Jagdalpur, Vengurla and Vridhachalam.

## Production of Planting Material :

A total of 553784 grafts were produced during 2019-20 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	85000
Bhubaneswar	15000
Hogalagere	1219
Jagdalpur	2000
Jhargram	5000
Madakkathara	159087
Pilicode	12000
Vengurla	141900
Vridhachalam	132578
<b>TOTAL</b>	<b>553784</b>

## REPORT OF THE ANNUAL GROUP MEETING OF SCIENTISTS OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW-2019

The Annual Group Meeting (AGM) of Scientists of AICRP on Cashew was organized at the University of Horticultural Sciences, Bagalkot from 13<sup>th</sup> to 14<sup>th</sup> December 2019. Dr. Indires K.M., Hon'ble Vice Chancellor of UHS, Bagalkot, Dr. N. Basavaraj, Director of Research, UHS, Bagalkot, Dr. W.S. Dhillon, ADG (Hort. Sci.), ICAR, New Delhi, Dr. M.G. Nayak, Director (Acting), ICAR-DCR, Puttur and Sri Venkatesh N Hubballi, Director, DCCD, Kochi participated in the AGM. About 75 delegates which included the scientists from the Coordinating Centres of AICRP-Cashew, scientists from DCR, Invitees, UHS Staff, Press and Media persons participated in the said Group Meeting. The welcome address was delivered by Dr. N. Basavaraj, Director of Research, UHS, Bagalkot. The Presidential address was delivered by Dr. K.M. Indires, Vice Chancellor, UHS Bagalkot where he mentioned about the scope of cashew cultivation over other plantation and fruit crops in non-traditional areas of Karnataka and the requirement of transfer of technology to the enterprunering farmers. Dr. W. S. Dillion, ADG (HS), ICAR, New Delhi discussed about the development of Horticultural sector to increase also GDP and area expansion in recent years in India. He emphasized on innovative technologies which need to be adopted in cashew cultivation for increasing the productivity of cashew. He also focused on undertaking studies on cashew rootstocks suitable for drought and salinity stresses.

The Project Coordinator's report was presented by Dr. M.G. Nayak, Director (Acting) where he highlighted the activities taken up by 14 AICRP Cashew Centers. He mentioned that 1567 cashew accessions were maintained at AICRP centres and 27 new accessions were also collected for evaluation of yield and yield attributing characters

during the year 2018-19. He also mentioned that a new trial on evaluation of promising bold nut, bigger apple types and high yielding cashew genotypes was initiated in the centres. In addition to the trial on hybridization and selection, another trial on rapid clonal hybrid evaluation which aimed at bringing desirable characters from promising germplasm accessions was under progress at Bhubaneswar, Madakkathara, Vridhachalam and Vengurla centers. During the year 2018-19, around 3.61 lakh cashew grafts were produced and supplied to farmers. He also mentioned that the AICRP centers are also playing major role in transfer of technologies for cashew cultivation and more than 49 trainings/awareness camps on different aspect of cashew cultivation and management practices have been taken up in which around 1000 farmers participated.

On this occasion, five publications from HRES, Hogalagere, CRS, Bhubaneswar and RRS, Jhargram were released. Later, the technical sessions on 'Crop Improvement', chaired by Dr. N. Basavaraj, Director of Research, UHS, Bagalkot and 'Crop Management' chaired by Dr. D.R. Patil, Assoc. Director of Research & Extension, UHS, Bagalkot were held on 13<sup>th</sup> December 2019. The session on 'Crop Protection" was held on 14<sup>th</sup> December 2019 followed by "Interaction Session with farmers, scientists, processors and officials from development departments being chaired by Dr. S.I. Hanamashetti, (former Dean, (Hort.), College of Horticulture, Arabavi, UHS, Bagalkote, and co-chaired by Sri. Venkatesh N. Hubballi, Director, DCCD, Kochi. The problems and suggestions of farmers regarding cashew were also discussed and the AGM was concluded with the plenary session.



**Inauguration**



**Dignitaries on the dias**



# **EXPERIMENTAL RESULTS**



# **I. CROP IMPROVEMENT**



## I. CROP IMPROVEMENT

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

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



The objectives of the project are:

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

During the current year, 28 germplasm in the respective Regional Cashew Field Gene accessions have been collected by different Banks (RCFGBs). The total number of accessions centres of AICRP on Cashew and are planted conserved so far are 1583 (Table. 1.1).

**Table 1.1 : Cashew germplasm holding in different centres**

Centre	No. of accessions		
	Earlier existing	Collected during 2019-20	Existing
<b>East Coast</b>			
Bapatla	111	--	111
Bhubaneshwar	112	2	114
Jhargram	164	4	168
Vridhachalam	208	--	208
<b>West Coast</b>			
Goa	104	--	104
Madakkathara	142	--	142
Paria	0	7	7
Pilicode	101	5	106
Vengurla	357	--	357
<b>Plains tract/others</b>			
Darisai	18	6	24
Hogalagere	104	--	104
Jagdalpur	72	4	76
Kanabargi	3	--	3
Tura	59	--	59
<b>Total</b>	<b>1555</b>	<b>28</b>	<b>1583</b>

## BHUBANESWAR

During the fruiting season of 2018-19, two cashew germplasm accessions were collected and included in germplasm conservation block. With addition of these two new accessions, the total number of germplasm collections are increased to 114. Out of 114 germplasm collections, 40 local types, 71 obtained from other centers and 3 hybrids

developed at the center are included in germplasm conservation block.

During the fruiting season (2018-19), two new germplasm accessions viz. OC-174 & OC-175 were collected from villages Godipada and Bahadajhola of district Nayagarha, Odisha. The salient features of the two newly collected germplasm accessions are presented in Table 1.2.

**Table 1.2 : Salient features of collected germplasm at Bhubaneswar Centre, 2018-19**

Sl. No.	Accession No.	Approx. age of tree	Av. nut wt.(g)	Av. apple wt.(g)	Apple colour	Av. nut yield (kg/plant)	Special features
1.	OC-174	15 yrs.	6.4	50.0	Yellow	30.0	Cluster bearing & high nut yield
2.	OC-175	10 yrs.	11.3	65.0	Yellow	10.0	Bold nut & high nut yield

### Evaluation of germplasm:

Among the evaluated germplasm, accession OC-163 (2012 planted) recorded maximum mean tree height (3.28m), trunk girth (32.82cm), canopy spread (2.88m in E-W & 3.30 m in N-S), mean canopy area (7.50 m<sup>2</sup>) and number of laterals m<sup>-2</sup> (16.47). Similarly accessions, OC-165 (2013 planted), OC-166 (2014 planted) and OC-168 (2016 planted) recorded maximum as trunk girth, canopy spread, canopy area and number of laterals m<sup>-2</sup>.

It revealed that flowering season of evaluated germplasm varied from 4<sup>th</sup> week of November to

4<sup>th</sup> week of March. The mean duration of flowering ranged from minimum 58 days in OC-165 to maximum 74 days in OC-167. Mean number of panicles m<sup>-2</sup> was recorded maximum for accession OC-163 (13.43) while the lowest was recorded for the accession OC-169 (9.71). Ratio of bisexual to male flowers was recorded maximum for the accession OC-169 (0.20) and minimum for OC-167 (0.04). Accessions OC-163 and OC-164 recorded maximum number of nuts m<sup>-2</sup> (24.20) and nuts panicle<sup>-1</sup> (8.0) respectively during the fruiting season.

**Table 1.3 : Yield parameters of cashew germplasm at Bhubaneswar Centre, 2018-19\***

Accession No.	Flowering duration (days)		Mean no. of panicles m <sup>-2</sup>	Ratio of bisexual : male flowers	Mean no. of nuts m <sup>-2</sup>	Mean no. of nuts panicle <sup>-1</sup>
	Range	Mean				
OC-163	2 <sup>nd</sup> week of Jan. to 3 <sup>rd</sup> week of Mar.	67	13.43	0.16	24.20	6.6
OC-164	4 <sup>th</sup> week of Nov. to 4 <sup>th</sup> week of Jan.	63	11.61	0.10	14.50	8.0
OC-165	2 <sup>nd</sup> week of Jan. to 2 <sup>nd</sup> week of Mar.	58	11.30	0.10	14.20	5.7

OC-166	2 <sup>nd</sup> week of Jan to 3 <sup>rd</sup> week of Mar.	68	11.10	0.07	10.55	3.2
OC-167	2 <sup>nd</sup> week of Jan. to 4 <sup>th</sup> week of Mar.	74	11.80	0.04	12.65	5.0
OC-168	2 <sup>nd</sup> week of Jan. to 4 <sup>th</sup> week of Mar.	73	10.55	0.11	11.30	4.1
OC-169	2 <sup>nd</sup> week of Jan. to 3 <sup>rd</sup> week of March	65	9.71	0.20	10.40	3.8

#### **\*Observational strips**

Data on yield attributes and nut yield (Table 1.4) revealed differences among the evaluated germplasm accession. Nut weight was recorded maximum for the accession OC-166 (8.5g) while mean apple weight and shelling were recorded

maximum for the accession OC-165 (63.6g & 31.0%). Similarly, mean annual nut yield at 5<sup>th</sup> harvest was recorded maximum for the accession OC-163 (1.50 kg).

**Table 1.4 : Yield parameters of cashew germplasm at Bhubaneswar Centre, 2018-19\***

Accession No.	Mean nut wt. (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg tree <sup>-1</sup> )	Cum. nut yield (kg tree <sup>-1</sup> )
<b>For 5 harvests</b>					
C-163	7.0	45.4	30.0	<b>1.50</b>	6.03
<b>For 4 harvests</b>					
OC-164	7.5	47.7	29.0	1.00	2.25
OC-165	7.0	<b>63.6</b>	<b>31.0</b>	1.00	2.10
<b>For 3 harvests</b>					
OC-166	<b>8.5</b>	50.0	28.5	0.87	1.87
OC-167	7.4	61.5	27.6	0.60	1.44
<b>For 2 harvests</b>					
OC-168	8.0	50.0	29.0	0.50	0.70
OC-169	7.7	53.0	28.5	0.55	0.90

#### **\*Observational strip**

**N.B.:** Data recording on mean annual nut yield (kg plant<sup>-1</sup>) for the fruiting season 2018-19 couldn't be completed due to occurrence of cyclone "FANI" on 03. 05. 2019. Partially recorded yield data is presented in the report.

#### **DARISAI**

Among the evaluated germplasm accession, two accessions, DSI-107 (4.98 Kg/plant) & DSI-103 (4.62 Kg nut/plant) were identified for higher nut yield. It was observed that flowering in different germplasm ranged from 2<sup>nd</sup> week of November to 2<sup>nd</sup> week of April with maximum mean flowering duration of 132 days, in accession DSI-107 &

minimum of 80 days in accession DSI-105. Mean nut weight was recorded maximum in accession DSI-107 (9.04g), followed by accession DSI-111 (8.83g). The cumulative nut yield was maximum in accession DSI-107 (14.22 Kg/plant) followed by accession DSI-103 (13.46 Kg/plant) for four harvests.

## GOA

1. Germplasm collection and maintenance : Total of 104 germplasm accessions which were collected and maintained are given below:

Jumbo nut types : 17 accessions

Bold nut type : 45 accessions,

Medium nut and high yielders : = 13 accessions

High yielders/ cluster bearers irrespective of nut size = 25 accessions

Dwarf canopy types : 3 accessions

Very compact canopy type : 1 accession

2. **New germplasm accessions identification** : Five new accessions viz. Durga-1/18, Barsem-1/18, Barsem-3/18, Karvem-1/18 and Karvem-2/18 were identified for bold nut (in the range of 7.68-11.86g), shelling percentage (in the range of 28.62-32.23%) and two accessions viz., Arla Keri-1/8 and Barsem-2/18 were identified for their cluster bearing habit.

## HOGALAGERE

Layout of the experiment has been done at HREC, Hogalagere and planting was taken up in two stages. Results presented here are from the plants of first stage planting (Planted during September 2014) and the second stage planting was done on December 2016.

### a. Evaluation:

The plant height observations of germplasm accessions revealed that the mean tree height ranged from 2.4 to 4.3 m, trunk girth ranged from 32.5 to 60.3 cm and canopy area ranged from 11.0 to 49.6 m<sup>2</sup>. Highest plant height was recorded in HREC-11 (4.3 m). Maximum stem girth (60.3cm) canopy area (49.6 m<sup>2</sup>) were recorded in HREC-07 and HERC-39.

Observations on yield parameters revealed that nut weight ranged from 4.3 to 11.3 and that of the nut yield from 0.10 to 3.62 kg/tree. The highest nut weight recorded was in HREC-11 (11.3g) and highest nut yield recorded was in HREC-09 (3.62 kg/tree).

**Table 1.5 : Yield parameters of cashew germplasm during 2018-19 (date of planting 25-09-2014) at the age of 4 years at Hogalagere.**

Sl. No.	Accession No.	Flowering duration (days)	No. of nuts / panicle (Nos.)	Nut weight (g)	Yield/plant (kg)
1	HREC-01	59	6.5	4.9	1.47
2	HREC-02	68	10.3	5.1	0.52
3	HREC-03	58	6.8	7.1	0.69
4	HREC-04	100	6.3	6.4	0.42
5	HREC-06	65	7.0	6.8	2.80
6	HREC-07	70	3.7	5	0.29
7	HREC-08	41	4.3	5.2	0.23
8	HREC-09	52	4.8	4.8	3.62
9	HREC-10	54	3.7	6.8	1.36
10	HREC-11	75	7.5	11.3	0.53
11	HREC-12	80	5.2	4.9	0.60
12	HREC-13	66	7.7	7.1	0.49
13	HREC-14	66	6.1	7.8	1.53

14	HREC-15	83	6.5	5.2	0.93
15	HREC-16	70	6.8	6.4	2.72
16	HREC-17	76	8.3	5.5	0.39
17	HREC-18	71	5.6	6.3	0.27
18	HREC-20	66	12.4	6.4	1.18
19	HREC-21	85	8.3	5.1	1.17
20	HREC-22	73	9.3	5.3	1.22
21	HREC-23	55	9.4	5.4	0.98
22	HREC-24	69	4.7	4.7	0.50
23	HREC-25	70	7.7	5.8	0.13
24	HREC-26	70	7.2	6.1	1.64
25	HREC-27	68	5.7	7.3	3.60
26	HREC-28	60	7.1	5.2	1.45
27	HREC-29	78	8.8	5.8	1.19
28	HREC-30	61	10.7	5.5	0.26
29	HREC-31	70	7.7	5.2	1.18
30	HREC-32	75	12.5	5.8	1.26
31	HREC-33	67	9.9	5.3	0.91
32	HREC-35	72	3.0	5.3	0.21
33	HREC-36	58	1.6	4.3	0.10
34	HREC-38	35	3.7	4.5	0.48
35	HREC-39	58	2.6	6.8	0.30
36	HREC-40	55	3.5	4.5	0.57
37	HREC-41	26	3.6	5.6	0.18
38	HREC-42	64	2.9	4.9	0.51
39	HREC-43	63	3.9	5.3	1.05
40	HREC-44	68	3.2	6.5	0.52
41	HREC-45	26	6.4	5.6	1.28
42	HREC-49	58	7.1	5.5	1.64
43	HREC-50	52	4.4	4.4	1.07

## JAGDALPUR

During the fruiting season (2018-19), the survey was conducted in the five blocks viz., Bakawand, Jagdalpur, Tokapal, Bastanar and Darbha of Bastar District, Geedam block of District and Bhanpuri block of Kondagaon District. The survey was aimed to select germplasm for bold nut, cluster bearing, early season flowering and compact canopy. Four germplasm accessions from Bakawand districts viz., Kaudawand-1, Kaudawand-2, Rajnagar-1 and Rajnagar-2 were selected for bold nut and apple

characters. Similarly, two germplasm accessions from Darbha district viz., Dhodhrepal-1 and Dhodhrepal-2 were selected for cluster bearing and medium to large size nut character. A off-type genotype was observed in Bhanpuri village which was reported to be early in fruiting under Bastar agro-climatic conditions. The nuts of Bhanpuri-1 can be harvested in late January, however, its nut is inferior in quality. Total of four germplasm accessions viz., Kaudawand-1, Kaudawand-2, Dhodhrepal-1 and Dhodhrepal-2 were grafted during 2019 and

field plantation will be carried out next year in the gene bank. Rest of the germplasm accessions will be studied further in coming fruiting seasons for

inclusion in gene bank. The in-situ observations and detailed information are presented in Table 1.6.



Fig. Promising germplasm selection from Kaudawand village of Bastar District

Table 1.6 : Nut, apple and tree characters of surveyed germplasm during 2018-19 at Jagadalpur

Sl. No.	Collection Name	Average nut weight (g)	Average apple weight (g)	Apple colour	Average nut yield (kg/plant)	Special features
1.	Kaudawand-1	9.21	49.43	Orange	12	Nuts of this genotype are bold with 3-5 nuts per panicle and profuse flowering.
2.	Kaudawand-2	11.12	67.41	Yellow	11	Bold nut genotype, compact canopy and profuse flowering.
3.	Rajnagar-1	8.41	79.62	Yellow	9	Late season genotype, with large size apples and high juice recovery.
4.	Rajnagar-2	7.26	51.68	Orange	9	Mid season in fruiting. Semi spreading in branching. Apples are low in acidity.
5.	Dhodhrepal-1	7.41	61.24	Orange	4	Cluster bearing habit. Late season in fruiting.
6.	Dhodhrepal-2	8.67	58.26	Orange	5	Upright tree habit. Cluster bearing habit. Nuts are above 8.5 g. Very Late season in fruiting and nuts are harvested during late May.
7.	Bhanpuri-1	4.86	51.26	Yellow	6	This genotype is extra early in flowering and fruiting. Peak season of flowering is December and Nuts can be harvested starting from last month of January.

## Evaluation of promising cashew germplasm of Bastar region

### Experimental details

Number of germplasm accession	: 6
Number of plants/germplasm accession	: 4
Year of planting	: 2018 and 2019

The trial was initiated during August 2018 with 16 germplasm and rest of the germplasm were planted during 2019. The aim of the present trial is to find out suitable germplasm for bold nut, cluster bearing with good nut character, tolerance to major pests (leaf miner, leaf folder and TMB), dwarf and compact canopy for Bastar region. These accessions were selected during survey and collection programme was started from 2006. Until now CARS-1 to CARS-11 were maintained in SG CARS, Jagdalpur in gene bank and rest of the germplasm accessions were only studied *in-situ*. All 24 germplasm were planted in Upland Research Station, Lamker (District Bastar) for evaluation.

During 2018-19, scion sticks were collected from eight different selected genotypes viz., CARS-4, CARS-6, CARS-7, CARS-14, CARS-16,

CARS-22, CARS-23 and CARS-24 under survey and collection programme. The clonal planting material were raised by softwood grafting. Grafted plants of collected germplasm were planted in the gene bank of Lamker for further evaluation. *In-situ* characterization of genotypes from CARS-1 to CARS-24 has been completed.

### CONCLUDED TRIAL

## Evaluation of promising DCR entries under Bastar Plateau conditions

### Experimental Details

No. of accessions	: 10
Plants per accessions	: 6
Year of planting	: 1996

The experimental data presented in Table 1.7 revealed that during 2018-19, the maximum tree height (8.59 m), number of flowering laterals/m<sup>2</sup> (17.75) and mean nut weight (8.50 g) were reported in NRC-138. The maximum mean number of nuts per panicle (6.20) and cumulative yield for 20<sup>th</sup> harvest (117.11 kg/tree) were reported in NRC-137. Whereas, maximum apple weight (104.40 g) and shelling percentage (29.50) was reported in NRC-140 and NRC-131 respectively.

**Table 1.7 : Mean annual nut yield (kg/tree) of DCR entries from 2012-13 to 2016-17 at Jagdalpur**

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

Based on the yield data from 2012-13 to 2016-17, accessions, NRC-137 and NRC-138 performed well compared to other accessions. The experiment was concluded during 2018-19. These accessions are maintained in the gene bank of AICRP Cashew, Jagdalpur.

Evaluation of promising NRC entries was concluded last year and report was presented before the QRT. From the studies it was revealed that NRC-137 and NRC-138 germplasm accession were found to be promising for Bastar region.

### **JHARGRAM**

At present, the center is maintaining 33 primary germplasm collections, 78 secondary germplasm collections and 57 varieties, therefore, a total of 168 total germplasm accessions.

During 2018-19, the centre has collected 4 germplasm accessions from the farmers' orchard located in the Jhargram district. The orchards are not maintained properly; still the accessions exhibited higher nut weight (9.08m), high shelling percentage and high yield. The plants were not affected by CSRB or TMB. So they were found promising and were collected and added to the germplasm bank of AICRP on Cashew, RRS, BCKV, Jhargram.

### **MADAKKATHARA**

#### **GERMPLASM COLLECTION**

During the 2018-19, germplasm survey was undertaken in parts of Idukki, Kollam and Kannur districts of Kerala. A bunch bearing type from Idukki, suitable for "High Hill - Agro Ecological Zone IV" and a local bold nut genotype from Kannur were identified for evaluation.

#### **GERMPLASM CONSERVATION**

The germplasm conservation block has been established with 142 accessions by planting four plants of each accession at a closer spacing of 4m x 4m. Two genotypes viz., H03 178 and H03 173 were identified from the Farm field of CRS, Madakkathara, for promising nut and apple characters and included in the germplasm conservation block.

### **PILICODE**

A new trial with new germplasm accessions was initiated in 2017. The promising variety from the earlier trial, PLD 4 was also included in the new trial. The observations recorded on plantlets are furnished here under. The germplasm showed significant differences in height, spread in both NS and EW directions and canopy area. Girth of the plants did not show any differences.

Regarding plant height, accessions except PLD 88 and PLD 91 had the highest height. Shortest plants were observed with PLD 91 (0.74m) and PLD 88 (0.91m). Canopy spread in EW direction was highest for PLD 83, PLD 84, PLD 85 and PLD 86. Canopy spread (EW) was minimum in PLD 91. Regarding the NS Spread, PLD 83 was the highest. Lowest spread was observed with PLD 91 and PLD 90. Highest canopy area was observed in PLD 83, PLD 86 and PLD 84. Lowest was observed in PLD 91.



**Plate 1: Field view of the plot**

### **TURA**

During 2018-19, two early bearing and one bold nut cashew genotype have been characterized and passport data were recorded. The grafted plants were also produced for subsequent evaluation.

### **VENGURLA**

At present, there are total 318 cashew germplasm accessions in the gene bank and of these, 38 types were collected from other centres.

The 10 cashew accessions planted during 2005 were evaluated and characterized during the year 2018-19 as per descriptor. Growth observations of all 21 types revealed that among the 21 types, the maximum tree height (5.07 m), stem girth (58.67 cm), EW canopy spread (5.58 m), NS canopy spread (6.15 m), canopy area (26.96 m<sup>2</sup>) and number of laterals/m<sup>2</sup> (29.0/m<sup>2</sup>) were recorded in RFRS 195. Total 21 cashew accessions were planted during 2008-2018, out of which, 17 cashew accessions planted during 2014 to 2018 are small and yet to start flowering and fruiting and only 4 accessions have started the flowering, fruiting and started giving yield. Among the 4 types, the

maximum flowering duration (111.70 days), number of nuts per sq. m. (30.20) and number of nuts per panicle (5.40) were recorded in RFRS 195. The highest sex ratio (0.23) was observed in RFRS 198.

Yield attributing data of 4 cashew germplasm showed that RFRS 198 had maximum nut weight (7.80 g). The highest apple weight (70.0 g) was recorded in RFRS 196. The highest shelling percentage (32.0) was recorded in RFRS 195. The maximum annual nut yield (6.49 kg/tree) and cumulative nut yield at 6 harvests (17.24 kg/tree) was observed in RFRS 195 for the year 2018-19.

**Table 1.8 : Yield parameters of promising cashew germplasm at Vengurle centre during the year 2018-19**

Accession No.	Nut wt (g)	Apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree)	Cum. yield (kg/tree)
RFRS 195	6.10	50.00	32.00	6.490	17.24*
RFRS 196	7.30	70.00	28.50	0.340	0.90**
RFRS 197	7.60	68.00	28.00	0.410	0.94**
RFRS 198	7.80	45.00	30.00	0.175	0.605**

\*Cum. yield for 6 harvests and \*\* Cum. yield for 3 harvests

## VRIDHACHALAM

The trees of accessions from this project are conserved in the gene bank at Regional Research Station, Vridhachalam.

## Gen 1a : Evaluation of Cashew Nut and Shell Liquid (CNSL) free germplasm accessions

*Centres: East Coast* : Bapatla and Vridhachalam

*West Coast* : Vengurla

*Plains / others* : Hogalagere



**Objective:** To evaluate CNSL free accessions for yield and yield attributes

### VENGURLA

**Design** : RCBD  
**Replication** : Four  
**Treatment** : Six CNSL free types  
**Treatment Details** : T<sub>1</sub> : NRC-116  
T<sub>2</sub> : NRC-188  
T<sub>3</sub> : NRC-189  
T<sub>4</sub> : NRC-281  
T<sub>5</sub> : NRC-285  
T<sub>6</sub> : RFRS-195  
**Spacing** : 5 x 5 m  
**Year of planting** : 1<sup>st</sup> July, 2018

The replicated trial of all six CNSL free types was started at Vengurla centre during July, 2018. The care and maintenance of the planted grafts is in progress. Observations on vegetative growth parameters of the trial are recorded in June, 2019.

### VRIDHACHALAM

The scion sticks of two germplasm accessions viz., NRC 189 and NRC 281 from DCR, Puttur were collected and grafted at Regional Research Station, Vridhachalam. Planting was done during December 2019. The other three types available at DCR, Puttur will be collected and planted during 2020.

## Gen.3. Varietal Evaluation Trials

### Expt.1. Multi Location Trial – III

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

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



#### HOGALAGERE

This experiment was laid out at HREC, Hogalagere in the beginning of 2017. The plants are less than three years old.

#### VENGURLA

The MLT-III trial was concluded by AICRP-Cashew, Vengurla centre during the year 2018-19 after completing the 7 crop harvests.

#### Inference

Among the 11 genotypes studied under MLT-III trial, on the basis of pooled study, the highest number of laterals/m<sup>2</sup>, number of panicles/m<sup>2</sup>, fruit set/m<sup>2</sup> and nuts/panicle were maximum in B.H.6 (29.26/m<sup>2</sup>), H-1593 (18.25/m<sup>2</sup>) and B.H. 85 (32.30/m<sup>2</sup> and 5.80). Whereas, the maximum nut weight were recorded in V-7 (8.92g), B.H.6 (8.53g)

& H-662 (8.49g) while apple weight was maximum in B.H.6 (82.53g). The highest yield (5.40 kg/tree or 1.05 t/ha) and cumulative yield for 7 harvests (37.82 kg/tree) were recorded in H-662. The highest shelling percentage was recorded in B.H.6, B.H.85, H-675, H-1593 and Goa 11/6. None of the genotypes were found to be TMB tolerant during the investigation period.

In overall, H-662 appeared to be best and performed well in respect of yield (5.40 kg/tree or 1.05 t/ha and cumulative yield for 7 harvests 37.82 kg/tree) as compared to rest of the genotypes and having medium bold size nut (8.49g). Although, H-662 exhibited lower nut yield, yet it exhibited 100% higher yield advantage over released varieties (V-7, V-8 & V-9) and the specific features in said hybrid during investigation period was not observed.

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

*Centres: East Coast* : Bapatla, Jhargram and Vridhachalam  
*West Coast* : Pilicode  
*Plains / others* : Darisai, 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.

### BAPATLA

The trial was laid out during the year September 2014 with the following released varieties of different centres.

Year of Planting : September, 2014  
 Design : RBD  
 No. of Replications : 3  
 No. of plants per replication : 4

State	No.	Released varieties
Andhra Pradesh	3	BPP-4, BPP-6 and BPP-8
Maharashtra	4	Vengurle-1, Vengurle-4, Vengurle-6 and Vengurle-7
Karnataka	5	Chintamani-1, Ullal-1, Ullal-3, Ullal-4, UN-50
Kerala	7	Madakkathara-1, Madakkathara-2, Priyanka, Dhana, Kanaka, Amrutha and K-22-1.
West Bengal	1	Jhargram-1
Orissa	1	Bhubaneswar-1
DCR Puttur	2	NRCC Sel-2, Bhaskara
Tamilnadu	1	VRI-3
GOA	1	Goa-1
<b>Total</b>	<b>25</b>	

Among the 25 released varieties of different centres evaluated, there was no significant difference observed with respect to mean plant height, canopy height and mean canopy spread.

Among the 25 genotypes studied, the duration of flowering ranged from 66.0 days to 87.0 days. The shortest flowering duration was recorded in Chintamani-1 (66.0 days) followed by Jhargram-1 and Ullal 4 (67.0 days). With respect to flowering intensity, mean number of flower panicles per

square meter and mean number of nuts per panicle were found to be significant. The flowering intensity per square meter was highest in Amrutha (17.30) followed by Kanaka (17.20) and Madakathara-1 (17.00). The mean no of nuts per square meter was highest in Madakathara-1 (35.56) followed by BPP 4 (34.20) and Madakathara-2 (33.20). The mean no of nuts per panicle was found maximum in BPP 4 and Madakathara-1 (4.30) followed by Madakathara - 2 (4.20).

**Table 1.9 : Yield parameters of cashew genotypes in MLT-V at Bapatla Centre during 2018-19**

Sl.No.	Variety/ Genotype	Nut weight (g)	Apple weight (g)	Shelling (%)	Nut Yield /tree (kg) (Harvest No.2)
1.	BPP 4	5.30	35.10	31.80	3.57
2.	BPP 6	6.61	42.67	29.40	1.87
3.	BPP 8	8.20	63.00	26.80	3.96
4.	BBSR -1	4.36	34.00	34.17	2.35
5.	CHINTAMANI-1	5.10	26.00	32.78	1.96
6.	JHARGRAM-1	5.06	35.00	30.10	2.30
7.	MADAKATHARA-1	4.37	38.10	33.00	1.96
8.	MADAKATHARA-2	5.10	39.00	32.14	2.20
9.	K-22-1	8.10	51.00	31.10	2.62
10.	DHANA	7.20	50.00	26.74	2.80
11.	KANAKA	5.90	70.00	27.40	2.32
12.	PRIYANKA	9.20	71.20	28.64	1.97
13.	AMRUTHA	6.10	63.30	31.34	1.88
14.	VENGURLA -1	5.90	62.60	31.14	2.43
15.	VENGURLA -4	6.90	51.00	31.70	1.93
16.	VENGURLA -6	9.30	54.30	30.10	1.75
17.	VENGURLA -7	8.42	56.30	28.08	3.00
18.	VRI-3	6.86	44.30	31.00	2.85
19.	NRCC SEL 2	7.43	63.10	30.85	2.60
20.	ULLAL 1	4.30	26.00	30.00	2.84
21.	ULLAL 3	7.42	37.00	30.76	2.30
22.	ULLAL 4	5.30	29.00	29.67	1.53
23.	UN 50	7.80	61.00	29.67	2.30
24.	GOA 1	6.50	64.00	33.37	1.75
25.	BHASKARA	6.50	43.50	27.27	2.92
	CD@5%	1.74	6.14	3.37	0.88
	SEm ±	0.61	2.15	1.18	0.31

With respect to mean nut weight, mean apple weight, shelling percentage and mean annual nut yield per tree, the varieties were found to be significant. Among the 25 released varieties, the mean nut weight was maximum in Vengurla-6 (9.30g) followed by, Priyanka (9.20 g) Vengurla-7 (8.42g) and BPP-8 (8.20 g). The maximum mean

annual nut yield per tree was recorded in BPP-8 (3.96 kg) followed by BPP 4 (3.57 kg) and Vengurla-7 (3.00 kg). With regard to the mean apple weight, the highest was recorded in Priyanka (71.20 g) followed by Kanaka (70.00 g). The shelling percentage was recorded highest in BBSR-1 (34.17) followed by Goa-1 (33.37).

## DARISAI

**Table 1.10 : Yield parameters of cashew genotypes in MLT-V at ZRS, Darisai Centre during the year 2018-19**

Accession	Year of planting	Mean nut wt. (g)	Mean apple wt. (g)	No. of laterals /m <sup>2</sup>	Duration of flowering days	Mean yield (kg/ tree)	Cumulative yield (Four harvests)
BH6	2011	7.58	75.01	21.72	102.15	4.01	12.70
BH85	2011	7.32	61.59	15.79	114.85	3.82	9.98
H1597	2011	7.78	64.42	23.38	97.24	4.23	13.08
H662	2011	7.24	75.55	19.42	95.89	3.68	11.64
H675	2011	4.86	66.76	13.46	102.98	4.19	11.23
H11	2011	5.68	73.56	16.96	129.14	4.26	12.68
H14	2011	4.96	65.92	14.14	95.15	4.65	11.91
H32/4	2011	6.88	62.94	15.78	87.81	3.86	11.45
GOA11/6	2011	6.28	75.52	11.62	120.01	2.65	9.03
BPP-4	2011	6.75	40.12	19.42	94.05	3.26	11.51
BPP-6	2012	6.24	42.72	25.52	97.92	5.08	14.54
BPP-8	2012	8.08	72.58	35.66	117.93	4.65	14.99
DHANA	2012	8.56	71.43	30.52	115.22	2.85	12.53
MADAKKATHARA-1	2012	7.82	41.66	10.65	91.76	2.13	6.64
MADAKKATHARA-2	2012	7.64	50.92	12.29	113.92	1.72	7.44
KANAKA	2012	10.38	57.35	18.26	118.13	3.29	11.02
VENGURLA-1	2012	8.64	61.97	16.32	96.57	2.72	10.14
PRIYANKA	2012	12.08	81.03	27.86	91.97	2.94	12.07
ULLAL-1	2013	7.44	44.57	14.48	131.78	1.48	8.41
GOA-1	2013	7.36	52.61	12.73	114.95	3.06	8.78
BHASKAR	2013	8.34	50.92	14.15	124.42	2.98	9.52
VRI-3	2013	6.32	61.86	33.87	87.58	4.37	14.29
K22-1	2013	8.31	115.14	13.7	132.22	2.25	8.3
JHARGRAM-2	2014	5.62	47.56	14.93	98.78	2.85	8.57
SEm±		1.24	13.24	2.24	4.86	0.23	0.48
CD(5%)		3.78	39.24	6.78	14.84	0.58	1.45
CV(%)		13.46	15.78	13.47	16.18	14.32	13.54

The cumulative yield of variety BPP-8 (14.99 Kg/plant) on the basis of four harvests was maximum followed by BPP-6 (14.54 Kg/plant) VRI-3 (14.29 Kg/plant) and H-1597 (13.08 Kg/plant). Duration of flowering ranged from 132.22 days in K22-1 to 87.58 days in VRI-3. Range of mean apple weight was 115.14 gm in K22-1 to 40.12 gm in BPP-4. Mean nut weight was highest in Priyanka (12.08 gm) followed by Kanaka (10.38 gm).

## HOGALAGERE

The growth parameters of varieties during 2018-19 showed tree height ranging from 2.0 to

3.2 m and trunk girth from 28 to 53 cm. The maximum plant height was recorded in UN-50 and Jhargram-1 (3.2 m) and stem girth in Goa-1 (53 cm). The canopy spread of the varieties ranged from 8.0 to 25.5 m<sup>2</sup> with maximum in Jhargram-1 and flowering duration ranged from 32 to 93 days with maximum in Jhargram-1. Among the yield parameters, percent flowering intensity per square meter ranged from 61 to 97 (maximum Kanaka), fruits per panicle ranged from 4.4 to 7.8 (maximum Chintamani-2), nut weight from 5.2 to 11.3g (max. Vengurla-7), yield per plant ranged from 0.93 to 3.24 kg (Ullal-4), while apple weight was in the range of 27.0 to 94.2g (max. Goa-1).

**Table 1.11 : Yield parameters of cashew genotypes in MLT-V (Date of planting 02-01- 2015) at Hogalagere**

Sl. No.	Variety	Fl.Int./sq.m (%)	Fruits/panicle (No.s)	Nut weight (g)	Yield / plant (kg)	Apple weight (g)	TMB tolerance
01	Chintamani-1	75	5.4	7.6	2.12	36.4	medium
02	Madakathara 1	87	5.1	6.9	0.99	71.1	medium
03	Vengurla-1	87	5.8	5.3	2.67	43.2	High
04	Priyanka	76	6.0	6.3	1.36	32.3	High
05	Goa-1	84	5.8	7.2	2.69	94.2	High
06	Bhaskara	84	5.0	6.7	1.12	61.1	High
07	Ullal-3	73	6.0	8.4	2.85	44.0	medium
08	BPP-6	81	5.9	5.6	2.96	39.5	medium
09	Madakkathara-2	82	6.7	6.7	1.39	65.0	medium
10	Vengurla-6	74	6.6	7.8	2.10	59.1	High
11	Vengurla-7	72	5.8	11.3	1.37	32.1	High
12	K-22-1	96	7.5	7.8	1.64	38.5	medium
13	NRCC-sel-2	89	5.5	7.2	1.32	47.4	High
14	Ullal-1	61	4.5	7.6	2.47	44.7	High
15	Ullal-4	76	5.7	7.5	3.24	74.3	High
16	UN-50	72	4.9	9.5	0.93	51.6	High
17	Kanaka	97	5.4	5.9	1.25	59.8	High
18	Jhargram -1	93	4.4	5.8	1.68	43.4	High
19	Chintamani-2	90	7.8	5.6	1.05	29.4	High
20	Amrutha-10	91	5.7	5.2	2.56	47.9	High
21	VRI-3	96	5.8	5.9	2.70	27.0	Medium
22	BPP-4	76	5.3	8.5	1.76	29.5	Medium
23	Dhana	87	5.2	8.1	1.35	43.7	High
	<b>SEm ±</b>	2.63	0.34	0.54	0.16	2.28	-
	<b>CD at 5%</b>	7.51	0.98	1.53	0.45	6.50	-
	<b>CV %</b>	5.55	10.36	13.22	13.57	8.14	-

## JAGDALPUR

The experiment was laid out during 2018-19 with the identified cashew varieties with 4 plants per variety. Twenty one varieties were planted during the year 2019. Grafting of procured scions of three varieties viz., Amrutha, Ullal-3 and Ullal-4 has been prepared and they will be planted in December-January months. Being the first year of planting, no observations were recorded. The vegetative growth of the plants was satisfactory.



## JHARGRAM

The varieties were grouped into three different groups based on the nut weight i.e. bold nut having weight between (7- 9)g, medium nut weight between

(5 - 6)g and small nut (<5g). Among the 24 varieties, varieties such as Priyanka, Vengurla-7, UN-50, BPP-8, Vengurla-6, Ullal-3, NRCC-2, Bhaskara and Dhana had bold nuts. Most of the varieties produced medium sized nuts. Among the twenty four varieties, Bhubaneswar-1 and Jhargram-1 produced small sized nuts (4 - 5 g nut weight). Significant variations were observed with respect to apple weight of the varieties. Priyanka and Bhaskara were on par with respect to apple weight but produced heaviest apples (92.4 – 99.4g), while the smallest apples were recorded in Madakkathara-2 (39.53g).

In case of shelling percentage, varieties were statistically on par with each cases. Maximum yield was recorded in Vengurla-7 (10.69 Kg/tree). Other varieties were statistically on par with respect to yield /tree. Cumulative yield for 6 harvests was maximum in Vengurla – 7 (36.93 Kg/tree) followed by Bhaskara (34.85 Kg/tree) and Ullal-3 (27.78 Kg/tree) while it was minimum in Madakkathara – 2 (14.22 Kg/tree). Therefore, based on the main four yield characters i.e. nut weight, shelling%, yield/tree and cumulative yield/tree for recommending varieties for the red and laterite zone of West Bengal, Vengurla-7, Bhaskara, Ullal-3, BPP-8 and Dhana were found promising varieties for this region.

**Table 1.12 : Yield parameters of cashew genotypes in MLT-V at Jhargram centre during 2018 -19 (Year of Planting: 2010)**

Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual Nut Yield (kg/tree)	Cum. Yield (kg/tree) (for 6 Harvests)
Bhaskara	7.75	92.40	27.78	8.75	34.85
Madakathara II	6.85	48.00	26.24	5.09	18.36
Bhubaneswar 1	5.00	55.00	31.03	4.83	24.72
K-22-1	6.10	61.13	28.74	4.08	19.30
Chintamani 1	6.75	41.08	30.44	3.99	16.68
Ullal 4	5.70	87.53	26.29	4.66	23.04
Vengurla 7	9.00	54.65	30.96	10.69	36.93
VRI - 3	6.95	43.13	28.40	3.30	18.47
BPP-6	5.70	66.80	25.35	3.68	15.88

Amrutha	6.55	51.33	30.51	3.35	18.08
Vengurla 4	6.90	73.20	29.00	5.05	23.14
Goa 1	6.95	69.47	30.17	5.22	18.90
Madakkathara 2	6.35	39.53	27.55	3.99	14.22
Priyanka	9.40	99.43	24.27	4.68	17.68
BPP-8	8.40	80.78	29.83	5.02	23.66
Kanaka	6.25	85.25	30.25	6.05	22.06
Vengurla 1	5.90	62.68	21.59	5.48	19.67
Vengurla 6	8.35	91.76	30.65	4.81	17.87
Ullal 3	8.05	54.00	29.07	7.68	27.78
Dhana	7.50	65.28	29.46	5.27	19.54
BPP 4	5.80	56.98	25.38	3.09	15.54
UN-50	8.88	67.48	30.69	6.81	23.15
Jhargram 1	4.90	56.95	31.15	3.86	16.82
NRCC Sel-2	7.80	60.03	29.48	3.74	17.84
SEM±	0.24	0.86	1.23	0.59	
C.D. at 5%	0.67	2.43	3.48	1.67	
CV%	6.80	2.64	8.64	23.06	

## PILICODE

The experiment was laid out during 2007-08. Twenty five varieties were allotted for the experiment and 20 released varieties with 10 plants each were planted during June 2008. The biometric observations were recorded. The varieties differed among themselves for all the biometric characters studied.

Higher proportion of bisexual flowers to male flowers was found in Priyanka (0.20, 0.28) followed by Ullal-3 and Bhaskara while least was observed

in BPP 8 and Ullal 1 (0.05). Nut set/sq.m was highest in K-22-1 (12.00). Highest nut weight was recorded in Amrutha and Priyanka followed by BPP 8. Heaviest apples were found in BPP 8 followed by NRCC Sel 2. Highest shelling percentage was recorded with NRCC Sel-2, Ullal-1, Ullal-4, UN-50 and Vengurla 4. Priyanka had the highest annual nut yield which was followed by Kanaka. Priyanka and Kanaka had the highest cumulative yield. This was followed by Madakkathara-2. Least cumulative yield was reported from VRI-3 and BPP-6.

**Table 1.13 : Yield parameters of cashew genotypes in MLT-V at Pilicode centre during 2018-19 (2008 planted)**

Accession No.	Mean nut wt. (g)	Mean apple wt.	Shelling % (g)	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 6 Harvests)
BPP-6	9.03	52.00	31.38	0.73	6.28
BPP-8	9.32	92.50	30.55	2.61	24.84
Bhubaneswar-1	8.22	73.50	28.96	4.08	42.13
Madakkathara-1	6.50	47.50	32.61	6.41	24.32
Madakkathara-2	7.02	63.50	32.26	6.09	55.11
K-22-1	6.31	52.00	28.54	1.11	15.38

Dhana	6.54	61.50	35.18	2.80	9.11
Kanaka	9.48	60.00	31.50	18.18	82.51
Priyanka	10.01	62.25	32.18	21.93	86.37
Amrutha	10.48	63.00	31.20	1.97	35.74
Vengurla-4	7.51	53.00	34.25	1.13	7.63
Vengurla-7	9.01	48.75	33.22	4.02	15.49
VRI-3	9.02	52.00	32.27	0.80	6.52
NRCC Sel-2	8.29	85.50	35.39	1.19	7.34
Ullal-1	6.87	50.00	34.20	10.41	27.26
Ullal-3	8.09	53.00	33.47	5.92	23.71
Ullal-4	8.97	54.00	34.10	4.97	44.72
UN-50	8.46	62.50	34.07	7.27	16.52
Goa-1	5.81	57.50	32.63	1.76	12.53
Bhaskara	8.57	54.00	33.62	1.74	19.54
CD at 5%	1.39	6.23	1.12	2.20	
CV%	8.12	4.72	1.63	19.29	

### Gen.3. Special Multi Location Trial – (MLT – VI )

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).



#### DARISAI

**Table 1.14 : Yield parameters of cashew genotypes in MLT-VI at ZRS, Darisai Centre during the year 2018-19**

Accession	Year of planting	Mean flowering duration (Days)	Mean apple wt. (gm)	Mean nut wt. (g)	Mean nut yield 4 <sup>th</sup> Year (kg/tree)	Cumulative Nut Yield (kg/plant) of four harvest
NRCC sel-1	2010	104.42	72.78	6.92	2.94	10.3
NRCC sel-2	2010	116.05	67.46	7.62	3.74	12.6
M44/3	2010	99.54	42.52	6.28	4.04	12.66
M15/4	2010	108.03	82.92	7.72	4.42	13.5
BPP3/33	2012	104.32	61.78	6.91	3.48	11.4
BPP10/19	2012	99.68	55.18	6.47	2.94	10.1
BPP30/1	2012	96.57	49.26	6.92	2.32	7.4
BPP 3/28	2012	92.64	73.35	7.86	3.68	10.5
H303	2012	112.86	68.97	8.58	3.82	11.8
H255	2013	109.92	72.61	6.08	3.94	12.9
H367	2013	99.86	104.94	7.12	3.44	12
H68	2013	102.94	71.28	5.42	4.14	13.1
SEm±		3.34	4.02	0.39	0.18	0.28
CD (5%)		9.12	11.96	1.04	0.51	0.74
CV (%)		14.56	15.48	14.18	13.34	13.28
CV (%)		14.62	16.76	13.86	12.38	12.56

The mean flowering duration ranged from 92.64 days (BPP-3/28) to 116.05 days (NRCC-Sel-2). The varieties H-303 (112.86 days) and H-255 (109.92 days) are significantly at par. The mean apple weight of variety H-367 (104.94 gram) are significantly superior to all other variety tested. The mean nut weight of H-303 recorded the highest

nut weight (8.58 gram) followed by BPP-3/28 (7.86 gram). The maximum nut yield was recorded in M-15/4 (4.42 kg/plant) followed by 4.14 kg in H-68 in fourth harvest. The cumulative yield was also highest in M-15/4 (13.5 Kg/plant) followed by H-68 (13.1 Kg/plant) after fourth harvests.

## KANABARGI

Year of planting	: 2015
Design	: RBD
Replication	: Three
Spacing	: 6 m x 6m
Number of plant per replication	: 5
Varieties/No. of entries	: 8
1. NRCCSel-2	5. Bhaskara
2. BPP-8	6. Dhana
3. VRI-3	7. VRI (CW) H-1
4. H 303	8. Vengurla 4

The Vegetative growth parameters of 3<sup>rd</sup> year are presented below in Table 1.15.

Significant difference was recorded with respect to plant height and trunk girth. Maximum plant height (m) were recorded in VRI-3, Dhana and Bhaskara, while VRI-H-1 recorded lower plant height. Maximum and minimum trunk girth were recorded in VRI-3 followed by Bhaskara and BPP-8. No significant difference was found with respect to tree spread and nut yield.

**Table 1.15 : Performance of different varieties of cashew at HRES, Kanabargi**

Sl. No.	Treatments	Plant height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height	Tree Spread (m <sup>2</sup> )		Nut yield (kg/tree)
						EW	NS	
1	H-303	2.60	46.00	0.47	2.13	3.28	4.18	1.57
2	VRI-H-1	2.08	37.67	0.77	1.58	2.78	2.87	1.87
3	NRCC-2	2.83	49.67	0.68	2.15	3.33	3.57	2.41
4	Vengurla-4	2.87	45.00	0.43	2.43	3.62	3.40	1.74
5	Bhaskar	2.63	54.50	0.40	2.26	3.50	3.42	2.42
6	VRI-3	3.50	56.17	0.47	3.03	3.75	3.47	1.41
7	Dhana	2.93	43.67	0.34	2.58	3.13	3.10	1.80
8	BPP-8	2.83	37.50	0.43	2.40	2.92	2.77	0.96
	SEm±	0.14	2.11	0.09	0.13	0.18	0.37	0.21
	CD 5%	0.42	6.39	0.26	0.39	0.55	1.13	0.63



H-303



VRI-H-1



NRCC-2



V-4

## TURA

Among the cashew genotypes highest plant height was recorded in Bhaskara (4.13 m) followed by VRI (CW) H-1 (3.68 m) and Dhana (3.67 m), while lowest in VRI-3 (2.64 m). Plant spread (NS x EW) was recorded highest in Dhana (4.51 x 5.03 m), while lowest in H-303 followed by BPP-8.

**Table 1.16 : Growth attributes of cashew genotypes in MLT-VI at Tura Centre during 2018-19**

Accession	Year of planting	Plant height (m)	Plant spread (m)	
			NS	EW
Dhana	2010	3.67	4.51	5.03
VRI (CW)H-1	2011	3.68	3.70	3.67
Bhaskara	2015	4.13	3.64	3.87
BBP-8	2015	3.27	2.72	3.80
VRI-3	2015	2.64	3.23	3.24
H-303	2015	3.50	2.57	3.57
V-4	2015	3.13	3.83	4.00
SEm±		0.20	0.35	0.42
CD (0.05)		0.61	1.05	1.27

## Gen.4. Hybridization and Selection

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

*West Coast* : Goa and Vengurla

*Plains / others* : Hogalagere



The objective of this experiment is to utilize 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

Existing F1 progenies have been evaluated for the vegetative characters and reproductive traits such as duration of flowering, yield and nut weight etc. The mean nut weight was maximum in H-218 (11.00 g) followed by H-194 (5.88 g). The mean apple weight was recorded highest in H-200 (58.30 g) followed by H-194 (54.8 g). The shelling percentage was found highest in H-200 (28.63) followed by H-186 (28.39). The annual nut yield per tree was found highest in H-218 (18.00kg) followed by H-187 (0.88 kg). The cumulative nut yield per tree was found highest in

H-218 (116.75 kg) followed by H-197 (72.83 kg) for 10 annual harvests.

The mean nut weight was found highest in H-362 (8.03g) followed by H-359 (7.61g). The shelling percentage was highest in H-350 (32.55) followed by H-371 (29.95). The mean annual nut yield per tree was recorded highest in H-365 (11.0 kg/tree) followed by H-355 (10.20 kg/tree). The cumulative nut yield was found highest in H-365 (107.05 kg) followed by H-355 (101.91 kg/tree) for 8 annual harvests.

**Table 1.17 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2009**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 6 <sup>th</sup> harvest (2019)	Cum. nut yield (kg/tree) (for 6 Harvests) 2014-2019
H445	M15/4xT.No.30/1	6.57	41.25	28.82	1.30	17.25
H 461	VRI-3xBPP-9	7.71	53.75	29.21	1.86	28.96
H 464	BPP-3xPRIYANKA	6.86	43.75	29.72	1.73	24.43
H 467	BPP-3xPRIYANKA	7.43	78.75	28.96	9.2	31.90
H 472	VRI-3xBPP-8	6.8	66.25	23.42	8.5	30.45
H 474	VRI-3xBPP-8	8.95	43.75	25.72	1.05	20.55
H 483	M15/4xTNO.228	5.71	53.75	20.58	2.30	29.10
H 485	M15/4xTNO.228	7.49	51.25	26.68	1.38	19.63
H 486	VRI-2xBPP-8	6.81	48.75	28.58	1.43	19.13
H 487	VRI-2xBPP-8	6.37	55.25	27.72	1.35	19.10

H 488	VRI-2xBPP-8	4.01	27.25	25.74	1.55	17.70
H 491	VRI-2xBPP-8	7.91	63.75	26.31	10.0	31.20
H 492	VRI-2xBPP-8	8.19	43.75	19.11	1.85	25.70
H 493	VRI-2xBPP-8	4.86	31.25	22.58	1.55	21.15
H 496	VRI-2xBPP-8	7.23	43.75	22.98	2.05	21.70
H 497	VRI-2xBPP-8	5.34	27.25	21.88	1.30	17.10

The mean nut weight was recorded highest in H-474 (8.95 g) followed by H-462 & H-490 (8.46 g). The mean apple weight was found highest in H-462 (85.25 g) followed by H-463 (74.95 g). The shelling percentage was recorded maximum in H-482 (30.58) followed by H-468 (30.30). The

mean annual nut yield was found highest in H-491 (10.0 kg/tree) followed by H-467 (9.20 kg/tree). The cumulative nut yield was maximum in H-467 (31.90 kg/tree) followed by H-491 (31.20 kg/tree) for 6 annual harvests.

**Table 1.18 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2010**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 5 <sup>th</sup> harvest (2019)	Cum. yield (kg/tree) (for five harvests) 2015-2019
H504	T.No.30/1 x M15/4	7.02	47.1	25.65	1.85	21.31
H 525	BPP-5 x BPP-8	6.01	57.3	26.42	1.10	14.46
H 530	T.No. 30/1 x Priyanka	9.68	92.6	20.5	3.55	33.50
H 531	T.No. 30/1 x Priyanka	6.68	73.1	18.75	1.05	13.85
H 532	T.No. 30/1 x Priyanka	6.58	47.1	25.71	1.10	13.60
H 546	BPP-5 x H-320	5.42	47.1	28.3	1.15	12.54
H 547	BPP-5 x H-320	5.56	46.6	28.28	1.30	14.04
H 548	BPP-5 x H-320	6.66	74.1	29.49	1.00	13.10
H 554	BPP-3 x Priyanka	7.36	44	25.5	1.33	16.68
H 555	BPP-3 x Priyanka	3.96	39.1	31	1.35	16.33
H 556	BPP-3 x Priyanka	8.86	69.1	32.89	1.23	13.29
H 558	BPP-3 x Priyanka	6.89	44.6	20.23	1.10	12.45
H 581	VRI-3 x BPP-8	4.69	70.6	26.72	1.20	14.27
H 582	VRI-3 x BPP-8	5.41	37.6	28.28	0.95	12.04
H 585	H-36 x VRI-3	5.06	73.6	29.61	1.21	14.26

The mean nut weight was recorded highest in H-530 (9.68 g) followed by H-556 (8.86 g). The mean apple weight was found highest in H-587 (99.6 g) followed by H-534 (96.1 g). The shelling percentage was recorded maximum in H-540 (32.5) followed by H-523 (29.76). The mean annual nut

yield was found highest in H-530 (3.55 kg/tree) followed by H-504 (1.85 kg/tree). The cumulative nut yield was recorded highest in H-530 (33.50kg/tree) followed by H-504 (21.31kg/tree) for 5 annual harvests.

**Table 1.19 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2011**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 4 <sup>th</sup> harvest (2019)	Cum. yield (kg/tree) (for five harvests) 2016-2019
H590	BPP-8 x Vengurla-2	4.91	43.0	25.38	1.31	11.61
H591	BPP-8 x Vengurla-2	4.86	59.5	24.57	1.68	14.68
H596	BPP-8 x BPP -9	3.40	45.5	34.25	1.56	17.06
H605	BPP-8 x T.No.40/1	4.31	20.5	12.95	1.30	11.00
H621	BPP-8 x Vengurla-5	6.79	40.5	21.3	1.75	15.45
H622	BPP-8 x Vengurla-4	4.96	52	26.53	1.58	14.03
H623	BPP-8 x Vengurla-4	5.8	72.5	27.53	2.25	19.85
H630	BPP-8 x Vengurla-4	4.41	50.5	28.28	1.58	14.23
H631	BPP-8 x Hy94-T4	4.60	23.0	25.73	1.60	14.80
H632	BPP-8 x Hy94-T4	3.46	64.0	26.57	1.70	15.70
H633	BPP-8 x Hy94-T4	6.00	37.0	25.44	1.20	11.05
H636	BPP-8 x Hy94-T4	4.18	30.5	13.08	6.04	16.04
H641	BPP-8 x Hy94-T4	5.06	79.5	27.97	1.28	11.43
H642	BPP-8 x Hy94-T4	8.54	96	22.27	1.63	17.83

The mean nut weight was recorded highest in H-642 (8.54 g) followed by H-643 (7.74 g). The mean apple weight was found highest in H-642 (96.00g) followed by H-602 (92.50g). The shelling percentage was recorded maximum in H-596 (34.25) followed by H-598 (29.57). The mean annual

nut yield was found highest in H-635 (12.0 kg/tree) followed by H-623 (2.25 kg/tree). The cumulative nut yield was recorded highest in H-623 (19.85 kg/tree) followed by H-642 (17.83 kg/tree) for four annual harvests.

**Table 1.20 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2011FS**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 3 <sup>rd</sup> harvest (2019)	Cum. yield (kg/tree) (for three harvest) 2019
H653	T.No.228 x BPP-9	3.89	41.05	28.1	1.20	11.00
H654	BPP-8 x T.No.2/22	6.5	38.05	25.1	0.90	7.90
H655	T.No.2/22 x BPP-5	4.49	33.55	20.4	0.85	7.45
H656	T.No.228 x Priyanka	5.57	25.05	24.44	0.75	6.75
H657	T.No.228 x Priyanka	5.69	31.95	22.54	0.75	6.55
H658	T.No.228 x F.No.3	4.15	82.55	21.45	0.73	6.53
H660	BPP-5 x T.No.2/22	7.75	51.55	26.7	0.90	8.20

H661	BPP-5 x T.No.2/22	7.68	45.05	27.72	0.88	8.18
H663	T.No.228 x Priyanka	5.85	41.05	27.8	1.15	10.45
H664	Priyanka x T.No.30/1	4.63	29.05	24.8	0.75	6.75
H665	BPP-8 x Priyanka	6.37	35.55	25	0.70	6.50
H686	ABT-3 x T.No.40/1	5.45	46.05	22.5	0.30	7.30
H687	BPP-6 x Sel-2	5.69	46.85	22.42	1.35	8.25
H693	BPP-8 x T.No.228	4.19	43.7	25.4	0.63	7.23
H694	BPP-8 x T.No.228	4.21	46.53	25.18	1.05	9.05
H695	BPP-8 x Ullal-3	3.68	44.05	29.64	3.48	35.18

The mean nut weight was recorded highest in H-662 (8.58 g) followed by H-648 (7.69 g). The mean apple weight was found highest in H-658 (82.55g) followed by H-673 (68.05g). The shelling percentage was recorded maximum in H-695 (29.64) followed by H-648 (28.50). The mean annual nut yield was found highest in H-695 (3.48 kg) followed by H-653 (1.20 kg). The cumulative nut yield was recorded highest in H-695 (35.18 kg) followed by H-653 (11.0 kg) for three annual harvests.

**Table 1.21 : Yield parameters of different cashew hybrids at Bapatla Centre planted during 2012**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling (%)	Mean annual nut yield (kg/tree) 3 <sup>rd</sup> harvest (2019)	Cum. yield (kg/tree) (for three harvests) 2017-2019
H701	Kankady x BLA39/4	4.51	56.1	26.86	0.70	6.10
H702	Kankady x BLA39/4	5.99	47.1	26.94	0.45	3.39
H703	Kankady x BLA39/4	4.99	61.1	28.8	0.40	3.44
H704	Kankady x BLA39/4	5.3	51.6	26.9	0.35	3.05
H706	Kankady x BLA39/4	5.19	27.6	23	0.45	4.80
H710	T.No.10/19xKankady	7.4	62.1	27.2	0.48	4.28
H713	KankadyxT.No.10/19	6.6	44.6	26.04	0.33	3.03
H714	KankadyxT.No.10/19	7.04	64.1	20.04	0.40	3.80
H715	BPP-8 x Kankady	7.61	74	28.9	0.50	4.70
H716	BPP-8 x Kankady	7.43	42.6	21.59	0.85	7.85
H717	BPP-8 x Kankady	6.43	56.1	17.79	0.83	8.23
H718	BPP-8 x Kankady	5.59	54.85	25.04	0.75	7.55

The mean nut weight was recorded highest in H-715 (7.61 g) followed by H-716 (7.43 g). The mean apple weight was found highest in H-721 (77.1 g) followed by H-715 (74.0 g). The shelling percentage was recorded maximum in H-711 (29.8) followed by H-715 (28.9). The mean annual nut yield was found highest in H-716 (0.85 kg) followed by H-717 (0.83 kg). The cumulative nut yield was recorded highest in H-717 (2.83 kg) followed by H-716 (7.85 kg) for three annual harvests.

## BHUBANESWAR

During the fruiting season (2018-19), total 12 numbers of cross combinations were selected for the hybridization programme with the objective to develop dwarf, bold nut, cluster bearing and high yielding cashew hybrids. However, mature nuts could not be harvested due to cyclone which devastated the cashew experimental plots.

### Evaluation of cashew hybrids:

Evaluation of cashew hybrid genotypes during the fruiting season revealed that C2-6 recorded maximum tree height (5.35) while trunk girth was recorded maximum in Kankadi (47.63cm). Similarly, canopy spread (6.24 m in E-W & 6.44 m in N-S direction) and mean canopy area (92.5 m<sup>2</sup>) were recorded maximum for Dhana.

The results on flowering and yield attributing parameters revealed significant differences among the evaluated genotypes. The flowering period ranged from 2<sup>nd</sup> week of December to 1<sup>st</sup> week of May. The mean duration of flowering varied from minimum 54.5 days (Dhana) to maximum 70.0 days (Bubaneswar-1). Number of flowering laterals m<sup>-2</sup> was recorded maximum in C2-6 (26.88) and minimum

in VTH-711/4 (13.44). M44/3 recorded higher ratio of male to bisexual flowers (0.67) among the tested genotypes. Similarly, nuts m<sup>-2</sup> and mean number of nuts panicle<sup>-1</sup> were recorded maximum in RP-2 (39.61 & 14.5) and minimum in Kankadi (1.25 & 1.0) respectively.

It was found that among the evaluated genotypes, nut weight was recorded maximum in VTH-711/4 (14.23 g) while apple weight was maximum in Kankadi (97.75 g). Shelling percentage was recorded maximum in Bhubaneswar-1 (32.75%) followed by D-19 (31.86%) and C2-6 (31.57%). The mean annual nut yield (kg plant<sup>-1</sup>) at 3<sup>rd</sup> harvest was recorded significantly higher in C2-6 (4.25) and minimum for Kankadi (0.40 kg plant<sup>-1</sup>).

**Table 1.22 : Yield parameters of different cashew hybrids at Bhubaneswar Centre, 2018-19**

Hybrid No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree) (at 3 <sup>rd</sup> harvest)	Cum. yield (kg/tree) (for three harvests)
B-27	7.14	39.95	29.97	1.26	5.18
C-30	5.80	38.55	31.68	2.42	6.67
D-19	6.31	38.48	31.86	3.86	9.03
C2-6	8.18	32.76	31.57	4.25	10.20
BH-105	7.79	45.84	30.64	3.69	7.06
BBSR-1	5.29	33.04	32.75	2.28	6.96
RP-1	4.23	18.40	31.05	2.42	6.60
RP-2	4.18	28.46	32.54	2.65	7.16
M-44/3	4.63	23.38	27.53	3.02	7.08
Kankadi	12.30	97.75	22.65	0.40	0.81
VTH-711/4	14.23	83.76	32.01	0.44	0.99
NRCC Sel.-2	8.10	49.26	30.56	1.90	5.02
H-320	7.13	42.38	29.19	1.28	3.63
Dhana	7.24	33.30	30.54	3.55	8.05
BPP-8	7.76	53.30	29.98	3.67	7.62
Mean	7.35	43.90	30.30	2.47	-
SEm ±	0.41	2.32	0.72	0.12	-
CD at 5%	1.26	7.04	2.19	0.37	-
CV%	8.00	7.50	3.38	7.00	-

**N. B.:** Data recording on mean annual nut yield (kg plant<sup>-1</sup>) for the fruiting season 2018-19 couldn't be completed due to occurrence of cyclone "FANI" on 03.05.2019. Partially recorded yield data is presented in the report.

## GOA

### Crossing and raising of hybrid seedlings :

Crosses involving different parental combinations involving 2864 crosses were evaluated during

the flowering season of 2017-18. These crosses produced 403 hybrid nuts, during April to May 2018, from which 350 hybrid seedlings were raised.

**Table 1.23 : Crosses of different parental combinations for production of hybrid seed nuts during 2018 season at Goa**

Sl. No.	Parents	Total No. crosses	Successful crosses	% 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
		<b>2763</b>	<b>403</b>	<b>14.07</b>

During the current flowering season (January-March 2019), 3170 crosses were made and 182 hybrid nuts were collected.

### Evaluation of hybrids

Among 1<sup>st</sup> set of hybrids, raw nut yield varied from 0.3 kg/tree (HB-13/05) to 18.22 kg/tree (HB-31/05) with mean nut weight and shelling percentage of 7.4g and of 28% in the former, and 4.99g nut weight and 35.95% of shelling in the latter respectively. Two hybrids viz. HB-21/05 and HB-27/05 continued to record higher nut yield of 7.4kg/tree and 11.37kg/tree with mean nut weight of 8.21g and 8.02g, and shelling percentage of 28.96 and 28.04 respectively.

Seven hybrid seedlings of 2<sup>nd</sup> set started flowering and fruiting of which hybrid genotypes namely HB-N2/07, HB-27/07 (Tis.3 x Vengurla-4), 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 9.33 g. Two hybrids (HB-30/07 and HB-N1/07) had the mean nut weight of 10g each.

### HOGALAGERE

In this experiment, six promising hybrids from ARS, Chintamani were collected and planted at HREC, Hogalagere. They were planted in December 2016 and are still in establishing stage

in the field. In the season of Kharif of 2019, eight plants of new germplasm were identified based on their morphological traits (characters of bold, regular bearing, good apple) which will be utilized for hybridization programme in the flowering season. The leading varieties of the region and varieties recommended by DCR, Puttur will be utilized as female parents in the hybridization programme.

## JHARGRAM

It was observed that except H-113, other hybrids were statistically on par with respect to plant height, trunk girth, east to west and north to south spread and canopy area. The range of plant height was 2.29m to 3.55m and trunk girth was 19.25cm to 45.25cm. The range of canopy spread on both sides i.e East to West and North to South were 2.34m to 4.05m and 2.26m to 4.13m. The intensity of flowering per square meter of canopy area varied from 6.56 to 17.44 and statistically the hybrids were on par with respect to

flowering /m<sup>2</sup>. The hermaphrodite to total flower ratio varied from 0.23 to 0.47. There was significant difference recorded among the hybrids with respect to the intensity of nut bearing per square meter of canopy area. Maximum nuts were produced per unit area of canopy in H-132 (36.69) followed by H-37 (33.38) and H-126 (32.31) compared to the check variety BPP-8. Significant variation was also noticed among the hybrids with respect to number of nuts/panicle and cluster bearing hybrids were H-132, H-121, H-37 and H-126 (>8 nuts/panicle). Except H-139 and H-33, other hybrids were on par with respect to nut weight. Both H-139 and H-33 had bold nut (>8g). Except H-41, other hybrids were on par with respect to apple weight. Except H-139 and H-41, all other hybrids had more than 29% shelling recovery. H-132 produced maximum yield of 2.32 kg/tree and cumulative yield was also highest in H-132 for 2<sup>nd</sup> harvest (3.48 kg/tree).

**Table 1.24 : Yield parameters of different cashew hybrids at Jhargram Centre during the year 2018-19**

Hybrid No.	Cross combination	Year of planting	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 2 Harvests)
H-121	H- 2/15x Red Hazari	2015	5.97	71.10	30.25	1.78	2.57
H-132	H- 2/15x Red Hazari	2015	7.00	55.13	32.13	2.32	3.48
H-139	KGN – 1 x BLA -39-4	2015	9.04	66.59	22.71	1.01	1.31
H-33	Local x 2/9 Dicherla	2015	8.75	70.13	29.15	0.80	1.72
H-113	H- 2/15x Red Hazari	2015	7.45	72.23	31.67	0.39	1.31
H-35	Local x 2/9 Dicherla	2015	5.83	56.05	31.34	0.83	1.90
H-126	H- 2/15x Red Hazari	2015	6.06	54.05	31.63	1.55	2.35
H-37	Local x 2/9 Dicherla	2015	5.44	36.10	32.31	1.79	2.77
H- 41	Local x 2/9 Dicherla	2015	7.83	51.58	23.55	1.74	2.16
BPP-8		2015	6.56	61.57	32.12	1.46	2.15

During 2018, 23 F<sub>1</sub> progenies were planted from the crosses between JGM - 282 x JGM – 216. Among the parents, JGM – 282 is a semi dwarf, pruning responsive germplasm having small sized nuts, cluster bearer and heavy yielder while JGM - 216 is a bold nut type with intensive branching habit, producing 3 to 4 nuts/panicle and high shelling

recovery. Growth characters studied showed that H-197 was the tallest (2.5m) while the shortest were H-202 (1.1m). The range of stem girth, east to west spread and north to south spread were 7 to 9cm, 0.7 to 2.4m and 0.7 to 2.2m respectively. Maximum canopy area was recorded in H - 197 (8.65m<sup>2</sup>) and minimum in H - 182 (0.87m<sup>2</sup>).

## VENGURLA

A total of 4058 F<sub>1</sub> cashew progenies were planted at cashew farm, RFRS, Vengurla since 1999. The 2756 F<sub>1</sub> cashew progenies planted at 5m x 5m during 1999 to 2004 were evaluated during 2015. Out of these F1 progenies, the best

performing 58 hybrids were evaluated as promising hybrids as per the guidelines of DCR, Puttur.

Out of these 58 F<sub>1</sub> hybrids, replicated trial of the top performing 18 hybrids was initiated at AICRP-Cashew Vengurla centre during July, 2016. The detail of the trial is as follows.

<b>Trial</b>	:	Performance of new set of promising hybrids under Konkan conditions			
<b>Objectives</b>	:	1) To evaluate the performance of new set of promising hybrids			
<b>Design</b>	:	RBD			
<b>Replications</b>	:	3			
<b>Treatments</b>	:	18			
<b>Treatment details</b>	:	<b>Hybrid No.</b>	<b>Cross Combination</b>	<b>Hybrid No.</b>	<b>Cross Combination</b>
		T <sub>1</sub> - H-735	V-2 X B.T.65	T <sub>10</sub> - H-1016	M 26/2 X B.T.65
		T <sub>2</sub> - H-778	M 44/3 X B.T.22	T <sub>11</sub> - H-1039	M 26/2 X B.T.65
		T <sub>3</sub> - H-801	V-5 X B.T.1	T <sub>12</sub> - H-1155	V-5 X B.T.65
		T <sub>4</sub> - H-883	V-4 X Hy. 2/16	T <sub>13</sub> - H-1174	M 26/2 X B.T.1
		T <sub>5</sub> - H-939	V-4 X Hy. 2/16	T <sub>14</sub> - H-2005	V-8 x Priyanka
		T <sub>6</sub> - H-991	M 26/2 X B.T.65	T <sub>15</sub> - H-1675	V-4 X Hy.2/16
		T <sub>7</sub> - H-969	V-4 X Hy. 2/16	T <sub>16</sub> - H-1187	M 26/2 X B.T.1
		T <sub>8</sub> - H-958	V-4 X Hy. 2/16	T <sub>17</sub> - H-1306	Hy-2/16 X V-4
		T <sub>9</sub> - H-992	M 26/2 X B.T.65	T <sub>18</sub> -V-9 (Check)	V-4 X M-10-4
<b>Spacing</b>	:	7m x 7m			
<b>Year of planting</b>	:	July, 2016			
<b>Plants / replication</b>	:	3			
<b>Total plants</b>	:	162			

The growth of all the grafts is satisfactory. The second year (2018-19) vegetative growth parameters of new set of promising hybrid are recorded. Data revealed that there was non-significant differences among the different hybrids with respect to plant height (m), stem girth (cm), and EW spread (m), NS spread (m) and mean canopy spread (m).

However, the plant height ranged from 1.17m (H-801) to 2.23m (H-1174). Stem girth ranged from

9.55cm (H-883) to 20.89 (H-939). While, EW spread varied from 0.84m to 2.39m, NS spread ranged from 0.86m to 2.44m and mean canopy spread ranged from 0.85m to 2.42m in hybrids H-1187 to H-1675.

## VRIDHACHALAM

Crossing programme was undertaken to improve the existing released varieties of Tamil Nadu. The varieties, VRI-2 and VRI-3 were used as female parents. Promising types from germplasm

were selected for specific characteristics and used as male parents for crossing programme. L x T method of hybridization was carried out and the F1 seeds were planted during 2005, 2006 and 2008. Evaluation of the seedlings was carried out based on the recommendations of the AICRP group meeting. The promising F1 hybrids alone were selected to suit the objectives and carried over for further evaluation.

The hybrids planted during 2005, 2006 and 2008 were evaluated for characteristics viz., high yield, cluster bearing, high fruit set, high percentage of bisexual flowers, bold nuts, dwarfness and easy peeling of testa. Many promising hybrids were

identified and data were recorded. HC 1 resembled VRI 2 in terms of high yield, but had an important advantageous character of easy peeling of testa. HC 24 recorded higher fruit set, higher yield and bold nut (7.6 gms) along with easy peeling of testa. HC 10, HC 25, HC 27 and HC 30 were cluster bearing types with bold nuts. HC 10 was observed to have the typical characteristic of maintaining high yield even under water stress conditions. HC 22 and HC 25 had compact canopy, cluster bearing nature and bold nuts. HC 17 and HC 22 showed a different type of intensive branching pattern occupying less space of canopy area.

## Gen.4a : Rapid polyclonal hybrid evaluation trial

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

*West Coast* : Madakkathara and Vengurla

The objective of this experiment is to utilize accessions with high yield and other desirable traits selected from the germplasm conserved at various AICRP centres as parents and 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.



### BHUBANESWAR

#### Experimental details:

No. of hybrids : 5  
Spacing : 3m x 2m  
Number of plants / hybrid : 5  
Year of planting : 2017  
List of hybrids : C2-6(BH-26), H-504, H-12/05, H-2917 and VRI(cw)- H<sub>1</sub>

During the fruiting season (2018-19), the plants were covered with insect proof mosquito net in first week of January. Flowering initiated from 2<sup>nd</sup> week of January and it continued upto the month of May. Few nut set was observed in each genotype but all the nuts couldn't be harvested due to occurrence of cyclone "FANI" on 03.05.2019. Only 53 numbers of nuts were collected which were sown in polybags

for raising seedlings. Out of 53 nuts, only 44 nuts have been germinated which will be taken to main field for further evaluation.

### MADAKKATHARA

The above hybrids were planted in Randomized Block Design with three replications in 3m x 2m spacing @ 5 grafts/ replication following all recommended package of practices. The plants are now at vegetative stage.

### VENGURLA

Trial at Vengurla centre was initiated during July, 2018. The grafts of all high yielding hybrids were planted in 3m x 2m spacing @ 5 grafts/hybrids in July, 2018 and the growth of all the grafts are satisfactory. The grafts were covered with insect proof cover and introduced to pollinators for pollination.

Sr. No.	Accession No.	Original source of collection
1	C2-6	CRS, Bhubaneswar
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

### VRIDHACHALAM

The trial was initiated during September 2018.

## Gen. 5. Characterization of germplasm for cashew apple

Centres: East Coast : Bapatla

Plains / others : Jagdalpur

**Objective:** To identify germplasm having preferred apple characters suitable for value addition.



### BAPATLA

Among the 13 genotypes evaluated during the year 2018-19, the maximum mean annual nut yield per tree was recorded in BPP-8 (8.20 kg) followed by BLA 39/4 (6.80kg). The maximum nut weight was recorded in Priyanka (9.35 g) followed by BPP-8

(7.74 g). The maximum apple weight was recorded in Priyanka (96.50 g) followed by BPP-8 (62.10 g). The apple to nut ratio was highest in T.No.8/7 (12.86) followed by T.No. 2/14 (11.37). The juice recovery percentage was found maximum in BLA-39/4 (71.20%) followed by T.No.228 (71.20 %).

**Table 1.25 : Physical parameters of cashew germplasm for cashew apple at Bapatla.**

S. No.	Germplasm	Nut wt (g)	Apple wt (g)	Yield / tree (kg)	Apple nut ratio	Juice recovery (%)	Colour of the apple
1.	Priyanka	9.35	96.50	5.60	10.32	67.80	Red Yellow
2.	T.No: 2/14	4.24	48.20	4.15	11.37	59.10	Yellow
3.	T.No.17/5	4.18	35.10	4.20	8.39	58.60	Yellow
4.	T.No. 5/1	4.84	37.40	3.68	7.73	61.20	Yellow
5.	BLA. 139/1	4.86	35.10	4.10	7.22	57.80	Yellow
6.	BLA. 39/4	4.10	35.80	6.80	8.73	71.20	Yellow
7.	T.No. 3/4	4.26	41.20	3.70	9.67	63.10	Yellow
8.	T.No. 8/7	3.60	46.30	4.10	12.86	54.10	Yellow
9.	T.No. 18/3	4.70	48.95	3.80	10.41	57.10	Yellow
10.	Hy 95-T4	5.50	37.70	5.70	6.85	64.00	Yellow
11.	T.No. 12/1	4.25	41.20	3.55	9.69	59.10	Yellow
12.	T.No. 228	4.18	34.80	5.15	8.32	71.00	Red Yellow
13.	BPP-8	7.74	62.10	8.20	8.02	68.20	Yellow
	CD @ 5%	0.53	8.41	0.59	1.18	5.00	
	SEm±	0.18	2.88	0.18	0.40	1.70	

**Table 1.26 : Chemical parameters of cashew germplasm for cashew apple at Bapatla.**

S.No.	Germplasm	TSS (° Brix)	Vitamin-C (mg/100 g)	Tannins (mg/100 g)	Acidity (%)
1.	Priyanka	12.40	131.20	3.10	0.43
2.	T.No. 2/14	10.60	139.10	3.15	0.54
3.	T.No.17/5	10.80	147.10	3.26	0.52

4.	T.No. 5/1	9.40	136.10	3.54	1.01
5.	BLA. 139/1	10.50	152.10	3.60	1.12
6.	BLA. 39/4	10.26	154.10	3.33	0.89
7.	T.No. 3/4	11.56	168.10	3.16	0.86
8.	T.No. 8/7	11.20	170.80	3.30	0.56
9.	T.No. 18/3	11.50	166.20	3.16	0.53
10.	Hy 95-T4	10.67	162.10	3.26	0.60
11.	T.No. 12/1	10.56	124.10	3.34	0.78
12.	T.No. 228	10.44	130.10	3.33	0.74
13.	BPP-8	11.20	140.10	3.18	0.48
	CD at (5%)	1.03	5.41	0.25	0.09
	SEm±	0.45	1.84	0.08	0.03

Among the 13 genotypes the total soluble solids (TSS) ranged from 9.4° Brix to 12.4° Brix. However, the highest TSS was recorded in Priyanka (12.40). The maximum vitamin C content was recorded in T.No. 8/7 (170.80 mg/100gm) followed by T.No.18/3 (166.20 mg/100 gm). With regard to the tannin content, the lowest was recorded in Priyanka (3.10 mg/100 g) followed by T.No.2/14 (3.15 mg/100 gm). The acidity content was also lowest in Priyanka (0.43%) followed by BPP-8 (0.48%).

### JAGDALPUR

The present experiment was conducted during the year 2018-19 in eleven locally collected germplasm planted in the gene bank of SG CARS, Jagdalpur. These eleven cashew germplasm were evaluated for apple quality and its suitability for processing purpose. The physical and bio-chemical parameters of cashew apples are recorded.

The data revealed significant variation for apple weight, apple length, apple width, nut weight, nut width, apple to nut ratio, juice recovery, ascorbic acid, reducing sugars, non-reducing sugars and total sugars. Significantly maximum apple weight was recorded in CARS-8 (105.97 g) followed by CARS-11 (87.46 g) and CARS-9 (86.83 g). The maximum apple length was recorded in CARS-8 (63.09 cm) which was found to be at par with CARS-10 (59.89 cm) and CARS-11 (54.84 cm) whereas maximum apple width was found in CARS-11 (49.71 cm) followed by CARS-8 (48.47 cm). The highest nut weight (12.45 g) and nut length



**Fig. Germplasm accession CARS-10**

(39.93 mm) was recorded in CARS-8 whereas nut width (28.17 mm) was maximum in CARS-10. Apple to nut ratio was reported lowest in CARS-7 (5.04) which was found to be at par with CARS-4 (5.91). Whereas, maximum apple to nut ratio was reported in CARS-2 (10.75) which was statistically similar to CARS-11 and CARS-5. Highest juice recovery was observed in CARS-8 (81.20 %) followed by CARS-10 (77.10 %), CARS-7 (72.40 %) and CARS-3 (71.50 %).

The results presented in table (1.27) revealed that, among 11 germplasm studied, 4 germplasm had red colour apple, 4 germplasm had yellow colour apple and 3 germplasm had yellow red colour apple. There was significant difference in the TSS of evaluated germplasm. Significantly maximum TSS was recorded in CARS-11 (14.65 °Brix) while it was in minimum in CARS-5 (11.49°Brix). The higher acidity was recorded in CARS-11 (0.51%) which was

on par with CARS-6 (0.50%). Whereas, significantly lower acidity was reported in CARS-8 (0.23 %). The reducing sugar ranged from 5.88 to 8.41 % in germplasm accessions. The higher reducing sugar content was recorded in CARS-2 (8.41 %) which was found to be at par with CARS-3 (8.31 %), CARS-5 (8.20 %), CARS-7 (7.99 %) and CARS-4 (7.78 %) whereas minimum reducing sugar was observed in CARS-1 (5.88 %). The data from Table

showed significant difference among treatment in total sugar in the studies germplasm. The highest total sugar was observed in the germplasm CARS-5 (16.72 %) which was at par with CARS-5 (16.72 %). The lowest total sugar was reported in CARS-1 (10.31 %). Tannin content was reported highest in CARS-1 (3.46 mg/100g) followed by CARS-11 (3.45 mg/100g) whereas minimum tannin was reported in CARS-6 (2.74 mg/100g) during 2018-19.

**Table 1.27 : Physiochemical characters of different germplasm at Jagdalpur**

Germplasm	Cashew apple colour	Cashew apple shape	Total Soluble Solids (°Brix)	Acidity (%)	Ascorbic acid (mg/100g)	Reducing Sugar (%)	Total Sugar (%)	Tannin (mg/100 g)
CARS-1	Red	Round	12.37	0.26	277.33	5.88	10.31	3.46
CARS-2	Yellow	Round	12.19	0.30	255.33	8.41	13.50	3.12
CARS-3	Red	Pyriform	14.03	0.33	258.67	8.31	16.71	3.25
CARS-4	Yellow	Pyriform	13.53	0.42	247.33	7.78	14.11	3.08
CARS-5	Yellow Red	Conical to Obovate	11.49	0.32	246.33	8.20	16.72	3.11
CARS-6	Yellow Red	Conical to Obovate	11.91	0.50	256.67	6.34	13.35	2.74
CARS-7	Yellow	Pyriform	12.44	0.36	245.00	7.99	13.50	3.65
CARS-8	Red	Pyriform	15.15	0.23	257.67	6.42	13.14	3.12
CARS-9	Yellow	Pyriform	13.00	0.46	242.00	7.47	10.66	3.22
CARS-10	Red	Pyriform	11.53	0.32	236.00	6.94	12.44	2.90
CARS-11	Yellow Red	Conical to Obovate	14.65	0.51	216.33	6.32	11.40	3.45
C.D. (p=0.05)	-	-	0.30	0.02	9.36	1.11	1.31	0.22
SE(m) ±	-	-	0.87	0.06	3.44	0.37	0.44	0.08

The association of quantitative and qualitative characters were studied in cashew apple germplasm accessions. Apple weight significantly positive correlation with apple width and nut weight whereas, it was significantly positive correlated with nut length. Apple length was significantly positively correlated with apple width, nut length and juice recovery whereas, apple width was highly significantly positively correlated with nut length and nut width.

Similarly, nut length and nut width were associated with each other. Apple to nut ratio was found to be positively correlated with apple weight. Juice recovery was found to be significantly correlated with apple width and nut weight. Ascorbic acid was significantly negatively correlated with nut width. Reducing sugars was significantly positively correlated with total sugars.

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

Centres: East Coast : Plains / others : Jagdalpur

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

### JAGDALPUR

Design of experiment : Completely Randomized Design

Treatments : 10

Varieties : Vengurla-4, Vengurla- 7, Vengurla- 9, BPP-1, BPP-4, BPP-8, VRI-3, NRCC Selection-1, NRCC Selection-2 and Priyanka

The study was conducted during the fruiting season of 2018-19 at SG CARS, Jagdalpur using ten varieties. The experiment on organoleptic evaluation was conducted in Horticulture Laboratory, SG CARS, Jagdalpur and 15 judges were involved in scoring the prepared product i.e., RTS and



Jam. Five point scale was used to draw the results. Among the varieties studied for the preparation of ready, to serve beverage, the highest organoleptic score for appearance, taste, flavour and texture were recorded in variety VRI-3 whereas, the highest score for colour was recorded in Vengurla-4. Variety BPP-4 had lowest scores for all sensory parameters under study. The overall acceptability and shelf life (days) was found to be highest in VRI-3. However, the TSS recorded highest in the RTS prepared from NRCC Selection-1. Based on the current study cashew apple of variety VRI-3 was found to be suitable for RTS preparation.



**Table 1.28 : Evaluation of organoleptic score of RTS for cashew apple at Jagdalpur Centre**

Variety	Appearance	Taste	Colour	Flavour	Texture	Overall Acceptability	TSS	Shelf life (days)
Vengurla-4	3.7	3.3	4.0	3.7	3.4	3.7	14.3	112
Vengurla-7	3.1	3.3	2.9	3.3	3.4	3.3	13.4	119
Vengurla-9	2.7	3.1	2.8	2.8	2.4	2.6	13.6	112
BPP-1	2.6	2.5	2.5	3.1	2.4	2.6	12.9	105

BPP-4	2.3	2.1	2.5	2.7	2.3	2.3	14.8	126
BPP-8	3.2	3.3	3.6	3.4	3.0	3.1	13.7	112
VRI-3	4.0	4.1	3.4	4.2	4.1	4.1	14.8	133
NRCC Selection-1	3.2	3.7	3.1	3.2	3.3	3.2	15.2	112
NRCC Selection-2	3.3	2.7	3.2	2.9	3.1	3.1	14.3	119
Priyanka	2.7	3.4	3.3	2.8	2.9	3.0	13.9	105

(Note : Scale of scoring, Excellent-5, Very good-4, Good-3, Fair-2, Poor-1)

Similarly, same varieties were evaluated for the jam preparation. Among these varieties, NRCC selection-1 recorded highest score for appearance and colour whereas highest score for taste and texture was recorded in VRI-3. Flavour was recorded highest in Priyanka. The lowest score for appearance, colour and flavor was recorded in Vengurla-9. The overall acceptability of product

was recorded highest for the jam prepared from NRCC Selection-1 followed by VRI-3. Shelf life of jam was found to be highest in VRI-3. During the shelf life study, crystallization was reported to be a major problem in Vengurla-7, NRCC Selection-2 and BPP-1. Priyanka had highest sweetness of jam compared to the other varieties under study.

**Table 1.29 : Evaluation of organoleptic score of Jam for cashew apple at Jagdalpur Centre**

Variety	Appearance	Taste	Colour	Flavour	Texture	Overall Acceptability	Shelf life
Vengurla-4	3.2	3.6	2.8	3.1	3.2	3.2	182
Vengurla 7	3.1	2.9	2.5	2.9	2.8	2.9	161
Vengurla -9	2.6	3.0	2.5	2.9	2.8	2.8	168
BPP-1	3.4	3.0	3.6	3.0	3.1	3.1	154
BPP-4	2.9	3.6	2.6	3.0	2.6	2.5	175
BPP-8	3.4	3.5	3.1	3.0	3.3	3.3	154
VRI-3	3.8	3.9	3.5	3.1	3.3	3.8	189
NRCC Selection-1	3.9	3.5	3.9	3.3	3.1	4.3	161
NRCC Selection-2	3.3	3.6	3.1	3.3	2.6	3.1	154
Priyanka	3.5	3.4	3.3	3.4	2.9	2.6	182

(Note : Scale of scoring, Excellent-5, Very good-4, Good-3, Fair-2, Poor-1)

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

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

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

*Plains / others* : Jagdalpur, Kanabargi



**Objective** : To evaluate the performance of promising bold nut, bigger size apple and high yielding cashew genotypes at different AICRP 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	Tiswadi-3, Tudal-1, HB22/05
4	RFRS, Vengurla	H-3043, H-2873, V-7
5	CRS, Bhubaneswar	C-136, D-21, E-22
6	DCR, Puttur	H-126, H-130, NRC-301 and NRC-493

The trial has been initiated at all the centres during 2019.



## **II. CROP MANAGEMENT**



## II. CROP MANAGEMENT

### Hort. 1a : Nutrient management for yield maximization in cashew

Centres: East Coast : Bhubaneswar

West Coast : Paria

Plains / others : Hogalagere

**Objective** : To investigate the effect of nutrient management approaches on growth, yield and soil properties



#### BHUBANESWAR

Cashew variety, Balabhadra was planted during the year 2014 at a spacing of 7.0m x 7.0m in Randomized Block Design with four replications. Application of 100% RDF+10 Kg FYM along with foliar spray of major nutrients (3% Urea + 0.5%  $H_3PO_4$  + 1%  $K_2SO_4$ ), and micro-nutrients (0.5%  $ZnSO_4$ +0.1%, Boron+0.5%  $MgSO_4$ ) in the treatment  $T_5$  was found to be superior with respect to plant height (4.06m), trunk girth (38.44cm) and nut yield

(3.86 kg/plant) over other treatments followed by  $T_3$  (nut yield 3.65 kg/plant) and then  $T_4$  (3.52 kg/plant). Lowest response with respect to all the growth and yield parameters was observed in the treatment  $T_6$  i.e. control. The highest cumulative nut yield for last three harvest was recorded in the treatment  $T_5$  (8.42 kg/plant) followed by  $T_3$  (8.01 kg/plant). The Tea Mosquito Bug infestation was low in all the treatments.

**Table 2.1 : Yield parameters of cashew at Bhubaneswar during 2018-19**

Treatment details		Apple weight (gm)	Nut weight (gm)	Nut yield (kg/plant)	Cum. nut yield (kg/plant) 3 <sup>rd</sup> harvest	Tea mosquito bug infestation
$T_1$	100% recommended dose of NPK fertilizer(RDF) i.e.500:250:250g NPK/plant/year	51.35	6.71	3.25	7.09	Low
$T_2$	100% RDF + 10kg FYM/plant/year	51.80	6.84	3.36	7.53	Low
$T_3$	100% RDF + 10kg FYM/plant/year + Foliar spray of major nutrients(3% Urea + 0.5% $H_3PO_4$ +1% $K_2SO_4$ )	52.75	7.18	3.65	8.01	Low
$T_4$	100% RDF + 10kg FYM/plant/year + + Foliar spray of secondary and micro-nutrient 0.5% $ZnSO_4$ +0.1% Solubor (Boron) + 0.5% $MgSO_4$	54.25	7.55	3.52	7.78	Low
$T_5$	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% $MgSO_4$ )	55.65	7.72	3.86	8.42	Low

T <sub>6</sub>	Control	49.62	6.26	2.78	6.31	Low
	Mean	52.57	7.04	3.40		
	SEm±	2.65	0.23	0.19		
	CD at 5%	7.95	0.68	0.56		
	CV (%)	10.09	6.43	10.92		

## HOGALAGERE

The experiment of nutrient management for yield maximisation in cashew was conducted during the year of 2018-19. The plants were fed with 100% RDF + 10 kg FYM along with foliar spray of major nutrients (3% urea + 0.5 % H<sub>3</sub>PO<sub>4</sub>+1% K<sub>2</sub>SO<sub>4</sub>), and micronutrients (0.5% ZnSO<sub>4</sub>+ 0.1% solubor as boron source + 0.5% MgSO<sub>4</sub>). The infestation of

Tea mosquito bug was low in all the treatments. Overall, the outcome of the result depicts that the treatment T<sub>5</sub> i.e., 100% RDF + 10 kg FYM along with foliar spray of major nutrients (3% urea + 0.5 % H<sub>3</sub>PO<sub>4</sub>+1% K<sub>2</sub>SO<sub>4</sub>), secondary and micronutrients (0.5% ZnSO<sub>4</sub>+ 0.1% solubor as boron source + 0.5% MgSO<sub>4</sub>) performed as the best treatment among all the six treatments.

**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)	TMB Infestation	Cumulative yield (Kg/tree) (4 No. of harvests)
T <sub>1</sub>	118	36.53	7.23	9.30	low	23.75
T <sub>2</sub>	118	36.71	7.26	9.42	low	26.53
T <sub>3</sub>	121	37.08	7.40	9.65	low	27.48
T <sub>4</sub>	121	37.18	7.44	9.81	low	24.94
T <sub>5</sub>	124	38.10	7.52	10.85	low	29.08
T <sub>6</sub>	115	36.03	7.08	7.95	low	16.75
SEm±	0.5913	1.14	0.04	0.34	-	-
CD@5%	1.782	3.46	0.13	1.03	-	-
CV	0.9918	6.21	1.20	7.24	-	-

**Nutrient management for yield maximization in cashew**



**Fertilizer application, foliar spraying of nutrients and plot visualisation of nutrient management experimental plot**

## Hort.2: Fertilizer application in high density cashew plantations

Centres: East Coast : Bapatla

Plains / others : Hogalagere

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



### HOGALAGERE

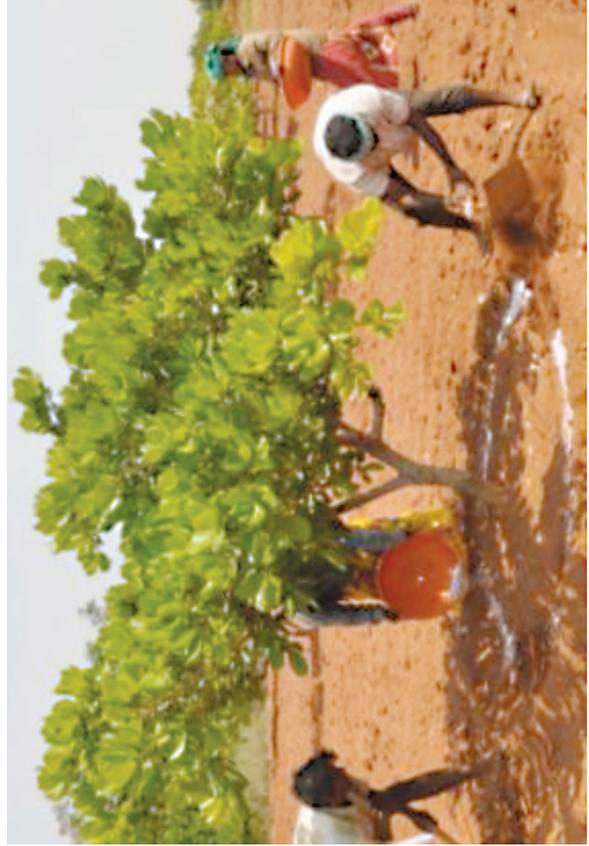
The experiment was conducted during 2018-19, with a combination of 3 spacing levels and 3 level doses of fertilizer treatments under split plot design.

Among the spacing and fertilizer level interaction treatments, there were no significant difference and in all the 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)	Nut weight (g)	Nut yield		TMB Infestation	Cumulative yield (3 harvests) (Kg/ plant)
				(Kg/pl)	(Q/ha.)		
S <sub>1</sub> M <sub>1</sub>	118	35.52	7.12	3.46	6.92	low	7.12
S <sub>1</sub> M <sub>2</sub>	115	36.62	7.10	3.52	7.05	low	7.40
S <sub>1</sub> M <sub>3</sub>	117	35.50	7.18	3.58	7.16	low	7.50
S <sub>2</sub> M <sub>1</sub>	115	34.96	7.08	3.24	13.49	low	6.69
S <sub>2</sub> M <sub>2</sub>	117	35.34	7.12	3.28	13.65	low	6.85
S <sub>2</sub> M <sub>3</sub>	115	35.48	7.12	3.28	13.65	low	6.82
S <sub>3</sub> M <sub>1</sub>	115	35.54	7.02	3.09	15.47	low	6.37
S <sub>3</sub> M <sub>2</sub>	118	34.90	7.08	3.17	15.87	low	6.57
S <sub>3</sub> M <sub>3</sub>	118	35.08	7.06	3.14	15.68	low	6.49
Mean	117	35.44	7.10	3.31	12.10	-	6.87
S.E.M+							
Spacing	0.39	0.03	0.03	0.04	0.17	-	-
Fertilizers	0.70	0.07	0.03	0.03	0.12	-	-
Spacing x Fertilizers	1.07	0.11	0.05	0.06	0.24	-	-
CD@5%							
Spacing	NS	0.12	NS	0.15	0.66	-	-
Fertilizers	NS	0.23	NS	NS	NS	-	-
Spacing x Fertilizers	NS	0.34	NS	NS	NS	-	-

Fertilizer application in high density cashew plantation



Application of three different doses of fertilizers to three levels of spacing plots

### Hort.3: Drip irrigation trial

Centres: Plains / others : Jagdalpur and Hogalagere

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



#### Experimental Details :

Treatments : 5

- T1 : No Irrigation
- T2 : Irrigation 20% of Cumulative Pan Evaporation (CPE).
- T3 : Irrigation 40% of Cumulative Pan Evaporation (CPE).
- T4 : Irrigation 60% of Cumulative Pan Evaporation (CPE).
- T5 : Irrigation 80% of Cumulative Pan Evaporation (CPE).
- Spacing = 7 x 7m
- Variety = Hogalagere : Chintamani-1  
Vengurla : Vengurla-7  
Vridhachalam : VRI-3

#### HOGALAGERE

The drip irrigation trial was conducted with five levels of irrigation on the basis of cumulative pan evaporation (CPE) during the year of 2018-19. Among the different levels of irrigation treatments, T<sub>5</sub> i.e., 80% cumulative pan evaporation was found to be significantly superior over other treatments in vegetative parameters like plant height (3.71m), stem girth (17.39cm), canopy height (2.2m), mean canopy diameter (6.69m) and mean canopy surface area (131.09 m<sup>2</sup>). The yield

attributing traits like flowering duration (121 days), nut yield per plant (11.04 kg) and cumulative yield of 4<sup>th</sup> season harvest (30.40 kg) were also found to be significantly superior over other treatments. Among all the treatments, T<sub>1</sub> i.e., no irrigation was recorded lower values in all vegetative and yield parameters and the TMB infestation was low irrespective of all the treatments. Hence, among all the five different levels of irrigation treatments, T<sub>5</sub> i.e., 80% cumulative pan evaporation was found to be the best treatment.

**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)	Mean apple weight (g)	Mean nut weight (g)	Nut yield (Kg/ plant)	TMB Infestation	Cumulative yield (Kg/plant) (4 harvests)
T1	110	36.80	7.02	7.86	Low	18.99
T2	115	37.50	7.22	8.75	Low	22.08
T3	118	38.02	7.26	9.02	Low	24.21
T4	118	38.34	7.28	9.58	Low	26.14
T5	121	38.84	7.34	11.04	Low	30.40
SEm±	0.6997	0.1994	0.0276	0.0673	-	-
CD@5%	2.1562	0.6145	0.0850	0.2075	-	-
CV	1.2017	1.0523	0.7640	1.4560	-	-

**Drip irrigation trial**



**Recommended dose of fertilizer application, scheduling of irrigation and fruit bearing in Drip irrigation experimental plot**



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

Centres: East Coast : Bapatla, Jhargram and Vridhachalam

Plains / others : Jagdalpur

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



### BAPATLA

As per the recommendations of AGM held at Vridhchalam, limb pruning was done in 4 x 4 m spacing up to 1m height on 10.09.2017. All the limb pruned plants showed emergence of new shoots

within a month. Control measures were taken for CSRB by spraying of Chlorpyrifos@10ml/liter. 25% of the trees died due to CSRB infestation after limb pruning.

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

Spacing	Mean Plant height (m)	Mean Canopy Height (m)	Mean Trunk Girth (cm)	Mean canopy spread (m)	Mean Canopy surface area (m <sup>2</sup> )	Ground area coverage by canopy (%)
4m x 4m	3.20	2.60	86.00	3.60	17.86	21.22
8m x 8m	5.22	4.95	96.90	8.89	82.30	54.10

During the year 2018-19, growth parameters were recorded in 8x8 m spacing with respect to the mean plant height (5.18 m), mean canopy height

(4.91 m), mean trunk girth (95.28 cm), mean canopy spread (8.85 m), mean canopy surface area (81.86 m<sup>2</sup>) and ground area coverage by canopy (52.14%).

**Table 2.6 : Yield parameters of cashew in normal and high density planting at Bapatla centre**

Spacing	Date of first Flowering	Date of last Flowering	Duration of Flowering (days)	Flowering Intensity/ Sqmt	Mean no nut/m <sup>2</sup>	Mean no nuts/ panicle
4m x 4m	24.02.19	18.05.19	83.00	6.87	10.43	2.00
8m x 8m	26.02.19	20.5.19	84.00	10.40	18.32	1.50

Flowering duration was recorded 112.0 days in 8x8m spacing, whereas mean number of flowering laterals, mean number of nuts/m<sup>2</sup> and mean number

of nuts per panicle were found to be 19.50, 18.32 and 2.00 in 8x8 m spacing.

**Table 2.7 : Yield parameters of cashew in normal and high density planting at Bapatla centre**

Spacing	Mean Nut weight (g)	Mean Apple weight (g)	Nut yield (Kg/ha)	Mean Nut yield kg/tree (Harvest No.12)	CNY kg/tree (2008-2019)
4m x 4m	5.12	53.65	687.50	1.10	15.19
8m x 8m	5.23	56.00	436.80	2.80	30.76

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

Harvest	Yield (kg/ha.)		Net returns (Rs/ha.)		B.C.ratio	
	(4m x 4m)	(8m x 8m)	(4m x 4m)	(8m x 8m)	(4m x 4m)	(8m x 8m)
1	268.75	50.00	-8875.00	-3240.00	-0.35	-0.51
2	400.00	71.76	-1000.00	-1934.4	-0.04	-0.31
3	515.00	112.5	5350.00	-292.5	0.19	-0.04
4	587.5	142.0	10062.50	2210.0	0.35	0.31
5	2000.0	436.8	111875.00	23556.0	3.97	3.35
6	1825	567.8	96500.00	31946.0	3.08	4.09
7	1487.5	650.52	80312.5	40987.5	2.57	5.25
8	1012.5	486.7	51000	18936.0	1.76	2.05
9	662.50	605.28	28750	23422	0.43	1.42
10	562.50	399.36	26250	19936	0.60	1.00
11	-	686.40	-	48640	-	2.43
12	687.50	436.80	30000	15000	1.15	0.83

### JAGDALPUR

The present trial was conducted as per the recommendation of AGM-2018 with variety NRCC selection-2. Twenty four plants per spacing were

planted on observational basis. The trial is in the initial experimentation and the crop is in the initial stage of vegetative growth. The data for growth parameters were recorded during the year 2019.

**Table 2.9 : Growth parameters of high density planting at Jagdalpur**

Parameters	Mean	
	4 x 4 m	8 x 8 m
Plant height (m)	0.45	0.43
Trunk girth (cm)	4.56	3.89
Canopy spread E-W (m)	28.2	24.6
Canopy spread N-S (m)	13.4	16.7



### JHARGRAM

**Table 2.10 : Growth parameters of cashew in normal and high density planting at Jhargram centre during the year 2018-19 (Year of Planting 2010)**

Spacing	Mean tree height (m)	Mean stem girth (cm)	Mean canopy diameter (m)	Mean canopy surface area (m <sup>2</sup> )	Ground coverage by canopy (%)
4m x 4m	3.91	49.5	3.62	16.2	67.2
8m x 8m	5.32	76.0	8.23	71.7	83.2

**Table 2.11 : Yield parameters of cashew in normal and high density planting at Jhargram centre during the year 2018 - 19**

Spacing	Duration of flowering (days)	Mean no. of panicles/m <sup>2</sup>	Mean nut weight (g)	Mean apple wt. (g)	Mean annual nut yield		Cum. nut yield (Kg/tree) (for 5 hvts)
					(Kg/tree)	(Kg/ha)	
4m x 4m	61	3.71	7.75	75.5	0.84	524.4	8.7
8m x 8m	65	5.29	8.1	72	5.89	919.1	32.8

**Table 2.12 : Yield and B:C ratio in high density trials at Jhargram centre during the year 2018-19**

Harvest	Yield (Kg/ha.)		Net returns (Rs/ha.)		B:C ratio	
	(4m x 4m)	(8m x 8 m)	(4m x 4 m)	(8m x 8 m)	(4m x 4 m)	(8m x8 m)
1 <sup>st</sup> harvest	1056.3	416.5	55604.5	24580.4	3.0	5.4
2 <sup>nd</sup> harvest	693.8	184.1	30229.5	8309.6	1.6	1.8
3 <sup>rd</sup> harvest	750.0	497.6	34167.0	30258.8	1.9	6.6
4 <sup>th</sup> harvest	1365.8	653.3	77272.3	41154.6	4.2	9.0
5 <sup>th</sup> harvest	362.5	1976.79	41749	307241	2.57	15.61
6 <sup>th</sup> harvest	524.4	919.1	41432	82054	2.549	4.31

The plants under 4m x 4m spacing were pruned to reduce the height to 3.0m while in case of plants under 8m x 8m spacing, only criss - cross branches and the branches bending towards the ground were removed selectively.

Maximum plant height, trunk girth, canopy spread, canopy area, ground coverage and flowering /m<sup>2</sup> were recorded in 8m x 8m spacing. During 2018 - 19 yield /tree as well as yield /ha were highest in trees spaced at 8m x 8m. Upto 4<sup>th</sup> 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 in 2017, the yield /ha was reduced in case of trees spaced at 4m x 4m and on 5<sup>th</sup> and 6<sup>th</sup> harvest, the unit area yield was maximum in 8m x 8m spacing plot (1976.79 kg/ha and 919.1 kg/ha respectively). The benefit : cost ratio was more in 8m x 8m spacing due to less number of labour requirement for pruning and other agronomic practices. Therefore, it is clear that for BPP- 8 variety, 8m x 8m spacing is more profitable than high density planting.

## Hort.6: Intercropping in Cashew

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

**West Coast :** Madakkathara, Paria and Vengurla

**Plains / others :** Darisai and Kanabargi

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

Among the different intercrops studied during the initial years of cashew the treatment T<sub>2</sub> (Cashew + Marigold) recorded maximum yield (2171 kg/ha) and was superior over other treatments and this was followed by T<sub>1</sub> (Cashew + China aster) of 1203 kg/ha and T<sub>4</sub> (Cashew + Crossandra) recorded the lowest yield (353 kg/ha).

Further, the economics of growing intercrops, it is seen that growing Crossandraas inter crop in cashew orchard gives the higher net profit of Rs.1,33,300/- with BC ratio of 2.96 followed by china aster of Rs.1,04,540/- and BC ratio of 2.32 and the lowest net profit was obtained in Chrysanthemum of Rs.66,120/- with BC ratio of 1.47.

### DARISAI

**Table 2.13 :** Yield and economics of cashew and intercrops in intercropping trial at Darisai Centre during the year 2018-19

Variety: V4

Treatment Details	Mean Yield of intercrop Q/ha	Mean Yield of cashew Q/ha	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				B:C Ratio
			Cashew	Inter-crop	Cashew + Intercrop	Cashew	Inter-crop	Total	Net Profit	
T1	112.26	7.16	49560	44550	94110	118140	246972	365112	271002	2.88
T2	221.34	8.05	49560	53680	103240	132825	243474	376299	273059	2.64
T3	44.86	7.08	49560	27225	76785	116820	125608	242428	165643	2.16
T4	54.46	7.42	49560	40315	89875	122430	179718	302148	212273	2.36
T5	---	8.92	49560	---	49560	118140	---	118140	68580	1.38

#### Treatment Details:-

- T1- Cashew (Var.V4) + Tomato (Var. Swarn Samridhi)
- T2- Cashew (Var.V4) + Cabbage (Var. Golden acre)
- T3- Cashew (Var.V4) + Frenchbean (Var. Arka komal)
- T4- Cashew (Var.V4) + Pea (Var. Arkel)
- T5- Cashew (Var.V4)

#### Selling Price :

Cashew Rs.165 /kg, Tomato Rs.22/kg, Cabbage Rs.11/kg, Frenchbean Rs.28/kg, Pea Rs.33/kg.

Cashew + Tomato recorded the highest B/C ratio 2.88 followed by cashew + cabbage 2.64.

## JHARGRAM

Cowpea (KSP 178), Okra (Samrat), cluster bean (Pusa nababahar), marigold (Bidhan Basanti) and Pumpkin (VNR P6) were grown as intercrops with the newly planted plantation of BPP-8 spaced at 4m x 4m leaving 1.0 m space from the base of the cashew plants.

The available space for intercrops was 75%. Cost benefit ratio revealed that pumpkin was the most profitable crop (1.82) during the 2<sup>nd</sup> year of planting under high density cashew plantation followed by marigold (0.63). The return from okra cultivation under the high density plantation did not meet fully the initial establishment cost of cashew with intercrop. Therefore, the benefit : cost ratio were negative for okra, though it is better to grow intercrops instead of growing cashew as a sole crop as because there is no return from the plot where cashew was grown as sole crop, the Benefit : Cost ratio being - 1.0.

## KANABARGI

The trial was laid out for sixth year by planting six intercrops in the existing cashew plantation (Planted in the year 1992 and limb pruned) spaced at

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

Mean cashew nut yield was significantly influenced by different intercrops. Highest cashew yield per plant was recorded when inter cropped with chrysanthemum (4.10 kg/plant) followed by China aster (4.06 kg/ plant) and knoll Khol (4.05 kg/plant). Minimum yield was recorded in cashew alone (3.66 kg/plant).

Net profit from main crop and intercrops was recorded maximum from Cashew + Gaillardia intercrop (Rs 180361.50) followed by Cashew + Chrysanthemum inter crop (Rs. 147125.83). Minimum was recorded in Cashew + Cabbage intercrop (Rs. 82465.75). Highest benefit to cost ratio was recorded in cashew alone (3.20) followed by Cashew + Cauliflower intercrop (2.83) and Cashew + china Aster (2.71) whereas minimum was recorded in Cashew + Cabbage (2.42).



**China aster + Cashew**



**Gaillardia + Cashew**



**Chrysanthemum + Cashew**



**Cabbage + Cashew**



**Cauliflower + Cashew**



**Knol khol + Cashew**

## **MADAKKATHARA**

Among six vegetables grown as intercrops, tomato recorded the highest yield of 100.4 Q/ha followed by bhindi with a yield of 69.8 Q/ha. Lowest yield was recorded for chilli (6.9 Q/ha).

Economic analysis revealed a highest B:C ratio of 1.75 in the treatment intercropped with

amaranthus followed by bhindi (1.21). Though the yield from tomato is the highest (100.4 Q/ha), the selling price was low and hence a BC ratio of 0.78. BC ratio was negative in the treatment with cashew as a sole crop. Hence, the trial indicates that growing high value vegetables as intercrop in the initial years of cashew plantation has economic benefit.



**Amaranthus, Brinjal, Bhindi, Tomato, Chili + Cashew**

### **PARIA**

The highest inter crop yield/ha (44.00 q/ha) was recorded in treatment cashew + coriander (T1) which was followed by treatment cashew + spinach (T3) and treatment cashew + fenugreek (T2) in gaining higher yield of intercrops. Highest net return of Rs. 88,224 ha<sup>-1</sup> was recorded under the inter crop of coriander (T1) alongwith highest benefit:cost ratio of 2.67. It was followed by the inter crop of spinach (T3) with benefit: cost ratio of 2.58.

### **Vengurla**

The trial Hort.6 on Intercropping in cashew with new sets of regional important intercrops was laid out in Rabi season, 2018 at AICRP-Cashew, Vengurla centre. Yield observation of both main & inter-crops were recorded during 2018-19. It was observed that treatment Yardlong bean (T<sub>1</sub>) recorded significantly the highest yield of 148.98 q/ha and superior over rest of the treatments. The maximum yield was recorded when Yardlong bean (T<sub>1</sub>) was intercropped in cashew (2.86 q/ha) however it was at par with all the treatments including control (sole crop). The maximum net returns of Rs. 544032/-

were obtained from cashew + Yardlong bean (T1) with B: C ratio of 1:6.01.

### **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 cluster bean (Pusa Navbahar) were sown as intercrops in VRI 3 plot (year of planting 2013) in an area of 20 cents each during 2019-20.

The trial was repeated with same intercrops to find out the consistency of the intercrops giving more income to farmers during 2019-20. Sowing was done during the third week of January, 2019. The net return is higher in Cashew + Bhendi (Rs. 72,580/ha) and the benefit cost ratio is also high (2.28) 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 returns, the cost of cultivation is higher and BC ratio is low.

## Hort.7: Organic Management of Cashew

*Centres: East Coast* : Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

*West Coast* : Madakkathara and Vengurla

*Plains / others* : Darisai, Hogalagere and Kanabargi



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.

### BAPATLA

#### Treatments:

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

#### Techniques to be adopted:

Design	: RBD
Variety	: BPP-8
Spacing	: 7m x 7m
Year of planting	: October, 2014
Number of Replications	: 3
Number of Treatments	: 8
Number plants/treatment	: 6
Duration	: 12 years

Among the treatments, the mean plant height was recorded highest in T4 (2.42m) followed by T3 (2.36m) and T5 (2.28m). The mean trunk girth was recorded highest in T4 (35.60 cm) followed by T8 (33.00 cm). The mean canopy spread was recorded

maximum in T4 (3.35 m) followed by T5 (3.15 m) and canopy surface area was recorded maximum in T4 (11.54 m<sup>2</sup>) followed by T6 and T5 (11.00 m<sup>2</sup> and 10.54 m<sup>2</sup>) respectively.

The shortest flowering duration was recorded in T8 (67.0 days) followed by T3 (68.0 days). With respect to flowering intensity, mean number of nuts per square meter and mean number of nuts per panicle were found to be significant. The flowering intensity per square meter was highest in T6 (7.15) followed by T2 (6.30). The mean no of nuts per square meter was highest in T5 (7.77) followed by T1 (7.47). The mean no of nuts per panicle was maximum in T4 (1.62), T5 (1.58) followed by T1 (1.57).

**Table 2.14 : Yield parameters of cashew in organic management at Bapatla Centre**

SI.No.	Variety/ Genotype	Nut weight (g)	Apple weight (g)	Shelling (%)	Nut yield /tree (kg) (2 <sup>nd</sup> harvest) 2019
1.	T1	8.60	59.18	24.20	4.00
2.	T2	7.80	65.53	27.20	3.80
3.	T3	8.30	62.20	24.80	3.15
4.	T4	8.80	71.20	28.80	4.50
5.	T5	8.90	60.00	26.10	2.75
6.	T6	8.35	67.83	23.42	3.10
7.	T7	8.20	64.20	29.20	3.10
8.	T8	7.40	63.00	24.20	3.00
	CD@5%	N.S.	6.50	N.S.	0.52
	SEm±	0.41	2.12	1.51	0.17

Variation in mean nut weight and shelling percentage were found to be non significant, while mean annual nut yield per tree and mean apple weight were found to be significant. Among the treatments, the mean nut weight was maximum in T<sub>5</sub> (8.90 g) followed by T<sub>6</sub> (8.35 g) and T<sub>2</sub> (7.80 g). The maximum mean annual nut yield per tree was recorded in T<sub>4</sub> (4.50 kg) followed by T<sub>1</sub> (4.00 kg) and T<sub>2</sub> (3.80 kg). With regard to the mean apple weight, the highest was recorded in T<sub>4</sub> (71.20 g). The shelling percentage was recorded highest in T<sub>7</sub> (29.20) followed by T<sub>4</sub> (28.80).

### BHUBANESWAR

The experiment on organic management was laid out during the year 2007 in Randomized Block Design with three replications and eight treatments on cashew variety H 2/16 (BPP-8) at a spacing of 7m x 7m. It is revealed from the data that the application of recommended dose of fertilizer + 10kg FYM (T<sub>8</sub>) recorded maximum plant height (6.18m), canopy diameter (10.32m), canopy surface area (78.28m<sup>2</sup>) and ground coverage by canopy (145.24%) compared to all other treatments under study. Highest stem girth of 81.14cm was recorded with the application of 100%N as FYM + Bio-fertilizers Consortium 200g (T<sub>2</sub>) followed by, T<sub>8</sub>, T<sub>1</sub>, T<sub>7</sub> and T<sub>5</sub>.

The different treatments significantly influenced the yield attributes of cashew. The results on yield and yield attributes revealed significant variations for nut weight, apple weight and annual nut yield (kg/ha) due to various organic management aspects. Recommended doses of fertilizer + 10kg FYM (Control) T<sub>8</sub> produced highest nut weight (8.40g) and annual nut yield (1858.44kg/ha) than other treatments. However, statistically parity was observed for weight of nut as well as apple with T<sub>3</sub> and T<sub>4</sub>. Similarly, although no much variation was recorded with number of panicles/m<sup>2</sup>, the T<sub>8</sub> recorded maximum value of 23.60. The results on cumulative nut yield/tree over 10<sup>th</sup> harvest revealed wide variations from 26.07kg in T<sub>6</sub> to maximum 46.25kg in T8 in variety BPP-8.

The data on economics of cashew under organic management revealed that the maximum net returns of Rs 1,42,022.80 per hectare was obtained from treatment T<sub>7</sub> i.e. 25 % N as FYM + Recycling of organic residue + *In-situ* green manuring / green leaf manuring + Bio-fertilizers Consortium (200 g). The benefit:cost ratio was higher (3.44) in T<sub>8</sub> with the application of recommended doses of fertilizer + 10 kg FYM and lowest (2.02) in T<sub>4</sub> with 100 % N as Vermicompost + (200 g). The lowest benefit: cost ratio was due to the high cost of vermicompost. The overall results observed during 2018-19 revealed the superiority of both T<sub>7</sub> (25 %

N as FYM + Recycling of organic residue + *In-situ* green manuring / green leaf manuring + Bio-fertilizers Consortium-200g) and T<sub>2</sub> (100 % N as FYM + Bio-fertilizers Consortium (200g) among the different organic sources towards cashew production.

Incidence of shoot tip caterpillar, inflorescence thrips and apple and nut borer were observed in all the treatments during flushing, flowering and fruit setting in cashew. Incidence of tea mosquito bug was reported only in the treatment T<sub>6</sub>, T<sub>7</sub> and T<sub>8</sub>, whereas in the treatment T<sub>8</sub>, i.e. recommended doses of fertilizer + 10 kg FYM, maximum incidence of tea mosquito bug (1.20), shoot tip caterpillar (6.6%), inflorescence thrips (6.2 population/inflorescence), apple and nut borer (8.8%) were found.

#### DARISAI

Recommended dose of fertilizer (N 500

gm, P<sub>2</sub>O<sub>5</sub> 250 gm & K<sub>2</sub>O 250 gm ) + 10 Kg FYM (Control) recorded the maximum nut yield / plant (4.63 Kg) followed by T<sub>2</sub> (4.18 Kg) where 100 % N + Bio-fertilizer 200gm/plant was applied and also T<sub>7</sub> (4.14 Kg/plant) where 25 % N as FYM + recycling of organic residue + in situ green manuring + Bio-fertilizer (200 gm/plant) was applied. On the basis of cumulative yield (Four harvests), T<sub>8</sub> (Control) was significantly superior to all other organic treatments.

#### HOGALAGERE

Among the different combination of treatments, T<sub>7</sub> (25%N as FYM + Recycling of organic residue + in situ green manuring /green leaf manuring + BFC @ 200g/tree/year) performed as the best treatment which was followed by T<sub>8</sub>. The tea mosquito bug infestation was low in all the eight treatments of experiment.

**Table 2.15 : The influence of organic manures, bio-fertilizers and other organic sources on yield parameters of cashew at HREC, Hogalagere during 2018-19**

Treatments	Flowering duration (Days)	Mean apple weight (g)	Mean nut weight (g)	Nut yield (Kg/plant)	TMB Infestation	Cumulative yield (3 <sup>rd</sup> harvest)
T <sub>1</sub>	119	33.68	6.65	3.18	Low	6.42
T <sub>2</sub>	117	33.94	6.82	3.53	Low	7.42
T <sub>3</sub>	119	33.60	6.71	3.28	Low	6.70
T <sub>4</sub>	119	34.56	6.76	3.41	Low	7.07
T <sub>5</sub>	117	33.25	6.60	3.09	Low	6.20
T <sub>6</sub>	119	33.21	6.57	3.02	Low	6.01
T <sub>7</sub>	121	35.82	7.05	4.18	Low	8.65
T <sub>8</sub>	124	36.42	6.93	4.05	Low	8.56
SEm±	0.9247	0.4386	0.0546	0.0695	-	-
CD@5%	2.8052	1.3304	0.1656	0.2109	-	-

**Organic management of cashew**



**Application of cow dung slurry, green leaf manuring and plot view of organic block**

## JHARGRAM

Significant differences were noticed among the treatments with respect to number of panicles/m<sup>2</sup>. In case of panicle density on the canopy surface, T<sub>8</sub> treatment recorded maximum while all other treatments were statistically on par. Maximum 8 panicles /m<sup>2</sup> were recorded with T<sub>8</sub>. The treatments had similar effect on the BPP-8 cashew plants with respect to nuts/m<sup>2</sup>. There were significant differences recorded with respect to yield/tree. The

plants treated with recommended dose of fertilizer and manure yielded maximum (7.64 kg/tree) while T<sub>7</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> treatments exhibited similar effects on yield of individual tree and minimum impact was noticed with T<sub>3</sub>, T<sub>5</sub> and T<sub>6</sub> treatments. Cumulative yield record showed that T<sub>1</sub> treatment recorded maximum yield /tree in 8 harvests. Benefit cost ratio reveal that T<sub>8</sub> was the best treatment followed by T<sub>3</sub> and T<sub>1</sub>.

**Table 2.16 : Economics of organic management in cashew ( 2007 – 2019) at Jhargram**

Treatment	Yield/ha (Kg) 2019	Cumulative cost/ha (2007-2019) (Rs.)	Cumulative return /ha (Rs.)	Cumulative net return/ha (Rs.)	B:C
T1 - 100 % N as FYM	977.1401	258081	832676	574595	2.23
T2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	928.3467	279336	721449	442113	1.58
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	683.1674	218665	708189	489524	2.24
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	886.494	407425	684746	277321	0.68
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	610.0187	227036	566262	339226	1.49
T6 - In situ green manuring / green leaf manuring to meet 100 % N	595.657	873569	569945	-303624	- 0.35
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	988.3879	947042	643210	-303832	- 0.32
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	1192.071	206690	831173	624483	3.02

## KANABARGI

Highest tree height (4.84m) and canopy height (4.50 m) were with 100% N from FYM+Bio fertilizer consortium (200g/tree/year). No significant

difference was observed with respect to trunk girth, trunk height and nut yield among all the treatments.

**Table 2.17 : Vegetative and yield parameters of Cashew organic trial during the year 2018-19 at Kanabargi**

Sl. No.	Treatments	Tree height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height (m)	Canopy diameter (m)	Nut yield (kg/tree)	Nut yield (kg/ha)
1	100% N from FYM	3.43	58.33	0.47	2.96	4.88	8.50	2364.36
2	100% N from FYM+Bio fertilizer consortium (200g/tree/year)	4.84	63.25	0.75	4.50	5.08	9.96	2768.24
3	50% N from FYM+Bio fertilizer consortium (200g/tree/year)+rock phosphate	3.30	51.64	0.49	2.81	4.40	8.50	2364.10
4	100% N from vermi-compost + Bio fertilizer consortium (200g/tree/year)	3.18	58.50	0.43	2.76	4.60	7.34	2040.71
5	Recycling of organic residue with the addition of 20% cow dung slurry	3.23	57.17	0.33	2.89	4.45	9.64	2678.82
6	In situ green manuring	2.92	47.49	0.28	2.64	4.05	8.49	2361.33
7	25% N as FYM + recycling of organic residue + insitu green manuring	3.51	59.47	0.46	3.04	4.77	9.70	2697.33
8	Recommended dose of fertilizer	3.59	61.50	0.53	3.07	4.85	8.77	2438.61
	S.E.m±	0.32	4.73	0.11	0.29	0.47	1.26	350.49
	CD 5%	0.96	14.36	0.32	0.89	1.43	3.82	1063.09
		S	NS	NS	S	NS	NS	NS

S- Significant

NS-Non significant



Application of FYM, Cow dung and green manure in organic block at Kanabargi

### MADAKKATHARA

No significant difference was observed among all the treatments in terms of their response on growth and yield parameters. BC ratio above 1 was observed in the treatments T<sub>1</sub> (100 % N as FYM), T<sub>2</sub> (100 % N as FYM + Bio-fertilizers (*Azotobacter* +

*Azospirillum* + PSB) 200 g), T<sub>5</sub> (Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung) and T<sub>7</sub> (25% Nas FYM + Recycling of organic residue + *In-situ* green manuring / green leaf manuring + Bio-fertilizers (200 g)).

**Table 2.18 :** Yield parameters of cashew under organic management at Madakkathara centre during 2018-19

Treatment	No. of panicles/ m <sup>2</sup>	Nut Weight (g)	Apple Weight (g)	Annual Nut yield (Kg/tree)	BC ratio
T1	6.20	7.64	74.71	6.18	1.10
T2	8.06	7.70	72.44	6.91	1.18
T3	6.79	7.46	68.28	5.50	0.87
T4	6.92	7.67	71.89	6.11	0.07

T5	6.86	7.88	66.81	5.47	1.05
T6	5.54	6.26	81.17	5.17	0.86
T7	6.54	8.25	77.60	6.42	1.13
T8	6.58	7.92	72.94	5.78	0.95
Mean	6.68	7.59	73.23	5.69	
CD @ 5%	NS	NS	NS	NS	



**Plot view of organic block at Madakkathara**

## Vengurla

Data on vegetative growth parameters during the year 2018-19 were recorded and it revealed that there was no significant difference among the treatments in respect to growth attributes. The organic treatments significantly affected the flowering attributes except flowering duration (days) during the year 2018-19. The flowering duration ranged from 91-20 days in treatment T<sub>6</sub> to 95-17 days in T<sub>5</sub>. Significantly, maximum flowering panicles (22.63/m<sup>2</sup>) were recorded in the treatment T<sub>4</sub> (100% N as Vermicompost + BCF) which was at par with treatments T<sub>8</sub> (21.60/m<sup>2</sup>) and T<sub>7</sub> (20.20/m<sup>2</sup>).

The different treatments significantly influenced the yield attributes of cashew cv. Vengurla-4 under organic management during the year 2018-19. The treatment T<sub>7</sub> (25% N as FYM + Recycling of organic residues + *In-situ* green manuring/green leaf manuring + BCF (200g/tree) recorded significantly

the highest nut weight of 10.10 g and was on par with the treatment T<sub>4</sub> (100% N as Vermicompost + BCF) i.e. 9.53 g. Significantly the highest apple weight (84.43 g) was recorded in T<sub>4</sub> (100% N as Vermicompost + BCF) and was on par with treatment T<sub>1</sub>-100 % N as FYM (81.10 g).

The annual nut yield of cashew cv. Vengurla-4 under organic management was recorded. Significantly the highest nut yield of 1815.60 kg/ha was recorded with application of recommended dose of fertilizer + 10 kg FYM-Control (T<sub>8</sub>) and it was at par with treatments T<sub>4</sub> (1770.04 kg/ha), T<sub>1</sub> (1712.24 kg/ha), T<sub>2</sub> (1504.16 kg/ha) and T<sub>6</sub> (1376.32 kg/ha). While, the lowest yield of 976.48 kg/ha was obtained by recycling of organic residue with the addition of 20% cow dung slurry (T<sub>5</sub>). The highest cumulative yield for last 8 harvests was recorded in treatment T<sub>8</sub> (48.27 kg/tree) followed by T<sub>4</sub> (41.99 kg/tree).

The data on economics of cashew under organic management revealed that the maximum net returns of Rs. 2,02,639/- was obtained from treatment T<sub>8</sub> (Recommended dose of fertilizer + 10

kg FYM-Control). However, the maximum B:C ratio of 6.12:1 was recorded in treatment T<sub>4</sub> (100% N as Vermicompost + BFC).

**Table 2.19 : 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 <sub>1</sub>	100 % N as FYM	1712.24	114000	231152	117152	1:2.03
T <sub>2</sub>	100% N as FYM + BCF (200g/tree)	1504.16	117060	203062	86002	1:1.73
T <sub>3</sub>	50% N as FYM + BCF (200g/tree) + Rock phosphate	1101.60	76260	148716	72456	1:1.95
T <sub>4</sub>	100% N as Vermicompost + BCF (200g/tree)	1770.04	39060	238955	199895	1:6.12
T <sub>5</sub>	Recycling of organic residue with the addition of 20 % cow dung slurry (20% weight of organic residue as cow dung slurry)	976.48	42120	131825	89705	1:3.13
T <sub>6</sub>	<i>In situ</i> green manuring /green leaf manuring to meet 100% (Retain litter + planting cowpea)	1376.32	40080	185803	145723	1:4.64
T <sub>7</sub>	25% N as FYM + Recycling of organic residues + <i>In situ</i> green manuring/green leaf manuring + BFC (200g/tree)	995.52	59460	134395	74935	1:2.26
T <sub>8</sub>	Recommended dose of fertilizer + 10 kg FYM (Control)	1815.60	42467	245106	202639	1:5.77

**Note:** Rate of cashew raw nut @ Rs. 135/- per kg during the year 2018-19

The highest available soil N content (312.20 kg/ha) was recorded with the application of recommended dose of fertilizer + 10 kg FYM (T<sub>8</sub>) and it was significantly superior over rest of the treatments. The available P<sub>2</sub>O<sub>5</sub> was found significantly the maximum in treatment T<sub>8</sub> (37.61 kg/ha) and was at par with treatments T<sub>7</sub> (36.56 kg/ha), T<sub>3</sub> (34.13 kg/ha) and T<sub>4</sub> (32.93 kg/ha). The available soil K<sub>2</sub>O content was significantly the highest (910.50 kg/ha) by application of 100% N as Vermicompost + BFC - 200g/tree (T<sub>4</sub>) and was superior over rest of the treatments.

The data on soil microbial population which were analyzed during the year 2018-19 are presented. It is evident from data that the highest total microbial count i.e. colony forming unit (CFU) at five dilution (27x10<sup>5</sup>) was recorded in treatment T<sub>4</sub> (100% N as Vermicompost + BFC - 200g/tree) followed by treatment T<sub>7</sub> - (25% N as FYM + Recycling of organic residues + *In situ* green manuring/ green leaf manuring + BFC - 200g/tree (21 x 10<sup>5</sup>) while, the lowest total microbial count (8x10<sup>5</sup>) was observed in treatment T<sub>8</sub> (RDF + 10 kg FYM).

## VRIDHACHALAM

Inorganic fertilizer treatment (T8) recorded the highest values for mean canopy diameter, mean surface area, mean flowering laterals per m<sup>2</sup>, nut

yield and cumulative yield followed by T7 with 25 % N as FYM + Recycling of organic residue + *In situ* green manuring / green leaf manuring + Bio-fertilizers consortium (200 g).

**Table 2.20 : Benefit Cost ratio of cashew under organic management at Vridhachalam**

Treatment	Materials required	Cost of Material	Cost of Cultivation	Mean annual nut yield (kg/ha)*	Income @Rs.100/Kg of raw nuts	BC ratio
T1 - 100 % N as FYM	FYM 40 tonnes	24000	42000	1128	112800	2.68
T2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	40 T FYM and Biofertilizers	28000	46000	1095	109500	2.38
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	20 T FYM & Biofertilizers	16000	38000	1086	108600	2.85
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	10 T Vermicompost	50000	68000	1240	124000	1.82
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0% weight of organic residue as cow dung)	Organic residue collection and labour cost	16000	53000	1109	110900	2.09
T6 - In situ green manuring / green leaf manuring to meet 100 % N	Growing cost of green manure crops (3 seasons)	24000	42000	1160	116000	2.76
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	FYM 10 tonnes + Growing cost of green manure	22000	44000	1248	124800	2.83
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	Urea 440 Kg SSP 150 Kg Potash 80 Kg FYM 2 T	16000	43000	1695	169500	3.94

The benefit cost ratio was higher (3.94) in T8 with recommended dose of fertilizers and was lower in T4 (1.82) with 100 per cent Nitrogen given in the

form of vermicompost. The lower benefit cost ratio was due to high cost of vermicompost.

## Hort.8 : Spacing cum fertilizer trial

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

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



### DARISAI

S1: 10m x 5m, S2: 6m x 4m, S3: 5m x 4m.

#### Fertilizer Application Level

1<sup>st</sup> Year - 1/5<sup>th</sup>

2<sup>nd</sup> Year - 2/5<sup>th</sup>

M1: 75 Kg N, 25 Kg P<sub>2</sub>O<sub>5</sub>, 25Kg K<sub>2</sub>O,

3<sup>rd</sup> Year - 3/5<sup>th</sup>

4<sup>th</sup> Year - 4/5<sup>th</sup>

M2: 150 Kg N, 50 Kg P<sub>2</sub>O<sub>5</sub>, 50Kg K<sub>2</sub>O

5<sup>th</sup> Year - full dose

M3: 225 Kg N, 75 Kg P<sub>2</sub>O<sub>5</sub>, 75Kg K<sub>2</sub>O

Var.: BPP-8

**Table 2.21 :** Interaction effect between tree densities and fertilizer dose on yield parameters of cashew under spacing cum fertilizer trial at Darisai centre during the year 2018-19

Treatment	Flowering Days	Mean flowering lateral/ (m <sup>2</sup> )	Mean nut wt.(gm)	Mean apple wt.(gm)	Mean nut yield (kg/tree)	Cumulative Yield for four harvests Kg/plant
S1M1	93.06	20.99	7.28	7.76	5.98	14.84
S1M2	109.88	30.57	7.94	8.34	7.14	17.87
S1M3	95.22	23.07	7.12	7.56	5.15	13.2
S2M1	102.42	31.66	7.62	8.12	4.38	11.78
S2M2	93.08	40.32	7.78	8.14	4.19	12.14
S2M3	92.08	34.99	7.63	7.95	2.88	9.68
S3M1	88.89	29.49	7.55	7.92	2.59	8.59
S3M2	85.86	34.56	7.21	7.53	2.98	10.33
S3M3	81.66	31.96	7.02	7.22	2.06	7.81
SEm±	3.31	2.39	0.17	2.54	0.29	0.31
CD (5%)	9.84	7.13	0.49	7.64	0.81	0.87
CV (%)	14.38	13.46	12.18	15.68	13.38	14.36

S<sub>1</sub>M<sub>2</sub> is significantly superior in current year yield & also in cumulative yield on the basis of four harvests among all other interactions tested.

### 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

**Progress :**

Significant difference was found among the spacing levels with respect to canopy diameter, tree height, Trunk girth, and nut yield. Nut yield

in (22.75 kg/tree) was highest with the spacing (8 m x 8 m) followed by spacing of (10m x 4m) and (6.5m x 6.5m) giving 17.57kg/tree and 13.03 kg/tree respectively.



Plot view spacing cum fertilizer trial at Kanabargi

**Table 2.22: Vegetative and yield parameters in cashew as influenced by three spacing levels at Kanabargi during the year 2018-19**

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)	13.08	193.33	0.92	10.44	18.06	22.75
2	Spacing 2 (10m x 5m)	11.29	177.17	0.81	8.88	17.24	17.57
3	Spacing 3 (6.5 x 6.5m)	12.72	184.33	0.84	9.91	16.06	13.03
4	Treatment Mean	12.36	184.94	0.86	9.74	17.12	17.78
	SEm±	0.15	1.45	0.05	0.13	0.20	0.56
	CD 5%	0.42	4.22	0.16	0.38	0.59	1.63
		S	S	NS	S	NS	S

Significant difference was found among the fertilizer levels with respect to trunk girth (182.83 cm) and canopy diameter (18.27 cm) which were recorded in fertilizer level Fertilizer 1 (52:13:13g NPK/plant/year). Tree height, trunk height, canopy

height and nut yield were non-significant among all treatments.

Spacing cum fertilizer interaction effect was non-significant among all treatments.

**Table 2.23 : Vegetative and yield parameters in cashew as influenced by three fertilizer levels at Kanabargi during the year 2018-19**

Sl. No.	Treatments	Tree height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height (m)	Canopy diameter (cm)	Nut yield kg/tree	Nut yield kg/ha
1	Fertilizer 1 (52:13:13g NPK/plant/year)	12.59	182.83	0.80	9.81	18.27	16.94	3198.36
2	Fertilizer 2 (78:20:20g NPK/plant/year)	12.03	177.89	0.79	9.88	15.74	16.99	3238.44
3	Fertilizer 3 (117:29:29g NPK/plant/year)	12.47	194.11	0.98	9.54	17.34	19.42	3700.85
4	Treatment Mean	12.36	184.94	0.86	9.74	17.12	17.78	3379.22
	SEm±	0.15	1.45	0.05	0.13	0.20	0.56	97.30
	CD 5%	0.42	4.22	0.16	0.38	0.59	1.63	283.40
		NS	S	NS	NS	S	NS	NS

**Table 2.24 : Vegetative and yield parameters in cashew as influenced by spacing cum fertilizer interaction effect at Kanabargi during the year 2018-19**

Sl.No.	Treatments	Tree height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height (m)	Canopy diameter (m)	Nut yield kg/tree	Nut yield kg/ha
1	S1F1	4.52	66.56	0.87	3.48	6.40	7.95	1240.39
2	S1F2	4.36	61.22	0.68	3.62	5.71	7.05	1099.33
3	S1F3	4.20	65.56	1.22	3.34	5.96	7.75	1208.97
4	S2F1	3.64	56.28	0.78	2.85	6.42	4.57	913.07
5	S2F2	3.66	56.78	0.92	2.83	5.27	5.74	1148.67
6	S2F3	3.99	64.11	0.72	3.20	5.55	7.26	1451.47
7	S3F1	4.42	60.00	0.77	3.48	5.45	4.43	1044.90
8	S3F2	4.02	59.89	0.77	3.42	4.77	4.20	990.44
9	S3F3	4.28	64.44	0.99	3.00	5.84	4.41	1040.42
	Treatment Mean	4.12	61.65	0.86	3.25	5.71	5.93	1126.41
	SEm±	0.25	2.51	0.09	0.23	0.35	0.97	168.53
	CD 5%	0.74	7.31	0.27	0.66	1.03	2.83	490.86
		NS	NS	NS	NS	NS	NS	NS

## PARIA

All the growth as well as yield parameters were observed to be non-significant at individual as well as interaction level.

Spacing: S1-8x8m

S2-6.5x6.5m

S3-5x5m

Fertilizer:F1-75-25-25NPK

F2-150-50-50NPK

F3-225-75-75NPK

Var.:V-4

**Table 2.25 : Effect of different levels of spacing and fertilizers on growth and yield of cashew at Paria**

Treatments	Trunk girth (m)	Plant height (m)	Mean canopy area (m)	Canopy volume (m <sup>3</sup> )	Nuts/plant	Nut yield (q/ha)
S1F1	0.69	4.56	5.57	77.35	109.33	3.06
S1F2	0.57	3.82	5.04	73.76	55.83	1.56
S1F3	0.61	4.29	5.21	77.16	36.50	1.02
S2F1	0.65	4.75	6.13	93.79	76.33	1.26
S2F2	0.71	5.33	7.20	152.39	55.33	0.91
S2F3	0.50	3.65	4.59	64.30	90.50	1.49
S3F1	0.53	5.01	4.58	54.59	24.66	0.27
S3F2	0.62	4.98	5.71	88.47	61.16	0.66
S3F3	0.53	4.16	4.74	50.10	26.50	0.29

## Hort.9: Evaluation of production potential of newly developed variety Bidhan Jhargram - 2 at different spacings

Centres: East Coast : Jhargram

Plains / others : Darisai

The objective of this trial is to evaluate the new variety at different location for production potential under different spacing.



### JHARGRAM

There were 4 different spacing i.e. 10m x 10m, 8m x 8m, 7m x 5m and 4m x 4m. There were 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, 2018. The growth parameters were recorded during December, 2018 and yield characters were recorded during January to May, 2019.

**Table 2.26 :** Yield parameters of Bidhan Jhargram - 2 under Spacing trial at Jhargram centre during the year 2018 -19

Treatment	Mean no. of panicles/ m <sup>2</sup>	Mean no. of nuts/ m <sup>2</sup>	Mean nut weight (g)	Mean annual nut yield (kg/tree)	Yield / unit area (Kg/ha)	Cumulative yield/ha (Kg/ha) (2 <sup>nd</sup> harvest)
T <sub>1</sub> - 10m x 10m	2.50	7.17	9.29	1.74	173.66	470.59
T <sub>2</sub> - 8m x 8m	2.33	6.83	9.15	1.80	281.36	710.72
T <sub>3</sub> - 7m x 5m	2.71	7.96	9.14	1.80	513.67	1056.09
T <sub>4</sub> - 4m x 4m	3.42	10.29	9.02	1.21	754.28	2203.44
SEm ±	NS	0.47	NS	0.12	34.10	
CD at 5%		1.39		0.36	100.61	
CV%		14.36		8.39	19.39	

The data on growth parameters showed that the treatments were significantly different with respect to tree height. Spacing at (8m x 8m) and (7m x 5m) were on par with respect to plant height and had tallest trees while the trees spaced at 4m x 4m were the shortest. No variations were observed with respect to stem girth under different spacing treatments. Spacing at (10m x 10m), (8m x 8m) and (7m x 5m) were on par with respect to

canopy spread on both sides and canopy area, while significant variation was noticed with spacing at (4m x 4m) and other spacing treatments. The treatments showed significant difference with respect to ground coverage. After pruning, within 5 months time, the canopies of the trees spaced at (4m x 4m) had covered 56.14% of the allotted ground area which was the maximum, while trees under (10m x 10m) spacing covered only 18.21% area on the ground by

the canopy which was the minimum. It means trees under (4m x 4m) spacing needed heavy pruning every year for proper flowering and fruiting. There were no significant differences recorded among the treatments with respect to nut weight and number of panicles/m<sup>2</sup>. Significant variation was noticed among the four spacing treatments with respect to nuts/m<sup>2</sup> and yield/tree. Maximum nuts/m<sup>2</sup> (10.29) was recorded in (4m x 4m) spaced plants but

yield /tree was highest (1.8kg/tree) in 8m x 8m and 7m x 5m spaced plants which was on par with 10m x 10m. Highly significant differences were recorded among the treatments with regard to yield/ha and it was highest in the plot where plants were spaced at 4m x 4m (754.28 kg/ha). The data on second harvest revealed that cumulative yield for two harvests was highest in 4m x 4m spacing (2203.4 kg/ha).

## Hort. 11: Ultra high density planting in cashew



**Centres: East Coast** : Bapatla, Bhubaneswar, Jhargram

**West Coast** : Madakkathara, Paria and Vengurla

The objective of this trial is to identify the suitable variety for ultra high density and to study the economic feasibility of ultra high density Vs normal planting density planting in cashew.

### MADAKKATHARA

#### Treatment details:

Main plot-	Spacing	Sub plot -	Varieties
S1 :	2.5 x 2.5 m	V <sub>1</sub> :	Vridhachalam-3
S2 :	3 x 3 m	V <sub>2</sub> :	NRCC Selection-2
S3 :	3.5 x 3.5 m	V <sub>3</sub> :	Poornima
S4 :	8 x 8 m (Control)		

#### Experimental details:

Year of planting : 2017  
 Design : Split plot  
 Replication : 4

There were four spacings (2.5m, 3.0m, 3.5m and 8.0m) and three varieties (VRI-3, NRCC Selection-2 and Poornima) and the experiment was laid out in split plot design with 12 treatments and three replications. The data on the effect of spacing and varieties on growth parameters are

presented. Statistical analysis of data revealed that spacing and varieties had no significant effect on the growth parameters. Significant difference was also not found among any of the characters, when the interaction effects of varieties and spacing were studied.

**Table 2.27: Effect of spacing and varieties on growth parameters under ultra high density planting at Madakkathara**

Treatments	Height (m)	Girth (m)	Canopy diameter (m)	Canopy surface area (m <sup>2</sup> )	Trunk height (m)
S <sub>1</sub>	0.93	0.15	1.49	3.34	0.25
S <sub>2</sub>	1.10	0.21	1.37	3.15	0.20
S <sub>3</sub>	1.10	0.15	1.33	2.96	0.28
S <sub>4</sub>	1.02	0.15	1.24	2.63	0.29
CD @ 5%	NS	NS	NS	NS	NS
V <sub>1</sub>	1.01	0.15	1.32	2.84	0.28
V <sub>2</sub>	1.05	0.15	1.45	3.34	0.25
V <sub>3</sub>	1.05	0.19	1.30	2.88	0.25
CD @ 5%	NS	NS	NS	NS	NS
S <sub>1</sub> V <sub>1</sub>	1.12	0.22	2.01	4.18	0.37

$S_1V_2$	1.30	0.17	2.17	5.11	0.30
$S_1V_3$	1.48	0.20	1.79	4.05	0.32
$S_2V_1$	1.47	0.21	1.76	3.98	0.27
$S_2V_2$	1.49	0.21	1.94	4.52	0.27
$S_2V_3$	1.44	0.44	1.81	4.12	0.25
$S_3V_1$	1.43	0.21	1.75	3.81	0.39
$S_3V_2$	1.58	0.23	1.99	4.67	0.36
$S_3V_3$	1.39	0.19	1.57	3.36	0.36
$S_4V_1$	1.35	0.18	1.51	3.16	0.38
$S_4V_2$	1.42	0.20	1.65	3.55	0.39
$S_4V_3$	1.33	0.20	1.79	3.83	0.41
CD @ 5%	NS	NS	NS	NS	NS



**Plot view of UHDP at Madakkathara**

## **VENGURLA**

Date of planting	: 1 <sup>st</sup> July, 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
	$V_3$ : V-9 (Control)
No. of plants/ treatment/ repl.	: 6

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

training (Removal of side sprouts up to 1.5' – 2.0' on main stem) of experimental grafts were frequently done at regular interval. Similarly, terminal bud was nipped off at 1 m height from ground level.



# **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, Paria and Vengurla

*Plains / others:* Hogalagere, Jagdalpur and Kanabargi

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.



#### BAPATLA

Three sprays were imposed at 30-35 days interval at flushing, flowering and at fruit & nut development stages. Incidence of pests was recorded according to the standard procedures. Incidence of leaf and blossom webber and shoot tip caterpillar was recorded from 52 leader shoots/ laterals per tree covering all four directions. A total of 8 trees were observed per treatment a day before

spray and 30 days after each spray. As for apple and nut borer total number of nuts and no. of damaged nuts were counted in 52 panicles/tree at 30 days after 3<sup>rd</sup> spray. Thrips damage was graded on 100 nuts/tree following 0 to 4 scale. Counts of spiders and ants were recorded at 30 days after 3<sup>rd</sup> spray by tapping 52 panicles per tree on 1 sq. foot card board.

**Table 3.1 : Efficacy of different insecticides against pest complex in cashew (2018-19) at Bapatla**

Treatment	Shoot tip caterpillar damaged shoots (%)		Leaf folder Damage (%)	
	Before spray	30 days after 1 <sup>st</sup> spray	Before spray	30 days after 1 <sup>st</sup> spray
T <sub>1</sub> Thiamethoxam 25 WG (0.1 g/l)	2.56 (9.08)	12.39 <sup>cd</sup> (20.27)	1.42 (6.72)	5.79 <sup>cd</sup> (13.70)
T <sub>2</sub> Thiamethoxam 25 WG (0.2 g/l)	1.73 (6.19)	8.41 <sup>de</sup> (16.61)	2.20 (8.46)	7.26 <sup>bc</sup> (15.61)
T <sub>3</sub> Carbosulfan 25 EC (2 ml/l)	3.10 (10.03)	11.01 <sup>cd</sup> (19.21)	3.36 (9.89)	8.24 <sup>bc</sup> (16.59)
T <sub>4</sub> Buprofezin 25 SC (2 ml/l)	2.39 (8.43)	13.74 <sup>c</sup> (21.64)	3.11 (9.92)	8.19 <sup>bc</sup> (16.48)
T <sub>5</sub> <i>Beauveria bassiana</i> WP (1 g/l)	2.58 (9.12)	16.63 <sup>bc</sup> (23.86)	2.22 (8.45)	8.89 <sup>b</sup> (17.27)
T <sub>6</sub> <i>Beauveria bassiana</i> WP (5 g/l)	2.63 (9.03)	20.85 <sup>ab</sup> (27.01)	2.10 (8.27)	10.17 <sup>b</sup> (18.56)
T <sub>7</sub> λ – Cyhalothrin 5 EC (0.6 ml/l)	4.34 (11.57)	3.09 <sup>f</sup> (9.60)	3.16 (9.81)	4.07 <sup>d</sup> (11.43)

T <sub>8</sub> 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.	3.08 (9.83)	5.39 <sup>ef</sup> (13.25)	1.66 (7.40)	3.43 <sup>d</sup> (10.52)
T <sub>9</sub> Untreated check	2.41 (8.80)	27.13 <sup>a</sup> (31.34)	1.66 (7.32)	15.73 <sup>a</sup> (23.25)
CD (0.05)	N.S.	4.87	N.S.	3.38
SEm (±)	1.44	1.66	1.10	1.15
CV (%)	31.46	16.33	25.91	14.44

Figures in parentheses are arc sin transformed values

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

During 2018-19, the incidence of different important foliage, flower and nut feeding pests of cashew was medium to low. The incidence of leaf and blossom webber was very low (almost zero) in all treatments. While for shoot tip caterpillar, T<sub>7</sub> was found to be effective and which was on par with T<sub>8</sub> compared to other treatments. Similarly for leaf folder T<sub>7</sub> and T<sub>8</sub> were found to be more effective in managing the pest compared to rest of the treatments.

**Table 3.2 : Efficacy of different insecticides against pest complex in cashew (2018-19) at Bapatla**

Treatment	Apple and nut borer damage (%)		Leaf miner Damage (%)	
	Before spray	30 days after 3 <sup>rd</sup> spray	Before spray	30 days after 1 <sup>st</sup> spray
T <sub>1</sub> Thiamethoxam 25 WG (0.1 g/l)	-	2.88 <sup>cd</sup> (9.70)	2.13 (7.61)	9.23 <sup>b</sup> (17.64)
T <sub>2</sub> Thiamethoxam 25 WG (0.2 g/l)	-	2.98 <sup>cd</sup> (9.89)	1.09 (5.76)	6.10 <sup>c</sup> (14.28)
T <sub>3</sub> Carbosulfan 25 EC (2 ml/l)	-	4.73 <sup>bc</sup> (12.02)	3.73 (10.86)	9.69 <sup>b</sup> (18.01)
T <sub>4</sub> Buprofezin 25 SC (2 ml/l)	-	8.45 <sup>ab</sup> (16.53)	3.57 (10.85)	10.06 <sup>b</sup> (18.44)
T <sub>5</sub> <i>Beauveria bassiana</i> WP (1 g/l)	-	8.39 <sup>a</sup> (16.67)	2.48 (8.93)	10.67 <sup>b</sup> (19.05)
T <sub>6</sub> <i>Beauveria bassiana</i> WP (5 g/l)	-	7.20 <sup>ab</sup> (15.46)	2.49 (8.42)	11.37 <sup>b</sup> (19.67)
T <sub>7</sub> λ – Cyhalothrin 5 EC (0.6 ml/l)	-	1.61 <sup>d</sup> (6.03)	3.70 (10.75)	3.59 <sup>d</sup> (10.79)
T <sub>8</sub> 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.	-	1.36 <sup>d</sup> (6.49)	1.61 (7.17)	3.62 <sup>d</sup> (10.90)
T <sub>9</sub> Untreated check	-	10.78 <sup>a</sup> (18.98)	2.72 (9.36)	16.62 <sup>a</sup> (24.01)
CD (0.05)		4.62	N.S.	2.31
SEm (±)		1.57	1.41	0.79
CV (%)		25.32	31.75	9.26

Figures in parentheses are arc sin transformed values

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

The treatment T<sub>8</sub> offered better control against apple and nut borer damage which was on par with T<sub>7</sub>. Similar trend was observed in leaf miner also.

Population of spiders was maximum in untreated check and treatment T<sub>5</sub> followed by T<sub>6</sub> and T<sub>4</sub> while in T<sub>7</sub> and T<sub>8</sub> treated plants less number of spiders were recorded compared at 30 days after 1<sup>st</sup> spray.

## BHUBANESWAR

During the year, two natural calamities i.e. summer storm (Kalbaisakhi) and cyclonic storm (Fani) occurred during the fruiting season and drastically affected the cashew plantation in the coastal districts of Odisha including Bhubaneswar. Insect pests namely TMB, STC and red banded thrips was noticed with variable intensities during the cropping season.

Before insecticidal treatments, the TMB incidence varied from 0.72- 0.88 (0-4 scale) which was non-significant. No significant variation of TMB

incidence was found among insecticidal treatments 15 days after application of insecticides. Incidence of the shoot tip caterpillar varied from 4.61 to 5.34 per cent before spraying. Significantly least STC incidence was recorded under  $\lambda$  – cyhalothrin (T<sub>6</sub>), Carbosulfan (T<sub>2</sub>), and *B bassiana* (T<sub>5</sub>). Incidence of the redbanded thrips varied from 54.30 to 62.50 per leaf before spraying. Significantly less population (4.51-6.07/ leaf) was observed in T<sub>1</sub>, T<sub>2</sub> and T<sub>6</sub> at 15 days after spraying as against 54.6 per leaf in the untreated control.

The spider population varied from 1.25 to 3.29 per lateral among treatments. The spider population was higher in T<sub>1</sub> (Thiamethoxam), T<sub>4</sub> and T<sub>5</sub>. Before cyclone fani the nut yield varied from 2.01 to 2.35 kg/ plant among the treated plants as against 1.85 kg /plant in the control. As such, no significant difference in yield was found among the treated plants. The cost benefit ratio was more than 0.3 in T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>6</sub>.

**Table 3.3 : Effect of insecticides against pest complex in cashew (2018-19) at Bhubaneswar**

Treatment	STC (% DS)		Red banded thrips	
	BS*	15 DAS*	BS	15 DAS **
T <sub>1</sub> Thiamethoxam 25 WG (0.2 g/l)	4.78 (2.18)	3.01 (1.73)	62.50	5.39 (13.61)
T <sub>2</sub> Carbosulfan 25 EC (2 ml/l)	5.02 (2.24)	2.31 (1.51)	60.03	6.07 (14.10)
T <sub>3</sub> Buprofezin 25 SC (2 ml/l)	5.34 (2.31)	5.17 (2.27)	54.30	24.55 (29.57)
T <sub>4</sub> <i>Beauveria bassiana</i> WP (1 g/l)	4.61 (2.14)	4.88 (2.21)	60.63	39.85 (37.08)
T <sub>5</sub> <i>Beauveria bassiana</i> WP (5 g/l)	5.09 (2.20)	2.73 (1.65)	58.75	35.64 (36.56)
T <sub>6</sub> $\lambda$ – Cyhalothrin 5 EC (0.6 ml/l)	4.94 (2.22)	2.14 (1.46)	56.48	4.51 (12.06)
T <sub>7</sub>	4.97 (2.23)	5.52 (2.34)	62.45	54.61 (47.65)
SEm (±)	NS	0.06	NS	1.85
CD (0.05)	-	0.19	-	5.54

\* Figures in parentheses are square root transformed value

\*\* Figures in parentheses are angular transformed (Arcsine) values

## HOGALAGERE

The damage of TMB on shoots and panicles ranged between 2.00 to 2.38 and 2.09 to 3.37, respectively before spraying the insecticides. The TMB damage on young shoots at 7 and 15 days after spray ranged from 0.65 to 2.46 and 0.32 to 2.76, and on panicles from 0.31 to 3.12 and 0.02 to 3.25 respectively. The damage was significantly less under T<sub>2</sub> compared to all the sprays followed by T<sub>7</sub> and T<sub>8</sub>. Whereas, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub> treatments

were least effective in reducing TMB damage. The maximum nut yield was recorded in treatment T<sub>2</sub> (7.02kg/tree), followed by Lambda cyhalothrin (6.87kg/tree). The minimum yield was recorded in *Beauvaria bassiana* (1&5 g/l) and *Buprofezin* (2ml/l) treatments. Similar trend was observed for against apple and nut borer, thrips and aphids. However the maximum population of spider, ladybird beetles, green lacewing and syrphids was recorded in T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub> as compared to remaining treatments.

**Table 3.4 : Efficacy of different insecticides against Tea Mosquito Bug (TMB) incidence in cashew at HREC, Hogalagere centre during 2018-19**

Treatments		TMB incidence on 52 leader shoots/panicles at diff. days after spray (DAS)						Mean	Nut yield (Kg/tree)
		On shoots			On Inflorescence				
		BS	7	15	BS	7	15		
T <sub>1</sub>	Thiamethoxam 25WG (0.1g/l)	2.26	1.79	1.67	2.63	0.86	1.96	1.78	5.25
T <sub>2</sub>	Thiamethoxam 25 WG (0.2 g/l)	2.02	0.65	0.32	2.38	0.31	0.02	0.74	7.02
T <sub>3</sub>	Carbosulfan 25 EC (2 ml/l)	2.09	0.87	0.48	2.09	0.87	0.51	0.96	6.32
T <sub>4</sub>	Buprofezin 25 SC (2 ml/l)	2.38	1.24	1.43	2.38	1.86	1.23	1.63	6.00
T <sub>5</sub>	<i>Beauvaria bassiana</i> (IIHR strain) (1g/l)	2.28	1.89	1.65	3.18	2.88	3.09	2.54	5.10
T <sub>6</sub>	<i>Beauvaria bassiana</i> (IIHR strain) (5 g/l)	2.00	1.64	1.89	3.00	2.90	3.11	2.51	5.46
T <sub>7</sub>	λ – Cyhalothrin 5 EC @ 0.6ml/l)	2.16	0.78	0.58	2.16	0.77	0.24	0.90	6.87
T <sub>8</sub>	Untreated control	2.37	2.46	2.76	3.37	3.12	3.25	2.99	4.87
	SEm (±)	0.12	0.11	0.10	0.21	0.12	0.14	-	-
	CD @ 5%	0.37	0.34	0.31	0.64	0.35	0.41	-	-
	CV	11.21	16.01	15.26	16.06	13.69	16.13	-	-

**Table 3.5 : Efficacy of different insecticides against pest complex in cashew at HREC Hogalagere centre during 2018-19**

Treatments		Incidence of diff. pests on 52 leader shoots / inflorescence					
		Apple and nut borer		Thrips		Aphids	
		BS	15 DAS	BS	15 DAS	BS	15 DAS
T <sub>1</sub>	Thiamethoxam 25WG (0.1 g/l)	1.10	0.82	3.01	0.82	3.01	0.5
T <sub>2</sub>	Thiamethoxam 25 WG (0.2 g/l)	2.20	0.47	2.19	0.41	3.00	0.11
T <sub>3</sub>	Carbosulfan 25 EC (2 ml/l)	2.50	0.66	3.12	0.65	2.74	0.23
T <sub>4</sub>	Buprofezin 25 SC (2 ml/l)	3.77	0.72	2.61	0.68	3.10	0.48
T <sub>5</sub>	<i>Beauvaria bassiana</i> (1 g/l)	2.54	1.9	3.43	1.06	2.83	2.97
T <sub>6</sub>	<i>Beauvaria bassiana</i> (5 g/l)	3.06	0.77	2.04	0.79	3.12	3.23
T <sub>7</sub>	λ – Cyhalothrin 5 EC @ 0.6ml/l	2.15	0.92	1.13	0.47	3.80	0.12
T <sub>8</sub>	Untreated control	1.72	1.03	3.16	2.94	2.85	3.46
	SEm (±)	0.14	0.07	0.21	0.08	0.24	0.10
	CD at 5%	0.43	0.20	0.62	0.23	0.73	0.29
	CV (%)	12.07	14.33	15.95	15.66	15.84	13.64

**Table 3.6 : Efficacy of different insecticides against pest complex in cashew at HREC, Hogalagere during 2018-19**

Treatment	Incidence of diff. predators on 52 leader shoots / inflorescence								
	<i>Oxyessweta</i>		<i>Menochilus sexmaculatus</i>		<i>Chrysoperla sp.</i>		<i>Syrphids</i>		
	BS	15 DAS	BS	15 DAS	BS	15 DAS	BS	15 DAS	
T <sub>1</sub> : Thiamethoxam 25 WG (0.1g/l)	1.85	1.07	1.51	0.28	1.75	0.72	2.35	0.85	
T <sub>2</sub> : Thiamethoxam 25 WG (0.2g/l)	2.29	0.48	2.24	0.44	1.89	0.51	1.65	0.67	
T <sub>3</sub> : Carbosulfan 25 EC (2ml/l)	2.03	0.62	0.35	0.76	2.42	1.89	1.25	0.50	
T <sub>4</sub> Buprofezin 25 SC (2 ml/l)	2.71	1.21	2.00	1.47	2.37	1.23	1.56	1.12	
T <sub>5</sub> <i>Beauvaria bassiana</i> (1 g/l)	2.95	2.42	2.35	2.64	2.29	2.34	2.25	2.98	
T <sub>6</sub> <i>Beauvaria bassiana</i> (5 g/l)	2.26	2.39	2.00	2.37	2.32	2.76	2.30	2.65	
T <sub>7</sub> λ – Cyhalothrin 5 EC @ 0.6ml/l	2.41	1.12	2.27	0.67	2.18	0.65	2.20	0.66	
T <sub>8</sub> Untreated control	2.87	2.98	2.89	2.99	2.27	2.76	2.19	2.85	
	SEm (±)	0.17	0.11	0.17	0.12	0.18	0.11	0.14	0.12
	CD at 5%	0.53	0.33	0.51	0.36	0.54	0.34	0.42	0.35
	CV (%)	14.42	14.35	17.21	16.45	16.36	13.93	14.25	15.31

## JAGDALPUR

The results of the insecticides against TMB revealed that the efficacy of different insecticides were statistically superior over untreated control. The pre treatment damage score of TMB was non-significant in all treatments including untreated control. After first spray, the damage score was low (0.045) in  $T_7$  which was at par with  $T_2$  with damage score 0.090 followed by  $T_1$  and  $T_4$  with 0.223 and 0.243 scores. After the second spray, the damage score was minimum (0.015) in  $T_7$  which was found to

be at par with  $T_2$  and  $T_4$  with 0.070 and 0.128 scores respectively.

Similar results were also observed in 30 days after third spray in which  $T_7$  showed least damage. Overall the efficacy of most effective insecticide  $T_7 > T_2 > T_1$  and  $T_4 > T_6$ .

While, the mean population of natural enemies ants, spiders, lady bird beetle and *Brumus* was considerably less in sprayed trees compared to unsprayed trees.



Fig. Infestation of leaf folder in experimental plot at Jagdalpur

**Table 3.7 : Efficacy of insecticides on the incidence of TMB at Jagdalpur, centre**

Treatment	First spray		Second spray		Third spray		Mean of three spray
	Pre treatment mean damage score (0-4)	Post treatment mean damage score (0-4)	Pre treatment mean damage score (0-4)	Post treatment mean damage score (0-4)	Pre treatment mean damage score (0-4)	Post treatment mean damage score (0-4)	
T <sub>1</sub> Thiamethoxam 25 WG (0.1 g/l)	0.840 (1.356)	0.223 (1.106) <sup>bc</sup>	0.995 (1.412)	0.146 (1.071) <sup>bcd</sup>	0.505 (1.227)	0.080 (1.039) <sup>bc</sup>	0.150 (1.072) <sup>bc</sup>
T <sub>2</sub> Thiamethoxam 25 WG (0.2 g/l)	0.750 (1.323)	0.090 (1.044) <sup>ab</sup>	1.065 (1.437)	0.070 (1.035) <sup>ab</sup>	0.493 (1.222)	0.034 (1.017) <sup>ab</sup>	0.065 (1.031) <sup>ab</sup>
T <sub>3</sub> Carbosulfan 25 EC (2 ml/l)	0.905 (1.376)	0.316 (1.144) <sup>cdef</sup>	0.990 (1.410)	0.195 (1.093) <sup>bode</sup>	0.505 (1.227)	0.155 (1.075) <sup>ef</sup>	0.222 (1.107) <sup>cde</sup>
T <sub>4</sub> Buprofezin 25 SC (2ml/l)	0.820 (1.349)	0.243 (1.115) <sup>cd</sup>	1.095 (1.447)	0.128 (1.062) <sup>abc</sup>	0.475 (1.214)	0.088 (1.043) <sup>cd</sup>	0.153 (1.074) <sup>b</sup>
T <sub>5</sub> <i>Beauveria bassiana</i> (1g/l)	0.895 (1.376)	0.375 (1.173) <sup>cdefg</sup>	1.085 (1.444)	0.355 (1.164) <sup>defg</sup>	0.540 (1.241)	0.200 (1.095) <sup>g</sup>	0.31 (1.145) <sup>cdef</sup>
T <sub>6</sub> <i>Beauveria bassiana</i> ( 5g/l)	0.91 (1.384)	0.275 (1.129) <sup>cde</sup>	1.125 (1.458)	0.233 (1.110) <sup>cdef</sup>	0.561 (1.250)	0.144 (1.070) <sup>e</sup>	0.217 (1.103) <sup>cd</sup>
T <sub>7</sub> λ – cyhalothrin 5EC (0.6ml/l)	0.930 (1.384)	0.045 (1.022) <sup>a</sup>	1.005 (1.416)	0.015 (1.009) <sup>a</sup>	0.490 (1.220)	0.013 (1.006) <sup>a</sup>	0.024 (1.013) <sup>a</sup>
T <sub>8</sub> Untreated check	0.960 (1.400)	1.060 (1.435) <sup>h</sup>	1.138 (1.462)	1.085 (1.444) <sup>h</sup>	0.540 (1.241)	0.498 (1.224) <sup>f</sup>	0.881 (1.369) <sup>g</sup>
CD (p=0.05)	NS	0.069	NS	0.059	NS	0.014	0.068
SEm (±)	0.016	0.023	0.017	0.020	0.009	0.005	0.02
CV (%)	2.37	4.09	2.31	3.55	1.40	0.88	3.44

\*Damage score values in the parentheses are square root transformation values

\*\*Data presented in table is mean damage score after 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> spray

Table 3.8 : Efficacy of insecticides on the incidence of different pests at Jagdalpur, centre

Treatment	Mean damage after third spray											
	Thrips		Shoot tip caterpillar		Leaf miner		Leaf folder					
	Pre treatment damage score (0-4)	Post treatment damage score (0-4)	Pre treatment % damage	Post treatment % damage	Pre treatment % damage	Post treatment % damage	Pre treatment % damage	Post treatment % damage				
T <sub>1</sub> Thiamethoxam 25 WG (0.1 g/l)	0.995 (1.412)	0.218 (1.103) <sup>c</sup>	12.443 (20.645)	5.600 (13.668) <sup>d</sup>	4.600 (12.352)	0.528 (4.163) <sup>d</sup>	8.300 (16.733)	3.034 (10.029) <sup>e</sup>				
T <sub>2</sub> Thiamethoxam 25 WG (0.2 g/l)	0.945 (1.394)	0.151 (1.073) <sup>b</sup>	11.424 (19.741)	2.750 (9.492) <sup>a</sup>	4.525 (12.266)	0.320 (3.241) <sup>b</sup>	8.075 (16.493)	2.189 (8.493) <sup>bc</sup>				
T <sub>3</sub> Carbosulfan 25 EC (2 ml/l)	1.015 (1.419)	0.268 (1.126) <sup>d</sup>	12.125 (20.361)	3.000 (9.936) <sup>b</sup>	4.750 (12.563)	0.348 (3.337) <sup>bc</sup>	7.935 (16.343)	2.302 (8.703) <sup>cd</sup>				
T <sub>4</sub> Buprofezin 25 SC (2ml/l)	0.980 (1.407)	0.244 (1.116) <sup>cd</sup>	12.375 (20.577)	5.900 (14.049) <sup>d</sup>	5.220 (13.199)	0.825 (5.209) <sup>f</sup>	8.875 (17.317)	3.585 (10.909) <sup>fg</sup>				
T <sub>5</sub> <i>Beauveria bassiana</i> (1g/l)	1.035 (1.426)	0.335 (1.155) <sup>e</sup>	11.892 (20.152)	6.063 (14.227) <sup>d</sup>	5.358 (13.371)	0.710 (4.381) <sup>e</sup>	8.340 (16.761)	3.950 (11.459) <sup>h</sup>				
T <sub>6</sub> <i>Beauveria bassiana</i> ( 5g/l)	1.015 (1.419)	0.290 (1.136) <sup>de</sup>	11.850 (20.118)	4.650 (12.434) <sup>c</sup>	4.675 (12.457)	0.558 (4.279) <sup>de</sup>	8.150 (16.574)	3.286 (10.436) <sup>ef</sup>				
T <sub>7</sub> λ – cyhalothrin 5EC (0.6ml/l)	1.010 (1.418)	0.080 (1.039) <sup>a</sup>	11.625 (19.920)	1.875 (7.852) <sup>a</sup>	4.715 (12.523)	0.203 (2.277) <sup>a</sup>	7.875 (16.289)	1.650 (7.373) <sup>a</sup>				
T <sub>8</sub> Untreated check	1.050 (1.432)	1.040 (1.428) <sup>f</sup>	12.500 (20.695)	12.375 (20.585) <sup>e</sup>	5.325 (13.333)	1.915 (7.951) <sup>g</sup>	8.940 (17.385)	7.725 (16.129) <sup>i</sup>				
CD (p=0.05)	NS	0.022	NS	1.105	NS	0.120	NS	0.478				
SEm (±)	0.014	0.007	0.339	0.373	0.343	0.041	0.334	0.161				
CV (%)	1.99	1.27	3.34	5.84	5.37	1.82	3.99	3.09				

\*Values in the parentheses of damage score are square root transformation values

\*\*Values in the parentheses of per cent damage are arc sin transformation values

## MADAKKATHARA

### Influence of insecticides on tea mosquito bug damage

The trial was conducted in the mid season variety Priyanka. Since, the TMB population was very low during November, first round of spray was skipped and second and third round of spray was given during December and January coinciding with flowering and fruiting. The TMB incidence before second spray and 15 days after second and third spray are presented.

Before spraying of insecticides, the average TMB damage on laterals and panicles was 0.394 and 0.403 respectively. The treatments showed significant difference with respect to TMB damage on both laterals and panicles. After 15 days of second and third spray, treatments T<sub>1</sub> and T<sub>2</sub> showed significantly lowest damage score of TMB. Treatment T<sub>9</sub> (POP, KAU) also recorded lowest damage score of TMB and nut yield per tree was highest in T<sub>1</sub> and T<sub>9</sub>.

**Table 3.9 : Efficacy of different insecticides against TMB Incidence in cashew at Madakkathara Centre (2018-19)**

Treatments		TMB incidence on 30 leader shoots/panicles at different days after spray (DAS)						Nut Yield (Kg/Tree)
		On Laterals			On Panicles			
		BS	15 days after II spray	15 days after III spray	BS	15 days after II spray	15 days after III spray	
T <sub>1</sub>	Thiamethoxam (0.1g/l)	0.368 (0.931) <sup>a</sup>	0.024 (0.723) <sup>d</sup>	0.007 (0.712) <sup>d</sup>	0.440 (0.966) <sup>a</sup>	0.026 (0.724) <sup>d</sup>	0.000 (0.707) <sup>d</sup>	4.35a
T <sub>2</sub>	Thiamethoxam (0.2g/l)	0.286 (0.887) <sup>a</sup>	0.000 (0.707) <sup>d</sup>	0.000 (0.707) <sup>d</sup>	0.334 (0.913) <sup>a</sup>	0.000 (0.707) <sup>d</sup>	0.000 (0.707) <sup>d</sup>	3.35 <sup>ab</sup>
T <sub>3</sub>	Carbosulfan (2ml/l)	0.363 (0.929) <sup>a</sup>	0.096 (0.771) <sup>bcd</sup>	0.039 (0.734) <sup>bcd</sup>	0.298 (0.887) <sup>a</sup>	0.055 (0.744) <sup>cd</sup>	0.000 (0.707) <sup>d</sup>	3.24 <sup>ab</sup>
T <sub>4</sub>	Buprofezin (2ml/l)	0.360 (0.927) <sup>a</sup>	0.081 (0.762) <sup>bcd</sup>	0.023 (0.723) <sup>cd</sup>	0.410 (0.952) <sup>a</sup>	0.131 (0.794) <sup>bcd</sup>	0.000 (0.707) <sup>d</sup>	3.018 <sup>ab</sup>
T <sub>5</sub>	<i>Beauveria bassiana</i> WP (0.5g/l)	0.444 (0.971) <sup>a</sup>	0.048 (0.738) <sup>cd</sup>	0.081 (0.761) <sup>abc</sup>	0.457 (0.977) <sup>a</sup>	0.242 (0.861) <sup>ab</sup>	0.224 (0.842) <sup>ab</sup>	1.295 <sup>b</sup>
T <sub>6</sub>	<i>Beauveria bassiana</i> WP (1g/l)	0.445 (0.972) <sup>a</sup>	0.177 (0.819) <sup>abc</sup>	0.101 (0.774) <sup>ab</sup>	0.432 (0.965) <sup>a</sup>	0.165 (0.809) <sup>bc</sup>	0.138 (0.796) <sup>bc</sup>	1.515 <sup>b</sup>
T <sub>7</sub>	<i>Beauveria bassiana</i> (5g/l)	0.437 (0.967) <sup>a</sup>	0.219 (0.843) <sup>ab</sup>	0.039 (0.734) <sup>bcd</sup>	0.417 (0.957) <sup>a</sup>	0.105 (0.778) <sup>cd</sup>	0.057 (0.746) <sup>cd</sup>	1.248 <sup>b</sup>
T <sub>8</sub>	λ – cyhalothrin (0.6 ml/l)	0.393 (0.944) <sup>a</sup>	0.032 (0.729) <sup>d</sup>	0.017 (0.719) <sup>cd</sup>	0.500 (1.000) <sup>a</sup>	0.082 (0.762) <sup>cd</sup>	0.022 (0.722) <sup>d</sup>	1.343 <sup>b</sup>
T <sub>9</sub>	POP, Kerala	0.446 (0.972) <sup>a</sup>	0.083 (0.762) <sup>bcd</sup>	0.000 (0.707) <sup>d</sup>	0.370 (0.932) <sup>a</sup>	0.025 (0.724) <sup>d</sup>	0.000 (0.707) <sup>d</sup>	3.95 <sup>a</sup>
T <sub>10</sub>	Untreated check	0.395 (0.946) <sup>a</sup>	0.262 (0.870) <sup>a</sup>	0.144 (0.802) <sup>a</sup>	0.373 (0.934) <sup>a</sup>	0.313 (0.900) <sup>a</sup>	0.107 (0.776) <sup>a</sup>	2.41 <sup>ab</sup>
	Mean	0.3937	0.1022	0.0451	0.4031	0.1144	0.0548	3.21
	SEm (±)	0.079	0.007	0.002	0.118	0.008	0.004	1.47
	CD at 5%	NS	0.089	0.064	NS	0.131	0.146	2.14

\* BS: Before spray

### Influence of insecticides on insect pests other than tea mosquito bug

Only the infestation of leaf miner and thrips were noticed during this period. However, no significant difference was observed among the treatments. Apple and nut borer infestation was not observed during the season.



Tea mosquito bug



TMB infestation on shoot



TMB infestation on tender nuts



### PARIA

The population of TMB on shoots and panicles ranged between 1.21 to 1.49 and 1.19 to 1.40, respectively before spraying the insecticides. The TMB damage score at 7 days and 15 days after the spray ranged from 0.43 to 1.59 and 0.15 to 1.68 on shoots and 0.49 to 1.53 and 0.21 to 1.78 on panicles.

### Influence of insecticides on natural enemies

Population of natural enemies was higher before spraying but no significant difference in their population was observed among the treatments after 30 DAS.

Among the insecticidal treatments, T<sub>3</sub> (Carbosulfan) was observed to be superior for the management of TMB on shoots and panicles followed by T<sub>4</sub> (Buprofezin). Whereas, the treatment of *Beauveria bassiana* (1 g/l) and Thiamethoxam (0.1g/l) were found to be least effective in controlling the TMB.

**Table 3.10 : Efficacy of different insecticides against tea mosquito bug incidence in cashew at Paria centre during the year 2018-19**

Treatments		On shoots			On panicles		
		BS	7 DAS	15 DAS	BS	7 DAS	15 DAS
T <sub>1</sub>	Thiamethoxam 25% WG 1g/10 lit	1.38	1.31	1.42	1.40	1.29	1.27
T <sub>2</sub>	Thiamethoxam 25% WG 2g/10 lit	1.44	1.08	0.92	1.32	1.01	0.90
T <sub>3</sub>	Carbosulfan 25% EC 20ml/10 lit	1.31	0.43	0.15	1.19	0.55	0.26
T <sub>4</sub>	Buprofezin 25% SC 20 ml/10 lit	1.29	0.52	0.18	1.37	0.49	0.21
T <sub>5</sub>	<i>Beauveria bassiana</i> 10 g/10 lit	1.38	1.44	1.47	1.33	1.32	1.41
T <sub>6</sub>	<i>Beauveria bassiana</i> 50 gm/10 lit	1.21	1.14	1.05	1.28	1.07	0.93
T <sub>7</sub>	λ – Cyhalothrin 5% EC 6 ml /10 lit	1.47	0.79	0.53	1.27	0.74	0.45
T <sub>8</sub>	Untreated control	1.49	1.59	1.68	1.34	1.53	1.78
	SEm (±)	0.10	0.05	0.06	0.04	0.05	0.05
	CD at 5%	NS	0.16	0.17	NS	0.14	0.17
	CV%	12.04	8.90	10.40	5.83	7.89	10.46

For thrips minimum damage was observed in (T<sub>4</sub>) Buprofezin (0.09) after 3<sup>rd</sup> spray which was statistically on par with T<sub>3</sub> (Carbosulfan) and T<sub>7</sub> (λ – Cyhalothrin). The maximum nut yield was recorded in Buprofezin treated plots.

**Table 3.11 : Efficacy of different insecticides against pest complex in cashew at Paria centre during the year 2018-19**

Treatments		Thrips damage score on nuts	Nut Yield (kg/plant)
		30 days after 3 <sup>rd</sup> Spray	
T <sub>1</sub>	Thiamethoxam 25% WG 1g/10 lit	0.37	1.22
T <sub>2</sub>	Thiamethoxam 25% WG 2g/10 lit	0.25	2.25
T <sub>3</sub>	Carbosulfan 25% EC 20ml/10 lit	0.14	3.80
T <sub>4</sub>	Buprofezin 25% SC 20 ml/10 lit	0.09	4.12
T <sub>5</sub>	<i>Beauveria bassiana</i> 10 g/10 lit	0.40	1.20
T <sub>6</sub>	<i>Beauveria bassiana</i> 50 gm/10 lit	0.35	2.50
T <sub>7</sub>	λ – Cyhalothrin 5% EC 6 ml /10 lit	0.15	3.70
T <sub>8</sub>	Untreated control	0.65	0.97
	SEm (±)	0.03	0.08
	CD at 5%	0.08	0.24
	CV%	16.00	5.57

The populations of natural enemies were recorded before spray and 30<sup>th</sup> days after 3<sup>rd</sup> spray. Maximum population of spiders, ants and lady bird beetles were recorded under *Beauveria bassiana* and untreated control.

### **VENGURLE**

Trial was not conducted during the year 2018-19 due to very low incidence of tea mosquito bug and thrips in experimental plot.

### **VRIDHACHALAM**

As per the technical programme, three round spray schedule of chemical insecticides was followed at flushing, flowering and fruit formation stages. 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. 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 revealed that after first, second and third spraying, the efficacy of different insecticides on TMB was at par, but statistically superior over untreated control. The pre-treatment damage score of TMB was non-significant in all treatments. Gradual reduction of fresh infestation was observed two weeks after each round of spray. After first spray, the damage score was low (0.175) in T<sub>4</sub>, followed by T<sub>5</sub> and T<sub>1</sub> which was at par each other. The same trend was observed in 15 DAS and 30 DAS also.

After the second spray, the damage score ranged between 0.275 and 1.200 in different treatments as against 3.525 in untreated control. While, thirty days after third spray, the damage score decreased and ranged between 0.0018 and 0.375 in various treatments as against 3.675 in control. The overall efficacy is as follows: T<sub>4</sub> > T<sub>5</sub> > T<sub>1</sub> > T<sub>2</sub> > T<sub>3</sub>.

**Table 3.12 : Effect of insecticides on the incidence of TMB at Vridhachalam**

Treatment		(Mean of four replications)																	
		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)			I Spray			Pre-treatment damage score (0-4)			II Spray			Pre-treatment damage score (0-4)			III Spray		
T <sub>1</sub>	Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	1.950 (1.717)	0.525 (1.235)	0.300 (1.139)	0.125 (1.060)	3.100 (2.025)	0.400 (1.183)	0.325 (1.151)	0.253 (1.119)	3.500 (2.121)	0.450 (1.204)	0.350 (1.161)	0.2250 (1.106)	0.0975 (1.048)	0.0083 (1.004)				
T <sub>2</sub>	Carbosulfan 25 EC @ 2 ml/lit. all the three sprays	1.950 (1.717)	0.800 (1.341)	0.650 (1.284)	0.550 (1.245)	3.025 (2.006)	0.800 (1.341)	0.450 (1.204)	0.445 (1.202)	3.525 (2.127)	0.450 (1.204)	0.450 (1.204)	0.2250 (1.106)	0.0975 (1.048)	0.0083 (1.004)				
T <sub>3</sub>	Buprofezin 25 % SC @ 2 ml/lit. all the three sprays	2.000 (1.732)	1.200 (1.483)	0.975 (1.405)	0.750 (1.323)	3.150 (2.037)	1.200 (1.483)	0.725 (1.313)	0.688 (1.299)	3.425 (2.103)	0.650 (1.284)	0.650 (1.284)	0.3500 (1.162)	0.3500 (1.162)	0.3750 (1.172)				
T <sub>4</sub>	Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	1.975 (1.725)	0.175 (1.084)	0.125 (1.060)	0.090 (1.044)	3.000 (2.000)	0.275 (1.129)	0.150 (1.072)	0.045 (1.022)	3.475 (2.115)	0.123 (1.059)	0.123 (1.059)	0.0063 (1.003)	0.0063 (1.003)	0.0018 (1.001)				
T <sub>5</sub>	Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays	1.925 (1.710)	0.350 (1.162)	0.275 (1.129)	0.125 (1.060)	3.150 (2.037)	0.375 (1.172)	0.275 (1.129)	0.238 (1.112)	3.575 (2.139)	0.300 (1.140)	0.300 (1.140)	0.0773 (1.038)	0.0773 (1.038)	0.0078 (1.004)				
T <sub>6</sub>	Untreated control	2.000 (1.725)	2.475 (1.864)	2.800 (1.949)	3.050 (2.012)	3.225 (2.055)	3.525 (2.127)	3.675 (2.162)	3.700 (2.168)	3.550 (2.133)	3.600 (2.145)	3.600 (2.145)	3.6250 (2.150)	3.6250 (2.150)	3.6750 (2.162)				
	C.D.	NS	0.049	0.061	0.030	NS	0.043	0.034	0.019	NS	0.047	0.047	0.038	0.038	0.032				
	SE(m)	0.010	0.016	0.020	0.010	0.015	0.014	0.011	0.006	0.018	0.016	0.016	0.012	0.012	0.011				
	SE(d)	0.014	0.023	0.028	0.014	0.021	0.020	0.016	0.009	0.025	0.022	0.022	0.017	0.017	0.015				
	C.V.	1.16	2.37	3.03	1.52	1.47	2.02	1.64	0.96	1.65	2.34	2.34	1.97	1.97	1.68				

DAS - Days After Spraying  
 Values in the parentheses are  $\sqrt{x + 0.5}$  transformed values

**Table 3.13 : Efficacy of insecticides against foliar pests at Vriddhachalam**

Treatment	Mean damage after 3 <sup>rd</sup> spray												(Mean of four observations)	
	TMB Damage %		Leaf Miner %		Leaf and Blossom Webber %		Apple and Nut Borer %		Leaf Thrips Population (Nos.)		Yield (Kg per tree)			
	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS
T <sub>1</sub>	3.825 (11.263)	2.175 (8.476)	4.875 (12.750)	1.500 (7.026)	4.475 (12.129)	0.888 (5.402)	1.350 (6.657)	0.002 (0.264)	9.125 (3.181)	0.425 (1.193)	9.125 (3.181)	0.425 (1.193)	6.525 (2.742)	6.525 (2.742)
T <sub>2</sub>	3.925 (11.415)	2.438 (8.976)	4.825 (12.683)	1.600 (7.262)	4.400 (12.018)	0.825 (5.204)	1.550 (7.140)	0.028 (0.939)	9.075 (3.173)	0.500 (1.224)	9.075 (3.173)	0.500 (1.224)	6.325 (2.705)	6.325 (2.705)
T <sub>3</sub>	3.750 (11.160)	2.475 (9.046)	4.925 (12.816)	1.825 (7.757)	4.500 (12.175)	1.013 (5.771)	1.575 (7.202)	0.035 (1.057)	9.025 (3.165)	0.600 (1.265)	9.025 (3.165)	0.600 (1.265)	6.225 (2.686)	6.225 (2.686)
T <sub>4</sub>	3.850 (11.310)	1.588 (7.203)	4.975 (12.883)	0.823 (5.196)	4.525 (12.207)	0.785 (5.072)	1.600 (7.264)	0.001 (0.200)	9.100 (3.177)	0.225 (1.103)	9.100 (3.177)	0.225 (1.103)	7.125 (2.849)	7.125 (2.849)
T <sub>5</sub>	3.800 (11.234)	2.100 (8.328)	4.850 (12.717)	1.250 (6.406)	4.475 (12.129)	0.908 (5.462)	1.800 (7.701)	0.003 (0.311)	9.200 (3.193)	0.450 (1.203)	9.200 (3.193)	0.450 (1.203)	6.850 (2.800)	6.850 (2.800)
T <sub>6</sub>	3.925 (11.422)	4.075 (11.636)	4.900 (12.783)	4.935 (12.829)	4.750 (12.531)	3.750 (11.161)	1.700 (7.486)	1.763 (7.622)	9.175 (3.189)	9.125 (3.182)	9.175 (3.189)	9.125 (3.182)	4.950 (2.437)	4.950 (2.437)
	NS	0.598	NS	0.286	NS	0.362	NS	0.191	NS	0.078	NS	0.078	0.028	0.028
	0.188	0.197	0.052	0.094	0.587	0.119	0.149	0.063	0.009	0.026	0.009	0.026	0.009	0.009
	0.266	0.278	0.074	0.133	0.831	0.168	0.211	0.089	0.013	0.036	0.013	0.036	0.013	0.013
	3.32	4.41	0.81	2.42	9.63	3.75	4.12	7.26	0.56	3.34	0.56	3.34	0.68	0.68

PTC - Pre Treatment Count; DAS: Days After Spraying

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

The population trend of TMB and other foliar feeding insects was recorded. Thirty days after 3<sup>rd</sup> spray, all the insecticides 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. The mean population of natural enemies spiders, coccinellids, ants and braconid wasp was considerably reduced in sprayed trees, but in unsprayed trees higher number of natural enemies including weaver ants and *Cotesia* wasps were observed throughout the season.

## Ent. 2: Control of cashew stem and root borer

### Expt. 2. Curative control trial

*Centres: East Coast :* Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

*West Coast :* Madakkathara and Vengurla

*Plains / others:* Hogalagere and Jagdalpur

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



#### BAPATLA

**Table 3.14 :** 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)	20	7	35.0	65.0
2.	Neem oil Swabbing (5%)	20	11	55.0	45.0
3.	Imidacloprid (2 ml/l) (Swabbing and Drenching)	20	6	30.0	70.0
4.	Chlorpyrifos (10 ml/l) (Treated Check)	20	9	45.0	55.0
5.	Untreated check (only removal of CSR grubs)	20	14	70.0	30.0

**Table 3.15 :** 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 Diameter	< 60 cm	5	0	0.0	5	100.0
	60-80cm	12	0	0.0	12	100.0
	80-100 cm	36	21	58.3	15	41.7
	>100 cm	47	26	55.3	21	44.7
<b>Total</b>		<b>100</b>	<b>47</b>	<b>47.0</b>	<b>53</b>	<b>53.0</b>
Age of the tree	< 10 years	9	0	0.0	9	100.0
	10-15 years	30	13	43.3	17	56.7
	>15years	61	34	55.7	27	44.3
<b>Total</b>		<b>100</b>	<b>47</b>	<b>47.0</b>	<b>53</b>	<b>53.0</b>

<b>Zone of attack</b>	C + R	18	11	61.1	7	38.9
	C + S	30	12	40.0	18	60.0
	R	0	0	0	0	0
	S	26	6	23.1	20	76.9
	C	2	2	100.0	0	0.0
	C + S + R	24	16	66.7	8	33.3
<b>Total</b>		<b>100</b>	<b>47</b>	<b>47.0</b>	<b>53</b>	<b>53.0</b>
<b>Yellowing of canopy</b>	Canopy yellowing	26	25	96.1	1	3.9
	Canopy not yellowing	74	22	29.7	52	70.3
<b>Total</b>		<b>100</b>	<b>47</b>	<b>47.0</b>	<b>53</b>	<b>53.0</b>
<b>% of bark circumference damaged</b>	<25	36	4	11.2	32	88.8
	26-50	37	18	48.7	19	51.3
	51-75	17	15	88.2	2	11.8
	>75	10	10	100.0	0	0.0
<b>Total:</b>		<b>100</b>	<b>47</b>	<b>47.0</b>	<b>53</b>	<b>53.0</b>

During the year, among the insecticides evaluated as post extraction prophylaxis, Imidacloprid (Swabbing and drenching) @ 2ml/l had offered protection to the tune of 70.00 % trees without re-infestation followed by Fipronil Swabbing 2 ml/l with 65.00 % trees without re-infestation. The other treatments Chlorpyrifos 10 ml/l (Treated Check) and neem oil 5% (Swabbing) has offered 55.00 and 45.00 percent protection without re-infestation and are superior over the control treatment which recorded 30% trees without re-infestation. Preferential zone of attack is stem + collar in 30.00 per cent of trees (30/100) followed by stem and color+root in 26.00 and 24.00 percent of trees.

## **BHUBANESWAR**

The total number of CSRB infested plants was 93 out of which 53 plants (56.98%) showed without reinfestation over the PEP treatments. Maximum recovery (15.05 %) was achieved in T<sub>4</sub> Chlorpyrifos

swabbing (10 ml/l) followed by swabbing and soil drenching of Imidacloprid (12.90%) and swabbing of Fipronil (11.82%) as against 7.52% plant recovery in mechanical extraction of grub only.

The physical parameters on infestation of CSRB revealed that the infestation increased with increase in stem girth upto 80-100cm. Highest infestation (46.23%) was recorded in 80-100cm followed by 60-80cm stem girth but highest recovery was observed in 60-80cm. Highest infestation of CSRB was found in age group 10-15 years but highest recovery (61.29%) was recorded in plants of age group more than 15 years. The stem and collar region zone of attack recorded highest incidence of stem borer i.e. 40 out of 93 plants (43.01%). However, highest recovery (100%) was detected in case of root zone attack. About 57.1% of borer had consumed 51-75% of bark circumference. 14 out of 93 plants (15.0%) showed yellowing of canopy while the remaining cashew plants were non yellow.

**Table 3.16 : Efficacy of post extraction prophylaxis (PEP) treatment at Bhubaneswar**

Treatment	No of trees treated	No. of trees without reinfestation	Recovery (%)
T <sub>1</sub> Fipronil swabbing (2ml/l)	16	11	11.82
T <sub>2</sub> Neem oil swabbing (5% suspension)	15	9	9.68
T <sub>3</sub> Imidacloprid (2ml/l) swabbing & soil drenching	16	12	12.90
T <sub>4</sub> Chlorpyrifos swabbing (10ml/l)	18	14	15.05
T <sub>5</sub> Mechanical extraction of grub (treated check)	14	7	7.52
T <sub>6</sub> Untreated check	14	0	0
<b>Total</b>	<b>93</b>	<b>53</b>	<b>56.98</b>

**Table 3.17 : Physical parameter of CSRB treated tree at Bhubaneswar**

Parameters	Category	No of trees treated	No of trees reinfested	% reinfested	No of trees not reinfested	% of trees not reinfested
Stem girth	<60 cm	4	0	0	4	100
	60-68cm	26	20	38.46	16	61.54
	80-100cm	43	21	48.84	22	51.16
	100cm	20	9	45.0	11	55.0
<b>Total</b>		<b>93</b>	<b>40</b>	<b>43.02</b>	<b>53</b>	<b>56.98</b>
Age of tree	<5year	0	0	0	0	0
	5-10 yr	10	4	40.0	6	60.0
	10-15 yrs	52	24	46.15	28	53.84
	>15 yrs	31	12	38.71	19	61.29
<b>Total</b>		<b>93</b>	<b>40</b>	<b>43.02</b>	<b>53</b>	<b>56.9</b>
Zone of attack	C+R	10	4	40.0	6	60.0
	C+S	40	20	50.0	20	50.0
	R	5	0	0	5	100
	S	21	10	46.62	11	52.38
	C+S+R	17	8	47.05	9	52.94
<b>Total</b>		<b>93</b>	<b>40</b>	<b>43.02</b>	<b>53</b>	<b>56.9</b>
Bark circumference damage (%)	<25	16	4	25.0	12	75.0
	25-50	26	12	46.15	14	53.85
	51-75	28	16	57.14	12	42.86
	>75	23	8	30.67	15	65.21
<b>Total</b>		<b>93</b>	<b>40</b>	<b>43.02</b>	<b>53</b>	<b>56.98</b>
Yellowing of canopy	Yellow	14	4	28.57	10	71.43
	Not yellow	79	36	45.57	43	54.43
<b>Total</b>		<b>93</b>	<b>40</b>	<b>43.02</b>	<b>53</b>	<b>56.98</b>

## HOGALAGERE

Infestation and re-infestation percentage of the CSR B were observed in treated trees during Oct.-Nov., Jan- Feb and April – May. The treatment Fipronil (2ml/l) and Chlorpyrifos (0.2%) were found to be most effective against grubs of CSR B

with 86.67% and 80.00% trees without reinfestation, respectively. However, the other treatments also maintained their superiority over control in suppressing the population. In treated check, where only grubs extraction was adopted, 46.67% trees could recover.

**Table 3.18: Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSR B) 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 swabbing @ (2ml/l) (during Oct.-Nov., Jan.- Feb. and April - May)	15	13	86.67
2	Neem oil swabbing 5% suspension	15	6	40.00
3	Imidacloprid 17.8 SL @ 2ml/l as swabbing and drenching	15	8	53.33
4	Chlorpyrifos 20 EC(0.2%) @ 10ml/l	15	12	80.00
5	Treated check - only removal of CSR B grubs	15	7	46.67
6	Untreated control	15	4	26.67
	<b>Total</b>	<b>90</b>	<b>50</b>	<b>-</b>

The incidence of cashew stem and root borer was monitored randomly at fortnightly interval in old and neglected cashew gardens. Trees with 60-100 cm stem girth showed maximum damage (87.50%) and with respect to age of trees, more than 15 years old trees were highly prone to CSR B

damage (60%). The zone of CSR B attack was noticed maximum at collar + stem (80%) and canopy yellowing of trees was observed in 83.3 per cent of treated trees. The plants with less than 25% bark circumference damage recorded recovery to a tune of 80.0%.

**Table 3.19 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at HREC, Hogalagere during 2018-19**

Physical parameters		No. of plants observed after PEP	No. of plants reinfested after PEP	% CSR B preference
Stem girth	< 60 cm	6	3	50.00
	60-100 cm	8	7	87.50
	> 100 cm	6	4	66.67
<b>Total</b>		<b>N=20</b>	<b>N=14</b>	<b>-</b>
Age of the tree	<10 years	4	0	0
	10-15 years	8	0	0
	>15 years	10	6	60.00
<b>Total</b>		<b>N=22</b>	<b>N=6</b>	<b>-</b>

Zone of attack	C + R	5	1	20.00
	C + S	5	4	80.00
	C + S + R	5	3	60.00
<b>Total</b>		<b>N=15</b>	<b>N=8</b>	-
Yellowing of Canopy	Canopy Yellowing	6	5	83.3 %
	Canopy not yellowing	6	3	50.0 %
<b>Total</b>		<b>N=12</b>	<b>N=8</b>	-
% of bark circumference damaged	< 25	5	4	80.00
	26-50	5	3	60.00
	51-75	5	1	20.00
	>75	5	0	0
<b>Total</b>		<b>N=20</b>	<b>N=8</b>	-

### JAGDALPUR

The post extraction prophylaxis treatment was carried out in 108 trees of forest plantation in Ghatkawali village of Bastar District during 2018-

19. After the removal of grubs and cocoons from the infested trees the insecticide were swabbed on the trunk, stem and exposed roots and drenched in the root region.

**Table 3.20 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Jagdalpur centre during the year 2018-19**

Treatment	Total number of trees treated	No. of trees without reinfestation	% trees without reinfestation (Recovery %)	No. of trees re-infested	% of trees re-infested
T <sub>1</sub> : Fipronil swabbing (2ml/l)	18	8	44.44	10	55.56
T <sub>2</sub> : Neem oil swabbing (5%)	18	3	16.67	15	83.33
T <sub>3</sub> : Imidacloprid (2 ml/l)	18	9	50.00	9	50.00
T <sub>4</sub> : Chlorpyrifos (10 ml/l)	18	14	77.78	4	22.22
T <sub>5</sub> : Treated check (only removal of CSRB grubs)	18	2	11.11	16	88.89
T <sub>6</sub> : Untreated check	18	0	0.00	0	0.00
<b>Total</b>	<b>108</b>	<b>36</b>	-	<b>54</b>	-

The data presented showed that the maximum recovery of 77.78 per cent was observed in T<sub>4</sub> as swabbing and drenching of CSRB infested tree followed by T<sub>3</sub> and T<sub>1</sub> led to 50.00% and 44.44% recovery whereas, minimum recovery of 11.11 per

cent was observed in T<sub>5</sub> as against no recovery in untreated check. The overall results indicated that chlorpyrifos recorded maximum recovery, followed by Imidacloprid and Fipronil.

**Table 3.21 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at Jagdalpur centre during the year 2018-19**

Physical parameters		No. of trees treated	No. of trees infested after PEP	% of trees reinfested after PEP	No. of trees not reinfested after PEP	% of trees not reinfested
Stem diameter	< 19 cm	7	2	28.57	5	71.43
	19-32 cm	63	34	53.97	29	46.03
	> 32 cm	38	17	44.74	21	55.26
<b>Total</b>		<b>108</b>	<b>53</b>	<b>49.07</b>	<b>55</b>	<b>50.93</b>
Age of the tree	<10 years	0	0	0.00	0	
	10-15 years	11	2	18.18	9	81.82
	>15 years	97	47	48.45	50	51.55
<b>Total</b>		<b>108</b>	<b>56</b>	<b>51.85</b>	<b>52</b>	<b>48.15</b>
Zone of attack	C	41	23	56.10	18	43.90
	S	6	3	50.00	3	50.00
	R	4	2	50.00	2	50.00
	C+S	33	12	36.36	21	63.64
	C+R	16	9	56.25	7	43.75
	R+S	0	0	0.00	0	0
	C+S+R	8	5	62.50	3	37.50
<b>Total</b>		<b>108</b>	<b>54</b>	<b>50.00</b>	<b>54</b>	<b>50.00</b>
Yellowing of canopy	Canopy yellowing	12	11	91.67	1	8.33
	Canopy not yellowing	96	42	43.75	54	56.25
<b>Total</b>		<b>108</b>	<b>53</b>	<b>49.07</b>	<b>55</b>	<b>50.93</b>
% of bark circumference damaged	< 25	53	33	62.26	20	37.74
	26-50	23	13	56.52	10	43.48
	51-75	8	3	37.50	5	62.50
	>75	6	4	66.67	2	33.33
<b>Total</b>		<b>90</b>	<b>53</b>	<b>58.89</b>	<b>37</b>	<b>41.11</b>

Observation recorded in the physical parameters of treated cashew trees under post extraction prophylaxis (PEP) curative trial and details are presented. The data revealed that the cashew trees having 19 - 32 cm of diameter were more prone to the attack of CSRB (53.97%) followed

by stem diameter more than 100 cm (44.74 %). Comparing the age of the infested trees, in respect to re-infestation after PEP, more than 15 years old cashew trees (48.45 %) were more susceptible to the attack of CSRB. Preferential zone of re-infestation by CSRB in the trees were Collar + Stem + Root

zone followed by Collar + Root and Root zone with 62.50, 56.25 and 56.10 per cent re-infested trees respectively. Yellowing of canopy was observed in 91.67 per cent of re-infested trees. Trees with more than 75 per cent bark circumference damage had maximum re-infestation of 66.67 per cent followed by less than 25 per cent bark circumference damage with 62.26 per cent of reinfestation.

The data presented in two way table between age of tree and stem diameter revealed that all the trees having stem diameter below 19 cm belonged to the age of below 10 years. In stem diameter 19 - 32 cm, 35 trees belonged to age of 10-15 years and 27 trees belonged to age more than 15 years, whereas, the trees with more than 32 cm stem diameter were more than 15 years old.

**Table 3.22 : Two way table (Stem diameter vs Age of Tree)**

Stem diameter \ Age of Tree	Age of Tree			Total
	<10 years	10-15 years	>15 years	
< 19 cm	7	0	0	7
19 - 32 cm	1	35	27	63
> 32 cm	0	0	38	3
<b>Total</b>	<b>0</b>	<b>11</b>	<b>97</b>	<b>108</b>

## MADAKKATHARA

During 2018-19, among the insecticides evaluated as post extraction prophylaxis (PEP), swabbing of neem oil @ 50 ml/l and drenching of chlorpyrifos @ 10ml/l have offered highest recovery after CSR B infestation with 85 per cent trees without

reinfestation. Other insecticides like Fipronil and imidachloprid also provided protection above 75 per cent without reinfestation and were superior over the control which recorded only 45 per cent recovery.

**Table 3.23 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSR B) at Madakkathara centre (2018-19)**

Treatment	Total number of trees treated	No. of trees without reinfestation / persistent attack	% trees without reinfestation / persistent attack
T <sub>1</sub> - Fipronil swabbing 2ml/l	20	15	75%
T <sub>2</sub> - Neem oil swabbing 5% (50ml/l)	20	17	85%
T <sub>3</sub> - Imidachloprid (swabbing and drenching) 2ml/l	20	16	80%
T <sub>4</sub> - Chlorpyrifos (treated check) 10 ml/l	20	17	85%
T <sub>5</sub> - Untreated check (only removal of CSR B grubs)	20	9	45%

Physical parameters of cashew trees have a significant role on CSRB attack. The maximum infestation was observed in trees with stem girth of more than 100 cm (68 trees) and diameter of 30-45 cm (47 trees) and age more than 15 years (75 trees). The highest attack of CSRB was noticed in

collar and root zone. Yellowing of the canopy was observed only in 8 out of 100 infested trees.

Trees having stem girth less than 60 cm and diameter 5-15 cm and age less than 10 years have escaped reinfestation.

**Table 3.24 : Physical parameters of treated cashew trees under post extraction prophylaxis trial at Madakkathara Centre during the year 2018-19.**

Physical parameters		Total trees treated	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	9	0	0	9	100
	60-100 cm	13	3	23.08	10	76
	80-100 cm	10	3	30.00	7	70.00
	> 100 cm	68	20	28.99	48	71.01
	<b>Total</b>	<b>100</b>	<b>26</b>		<b>74</b>	
Diameter	5-15 cm	7	0	0	7	100
	15-30 cm	23	8	34.78	15	65.21
	30-45 cm	47	12	25.53	35	74.46
	45-60 cm	23	6	26.08	17	73.91
	<b>Total</b>	<b>100</b>	<b>26</b>		<b>74</b>	
Age of the tree	<10 years	10	-	-	10	100
	10-15 years	15	1	6.67	14	93.33
	>15 years	75	25	33.33	50	66.67
	<b>Total</b>	<b>100</b>	<b>26</b>		<b>74</b>	
Zone of attack	C + R	42	9	21.43	33	78.57
	C	8	1	12.5	7	87.5
	C + S + R	16	13	81.25	3	18.75
	R	34	3	8.82	31	91.18
	<b>Total</b>	<b>100</b>	<b>26</b>		<b>74</b>	
Yellowing of canopy	Yellowing	8	6	75	2	25
	no yellowing	92	20	21.74	72	78.26
	<b>Total</b>	<b>100</b>	<b>26</b>		<b>74</b>	
% of bark circumference damaged	< 25	42	7	16.67	35	83.33
	26-50	43	8	18.60	35	81.40
	51-75	10	6	40	4	60
	>75	5	5	-	0	0
	<b>Total</b>	<b>100</b>	<b>26</b>		<b>74</b>	

A close relationship was found between the age and stem girth of cashew trees on CSRB attack. A two-way table using Chi-square showed

a significant association of stem girth and age of trees with the CSRB attack.

**Table 3.25 : Two way table (Age vs Stem Girth)**

Stem Girth \ Age	<60 cm	60-80 cm	80-100 cm	>100 cm
5-10 years	9	1	0	0
10-15 years	0	9	6	0
>15 years	0	0	7	68



**Treatment of CSRB infested trees at Madakkathara**

## VENGURLE

**Table 3.26 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Vengurle centre during the year 2018-19**

Treatment	Total number of trees treated	No. of trees without reinfestation / persistent attack	% trees without reinfestation/ persistent attack
Fipronil swabbing 2ml/lit	20	18	90
Neem oil swabbing 5%	20	10	50
Imidachloprid (swabbing and dranching) 2ml/lit	20	13	65
Chlorpyriphos 10ml/lit	20	17	85
Treated check (only removal of grub)	20	6	30
Untreated check	20	3	15

The results indicated that the treatment T<sub>1</sub> (Fipronil swabbing 2ml/lit) recorded 90.00 per cent trees without reinfestation followed by treatment T<sub>4</sub> Chlorpyriphos (0.2%) 85.00 per cent trees without reinfestation. Reinfestation was more in Control (T<sub>6</sub>) 15.00 percent trees.

**Table 3.27 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at Vengurle Centre during the year 2018-19**

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	6	5.0	21	17.5
	60-100 cm	20	16.67	35	29.17
	> 100 cm	28	23.33	10	8.33
<b>Total</b>		<b>54</b>	<b>45.0</b>	<b>66</b>	<b>55.0</b>
Age of the tree	<10 years	5	4.17	18	15.0
	10-15 years	10	8.33	35	29.17
	>15 years	39	32.5	13	10.83
<b>Total</b>		<b>54</b>	<b>45.0</b>	<b>66</b>	<b>55.0</b>
Zone of attack	C + R	14	11.67	10	8.33
	C + S	30	25.0	16	13.33
	C + S + R	10	8.33	40	33.33
<b>Total</b>		<b>54</b>	<b>45.0</b>	<b>66</b>	<b>55.0</b>
Yellowing of canopy	Canopy yellowing	2	1.67	-	-
	Canopy not yellowing	52	43.33	66	55
<b>Total</b>		<b>54</b>	<b>45.0</b>	<b>66</b>	<b>55</b>
% of bark circumference damaged	< 25	4	3.33	30	25.0
	26-50	10	8.33	20	16.67
	51-75	15	12.5	10	8.33
	>75	25	20.83	6	5.0
<b>Total</b>		<b>54</b>	<b>45.0</b>	<b>66</b>	<b>55.0</b>

During the year, a total of 120 trees were treated for cashew stem and root borer management. The data on the physical parameters of infested trees and not infested trees was recorded and presented.

The tree having the stem girth >100 cm are more prone to CSRB damage. Further, trees having age more than 15 years are more prone to CSRB infestation whereas the tree within the age of 10-15 years recorded less infestation. In case of zone of attack, the collar+stem recorded more infestation of stem and root borer whereas, it was minimum in collar + stem + root. In case of bark circumference damaged removal of >75 percent bark showed more number of tree infested whereas, the removal of >25 percent bark showed more tree without re-infestation after the removal of grub.

## VRIDHACHALAM

Maximum recovery of 71.88 % was observed in chlorpyrifos 20 EC @10 ml/lit. of water as swabbing and drenching of CSRB infested trees as against mere recovery of 5.88 in treated check (only removal of CSRB grubs). Treatments with Fipronil 5% SC swabbing @ 2ml/lit. and Imidachlopid 17.8 SL swabbing and drenching @ 2ml/lit. lead to 52.00 and 48.00% recovery respectively as against nil recovery in untreated check. The overall results indicate that chlorpyrifos recorded maximum recovery, followed by Fipronil and Imidachlopid which are at par in reducing the CSRB infestation, with an average cost of protection of Rs.87/-, Rs.95/- and Rs.98/- respectively.

**Table 3.28 : 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 <sub>1</sub>	Fipronil 5% SC Swabbing@ 2ml/lit	25	13	52.00b	3	95.00
T <sub>2</sub>	Neem Oil suspension 5% Suspension Swabbing and Drenching	23	8	34.78c	3	79.00
T <sub>3</sub>	Imidachlopid 17.8 SL Swabbing and Drenching @ 2ml/lit	25	12	48.00b	3	98.00
T <sub>4</sub>	Chlorpyrifos 20 EC @ 10ml / lit. Swabbing and Drenching	32	23	71.88a	3	87.00
T <sub>5</sub>	Treated check (only removal of CSRB grubs followed)	17	01	5.88d	3	52.00
T <sub>6</sub>	Untreated check	19	-	-	-	-
<b>Total</b>		<b>141</b>	<b>141</b>	<b>57</b>		

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 (83.87%) were more prone to the attack of CSRB infestation. Comparing the age of the cashew infested trees, more than 15 - year old cashew trees (67.16%) 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

71.05, 67.50 and 64.52 per cent re- infested trees respectively. Yellowing of canopy showed 90.63 per cent re-infestation. Trees with less than 25 per cent bark circumference damage had maximum re-infestation with 69.57 per cent followed by 51-75 per cent bark circumference damage (61.90 % 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 3.29 : 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	10	3	30.00	7	70.00
	60-80 cm	64	42	65.62	22	34.38
	80-100 cm	31	26	83.87	5	16.13
	>100 cm	36	13	36.11	23	63.89
<b>Total</b>		<b>141</b>	<b>84</b>		<b>57</b>	
Age of the tree	< 10 years	0	0			
	10-15 years	74	39	52.70	35	47.29
	>15 years	67	45	67.16	22	32.84
<b>Total</b>		<b>141</b>	<b>84</b>		<b>57</b>	
Zone of attack	Collar+Root	38	27	71.05	11	28.95
	Collar+Stem	31	20	64.52	11	35.48
	Root	6	0	0	6	100.00
	Stem	11	5	45.45	6	54.54
	Collar	12	5	41.67	7	58.33
	Stem+Root	3	0	0	3	100.00
	Collar+Stem+Root	40	27	67.50	13	32.50
<b>Total</b>		<b>141</b>	<b>84</b>		<b>57</b>	
Yellowing of canopy	Canopy yellowing	64	58	90.63	6	9.38
	Canopy not yellowing	77	26	33.77	51	66.23
<b>Total</b>		<b>141</b>	<b>84</b>		<b>57</b>	
% of bark circumference damaged	< 25	69	48	69.57	21	30.43
	26-50	51	23	45.09	28	54.90
	51-75	21	13	61.90	8	38.09
	> 75	0	0	0	0	0
<b>Total</b>		<b>141</b>	<b>84</b>		<b>57</b>	

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

*Centres: East Coast :* Bapatla, Bhubaneswar, 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 was done at weekly intervals and samples were

maintained 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.

**Table 3.30 : Influence of abiotic factors on the activity of pest complex of cashew at Bapatla**

Variable	Leaf and blossom webber	Leaf miner	Leaf Folder	Shoot tip Caterpillar	Apple and nut borer
X <sub>1</sub> -Maximum Temperature	-0.16	-0.47	-0.13	-0.15	-0.81
X <sub>2</sub> -Minimum Temperature	0.20	-0.13	-0.05	0.11	0.31
X <sub>3</sub> -RH (m)	0.01	-0.29*	-0.04	0.10	-0.49
X <sub>4</sub> -RH (e)	-0.01	0.03	0.00	-0.03	0.08
X <sub>5</sub> -Rain fall	-0.02	0.05	0.03	-0.03	-0.10
R <sup>2</sup> Value	0.21	0.63	0.51	0.13	0.16
% Variation	21.67	62.60	51.16	12.88	16.17

\*= r at 5% level of significance

During 2018-19, the relation between the percent pest damage (Y) and weather variables such as Max.Temp (X<sub>1</sub>), Min.Temp. (X<sub>2</sub>), Relative Humidity (m) (X<sub>3</sub>), Relative Humidity (e) (X<sub>4</sub>) and Rainfall (X<sub>5</sub>) was worked out by subjecting the data collected over 25 standard weeks to Multiple Linear Regression Analysis.

Among the factors of pests, only leaf miner population showed significant negative correlation with Relative Humidity (m) (X<sub>3</sub>) and all five

independent variables have accounted for 62.60 percent of total variation in percent leaf damage by leaf miner (R<sup>2</sup>=0.62).

#### BHUBANESWAR

Seasonal incidence of insect pests during 2018-19 revealed that there was low incidence of shoot tip caterpillar and redbanded thrips while leaf miner, leaf and blossom webber incidence remained negligible. Tea mosquito bug incidence was noticed only during the 2<sup>nd</sup> week of April but the

population declined due to kalbaisakhi storm. The occurrence of other pests was affected due to the cyclonic storm Fani.

A positive but non-significant correlation with weather parameters was observed for the shoot tip caterpillar except sunshine hours. In case of red banded thrips, a significant correlation was observed with the evening RH ( $r = -0.526$ ). A positive correlation was observed with maximum temperature P ( $r = 0.259$ ), RH morn ( $r = 0.06$ ) and bright sunshine ( $r = 0.342$ ) but non-significant.

**Table 3.31 : Correlation of pest incidence with weather parameters at Bhubaneswar**

Weather parameter	STC	Red banded thrips
Temp. Max	0.372	0.259
Temp. Min	0.424	-0.171
RH morn.	0.064	0.006
RH even	0.342	-0.526*
Rain fall	0.202	-0.423
BSH	-3.342	0.342
R <sup>2</sup>	82.6	61.32

## HOGALAGERE

A total of fourteen species of insect pests infesting and breeding on cashew and four species of their natural enemies were recorded at varied intensity

in maidan parts of Karnataka. Among them, tea mosquito bug and cashew stem and root borer were found to be the major insect pests in the region.

**Table 3.32 : Influence of abiotic factors on the activity of pest complex of cashew during 2018-19 at Hogalagere**

Sl. No.	Common Name	Plant part affected	Period of occurrence	Intensity
<b>Order : Hemiptera</b>				
1	Tea mosquito bug	Tender shoots, panicles, young apples & nuts	Oct - Mar	Low to moderate (5-12%)
2	Cotton mealy bug	Leaf, panicle, apples & nuts	Nov -Jan	Low (<5%)
3	Scale insect	Young leaf	Throughout the year	Low (<5%)
4	Man faced bug	Shoot, tender apples & nuts	Feb	Low (<5%)
5	Aphid	Tender shoots, panicles and young apples & nuts	Nov-May	Low (<5%)
6	Wiptail mealy bug	Tender shoots, panicles, young apples & nuts	Feb-May	Low (<5%)
<b>Order : Thysanoptera</b>				
7	Thrips	Leaf, apple & nuts	Jul-Feb	Low to moderate (5-8%)
8	Inflorescence thrips	inflorescence, tender apple & nuts	Dec-May	Low (<5%)
<b>Order: Coleoptera</b>				
9	Cashew stem and root borer	stem and root	Throughout the year	Low to moderate (5-15%)
10	Ash weevil	Young leaf	Throughout the year	Low (<5%)
<b>Order: Lepidoptera</b>				
11	Leaf miner	Young leaf	May-Sep	Low (<5%)
12	Hairy caterpillar	Leaf and panicle	Nov-Jan	Low (<5%)
13	Apple and nut borer	Apple and nuts	Jan-Mar / Feb-Jun	Low to moderate Low (5-8%)
14	Bark eating caterpillar	Stem & branches bark	Throughout the year	Low (<5%)

**Table 3.33 : Incidence of natural enemies in cashew ecosystem during 2018-19 at Hogalagere**

Sl. No.	Predators	Host pest	Month of occurrence	Intensity
1	<i>Oxyptessweta</i> Order: <i>Arenae</i>	<i>Helopeltisantonii</i>	Oct - Mar.	Low to moderate (5-12%)
2	<i>Menochilussexmaculatus</i> (Coccinellidae: Coleoptera)	<i>Toxopteraodinae</i> <i>Ferrisiavirgata</i>	Feb.-May	Low to moderate (5-9%)
3	<i>Chrysoperlazastrowi</i> (Chrysopidae: Neuroptera)	<i>Toxopteraodinae</i> <i>Ferrisiavirgata</i>	Jan.-May	Low (<5%)
4	<i>Paragensyerburiensis</i> (Syrphidae: Diptera)	<i>Toxopteraodinae</i> <i>Ferrisiavirgata</i>	Jan.-May	Low (<5%)

The correlation between the pest incidence and weather parameters revealed that minimum temp (+0.61), morning relative humidity (+0.45) had a positive significant correlation with the activity of TMB, but negative correlation was established with maximum temperature (-0.74) and evening relative humidity (-0.21). The no. of rainy days (-0.15) had significant correlation with TMB activity. The activity of CSRFB was observed throughout the year but its peak activity was noticed during December, April and May. The minimum temperature (+0.04), rainfall (+0.10) and number of rainy days (+0.14) had significant positive correlation with the incidence of CSRFB and negative correlation was noticed with maximum temperature (-0.47), morning & evening relative humidity (-0.46 & -0.41), respectively.

Apple and nut borer (ANB) had positive correlation with maximum temperature (+0.59), morning relative humidity (+0.06), rainfall (+0.24)

and number of rainy days (+0.28). The minimum temperature (-0.56) and evening relative humidity (-0.03) had exhibited negative correlation with activity of ANB. The infestation of Thrips showed highly significant positive correlation with maximum temperature (+0.48) and positive correlation with evening relative humidity (+0.18). The negative correlation was obtained with rest of the weather parameters. The aphid infestation had highly significant positive correlation with maximum temperature (+0.39) and evening relative humidity (+0.41), whereas the rest of the parameters had negative correlation.

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

**Table 3.34 : Incidence of different cashew pests during different months during 2018-19 at Hogalagere**

	2018					2019				
	TMB (% damage)	CSRFB (% damage)	ANB (% damage)	Thrips (No./ shoot or panicle)	Aphids (No. affected shoots/	TMB (% damage)	CSRFB (% damage)	ANB (% damage)	Thrips (No./shoot or panicle)	Aphids (No. affected shoots/ plant)
Jan	0.00	0.00	0.00	0.00	0.00	1.79	1.33	0.93	0.81	0.66
Feb	0.00	0.00	0.00	0.00	0.00	1.28	1.63	2.47	2.18	3.32
Mar	0.00	0.00	0.00	0.00	0.00	1.40	2.26	2.32	2.40	2.38
Apr	0.00	0.00	0.00	0.00	0.00	0.77	2.48	3.32	3.04	3.47
May	0.00	0.00	0.00	0.00	0.00	1.03	3.90	3.80	3.89	3.52
Jun	0.00	0.00	0.00	0.00	0.00	1.44	3.62	3.29	3.99	3.07
Jul	0.00	0.00	0.00	0.00	0.00	0.60	2.63	4.77	2.58	2.52

Aug	1.22	1.79	1.00	0.70	1.58	-	-	-	-	-
Sep	1.05	1.82	1.32	1.69	1.77	-	-	-	-	-
Oct	0.87	2.74	0.76	1.78	0.95	-	-	-	-	-
Nov	1.37	2.39	0.91	1.29	0.83	-	-	-	-	-
Dec	1.62	2.60	0.76	1.39	1.48	-	-	-	-	-

## JAGDALPUR

The study was conducted in three locations viz., Turenar, Sonarpal and Dimrapal villages of Bastar district at weekly intervals from ten randomly selected cashew trees at each location in every month from 52 leader shoots of each tree from all the four sides. The tree age of Turenar, Sonarpal and Dimrapal was 12 -14, 20-22 and 30-35 year respectively. The crop observation taken throughout the year the correlation coefficient of insect-pests incidence in Bastar districts are presented.

The data revealed that TMB incidence showed negative significant correlations with maximum temperature, minimum temperature and wind velocity whereas significantly positive correlation with morning relative humidity. The incidence of shoot tip caterpillar showed highly negative significant correlation with maximum temperature, minimum temperature and wind velocity. Population of leaf folder and leaf miner showed significant negative correlation with maximum temperature, minimum temperature and wind velocity, whereas significant positive correlation with morning relative humidity. The population of thrips is highly influenced by temperature and morning relative humidity.

The population of natural enemies was also recorded during 2018-19. Significant positive correlation was observed between population

of all natural enemies and morning RH. Spiders population is significantly negative correlated with maximum temperature in 1 per cent level of significance. Similarly significantly spiders are negatively correlated with wind velocity.

The regression equation indicated that an increase of 1°C of maximum temperature reduced the thrips population by 0.011 damage score per 52 leader shoots. Similarly, 1% increase of evening relative humidity increase the thrips population by 0.001 and TMB population by 0.005 damage score per 52 leader shoots. The mean population of leaf caterpillar, leaf miner, leaf folder increase, if 1% of evening relative humidity increases by 0.122, 0.115, and 0.226 per cent respectively. An increase in 1°C of maximum temperatures showed decrease in the mean population (0.002) of natural enemy ants. The multiple regression equations were developed for predicting the pests and natural enemies of cashew by using regression models. The results indicated that pests observed viz., thrips damage score ( $Y_5$ ), TMB damage score ( $Y_1$ ), shoot tip caterpillar per cent damage ( $Y_2$ ), leaf miner per cent damage ( $Y_4$ ), leaf folder per cent damage ( $Y_5$ ) were predicted to an extent of 73, 62, 83, 69 and 70 per cent respectively. Similarly, for the natural enemies viz., population of ants ( $Y_6$ ), spider ( $Y_7$ ), lady bird beetle ( $Y_8$ ), Brumus ( $Y_9$ ) were predicted to an extent of 69, 72, 58 and 52 per cent respectively.



Fig.: Natural enemies found in the experimental clot

**Table 3.35 : Regression analysis between pest-natural enemies of cashew and weather parameters during October 2018 to August 2019 at Jagdalpur**

S.N.	Biotic factors	Regression equation	R <sup>2</sup>	Adjusted R <sup>2</sup>
1	TMB (Y <sub>1</sub> )	$Y_1 = -0.128 + 0.002^*(X_1) - 0.005^*(X_2) + 0.001(X_3) + 0.005^*(X_4) - 0.004(X_5) + 0.015^*(X_6) - 0.013(X_7) - 0.005(X_8)$	0.622	0.421
2	Shoot tip caterpillar (Y <sub>2</sub> )	$Y_2 = 12.221 + 0.141^*(X_1) - 0.508^*(X_2) + 0.009(X_3) - 0.052^*(X_4) + 0.122(X_5) - 0.250^*(X_6) + 0.124(X_7) - 0.476(X_8)$	0.830*	0.739
3	Leaf folder % damage (Y <sub>3</sub> )	$Y_3 = 22.622 + 0.439^*(X_1) - 0.879^*(X_2) - 0.028(X_3) - 0.262^*(X_4) + 0.226(X_5) - 0.860^*(X_6) + 0.099(X_7) + 0.464(X_8)$	0.705	0.548
4	Leaf miner (Y <sub>4</sub> )	$Y_4 = 18.219 + 0.077^*(X_1) - 0.326^*(X_2) + 0.018(X_3) - 0.165^*(X_4) + 0.115(X_5) - 0.657^*(X_6) + 0.098(X_7) - 0.558(X_8)$	0.691	0.527
5	Thrips (Y <sub>5</sub> )	$Y_5 = 1.244 - 0.011^{**}(X_1) - 0.014^{**}(X_2) + 0.005(X_3) - 0.004^{**}(X_4) + 0.001(X_5) + 0.005^{**}(X_6) - 0.018(X_7) - 0.056(X_8)$	0.739*	0.600
6	Ant (Y <sub>6</sub> )	$Y_6 = -0.292 - 0.002^*(X_1) + 0.002^*(X_2) + 0.001(X_3) + 0.004^*(X_4) + 0.001(X_5) + 0.007^*(X_6) + 0.005(X_7) - 0.030(X_8)$	0.694	0.531
7	Spider (Y <sub>7</sub> )	$Y_7 = 0.015 + 0.000^*(X_1) - 0.002^*(X_2) + 0.001(X_3) + 0.001^*(X_4) + 0.001(X_5) + 0.001^*(X_6) + 0.001(X_7) - 0.012(X_8)$	0.727	0.582
8	Lady bird beetle (Y <sub>8</sub> )	$Y_8 = -0.172 + 0.001^*(X_1) + 0.001^*(X_2) + 0.001(X_3) + 0.0001^*(X_4) + 0.001(X_5) + 0.001^*(X_6) + 0.001(X_7) - 0.004(X_8)$	0.588	0.368
9	Brumus (Y <sub>9</sub> )	$Y_9 = 0.040 + 0.001^*(X_1) - 0.004^*(X_2) + 0.001(X_3) + 0.001^*(X_4) + 0.001(X_5) + 0.006^*(X_6) - 0.002(X_7) - 0.003(X_8)$	0.521	0.265

\* Significant at 5 % level, \*\*Significant at 1% level

X<sub>1</sub> - Maximum Temperature (°C), X<sub>2</sub> - Minimum Temperature (°C), X<sub>3</sub> - Rainfall (mm), X<sub>4</sub> - Relative Humidity (Morning %), X<sub>5</sub> Relative Humidity (Evening %), X<sub>6</sub> - Wind velocity (Kmph), X<sub>7</sub> - Sunshine (Hours), X<sub>8</sub> - Rainy days

## MADAKKATHARA

The insect pests and natural enemies of cashew were monitored through out the year from April 2018 to March 2019. The commonly found insect pests were TMB, leaf miner, Apple and nut borer and thrips. The percentage damage of all these insect pests were observed. The attack of

TMB was observed from October-March. TMB population was fluctuating and the population build up occurs coinciding with the flushing stage of the crop phenophase during October-November period. Later the population increased and reached at peak during flowering stage of the crop and thereafter the population decreased.

**Table 3.36 : Seasonal occurrence of insect pests at Madakkathara centre during 2018-19**

Season	TMB (DS)	Leaf miner damage (%)	Thrips (DS)	ANB damage (%)
April	0.00	0.00	0.00	0.00
May	0.00	0.00	0.00	0.00
June	0.00	12.5	0.00	0.00
July	0.00	2.71	0.074	0.00
August	0.00	7.82	0.00	0.00
September	0.00	8.31	0.00	0.00
October	0.044	23.15	0.125	0.00
November	0.072	24.71	0.074	0.00
December	0.095	22.90	0.172	0.00
January	0.203	19.53	0.00	0.125
February	0.221	0.00	0.00	0.00
March	0.065	0.00	0.00	0.00

\*TMB: Tea mosquito bug, \*ANB: Apple and nut borer, \*DS: Damage score

As new flushes emerged with the rain, leaf miner damage was observed from June-January. The leaf miner population coincided with the emergence of new flushes in the crop. The attack of leaf miner was highest during November. Slight damage of apple and nut borer was recorded during the month of January. The thrips were present only during October-December with a maximum damage score of 0.172 in the month of December.

Seasonal occurrence of natural enemies like red ant, black ant and spiders was also recorded. All the three natural enemies were present through out the year. The red ant population was high during September. The population of black ant was maximum during April and spider during August.

**Table 3.37: Seasonal occurrence of natural enemies at Madakkathara centre during 2018-19**

Season	Red ant	Black ant	Spider
April	3.75	26.62	2.25
May	1.50	21.12	2.25
June	3.75	21.12	4.37
July	7.62	15.5	5.37
August	4.00	22.25	6.12
September	8.00	5.12	1.25
October	2.37	9.12	1.62
November	4.12	8.00	2.75
December	6.00	7.12	1.87
January	3.25	4.62	2.12
February	1.87	15.62	2.87
March	3.75	9.625	1.25

## Correlation between abiotic factors and different insect pests

The population dynamics of all these regional pests were investigated and the damage score of these insect pests were correlated with the weather factors of second previous week. The correlation between TMB and weather parameters revealed that, the incidence of TMB showed significant negative correlation with minimum temperature and evening relative humidity.

The correlation study between thrips population and weather parameters indicated that the incidence of thrips showed negative but significant correlation with minimum temperature, evening humidity and rainfall. But in the case of leaf miner, no significant correlation was established with any of the weather parameters. Only the phenophase of the crop influenced the build up of leaf miner. Hence, it is the availability of food source in combination with conducive weather parameters that influence the population dynamics of insect pests of cashew.

### PARIA

The correlation studies showed that TMB incidence was negative and significantly correlated with temperature, wind velocity and evaporation. Other weather parameters showed non significant with TMB incidence. Likewise Thrips incidence showed negatively significant with temperature and evaporation.

### VENGURLE

The data from Table revealed that in the year 2018-19 the TMB incidence shows significant negative correlation with minimum temperature ( $r = -0.743$ ) and evening humidity ( $r = -0.586$ ). The incidence of thrips showed negative significant correlation with minimum temperature ( $r = -0.658$ ). The incidence of apple and nut borer showed significant negative correlation with minimum temperature ( $r = -0.702$ ).

**Table 3.38 : Influence of abiotic factors on the activity of pest complex of cashew at Paria centre during the year 2018-19**

Weather Parameters	TMB	Thrips
X <sub>1</sub> - Maximum Temp	-0.699*	-0.716*
X <sub>2</sub> - Minimum Temp	-0.841*	-0.721*
X <sub>3</sub> - RH (m)	0.084 <sup>NS</sup>	0.067 <sup>NS</sup>
X <sub>4</sub> - RH (e)	-0.056 <sup>NS</sup>	-0.100 <sup>NS</sup>
X <sub>5</sub> - Bright sunshine hours	-0.038 <sup>NS</sup>	0.120 <sup>NS</sup>
X <sub>6</sub> - Wind velocity	-0.448*	-0.227 <sup>NS</sup>
X <sub>7</sub> -Evaporation	-0.708*	-0.502*
Intercept	4.244	0.795
R <sup>2</sup>	0.898	0.754
Standard Error	0.187	0.103

\*= significant at 5%



**Table 3.39 : Influence of abiotic factors on the activity of pest complex of cashew at Vengurle centre during the year 2018-19**

Weather Parameters	TMB	THRIPS	ABN
X <sub>1</sub> - Maximum Temp	-0.009	-0.015	-0.019
X <sub>2</sub> - Minimum Temp	-0.743*	-0.658*	-0.702*
X <sub>3</sub> - RH (m)	0.274	0.206	0.249
X <sub>4</sub> - RH (e)	-0.586*	-0.540	-0.538
X <sub>5</sub> - Rain fall	-0.282	-0.281	-0.258

\* - Significant at 5% level of significance.

r = 0.576 at 5% level of significance

## VRIDHACHALAM

During the year (from June 2018 to August 2019), the relation between the TMB population ( $Y_1$ ), leaf and blossom webber (% damage) ( $Y_2$ ), Leaf miner (% damage) ( $Y_3$ ), Leaf thrips population ( $Y_4$ ), Apple and nut borer (% damage) ( $Y_5$ ), Leaf folder (% damage) ( $Y_6$ ), Shoot tip caterpillar (% damage) ( $Y_7$ ), CSR (B) (% damage) ( $Y_8$ ) and the natural enemies viz., population of spiders ( $Y_9$ ), ants ( $Y_{10}$ ), coccinellids ( $Y_{11}$ ), braconids ( $Y_{12}$ ) and wasp ( $Y_{13}$ ) and weather variables such as maximum temperature ( $^{\circ}\text{C}$ ) ( $X_1$ ), Relative Humidity (Morning %) ( $X_2$ ), Rainfall ( $X_3$ ), Rainy days ( $X_4$ ), Wind speed (Km/hr.) ( $X_5$ ) and sunshine (hours) ( $X_6$ ) was observed.

The incidence of TMB was confined from flushing to fruiting season. Its activity was observed from first week of February 2019 to third week of April 2019. Maximum TMB damage was observed during the second week of March with mean damage score ranging between 2.09 and 3.66. Nut borer activity during non-bearing periods could not be traced out. Cashew leaf miner was found from August to March with a maximum of 3.24 % leaf damage during first fortnight of February 2019. Cashew leaf folder was also observed from August 2018 - March 2019 with 3.1 % to 8.35 % leaf damage observed in young plantations. Maximum damage was noticed during August 2019. Whereas, Leaf and blossom webber damage was observed maximum during August 2018 and 2019. Cashew Leaf thrips population (15.68) was noticed in May 2019. However, shoot tip caterpillar was observed during January to February - 2019. The CSR (B) damage (31-38 %) was prevailing throughout the season but maximum was recorded during June to August 2019.

Correlation studies revealed that sunshine (hours) and maximum temperature ( $^{\circ}\text{C}$ ) were significant and positively correlated with the TMB population. 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. 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 while incidence of shoot tip caterpillar was negatively correlated to it. The population of LBW, LM and CSR (B) significantly decreased with morning RH. Wind speed has positive correlation with shoot tip caterpillar. Sun shine hours has positive correlation with TMB and apple and nut borer.

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. Spiders and ants have positive correlation with maximum temperature. Rainfall has positive correlation with coccinellids and braconids. Wind speed has negative correlation with braconids and wasps.

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 2018 to August 2019. The regression equation indicated that a decrease in  $1^{\circ}\text{C}$  of maximum temperature reduced the TMB population by 0.3 per 52 Leader shoots. Similarly, Rainfall also reduced TMB population by 0.02, 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 the CSR (B) damage to 3%.

For every increase in 1°C in maximum temperature, TMB population increase by 0.3 times. But for every decrease in single rainy days, TMB population decreases by one time.

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 (R<sup>2</sup>) indicated that pests observed viz., TMB Population (Y<sub>1</sub>), Leaf and blossom webber

(% damage) (Y<sub>2</sub>), Leaf miner (% damage) (Y<sub>3</sub>), Leaf thrips Population (Y<sub>4</sub>), Apple and nut borer (% damage) (Y<sub>5</sub>), Leaf folder (% damage) (Y<sub>6</sub>), Shoot tip caterpillar (% damage) (Y<sub>7</sub>), CSRB (% damage) (Y<sub>8</sub>) were predicted to an extent of 92, 52, 70, 84, 72, 74, 96 and 77 per cent respectively. Similarly, for the natural enemies viz., population of spiders (Y<sub>9</sub>), ants (Y<sub>10</sub>), coccinellids (Y<sub>11</sub>), braconids (Y<sub>12</sub>) and wasp (Y<sub>13</sub>) were predicted to an extent of 67, 78, 70, 90 and 58 per cent respectively.

**Table 3.40 : Regression analysis between pests of cashew and weather parameters during June - 2018 and August - 2019 at Vridhachalam.**

Sl. No.	Biotic factors	Regression equation	R <sup>2</sup>
1.	TMB Population (Y <sub>1</sub> )	$Y_1 = -20.23 + 0.3 (X_1) + (0.1) (X_2) + 0.02 (X_3) + (-1) (X_4) + 1 (X_5) + 0.3 (X_6)$	0.92 **
2.	Leaf and blossom webber (% damage) (Y <sub>2</sub> )	$Y_2 = -23.02 + 0.5 (X_1) + 0.1 (X_2) + (-0.1) (X_3) + 3 (X_4) + (-1) (X_5) + 0.3 (X_6)$	0.53
3.	Leaf miner (% damage) (Y <sub>3</sub> )	$Y_3 = 5.24 + 0.1 (X_1) + (-0.1) (X_2) + (-0.04) (X_3) + 1 (X_4) + (-1) (X_5) + (0.04) (X_6)$	0.70
4.	Leaf thrips Population (Y <sub>4</sub> )	$Y_4 = -74.61 + 1 (X_1) + 0.3 (X_2) + 0.1 (X_3) + (-3) (X_4) + 1 (X_5) + 1 (X_6)$	0.84 **
5.	Apple and nut borer (% damage) (Y <sub>5</sub> )	$Y_5 = -62.48 + 0.5 (X_1) + 0.5 (X_2) + 0.02 (X_3) + (-1) (X_4) + 0.2 (X_5) + 1 (X_6)$	0.72 **
6.	Leaf folder (% damage) (Y <sub>6</sub> )	$Y_6 = -40.45 + 1 (X_1) + 0.2 (X_2) + (-0.1) (X_3) + 3 (X_4) + 1 (X_5) + (-0.4) (X_6)$	0.74
7.	Shoot tip caterpillar (% damage) (Y <sub>7</sub> )	$Y_7 = 32.12 + (-1) (X_1) + (-0.02) (X_2) + (-0.05) (X_3) + 1 (X_4) + 1 (X_5) + 1 (X_6)$	0.96 **
8.	CSRB (% damage) (Y <sub>8</sub> )	$Y_8 = -82.27 + 4 (X_1) + 1 (X_2) + (-1) (X_3) + 8 (X_4) + 4 (X_5) + (-3) (X_6)$	0.77

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

**Table 3.41 : Regression analysis between natural enemies of cashew and weather parameters during June - 2018 and August - 2019 at Vridhachalam**

Sl. No.	Biotic factors	Regression equation	R <sup>2</sup>
1.	Spiders (Y <sub>9</sub> )	$Y_9 = (-0.570) + 0.2 (X_1) + (0.02) (X_2) + (-0.005) (X_3) + (0.1) (X_4) + (0.2) (X_5) + 0.01 (X_6)$	0.67
2.	Ants (Y <sub>10</sub> )	$Y_{10} = 7.65 + (-1) (X_1) + (-0.2) (X_2) + (-0.02) (X_3) + 0.1 (X_4) + (-2) (X_5) + 0.2 (X_6)$	0.78
3.	Coccinellids (Y <sub>11</sub> )	$Y_{11} = 1.06 + 0.1 (X_1) + 0.02 (X_2) + (-0.004) (X_3) + (0.2) (X_4) + 0.002 (X_5) + (-0.2) (X_6)$	0.70 *
4.	Braconids (Y <sub>12</sub> )	$Y_{12} = 3.92 + (-0.03) (X_1) + (-0.01) (X_2) + (-0.002) (X_3) + (0.04) (X_4) + 0.001 (X_5) + (-0.0002) (X_6)$	0.90 **
5.	Wasp (Y <sub>13</sub> )	$Y_{13} = 10.35 + (-0.1) (X_1) + (-0.04) (X_2) + (-0.01) (X_3) + 0.2 (X_4) + (-1) (X_5) + 0.1 (X_6)$	0.58

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

Maximum temperature (°C) (X<sub>1</sub>),

Relative Humidity (Morning%) (X<sub>2</sub>),

Rainfall (X<sub>3</sub>),

Rainy days (X<sub>4</sub>),

Wind speed (Km/hr.) (X<sub>5</sub>)

Sunshine (hours) (X<sub>6</sub>)

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

*Centres: East Coast :* Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

*West Coast :* Madakkathara and Vengurla

*Plains / others:* Hogalagere and Jagdalpur



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

### BAPATLA

During the year 2018-19, among the 37 accessions screened to identify the tolerant lines against the pests of cashew, H-94-T<sub>4</sub> has recorded highest incidence of leaf and blossom webber (3.67%) and T.No. 7/12 has recorded with the lowest incidence (0.00%). The accession ABT-3 has recorded with the highest incidence of leaf miner

(7.96%) and leaf folder (2.64%). The accession T. No. 12/1 has recorded highest incidence of shoot tip caterpillar (2.37%). The accession line T. No. 129 has recorded with highest incidence of apple and nut borer (15.03%) and T. No. 18/3, T. No. 3/7, T. No. 3/4, T. No. 1/41, T. No. 8/7, T. No. 4/3, T. No. 4/5 and T. No. 6/14 were observed no incidence during this season (0.00%).

**Table 3.42 : Screening of cashew germplasm to locate tolerance / resistance to major pests of the region (2018-19) at Bapatla**

S. No.	Entry	IC No.	Leaf and blossom webber damaged shoots (%)	Leaf miner damaged leaves (%)	Leaf folder damaged leaves (%)	Shoot tip caterpillar damaged shoots (%)	Apple and nut borer damaged nuts (%)
1.	Priyanka	250140	0.54	4.44	1.35	1.68	10.00
2.	T.No.129	249784	0.28	1.38	0.28	1.65	15.03
3.	T.No.275	249982	2.06	1.31	1.02	1.02	1.07
4.	T.No.274	302488	1.60	3.10	1.78	1.19	1.49
5.	T.No.12/1	---	0.87	2.79	1.04	2.37	0.00
6.	T.No.12/8	---	1.51	2.69	0.77	0.16	2.30
7.	T.No.18/3	---	0.85	4.58	1.15	0.43	0.00
8.	ABT-3	302391	1.77	7.96	2.64	0.65	14.64
9.	ABT-2	302390	1.18	2.84	0.31	1.08	1.50
10.	T.No.3/7	--	1.03	5.80	0.89	0.75	0.00
11.	T.No.3/4	---	0.44	3.92	1.27	0.63	0.00

12.	T.No.1/1	---	0.69	1.86	0.13	0.00	0.00
13.	T.No.8/7	302437	0.29	4.11	0.88	0.88	0.00
14.	T.No.4/3	302442	0.33	5.81	0.89	0.45	0.00
15.	T.No.4/5	---	0.74	6.36	1.56	0.94	0.00
16.	T.No.30/1	302368	0.82	2.91	0.51	0.00	7.87
17.	T.No.228	302376	1.41	3.18	1.24	1.23	5.37
18.	T.No.233	302374	0.60	2.02	1.15	1.44	6.00
19.	T.No.244	302379	1.01	1.15	0.14	0.43	7.90
20.	T.No.268	302381	1.53	3.65	0.14	1.97	5.92
21.	BLA 139-1	---	1.73	4.30	0.48	0.64	5.13
22.	BLA 39/4	---	1.98	4.24	0.42	1.55	1.84
23.	T.No.5/1	250025	3.37	1.28	0.32	0.95	6.68
24.	T.No.10/2	249911	1.31	2.26	0.48	0.96	2.22
25.	T.No.7/12	302434	0.00	0.91	0.00	0.00	0.00
26.	T.No.71	302370	1.41	4.77	0.61	0.61	12.45
27.	T.No.277	302384	0.75	4.76	0.29	1.33	2.56
28.	T.No.2/14	302446	1.50	3.61	0.45	2.11	7.66
29.	Ch.gudem	302409	0.93	1.27	0.41	0.55	11.11
30.	ASRPT	---	0.30	3.94	0.00	1.52	6.48
31.	T.No.40/1	---	0.59	1.93	0.45	0.00	1.96
32.	T.No.6/14	302432	2.99	1.97	0.00	1.96	0.00
33.	Hy 94-T3	---	0.62	0.16	0.16	0.16	2.22
34.	T.No.2/5	302387	0.46	1.33	0.29	0.15	5.28
35.	Hy 94-T4	---	3.67	2.19	0.33	1.96	0.00
36.	Hy 95-T4	---	1.24	2.45	0.31	1.53	7.92
37.	Vetapalem	----	0.86	1.44	0.29	0.87	1.52

Infestation by	Min. damage recorded (range)	Germplasm	Max. damage recorded (range)	Germplasm
Leaf and blossom webber	0-5%	T.No.129, T.No.274, T.No.12/1, T.No.12/8, ABT-3, ABT-2, T.No.3/7, T.No.8/7, T.No.4/3, T.No.4/5, T.No.30/1, T.No.233, T.No.244, T.No.268, BLA 139-1, T.No.5/1, T.No.7/12, T.No.71, T.No.277, T.No.40/1, Hy 94-T3, T.No.2/5, Hy 95-T4, Priyanka, T.No.275, T.No.18/3, T.No.3/4, T.No.1/1, T.No.228, BLA 39/4, T.No.2/3, T.No.10/2, T.No.2/14, Ch.gudem, ASRPT, T.No.6/14, Hy 94-T4, Vetapalem	5.1-10%	-

Leaf miner	0-5%	T.No.129, T.No.12/8, ABT-2, T.No.1/1, T.No.228, T.No.244, M 15/4, BLA 139-1, T.No.2/3, T.No.7/12, T.No.40/1, Hy 94-T3, Hy 94-T4, Hy 95-T4, Vetapalem, Priyanka, T.No.275, T.No.12/1, T.No.18/3, T.No.3/4, T.No.8/7, T.No.30/1, T.No.233, T.No.268, T.No.17/5, BLA 39/4, T.No.5/1, T.No.10/2, T.No.71, T.No.277, T.No.2/14, Ch.gudem, ASRPT, T.No.6/14, T.No.274, T.No.2/5	5.1 -10%	ABT-3, T.No.3/7, T.No.4/3, T.No.4/5
Leaf folder	0-5%	Priyanka, T.No.129, T.No.275, T.No.274, T.No.12/1, T.No.12/8, T.No.18/3, ABT-3, ABT-2, T.No.3/7, T.No.3/4, T.No.1/1, T.No.8/7, T.No.4/3, T.No.4/5, T.No.30/1, T.No.228, T.No.233, T.No.244, T.No.268, M 15/4, BLA 139-1, T.No.17/5, BLA 39/4, T.No.5/1, T.No.10/2, T.No.7/12, T.No.71, T.No.277, T.No.2/14, Ch.gudem, ASRPT, T.No.40/1, T.No.6/14, Hy 94-T3, T.No.2/5, Hy 94-T4, Hy 95-T4, Vetapalem, T.No.2/3	5.1-10%	-
Shoot tip caterpillar	0-5%	Priyanka, T.No.129, T.No.12/8, T.No.30/1, T.No.268, M 15/4, BLA 139-1, BLA 39/4, T.No.5/1, T.No.2/3, T.No.10/2, T.No.7/12, T.No.71, T.No.2/14, T.No.40/1, Hy 94-T3, T.No.2/5, Hy 95-T4, T.No.275, T.No.274, T.No.12/1, T.No.18/3, ABT-3, ABT-2, T.No.3/7, T.No.3/4, T.No.1/1, T.No.8/7, T.No.4/3, T.No.4/5, T.No.228, T.No.233, T.No.244, T.No.17/5, T.No.277, Ch.gudem, ASRPT, T.No.6/14, Hy 94-T4, Vetapalem	5.1-10%	-
Apple and nut borer	0-5%	T.No.12/1, T.No.18/3, ABT-2, T.No.1/1, T.No.10/2, T.No.7/12, T.No.40/1, T.No.6/14, Hy 94-T3, Vetapalem, T.No.274, T.No.2/3, T.No.277, Hy 94-T4, T.No.275, T.No.12/8, T.No.3/7, T.No.3/4, T.No.8/7, T.No.4/3, T.No.4/5, BLA 39/4	5.1-10%	Priyanka, T.No.129, ABT-3, T.No.30/1, T.No.228, T.No.233, T.No.244, T.No.268, BLA 139-1, T.No.5/1, T.No.71, T.No.2/14, Ch.gudem, ASRPT, T.No.2/5, Hy 95-T4

## BHUBANESWAR

Extent of damage by leaf miner ranged between 0.5 and 1.5% damaged leaf in all the germplasm. Low incidence of shoot tip caterpillar was noticed after new flushing for a very short period

in 50 per cent of the cashew germplasm. The red banded thrips incidence at higher intensity ( 11.21-72.54 per leaf) in 15 germplasm while remaining germplasm remained free from the attack by the pest.

**Table 3.43 : Reaction of germplasm accession against insect pests in Bhubaneswar**

Pest	Accession	Min damage	Accession	Max. damage
LM	100 No	0.5-1.0 %DL		
STC	100 No	0.5-1.0 % DS		
Red banded thrips	85 Nos	0-5 No/leaf	OC 65,OC 140	7.5-11.0/ leaf

## HOGALAGERE

The reactions of MLT-1992 and MLT-2002 entries maintained at HREC, Hogalagere and ARS, Chintamani were observed to identify the susceptibility/resistant or tolerance to infestation

of TMB and other major pests. The data indicated that none of the yielding accessions have shown resistant or tolerance to TMB infestation.

**Table 3.44 : 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 52 leader shoots			Thrips (% damage)
			TMB (% damage)	Leaf miner (No. blotches/shoot)	Apple & nut borer (% damage)	
1	Vengurla	H-68	1.76	1.52	1.78	0.67
2		H-367	1.66	0.64	1.46	1.12
3		H-303 (V-9)	1.75	0.61	0.91	1.24
4		H-255	1.63	1.80	0.60	1.69
5		H-320	1.49	1.57	1.54	0.99
6	Vridhachalam	M-4/3	1.63	1.65	1.73	0.74
7		M-15/4	0.61	0.98	1.22	1.73
8	NRCC, Puttur	NRCC-1	0.78	1.41	1.29	0.85
9		NRCC-2	0.84	1.66	0.99	0.62
10	Bapatla	TN-30/1	1.69	1.17	1.67	0.83
11		TN-3/33	0.77	1.77	0.72	1.04
12		TN-10/19	1.19	1.02	1.26	0.84
13		TN-3/28	1.41	1.30	1.08	0.92
14	Ullal	Ullal-1	0.79	1.53	0.68	0.69

**Table 3.45 : 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 52 leader shoots		
			TMB (% damage)	Leaf miner (No. blotches/ shoot)	Apple & nut borer (% damage)
1	Bhubaneswar	BH-6	1.48	1.27	1.26
2		BH-85	1.52	1.01	0.82
3	Madakkathara	H-1593	1.56	1.11	1.34
4		K-22-1	1.18	1.67	1.18
5	Vengurla	H-662	1.67	1.62	1.24
6		H-675	1.36	1.59	0.80
7	Puttur	H-32/4	1.00	1.06	0.70
8		Goa-11/6	0.76	1.61	1.13
9	Vridhachalam	H-11	0.91	1.21	1.21
10		H-14	0.85	1.22	1.20
11	Chintamani	Chintamani-1	1.17	1.65	0.78

### JAGDALPUR

Screening of cashew germplasm was conducted to locate tolerant / resistant types to major pests of the region in the gene bank and multi location trial-II of SG CARS, Jagdalpur.

Among twelve promising DCR entries planted during 1997 in SG CARS Jagdalpur, which are 21 years old, all the germplasm recorded low score for thrips and TMB. The lowest score for

thrips was recorded in NRC-138 (0.21), whereas, germplasm NRC-137 had minimum score for TMB (0.01). The experimental data presented revealed that caterpillars are the major pest problem under Jagdalpur conditions. The shoot tip caterpillar infestation ranged from 10.84 to 14.08 per cent, minimum percentage of leaf damage was reported in NRC-136. The lowest damage with respect to leaf miner and leaf folder was recorded in NRC-138 (2.51%) and NRC-140 (7.28 %) respectively.

**Table 3.46 : Screening of promising DCR entries for tolerance/ resistance to the major pests at Jagdalpur during the year 2018-19**

Germplasm	Thrips (mean damage score 0-4 scale)	TMB (mean damage score 0-4 scale)	Shoot tip caterpillar (% of damaged leaves)	Leaf miner (% of mined leaves)	Leaf folder (% of damaged leaves)
NRC-130	0.34	0.04	11.94	4.08	9.04
NRC-131	0.23	0.04	11.17	4.98	8.95
NRC-136	0.31	0.15	10.84	3.46	8.96
NRC-137	0.22	0.01	11.16	3.71	8.22
NRC-138	0.21	0.02	14.08	2.51	7.80
NRC-140	0.26	0.04	12.83	5.83	7.28
NRC-190	0.22	0.05	11.72	3.10	8.67
NRC-191	0.22	0.14	12.23	4.85	9.33
NRC-192	0.28	0.15	12.34	5.40	9.51
NRC-193	0.38	0.04	12.27	3.17	10.30
Aakhane	0.32	0.15	17.31	7.13	10.16
VTH 711/4	0.23	0.19	11.87	5.80	8.82

Locally collected germplasm were studied for tolerance to pests which are 06-10 years old, maintained in the gene bank of SGCARS, Jagdalpur. Screening of local germplasm revealed that all germplasm recorded low score for thrips and TMB. Lowest score for thrips was recorded in CARS-4 (0.19) whereas maximum in CARS-2 (0.35). There were no TMB infestation reported in CARS-3,

CARS-10 and CARS-11 germplasm during 2018-19 however, maximum TMB score was reported in CARS-2 (0.58). The results cannot be concluded as CARS-3, CARS-10 and CARS-11 were immune to TMB because infestation of TMB was reported to be low under Jagdalpur conditions. The germplasm CARS-1 had minimum damage of leaf caterpillar, leaf miner and leaf folder during 2018-19.

**Table 3.47 : Screening of local germplasm for tolerance/ resistance to the major pests at Jagdalpur during the year 2018-19**

Germplasm	Thrips (mean damage score 0-4 scale)	TMB (mean damage score 0-4 scale)	Shoot tip caterpillar (% of damaged leaves)	Leaf miner (% of mined leaves)	Leaf folder (% of damaged leaves)
CARS-1	0.33	0.08	6.75	2.29	6.78
CARS-2	0.35	0.58	8.54	4.97	8.67
CARS-3	0.30	0.00	13.10	5.73	7.56
CARS-4	0.19	0.05	9.59	7.87	9.08
CARS-5	0.31	0.11	10.54	4.19	8.63
CARS-6	0.28	0.02	11.57	5.27	8.40
CARS-7	0.21	0.03	10.29	7.33	8.66
CARS-8	0.29	0.17	11.81	3.51	7.87
CARS-9	0.27	0.53	9.70	3.84	8.28
CARS-10	0.24	0.00	15.29	3.95	8.40
CARS-11	0.33	0.00	15.48	6.27	8.66
CARS-18	0.27	0.18	14.91	3.31	8.54

The data recorded in MLT –II entries planted in the year 2002 -2001 (18 years old) for tolerance / resistance to the major pests revealed that, TMB and thrips incidence was very low during the year

whereas all germplasm were infested by shoot tip caterpillar and leaf folder. The damage of leaf miner was recorded lower in NRCC Sel. 1 which had only 2.67 per cent infestation.

**Table 3.48 : Screening of MLT-II entries for tolerance/ resistance to the major pests at Jagdalpur during the year 2018-19**

Germplasm	Thrips (mean damage score 0-4 scale)	TMB (mean damage score 0-4 scale)	Shoot tip caterpillar (% of damaged leaves)	Leaf miner (% of mined leaves)	Leaf folder (% of damaged leaves)
H-68	0.23	0.03	15.29	3.42	7.54
H-255	0.27	0.16	13.70	3.43	7.92
H-303	0.37	0.17	12.77	4.16	8.16
H-320	0.27	0.15	13.04	5.48	7.92
H-367	0.30	0.02	13.62	2.93	8.33
NRCC Sel. 1	0.32	0.04	15.20	2.67	8.32
NRCC Sel. 2	0.26	0.11	12.51	7.30	10.76
3/28	0.23	0.12	11.07	10.22	7.63
3/33	0.37	0.26	15.15	4.04	9.72
30/1	0.18	0.17	10.71	7.82	7.83
10/19	0.38	0.56	9.45	6.35	8.17
VRI-1	0.21	0.17	13.11	7.15	8.16
VRI-2	0.19	0.29	11.39	7.75	8.43
Vengurla-4	0.24	0.05	12.91	7.27	8.52

**Table 3.49 : Minimum and maximum damage scores recorded in germplasm during 2018-1 at Jagdalpur**

Infestation by	Minimum damage	Germplasm	Max. damage recorded (range)	Germplasm
Thrips (0-4 scale)	0	-	0.5-1.0	-
TMB (0-4 scale)	0	CARS-10, CARS-11, CARS-3	0.5-1.0	10/19, CARS-9, CARS-2
Shoot tip caterpillar	0-5 %	-	15-20 %	H-68, NRCC Sel. 1, 3/33, CARS-10, CARS-11, Aakhane
Leaf miner	0-5 %	H-68, H-255, H-303, H-367, NRCC Sel. 1, 3/33, CARS-1, CARS-2, CARS-5, CARS-8, CARS-9, CARS-10, CARS-18, NRC-130, NRC-131, NRC-136, NRC-137, NRC-138, NRC-190, NRC-191, NRC-193	10-15 %	3/28
Leaf folder	0-5 %	-	10-15 %	NRCC Sel. 2, NRC-193, Akhane

## VENGURLE

During the year 2018-19, the variety V-5 recorded lowest TMB incidence (0.092) whereas, it was maximum in the variety Goa 11/6 (0.223). In case of thrips the variety V-1 (0.087) recorded lowest TMB infestation whereas it was maximum in variety V-8 (0.264).

**Table 3.50 : Screening of cashew germplasm to locate tolerance/resistance to major pests of the region at Vengurle centre during the year 2018-19**

Infestation by	Min. damage recorded (range)	Germplasm	Max. damage recorded (range)	Germplasm
Tea Mosquito Bug	0.09	V-5	0.22	Goa 11/6
Flower thrips	0.08	V-1	0.26	V-8

## VRIDHACHALAM

The damage score for TMB infestations in various MLT entries ranged from 1.4-3.7. The score was low in ME 20/1 with mean damage score of

1.4. In other cashew entries, the mean damage score ranged between 1.9 and 3.7. So, none of the cashew entries have shown immune or resistant reactions to TMB infestation under field condition.

**Table 3.51 : 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	2.4	2.8	1.5	0.0	0.0	0.0
H 1600	2.2	3.5	1.2	0.0	0.0	0.0
H 1608	2.5	3.4	1.5	0.0	0.0	0.0
H 1610	2.6	3.5	2.2	0.0	0.0	0.0
H 129	2.8	3.6	2.2	0.0	0.0	0.0
H 40	3.7	2.0	3.0	0.0	0.0	0.0
H 2/15	2.8	3.4	1.3	0.0	0.0	0.0
H 2/16	3.7	2.6	2.3	0.0	0.0	0.0
H 33/3	2.0	2.8	3.0	0.0	0.0	0.0
H 44/3	2.2	2.6	1.6	0.0	0.0	0.0
M 26/2	2.8	3.0	3.7	0.0	0.0	0.0
ME 20/1	1.4	2.5	1.6	0.0	0.0	0.0
VTH 30/4	3.0	3.4	1.5	0.0	0.0	0.0
VTH 59/2	3.2	3.4	1.2	0.0	0.0	0.0
V 2	3.0	2.6	1.2	0.0	0.0	0.0
V 3	3.2	2.6	3.2	0.0	0.0	0.0
V 4	3.2	3.1	2.5	0.0	0.0	0.0
V 5	1.9	3.2	2.8	0.0	0.0	0.0

Screening of F<sub>1</sub> hybrids revealed that all the cross combinations were susceptible to TMB infestation. However, the damage score was low

(2.0) in H 10, H14 and H 16 followed by H 17 and H13, H15 with a mean damage score of 2.4 and 2.6 respectively.

**Table 3.52 : Screening of F1 hybrids for tolerance to cashew pests at Vridhachalam**

Hybrid Number	Cross combination	TMB mean damage score 0-4 scale in 52 leader shoots	Leaf & blossom webber % shoot damaged / 52 leader shoots	Inflorescence caterpillars (% of damaged panicle out of 52 panicles)	Leaf miner % of mined (leaves) on five laterals	Apple & Nut borer (% of apples damaged / 52 panicles)
H 10	M 10/4 x M 26/1	2.0	3.5	2.5	1.8	0.0
H 11	M 10/4 x M 45/4	3.0	3.8	3.5	1.5	0.0
H 12	M 10/4 x M 75/3	2.8	3.8	2.8	1.0	0.0
H 13	M 26/2 x M 26/1	2.4	3.5	2.5	1.2	0.0
H 14	M 26/2 x M 45/4	2.0	5.0	2.8	1.2	0.0
H 15	M 26/2 x M 75/3	2.6	5.0	2.8	2.0	0.0
H 16	M 44/3 x M 26/1	2.0	5.0	2.5	2.5	0.0
H 17	M 44/3 x M 45/1	2.4	4.8	2.8	2.2	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 of AICRP-Cashew are located in the East Coast, West Coast and Plains Region (plateau region) of the country.

The centres in 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 for 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<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O. 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<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O. 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<sub>2</sub>O<sub>5</sub> and high in K<sub>2</sub>O. 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 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 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 Hogalagere, Darisai, Jagdalpur centres and a co-operating centre at Arabhavi in this region. Hogalagere 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<sub>2</sub>O<sub>5</sub> and high in K<sub>2</sub>O. 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). 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**

The centre had organized the Rythu Sadassu at Bethapudi village of Bapatla mandal, Guntur Dist, on 08.03.2019 under RHWE Programme in which around 100 No's of farmers attended the programme. The centre has organized District level farmers training programme on Cashew at Koyyuru, Visakhapatnam District., Andhra Pradesh on 25.03.2019 sponsored by Directorate of Cashewnut and Cocoa Development (DCCD), Cochin Kerala. The centre organised 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 sponsored by DCCD.

The Scientist of the Centre have attended ZREAC meeting at KVK, Venkataramannagudem on 15.4.2019 and clarified the doubts of farmers regarding cashew. The scientists have attended 12<sup>th</sup> State Level Technical Programme (SLTP) meeting at Venkataramannagudem from 24.4.2019 to 27.4.2019 and presented the research findings for the year 2017-18 and new proposal for 2019-20. The scientists of the Centre attended training programme as resource persons and explained to cashew farmers from ITDA, Andhra Pradesh about the topics like Scenario of Cashew in India, Cashew Production technology, Cashew nut processing, Rejuvenation of Cashew and Pest and Diseases organized by Watershed Management, Government of Andhra Pradesh from 9.05.2019 to 10.05.2019 at ETC, Bapatla. Field visit was conducted for Cashew farmers from ITDA, Andhra Pradesh, at CRS, Bapatla on 10.05.2019 where

they were explained about advanced production technology in cashew and Integrated Pest management of Cashew. The scientist of the centre had conducted roving survey in cashew orchards at Devarapalli and Nallajerla Mandals of W.G. on 13.05.2019 and 14.05.2019. The survey conducted mainly for observing the Rugose Spiralling Whitefly (RSW). Advise was given to farming community and extension personnel in surveyed areas to reduce the indiscriminate use of synthetic pyrethroids (Lamda Cyhalothrin and Deltamethrin etc.) on cashew. The scientists also attended the National Symposium on “The Choice of farming models for income security: towards equity and sustainability” from 21<sup>st</sup> – 22<sup>nd</sup>, June, 2019 at Agricultural College, Bapatla, ANGRAU.

The scientists attended pasidi pantalu phone in live programme on “Jeedimaamidi saagulo adhika digubadulaku suchanalu” on 05.08.2019 at Dooradarsan Kendra, Vijayawada and three radio talks on “Jeedimaamidilo melaina Yajamaanya paddatulu” on 5.8.2019; “Jeedimaamidilo Sasya rakshna” at All India Radio, Vijayawada on 07.08.2019 and “Jeedimaamidi Thotallo Yajamanyam” at AIR, Vijayawada on 15.11.2019. The scientists of the centre attended the DCCD sponsored National Level Training Programme on Cashew from 23<sup>rd</sup> to 26<sup>th</sup>, December 2019 at IMAGE, Bhubaneswar as a resource person and delivered lecture on “Importance of high density planting & Canopy management”. The scientists have also given information to the students of BSc (Hons.) and BSc. (Ag.) on different research activities on cashew, grafting technique in cashew, cashew nut processing, cashew apple processing and pest and disease management in cashew.

### **BHUBANESWAR**

The scientists of the centre have participated and imparted training on production technology, crop management, plant protection measures, value addition and post-harvest management of cashew at two District Level Seminar on Cashew under MIDH Scheme organised by Odisha State Cashew

Development Corporation Ltd, Bhubaneswar at Chittri in Jajpur district on 4<sup>th</sup> February, 2020 and Lahanga in Khordha District on 12<sup>th</sup> February, 2020. The scientists have also imparted training to 25 number of farmers of Khallikote block and 35 number of farmers of Kabisuryanagar block of Ganjam district on cashew production technology on 24<sup>th</sup> September, 2019 and 23<sup>rd</sup> October, 2019 respectively under Extension Reforms Scheme of Government of Odisha.

The scientists delivered lectures on management of cashew orchards and care in cashew nursery in two skill based training for entrepreneurship development on “Orchard management” and “Fruit Crops Nursery Management” organised by Directorate of Horticulture, Government of Odisha under Rashtriya Krishi Vikash Yojana (RKVY) on 8th January and 28<sup>th</sup> February, 2020 respectively. The scientists of the centre participated and acted as resource person in three days National Level Training Programme on Cashew at Bhubaneswar from 23<sup>rd</sup> to 26<sup>th</sup> December, 2019 sponsored by DCCD under MIDH Scheme.

Ten number of field visits/discussions were made on various aspects of cashew cultivation and suitable suggestions were provided to the farmers. The scientist of the centre has participated as an expert on the topic “Kaju Phasalara Jatna” in Pallishree. Programme at Doordarshan Kendra, Bhubaneswar on 23<sup>rd</sup> January, 2020 and attended Doordarshan “Live-Phone-in Programme” on Krishi Darshan on the topic “Amba O Kaju Phasalara Jatna” on 6<sup>th</sup> March, 2020.

### **JAGDALPUR**

The centre has conducted one day training programme on cashew processing technology to farmers from Nabranpur District Odisha on 26<sup>th</sup> April 2019. Scientists of the centre have delivered 3 radio talks, one lecture in district level seminar and six training programme under badi cultivation, promotion of cashew cultivation,

processing of cashew apple and pest management in cashew.



The centre has provided free planting materials to farmers of Bade Chakwa, Duganpal and Chokar villages of Bastar District. Now centre is promoting some new promising varieties under Bastar district under high density planting under such programme in village Duganpal K-22-1 was planted under 5 x 4 m distance under 1.5 acre land similarly variety VRI-3 was planted in 2 acre land of village Bade Chakwa of District Bastar. Bold nut variety Priyanka was planted in 4 acre under 7 x 7 m spacing in the field of farmer name Sonu in village Chokar, District Bastar. In the year 2019 around 2,000 grafts were distributed to the tribal farmers free of cost for promotion of cashew cultivation.

### **JHARGRAM**

During April, 2019, women Self Help Groups were trained on processing of cashew apple at Garbeta G.P. in Paschim Medinipur district under two different training programmes on 18.04.2019 and 27.04.2019. A total of 40 women attended the training programme and practically produced cashew apple syrup during the training programme. Another training was organized on cashewnut cultivation for field level staffs of Usher mukti project of Government of West Bengal on 24.04.19 at RRS, BCKV, Jhargram. On 21.05.2019, 10 youngsters from Sankrail block of Jhargram district were trained on cashew apple processing in the centre. On 04.06.2019 a training on Propagation of cashew was organized for 40 farmers at RRS, BCKV, Jhargram under Usharmukti project of MGNREGA of GOWB.

The Horticulturist of the project participated in a radio talk on cashew cultivation for West Bengal and Bangladesh in “Maitree” programme of All India Radio, Kolkata, broadcasted on 25.07.19. During November, 2019 scientist of the centre attended 5 training classes as an expert of nursery management. 250 trainees were trained on various aspects of nursery management of horticultural crops. The trainings were organized by the state Horticulture Department, GOWB.

During December, 2019 scientist of the centre attended 2 training classes as an expert of nursery management. 100 trainees were trained on various aspects of nursery management of horticultural crops. The trainings were organized by the state Horticulture Department, GOWB. During 2019-20, 3 trainings were organised under SCSP Scheme; first on 10.01.2020 for 60 farmers at Shankrail block of Jhargram district; second on 28.01.2020 for 60 farmers at Aranya Sundari Mahila Mahasanga, Jhargram district and third on 07.02.2020 for 50 farmers at RRS Jhargram. The farmers were trained on various aspects of cashew cultivation such as propagation methods, planting technique, maintenance of cashew orchards, management of pest and diseases of cashew crops, processing of cashew apple and nut.

Apart from trainings under SCSP project 6.62 ha cashew plantation was developed at the Godbeta block of Paschim Medinipur district of West Bengal and 1 ha at the Gopiballavpur – I block of Jhargram district. 17 scheduled caste farmers were identified as beneficiaries for the area expansion programme. 20 scheduled caste cashew farmers were supported with small implements such as sprayers, water cans, pruning loopers, secateurs, measuring tapes.

## **MADAKKATHARA**

The Centre had conducted a sponsored training programme on cashew apple processing to team TANAGER (International NGO), Andhra Pradesh

for 3 days from 8<sup>th</sup> to 10<sup>th</sup> of April 2019 at CRS, Madakkathara. Consultancy visit was taken up to Adathegalacluster, East Godavari, Andhra Pradesh of team TANAGER on value addition of cashew apple from 17 to 19 June 2019. The centre has conducted a sponsored training programme to team SERP (Society for Elimination of Rural Poverty), Andhra Pradesh on “Cashew apple and raw nut processing” for 3 days (7<sup>th</sup>, 8<sup>th</sup> and 9<sup>th</sup> of May 2019) in the centre. The scientists have taken up consultancy visit to Kasargod Cashew Estate of Plantation Corporation of Kerala in connection to cashew apple processing on 31/12/2019 and also visit to viable distillery for the production of cashew apple liquor at Goa from 11<sup>th</sup> November to 14<sup>th</sup> November.

The centre had participated in exhibition organized by Department of Agriculture, Government of Kerala, in connection with district level seminar Njattuvela Utsavam 2019 at Mathilakam Block, Thrissur District, during the period from 29.06.2019 to 30.07.2019. Conducted DCCD Sponsored Technical series “Cashew Vigyan Mela” from February 14 to February 17, 2020 at CRS, Madakkathara. Participated and presented topic on cashew varieties in the seminar organized by Malayala Manorama at North Malabar Chamber Hall, Kannur on 17/05/2019.

SCSP training programme on “Cashew production Management and cashew apple processing” was conducted on 06/02/2020 from Nediyrrippu SC colony, Malappuram and 15/02/2020 at CRS, Madakkathara to Kottassery SC colony. Diagnostic visit to Cashew Plantation, Mannarkkad Estate on 12/4/2019 and at Athirappilly Estate on 17/4/2019 was made by the centre.

## **PARIA**

During the year, the scientists of the centre have conducted/attended farmers training programme, Khedut Sibir, Khedut Din, Krishi Mela,

TV programme and farmers scientist interaction meet. Five farmers training on scientific cultivation of cashew was held at FTC-Pardi and Paria Farm in which 359 nos. had participated. Six farmers training on “Control of pest and disease in fruit crops and cashew was conducted in which 431 nos. had participated. Further, two training programme on “Organic Farming” were organized for 216 nos. of participants. Two training programme on “Rat control” was conducted for 81 participants. The Centre had also organized training programme on “Preparation of Jeevamruta and uses” in which about 93 nos. had participated.

### **PILICODE**

The scientist from the centre served as resource person under various training programmes organized for farmers dealing with scientific cashew cultivation by KVK Kannur and for input dealers of Kannur and Kasaragod district through DAIESI programme.

### **VENGURLE**

The scientists of the centre have conducted six trainings programme on crop production, crop management and cashew apple processing for 400 Nos. of participants. The scientists have conducted one DCCD sponsored “District Level Seminar on Cashew production technology” (one day) on 28<sup>th</sup> January, 2020 for 150 Nos. of participants at Hirlok, Kudal. Similarly, another DCCD sponsored “District Level Seminar on Cashew production technology” was conducted on 12<sup>th</sup> February, 2020 for 150 Nos. of participants at Kunde, Kudal. The scientists have conducted four DCCD sponsored trainings programme especially for rural unemployed women on “Utilization of Cashew Apple for Unemployed Women” during 4<sup>th</sup> March to 11<sup>th</sup> March, 2020 at

RFRS, Vengurla in which 25 participants attended in each training. Scientist Farmers Forum on Cashew and Mango meetings and field visit was organized by DSAO, Sindhudurg at monthly interval during the reporting period in which the actual problem of the cashew/mango farmers have been solved at farm level in order to get the immediate results.

The scientist of this centre has participated in interview on “Management of insect pest of Cashew” in Doordarshan Krishi Darshan programme at Varali, Mumbai and telecasted on 09<sup>th</sup> January, 2020. The scientist of this centre has delivered lecture as a resource person on “Importance of Vengurla-4 and Vengurla-7 varieties in cashew development and their cultivation practices” in the DCCD sponsored “National Level Training Programme on Cashew” held during 31<sup>st</sup> July, 2019 to 2<sup>nd</sup> August, 2019 at Hotel Dharmavara Residency, Brahmavar, Udupi, Karnataka state.

In addition to this, station have also organized various extension programme specially the method and result demonstration on the topic viz., on fertilizer management in cashew, softwood grafting technique, integrated nutrient management in cashew, plant protection in cashew, cashew apple processing, CSRB management in cashew in different villages of Sindhudurg district. Six trainers training programmes on cashew was organized in which around 264 trainers had participated; ten method demonstrations were organized by this station in which 279 participants had participated; six result demonstrations organized by this station in which 91 participants participated; total 19 farmers rallies organized by this station in Sindhudurg district in association with State Agriculture Department in which 1356 participants had participated.



Organized on DCCD sponsored “District Level Seminar on Cashew production technology” (one day) on 28<sup>th</sup> January, 2020 at Hirlok, Kudal



Organized on DCCD sponsored “District Level Seminar on Cashew production technology” (one day) on 12<sup>th</sup> February, 2020 at Kunde, Kudal



Organized on DCCD sponsored “Utilization of Cashew Apple for Unemployed Woman” during 4<sup>th</sup> March to 11<sup>th</sup> March, 2020 at RFRS, Vengurla



### 3. RESEARCH PUBLICATIONS

#### BAPATLA

Innovative strategy in augmenting quality planting material production of cashew by K. Umamaheswara Rao, B. Nagendra Reddy, K. Dhanumjaya Rao, The Cashew & Cocoa Journal Vol. VIII No.2, Page No. 21-31.

Innovative Strategy in Augmenting Quality Planting Material Production by Umamaheswara Rao. K, Nagendra Reddy. B and Dhanumjaya Rao. K. In Souvenir of National Conference on Cashew: “Productivity Enhancement and Value Addition for Doubling Farmer’s Income” at Vijayawada on 22<sup>nd</sup> – 23<sup>rd</sup> Feb, 2019.

#### BHUBANESWAR

##### Extension Bulletins/Booklets /Leaflets

Panda, P. K. and Sethi, K. 2019. *Adhika Labha pain Kaju Bagichare Antta Phasala (In Odia)*. Published by AICRP on Cashew, OUAT, Bhubaneswar, pp-4.

##### List of publications :

##### Research Publications :

Mirdha, M., Sethi, K., Panda, P.K., Mukherjee, S.K., Tripathy, P. and Dash, D.K. 2019. Studies on physio-chemical parameters of cashew (*Anacardium Occidentale* L.) apple for value addition. *Agriculture Science Digest-A*

Research Journal, 39(1):15-20.

Sethi, K., Tripathy, P. and Mirdha, M., 2019. A study on the heterosis in cashew (*Anacardium occidentale* L.). *International Journal of Farm Sciences*, 9(3) : 1-3.

Sahoo, S., Sethi, K., Dash, M. and Tripathy, P. 2020. Evaluation of F1 hybrids of Cashew (*Anacardium occidentale* L.). *International Journal of Agricultural Sciences*, 16(1) : 79-85.

Sethi, K., Dash, M. and Tripathy, P. 2020. Character Association and Multivariate Analysis in Cashew (*Anacardium occidentale* L.). *International Journal of Bio-resource and Stress Management*, 11(1) : 64-72.

#### **Research papers presented at International and National Seminar/Symposia:**

Panda, P. K., Patnaik, R. K. and Sethi, K. 2020. Economics of Cashew (*Anacardium occidentale* L.) nut yield cv.BPP-8 on different organic sources of nutrients. In: *Regional Seminar on Perspectives of Horti-business in Development of North Eastern Region*, 24-25 Feb.2020, CHF, Pasighat, Arunachal Pradesh. Pp.102-103.

#### **Popular Article:**

Panda P. K., Sethi K. and Mukherjee S. K. 2019. Lanka Amba Phasalara Amala O Parabarti Jatna. *Chasirara Sansara*, 52(2-3):25-27.

#### **JAGDALPUR**

Nirala, Y. S., Ramteke, V., Mandwai, N. C., Nanda, H. C. and Roy, S. 2019. Influence of weather factors on the incidence of pest complex of cashew. *Int. J. Chemicals Studies*. 7(5): 961-963.

#### **JHARGRAM**

##### **Extension Bulletins/ Booklets /Leaflets**

Poduval Mini, Cashew Calendar of Operation both in English and Bengali Published by AICRP

on Cashew, RRS, BCKV, Jhargram, West Bengal, 14p.

#### **PILICODE**

Meera Manjusha A.V. and Seema B.R., 2019, Varietal screening of cashew apple for preparation of RTS and Jam. *International Journal of Chemical studies*, 7(6):1938-1941.

#### **MADAKKATHARA**

##### **Research papers**

Menon, J.S. 2019. Dynamics of Cashew Apple Products from Cashew Research Station, Madakkathara. *The Cashew & Cocoa Journal* April-June 2019.

##### **Popular articles**

Menon, J.S. 2019. *Kasumavu gaveshana kendram, Madakkathara. krishiyankanam. June-july 2019* (Malayalam)

Menon, J.S. 2019. *Parangimangapazhakkalle. Krishijagan. May 2019*

##### **Technical bulletin**

News letter-KAU Cashew News 2019 Vol. 1 Jan 2020

An album on birds of flowering cashew plantation, "Kasumavinthoppilepookkala paravakal"

A brochure on Cashew Research Station, Madakkathara

A leaflet on hybrid cashew varieties, "Kasumavilesankarainanga" prepared by Dr. Asna A.C.

#### **VENGURLA**

##### **I) Research papers:**

Gajbhiye, R. C., Bhingarde, R. T., Pawar, S. N., Zote, V. K., Salvi, S. P. and Sawant, B. N. 2020. Evaluation of cashew (*Anacardium occidentale* L.) genotypes under South Konkan conditions. *Multilogic In Science*, IX(XXXII): 380-384.

## II) Book published:

Gajbhiye, R. C., Khandekar, R. G., Salvi, B. R., Bhawe, S. G., Haldankar, P. M., Torane, S. R., Haldavanekar, P. C., Sawant, B. N., Zote, V. K., and Rite, Shrikant, 2019. Book on Cashew Production Technology and Processing-In Marathi local language published by Director of Extension Education, Dr. BSKKV, Dapoli.

## III) Popular article:

Gajbhiye, R. C., Haldavanekar, P. C. and Zote, V. K. 2019. Cashew Cultivation Technology. Shetkari, Pp. 50-53.

## VRIDHACHALAM

Velmurugan, S. 2019. High density planting and Ultra high density planting system in Cashew: A boon for doubling the farmers' income. *Agriculture and Food: E-Newsletter*, Vol. 1 (12), p. 39-43

Velmurugan, S., S. Jayaprabhavathi and A. Mothilal. 2019. Studies on the performance of released varieties of cashew (*Anacardium occidentale* L.) at Vridhachalam. In: Proc. of the National Conference on 'Climate smart agriculture for livelihood security: Challenges and opportunities' held at ADAC & RI, Trichy during 13-14 Sept. 2019, p. 152

## 4. STAFF POSITION

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## 5. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2019-20

### Allocation

(Rs. in lakhs)

Centre	Details of sanctioned provision					
	Pay and Allowances	TA	Recurring contingency	Non-Recurring contingency	Grand Total	ICAR share
Bapatla	61.00	1.40	7.72	1.00	71.12	53.34
Bhubaneshwar	46.95	1.20	5.12	1.00	54.27	40.70
Hogalagere	35.20	1.00	6.00	0.85	43.05	32.29
Darisai	21.15	0.60	2.80	0.00	24.55	18.41
Jagdapur	23.50	1.00	4.60	1.83	30.93	23.19
Jhargram	16.40	0.60	6.08	1.00	24.08	18.06
Madakkathara	41.41	1.20	4.20	1.00	47.81	35.86
Paria	28.00	1.00	3.80	0.50	33.30	24.98
Pilicode	14.50	0.60	1.60	1.00	17.70	13.28
Vengurla	55.50	1.40	5.92	1.00	63.82	47.87
Vridhachalam	57.50	1.40	6.67	1.15	66.72	50.04
KRCCH, Arabhavi	0.00	0.60	3.68	0.00	4.28	3.21
ICAR Res. Compl. For Goa, Goa	0.00	0.00	2.50	0.00	2.50	1.88
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	0.0	0.00	0.0	0.0
Provision for PC Cell	0.00	0.00	4.03	3.00	7.03	5.27
<b>Total</b>	<b>401.11</b>	<b>12.00</b>	<b>64.72</b>	<b>13.33</b>	<b>491.16</b>	<b>368.38</b>
<b>ICAR Share</b>	<b>300.83</b>	<b>9.00</b>	<b>48.54</b>	<b>10.00</b>	<b>368.38</b>	
Provision for SCSP						40.00
<b>GRAND TOTAL</b>						<b>408.38</b>

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

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	57.92	1.19	10.26	0.00	69.37	52.03
Bhubaneshwar	42.92	0.72	5.11	0.52	49.27	36.95
Hogalagere	35.20	1.00	6.00	0.85	43.05	32.29
Darisai	18.57	0.39	3.75	0.00	22.71	17.03
Jagdapur	17.87	1.30	9.70	0.80	29.67	22.25
Jhargram	16.34	0.76	6.50	0.67	24.27	18.20
Madakkathara	40.97	0.33	4.77	0.99	47.06	35.30
Paria	27.54	0.45	3.80	0.43	32.22	24.17
Pilicode	14.03	0.58	1.59	1.00	17.20	12.90
Vengurla	55.44	0.35	7.86	1.00	64.65	48.49
Vridhachalam	50.82	1.31	6.65	1.09	59.87	44.90
KRCCH, Arabhavi	0.00	0.18	4.49	0.00	4.67	3.50
ICAR Res. Compl. For Goa, Goa	0.00	0.00	2.50	0.00	2.50	1.88
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	4.61	0.00	4.61	3.46
Provision for RC for PC Cell	0.00	0.00	4.02	2.19	6.21	4.66
<b>Total</b>	<b>377.62</b>	<b>8.56</b>	<b>81.61</b>	<b>9.54</b>	<b>477.33</b>	<b>358.00</b>
<b>ICAR Share</b>	<b>283.22</b>	<b>6.42</b>	<b>61.21</b>	<b>7.16</b>	<b>358.00</b>	
Provision for SCSP						28.23
<b>GRAND TOTAL</b>						<b>386.23</b>

## 6. METEOROLOGICAL DATA OF DIFFERENT CENTRES

### BAPATLA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	RH (%)		Rainfall (mm)	Rainy days (No)
			(m)	(e)		
April-2019	34.7	26.1	79.0	73.0	0.0	0
May-2019	37.6	28.5	76.0	73.0	0.0	0
June-2019	38.4	28.7	70.0	64.0	91.8	6
July-2019	34.6	26.3	77.0	70.0	239.2	20
Aug-2019	34.0	25.9	79.0	69.0	98.4	17
Sept-2019	32.4	25.7	83.0	75.0	225.0	15
Oct-2019	31.0	24.9	86.0	81.0	257.2	19
Nov-2019	31.3	22.7	86.0	73.9	30.0	3
Dec-2019	29.8	20.3	86.1	69.4	0.4	2
Jan-2020	29.8	20.4	85.4	66.5	79.8	2
Feb-2020	30.7	20.6	81.6	61.5	10.7	3
Mar-2020	34.2	23.1	84.5	53.2	0.0	0
<b>Total</b>					<b>1032.5</b>	<b>87</b>

### BHUBANESWAR

Months	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days	BSH
	Max.	Min.	Max.	Min.			
April-2019	38.0	25.3	91	45	29.6	5	8.2
May-2019	37.1	27.4	92	54	197.7	2	8.1
June-2019	35.5	26.6	91	64	144.6	13	6.4
July-2019	32.9	26.0	92	74	341.7	20	4.4
Aug-2019	32.1	26.0	95	78	319.4	21	2.6
Sept-2019	32.1	25.7	94	78	406.5	15	3.9
Oct-2019	32.6	24.2	94	70	312.6	11	6.3
Nov-2019	30.2	20.0	94	55	4.0	1	5.9
Dec-2019	28.3	16.2	92	56	0.0	0	5.6
Jan-2020	27.9	16.1	94	52	12.7	4	5.8
Feb-2020	28.5	16.3	93	47	94.2	5	5.2
Mar-2020	34.2	22.1	95	49	56.5	7	7.5
<b>Total</b>					<b>1919.5</b>	<b>104</b>	

## DARISAI

Month	Rainfall (mm)	No. of rainy days	Temperature (°C)	
			Maximum	Minimum
April-2019	86.4	6	35.0	22.8
May-2019	123.4	3	37.4	24.5
June-2019	109.2	7	34.9	25.6
July-2019	210.8	11	32.9	25.5
Aug-2019	314.0	19	31.8	25.5
Sept-2019	281.0	16	31.3	25.5
Oct-2019	228.6	9	30.5	23.4
Nov-2019	0.0	0	30.2	17.6
Dec-2019	11.0	1	25.8	13.6
Jan-2020	28.4	2	25.7	12.4
Feb-2020	12.0	3	27.7	13.3
Mar-2020	42.4	7	32.6	18.7
<b>Total</b>	<b>1447.2</b>	<b>84</b>		

## HOGALAGERE

Months	Rainfall (mm)	Rainy days (No.s)	Temperature (° c)		Relative Humidity (%)		Wind speed (km/hr)
			Max. (Average)	Min. (average)	Max. (average)	Min. (average)	Max. (average)
April-2019	44.8	3	35.69	20.67	86.03	26.17	26.81
May-2019	44.7	6	35.62	22.39	84.84	34.55	30.86
June-2019	162.1	4	31.68	21.84	89.93	52.13	36.00
July-2019	56.0	4	29.63	21.45	89.10	56.81	37.38
Aug-2019	71.2	6	28.09	20.92	91.35	64.06	35.94
Sept-2019	147.2	14	29.16	20.58	92.30	63.60	27.61
Oct-2019	139.2	14	28.94	20.13	90.87	66.71	22.16
Nov-2019	34.5	5	27.63	18.62	84.03	62.27	20.76
Dec-2019	5.2	1	26.38	18.09	90.23	52.03	21.13
Jan-2020	0	0	28.15	15.76	90.23	42.16	18.83
Feb-2020	0	0	30.06	17.42	87.62	34.90	24.07
Mar-2020	0	0	34.67	19.96	80.29	32.84	22.38
<b>Total</b>	<b>704.9</b>	<b>57</b>					

## JAGDALPUR

Month	Temperature (°C)		Rainfall (mm)	Relative humidity (%)		Wind velocity (kms)	Sun shine (hrs)	Rainy days (No.s)
	Maximum	Minimum		morning	evening			
April-2019	39.00	23.40	0.00	61.00	26.00	4.30	7.80	3.00
May-2019	38.20	23.00	0.00	67.00	44.00	7.30	7.40	5.00
June-2019	34.50	24.80	33.60	86.00	58.00	6.20	8.60	9.00
July-2019	24.30	21.80	171.00	97.00	98.00	5.40	0.00	21.00
Aug-2019	29.00	23.20	5.20	89.00	77.00	3.50	2.00	22.00
Sept-2019	28.70	21.00	0.00	92.00	68.00	4.30	0.50	16.00
Oct-2019	29.30	21.40	0.00	96.00	65.00	0.20	5.50	11.00
Nov-2019	29.40	11.60	0.00	98.00	36.00	2.30	8.80	0.00
Dec-2019	27.20	9.00	0.00	98.00	39.00	3.40	2.20	0.00
Jan- 2020	28.00	12.70	0.00	95.00	49.00	1.80	6.90	2.00
Feb- 2020	30.70	11.50	0.00	88.00	35.00	1.90	9.20	2.00
Mar- 2020	37.30	21.20	0.00	77.00	33.00	3.70	8.20	3.00
<b>Total</b>			<b>209.8</b>					<b>94</b>

## JHARGRAM

Month	Temp (°C)		Relative Humidity (%)	Max. Wind Speed (mph)	Cloud cover (%)	Rainfall (mm)	Rainy days (No.s)	Average Pressure (mb)	Sun shine hours
	Max.	Min.							
April-2019	40	27	46	27.6	14	123.6	8	1007.4	327.5
May-2019	42	29	48	27.5	13	209.1	7	1004.0	360.5
June-2019	39	29	57	24.4	31	218.4	18	1000.7	314.0
July-2019	35	28	67	20.4	53	188.4	29	1000.1	250.5
Aug-2019	33	26	78	18.6	62	342.6	31	1000.3	184.5
Sept-2019	30	24	84	19.3	61	427.6	27	1006.1	149.0
Oct-2019	30	23	78	11.3	51	375.2	26	1011.4	184.5
Nov-2019	29	20	61	13.2	11	23.2	3	1013.3	277.5
Dec-2019	26	17	51	12.6	19	3.1	4	1016.3	286.5
Jan-2020	26	16	48	13.1	19	11.1	5	1015.7	279.5
Feb-2020	29	18	42	13.7	17	7.4	6	1015.5	262.0
Mar-2020	34	24	44	17.4	22	36.0	14	1011.4	292.0
<b>Total</b>						<b>1965.7</b>	<b>178</b>		

## KANABARGI

Months	Rainfall (mm)	Rainy days (No.s)	Temperature (° c)		Relative Humidity (%)	
			Max. (Average)	Min. (Average)	Max. (Average)	Min. (Average)
April-2019	0	0	35.80	20.35	83.86	17.15
May-2019	8.00	2	35.85	23.80	87.88	16.41
June-2019	161.82	12	26.50	22.69	93.23	59.41
July-2019	452.72	21	22.50	21.25	96.58	69.48
Aug-2019	734.00	30	22.28	20.20	96.44	79.38
Sept-2019	176.65	10	23.35	22.64	91.00	65.47
Oct-2019	259.44	12	23.56	18.85	89.22	35.57
Nov-2019	36.66	3	22.34	16.35	86.54	34.45
Dec-2019	0	0	24.89	17.56	72.34	35.21
Jan-2020	0	0	25.64	18.24	62.26	34.25
Feb- 2020	0	0	26.78	20.36	58.65	34.36
Mar- 2020	0	0	30.54	22.45	58.32	29.45
<b>Total</b>	<b>1829.29</b>	<b>90</b>				

## MADAKKATHARA

Month & Year	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Rainy days (No.s)	Total Sunshine hours (h)
	Max.	Min.	Max.	Min.			
April-2019	35.9	25.32	86.4	55	15.34	0	7.9
May-2019	34.58	24.78	89	60	12.13	1	6.5
June-2019	31.95	23.48	93.5	74.5	81.15	3.75	3.58
July-2019	30.48	22.66	95.20	74.20	134.92	4.6	4.79
Aug-2019	29.1	21.53	96.5	83	250.58	6	6.95
Sept-2019	31.45	21.93	95.5	74.25	93.48	4.25	3.5
Oct-2019	32.53	21.48	91.75	67.25	96.55	3.5	7.07
Nov-2019	32.85	22.10	82.25	61	36.67	1	7.1
Dec-2019	32.33	22.13	72.25	51.25	0.43	0	7.13
Jan-2020	32.83	20.15	71.5	37.75	0	0	8.3
Feb-2020	35.6	23.83	78.75	41.75	0	0	7.73
Mar-2020	36.8	24.95	85	44	0	0	8.53
<b>Total</b>					<b>721.25</b>	<b>24.1</b>	

## PARIA

Month	Max. Temp.	Min. Temp.	RH (M)	RH (E)	Wind velocity	Rainfall (mm)	Sunshine hours	Evaporation (mm)
Apr-19	37.39	26.08	71.33	38.15	3.24	0.0	9.55	6.28
May-19	35.42	27.69	73.20	47.90	5.17	0.0	10.54	6.83
Jun-19	34.87	28.06	79.14	61.10	6.37	371.7	5.60	5.67
Jul-19	31.35	26.40	90.50	81.63	5.74	1025.5	1.78	2.80
Aug-19	29.93	25.75	92.10	86.84	5.98	675.3	2.17	3.43
Sep-19	31.03	25.58	93.57	84.86	3.29	838.3	2.38	2.68
Oct-19	33.55	25.23	88.20	71.47	1.54	43.8	5.05	3.17
Nov-19	34.00	22.73	89.79	60.70	1.04	82.4	6.59	2.80
Dec-19	32.42	19.23	86.23	60.70	1.10	0.0	7.76	3.02
Jan-20	30.78	13.58	79.29	54.53	1.68	0.0	8.54	3.55
Feb-20	34.32	16.61	68.89	42.33	1.85	0.0	8.96	4.87
March-20	33.87	19.38	77.92	56.39	2.76	0.5	9.41	5.50
<b>Total</b>						<b>3037.5</b>		

## PILICODE

Month & year	Temperature ( °C)		Mean RH		Rainfall (mm)	Rainy days (No.s)	Bright Sunshine hours
	Max	Min	Max	Min			
April-2019	33.5	25.3	81	61	41.7	1	8.1
May-2019	33.3	26.1	86	66	42.3	5	9.0
June-2019	31.3	25.1	92	74	698.2	22	5.4
July-2019	29.3	24.0	94	81	1129.3	28	2.7
Aug-2019	28.7	23.9	95	83	1061.6	29	2.4
Sept-2019	29.5	24.0	93	78	510.1	23	3.5
Oct-2019	29.7	23.8	92	78	487.2	16	4.8
Nov-2019	31.5	23.5	91	68	93.6	3	8.5
Dec-2019	31.6	22.8	92	62	91	3	7.4
Jan-2020	31.6	21.7	91	58	0	-	9.4
Feb-2020	32.0	22.4	91	58	45.8	1	8.8
Mar-2020	32.6	24.2	88	68	3.0	1	8.4
<b>Total</b>					<b>4203.8</b>	<b>132</b>	

## TURA

Month	Rainfall (mm)	Rainy Days (No.s)	Humidity		Temperature	
			Max	Min	Max	Min
April-2019	132.6	9	89	60	38	17
May-2019	290	17	90	59	33	16
June-2019	294.8	19	91	70	39	17
July-2019	339	12	91	70	42	17
Aug-2019	41.0	4	90	70	35	17
Sept-2019	66.4	8	89	60	39	16
Oct-2019	235.0	6	86	62	36	16
Nov-2019	11	1	84	60	37	15
Dec-2019	0	0	80	60	29	15
Jan-2020	0	0	84	57	32	16
Feb-2020	0	1	87	59	33	14
Mar-2020	23.7	4	87	60	32	15
<b>Total</b>	<b>1433.5</b>	<b>81</b>				

## VENGURLA

Month	Temperature (°c)		Humidity (%)		Rainfall (mm)	Rainy days (No.s)
	Maximum	Minimum	Forenoon	Afternoon		
April-2019	34.54	23.36	79.65	60.86	00	00
May-2019	35.31	24.54	76.68	61.14	00	00
June-2019	33.44	24.50	87.61	75.00	1013.70	22
July-2019	29.73	23.82	90.17	86.63	1768.20	35
Aug-2019	30.65	23.57	94.43	81.47	945.70	25
Sept-2019	29.90	23.75	91.61	81.71	638.80	22
Oct-2019	33.47	22.83	87.89	67.29	108.00	11
Nov-2019	35.81	21.26	90.32	65.68	46.20	3
Dec-2019	34.63	20.61	88.66	70.87	00	00
Jan-2020	33.27	17.98	90.72	64.40	00	00
Feb-2020	34.99	18.39	88.25	54.71	00	00
Mar-2020	34.50	20.64	76.11	60.43	00	00
<b>Total</b>					<b>4520.60</b>	<b>118</b>

**VRIDHACHALAM**

Month	Rainfall (mm)	Rainy Days (No.s)	Temperature (°C)		Relative Humidity (%)		Sun Shine (Hrs)
			Max.	Min.	Morning	Evening	
April-2019	0	0	37.1	26.5	82.6	65.0	8.5
May-2019	38.2	1	38.3	27.9	77.3	55.6	8.8
June-2019	17.0	1	37.8	27.5	76.5	56.3	7.0
July-2019	109.2	7	37.2	26.4	85.2	65.8	5.6
Aug-2019	187.2	9	35.0	25.6	83.7	68.3	4.6
Sept-2019	240.8	14	33.5	25.7	86.6	71.5	5.1
Oct-2019	193.0	10	31.8	25.4	84.2	75.3	5.1
Nov-2019	106.8	10	32.2	24.9	83.5	75.1	5.5
Dec-2019	216.0	6	32.0	22.6	84.1	77.0	4.9
Jan-2020	36.0	5	31.6	21.4	86.3	78.4	6.5
Feb-2020	1.2	1	35.1	25.7	86.9	75.7	8.7
Mar-2020	0	0	39.1	27.2	86.6	70.2	8.0
<b>Total</b>	<b>1145.4</b>	<b>64</b>					

