

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना

ALL INDIA COORDINATED RESEARCH
PROJECT ON CASHEW

2021

ANNUAL REPORT



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वार्षिक प्रतिवेदन

ANNUAL REPORT

2021

परियोजना समन्वयकर्ता
डा. टी.एन. रविप्रसाद

PROJECT COORDINATOR
Dr. T.N. RAVIPRASAD



काजू अनुसंधान निदेशालय

पुत्तूर - 574 202, दक्षिण कन्नड, कर्नाटक

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

CONTENTS

प्राक्कथन		05
ABOUT THIS REPORT		06
INTRODUCTION		07

CHAPTER- I : TECHNICAL

1.	परियोजना समन्वयकर्ता की रिपोर्ट	09
2.	Project Coordinator's Report	12
3.	AICRP Cashew Centres	14
4.	Executive Summary	15
5.	Report of AGM – 2021 of AICRP-Cashew	17

EXPERIMENTAL RESULTS

I. CROP IMPROVEMENT

Gen.1.	Germplasm collection, conservation, evaluation, characterization and cataloguing	21
Gen.1a	Evaluation of CNSL free germplasm accessions	30
Gen.3.	Varietal Evaluation Trials	
	1. Multilocation trial-III	32
	2. Performance of released varieties (MLT-V)	33
	3. Multilocation trial (MLT – VI)	38
Gen.4.	Hybridization and Selection	41
	Rapid polyclonal hybrid evaluation trial	57
Gen.5.	Characterization of germplasm for cashew apple	59
Gen.6.	Evaluation of promising bold nut, bigger size apple types and high yielding cashew genotypes	62
Gen.7.	Trial on dwarf genotypes in cashew	66

II. CROP MANAGEMENT

Hort.1a.	Nutrient Management for yield maximization in cashew	68
Hort.2.	Fertilizer application in high density cashew plantations	70
Hort.3.	Drip irrigation trial	73
Hort.4.	High density planting - (Observational trial)	76
Expt.2.		
Hort.6.	Intercropping in cashew	78
Hort.7.	Organic management of cashew	88
Hort.8.	Spacing cum fertilizer trial	92

Hort.9.	Evaluation of production potential of newly developed variety Bidhan Jhargram-2 at different spacing	93
Hort.11.	Ultra high density planting in cashew	94
Hort.12.	Pruning response of different cashew varieties	102

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	105
Expt.4 :	Evaluation of Botanicals for the control of Tea Mosquito Bug and other insect pests	122
Ent.2.	Control of cashew stem and root borer	
Expt.2.	Curative control trial	143
Ent.3.	Influence of Biotic and Abiotic factors on the incidence of pest complex in cashew	157
Ent.4.	Screening of germplasm to locate tolerant/ resistant types to major insect pests of the region	175

CHAPTER II : ORGANISATION

1.	General characteristics of Centres of AICRP on Cashew	186
2.	Transfer of Technology	187
3.	Research Publications	202
4.	Staff Position	207
5.	Details of Budgetary provision and expenditure	210
6.	Meteorological data of different centres for the year	212

प्राक्कथन

यह, अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की 37 वीं वार्षिक प्रतिवेदन है। यह प्रतिवेदन में जनवरी – 2021 से दिसम्बर – 2021 तक का शोध परिणाम और अन्य जानकारी को शामिल किया गया है।

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

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

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

[टी.एन. रविप्रसाद]

प्रभारी निदेशक एवं परियोजना समन्वयकर्ता

स्थान : पुत्तूर

दिनांक : 1.1.2022

ABOUT THIS REPORT

This is the thirty seventh 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 January 2021 to December 2021.

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 Arabhavi (Karnataka), Barapani (Meghalaya) and Goa.

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



[TN RAVIPRASAD]

DIRECTOR & PROJECT COORDINATOR (ACTING)

Puttur

Dated : 1.1.2022

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) was started. During the period of XI plan, two new centres were added – one in Paria in Gujarat in 2009 and another in Darisai in Jharkhand in 2010. Further three co-operating centres are also functioning under AICRP-Cashew at Arabhavi, Barapani and Goa since 2009.

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

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

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

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

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

CHAPTER 1: TECHNICAL

परियोजना समन्वयकर्ता की रिपोर्ट

वर्तमान में काजू के अखिल भारतीय समन्वित अनुसंधान परियोजना के चौदह केंद्र काजू उगानेवाले बारह विभिन्न राज्यों में स्थित हैं। इन सभी केंद्रों पर विभिन्न राज्य कृषि विश्वविद्यालयों और आईसीएआर के संस्थानों का प्रशासनीक नियंत्रण होता है। परियोजना का वर्ष 2021 का मूल बजट आबंटन रु. 601.46 लाख (भा.कृ.अ.प. का शेयर) था और कुल व्यय रु. 622.94 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 गुटली गुणवत्तावाले और जैविक और अजैविक तनाव को सहने वाले किस्मों का विकास।
2. विभिन्न कृषि - मौसमी परिस्थितियों में काजू फसल के लिए कृषि प्रौद्योगिकी का मानकीकरण।
3. लागत प्रभावी, दक्ष पीडक एवं रोग प्रबंधन विधियों का विकास।

रिपोर्टाधीन अवधि के दौरान विभिन्न परियोजनाओं से पाये मुख्य निष्कर्ष यहां प्रस्तुत किए गए हैं।

फसल सुधार

कुल 1461 जननद्रव्य किस्मों को विभिन्न केंद्रों में संरक्षण किया गया है। इस साल में 25 नवीन किस्मों को अलग अलग केन्द्रों द्वारा संग्रह किया गया है। जहाँ तक इन किस्मों का मूल्यांकन का सवाल है, इस वर्ष, अलग अलग केन्द्रों द्वारा उपज और उपज के लिए कारण गुणों के आधार पर 92 किस्मों का मूल्यांकन किया गया है। वेंगुर्ला क्षेत्र में, जहाँ सब्जी बनाने में नरम कच्चा बीजों का माँग ज्यादा है, CNSL फ्री किस्मों का अध्ययन जारी है। विमोचित किस्मों का प्रदर्शन का एक अध्ययन में बापट्ला में BPP-4, दारिसाई में BPP-8 और होगलगेरे में उल्लाल-1 सबसे अच्छा प्रदर्शन दिखाया।

संकरण और चयन पर अध्ययन में, विभिन्न केंद्रों पर कुल 125 F1 संतानों का मूल्यांकन किया गया और कई आशाजनक प्रकारों की पहचान की गई। जगदलपुर और माडक्कथरा में प्रत्येक में 8 नए क्रॉस संयोजन विकसित किए गए जिसके परिणामस्वरूप 104 F1 संतानें प्राप्त हुईं। झारग्राम केंद्र में 4 नए क्रॉस कॉम्बिनेशन विकसित किए गए हैं, जिसके परिणामस्वरूप 64 पौधे तैयार किए गए हैं। भुवनेश्वर, माडक्कथरा, वृद्धाचलम और वेंगुर्ला केंद्रों में तेजी से क्लोनल हाइब्रिड मूल्यांकन परीक्षण, जिसका उद्देश्य आशाजनक जर्मप्लाज्म एक्सेशन से वांछनीय लक्षण लाना है,

प्रगति पर है। इसके अलावा, दस केंद्रों में होनहार बोल्ड नट, बड़े आकार के सेब के प्रकार और उच्च उपज देने वाले काजू जीनोटाइप के मूल्यांकन पर परीक्षण प्रगति पर है। काजू में बौने जीनोटाइप पर परीक्षण इस वर्ष के दौरान दस केंद्रों में शुरू होने जा रहा है, जिसके लिए कलम तैयार हो रहे हैं।

फसल प्रबंधन

काजू में उपज बढ़ाने के लिए पोषक तत्व प्रबंधन पर परीक्षण में, खेती का खाद के साथ उर्वरकों की अनुशंसित खुराक, साथ ही में प्रमुख और मामूली पोषक तत्वों को पतियों पर स्प्रे करना भुवनेश्वर और होगलगेरे में सर्वोत्तम परिणाम दिए। ड्रिप सिंचाई परीक्षण में, होगलगेरे केंद्र में 80% संचयी पैन वाष्पीकरण पर सिंचाई सबसे ज्यादा उपयोगी पाई गई। उच्च घनत्व रोपण-अवलोकन परीक्षण में यह पाया गया कि उच्च घनत्व (4m x 4m) में समय के साथ B:C अनुपात घटता गया और सामान्य रोपण व्यवस्था में (8m x 8m) यह अनुपात बढ़ता गया।

बापटला में इंटरक्रॉप गेंदा, दरिसई में टमाटर, झारग्राम में उश्द, चाइना एस्टर कनबर्गी में, माडक्कथरा में अरारोट, परिया में धनिया, वेंगुर्ला केंद्रों में यार्डलॉन्ग बीन ने अन्तराल फसल प्रयोग में उच्चतम शुद्ध रिटर्न दिया। जैविक प्रबंधन परीक्षण में, 100% सारजनक वर्मीकम्पोस्ट और जैव उर्वरक के रूप में देने से बापटला केंद्र में उच्चतम उपज मिली, जबकि 10 किलो खेती का खाद के साथ उर्वरक की अनुशंसित खुराक ने दारिसई, वृद्धाचलम और वेंगुर्ला में उच्चतम लाभ अनुपात दिया। हालांकि, खेती का खाद के रूप में 25% सारजनक + जैविक अवशेषों का पुनर्चक्रण + स्वस्थानी हरी खाद हरी पत्ती खाद + जैव-उर्वरक (200 ग्राम) होगलगेरे में सबसे अच्छा उपचार रहा। इसके अलावा, बापटला, भुवनेश्वर, झारग्राम, माडक्कथरा और वेंगुर्ला केंद्रों में उच्च घनत्व प्लांटिंग पर परीक्षण चल रहा है। वेंगुर्ला केंद्र में 2.5m x 2.5m (S1) अंतर (1.19 टन / हेक्टेयर) और किस्म VRI-3 (0.72 टन / हेक्टेयर) दूसरे वर्ष में बेहतर पाई गई। पांच केंद्रों में विभिन्न किस्मों में छंटाई का प्रतिक्रिया पर परीक्षण शुरू है।

फसल सुरक्षा

जगदलपुर और मडक्कथरा में अन्य कीटनाशकों की तुलना में एल-साइहलोथ्रिन (0.6 मिली/लीटर) छाया मच्छर, गुटली छुदेक, पत्तासुरंगकीट के खिलाफ और वृद्धाचलम में थिक्लोप्रिड (1.5 मिली/ली) अधिक प्रभावी पाया गया। हालांकि, थियोमेथोक्सम (0.2 ग्राम/ली) वेंगुर्ला केंद्र में और पारिया केंद्र में बुप्रोफेज़िन प्रभावी पाया गया। जहां तक वनस्पति विज्ञान का संबंध है, अजरडिक्विन 1% (1 मिली/ली) होगलगेरे और कनबर्गी में प्रभावी पाया गया, धतूरा मेटेल काढ़ा @ 5% जगदलपुर में, नीम के बीज की गिरी का अर्क @ 5% पिलिकोड में, धतूरा बीज का अर्क @ 5% वेंगुर्ला में प्रभावी पाया गया। एडथोडा, धतूरा, विटेक्स, कैलोट्रोपिस और नीम के पत्तों के

संयुक्त अर्क का छिड़काव गैर-लक्षित जीवों के लिए कम से कम विषाक्तता के साथ छाया मच्छर के खिलाफ प्रभावी पाया गया।

जहां तक काजू कांड और जड छेदक का संबंध है, क्लोरोपायरीफॉस (10 मि.ली./ली.) माडक्कथरा, वृद्धाचलम, होगालागेरे और जगदलपुर में प्रभावी पाया गया। हालांकि, बापटला केंद्र में इमिडाक्लोप्रिड (2 मि.ली./ली.) प्रभावी था। वेंगुर्ला केंद्रों में, फिप्रोनिल ने सर्वोत्तम परिणाम दिए।

प्रौद्योगिकी का हस्तांतरण

AICRP के समन्वय केंद्र भी प्रौद्योगिकी गतिविधियों के हस्तांतरण में शामिल हैं और उन्होंने 2021 के दौरान लगभग 3.19 लाख काजू कलमों का उत्पादन किया है जो काजू किसानों, सरकारी और गैर-सरकारी संगठनों को वितरित किए गए हैं। आवश्यक तकनीकी मार्गदर्शन के सहयोग के साथ नवीनतम उत्पादन तकनीकों का प्रसार करने के लिए विभिन्न केंद्रों द्वारा फ्रंटलाइन प्रदर्शन खेती तैयार किए गए हैं। गौरतलब है कि AICRP केंद्रों ने एससीएसपी, टीएसपी और अन्य कार्यक्रमों के तहत काजू की खेती और प्रबंधन प्रथाओं के विभिन्न पहलुओं पर 50 प्रशिक्षण कार्यक्रम आयोजित किए हैं, जिसमें 4000 से अधिक किसानों ने भाग लिया है।

PROJECT CO-ORDINATOR'S REPORT

The AICRP on Cashew has presently fourteen centers, which are located in 12 cashew-growing states of the country and are under the administrative control of different State Agricultural Universities/ ICAR Institutes. The original budget allocation of the project for the year 2021 was Rs. 601.46 lakhs (ICAR Share) and the expenditure was Rs. 622.94 lakhs (ICAR Share).

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

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

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

CROP IMPROVEMENT

The total germplasm accessions conserved at various centers is 1461. A total of 25 new germplasm accessions have been collected by different centers during the year. As for as evaluation of germplasm accessions are concerned, during the year, 92 accessions for yield and yield attributing characters have been evaluated by different centers. The trial on CNSL free accessions is under progress at Vengurle center where tender cashewnuts are in demand for culinary purposes. In the trial on performance of released varieties, BPP-4 at Bapatla, BPP-8 at Darisai, Ullal-1 at Hogalagere were found to be superior.

In the trial on hybridization and selection, a total of 125 F₁ progenies were evaluated at different centers and many promising types are identified. 8 new cross combinations each at Jagdalpur and Madakkathara were developed resulting in 104 F₁ progenies. 4 new cross combinations are developed at Jhargram center resulting in 64 plants. A rapid clonal hybrid evaluation trial which aims at bringing desirable characters from promising germplasm accessions is under progress at Bhubaneswar, Madakkathara, Vridhachalam and Vengurle centers. Further, the trial on evaluation of promising bold nut, bigger size apple types and high yielding cashew genotypes is under progress in ten centers. The trial on dwarf genotypes in cashew is going to be initiated in ten centers during this year for which grafts are getting ready.

CROP MANAGEMENT

In the trial on nutrient management for yield maximization in cashew, recommended dose of fertilizers with FYM and foliar spray of major and minor nutrients gave best results in Bhubaneswar and Hogalagere. In drip irrigation trial, irrigation at 80% cumulative pan evaporation

was found to be the best in Hogalagere center. In the high-density planting – observation trial, it was found that BC ratio goes on decreasing as the years advance in high density (4m x 4 m) and the reverse is true in case of normal planting (8 m x 8m).

The intercrop marigold at Bapatla, Tomato at Darisai, Blackgram at Jhargram, China Aster at Kanabargi, Arrowroot at Madakkathara, Coriander at Paria, Yardlong bean at Vengurle 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 Darisai, Vridhachalam and Vengurle. However, 25 % N as FYM + Recycling of organic residue + *in situ* green manuring green leaf manuring + Bio-fertilizers (200 g) was the best treatment at Hogalagere. Further, the trial on ultra high-density planting is under progress in Bapatla, Bhubaneswar, Jhargram, Madakkathara and Vengurle centers. In Vengurle center, 2.5m x 2.5m (S₁) spacing (1.19 t/ha) and variety VRI-3 (0.72 t/ha) were found to be superior in the second year. The trial on pruning response of different varieties is initiated in five centers.

CROP PROTECTION

L-Cyhalothrin (0.6 ml/litre) was found to be more effective compared to other insecticides against TMB, Shoot tip caterpillar, Apple and nut borer, leaf miner in Jagdalpur and Vridhachalam and Thicloprid (1.5 ml/l) in Madakkathara. However, Thiomethoxam (0.2g/l) was found to be effective in Vengurle centers and Buprofezin in Paria center. As for as botanicals are concerned, Azadirachtin 1% (1 ml/l) was found effective at Hogalagere and Kanabargi, *Datura metel* decoction @ 5 % at Jagdalpur, Neem seed kernel extract @ 5% at Pilicode, *Datura* seed extract @ 5 % at Vengurle, spraying of combined Leaf extracts of *Adathoda*, *Datura*, *Vitex*, *Calotropis* and Neem at Vridhachalam were found effective against TMB with least toxicity to non target organisms.

As for as CSRB is concerned, Chloropyriphos (10ml/l) was found to be effective in Madakkathara, Vridhachalam, Hogalagere and Jagdalpur. However, Imidachloprid (2ml/l) was effective in Bapatla center whereas, Fipronil gave the best results in Vengurle center.

TRANSFER OF TECHNOLOGY

The coordinating centers of AICRP are also involved in transfer of technology activities and have produced about 3.19 lakh cashew grafts during 2021 which were distributed to cashew farmers, government and non-government organizations. Frontline demonstration plots have been laid out by different centres to disseminate the recent production techniques with backup of necessary technical guidance. It is worth mentioning that the Centres of AICRP on Cashew have conducted 50 training programmes on different aspect of cashew cultivation and management practices under SCSP, TSP and other programs in which more than 4000 farmers have participated.

CENTRES OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW



HEADQUARTERS OF AICRP ON CASHEW

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

AICRP on Cashew Centres:

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

EXECUTIVE SUMMARY

The total germplasm accessions conserved at various centers is 1461. A total of 25 new germplasm accessions have been collected by different centers. 92 accessions for yield and yield attributing characters have been evaluated.

In the trial on hybridization and selection, a total of 125 F₁ progenies were evaluated at different centers and many promising types are identified.

In the trial on nutrient management for yield maximization in cashew, recommended dose of fertilizers with FYM and foliar spray of major and minor nutrients gave best results in Bhubaneswar and Hogalagere.

In drip irrigation trial, irrigation at 80% cumulative pan evaporation was found to be the best in Hogalagere center.

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For CSRB management, Chloropyriphos (10ml/l) was found to be effective in Madakkathara, Vridhachalam, Hogalagere and Jagdalpur. However, Imidachloprid (2ml/l) was effective in Bapatla center whereas Fipronil gave the best results in Vengurle center.

Fifty training programmes were conducted by different centers on different aspect of cashew cultivation and management practices under SCSP, TSP and other programs in which more than 4000 farmers have participated.

Production of Planting Material:

A total of 319435 grafts were produced during 2021 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	35000
Bhubaneswar	18500
Hogalagere	3000
Jagdapur	9500
Jhargram	3000
Kanabargi	0
Madakkathara	94133
Paria	0
Pilicode	7500
Vengurle	46060
Vridhachalam	102742
TOTAL	319435

REPORT OF THE ANNUAL GROUP MEETING OF SCIENTISTS OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW - 2021

The Annual Group Meeting (AGM) of Scientists of AICRP on Cashew was organized on a virtual platform during 5th to 6th December 2021. Dr. B.K. Pandey, Asst. Director General (Hort-II), ICAR, New Delhi; Dr. M.R. Dinesh, Former Director, ICAR-IIHR, Bengaluru; Dr. Ravi Bhat, Pr. Scientist, ICAR-CPCRI; Dr. P.S. Bhat, Former Principal Scientist, ICAR-IIHR, Bengaluru; Dr. T.N. Raviprasad, Director (Acting), ICAR-DCR, Puttur, Scientists from ICAR-DCR, Puttur and all the scientists of AICRP on Cashew from different centres had participated in the AGM.

The welcome address was delivered by Dr. T.N. Raviprasad, Director (Acting), ICAR-DCR, Puttur wherein he expressed his gratitude to Dr. A.K. Singh, DDG (Horticulture) – ICAR for his whole hearted support for all the activities of AICRP on Cashew.

The guest of honour of inaugural session Dr. B.K. Pandey, ADG (Hort.-II), ICAR, New Delhi in his address emphasized on how to increase the production and productivity of cashew through effective nutrient management by fertigation, drip irrigation and pest management etc. He also stressed upon proper survey and collection of good germplasm of cashew available in different cashew growing regions of India to avoid the duplication. He opined that organic cashew cultivation is a better option particularly in hilly and tribal regions. He urged upon the AICRP-C scientists not to use the banned pesticides in cashew and requested ICAR-DCR, Puttur to develop and design a template for uniform data presentation by the AICRP-C scientists. As large number of datasets have been generated, a common platform needs to be developed to host this data for easy access by individuals. He also requested cashew scientists to demonstrate and disseminate the developed technologies through KVKs and line departments to reach farmers.

Dr. A. K. Singh, DDG (Hort.) ICAR, New Delhi, Chief Guest of the session appreciated the efforts of scientists for developing technologies on various aspects viz., cashew cultivation, pest and disease management as well as preparation of different value-added products from cashew for the benefit of the farmers. He urged the scientists to identify the need of the country and accordingly develop suitable technologies which are economically viable and cost effective for achieving self-sufficiency in cashew production. He also emphasized on the following points for increasing the production and productivity of cashew in the country.

- a) Development of varieties responsive to climate change
- b) Production and distribution of quality planting material
- c) Good management practices for resource maximization
- d) Scientific management of water and nutrients etc.
- e) Development of apps to solve the problem of pest and diseases
- f) Effective control of pests and diseases by replacing the chemicals with biological means
- g) Proper checking and validation of the technologies
- h) Technologies should be more scientific and time bound
- i) Harnessing the vast knowledge of experts in the field

In his Project Coordinator's report, he highlighted the research activities carried out by the 14 different AICRP-C Centres on various aspects of crop improvement, crop management and crop protection during the last year and highlighted on graft production and extension activities executed by different AICRP centres.

He mentioned that during 2020-21, 25 new accessions have been developed for commercial production in different agro - ecological regions and 1461 accessions are being maintained at different AICRP Cashew centers. Around 92 accessions have been evaluated at various centres for their growth, yield and yield attributing characters. He also informed that a trial on CNSL free accessions is under progress at Vengurle center where tender cashewnuts are in demand for culinary purposes. Under crop management and crop protection trials achievements of different centres were reported with respect to intercrops, high density planting system, nutrient management, organic management, application of botanicals and chemicals. He also highlighted on the extension activities carried out by the different AICRP on Cashew centres including production of about 3.99 lakhs of cashew grafts supplied to the farmers, government and other non-government organizations. He also mentioned that the centres have taken up 50 training programmes on various aspects under TSP, SCSP and other programs wherein around 4000 farmers had participated and thereby disseminating the technologies in various regions. He also expressed his gratitude to the DDG, ADG from ICAR for continuous support, officials of different state universities for sincerely supporting AICRP on Cashew and successfully implementing the technical programme.

Later, the technical session on 'Crop Improvement' was held chaired by Dr. M.R. Dinesh, Former Director, ICAR-IIHR followed by 'Crop Management' session which was chaired by Dr. Ravi Bhat, Principal Scientist, ICAR-CPCRI, Kasaragod. The Crop Protection Session was held on 6th Dec. 2021 which was chaired by Dr. P.S. Bhat, Former Principal Scientist, ICAR-IIHR followed by Interactive Session chaired by Dr. Venkatesh Hubballi, Director, DCCD, Kochi wherein farmers, scientists, processors and officials from other development departments had participated. During the session the problems and suggestions of farmers regarding cashew was also discussed at length.

The Variety Release was chaired by Dr. B.K. Pandey, ADG (Hort.-II), ICAR, New Delhi. A proposal for release of variety JGM-282 (Bonsai Kaju) was received from RRS, Jhargram, West Bengal which was identified as a pruning responsive high yielding cashew variety suitable for high and ultra-high density planting systems. However, due to inconsistency in the yield data, it was suggested that the variety proposal with all necessary data needs to be presented in the interim meeting for further recommendations. The AGM was concluded with the plenary session and with vote of thanks by Dr. Mohana G.S. Principal Scientist and Scientist-in-charge, PC Cell, ICAR-DCR.

EXPERIMENTAL RESULTS

I. CROP IMPROVEMENT

I. CROP IMPROVEMENT

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

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

The objectives of the project are:

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

During the current year, 25 germplasm accessions have been collected by different centres of AICRP on Cashew and are planted in the respective Regional Cashew Field Gene Banks (RCFGBs). The total number of accessions conserved so far is 1498.

Table 1.1 : Cashew germplasm holding in different centres

Centre	No. of accessions		
	Earlier existing	Collected during 2020-21	Existing
East Coast			
Bapatla	111	--	111
Bhubaneswar	114	-	114
Jhargram	168	5	173
Vridhachalam	101	5	106
West Coast			
Goa	104	--	104
Madakkathara	142	6	148
Paria	7	4	11
Pilicode	101	2	103
Vengurla	358	2	360
Plains tract/others			
Darisai	25	1	26
Hogalagere	104	--	104
Jagdalpur	76	--	76
Kanabargi	3	--	3
Tura	59	--	59
Total	1473	25	1498

DARISAI

Among the evaluated germplasm, three accessions DSI-107 (5.84 Kg nut /plant), DSI-109 (5.58 Kg nut /plant) & DSI-103 (5.44 Kg nut / plant) were identified for higher nut yield. Mean nut weight was recorded maximum in accession DSI-107 (8.51 g), followed by accession DSI-114 (8.32 g) and DSI-111 (8.14 g), the cumulative yield was maximum in accession DSI-107 (25.47 Kg/plant).

Table 1.2 : Yield parameters of promising cashew germplasm at ZRS, Darisai, E. Singhbhum, BAU, Ranchi Centre during the year 2021

Accession	Year of planting	Nut /Bearing	Duration of flowering (days)	No. of flowering laterals /m ²	Nut wt. (g)	Apple wt (g)	Nut yield 6 th Year (kg/tree)	Cumulative Yield (kg/plant) of six harvests
DSI 101	2012	Bold nut	108.61	20.32	7.82	67.95	5.02	21.89
DSI 102	2012	Bold nut	112.14	24.83	7.21	56.45	4.78	21.90
DSI 103	2012	Cluster bearing	147.39	20.17	6.16	44.92	5.44	23.94
DSI 104	2012	Bold nut	111.87	15.36	7.31	69.25	4.08	18.24
DSI 105	2012	Bold nut	92.05	30.19	7.22	48.19	5.21	22.85
DSI 106	2012	Bold nut	96.71	38.47	8.12	57.20	4.84	21.59
DSI 107	2012	Bold nut	151.77	40.76	8.51	31.78	5.84	25.47
DSI 108	2013	Bold nut	92.79	20.67	7.02	39.92	4.12	18.35
DSI 109	2013	Bold nut	115.47	31.44	8.14	47.14	5.58	23.8
DSI 110	2013	Bold nut	135.78	36.02	7.87	36.56	3.65	15.21
DSI 111	2014	Bold nut	105.42	27.79	8.14	73.74	4.69	19.34
DSI 112	2014	Bold nut	124.14	22.09	7.69	34.51	5.17	22.52
DSI 113	2015	Bold nut	104.18	17.39	8.16	56.06	4.65	21.31
DSI 114	2015	Bold nut	113.72	11.09	8.32	48.50	4.74	20.53
DSI 115	2015	Bold nut	110.92	18.16	7.53	31.60	3.51	17.6
DSI 201	2016	Medium & Cluster bearing	95.50	9.72	5.61	34.03	0.96	2.44
DSI 202	2017	Medium & Cluster bearing	87.68	8.53	5.22	37.34	0.91	2.32

GOA

Germplasm collection and maintenance: A field Germplasm bank having 88 germplasm Accessions representing the following groups is maintained.

- Jumbo nut types : 10 accessions
- Bold „ „ : 40 accessions,
- Medium nut and high yielders : 13 accessions
- High yielders / cluster bearers irrespective of nut size : 23 accessions
- Dwarf canopy types : 2 accessions

Total germplasm collection: 88 accessions

Addition of new germplasm accessions: Two accessions *Viz.* Arla Keri-1 and Barsem-2, identified earlier for their cluster bearing habit, were clonally collected for adding to the Field Germplasm bank.

HOGALAGERE

Yield parameters of accessions planted in 2014 revealed that cashew apple weight ranged from 28.7g to 65.3 g, nut weight ranged from 5.5g to 10.3g, kernel weight ranged from 1.48g to 2.96g, shelling percentage ranged from 24.9% to 31.1% and that of the nut yield per tree ranged from 2.7 kg to 8.6 kgs. The highest cashew apple weight was recorded in HREC-30 (65.3g), the highest nut weight was noticed in HREC-11 (10.3g), the highest kernel weight was recorded in HREC-49 (2.75g), shelling percentage was high in HREC-51 (31.1%) and the higher yield was recorded in HREC-11 (8.6 kg/tree).

Yield parameters of accessions planted in 2016 revealed that cashew apple weight ranged from 28.5g to 45.0 g, nut weight ranged from 5.4g to 10.2g, kernel weight ranged from 1.54g to 2.64g, shelling percentage ranged from 22.4% to 32.1% and that of the nut yield per tree ranged from 2.4 kg to 6.1 kgs. The highest cashew apple weight was recorded in HREC-73 (45.0g), the highest nut weight was noticed in HREC-75 (10.2g), the highest kernel weight was recorded in HREC-53 (2.64g), shelling percentage was high in HREC-57 (32.1%) and the higher yield was recorded in HREC-86 (6.1 kg/tree).



Bearing cashew trees



Cashew apple Chintamani-1 var

Table 1.3 : Yield parameters of germplasm accessions - 2021 (DoP- 25-09-2014)

Sl. No.	Accession No.	Apple weight (g)	Nut weight (g)	Kernel weight (g)	Shelling (%)	Nut yield (Kg/tree)
1	HREC-1	36.0	6	1.73	27	4.1
2	HREC-2	51.2	6.6	1.9	28.5	5.1
3	HREC-3	35.1	6.3	1.8	27.5	4.6
4	HREC-4	30.2	6.2	1.74	27.2	4.2
5	HREC-5	34.8	7.9	2.37	30.7	6.9
6	HREC-6	28.7	7.4	2.12	29.9	6.4
7	HREC-7	35.5	6.3	1.77	27.3	4.3

8	HREC-8	37.1	6	1.63	26.9	3.7
9	HREC-9	42.6	6.2	1.75	27.2	4.3
10	HREC-10	28.8	8.9	2.39	30.8	7.0
11	HREC-11	56.2	10.3	2.56	24.9	8.6
12	HREC-12	52.9	6.5	1.84	27.7	4.8
13	HREC-13	33.7	7.2	1.99	29	6.0
14	HREC-14	58.4	6.5	1.84	28.3	5.3
15	HREC-15	40.4	7.7	2.24	28.9	6.1
16	HREC-16	28.7	6.6	1.88	28.3	5.1
17	HREC-17	37.0	6	1.67	27	3.8
18	HREC-18	42.3	7	1.97	28.9	5.8
19	HREC-20	32.5	7.2	2	29.1	6.1
20	HREC-21	39.0	7.2	1.99	29.1	6.0
21	HREC-22	61.6	6.2	1.76	27.3	4.3
22	HREC-23	32.8	6.4	1.8	27.6	4.8
23	HREC-24	36.0	6.7	1.91	28.5	5.2
24	HREC-25	36.2	5.8	1.52	26	3.0
25	HREC-26	32.2	6.8	1.94	28.7	5.3
26	HREC-27	43.4	7.7	2.18	30.4	6.5
27	HREC-28	56.1	6.8	1.96	28.8	5.5
28	HREC-29	32.4	7.3	2.18	29.7	5.9
29	HREC-30	65.3	6.3	1.77	27.4	4.4
30	HREC-31	42.7	7.8	2.24	30.5	6.7
31	HREC-32	33.3	6	1.63	26.7	3.5
32	HREC-33	40.4	5.9	1.56	26.7	3.5
33	HREC-35	42.8	6.5	1.86	28	5.1
34	HREC-36	37.4	6	1.66	27	3.8
35	HREC-38	33.8	6.5	1.85	27.8	5.0
36	HREC-39	40.1	5.7	1.51	25.9	2.9
37	HREC-40	35.6	6.3	1.79	27.4	4.5
38	HREC-41	30.2	7.2	1.98	28.9	6.0
39	HREC-42	42.9	5.9	1.73	29.4	6.7
40	HREC-43	35.1	6.2	1.76	27.3	4.3
41	HREC-44	31.9	5.7	1.52	26.7	6.5
42	HREC-45	31.0	7.3	2.07	29.7	6.3
43	HREC-46	61.0	5.5	1.48	25.7	2.7
44	HREC-49	38.9	7.3	2.75	29.7	6.3
45	HREC-51	42.3	9.8	2.06	31.1	7.2

Table 1.4 : Yield parameters of germplasm accessions - 2021 (DoP- 05-12-2016)

Sl. No.	Accession No.	Apple weight (g)	Nut weight (g)	Kernel weight (g)	Shelling (%)	Nut yield (Kg/tree)
1	HREC-52	32.1	7.6	2.19	28.8	4.0
2	HREC-53	34.6	9.4	2.64	28.1	4.0
3	HREC-54	33.1	5.4	1.69	31.3	4.3
4	HREC-55	44.4	7.7	1.93	25.1	2.4
5	HREC-56	35.9	8.8	2.21	25.1	2.7

6	HREC-57	29.6	6.1	1.96	32.1	4.2
7	HREC-58	40.9	7.1	1.59	22.4	3.1
8	HREC-59	41.3	6.4	1.74	27.2	3.8
9	HREC-60	34.9	7.6	2.23	29.3	3.5
10	HREC-61	43.9	7.6	2.18	28.7	3.2
11	HREC-63	43.7	5.9	1.69	28.6	2.9
12	HREC-64	42.9	6.4	1.79	28.0	3.4
13	HREC-65	30.8	5.6	1.69	30.2	3.8
14	HREC-66	39.9	7.3	2.10	28.8	3.0
15	HREC-67	32.2	7.1	1.97	28.9	5.9
16	HREC-68	39.2	7.9	2.06	26.1	2.5
17	HREC-69	34.7	6.3	1.87	29.7	3.9
18	HREC-70	41.6	6.9	1.97	28.8	5.6
19	HREC-71	38.7	6.5	1.54	23.7	3.7
20	HREC-72	30.9	7.3	2.27	31.1	2.7
21	HREC-73	45.0	6.9	1.84	26.7	2.9
22	HREC-74	32.1	6.2	1.73	27.9	2.9
23	HREC-75	44.0	10.2	1.78	27.4	3.9
24	HREC-76	33.7	6.6	2.04	30.9	3.5
25	HREC-77	37.8	6.5	1.97	30.3	3.1
26	HREC-78	29.2	7.0	2.23	31.9	3.0
27	HREC-79	36.3	6.3	1.85	29.4	3.1
28	HREC-80	35.4	6.5	1.89	29.1	3.5
29	HREC-82	38.0	6.0	1.57	26.2	3.7
30	HREC-83	42.2	6.8	1.91	28.1	3.3
31	HREC-84	28.5	6.1	1.76	28.9	3.5
32	HREC-85	32.6	6.7	1.88	28.1	2.9
33	HREC-86	35.7	7.3	2.05	29.4	6.1
34	HREC-88	38.8	6.8	1.99	29.3	3.1
35	HREC-89	30.6	6.4	1.75	27.3	3.1
36	HREC-90	34.0	7.1	1.95	27.5	3.3
37	HREC-91	40.6	6.0	1.61	26.8	2.8
38	HREC-92	38.7	6.1	1.63	26.7	4.1
39	HREC-93	33.4	7.2	1.92	26.7	3.8
40	HREC-94	44.8	6.5	1.74	26.8	3.4
41	HREC-95	36.5	6.4	1.70	26.6	3.0
42	HREC-96	39.8	6.0	1.70	28.3	3.1

JAGDALPUR

The trial has been initiated during August 2018 with 16 germplasm and rest of the germplasm were planted during 2019. The data revealed that, maximum plant height was observed in genotype CARS-18 (2.64 m) followed by CARS-13 (2.42). The canopy spread in North-South as well as East-West directions (2.64 and 2.71 m) were reported maximum in genotype CARS-13. Incidence of TMB reported very high in CARS-14.

JHARGRAM

During the year, collected the seeds of *Semecarpus anacardium* from the Ayodhya hills of Purulia district and seedlings were planted at the station.

Table 1.5 : Growth parameters of cashew germplasm at Jhargram centre during the year 2021

Sl. No.	Accession	Year of planting	Mean tree ht. (m)	Mean stem girth (cm)	Mean canopy spread (m)		Mean canopy area (m ²)	No. of laterals / m ²
					E-W	N-S		
1	JGM- 367	2018	2.78	28.50	3.35	3.35	14.99	7.56
2	JGM- 368	2018	2.90	30.00	3.25	2.75	14.35	7.13
3	JGM-394	2019	0.75	9.00	0.60	0.63	0.88	--
4	JGM- 395	2019	1.42	10.67	1.00	0.97	1.67	7.75

Table 1.6 : Reproductive parameters of cashew germplasm at Jhargram Centre during the year 2021

Sl. No.	Accession	Year of planting	No. of flowering laterals / m ²	Nuts/ m ²	Mean no. of nuts/ panicle	Nut wt (g)	Apple wt. (g)	Shelling %	Annual nut yield (kg/tree)
1	JGM- 367	2018	9.50	10.50	4.50	6.40	56.5	26.56	1.07
2	JGM- 368	2018	9.63	16.75	4.75	4.25	50.4	34.66	0.86
3	JGM-394	2019	--	--	--	--	--	--	--
4	JGM- 395	2019	8.75	0.00	0.00	0.00	--	0.00	0.00

Tables represent the growth and yield attributes of different cashew germplasm planted at Jhargram Centre during 2018 and 2019.

MADAKKATHARA

During the year 2021, survey was conducted in Iritty block of Kannur and Anchal block of Kollam districts of Kerala. Two bold nut genotypes were identified from the farmers fields of Kannur district. A local germplasm accession with purple-coloured nuts was also identified for evaluation. The special features of germplasm accessions identified for evaluation during 2021 are presented in Table. In addition to this, seeds of semi tall cashew genotypes were also collected from Goa for analyzing the growth habit of seedling population.

Table 1.7 : Characters of germplasm surveyed at CRS, Madakkathara during 2021

Sl. No.	Collection name	Apple colour	Nut Colour	Nut Weight (g)	Kernel Weight (g)	Special features
1.	Chadanakampara, Kannur	Red	Buff	10.09	2.57	Bold nut, Bunch bearing
2.	Peratta 1, Kannur	Orange red	Buff	10.17	3.01	Bold nut
3.	Peratta 2, Kannur	Yellow	Purple	6.40	2.17	Purple coloured nuts

Germplasm evaluation

The six cashew germplasm accessions planted during 2013 were evaluated for yield traits during 2021. Yield attributing traits of six cashew germplasm accessions are presented in Table. Accession CRS 169 recorded the highest nut weight (9.96g) and kernel weight (3.23g). The highest shelling percentage was recorded in the accession CRS 168 (36.79 %).

Table 1.8 : Yield parameters of cashew germplasm accessions evaluated at Madakkathara centre during 2021

Accession no.	Apple wt. (g)	Nut wt. (g)	Kernel wt. (g)	Shelling %	Yield (kg/tree)
CRS 162	60.71	8.85	1.89	21.35	3.53
CRS 163	55.23	6.67	1.60	23.98	2.92
CRS 166	141.16	9.04	2.13	23.56	2.71
CRS 168	65.20	7.12	2.62	36.79	2.61
CRS 169	72.95	9.96	3.23	32.43	3.23
CRS 170	61.24	7.16	2.48	34.63	2.60

PARIA

During the fruiting season of 2021, four cashew germplasm accessions were collected. The salient features of the four newly collected germplasm accessions are presented in Table.

Table 1.9 : Salient features of the four newly collected germplasm accessions

Sr. No.	Accession No.	Age of tree	Av.nut wt. (gm)	Av. apple wt. (gm)	Apple colour	Av. nut yield (kg/plant)	Special features
1	NCA-1	10	9.4	128.2	Yellow	5.57	Bold nut and early
2	NCA-2	10	4.4	40.8	Yellow	3.47	Small nut
3	NCA-3	10	3.6	25	Yellow	2.86	Small nut
4	NCA-4	10	5.2	77	Red	0.77	Small nut

PILICODE

The evaluated germplasm accessions showed significant differences in height, spread in both NS and EW directions and canopy area. Girth of the plants did not show any difference.

Table 1.10 : Biometric observations on the germplasm planted in 2017 (2020-21)

Germplasm	Height (m)	Girth (m)	Spread (EW)	Spread (NS)	Canopy Area (m ²)
PLD 83 (Thattukunnu)	2.34	0.25	2.34	2.33	21.16

PLD 84 (Mannamkund)	1.97	0.19	1.63	1.68	11.91
PLD 85 (Valiyanadan)	2.24	0.24	1.54	1.55	11.94
PLD 86 (Kanakakkunnu)	1.24	0.24	0.85	0.94	4.08
PLD 87 (Ponmalapallinadan)	2.45	0.21	2.17	2.09	19.66
PLD 88 (Kodolipram)	2.40	0.16	1.73	1.84	14.69
PLD 89 (PA-6)	1.59	0.15	1.22	1.38	7.81
PLD 90 (AY-M1)	2.06	0.20	1.45	1.47	9.03
PLD 91 (MCP- New)	2.14	0.16	1.20	1.23	7.56

TURA

During 2021, collection of scions and grafting of identified two early bearing and one bold seeded cashew genotype has been undertaken.



VENGURLE

Growth observations of 23 accessions were recorded during the year 2021. Among them, the maximum height (5.37 m), stem girth of 62.33 cm, EW canopy spread (5.87 m), NS canopy spread (6.33 m) and canopy area (30.52 m²) was recorded in RFRS 195.

Twelve cashew accessions planted during 2016 to 2020 are small and yet to start flowering. Among the 11 types, the maximum flowering duration (125.2 days) was recorded in RFRS 195. The maximum number of laterals (29.0/m²) and number of nuts per panicle (3.3) were noted in RFRS

196. RFRS 198 recorded the highest sex ratio (0.20). Whereas, the maximum number of nuts (19.0/m²) were observed in RFRS 200.

Yield attributing data of 11 cashew germplasm showed that RFRS 197 had the maximum nut weight (12.50 g) and apple weight (89.00 g). The highest shelling percentage (33.50%) was recorded in RFRS 195. The maximum annual nut yield (10.93 kg/tree) and cumulative nut yield at 8 harvests (36.565 kg/tree) was observed in RFRS 195 for the year 2020-21.



Germplasm accession collected during the year 2021

Table 1.11 : Yield parameters of promising cashew germplasm at Vengurla centre during the year 2021

Accession No.	Nut wt. (g)	Apple wt. (g)	Shelling (%)	Annual nut yield (kg/tree)	Cum. yield (kg/tree)
RFRS 195	6.00	57.50	33.50	10.930	36.565*
RFRS 196	7.20	62.00	28.60	2.150	3.400**
RFRS 197	12.50	89.00	28.10	1.130	2.380**
RFRS 198	7.70	53.00	30.10	1.720	2.527**
RFRS 200	10.00	50.00	27.50	1.260	1.260
RFRS 201	12.00	63.00	26.00	1.510	1.510
RFRS 202	8.40	70.00	29.20	0.780	0.780
RFRS 203	9.00	70.00	28.00	0.450	0.450
RFRS 204	10.00	62.00	29.00	0.290	0.290
RFRS 207	7.50	80.00	30.20	0.390	0.390
RFRS 208	7.00	72.00	29.30	0.210	0.210

*Cum. yield for 8 harvests, ** Cum. yield for 5 harvests and *** Cum. yield for 1 harvest

VRIDHACHALAM

Five germplasm accessions were collected from 5 villages of Cuddalore and Ariyalur districts viz, Kotteri, Veerarettikuppam Pudukoorapettai, Kachirayanattham and Thavadanallur for promising nut and apple characters and included in the germplasm conservation.

Gen 1a : Evaluation of CNSL free germplasm accessions

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

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

Experimental details

Number of genotypes : 6 (NRC-116, NRC-188, NRC-189, NRC-281, NRC-285, RFRS-195)
No. of replications : 4
Spacing : 5 x 5m

HOGALAGERE

Land preparation and experimental lay out has been prepared for planting. Also, requisition for scion sticks of different cashew varieties for this new experiment has been made and is being followed up for procurement of the material and raising of cashew grafts for the experiment.

MADAKKATHARA

Scion sticks of RFRS-195 were collected from Vengurla and grafting was done. The grafts of two genotypes with low CNSL content and variety Mridula were developed and maintained in the nursery. The grafts of remaining genotypes are waited for planting in the field.

VENGURLE

The replicated trial of all six CNSL free types were initiated at Vengurla centre during July, 2018. The growth of all experimental grafts is satisfactory. The vegetative growth observations for the year 2020-21 were recorded. The data showed significant results for all growth attributes except height.

Table 1.12 : Vegetative parameters of CNSL free cashew accessions at Vengurla centre during the year 2021

Treat. No.	Name of the cashew type	Height (m)	Stem girth (cm)	Canopy spread (m)		Mean spread (m)
				E-W	N-S	
T ₁	NRC-116	0.94	7.50	0.82	0.67	0.75
T ₂	NRC-188	1.11	10.12	1.06	1.10	1.08
T ₃	NRC-189	1.04	10.33	1.00	0.92	0.96
T ₄	NRC-281	1.00	10.25	1.12	1.07	1.09
T ₅	NRC-285	0.75	7.08	0.59	0.64	0.62
T ₆	RFRS-195	1.15	10.83	1.19	1.22	1.21
SEm ±		0.08	0.78	0.06	0.08	0.07
CD at 5%		N.S.	2.35	0.20	0.25	0.21
CV		16.57	16.66	13.51	17.95	15.00

VRIDHACHALAM

The scion sticks of RFRS-195 were collected and grafted. The scion sticks of NRC-5 types (NRC116, NRC188, NRC189, NRC281, NRC285) will be collected and planting will be taken up.

Gen.3. Expt.1. Multi Location Trial – III**Centres: 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

Yield parameters of accessions during 2021 revealed that cashew apple weight ranged from 32.5g to 74.0 g, nut weight ranged from 5.1g to 8.5g, kernel weight ranged from 1.5g to 2.6g, shelling percentage ranged from 28.2% to 31.7% and that of the nut yield per tree ranged from 2.5 kg to 4.0 kgs. The highest cashew apple weight was recorded in H-1597 (74.0g), the highest nut weight was noticed in BH-6 (8.5g), the highest kernel weight was recorded in BH-6 (2.6g), shelling percentage was high in H-14 (31.7%) and the higher yield was recorded in H-32/4 (4.0 kg/tree).

Table 1.13 : Yield parameters of cashew genotypes in MLT-III-2021 (DoP- 08-12-2016)

Sl. No.	Variety	Apple weight (g)	Nut weight (g)	Kernel weight (g)	Shelling (%)	Nut yield (Kg/tree)
01	BH 6	65.7	8.5	2.6	31.1	3.76
02	BH 85	68.1	7.6	2.3	30.9	2.83
03	H 1597	74.0	7.3	2.3	31.0	3.08
04	K 22-1	60.0	5.6	1.7	30.9	3.26
05	H 662	48.0	7.8	2.2	28.4	3.92
06	H 675	39.5	5.1	1.6	31.0	3.12
07	H 11	39.7	5.3	1.5	28.2	2.87
08	H 14	43.4	5.8	1.8	31.7	3.15
09	H 32/4	59.7	8.1	2.6	31.6	4.00
10	C-1	32.5	7.1	2.2	30.8	3.84
11	C-2	63.6	7.8	2.4	30.3	2.53
	SEm ±	3.73	0.40	0.10	1.45	0.25
	CD at 5%	11.02	1.17	0.29	4.28	0.73
	CV %	12.38	9.79	7.79	7.98	7.42

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

Centres: East Coast :

Bapatla

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

Results:

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
NRCC Puttur	2	NRCC sel-2, Bhaskara
Tamilnadu	1	VRI-3
Goa	1	Goa-1
Total	25	

Among the 25 released varieties of different centers of India evaluated, there was significant difference observed with respect to mean plant height, canopy height and stem girth. The mean plant height was recorded highest in Ullal-3 (3.94m) followed by Vengurla (3.78m) and Bhaskara (3.63m). Highest mean canopy height was noticed in Ullal-3 (3.58m) followed by Vengurla-4 (3.41) and BPP-6 (3.11 m). The mean trunk girth was recorded highest in Ullal-3 (49.83cm) followed by Vengurla-6 (49.17cm) and BPP-6 (48.67cm). The mean canopy spread was recorded maximum in Ullal-3 (5.13 m) followed by Ullal-4 (5.04 m) and NRCC Sel-2 (4.88 m) and canopy surface area was recorded maximum in Ullal 1 (21.20m²) followed by Goa-1 (19.50 m²) and Ullal-4 (19.40m²).

Among the 25 genotypes studied, the duration of flowering ranged from 88.0 days to 106.0 days. The shortest flowering duration was recorded in Kanaka (88.0 days) followed by UN-50 (90.0 days), Madakathara-1 and BPP-4 (91.0 days).



Fig : Different Varieties of Cashew under MLT –V at CRS Bapatla centre

Table 1.14 : Yield parameters of cashew genotypes in MLT-V at Bapatla Centre

Sl. No.	Variety	Nut weight (g)	Apple weight (g)	Shelling (%)	Nut Yield /tree (kg) (Harvest No.4) 2021	Cum.nut yield (kg/tree) (for 4 Harvests) 2018-21
1.	BPP 4	6.32	47.33	29.66	4.89	16.07
2.	BPP 6	6.04	42.50	28.62	3.07	8.94
3.	BPP 8	7.74	67.00	29.56	4.80	16.01
4.	BBSR -1	5.43	44.47	31.00	2.96	8.89
5.	CHINTAMANI-1	5.93	36.33	28.67	2.07	7.56
6.	JHARGRAM-1	5.43	46.83	29.40	2.13	7.74
7.	MADAKATHARA-1	6.04	43.80	30.30	4.54	10.78
8.	MADAKATHARA-2	6.37	44.67	30.37	3.48	11.72
9.	K-22-1	7.35	52.17	29.88	2.83	11.17
10.	DHANA	7.35	51.50	27.70	2.50	9.67
11.	KANAKA	6.30	65.07	28.00	2.15	10.32
12.	PRIYANKA	9.80	82.33	28.25	2.40	8.64
13.	AMRUTHA	7.02	63.87	30.03	2.27	7.62
14.	VENGURLA -1	6.09	61.23	29.23	3.93	11.05
15.	VENGURLA -4	7.24	56.63	30.65	2.63	9.24
16.	VENGURLA -6	7.54	55.07	30.25	2.28	7.41
17.	VENGURLA -7	8.48	56.63	30.05	2.35	8.88
18.	VRI-3	6.87	50.50	29.09	2.62	10.17
19.	NRCC SEL 2	7.61	61.73	29.14	2.92	9.59
20.	ULLAL 1	4.60	34.60	29.37	3.52	12.14
21.	ULLAL 3	6.33	47.47	30.08	3.80	10.03
22.	ULLAL 4	5.75	43.00	29.57	2.57	6.95
23.	UN 50	7.44	60.50	29.79	2.78	8.25
24.	GOA 1	7.00	66.13	31.10	3.31	9.49
25.	BHASKARA	5.75	50.80	28.78	4.27	10.72
	CD@5%	0.61	3.93	2.05	1.75	
	SEm ±	0.21	1.95	0.72	0.61	

The mean nut weight, mean apple weight, shelling percentage and mean annual nut yield per tree were found to be significant. Among the 25 released varieties, the mean nut weight was found maximum in Priyanka (9.80 g) followed by Vengurla 7 (8.48g) and BPP-8 (7.74g). The

maximum mean annual nut yield per tree during the year was recorded in BPP-4 (4.89 kg) followed by BPP 8 (4.80 kg) and Madakathara-1 (4.54 kg). With regard to the mean apple weight, the highest was recorded in Priyanka (82.33 g) followed by BPP-8 (67.00 g). The shelling percentage was recorded highest in Goa-1 (31.10) followed by BBSR -1 (31.00).

DARISAI

The cumulative yield of variety BPP-8 (26.75 Kg/plant) on the basis of six harvests recorded maximum yield, which was statistically on par with BPP-6 (25.28 Kg/plant) and VRI-3 (24.39 Kg/plant). Duration of flowering ranged from 152.14 days in K22-1 to 97.30 days in VRI-3. Mean apple weight recorded (94.30 g) in K22-1 to 36.05g in BPP-4. Mean nut weight was highest in Priyanka (9.67 g) followed by Kanaka (9.04 g).

Table 1.15 : Yield parameters of cashew genotypes in MLT-V at ZRS, Darisai, E. Singhbhum, BAU, Ranchi Centre during the year 2020-21

Accession	Year of planting	Nut wt. (g)	Apple wt. (g)	No. of laterals /m ²	Duration of Flowering (days)	Yield (kg/tree) 6 th Harvest	Cumulative Yield (Six Harvests)
BH6	2011	7.53	62.56	29.03	114.88	4.81	21.99
BH85	2011	7.31	52.91	18.60	128.25	4.39	18.46
H1597	2011	7.78	56.12	30.78	108.82	5.05	22.84
H662	2011	7.27	63.82	23.89	106.95	4.43	20.20
H675	2011	5.12	57.56	16.77	116.86	5.03	20.95
H11	2011	5.58	62.07	21.18	144.47	5.17	22.67
H14	2011	5.15	56.61	19.50	105.89	5.77	23.06
H32/4	2011	6.81	54.41	18.62	99.74	4.63	20.39
GOA11/6	2011	6.23	64.94	14.52	134.10	3.17	15.15
BPP-4	2011	6.76	36.05	22.31	104.77	3.93	19.10
BPP-6	2012	6.23	37.69	31.72	111.17	5.56	25.28
BPP-8	2012	8.22	61.70	41.50	130.94	6.09	26.75
DHANA	2012	8.48	60.08	37.84	129.78	3.39	19.08
MADAKKATHRA-1	2012	7.82	38.11	14.34	103.09	2.60	11.66
MADAKKATHRA-2	2012	7.60	43.25	12.52	127.19	2.10	11.50
KANAKA	2012	9.04	49.87	22.91	132.00	3.90	18.55
VENGURLA-1	2012	8.65	54.87	20.32	109.62	3.27	16.46
PRIYANKA	2012	9.67	69.58	34.35	103.63	3.61	19.04
ULLAL-1	2013	7.60	37.75	17.10	148.76	1.77	11.83
GOA-1	2013	7.47	46.01	17.51	132.65	3.53	15.60
BHASKAR	2013	8.43	43.76	18.74	142.23	3.50	16.28
VRI-3	2013	6.47	54.59	43.01	97.30	5.23	24.39

K22-1	2013	8.49	94.30	16.28	152.14	2.74	13.59
JHARGRAM-2	2014	5.82	43.15	18.17	110.28	3.45	15.23
SEm _±		1.37	11.76	3.02	4.61	0.45	0.96
CD (5%)		4.08	32.23	8.89	13.28	1.31	2.61
CV (%)		15.18	15.49	13.73	16.14	14.36	13.87

HOGALAGERE

Yield parameters of accessions revealed that cashew apple weight ranged from 33.3g to 84.3 g, nut weight ranged from 5g to 10g, kernel weight ranged from 1.3g to 2.9g, shelling percentage ranged from 26.5% to 34.1% and that of the nut yield per tree ranged from 3.2 kg to 8.4 kgs). The highest cashew apple weight (84.3kg), highest nut weight (10g) and highest kernel weight (2.9g) was recorded in Priyanka. Shelling percentage was high in Madakkathara-2 (34.1%) and the higher yield was recorded in Ullal-3 (8.4 kg/tree).

Table 1.16 : Yield parameters of of cashew genotypes in MLT-V-2021 (DoP-02-01-2015) at Hogalagere

Sl. No.	Variety	Apple weight (g)	Nut weight (g)	Kernel weight (g)	Shelling (%)	Annual nut yield (Kg/tree)
01	Chintamani-1	33.3	7.2	2.2	30.5	7.1
02	Madakathara-1	39.0	6.1	1.9	30.5	3.6
03	Vengurla-1	47.6	6.6	2.1	32.2	4.9
04	Priyanka	84.3	10.0	2.9	29.0	7.0
05	Goa-1	53.8	6.8	2.3	33.7	3.2
06	Bhaskara	51.3	6.8	2.0	30.1	5.3
07	Ullal-3	45.4	7.6	2.4	31.0	8.4
08	BPP-6	58.3	5.1	1.5	30.3	6.0
09	Madakkathara-2	60.0	6.4	2.2	34.1	6.2
10	Vengurla-6	44.7	6.6	2.0	30.1	4.6
11	Vengurla-7	57.1	8.0	2.6	32.6	7.5
12	k-22-1	49.3	6.6	2.0	30.0	3.7
13	NRCC-sel-2	55.6	7.7	2.4	31.2	4.5
14	Ullal-1	46.4	6.6	1.9	28.8	6.2
15	Ullal-4	54.2	6.9	2.1	31.0	4.4
16	UN-50	59.9	8.2	2.7	33.3	4.0
17	Kanaka	54.6	7.2	2.2	30.5	5.6
18	Jhargram -1	45.3	5.0	1.3	26.5	4.4
19	chintamani-2	62.5	7.6	2.3	30.3	4.8
20	Amrutha-10	57.5	7.5	2.2	28.9	3.7
21	VRI-3	44.8	6.0	1.8	29.9	6.1
22	BPP-4	49.2	5.8	1.7	29.9	4.9
23	Dhana	50.9	6.8	2.1	30.3	6.5
	SEM _±	1.62	0.16	0.06	0.88	0.15

CD at 5%	4.63	0.46	0.16	2.52	0.43
CV %	5.37	4.07	4.53	5.48	4.87

JAGDALPUR

The trail was laid out during 2018 at SG CARS, Jagdalpur Kumhrawand farm to evaluate the performance of released varieties under Bastar Agro-climatic conditions. There was no significant difference among the varieties for plant height and shelling per cent during 2020-21.

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

The flowering duration ranged in variety BPP-3/28 to NRCC Sel-2 from 107.37 days to 132.99 days. The apple weight of variety H-367 (92.12 gram) was significantly superior to all other variety tested. The nut weight of H-303 recorded the highest nut weight (6.11 gram) followed by BPP-3/28 (5.85 gram) the maximum nut yield was recorded in variety M-15/4 (5.43 kg/plant) followed by 4.93 kg in variety H-68 in sixth harvest. The cumulative yield was also the highest in M-15/4 (23.84 Kg/plant) on the basis of six harvests.

Table 1.17 : Yield parameters of cashew genotypes in MLT-VI at ZRS, Darisai, E. Singhbhum, BAU, Darisai Centre during the year 2020-21

Accession	Year of planting	Flowering duration (days)	Apple wt. (g)	Nut wt.(g)	Nut yield 6 th Year (kg/tree)	Cumulative Nut Yield (kg/plant) of six harvests
NRCC sel-1	2010	115.13	64.80	5.15	3.47	16.98
NRCC sel-2	2010	132.99	59.12	5.77	4.41	21.09
M44/3	2010	110.32	36.60	4.70	4.70	21.71
M15/4	2010	122.48	73.94	5.80	5.43	23.84
BPP3/33	2012	121.18	54.03	5.14	4.07	19.23
BPP10/19	2012	113.63	49.75	4.92	3.55	16.93
BPP30/1	2012	110.88	43.48	5.14	2.80	12.79
BPPP3/28	2012	107.37	64.56	5.85	4.34	18.85
H303	2012	128.52	61.36	6.11	4.47	20.40
H255	2013	126.71	64.08	4.58	4.67	21.89
H367	2013	116.95	92.12	5.30	3.99	19.68
H68	2013	118.55	63.49	4.10	4.93	22.59
SEm _±		4.01	3.63	0.38	0.33	
CD(5%)		10.87	9.56	1.08	0.87	
CV (%)		15.13	15.28	14.94	15.18	

KANABARGI

Year of planting : 2015
 Design : RBD
 Replications : Three
 Spacing : 6 m x 6m
 Number of plant per replication : 5

Varieties/No. of entries : 8

- | | |
|----------------|-------------|
| 1. H 303 | 5. Bhaskara |
| 2 VRI (CW) H-1 | 6. VRI-3 |
| 3 NRCC Sel-2 | 7. Dhana |
| 4 Vengurla 4 | 8. BPP-8 |



Fig : View of the MLT VI

This experiment was initiated during 2015 and vegetative and reproductivity growth characters are recorded.

Table 1.18 : Performance of different varieties of cashew at HRES, Kanabargi

Sl. No.	Treatments	Plant height (m)	Trunk girth (cm)	Trunk height (m)	Canopy height	Canopy diameter (m)	Nut yield (kg/tree)
1	H-303	3.68	59.89	72.00	3.07	4.91	5.29
2	VRI-H-1	3.14	41.08	82.33	2.35	3.14	3.32
3	NRCC-2	3.57	54.19	100.06	2.97	4.14	5.00
4	Vengurla-4	3.74	53.20	104.80	3.30	4.20	4.24
5	Bhaskar	4.16	59.75	95.67	3.78	4.83	5.08
6	VRI-3	3.92	59.38	106.93	3.50	4.48	3.94
7	Dhana	3.55	51.45	97.08	3.15	4.18	4.29
8	BPP-8	3.89	45.60	101.53	3.46	3.79	3.28
	S.Em±	0.14	2.11	5.39	0.15	0.23	0.32
	CD 5%	0.42	6.41	16.36	0.46	0.70	0.96
	CV (%)	6.45	6.90	9.83	8.16	9.52	12.75

TURA**Table 1.19 : Growth attributes of cashew genotypes in MLT-VI at Tura Centre during 2020-21**

Accession	Year of planting	Plant height (m)	Plant spread (m)		Plant survival (%)
			NS	EW	
Dhana	2010	3.56	5.40	5.12	55.0
VRI (CW) H-1	2011	3.95	4.45	4.20	9.00
Bhaskara	2015	5.61	4.71	4.68	40.0
BPP-8	2015	3.67	4.10	4.70	20.0
VRI-3	2015	2.39	3.90	3.70	15.0
Vengurla -9	2015	3.66	3.90	3.70	10.5
V-4	2015	3.10	4.41	4.38	15.0

Gen.4. Hybridization and Selection

Centres: East Coast :	Bapatla, Bhubaneswar, Jhargram and Vridhachalam
West Coast :	Goa, Madakkathara, Pilicode and Vengurla
Plains / others:	Darisai, Hogalagere and Jagdalpur

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, duration of flowering, yield, nut weight etc.



H 491 - Promising F₁ Hybrid at CRS Bapatla

Table 1.20 : Yield parameters of top cashew accessions 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) 5 th harvest (2021)	Cum. yield (kg/tree) (for five Harvests) 2017-2021
H 701	Kankady x BLA39/4	4.51	56.10	26.86	4.50	17.10
H 705	Kankady x BLA39/4	6.33	70.60	26.94	6.30	13.10
H 706	Kankady x BLA39/4	5.19	27.60	23.77	2.50	13.70
H 710	T.No.10/19xKankady	7.40	62.10	27.20	6.95	14.43
H 716	BPP-8 x Kankady	7.43	42.60	21.59	2.50	13.55
H 719	BPP-8 x Kankady	4.87	42.35	23.04	4.50	13.35

The mean nut weight was recorded highest in H-715 (7.71 g) followed by H-716 (7.43 g). The mean apple weight was found highest in H-721 (76.1 g) followed by H-715 (73.76 g). The shelling percentage was recorded maximum in H-711 (29.8) followed by H-715 (29.26). The mean annual nut

yield was found highest in H-10 (6.95 kg) followed by H-705 (6.30 kg). The cumulative nut yield recorded highest in H-701 (17.10 kg) followed by H-710 (14.43 kg) for five harvests.

BHUBANESWAR

During the fruiting season 2020-21, hybridization, was started with the objective to develop dwarf, bold nut, cluster bearing and high yielding F₁ progenies of cashew. Totally 1875 numbers of hermaphrodite flowers were pollinated in 17 different cross combinations. During the hybridization programme, fruit set ranged from minimum 15.8% to maximum 37.5% in different cross combinations. Total 127 numbers of nuts were harvested and were sown in poly bags for raising seedlings. Out of 127 seed nuts, 112 numbers of nuts were germinated. Germination of nuts varied from as low as 50% to as high as 100% in different cross combinations. The weak and rudimentary seedlings were discarded and finally 104 numbers of seedlings were planted on 18.08.2021 at a spacing of 6m x 6m following Augmented design.

Table 1.21 : Details of hybridization programme at Bhubaneswar Centre, 2020-2021

Sl. No.	Cross combinations	No. of flowers pollinated	No. of nuts harvested	% Fruit set	No. of seeds germinated	% Germination	No. of plants in the main field
1	RP-1 xKGN-1	95	4	31.6	2	50.0	2
2	M44/3xKGN-1	268	20	32.8	17	85.0	16
3	VRI-3 x KGN-1	177	4	23.7	4	100.0	4
4	BPP30/1 x KGN-1	50	5	24.0	5	100.0	5
5	Bhubaneswar 'C'-1xKGN-1	111	6	36.0	4	66.7	3
6	H2/15xKGN-1	200	16	34.0	16	100.0	14
7	BPP-8x KGN-1	234	8	36.3	8	100.0	8
8	V-7x KGN-1	76	2	15.8	2	100.0	2
9	RP-2x KGN-1	56	18	37.5	18	100.0	16
10	NRCC Sel-2xKGN-1	40	5	27.5	5	100.0	5
11	BPT-40xKGN-1	34	3	23.5	3	100.0	2
12	BanjhakusumxVTH-711/4	112	5	32.1	5	100.0	5
13	RP bold nutxVTH711/4	137	6	29.2	5	83.3	5
14	BPP-9 x VTH11/4	42	3	19.0	2	66.7	2
15	OS-5x VTH711/4	163	20	35.0	15	75.0	14
16	BPT-40x VTH-711/4	34	1	29.4	1	100.0	1
17	BT-10x TVH711/4	24	1	29.2	-	50.0	-
	Total	1875	127	-	112	-	104

Evaluation of promising F₁ progenies of cashew

Experimental details:

No. of genotypes	: 15
Design	: RBD
Replication	: 02
Spacing	: 7m x7m
Year of planting	: 2014

Details of genotypes : B-27(BH-27), C-30(BH-30), D-19(BH-19), C2-6(BH2-6), BH-105, Bhubaneswar-1, RP-1, RP-2, M-44/3, Kankadi, VTH-711/4, NRCC Sel.-2, H-320, Dhana and BPP-8

Among the fifteen evaluated cashew genotypes, D-19 (BH-19) recorded maximum for plant height (5.95m), canopy spread (6.45m in East -West direction) and canopy area (33.94 m²) while trunk girth (59.60cm) and canopy spread in North-South direction (6.80m) were recorded maximum in the genotype Dhana. The genotypic mean for plant height, trunk girth, canopy spread (E-W & N-S) and canopy area were 4.42m, 50.53cm, 5.25m, 5.23m and 22.04m² respectively.

The results on flowering and yield attributing parameters revealed significant differences among the evaluated genotypes. Mean duration of flowering was recorded maximum in Bhubaneswar-1 and BPP-8 (60.5 days each). Number of flowering laterals m⁻² was recorded maximum in C2-6 (20.38) while sex ratio was recorded maximum in genotype, M44/3 (0.28). Similarly, nuts m⁻² and mean number of nuts panicle⁻¹ were recorded maximum in genotypes RP-1 (56.37) and RP-2 (12.40) respectively. The genotypic mean for flowering duration (days), number of flowering laterals m⁻², sex ratio, nuts m⁻² and mean number of nuts panicle⁻¹ were recorded 55.23days, 17.55, 0.16, 25.38 and 5.55 respectively.

Yield characters revealed significant differences among the evaluated hybrids. Nut weight was recorded maximum in genotype VTH711/4 (13.75g) while apple weight was maximum in genotypes Kankadi (102.66g). Maximum shelling was recorded in genotype Bhubaneswar-1 (32.69 %). Mean annual nut yield (9.95kg plant⁻¹ at 5th harvest) as well as cumulative nut yield (28.4kg plant⁻¹ for 5th harvests) were recorded maximum in genotype C2-6 (BH2-6) during evaluation.

Table 1.22 : Yield parameters of F₁ progenies of cashew at Bhubaneswar Centre 2021

Hybrid No.	Mean Nut Wt (g)	Apple Wt. (g)	Shelling %	Annual nut yield (kg tree ⁻¹) (at 5 th harvest)	Cum. yield (kg tree ⁻¹) (for 5 harvests)
B-27(BH-27)	8.35	62.90	30.74	6.46	16.94
C-30(BH-30)	6.50	38.75	31.65	7.56	20.48
D-19(BH-19)	8.50	36.10	30.37	8.16	24.64
C2-6(BH2-6)	8.75	51.16	31.38	9.95	28.4
BH-105	7.55	49.65	30.38	7.01	19.82

BBSR-1	6.00	41.45	32.69	6.39	18.75
RP-1	5.25	29.60	30.70	5.96	17.76
RP-2	5.60	36.70	31.28	7.88	21.29
M-44/3	5.60	33.50	29.35	5.10	15.43
Kankadi	12.20	102.66	23.95	0.65	2.83
VTH-711/4	13.75	86.20	30.56	1.05	5.29
NRCC Sel.-2	7.60	56.48	30.56	6.52	16.74
H-320	7.85	47.15	29.70	4.43	10.46
Dhana	7.90	48.90	29.75	7.92	22.27
BPP-8	7.75	57.70	29.60	8.47	22.34
Mean	7.94	51.92	30.17	6.23	-
SEm(±)	0.18	2.00	0.40	0.16	-
CD at 5%	0.56	6.07	1.23	0.50	-
CV (%)	3.32	5.46	1.91	3.79	-

Evaluation of F₁ progenies (Year of planting 2017 and 2018)

Among the evaluated F₁ progenies, A1/17, A-2/18, B-1/18, B-5/18, G-2/18, G-6/18, H-2/18, L-2/18, L-6/18 and O-6/18 were found to be promising with respect to nut weight, shelling % and mean annual nut yield (kg plant⁻¹) at 2nd harvest. Among the F₁ progenies of year 2017 planting, A-1/17 was found to be most promising with respect to nut weight (9.2g), shelling % (30.5) and mean annual nut yield (2.73 kg plant⁻¹) at 2nd harvest. Among the 2018 planted F₁ progenies, B-1 recorded maximum nut weight (11.0g) while mean annual nut yield was recorded maximum in genotype L-6 (2.22 kg plant⁻¹). Similarly, shelling was recorded maximum in F₁ progeny G-2 (35.4%) during evaluation.

Table 1.23 : Yield attributing parameters and nut yield of promising F1 progenies-2020-2021

Hybrid No.	Year of first fruiting	Nuts panicle ⁻¹	Nut weight (g)	Apple weight (g)	Mean annual nut yield (kg plant ⁻¹)	Shelling %
Year of planting 2017						2nd harvest
A-1	2017	8.0	9.2	57.6	2.73	30.5
Year of planting 2018						2nd harvest
A-2	2018	4.0	10.0	42.1	0.65	33.3
B-1		4.0	11.0	42.4	0.51	30.3
B-5		6.0	8.5	60.3	1.74	31.0
G-2		6.0	7.7	31.0	1.31	35.4
G-6		8.0	7.5	43.1	2.09	32.5
H-2		3.0	8.2	47.2	0.81	32.3
L-2		8.5	7.8	45.6	1.15	30.3
L-6		9.0	7.7	42.0	2.22	32.2
O-6		3.0	8.5	34.2	0.55	33.9

Evaluation of promising F₁ progenies (Year of planting 2020)

Experimental details:

No. of genotypes	:	35
Replication	:	2
Design	:	RBD
Spacing	:	6m x 6m
Year of planting	:	2020

This experiment was laid out on 08.08.2020 with the objective to evaluate the performance of 35 numbers of identified F₁ progenies of cashew in replicated trial under standard management practices for future release. The plants are in vegetative stage.

GOA

Crossing and raising of hybrid seedlings: During the current flowering season (January-March 2021), 2763 crosses involving different parental combinations were made. Percent nut set of the crosses varied from 2 (Tiswadi-3 X HYB-31) to 35.71 (8A X Vengurla 4) and a total of 402 crosses resulted in the development and maturity of hybrid seed nuts which were collected and hybrid seedlings were raised.

Table 1.24 : Crosses of different parental combinations for production of hybrid seed nuts

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	13.16
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	18.78
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 Vengurla 4	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
		2763	402	14.55

b. Evaluation of crossed progeny

Among 1st set of crossed progeny, raw nut yield varied from 1.6 kg/tree (HB-13/05) to 20.07 kg/tree (HB-31/05) with mean nut weight and shelling percentage of 7.54g and of 28.2% in the former, and 6.14g nut weight and 31.45% of shelling in the later respectively. Two hybrids viz. HB-21/05 and HB-27/05 continued to record promising performance with nut yield of 7.65kg/tree and 11.37kg/tree with mean nut weight of 8.28g and 7.98g, and per cent shelling of 28.44 and 28.84 respectively.



HB-27/05

In the second set of crossed progeny, seven crossed seedlings started flowering and fruiting of hybrid genotypes namely HB-N2/07, HB-27/07 (Tis.3 X Vengurla-4), HB-28/07 and HB-29/07 which recorded a 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.



HB-27/07 (Tis.3 X Vengurla-4)

Third, fourth and fifth sets of crossed seedling progeny are planted in the field for further evaluation, which are still in different prebearing ages. Observations on initial growth parameters are being recorded.

HOGALAGERE**Details of Hybrids :**

Hybrid No.	Cross Combinations
H-01	Ullal-3 x Kankady 7/6
H-81	Ullal-3 x Vetore-56/1
H-151	NRCC-2 x Vetore-56
H-188	V-5 x Vetore-56
H-191	Ullal-3 x Vetore-56/2
H-2016	2/77-tuni x Vetore-56

Observations of flowering parameters of accessions revealed that, the highest duration of flowering was recorded in H-216 (90 days), highest number of flowering laterals per square was recorded in H-151 (21 laterals), highest number of non flowering laterals per square was recorded in Chintamani-2 and VRI-3 (9 laterals), flowering sex ratio was highest in H-01 and H-151 (0.14) and highest number of nuts per square meter was recorded in H-216 (26.3).

Yield parameters of accessions revealed that cashew apple weight ranged from 59.8g to 78 g, nut weight ranged from 6.5g to 10.5g, kernel weight ranged from 1.85g to 3.13g, shelling percentage ranged from 28.4% to 31.7% and that of the nut yield per tree ranged from 2.97 kg to 3.43 kgs). The highest cashew apple weight was recorded in H-81 (78g), the highest nut weight was noticed in H-81 (10.5g), the highest kernel weight was recorded in H-81 (3.13g), shelling percentage was high in H-191 (31.7%) and the higher yield was recorded in H-01-3 (3.43 kg/tree).

Table 1.25 : Yield parameters of selected cashew F1-Hybrids - 2021 (DoP- 06-12-2016)

Sl. No.	Variety	Apple weight (g)	Nut weight (g)	Kernel weight (g)	Shelling (%)	Annual nut yield (Kg/tree)
01	H-01	59.8	6.5	1.85	28.4	3.43
02	H-81	78.0	10.5	3.13	29.8	2.97
03	H-151	75.2	10.3	3.08	29.9	3.21
04	H-188	71.4	10.4	3.12	30.0	3.18
05	H-191	70.0	8.9	2.81	31.7	3.29
06	H-216	67.5	9.5	2.81	29.8	2.99
	SEm ±	2.98	0.35	0.14	1.45	0.16
	CD at 5%	8.98	1.06	0.41	4.36	0.48
	CV %	7.34	6.51	8.46	8.36	8.61

JAGDALPUR**Experimental details**

Number of cross combinations : 8
 Bold nut parents : CARS-8
 VTH 711/4

Cold tolerant : H-255
 Cluster bearing parents : CARS-10
 : CARS-3
 : H-303
 Compact canopy parents : Bastar Selection - 1
 : VRI-3



H 303 x VTH 711-4

New crosses between jumbo/bold nut, cold tolerant, cluster bearing and compact canopy genotypes were attempted during the flowering season 2021. Total 6 cross combinations were used for getting desirable crosses. The cross combinations made and nuts obtained are given in the Table. A total of 308 crosses were undertaken out of which successful crosses were 56. Seventeen nuts were harvested and planted in polybags for further planting.

Table 1.26 : Success among the different crosses of cashew

S. No.	Parents	No. of crosses attempted	No. of successful crosses	Per cent of successful crosses	No. of nuts obtained	Per cent of nuts obtained
Cluster bearing x Bold nut						
1.	H-303 x H-255	56	15	26.78	4	7.14
2.	H-303 x CARS-8	61	14	22.95	4	6.55
3.	H-303 x VTH 711/4	49	9	18.36	3	6.12
Compact canopy x Cold tolerant						
4.	Bastar Selection-1 x CARS-10	31	5	16.12	3	9.67
Compact canopy x Bold nut/ Cold tolerant						
5.	Bastar Selection-1 x	39	4	10.25	1	2.56

	VTH 711/4					
6.	VRI-3 x H-255	33	5	15.15	2	6.06
7.	VTH 7111/4 x VRI-3	21	2	9.52	0	0.00
Compact canopy x Cluster bearing						
8.	Bastar Selection-1 x CARS-3	18	2	11.11	0	0.00
	Total	308	56	18.18	17	30.03

*Low fruit set is attributed to heavy rainfalls during the crossing period and nut set stage.

JHARGRAM

Statistical analysis reveals that the hybrids are significantly different from the control (BPP-8) with respect to the growth characters like plant height, plant spread on both sides and canopy area. But the hybrids are on par among themselves with respect to the above-mentioned growth characters.

There were significant differences recorded among the hybrids with respect to nut weight and apple weight. The highest nut weight was recorded with the hybrid H-113 and H-139 both having nut weight more than 7 g which is again at par with BPP- 8 (7.10g). Again the hybrids H-33, H-121 and H-1 were at par with regards to nut weight which ranged between (5.85 – 6.15)g. In case of apple weight heaviest apples were produced by the hybrid H – 139 (103.40g) followed by H – 121 (65.1g) and BPP - 8 (60.3g). Smallest apple was produced by H – 37 (25.0g). The hybrids were at par with respect to the characters like yield and shelling %. Cumulative yield of 4 harvests revealed that H-113 was the highest yielder (15.83 kg/tree) followed by H – 37 (13.61 kg/tree) and H – 33 (13.37 kg/tree). Therefore, H-113 was found to be a promising hybrid with respect to the yield attributes like nut weight and cumulative yield and shelling percentage.

Table 1.27 : Yield parameters of different cashew hybrids at Jhargram Centre during the year 2020 - 21 (Year of Planting : 2015)

Hybrid No.	Cross combination	Nut wt (g)	Apple wt. (g)	Apple colour	Shelling %	Annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 4Harv.)
H-121	H- 2/15x Red Hazari	6.08 _b	65.1 _b	Yellow	32.05	4.46	12.40
H-132	H- 2/15x Red Hazari	5.15 _c	39.3 _e	Yellow	33.60	3.63	12.29
H-139	KGN - 1 x BLA -39-4	7.18 _a	103.4 _a	Yellow	31.09	3.32	6.40
H- 33	Local x 2/9 Dicherla	6.15 _b	51.1 _c	Yellow	33.73	3.32	13.37
H- 113	H- 2/15x Red Hazari	7.40 _a	50.3 _c	Yellow	31.34	5.06	15.83
H- 35	Local x 2/9 Dicherla	4.13 _e	50.5 _c	Yellow	29.97	3.20	9.59
H- 126	H- 2/15x Red Hazari	5.05 _c	45.2 _d	Yellow	32.65	5.61	12.48
H- 37	Local x 2/9 Dicherla	4.58 _d	25.0 _f	Yellow	31.71	5.42	13.61
H- 41	Local x 2/9 Dicherla	5.85 _b	45.6 _d	Yellow	37.10	5.04	11.83
BPP - 8		7.10 _a	60.3 _b	Yellow	33.38	2.63	7.82
S.Em +		0.15	1.35		1.28	1.29	
C.D. at 5%		0.44	3.91		3.73	3.74	
CV %		5.21	5.03		7.45	7.88	

Among the hybrids planted during 2018 heaviest apples were recorded in H- 181, H-201, H- 188, and H-189 and smallest in H-195 and H-185. Shelling percentage varied from 26% to 35.7%. In the second year of harvest the yield range was between 0.5 kg to 3.5 kg /plant in different F1 hybrids. Above 3 kg/plant yield was recorded in H- 195, H-190 and H-191 and 2 – 2.5kg/plant yield was recorded in H- 192, H- 189, H- 185, H- 197 and H- 193. Cumulative yield records revealed that highest yielder in 2nd harvest was H-195 (5.5Kg/plant) followed by H- 193 (4.8Kg/plant) and H- 190 (3.9Kg/plant) while the range of cumulative yield was between 0.6 kg – 5.5 kg/plant. As the objective of the crossing was to get semi-dwarf germplasm with higher nut weight and yield H-191, H-198 and H- 189 were found promising at this age.

Table 1.28 : Yield parameters of different cashew hybrids at Jhargram Centre during the year 2020 - 21 (Year of Planting : 2018)

Sl. No.	Hybrid No	Cross combination	Shelling %	Cashew Apple colour	Cashew Apple shape	Annual nut yield (kg/tree)	Cum. nut yield (kg/tree) 2 nd harvest
1	H - 181	BJ - 2 x JGM - 282	26.0	Pink	Obovate	0.6	0.6
2	H -182	BJ - 2 x JGM - 216	29.9	Red	Obovate	1.3	1.7
3	H - 183	BJ - 2 x JGM - 216	29.3	Red	Obovate	0.5	1.0
4	H -184	BJ - 2 x JGM - 216	28.6	Pink	Obovate	1.0	1.0
5	H -185	BJ - 2 x JGM - 216	28.3	Pink	Cylindrical	2.3	2.6
6	H -186	BJ - 2 x JGM - 282	32.2	Pink	Conicle	0.6	0.7
7	H -187	BJ - 2 x JGM - 216	32.5	Pink	Obovate	0.50	1.2
8	H -188	BJ - 2 x JGM - 216	31.7	Pink	Obovate	0.7	0.7
9	H -189	BJ - 2 x JGM - 216	34.5	Pink	Obovate	2.1	3.3
10	H -190	BJ - 2 x JGM - 216	26.5	Pink	Obovate	3.2	3.9
11	H -191	BJ - 2 x JGM - 282	29.3	Red	Round	3.1	3.1
12	H -192	BJ - 2 x JGM - 216	33.3	Pink	Obovate	2.0	3.5
13	H -193	BJ - 2 x JGM - 216	35.7	Pink	Obovate	2.5	4.8
14	H -194	BJ - 2 x JGM - 216	32.8	Pink	Obovate	1.2	1.2
15	H -195	BJ - 2 x JGM - 216	34.5	Pink	Cylindrical	3.5	5.5
16	H -196	BJ - 2 x JGM - 282	27.6	Red	Obovate	1.9	2.9
17	H -197	BJ - 2 x JGM - 216	31.0	Red	Obovate	2.4	3.3
18	H -198	BJ - 2 x JGM - 216	30.8	Pink	Cylindrical	1.7	2.2
19	H -199	BJ - 2 x JGM - 216	32.2	Pink	Round	1.2	1.2
20	H -200	BJ - 2 x JGM - 216	30.9	Pink	Round	1.1	1.1
21	H -201	BJ - 2 x JGM - 282	27.9	Red	Conicle	1.7	2.3

Table 1.29 : Growth parameters of different cashew hybrids at Jhargram Centre during the year 2020 - 21 (Year of Planting : 2019)

Sl. No.	Hybrid No	Cross combination	Mean tree height (m)	Mean stem girth (cm)	Canopy Spread (m)		Mean canopy area (m ²)	Vegetative flush / m ²
					E-W	N-S		
1	H - 202	Jhargram-1 x BPP 8	1.7	11.0	0.9	1.0	1.3	0.0
2	H - 203	Bidhan Jhargram-2 x Jhargram- 1	2.1	17.0	2.2	1.5	5.7	6.5
3	H - 204	Bidhan Jhargram-2 x Jhargram-1	2.3	17.0	1.6	1.7	5.5	5.5
4	H - 205	Jhargram-1 x BPP 8	2.3	17.0	1.9	1.6	4.8	5.5
5	H - 206	Bidhan Jhargram - 2 x Jhargram- 1	2.0	14.0	1.5	1.4	3.7	6.3
6	H - 207	Jhargram- 1 x BPP 8	2.0	15.0	1.5	1.8	3.4	5.0
7	H - 208	Jhargram- 1 x BPP 8	1.8	13.0	1.3	1.0	1.9	5.8

Table 1.30 : Cross combinations during 2021

Sl. No.	Cross Combination	No. of seeds harvested	No of seedlings planted (F1 progeny)
1	H- 139 X JGM - 282	20	19
2	BPP - 8 X JGM – 282	21	21
3	BJ – 2 X JGM - 282	20	20
4	BPP- 8 X H- 139	5	3
Total		66	64

Four cross combinations were made and 66 nuts collected and 64 seedlings were raised and planted during 2021.

MADAKKATHARA

During the year, hybridization was done with an objective to develop genotypes having bigger nut and cluster bearing habit. Madakkathara-1, Priyanka, Dharasree, Raghav and NRCC Sel-2 were used as parents.

Table 1.31 : Characteristic features of parents used in hybridization at CRS, Madakkathara during 2021

Varieties	Apple wt. (g)	Nut wt. (g)	No. of nuts per kg	Kernel wt. (g)	Shelling %	Tree yield (kg/tree)
Madk-1	35.4	6.2	161	1.64	26.8	13.8
Priyanka	105.9	10.8	93	2.87	26.5	17.0
Dharasree	73.2	7.8	128	2.4	30.5	15.0
Raghav	83.9	9.2	108	2.27	26.6	14.7
NRCC Sel-2	67.6	9.2	108	2.15	28.6	9.0

A total of four hundred and eighty crosses resulted in 38 per cent of initial set and 10 per cent of final set. Forty-eight hybrid nuts were collected, and hybrid seedlings were raised in polybags.

Table 1.32 : Details of nut set in hybridization at CRS, Madakkathara during 2021

Varieties	No. of pollinations	No. of initial set	Initial set (%)	No. of final set	Final set (%)
Madk-1 x NRCC sel-2	60	19	31.67	3	5.00
Madk-1 x Priyanka	60	37	61.67	14	23.33
Madk-1 x Raghav	60	30	50.00	9	15.00
Madk-1 x Dharasree	60	23	38.33	4	6.67
NRCC sel-2 x Madk-1	60	29	48.33	6	10.00
Priyanka x Madk-1	60	16	26.67	3	5.00
Raghav x Madk-1	60	17	28.33	5	8.33
Dharasree x Madk-1	60	11	18.33	4	6.67

Evaluation of hybrids

A preliminary evaluation of 44 hybrids developed during 2003 and 2004 resulted in the identification of 15 hybrids having nut weight above 10g and kernel weight 2.5g. The bold nut variety, Priyanka was used as check. The number of fruits per panicle ranged from 1.25 (H03-21/10) to 3.40 (H03-97/2). Vitamin C content ranged from 133.5 mg/100ml to 334.75 mg/100 ml. The hybrid population was evaluated for yield and quality traits for two consecutive years and the average values of 15 promising hybrids are presented in Table.

Table 1.33 : Yield attributing characters of hybrids evaluated at CRS, Madakkathara during 2021

Hybrid name	Cross	Apple wt (g)	Nut wt. (g)	Kernel wt. (g)	Shelling %	Yield/tree (kg)
H03-95/4	Vri-3 x Priyanka	66.24	12.44	4.19	33.73	2.1
H04-95/3	Vri-3 x Priyanka	46.2	10.9	3.1	28.44	10.01
H03-21/10	Sulabah x Priyanka	80.93	12.75	3.46	29.46	25.20
H03-110/1	Poornima x Priyanka	79.10	11.18	3.44	30.81	23.40
H03-107/15	K-22-1 x Sulabha	78.56	10.76	2.83	26.37	8.2
H03-18/17	Damodar x K-22-1	108.46	12.48	2.94	23.59	3.1
H04-2/3	H-8-1 x V2	68.03	12.48	3.34	26.76	15.5
H03-70/13	Priyanka x M44/3	106.65	11.16	3.25	29.14	9.8
H03-70/16	Priyanka x M44/3	76.35	10.95	3.16	28.92	10.6
H03-52/7	Priyanka x Vri-3	67.81	10.33	3.02	29.26	16.5
H03-52/6	Priyanka x Vri-3	61.38	10.17	2.62	25.77	21.0
H03-52/5	Priyanka x Vri-3	120.35	10.40	3.07	29.59	16.5
H03-36/8	Dhana x Mdk-1	64.94	10.60	2.72	28.72	22.10
H03-69/25	K-10-2 x M44/3	74.783	10.89	2.60	23.88	11.2
H03-97/2	Sulabha X Madk-1	86.23	9.91	3.12	31.75	24.50
Priyanka	BLA-139-1 x K-30-1	137.49	12.43	2.79	22.45	6.20

VENGURLE

On the basis of standard criteria *viz.*, compact canopy, cluster bearing habit, nut weight (more than 8 g), shelling percentage (more than 28%) and high yield, 12 F₁ cashew progenies were screened initially as promising hybrids during the year 2020-21. It is seen that among the promising hybrids, H-3740 recorded the maximum height (8.30 m) and minimum height found in H-3942 (3.40 m). The highest stem girth (93.0 cm) was recorded in H-3746. While, EW canopy spread (9.00 m), NS canopy spread (10.00 m) and canopy area (70.85 m²) noted the maximum in H-3719.

It is seen that the maximum flowering duration (98.0 days) recorded in H-3740 and H-3991. The maximum number of flowering laterals (30/m²) recorded in H-3831 and H-3874. Whereas, the highest nuts/m² (27.00/m²) was noted in H-3991 while, the highest numbers of nuts per panicle (4.5) recorded in H-3948. Sex ratio recorded highest in H-3873 (0.19).

With regards to yield attributes of promising hybrids, the maximum nut weight was recorded by H-3740 (13.30 g) followed by H-3746 (13.00 g). The highest apple weight of 107.0 g was recorded in H-3874. The highest annual nut yield was recorded in H-3719 (4.73 kg/tree). Cumulative yield for last 8 harvests was noted highest in H-3719 (37.33 kg/tree) followed by H-3882 (18.16 kg/tree), H-3740 (15.30 kg/tree), H-3889 (14.86 kg/tree) and H-3873 (14.64 kg/tree).

Table 1.34 : Yield parameters of different cashew hybrids at Vengurla Centre during the year 2021

Hybrid No.	Cross combination	Nut wt. (g)	Apple wt. (g)	Annual nut yield (kg/tree)	Cum. yield (kg/tree) harvests
3719	Hy. 2/16 X V-4	11.00	67.0	4.73	37.33*
3740	V-7 X Kankadi	13.30	90.0	2.70	15.30*
3746	V-5 X Kankadi	13.00	40.0	2.30	11.52*
3831	(V-5 X B.T.1) X B.T.1	6.20	34.0	2.90	11.76*
3873	V-2 X B.T.1	10.00	95.0	3.73	14.64*
3874	V-2 X B.T.1	9.00	107.0	1.10	11.12*
3882	V-2 X B.T.22	9.30	49.0	3.63	18.16*
3889	V-2 X B.T.65	7.60	71.0	2.18	14.86*
3942	V-5 X B.T.22	8.90	34.0	2.08	9.08**
3947	V-5 X B.T.22	9.40	62.0	2.45	9.49**
3948	V-5 X B.T.22	8.80	67.0	1.45	12.52**
3991	V-4 X M-44/3	6.60	52.0	4.51	12.83***

*Cum. yield for 8 harvests, ** Cum. yield for 7 harvests and *** Cum. yield for 5 harvests

The 2757 F₁ cashew progenies planted at 5m x 5m during 1999 to 2004 were evaluated during 2015. Out of these F₁ progenies, the best performing 56 hybrids were evaluated as promising hybrids.

Out of these 56 F₁ hybrids, replicated trial of the top performing 18 hybrids initiated at AICRP-Cashew Vengurla centre during July, 2016 under Gen.4. The detail of the trial is as follows.

Expt. Gen. 4	:	Performance of new set of promising hybrids under Konkan conditions																																										
Objectives	:	To evaluate the performance of new set of promising hybrids																																										
Location	:	AICRP-Cashew, RFRS, Vengurla																																										
Design	:	RBD																																										
Replication	:	3																																										
Treatment	:	18																																										
Treatment details	:	<table border="1"> <thead> <tr> <th>Hybrid No.</th> <th>Cross Combination</th> <th>Hybrid No.</th> <th>Cross Combination</th> </tr> </thead> <tbody> <tr> <td>T₁ - H-735</td> <td>V-2 X B.T.65</td> <td>T₁₀ - H-1016</td> <td>M 26/2 X B.T.65</td> </tr> <tr> <td>T₂ - H-778</td> <td>M 44/3 X B.T.22</td> <td>T₁₁ - H-1039</td> <td>M 26/2 X B.T.65</td> </tr> <tr> <td>T₃ - H-801</td> <td>V-5 X B.T.1</td> <td>T₁₂ - H-1155</td> <td>V-5 X B.T.65</td> </tr> <tr> <td>T₄ - H-883</td> <td>V-4 X H-2/16</td> <td>T₁₃ - H-1174</td> <td>M 26/2 X B.T.1</td> </tr> <tr> <td>T₅ - H-939</td> <td>V-4 X H-2/16</td> <td>T₁₄ - H-2005</td> <td>V-8 x Priyanka</td> </tr> <tr> <td>T₆ - H-991</td> <td>M 26/2 X B.T.65</td> <td>T₁₅ - H-1675</td> <td>V-4 X H-2/16</td> </tr> <tr> <td>T₇ - H-969</td> <td>V-4 X H-2/16</td> <td>T₁₆ - H-1187</td> <td>M 26/2 X B.T.1</td> </tr> <tr> <td>T₈ - H-958</td> <td>V-4 X H-2/16</td> <td>T₁₇ - H-1306</td> <td>H-2/16 X V-4</td> </tr> <tr> <td>T₉ - H-992</td> <td>M 26/2 X B.T.65</td> <td>T₁₈-V-9 (Check)</td> <td>V-4 X M-10-4</td> </tr> </tbody> </table>			Hybrid No.	Cross Combination	Hybrid No.	Cross Combination	T ₁ - H-735	V-2 X B.T.65	T ₁₀ - H-1016	M 26/2 X B.T.65	T ₂ - H-778	M 44/3 X B.T.22	T ₁₁ - H-1039	M 26/2 X B.T.65	T ₃ - H-801	V-5 X B.T.1	T ₁₂ - H-1155	V-5 X B.T.65	T ₄ - H-883	V-4 X H-2/16	T ₁₃ - H-1174	M 26/2 X B.T.1	T ₅ - H-939	V-4 X H-2/16	T ₁₄ - H-2005	V-8 x Priyanka	T ₆ - H-991	M 26/2 X B.T.65	T ₁₅ - H-1675	V-4 X H-2/16	T ₇ - H-969	V-4 X H-2/16	T ₁₆ - H-1187	M 26/2 X B.T.1	T ₈ - H-958	V-4 X H-2/16	T ₁₇ - H-1306	H-2/16 X V-4	T ₉ - H-992	M 26/2 X B.T.65	T ₁₈ -V-9 (Check)	V-4 X M-10-4
Hybrid No.	Cross Combination	Hybrid No.	Cross Combination																																									
T ₁ - H-735	V-2 X B.T.65	T ₁₀ - H-1016	M 26/2 X B.T.65																																									
T ₂ - H-778	M 44/3 X B.T.22	T ₁₁ - H-1039	M 26/2 X B.T.65																																									
T ₃ - H-801	V-5 X B.T.1	T ₁₂ - H-1155	V-5 X B.T.65																																									
T ₄ - H-883	V-4 X H-2/16	T ₁₃ - H-1174	M 26/2 X B.T.1																																									
T ₅ - H-939	V-4 X H-2/16	T ₁₄ - H-2005	V-8 x Priyanka																																									
T ₆ - H-991	M 26/2 X B.T.65	T ₁₅ - H-1675	V-4 X H-2/16																																									
T ₇ - H-969	V-4 X H-2/16	T ₁₆ - H-1187	M 26/2 X B.T.1																																									
T ₈ - H-958	V-4 X H-2/16	T ₁₇ - H-1306	H-2/16 X V-4																																									
T ₉ - H-992	M 26/2 X B.T.65	T ₁₈ -V-9 (Check)	V-4 X M-10-4																																									
Spacing	:	7m x 7m																																										
Year of planting	:	July, 2016																																										
Plant unit/replication	:	3																																										
Total plants	:	162																																										



H - 801



H - 991

The vegetative growth parameters (2020-21) of new set of promising hybrids revealed that, there was no significant difference among the hybrid with respect to vegetative growth parameters except EW spread (m) of cashew.

The flowering and fruiting parameters of new set of promising hybrid revealed that there was significant difference among the different hybrids with respect to flowering duration (days),

number of laterals per m², number of flowering panicles per m², fruit set per m² and number of nuts per panicle.

Yield attributes of new set of promising hybrids revealed that significantly the highest apple weight of 140.67 g and nut weight of 14.00 g was recorded in H-735 and superior over rest of the treatments. So far as yield is concerned, significantly the highest yield of new set of promising hybrids was recorded in H-778 (3.05 kg/tree & 0.62 t/ha) and at par with H-991 (2.96 kg/tree & 0.60 t/ha) and both these treatments were significantly superior over rest of treatments. The highest shelling percentage (31.37%) was recorded in H-801 and at par with treatments H-1187 (30.30%) and H-991 (30.00%). The highest cumulative yield for 2 harvests was recorded in H-1039 (4.69 kg/tree) followed by H-778 (3.18 kg/tree) and H-991 (3.08 kg/tree).

Table 1.35 : Yield parameters of new set of promising hybrid at Vengurla Centre during the year 2021

Hybrid No.	Apple weight (g)	Nut weight (g)	Yield (kg/tree)	Yield (t/ha)	Shelling (%)	Cum. Yield for 2 harvests (kg/tree)
H-735	140.67	14.00	0.29	0.06	26.50	0.36
H-778	76.00	8.30	3.05	0.62	28.87	3.18
H-801	60.67	6.67	1.13	0.23	31.37	1.20
H-883	90.67	12.67	0.65	0.13	27.97	1.63
H-939	79.67	9.40	0.74	0.15	29.67	0.82
H-991	73.33	10.17	2.96	0.60	30.00	3.08
H-969	99.67	10.30	0.88	0.18	28.90	1.89
H-958	50.67	10.50	0.36	0.07	29.57	0.59
H-992	101.00	10.73	0.77	0.16	29.27	0.87
H-1016	73.83	10.37	1.19	0.24	29.07	1.34
H-1039	84.00	10.47	2.39	0.49	28.70	4.69
H-1155	67.67	8.77	0.84	0.17	27.50	0.95
H-1174	68.67	10.93	1.18	0.24	27.30	1.29
H-2005	71.00	11.13	0.37	0.07	28.73	0.52
H-1675	37.67	12.47	0.47	0.09	27.07	0.52
H-1187	84.33	9.20	2.17	0.44	30.30	2.74
H-1306	92.33	9.87	1.05	0.21	28.33	1.18
V-9 (Check)	89.50	11.17	0.84	0.17	26.77	0.99
SEm ±	6.59	0.35	0.17	0.03	0.56	-
CD at 5%	18.93	1.01	0.50	0.10	1.62	-
CV %	14.25	5.87	25.27	25.28	3.40	-

VRIDHACHALAM

The hybrids planted during 2005, 2006 and 2008 were evaluated for characteristics viz., high yield, cluster bearing, good fruit set, high percentage of bisexual flowers, bold nuts, dwarfness and easy peeling testa. Hybrid HC 10 was observed to have the typical characteristic of high yield even under water stress conditions. HC 6 shows shorter internode and dwarf in nature. Hybrid HC-10 has been considered for varietal release. Planting material has been grafted for MLT to different centers.

The pooled mean data results are presented below:

Table 1.36 : Pooled mean data for growth parameters of different cashew hybrids at Vridhachalam centre (2014-21)

Hybrid No.	Cross combinations	Year of planting	Mean tree ht. (m)	Mean stem girth (cm)	Mean canopy area (m ²)	Ratio of male: bisexual flowers
HC1	VRI 2 X VRI 3	2005	4.27	62.34	28.8	6.48
HC2	VRI 3 x VSK 2	2005	4.77	43.82	28.3	13.16
HC3	VRI 3 x TK 1	2005	4.44	61.44	42.3	9.06
HC5	VRI 3 x VRI 2	2005	4.83	53.76	33.1	7.88
HC6	VRI 3 x KGN 1	2005	3.43	38.54	16.6	8.74
HC8	VRI 3 x PKP 1	2005	4.97	53.86	43.8	8.48
HC10	VRI 3 x KK 1	2006	4.53	48.68	37.2	15.84
HC 17	VRI 3 x AM 1	2006	3.83	39.14	17.0	8.88
HC 22	VRI 3 X TK 1	2008	4.33	38.24	21.9	11.62
HC 24	VRI 3X M 33/3	2008	3.64	38.74	14.7	5.90
HC 25	VRI 3 X VSK 3	2008	3.60	53.26	17.4	15.08
HC 27	VRI 3 X SL 1	2008	4.09	41.98	22.9	4.26
HC 30	VRI 3 x PV 1	2008	4.19	47.08	21.5	12.72

Table 1.37 : Pooled mean data for yield parameters of different cashew hybrids at Vridhachalam centre (2014-21)

Hybrid No.	Cross combinations	Year of planting	Mean nut wt. (g)	Mean apple wt. (g)	Shelling (%)	Mean nut yield (Kg/tree)	Cum yield (Kg/tree) (9 harvests)
HC1	VRI 2 X VRI 3	2005	5.90	25.93	27.60	5.20	35.21
HC2	VRI 3 x VSK 2	2005	6.30	31.83	26.50	4.10	27.30
HC3	VRI 3 x TK 1	2005	6.60	37.37	24.60	3.80	19.57
HC5	VRI 3 x VRI 2	2005	7.00	40.91	27.70	6.70	33.27
HC6	VRI 3 x KGN 1	2005	5.90	52.11	26.04	6.10	23.72
HC8	VRI 3 x PKP 1	2005	6.30	50.87	26.10	6.10	24.10
HC10	VRI 3 x KK 1	2006	7.40	34.46	28.70	11.70	45.32
HC 17	VRI 3 x AM 1	2006	6.10	34.26	27.08	5.60	29.48
HC 22	VRI 3 X TK 1	2008	7.30	48.86	28.66	5.60	25.13
HC 24	VRI 3X M 33/3	2008	7.00	31.86	26.14	6.20	26.92
HC 25	VRI 3 X VSK 3	2008	7.60	52.77	30.10	9.10	34.85
HC 27	VRI 3 X SL 1	2008	7.80	48.74	31.20	6.30	31.41
HC 30	VRI 3 x PV 1	2008	8.00	50.43	26.70	8.10	35.83

Gen.4 : Rapid polyclonal hybrid evaluation trial

Centres: East Coast :	Bapatla, Bhubaneswar and Vridhachalam
West Coast :	Madakkathara 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.

Experimental details:

No. of hybrids	: 5
Spacing	: 3m x 2m
Number of plants /hybrids	: 5
Year of planting	: 2017
List of accessions	:

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

BHUBANESWAR

Experimental details:

No. of seedlings planted in each genotype	: C2-6(BH-26) : 22
	: H-12/05 : 26
	: H-2917 : 31
	: VRI (cw)-H ₁ : 30
	: H-504 : 20

During the fruiting season 2020-21 thirty numbers of seeds nuts were harvested from each genotypes and all total 150 seed nuts were sown in poly bag on 17th May, 2021 for raising seedlings. Only 130 seed nuts were germinated and these germinated seedlings were planted in main field on 22.08.2021 at a spacing 6mx6m following Augmented design for further evaluation.

MADAKKATHARA**Experimental material :**

SI No	Sponsoring centres	Cashew genotype
1	CRS, Bhubaneswar	C2-6
2	ICAR Research Complex for Goa	H-12/05
3	CRS, Vridhachalam	VRI(cw)H1
4	CRS, Bapatla	H-504

Four hybrids (C2-6, H-12/05, VRI (cw)H1 and H-504) planted at a spacing of 3m x 2m were covered with insect proof net. Thirty nuts each were collected from the genotypes, C2-6, H-12/05, VRI (cw) H1 and seedlings were raised in polybags.

VENGURLE

The grafts of all high yielding hybrids are planted in 3m x 2m spacing @ 5 grafts/hybrids in July, 2018. The year 2020-21 is second year of experimentation. All grafts were covered with insect proof cover in cashew season 2020-21 and introduced pollinators for pollination. Total 37 Nos. of F₁ nuts were harvested i.e., 25 nuts from H-2917 and 12 nuts from VRI (cw) H1. Out of total 37 nuts, 22 nuts were germinated. Precocity of flowering observed early in cashew accession C2-6 (12th November, 2020).

30 Nos. of cashew polyclonal F₁ progenies were obtained from H-2917 in last two years. These polyclonal F₁ progenies are now ready for planting and will be planted in the field in December, 2021 for further evaluation.

Table 1.38 : Number of seeds produced through polyclonal hybridization

Sr. No	Accession No.	Precocity of flowering (No. of grafts per accession-5)	Flowering duration (days)	Number of nuts harvested from each accession	Number of seed germinated
1	C2-6	12 th - 20 th November, 2020	97.50	-	-
2	H-12/05	17 th November, 2020	96.00	-	-
3	H-2917	15 th – 21 st Nov., 2020	93.20	25	19
4	VRI (cw) H1	15 th – 25 th Nov., 2020	93.80	12	3
5	H-504	-	-	-	-
Total				37	22

Gen. 5. Characterization of germplasm for cashew apple

Centres: East Coast : Bapatla
West Coast : Pillicode

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

BAPATLA

Among the 13 genotypes evaluated during the year 2020-21, the maximum mean annual nut yield per tree was recorded in BPP-8 (9.05 kg) followed by BLA 39/4 (7.40kg). The maximum nut weight was recorded in Priyanka (9.60 g) followed by BPP-8 (8.02 g). The maximum apple weight was recorded in Priyanka (96.0 g) followed by BPP-8 (69.20 g). The apple nut ratio was highest in T.No.8/7 (13.26) followed by T.No. 2/14 (11.79). The juice recovery percentage was found maximum in T.No.228 (70.30 %) followed by BLA-39/4 (72.20%).

Table 1.39 : Physical parameters of cashew germplasm for cashew apple.

S. No	Germplasm	Nut wt (g)	Apple wt (g)	Yield /tree (kg)	Apple nut ratio	Mean No. of nuts /Panicle	Juice recovery (%)	Colour of the apple
1.	Priyanka	9.60	96.00	7.00	10.00	3.30	69.70	Red Yellow
2.	T.No: 2/14	4.34	51.20	4.35	11.79	4.20	54.30	Yellow
3.	T.No.17/5	4.20	36.23	4.60	8.59	4.10	57.20	Yellow
4.	T.No. 5/1	5.01	38.40	3.80	7.66	4.40	63.10	Yellow
5.	BLA. 139/1	4.96	36.10	4.20	7.27	7.42	58.10	Yellow
6.	BLA. 39/4	4.20	36.40	7.40	8.66	6.80	72.20	Yellow
7.	T.No. 3/4	4.46	42.30	4.85	9.48	3.40	63.20	Yellow
8.	T.No. 8/7	3.80	50.40	4.30	13.26	5.90	55.13	Yellow
9.	T.No. 18/3	4.85	49.60	4.00	10.22	4.70	57.20	Yellow
10.	Hy 95-T4	5.70	48.20	6.10	8.45	5.60	63.20	Yellow
11.	T.No. 12/1	4.45	45.30	3.75	10.17	4.00	59.60	Yellow
12.	T.No. 228	4.32	36.30	5.35	8.40	6.40	70.30	Red Yellow
13	BPP-8	8.02	69.20	9.05	8.62	4.50	68.40	Yellow
	CD @ 5%	0.55	4.08	0.70	1.07	0.59	3.42	
	SEm±	0.19	1.39	0.24	0.37	0.20	1.16	

Table 1.40 : Chemical parameters of cashew germplasm for cashew apple

S.No.	Germplasm	TSS (°Brix)	Vitamin-C (mg/100 g)	Tannins (mg/100 g)	Acidity (%)
1.	Priyanka	11.90	133.20	3.07	0.43
2.	T.No. 2/14	10.80	138.30	3.10	0.49
3.	T.No.17/5	10.90	152.10	3.15	0.50
4.	T.No. 5/1	9.56	137.10	3.22	0.98

5.	BLA. 139/1	10.20	137.43	3.45	1.04
6.	BLA. 39/4	9.67	156.20	3.25	0.86
7.	T.No. 3/4	11.20	169.10	3.15	0.84
8.	T.No. 8/7	11.30	170.10	3.20	0.49
9.	T.No. 18/3	11.45	168.40	3.21	0.52
10.	Hy 95-T4	10.80	165.20	3.19	0.59
11.	T.No. 12/1	10.54	127.30	3.24	0.69
12.	T.No. 228	10.44	134.10	3.26	0.74
13.	BPP-8	10.50	142.10	3.17	0.49
	CD at (5%)	0.62	13.66	0.15	0.101
	SEm±	0.21	4.65	0.05	0.034

Among the 13 genotypes the total soluble solids ranged from 9.56⁰ Brix to 11.90⁰ Brix. However, the highest TSS was recorded in Priyanka (11.90). The maximum vitamin C content was recorded in T.No. 8/7 (170.10 mg/100gm) followed by T.No.18/3 (168.40 mg/100 gm). With regard to the tannin content the lowest was recorded in Priyanka (3.07 mg/100 g) followed by T.No.2/14 (3.10 mg/100 gm). The acidity content was lowest in Priyanka (0.43%) followed by BPP-8, T.No.2/14 and T.No 8/7 (0.49%).

PILICODE

Highest ascorbic acid content was observed with PLD 93 (283.64 mg/100g) followed by PLD 94 (273.13 mg/100g). Tannin content was highest in PLD 91 (0.169%) followed by PLD 97(0.165%) and acidity percentage was highest in PLD 93 (0.90%). Least acidity was found in PLD 97(0.33%). Highest TSS was recorded in PLD 97 (10.10) PLD 98 (10.10) and PLD 91 (10.00) followed by PLD 98 (8.00). Sugar Acid ratio was highest for PLD 90 (30.98) followed by PLD 90 (20.22).

Table 1.41 : Biochemical characters of apple in different germplasm

Germplasm details	Ascorbic Acid Content mg/100g	Tannin %	TSS (°Brix)	Acidity (%)	Sugar Acid Ratio
PLD 89	201.33	0.096 (0.77)	8.57	0.49 (1.00)	17.50
PLD 90	171.24	0.106 (0.78)	9.10	0.45 (0.98)	20.22
PLD 91	181.82	0.16 (0.82)	10.00	0.76 (1.12)	13.31
PLD 92	200.00	0.12 (0.79)	8.77	0.64 (1.07)	13.93
PLD 93	283.64	0.14 (0.80)	9.17	0.90 (1.18)	10.27
PLD 94	273.13	0.12 (0.79)	9.30	0.60 (1.05)	15.80
PLD 95	254.55	0.13	8.17	0.76	10.75

		(0.80)		(1.12)	
PLD 96	213.35	0.15 (0.81)	9.17	0.64 (1.07)	14.56
PLD 97	230.53	0.16 (0.82)	10.17	0.33 (0.91)	30.98
PLD 98	181.82	0.12 (0.79)	10.17	0.79 (1.14)	12.88
SEm	2.530	0.007	0.123	0.019	1.023
CD at 5%	7.52	0.02	0.37	0.06	3.02
CV%	2.00	1.41	2.30	3.13	11.07

Figures in parentheses Square root($n+0.5$) transformed values

PLD 91 had Highest Fe content (87 ppm), followed by PLD 98 (63.67ppm). Least was in PLD 92 (36 ppm). PLD 95 had highest manganese content (9 ppm). Zinc content was highest in PLD 91 (1.50ppm) and PLD 93(1.4ppm), PLD 94 (1.4ppm), PLD 96 (1.4 ppm), PLD 94 (1.3 ppm)and PLD 97 (1.3 ppm) which were statistically on par. Copper content was highest with PLD 94 (5.2ppm) followed by PLD 91 (4.67ppm). Highest Calcium content was observed with PLD 94 (94ppm) followed by PLD 97 (81 ppm) and PLD 92 (80 ppm) which was statistically on par. Regarding magnesium content highest was observed with PLD 93 (418.33 ppm).

Gen. 6. Evaluation of promising bold nut, bigger size apple types and high yielding cashew genotypes

Centres: East Coast :	Bapatla, Bhubaneswar, Jhargram and Vridhachalam
West Coast :	Goa, Madakkathara, Pilicode and Vengurle
Plains / others:	Hogalagere, Jagdalpur and 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	:	16
No. of replications	:	2
No. of plants per genotype	:	4
Spacing	:	6m x 6m

Material :

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, Vengurle	H-3043, H-2873
5	CRS, Bhubaneswar	C-136, D-21, E-22
6	DCR, Puttur	H-126, H-130, NRC-301, NRC-493 and V-7

BHUBANESWAR

The experiment was laid out during the year 2019. Now the plants are at vegetative stage. However, flowering and fruiting were observed in all codes except 'F' and 'L'. Genotype code 'É', C1-36 and E-22 were the early flowering type (1st week of December). All other genotypes were medium to late flowering type.

GOA

Under this trial, the grafts of 16 bold nut genotypes with code numbers, received from different Centres were planted in the main field for evaluation.

HOGALAGERE

Land preparation and experimental lay out has been prepared.

JAGDALPUR**Experimental details**

Total number of genotypes	:	16
Design of experiment	:	Randomized block design
Number of Replications	:	2
Number of plants/genotype	:	4
Spacing	:	6 x 6 m
Date of Planting	:	25/08/2019

The experiment was laid out during August 2019 from the grafts procured from ICAR-DCR, Puttur. The data revealed that there were non-significant differences among the genotypes for vegetative characters like plant height and stem girth. The maximum plant height was recorded in 'P' (1.74 m) followed by 'J' (1.70 m). Stem girth was also reported maximum in 'P' (18.92 cm). The highest canopy spread in E-W direction was observed in 'P' which was at par with 'F' and 'C'. However highest canopy spread in N-S direction was reported in 'K'.

JHARGRAM**Experimental details:**

Total Number of genotypes	:	16
No. of replications	:	2
No. of plants per genotype per replication	:	3
Spacing	:	6m x 6m
Design	:	Randomized Block Design
Year of Planting	:	25 th September, 2019

Materials :

Sl. No.	Sponsoring centre	Cashew genotypes
1.	CRS, Bapatla	H - 218
2.	CARS, Jagdalpur	CARS - 8, CARS - 10 3
3.	CCARI, Goa	Tiswadi - 3, Tudal - 1, HB 22/05
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

After the second year of planting, though the plants flowered, fruit set was very meager. There were no significant differences among the varieties with regard to plant height, stem girth, North - South canopy spread and total no. of flowering per plant while the varieties were on par with respect to East-West canopy spread and canopy area.

KANABARGI

Year of planting	: 2019
Design	: RBD
Replication	: Three
Spacing	: 6 m X 6m
Number of plants per replication	: 3
Varieties/No. of entries	: 13



Layout of boldnut trial at Kanabargi

This experiment was initiated during 2019. Vegetative parameters are recorded.

MADAKKATHARA**Experimental details**

Number of genotypes	: 16
No. of replications	: 2
No. of plants per replication	: 4
Spacing	: 6m x 6m

Experimental materials:

Sl. No	Sponsoring centres	Cashew genotypes
1	CRS, Bapatla	H 218
2	CARS, Jagdalpur	CARS-8, CARS-10
3	CCAR, Goa	H 22/05, Tiswadi-3, Tudal-1
4	RFRS, Vengurla	H-3043, H-2873, V7
5	CRS, Bhubaneswar	C-136, D-21, E-22
6	DCR, Puttur	H-126, H-130, NRC-301, NRC-493

The experimental materials were planted in Randomized Block design with two replications at 6m x 6m spacing. All recommended package of practices were followed as per recommendations of KAU. During the year 2021, flowering was observed in the genotypes E, J, Q, C and D.

The growth parameters of 13 bold nut genotypes are recorded. The genotypes exhibited significance difference with respect to canopy diameter and highest value was observed in the genotypes K and N.

PILICODE

The vegetative parameters are recorded on the bold nut accessions.

VENGURLA

Design : RBD
 Replication : 2
 No. of plants : 4
 per genotypes
 Treatment : 17 genotypes from 6 centres
 Treatment :
 Details

Treatments	Code No.
T ₁	A
T ₂	B
T ₃	C
T ₄	D
T ₅	E
T ₆	F
T ₇	G
T ₈	H
T ₉	I
T ₁₀	J
T ₁₁	K
T ₁₂	L
T ₁₃	M
T ₁₄	N
T ₁₅	O
T ₁₆	P
T ₁₇	Q

1.	H-218	CRS, Bapatla
2.	CARS-8	CARS, Jagdalpur
3.	22/05	} CCARI, Goa
4.	Tiswadi-3	
5.	Tudal-1	
6.	H-3043	} RFRS, Vengurla
7.	H-2873	
8.	F-32	} CRS, Bhubaneswar
9.	C-136	
10.	D-21	
11.	E-22	
12.	H-29	
13.	H-125	} DCR, Puttur
14.	H-126	
15.	H-130	
16.	NRC-301	
17.	NRC-493	

Spacing : 6m x 6m
 Year of planting : June, 2020
 Results : The trial laid out as per design in June, 2020. Growth of all the experimental grafts is satisfactory. First year growth observations (2021-22) are recorded.

VRIDHACHALAM

The trial has been initiated with the planting materials (13 types) collected from DCR, Puttur during 2019 and the plants are under vegetative stage. The yield data will be recorded during ensuing year.

Gen. 7. Trial on Dwarf genotypes in cashew

Centres: East Coast :	Bapatla, Bhubaneswar, Jhargram and Vridhachalam
West Coast :	Madakkathara, Pilicode and Vengurle
Plains / others:	Hogalagere, Jagdalpur, Kanabargi

Objective : To assess dwarf and semi-dwarf accessions for their yield potential and seedling selection from these accessions for yield and yield attributing characters

EXPERIMENTAL DETAILS:

Genotypes	: 16 Accessions NRC 214, NRC 314, NRC 315, NRC 312, NRC 313, NRC 306, NRC 415, BDB 58, DB 626, TR8, Taliparamba, NRC 492, HC-6, H-3831, JGM-282 and local check (VRI-3)
Spacing	: 3m x 3m, 4m x 4m and 5m x 5m
Replications	: Three
Parameters to be recorded	: Tree height, Tree spread, Girth, Canopy coverage (% of the allotted area), Number of flowering laterals, Nut weight, Yield (kg/tree) and Cumulative yield (kg/tree).
Pruning	: Need based
Centres	: 10 Centres Vengurla, Kanabargi, Hogalagere, Puttur, Madakkathara, Vridhachalam, Bapatla, Jagdalpur, Bhubaneswar, Jhargram
Plants unit/ accession	: Four
Design	: Split Plot (Spacing as main plot and varieties as sub plots)*
	*High yielding varieties of the respective centers to be planted in the periphery of the experiment
Year of planting	: 2022-23



JGM – 282

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

Treatments:

- T₁: 100% Recommended Dose of N, P and K Fertilizer (RDF)*
 T₂: 100% RDF+10kg FYM / plant / year
 T₃: 100% RDF+10kg FYM / plant / year + foliar spray of major nutrients (3% Urea+0.5% H₃PO₄+1% K₂SO₄)
 T₄: 100% RDF+10kg FYM / plant / year + foliar spray of secondary and micronutrients (0.5% Zn SO₄+0.1% Solubor**+0.5% MgSO₄)
 T₅: 100% RDF+10kg FYM / plant / year + foliar spray of major nutrients (3% Urea+0.5% H₃PO₄+1% K₂SO₄) + foliar spray of secondary and micronutrients (0.5% Zn SO₄+0.1% Solubor+0.5% MgSO₄)
 T₆: Control

*100% RDF = The dose of N, P and K fertilizer as per the centre's recommendation

**Solubor = Source of fertilizer for Boron

BHUBANESWAR

There were significant variations for apple weight(g), nut weight(g) and nut yield/plant(kg) due to application of different macro and micro-nutrients. Application of 100% RDF+10 Kg FYM along with foliar spray of major nutrients (3% Urea + 0.5% H₃PO₄+ 1% K₂SO₄), secondary and micro-nutrients (0.5% ZnSO₄+0.1% Boron+0.5% MgSO₄) (T₅) was found to produce significantly highest apple weight (54.44 g), nut weight (7.56 g) as well as nut yield/plant (3.44 kg) than rest of the treatments. The results of cumulative nut yield/tree over 5th harvest revealed variations from 9.85 kg in T₆ to maximum of 14.42 kg in T₅ in variety Balabhadra. The incidence of Tea Mosquito Bug (TMB) infestation was low irrespective of the treatments.

The overall results observed during 2020-21 revealed the superiority of T₅ among the different macro and micro-nutrients application with respect to all the growth and yield parameters.

Table 2.1 : Yield parameters of cashew at Bhubaneswar during 2021

Treatments	Mean apple weight (gm)	Mean nut weight (gm)	Nut yield (kg/plant)	Cum. nut yield (kg/plant) for 5 harvests	Tea Mosquito Bug infestation
T ₁	50.88	6.74	2.23	10.96	Low
T ₂	51.30	6.92	2.70	12.04	Low
T ₃	51.86	7.18	2.92	12.84	Low
T ₄	52.45	7.34	3.05	12.91	Low
T ₅	54.44	7.56	3.44	14.42	Low
T ₆ Control	48.67	6.35	2.08	9.85	Low
Mean	51.60	7.02	2.74		
SEm±	1.95	0.18	0.15		
CD at 5%	5.87	0.53	0.46		
CV(%)	7.55	5.06	11.23		

HOGALAGERE

There were six treatments imposed in the experiments, among the treatments-5 (T₅) i.e., cashew trees imposed with 100% RDF (500:250:250g) + 10 kg FYM along with foliar spray of major nutrients (3% Urea + 0.5% MAP + 1% K₂SO₄), secondary and micronutrients (0.5% ZnSO₄ + 0.1% solubor as boron + 0.5% MgSO₄) was found significantly superior over remaining treatments in terms of growth parameters like Stem girth (17.91 cm) Canopy height (2.66 m), Canopy spread (E-W : 7.08 m except T₄ and N-S : 7.12 m), Mean canopy diameter (7.10 m), Canopy surface area (158.55 m²), and ground area covered by plant canopy (61.99%). Whereas Treatment-5 (T₅) was also recorded significantly superior over other treatments and followed similar trend as in growth attributing parameters, such as Nut yield per tree (14.50 kg), Yield per hectare (18.87 q), Cumulative nut yield for six years of harvest (56.82 kg), and Cumulative yield per hectare (88.64 q).

Table 2.2 : Influence of nutrient management approaches on Reproductive parameters of cashew at HREC, Hogalagere during 2021

Treatments	Flowering duration (Days)	Apple weight (g)	Nut weight (g)	Nut yield (Kg/plant)	TMB Infestation	Cumulative yield (Kg/tree) (6 harvests)
T ₁	121	36.21	7.00	11.26	low	45.14
T ₂	124	37.00	7.12	12.10	low	47.62
T ₃	127	38.05	7.15	12.80	low	50.50
T ₄	128	38.85	7.15	13.40	low	51.61
T ₅	130	39.03	7.20	14.50	low	56.82
T ₆	114	35.17	6.80	8.50	low	37.27
SEm±	1.42	0.80	0.05	0.339	-	1.165
CD@5%	4.30	2.42	0.16	1.022	-	3.510
CV	2.30	4.31	1.51	5.609	-	4.837

Hort.2: Fertilizer application in high density cashew plantations

Centres: 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 research on fertilizer application in high density cashew plantation with combination of three spacing levels and three level doses of fertilizer treatments was laid out under split plot design and recorded different growth and yield attributing parameters.

Spacing S1M3 (200 plants per hectare + 225 N : 75 P2O5 :75 K2O kg per hectare) had obtained significantly higher values in terms of Canopy surface area (25.21 m²) except S1M2 (23.41 m²), Apple weight (36.43 g), Nut yield per plant (6.75 kg) and cumulative nut yield per plant (14.45 kg). Whereas nut yield per hectare (28.29q) and cumulative yield per hectare for 5 harvests (60.76q) were found significant in S3M3 compared to remaining treatments of the experiment.

Whereas in case of different dose of fertilizer levels S1M3 also found significantly superior over others in term of growth and yield parameters such as Canopy Spread (3.55 m), Canopy surface area (25.21 m) except S1M2, Mean apple weight (36.43 g), Mean nut weight exclude S1M2, Nut yield per plant (6.95 kg) and cumulative nut yield per plant for 5 years of harvest (14.45 kg), but S3M3 was significantly superior in nut yield per hectare compared to others because of more number of plants accommodated in unit area. Mean while there were no significant difference among the treatment interactions of spacing and fertilizers.



Fertilizer application



Green leaf manuring



Manure application

Table 2.3 : Effect of spacing, fertilizers and Interaction of different spacing and fertilizer levels on yield contributing traits of Cashew at Hogalagere during 2021

Treatments	Flowering duration (Days)	Mean apple weight (g)	Mean nut weight (g)	Nut yield		Cumulative yield (3 No. of harvest)		TMB Infestation
				(Kg/ plant)	(Q/ha.)	(Kg/ plant)	(Q/ha.)	
S ₁ M ₁	120	36.02	7.15	6.30	12.61	low	13.42	30.14
S ₁ M ₂	122	35.91	7.18	6.50	13.00	low	13.90	30.19
S ₁ M ₃	124	36.43	7.23	6.95	13.90	low	14.45	30.22
S ₂ M ₁	120	35.40	7.10	5.60	23.33	low	12.29	30.00
S ₂ M ₂	120	35.82	7.09	5.80	24.15	low	12.65	30.01
S ₂ M ₃	121	35.96	7.17	6.10	25.40	low	12.92	30.05
S ₃ M ₁	115	35.00	7.01	5.05	25.23	low	11.42	29.50
S ₃ M ₂	116	35.00	7.06	5.40	27.00	low	11.97	29.40
S ₃ M ₃	121	35.20	7.12	5.65	28.23	low	12.15	29.80
Mean	120	35.64	7.12	5.93	21.43	-	12.80	29.92
SEm_±								
Spacing	0.84	0.03	0.02	0.06	0.26	-	0.12	0.02
Fertilizers	0.58	0.07	0.02	0.05	0.16	-	0.11	0.04
Spacing × Fertilizers	1.17	0.10	0.03	0.09	0.35	-	0.20	0.06
CD@5%								
Spacing	3.30	0.11	NS	0.23	1.02	-	0.48	0.06
Fertilizers	1.77	0.20	0.06	0.14	0.49	-	0.34	0.12
Spacing × Fertilizers	NS	NS	NS	NS	NS	-	NS	NS

Hort.3: Drip irrigation trial

Centres: East Coast
Plains / others:

Bhubaneswar
Jagdapur 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.

BHUBANESWAR

Experimental details:

Design : Randomized Block Design
Replication : Four

Treatment details : Five

- 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)

Cashew variety : Jagannath (BH-6)

Spacing : 7m X 7m

As per the decision taken in the AGM 2020, the trial on Hort.3: Drip irrigation has been initiated by clearing of the old plantation and preparation of land. The grafts of Jagannath (BH-6) will be planted at 7 m X 7 m spacing during November, 2021.

HOGALAGERE

Treatments : 5

- T1 : No Irrigation
- T2 : Irrigation 20% of Cumulative Pan Evaporation (CPE).
- T3 : Irrigation 40% of Cumulative Pan Evaporation (CPE).
- T4 : Irrigation 60% of Cumulative Pan Evaporation (CPE).
- T5 : Irrigation 80% of Cumulative Pan Evaporation (CPE).

Spacing = 7 x 7m
Variety = Chintamani-1
Vengurla-7
VRI-3

While on experimentation, five levels of irrigation was imposed during flowering and fruiting period i.e. T1-No irrigation, T2- irrigation 20% of CPE, T3-irrigation 40% of CPE, T4-irrigation 60% of CPE and T5-irrigation 80% of CPE, among the treatments, treatment-5 (T5) irrigation 80% of CPE i.e. 80% quantity of water irrigated based on the Cumulative Pan Evaporation was found to be significantly elevated over other level percentage of water irrigated based on CPE

in relation to growth at attributing traits such as Canopy height (2.82 m), Canopy spread (E-W : 7.11 m and N-S : 7.04 m), Mean canopy diameter (7.07 m), Mean canopy surface area (157.16 m²), Ground area covered by plant canopy (61.41%) and same trend was also followed in case of yield attributing parameters such as Apple weight (38.64 g), Mean nut weight (7.21 g), Nut yield per tree (14.86 kg), Nut yield per hectare (23.18 q), Cumulative yield of six years of harvest per tree (57.31 kg) and cumulative yield per tree for six year harvest (89.40 q).

Treatment-5 (T5) i.e. 80% irrigation on relay of CPE especially after 50% of flowering from February to April (summer duration was found to be best treatment compared to other treatments in the experiment and also the quantity and demand of irrigation was gradually increased from February to April).

Table 2.4 : The influence of different levels of drip irrigation on yield parameters of cashew at HREC, Hogalagere during 2020-21

Treatments	Flowering duration (days)	Apple weight (g)	Nut weight (g)	Nut yield (Kg/ plant)	TMB Infestation	Cumulative yield (Kg/plant) (6 harvests)
T ₁	118	35.05	6.85	8.25	Low	35.33
T ₂	130	36.10	7.00	11.13	Low	43.05
T ₃	134	36.90	7.05	12.08	Low	46.63
T ₄	136	38.10	7.08	13.64	Low	50.61
T ₅	136	38.64	7.21	14.86	Low	57.31
S.E.m _±	1.78	0.51	0.03	0.31	-	0.61
CD@5%	5.48	1.59	0.12	0.98	-	1.89
CV	2.72	2.80	1.10	5.32	-	2.64

Table 2.5 : The table depicting that mean values of cumulative pan evaporation and quantity of water applied to plants based on CPE values for different treatments during the year 2020-21 (from February 2021- April 2021)

Month	Evaporation rate (mm)	20% CPE (litres/plant/day)	40% CPE (litres/plant/day)	60% CPE (litres/plant/day)	80% CPE (litres/plant/day)
February	5.00	20.57	41.14	61.71	82.28
March	6.71	27.60	55.20	82.80	110.40
April	6.38	24.68	58.96	88.43	117.91
Average	6.03	24.28	51.77	77.65	103.53

T1= Control, T2= 20% CPE, T3=40% CPE, T4= 60% CPE, T5=80% CPE

Table 2.6 : Weather parameters of HREC, Hogalagere 2021

Month	Rainfall (mm)	No. of Rainy days	Temperature (°C)		Relative Humidity (%)		Wind speed (km/hr)
			Max. (Average)	Min. (average)	Max. (average)	Min. (average)	Max. (average)
February	44.6	02	27.00	15.61	88.14	42.89	20.06
March	0.0	0	33.96	16.31	81.94	35.32	19.68
April	53.5	04	35.78	19.54	87.77	32.97	20.59

JAGDALPUR**Experimental Details**

Variety : Vengurla-4
Year of planting : 2018

The trial has been initiated with variety Vengurla-4 grafts during 2018. All five treatments were replicated four times. Each treatment will be imposed in four plants per replication. The drip irrigation system has been established in experimental plot. The treatments will be imposed from current year January 2021 as per technical program. Evapotranspiration data of 30 years has been collected and mean values will be used for imposing the irrigations levels.

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

Centres: East Coast : Bapatla and Vridhachalam
Plains / others: Jagdalpur

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

BAPATLA

1) Year of Planting : October, 2002. **Variety:** BPP-5

Observation trial

Treatments: Two spacing: a) 4m x 4m (625 plants/ha)
 b) 8m x 8m (156 plants/ha)

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

Note:

1. All the limb pruned plants showed emergence of new shoots within a month.
2. Control measures were taken for CSRB by spraying of Chloripyriphos@10ml/litre.
3. 25% of the trees died due to CSRB infestation after limb pruning.

Table 2.7 : 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 ²)	Ground area coverage by canopy (%)
4m x 4m	3.53	3.37	78.10	4.63	27.42	78.23
8m x 8m	5.60	5.27	104.39	9.24	108.45	113.23

Table 2.8 : 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 ²	Mean No. nuts/panicle
4m x 4m	12.02.2021	13.05.2021	91	6.67	9.65	2.45
8m x 8m	14.02.2021	20.05.2020	96	8.90	11.34	2.78

Table 2.9 : Yield parameters of cashew in normal and high density planting at Bapatla centre

Spacing	Mean nut weight (g)	Mean apple weight (g)	Mean nut yield kg/tree (Harvest No.14)	Nut yield /ha	Cumulative nut yield (kg/tree) (2008-2021)
4m x 4m	5.23	52.30	2.00	1250.0	18.99
8m x 8m	6.22	56.35	4.50	702.0	38.38

The mean nut yield was recorded highest in 8x8 m spacing (4.50 kg/tree) and cumulative nut yield was also recorded highest in 8x8 m spacing (38.38 kg/tree) for fourteen annual harvests. After limb pruning during September 2017, 4x4m spacing recorded the yield of 2.00 kg for third harvest and cumulative nut yield of 18.99kg/tree for total 13 harvests.

Table 2.10 : Yield and B: C ratio in high density trials at Bapatla Centre

Harvest	Yeild (kg/ha.)		Net returns (Rs/ha.)		B.C. Ratio	
	(4m x 4m)	(8m x 8m)	(4m x 4m)	(8m x 8m)	(4m x 4m)	(8m x 8m)
1 st harvest	268.75	50.00	-8875.00	-3240.00	-0.35	-0.51
2 nd harvest	400.00	71.76	-1000.00	-1934.4	-0.04	-0.31
3 rd harvest	515.00	112.5	5350.00	-292.5	0.19	-0.04
4 th harvest	587.5	142.0	10062.50	2210.00	0.35	0.31
5 th harvest	2000.0	436.8	111875.00	23556.00	3.97	3.35
6 th harvest	1825	567.8	96500.00	31946.00	3.08	4.09
7 th harvest	1487.5	650.52	80312.5	40987.500	2.57	5.25
8 th harvest	1012.5	486.7	51000	18936.00	1.76	2.05
9 th harvest	662.50	605.28	28750	23422.00	0.43	1.42
10 th harvest	562.50	399.36	26250	19936.00	0.60	1.00
11 th harvest	-	686.40	-	48640.00	-	2.43
12 th harvest	687.50	436.80	30000	15000.00	1.15	0.83
13 th harvest	1125.0	486.72	50000.00	18937.00	1.25	0.94
14 th harvest	1250.0	702.00	50000.00	33180.00	2.00	1.10

JAGDALPUR

The present trial was replanted in the year 2019 as per recommendation of AGM-2018 with variety NRCC selection-2. The trial is in the initial stage of vegetative growth.

Table 2.11 : Early growth parameters in spacing trial

Spacing	Plant height (m)	Stem girth (cm)	Canopy spread	
			E-W (m)	N-W (m)
4 x 4 m	1.10	10.97	0.98	1.14
8 x 8 m	1.01	10.61	0.93	0.97

Hort.6: Intercropping in Cashew

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

- 1) Year of Planting : 1997 (Main Plot) Variety: BPP-6
 2) Design : RBD
 3) Experimental details : Treatments : 5 (China Aster, Marigold, Chrysanthemum , Crossandra and Cashew alone)

Among the different intercrops studied during the initial years of cashew the treatment T2 (Cashew + Marigold) recorded maximum yield of 2887 kg/ha and was superior over rest of the treatments followed by T₁ (Cashew + China Aster) of 1164kg/ha and T₄ (Cashew +Crossandra) recorded the lowest yield (211 kg/ha).

Further the economics of growing intercrops, it is seen from the data that growing Marigold as inter crop in cashew orchard gave higher net profit of Rs.90380/- with C.B ratio of 1.81 followed by crossandra Rs.86140/- and C.B ratio of 1.57 and the lowest net profit was obtained in Chrysanthemum Rs.39320/- with C.B. ratio of 0.65.

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

Treatment details	Yield of intercrop		Yield of cashew		Cost of cultivation (Rs./ha)			Returns (Rs./ha)				C.B ratio
	Kg/plot	Q/ha	Kg/tree	Q/ha	Cashew	Inter crop	Total	Cashew	Inter crop	Total	Net	
T1 Cashew + China Aster	7.39	11.64	7.20	10.94	25000	30000	55000	87520	46560	134080	79080	1.44
T2 Cashew + Marigold	18.48	28.87	6.80	10.33	25000	25000	50000	82640	57740	140380	90380	1.81
T3 Cashew + Chrysanthemum	3.25	5.07	6.50	9.88	25000	35000	60000	79040	20280	99320	39320	0.65
T4 Cashew + Crossandra	1.34	2.11	6.40	9.73	25000	30000	55000	77840	63300	141140	86140	1.57
T5 Cashew Alone	-	-	5.40	8.42	25000	---	25000	67360	---	67360	42360	1.69
C.D.@5%	0.75	1.67	0.37	0.97								
S.Em. ±	0.23	0.52	0.12	0.31								

Sale Price (Rs/Kg)

Raw Cashew Nuts	: 80.00	Chrysanthemum	: 40.00
China aster	: 40.00	Crossandra	: 300.00
Marigold	: 20.00		

BHUBANESWAR

Experimental details:

Design	: Randomized Block Design
Replication	: Four
Treatment details	: Five (4 different inter-crops)
	T ₁ - Okra
	T ₂ - Tomato
	T ₃ - Cowpea
	T ₄ - Marigold
	T ₅ - Cashew alone (Control)
Variety	: Balabhadra(BH-85)
Spacing	: 7m x 7m

As per the decision taken in the AGM 2020, the trial on intercropping in cashew with new sets of intercrops has been initiated by clearing of the old plantation and preparation of land. The grafts of Balabhadra (BH-85) will be planted at 7 m X 7 m spacing during November, 2021.

DARISAI

Table 2.13 : Yield and economics of cashew and intercrops in intercropping trial at ZRS, Darisai, Centre during the year 2020-21.

Variety: V4

Treatment Details	Mean yield of intercrop	Mean yield of cashew	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				B:C Ratio
	Q/ha	Q/ha	Cashew	Inter-crop	Cashew + Inter crop	Cashew	Inter-crop	Total	Net Profit	
T1	99.72	7.89	54640	49116	103756	78900	249300	328200	224444	2.16
T2	187.14	9.21	54640	59182	113822	92100	243282	335382	221560	1.95
T3	38.49	8.11	54640	30015	84655	81100	123168	204268	119613	1.41
T4	46.81	8.61	54640	44448	99088	86100	173197	259297	160209	1.62
T5	---	10.48	54640	---	54640	104800	---	104800	50160	0.92

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.100 /kg, Tomato Rs.25/kg, Cabbage Rs.13/kg, French bean Rs.32/kg, Pea Rs.37/kg.

Result: Cashew + Tomato recorded the highest B/C ratio 2.16 followed by cashew + cabbage 1.95.

JHARGRAM**Experimental Details :**

Design	: Randomised Block Design
Replications	: 6 (Three)
Year of planting of cashew plants	: 2017
Spacing of cashew plants	: 4 m x 4 m
Variety of Cashew	: BPP- 8
Intercrops Taken	: Cowpea (Local), Cluster bean (Pusa Nababahar), Black gram (Local), and turmeric (Local)
The available space for intercrops	: 50 %.

The cashew plants spaced at 4m x 4m spacing were pruned and the percentage ground coverage by canopy was restricted within 50% to facilitate intercropping under the plants. Therefore, the plants had no significant differences with respect to growth parameters. The cashew plants grown with different intercrops had equivalent result with respect to yield. Yield per unit area was maximum when cashew was intercropped with black gram. The B:C ratio was also highest in cashew + black gram combination.

Table 2.14 : Performance of cashew plants in the intercropping system 2021

Crop combination	Tree ht. (m)	Stem girth (cm)	Spread (m)	Canopy area (m ²)	Yield /tree (kg) 3 rd harvest	% Ground coverage by canopy	Yield/h a (Kg)
Cashew + Cowpea	2.76	26.67	2.93	12.08	1.26	42.45	787.90
Cashew + Black Gram	2.76	28.17	3.16	13.41	1.63	49.38	1021.0
Cashew + Cluster bean	2.87	29.50	3.00	13.12	1.76	45.02	1097.7
Cashew + Turmeric	2.93	28.25	2.87	12.68	1.11	40.86	691.91
Cashew alone	2.63	30.17	2.71	9.66	1.41	37.32	880.77
S.Em ±					0.11		
C.D. at 5%	NS	NS	NS	NS	0.31	NS	
CV %	8.10	13.43	13.03	24.92	17.96	23.72	

Table 2.15 : Yield and economics of cashew and intercrops in intercropping trial at Jhargram Centre during the year 2019-20

Treatment details	Yield of intercrop	Yield of cashew *	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				B:C Ratio
	Q/ha	Q/ha	Cashew	Inter-crop	Cashew + Intercrop	Cashew	Inter-crop	Total	Net	
Cashew + Cowpea	3.58	7.88	25740	40000	65740	70920	44270	115190	49450	0.75
Cashew + Black Gram	2.54	10.21		30265	56005	91890	102604	194494	138489	2.47
Cashew + Cluster bean	2.75	10.98		35200	60940	98820	51302	150122	89182	1.46
Cashew + Turmeric (Green)	25.54	6.92		175000	200740	62280	325312	387592	186852	0.93
Cashew alone	--	8.81		--	25740	79290	--	79290	53550	2.08

Available area for intercropping (Age 4 years) : 50%

Price of intercrop : Cowpea : Rs.20 /Kg, Black gram : 60 Rs. /Kg, Turmeric : Rs. 20/Kg, and Cluster Bean : Rs. 30/Kg.

Price of raw cashew nut : Rs. 90/kg

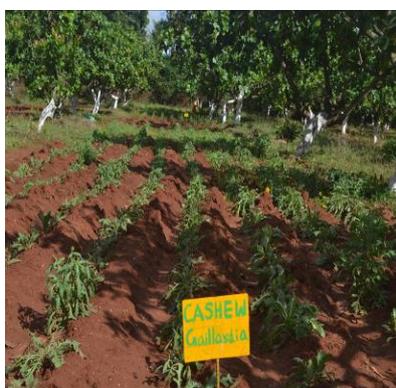
KANABARGI

Year of planting (intercrop)	: 2016
Location	: Horticultural Research station, Kanabargi
Design	: RBD
Treatments	: 6
Replications	: 4

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 size.



Intercropping with Cauliflower



Intercropping with Gaillardia



Intercropping with Knol Khol

Table 2.16 : Yield and economics of cashew based intercropping system based on mean yield at HREC, Kanabargi.

Sl. No.	Intercrop	Estimated yield (q/ha)	Cost of cultivation of intercrop (Rs/ha)	Total returns from intercrops (Rs./ha)	Net profit from intercrop (Rs./ha)
1	Cabbage	1419.00	19950.00	13054.80	-6895.20
2	Cauliflower	726.00	11400.00	5916.90	-5483.10
3	Knolkhol	2531.00	25080.00	31004.75	5924.75
4	Gaillardia	2651.00	70200.00	92785.00	22585.00
5	China Aster	1618.00	34010.00	61484.00	27474.00
6	Chrysanthemum	1758.00	48640.00	66804.00	18164.00

Cabbage @ Rs. 9.20/kg,
Gaillardia @ RS. 35/kg,
(Rates as per APMC)

Cauliflower @Rs. 8.15/kg,
china Aster 38/kg,

knoll khol @Rs. 12.25/kg,
Chrysanthemum @ Rs. 38/kg

Net profit from the intercrops was maximum recorded from china aster (Rs. 27474.00) and Gaillardia intercrop (Rs 22585.00). Negative results appear from intercrops with cabbage and cauliflower.

Table 2.17 : Yield of cashew (main crop) and economics of cashew based intercropping systems at HRS, Kanabargi, Belgaum

Sl. No.	Intercropping system	Cashew nut yield (Mean)		Gross expenditure (Main crop + Intercrop) (Rs/ha)	Gross income (Main crop + Intercrop) (Rs/ha)	Net Profit (Main crop + Intercrop) (Rs/ha)	Benefit Cost Ratio (BCR)
		Kg/tree	Q/ha (Estimated)				
1	Cashew + Cabbage	7.75	2146.75	77140.00	270664.80	193524.80	2.51
2	Cashew + Cauliflower	7.67	2124.59	68590.00	260867.70	192277.70	2.80
3	Cashew + knoll khol	7.76	2149.52	82270.00	288947.15	206677.15	2.51
4	Cashew + Gaillardia	8.25	2285.25	127390.00	367015.00	239625.00	1.88
5	Cashew + china Aster	7.67	2124.59	91200.00	316434.80	225234.80	2.47
6	Cashew + Chrysanthemum	6.96	1927.92	105830.00	298154.40	192324.40	1.82
7	Cashew alone	7.65	2119.05	57190.00	254286.00	197096.00	3.45

Net profit from main crop and intercrops was maximum recorded from Cashew + Gaillardia intercrop (Rs. 2,39,625.00) followed by Cashew + China aster inter crop (Rs. 2,25,234.80). Minimum was recorded in Cashew + Cauliflower intercrop (Rs. 1,92,277.70). Highest benefit to cost ratio was recorded in cashew alone (3.45) followed by Cashew + Cauliflower intercrop (2.80) and Cashew + cabbage (2.51) whereas minimum was recorded in Cashew + Chrysanthemum (1.82).

MADAKKATHARA

Experimental details:

Design : RBD
Replications : 3
Treatments : 6

Treatment details:

Sl. No.	Treatments
T ₁	Cashew + Ginger (<i>Zingiber officinale</i>)
T ₂	Cashew + East Indian Arrowroot (<i>Curcuma angustifolia</i>)
T ₃	Cashew + Black Turmeric (<i>Curcuma caesia</i>)
T ₄	Cashew + Aromatic Turmeric (<i>Curcuma aromatica</i>)
T ₅	Cashew + Mango Ginger (<i>Curcuma amada</i>)
T ₆	Cashew + Turmeric (<i>Curcuma longa</i>)
T ₇	Control (Cashew alone)

Intercropping in cashew was done with a new set of six popular aromatic spice crops. The intercrops were planted in a newly established cashew plantation of 5m x 5m spacing and managed under rainfed condition.

Table 2.18 : Yield and economics of cashew and intercrops in intercropping trial at CRS, Madakkathara (2021)

Treatments	Yield of intercrop	Yield of cashew	Cost of cultivation (Rs/ha)			Returns (Rs. /ha)				B:C ratio
	Q/ha	Q/ha	Cashew	Intercrop	Total	Cashew	Intercrop	Total	Net	
T ₁	116.83 ^d	0.893	20000	468000	488000	8037	1168300	1176337	688337	1.41
T ₂	297.50 ^a	0.820	20000	440000	460000	7380	1785000	1792380	1332380	2.90
T ₃	157.50 ^d	0.853	20000	682000	702000	7677	2362500	2370177	1668177	2.38
T ₄	120.83 ^d	0.820	20000	500000	520000	7380	1449960	1457340	937340	1.80
T ₅	175.00 ^{bc}	1.207	20000	405000	425000	10863	875000	885863	460863	1.08
T ₆	207.08 ^b	1.060	20000	438000	458000	9540	1242480	1252020	794020	1.73
T ₇	-	0.733	20000	-	20000	6597	-	6597	-13403	-0.67
SE (m)	19.89	0.25	[Selling price: Ginger @ Rs. 100/kg, East Indian Arrowroot @ Rs. 60/kg, Black Turmeric @ Rs. 150/kg, Aromatic turmeric @ Rs. 120/kg, Mango Ginger @ Rs. 50/kg, Turmeric @ Rs. 60/kg]							
CV (%)	15.87	33.68								
CD @ 5%	43.35	NS								



Intercropping in cashew at Madakkathara

Among the intercrops, the highest yield of 297.5 Q/ha was recorded in East Indian Arrowroot followed by turmeric (207.08 Q/ha). The economic analysis revealed the highest B:C ratio of 2.9 in the treatment T₂, with East Indian Arrowroot as intercrop. Cashew intercropped with Black turmeric also recorded B:C ratio above 2.0, because of its high price in market.

PARIA

The highest inter crop yield/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. 94326 ha⁻¹ was observed under the inter crop of coriander (T1) alongwith highest benefit: cost ratio of 2.86. It was followed by the inter crop of spinach (T3) with benefit: cost ratio of 2.75.

Table 2.19 : The yield and economics of intercropping in cashew

Treatments	Yield of IC	Yield of Cashew	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				B:C Ratio
	q/ha	q/ha	Cashew	IC	Cashew+IC	Cashew	IC	Total	Net	
T ₁ : C + Coriander	43.63	2.84	10900	22000	32900	31240	95986	127226	94326	2.86
T ₂ : C + Fenugreek	32.69	3.03	10900	22000	32900	33330	71918	105248	72348	1.19
T ₃ : C + Spinach	45.50	2.13	10900	22000	32900	23430	100100	123530	90630	2.75
T ₄ : C+ Amaranthus	8.58	1.52	10900	22000	32900	16720	21450	38170	5270	0.16
T ₅ : Cashew alone	0.00	1.44	10900	0	10900	15840	0	15840	4940	0.45
	SEm.	0.73								
	CD @5%	NS								
	CV %	57.75								

VENGURLE

- Design : R. B. D.
 Replication : Five
 Treatments : Five different inter-crops
 T₁ Cashew + Yardlong bean (Wali) (*Vigna unguiculata sp. sesquipedalis*)
 T₂ Cashew + French bean-Ghewda (*Phaseolus vulgaris*)
 T₃ Cashew + Cowpea (*Vigna unguiculata*)
 T₄ Cashew + Chilli (*Capsicum annum*)
 T₅ Cashew + Brinjal (*Solanum melongena*)
 T₆ Control (Cashew alone)
 Spacing : Cashew - 7m x 7m (204 plants/ha)
 Area planted with intercrop/ha- 4900 sq. m.
 Intercrop plot size - 25 sq. m. (5m x 5m)
 No. of intercrop plots/ha. – 196 Nos.
 Sole intercrop : Sole intercrops are planted near the experimental plot for comparison.
 Year of start : Rabi season, 2018
 Cashew variety : Vengurle-9 (planted in December, 2016)
 Cashew spacing : 7 x 7 m

Package of practices : Recommended package of practices including recommended dose of fertilizers and plant protection were followed for both main crop cashew and intercrops.



Brinjal as an Intercrop



Chilli as an Intercrop

Intercropping in cashew with new sets of regionally important intercrops trial (third year) was laid out in *Rabi* season, 2020-21 at AICRP-Cashew, Vengurla centre. Yield observations of both crops (main & inter-crops) was recorded and economics workout is presented in Table.

From the data presented in Table, it is observed that treatment Yardlong bean (T₁) recorded significantly the highest yield of 66.77 q/ha and superior over rest of the treatments. The maximum main crop cashew yield recorded more when Yardlong bean (T₁) was intercropped in cashew (9.42 q/ha) however, it was at par with treatment T₃ - Cashew + Cowpea (8.84 q/ha). The highest net returns of Rs. 284292/- was obtained from cashew + Yardlong bean (T₁) intercropping system with C:B ratio of 1:3.97.

Table 2.20 : Yield and economics of cashew and intercrops in intercropping trial at Vengurla Centre during 2020-21

Treatment details	Yield of inter-crop	Yield of cashew	Cost of Cultivation (Rs./ha)			Returns (Rs./ha)				C:B Ratio
	Q/ha	Q/ha	Cashew	Inter-crop	Cashew + Intercrop	Cashew	Inter-crop	Total	Net Income	
T ₁ : Y. L.bean	66.77	9.42	64766	31062	95828	113040	267080	380120	284292	1:3.97
T ₂ : F. bean	32.84	7.83	64766	22436	87202	93960	131360	225320	138118	1:2.58
T ₃ : Cowpea	30.98	8.84	64766	25732	90498	106080	123920	230000	139502	1:2.54
T ₄ : Chilli	23.27	7.72	64766	28034	92800	92640	93080	185720	92920	1:2.00
T ₅ : Brinjal	48.84	7.47	64766	29234	94000	89640	195360	285000	191000	1:3.03
S.Em. _±	0.96	0.29	-	-	-	-	-	-	-	-
CD at 5%	2.88	0.86	-	-	-	-	-	-	-	-
CV%	5.35	8.14	-	-	-	-	-	-	-	-
T ₆ : Control Cashew alone	0	6.85	64766	0	64766	82200	0	82200	17434	1:1.27

Area planted with intercrop/ha- 4900 sq. m.

Intercrop plot size - 25 sq. m.; No. of intercrop plots/ha. - 196

Price of produce (Rs. /kg): Yardlong bean - 40/kg; French bean - 40/ kg; Cowpea - 40/kg; Chilli - 40/kg and Brinjal - 40/kg.

Cashew raw nut - Rs.120/- per kg (University rate for the year 2020-21).

VRIDHACHALAM

High value transplantable flower crops namely *Viz.*, French Marigold, African Marigold, Cosmos and Zinnia were sown as intercrops in VRI-3 plot (year of planting 2013) in an area of 20 Cents each during 2020-2021. The trial was repeated with same intercrops to find out the consistency of the intercrops giving more income to farmers during 2020-2021. Sowing was done during the 1st week of November, 2020.

Table 2.21 : Yield and economics of cashew and intercrops in intercropping trial at Vridhachalam Centre during 2020-21

Treatments	Yield of Intercrop (q/ha)	Yield of Cashew (q/ha)	Cost of Cultivation			Returns (Rs/ha)				BC ratio
			Cashew	Intercrop	Cashew + Intercrop	Cashew	Intercrop	Total	Net	
Cashew + French Marigold	18	4.3	25000	29454	54454	55900	72000	127900	73446	2.4
Cashew + African Marigold	23	4.3	25000	29000	54000	55900	15000	170900	116900	3.9
Cashew + Cosmos	13	4.3	25000	18000	43000	55900	10400	66300	20300	0.57
Cashew + Zinnia	14	4.3	25000	19000	44000	55900	14000	69900	25900	0.73

The net return is higher in cashew + African marigold (Rs. 1,16,900/ha) and the benefit cost ratio is also high (3.9). All the flower crops gave high returns (BC>2).

Hort.7: Organic Management of Cashew

Centres: East Coast : Bapatla and Vridhachalam
Plains / others: Darisai and Hogalagere

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

Treatments details :

- T1 - 100 % N as FYM
- T2 - 100 % N as FYM +Bio-fertilizers (Azatobacter + 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 (200 g)
- T8 - Recommended doses of fertilizer +10 kg FYM (Control)

BAPATLA

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

Among the treatments, the mean plant height was recorded highest in T3 (3.36m) followed by T4 (3.23m) and T5 (3.07m). Highest mean canopy height was noticed in T3 (3.11 m) followed by T4 (2.93 m). The mean trunk girth was recorded highest in T4 (50.67 cm) followed by T2 (50.37 cm). The mean canopy spread was recorded maximum in T4 (5.04 m) followed by T1 (4.82 m) and canopy surface area was recorded maximum in T4 (30.24 m²) followed by T2 (29.32).

The shortest flowering duration was recorded in T1 (80.0 days) and followed by T4 (84.0 days). With respect to mean number of nuts per square meter and mean number of nuts per panicle was found to be significant. The flowering intensity per square meter was highest in T4 (12.22) followed by T8 (11.86). The mean no. of nuts per square meter was found highest in T4 (15.00) followed by T8 (14.22). The mean no of nuts per panicle was found maximum in T4 (4.37), followed by T2 (4.27).

Table 2.22 : Yield parameters of cashew in organic management at Bapatla Centre

Sl. No.	Treatment	Nut weight (g)	Apple weight (g)	Shelling (%)	Nut yield /tree (kg) (4th harvest) 2021	Cum. Nut Yield (kg/tree) (2018-2021)
1.	T1	7.99	74.65	26.99	5.10	16.52
2.	T2	8.02	75.65	29.18	5.30	16.65
3.	T3	7.82	71.03	28.02	5.28	14.95
4.	T4	8.12	79.33	28.80	5.90	18.10
5.	T5	7.96	69.93	27.00	4.20	13.30
6.	T6	7.77	66.26	25.24	4.00	13.40
7.	T7	7.61	66.47	28.42	4.30	13.93
8.	T8	7.81	72.85	28.60	4.80	15.06
	CD@5%	N.S.	4.62	NS	0.77	
	SEm ±	0.29	1.50	0.99	0.25	

Among the treatments, the mean nut weight was found maximum in T4 (8.12 g) followed by T2 (8.02 g) and T1 (7.99 g). The maximum mean annual nut yield per tree during the year was recorded in T4 (5.90 kg) followed by T2 (5.30 kg). With regard to the mean apple weight, the highest was recorded in T4 (79.33g). The shelling percentage was recorded highest in T2 (29.18) followed by T4 (28.80). The cumulative nut yield was recorded highest in T4 (18.10kg/tree) for four annual harvests.

DARISAI

Table 2.23 : Growth parameters of cashew under organic management at ZRS, Darisai centre during the year 2020-21. (Variety Balbhadra)

Treatment	Mean tree height (m)	Mean stem girth (cm)	Mean canopy diameter (m)	Mean canopy surface area (m ²)	Ground coverage by canopy (%)
T1	5.35	65.37	6.76	35.87	68.28
T2	4.01	68.29	6.97	38.14	70.68
T3	4.29	51.82	4.48	15.76	47.40
T4	4.72	55.41	5.19	21.14	58.54
T5	4.96	47.01	4.18	13.72	35.70
T6	5.57	44.58	4.06	12.94	33.70

T7	4.49	69.58	7.13	39.91	75.44
T8	4.48	73.18	7.39	42.87	80.40
SEm±	0.42	5.56	0.46	1.57	4.64
CD at 5%	1.13	14.82	1.09	3.89	12.43
CV (%)	13.58	15.19	15.38	14.51	15.87

Table 2.24 : Yield parameters of cashew under organic management at ZRS, Darisai centre during the year 2021

Treatment	Flowering laterals/m ²	Nut wt. (g)	Apple wt. (g)	Annual Nut Yield (kg/plant) 6 th Harvest	Cumulative Nut Yield (kg/plant) for Six harvests
T1	24.26	6.41	63.07	4.38	19.86
T2	25.05	6.62	55.88	4.93	21.88
T3	12.91	6.27	69.72	3.09	15.56
T4	23.56	6.54	61.06	4.56	20.41
T5	16.33	6.14	64.44	2.57	13.68
T6	27.48	6.35	67.49	4.16	19.03
T7	29.61	6.83	73.69	4.73	22.03
T8	33.41	7.06	77.37	5.43	24.28
SEm±	1.73	-	2.63	0.31	0.45
CD (5%)	5.07	NS	7.58	0.89	1.28
CV (%)	15.18	-	15.64	13.97	14.74

Recommended dose of fertilizer (N 500 gm, P₂O₅ 250 gm & K₂O 250 gm) + 10 Kg FYM (Control) recorded the maximum nut yield / plant (5.43 Kg) which was statistically on par with T₂ (4.93 Kg) where 100 % N + Bio-fertilizer 200gm/plant was applied and T₇ (4.73 Kg/plant) where, 25 % N as FYM + recycling of organic residue + in C₂ green manuring + Bio-fertilizer (200 gm/plant) was applied. On the basis of cumulative yield (Six harvests) T₈ (Control) was found significantly superior to all other organic treatments.

HOGALAGERE

Among the eight treatments T₈ i.e., recommended dose of fertilizers (500:250:250 NPK gram/tree/year) with 10 kg farm yard manure was recorded significantly higher values except T₇ in case of growth and yield attributing traits such as canopy height (2.40m) canopy spread (E-W:3.74m and N-S: 3.70 m), mean canopy diameter (3.72m), mean canopy surface area (29.91 m²), ground area covered by plant canopy (22.20%), nut yield per plant (8.32kg), nut yield per hectare (16.97q) cumulative yield per plant for 5 year harvest (23.13 kg) and cumulative yield per hectare for 5 year harvest (47.19q).

Whereas T₈ was also found on par with T₇ as well as T₄ in some of the parameters such as canopy spread (E-W and N-S), mean canopy diameter, flowering duration and shelling percentage.

However, T₈ recorded numerically higher values in majority of the growth and yield parameters and when looking only into the view of organic source, the treatment-7 and treatment-4 performed better, which were on par in nut yield per plant and nut yield per hectare.

However, T₇ was found numerically higher values in majority of the parameters when considered among the organic treatments. Hence, T₇ was found to be best treatment compared to other organic combination treatments and the tea mosquito bug infestation was observed low in all the treatments.

Table 2.25 : The influence of organic manures, bio-fertilizers and other organic sources on yield parameters of cashew at HREC, Hogalagere during 2020-21

Treatments	Flowering duration (Days)	Mean apple weight (g)	Mean nut weight (g)	Nut yield (Kg/plant)	Shelling (%)	TMB Infestation	Cumulative yield (Kg/plant) (6 harvests)
T ₁	119	35.00	7.07	6.60	30.00	Low	18.25
T ₂	122	35.60	7.11	7.50	30.15	Low	20.72
T ₃	120	35.20	7.09	7.00	30.05	Low	18.71
T ₄	124	36.17	7.16	7.90	30.20	Low	20.82
T ₅	118	34.50	7.01	5.50	29.90	Low	16.20
T ₆	118	34.20	6.95	5.05	29.80	Low	15.07
T ₇	125	36.22	7.21	8.05	30.40	Low	22.91
T ₈	128	36.47	7.17	8.32	30.45	Low	23.13
SEm±	6.4760	2.794	0.087	0.344	0.2796	-	0.8551
CD@5%	3.0444	0.563	0.702	2.807	0.5300	-	2.5069
CV	2.1348	0.921	0.029	0.113	0.0922	-	0.2819

VRIDHACHALAM

The trial has been concluded

Hort.8 : Spacing cum fertilizer trial

Centres: Plains / others: Darisai

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

DARISAI

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

Fertilizer Application Level

1st Year - 1/5th

2nd Year - 2/5th

M1: 75 Kg N, 25 Kg P₂O₅, 25Kg K₂O,

3rd Year - 3/5th

4th Year - 4/5th

M2: 150 Kg N, 50 Kg P₂O₅, 50Kg K₂O

5th Year - full dose

M3: 225 Kg N, 75 Kg P₂O₅, 75Kg K₂O

Variety: BPP-8

Table 2.26: Interaction effect between tree densities and fertilizer dose on yield parameters of cashew during 2020-21

Treatment	Flowering days	Mean flowering lateral/ (m ²)	Mean nut wt. (g)	Mean apple wt. (g)	Mean nut yield (kg/tree) at 6 th harvest	Cumulative yield for <u>six</u> harvests Kg/plant
S1M1	107.83	25.38	7.09	72.52	5.62	27.09
S1M2	126.63	37.10	7.87	80.80	6.27	31.99
S1M3	108.57	27.73	6.72	72.48	5.33	24.22
S2M1	116.63	37.62	7.26	75.53	5.08	21.67
S2M2	104.92	45.09	7.57	76.62	4.74	21.41
S2M3	101.92	41.08	7.35	72.17	3.31	16.06
S3M1	96.37	34.52	7.14	70.06	2.94	14.27
S3M2	98.89	37.85	6.98	67.30	3.43	16.95
S3M3	87.97	35.64	6.74	62.74	2.28	12.24
SEm±	3.96	2.96	0.28	2.57	0.24	0.41
CD (5%)	11.83	8.87	0.79	7.32	0.61	1.13
CV (%)	14.47	15.53	13.18	15.44	14.73	15.13

S₁M₂ is significantly superior in current year yield & also in cumulative yield on the basis of six harvests among all other interactions tested.

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

Experimental Details :

Treatments :

- i) T₁ – 10m x 10m ii) T₂ - 8m x 8m
 iii) T₃ - 7m x 5m iv) T₄ - 4m x 4m

No. of replications : 6
 Design : Randomized Block Design
 Year of Planting : 2014
 Variety : Bidhan Jhargram-2

There were significant differences among the different spacings with regard to different growth and yield attributes tested except panicles/m² and nut weight. The spacing treatments T₁, T₂, T₃ were on par with regard to tree height, stem girth, canopy spread, canopy area, nuts/m² and yield/tree whereas T₄ treatment is significantly different from the rest of the treatments. While in case of percentage ground coverage by canopy, significant variations were recorded among the treatments. Maximum ground area was covered by T₃ followed by T₄ and T₂ which were on par and minimum area was covered by T₁ treatment. Yield/ha values showed that T₃ had maximum yield compared to other treatments and minimum yield/ha was recorded in T₄ and T₁. Cumulative yield value depicted that at the 3rd harvest T₄ treatment had maximum cumulative yield/ha.

Table 2.27 : Yield parameters of Bidhan Jhargram - 2 under Spacing trial at Jhargram centre during the year 2020 – 21

Treatment	Mean no. of panicles/m ²	Mean no. of nuts/m ²	Mean nut weight (g)	Mean annual nut yield (kg/tree)	Yield /unit area (Q/ha)	Cumulative yield/ha (Kg/ha) (3 harvests)
T ₁ - 10m x 10m	15.71	10.33	8.03	4.29	4.29	899.54
T ₂ - 8m x 8m	14.67	9.63	8.00	4.31	6.73	1383.23
T ₃ - 7m x 5m	15.42	10.17	8.06	4.13	11.76	2232.49
T ₄ - 4m x 4m	13.33	6.38	8.00	0.74	4.63	2666.11
Sem \pm		0.63		0.25	0.59	
CD at 5%	NS	1.85	NS	0.73	1.74	
CV%	14.35	16.85	1.14	18.12	21.10	

Hort. 11: Ultra high-density planting in cashew

<i>Centres: East Coast:</i>	Bapatla, Bhubaneswar, Jhargram and Vridhachalam
<i>West Coast:</i>	Madakkathara, Pilicode and Vengurla
<i>Plains</i>	Hogalagere, Jagdalpur and Kanabargi

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

BHUBANESWAR

Experimental details:

Year of Planting :	2020
Design :	Split plot
Replication :	03

Treatment details:

Main plot : Spacing	Sub plot : Varieties
S ₁ : 2.5 m x 2.5 m	V ₁ : VRI-3
S ₂ : 3 m x 3 m	V ₂ : NRCC Sel-2
S ₃ : 7.5 m x 7.5 m (Control)	V ₃ : Balabhadra (Local check)

No. of plants/treatment/
Replication : 6 plants for UHDP and 3 plants for normal planting

The experiment was laid out during October, 2020 in split plot design with three replications. The growth of all the grafted plants is satisfactory. Care and maintenance of the grafted cashew plants are in progress. The initial training (Removal of side sprouts up to 1.5'-2.0' on main stem) of the grafts were frequently done at regular intervals. Similarly, the terminal bud was nipped off at 1m height from the ground level.

HOGALAGERE

This experiment has been initiated this year

JHARGRAM

Date of planting :	23 rd July, 2018
Design :	Split plot
Replication :	3

Treatment details : Main Plot : Spacing

S₁ : 8m x 8m (Control) S₂ : 5m x 5m S₃ : 3m x 3m

: Sub plot : Varieties

V₁ : VRI-3 V₂ : NRCC sel - 2 V₃ : K- 22 -1 (Control)

No. of plants/ treatment/ repl. : 4



Pruning in ultra high-density planting

Table 2.28 : Yield of varieties under ultra high-density planting of cashew at Jhargram centre during the year 2021

Treatment	Flowering/ m ²	Nuts/ m ²	Nut Weight (g)	Nut yield (Kg/Tree)
S1	2.6	34.0	5.9	0.58
S2	2.4	43.6	6.2	0.79
S3	2.7	41.2	6.1	0.71
C.D. at 5%	NS	2.14	NS	0.02
V1	2.6	42.8	5.3	0.67
V2	2.5	34.4	7.6	0.75
V3	2.6	41.6	5.3	0.65
C.D. at 5%	NS	2.54	0.31	0.03
S1V1	2.7	38.0	5.4	0.61
S1V2	2.6	30.7	7.7	0.69
S1V3	2.5	33.2	4.8	0.46
S2V1	2.5	49.0	5.3	0.75
S2V2	2.3	37.4	7.7	0.84
S2V3	2.4	44.5	5.6	0.77
S3V1	2.8	41.5	5.3	0.66
S3V2	2.6	35.1	7.3	0.72
S3V3	2.8	47.0	5.6	0.74
C.D. at 5%	NS	7.61	NS	NS
CV% (a)	18.13	11.23	10.66	7.19
CV% (b)	16.37	13.29	9.41	11.57

In most of the cases no significant variations were recorded with respect to growth parameters. Varietal difference was significant with regard to nut weight, but spacing or interaction effect was not significant on nut weight. The varieties as well as the spacing both had individual impact on nuts/m² and yield/tree and 5m X 5m spacing supported maximum nuts/m² and yield/tree followed by 3m X 3m. Among the three varieties VRI -3 had maximum nuts/m² but the yield /tree was highest in NRCC-2. Spacing had a significant impact on the yield/ha and maximum yield/ha was recorded in 3m X 3m (783.8 Kg) followed by 5m X 5m (157.3 Kg). In case of yield /ha varietal effect was non-significant in the first year of harvest but interaction effect was significant and the treatments S₃V₃ and S₃V₂ were on par but different from rest of the treatments. Therefore, the results showed that the varieties K-22-1 and NRCC-2 can produce more under UHDP during the initial years. The economics calculation of UHDP shows that during the first harvest mostly the B:C ratio was negative due to the initial establishment cost.

KANABARGI

Experiment to be initiated during 2021. The varieties VRI-3 , V-9 and V-4 has been grafted and will be planted during 2021.

MADAKKATHARA

Experimental details:

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

Treatment details:

Main plot - Spacing	Sub plot - Varieties
S ₁ : 2.5 x 2.5 m	V ₁ : VRI-3
S ₂ : 3 x 3 m	V ₂ : NRCC Selection-2
S ₃ : 3.5 x 3.5 m	V ₃ : Poornima
S ₄ : 8 x 8 m (Control)	



Fig: View of the ultra high-density planting

Three varieties (VRI-3, NRCC Selection-2 and Poornima) were planted at four spacings (2.5m, 3.0m, 3.5m and 8.0m) in split plot design with three replications

Spacing exhibited significant effect on the height, canopy diameter and canopy surface area of the trees with the highest value in main plot treatment S4 (8m x 8m). There was no significant difference in growth parameters with respect to varieties. The trees were regularly pruned to maintain a height of 1.5 m in the month of June. Over the last years, canopy spread was found to be high in subplot V1 (VRI-3).

Yield per tree was significantly high (590.4 g) in main plot S4 (8 x 8m). There was no significant difference among varieties in the initial period of bearing. When yield per unit area was considered, mainplot S1 (4.6 Q/ha), S3 (4.1 Q/ha) and S2 (3.6 Q/ha) recorded significantly higher yield. Subplot treatment means were not significantly different with respect to yield per unit area.

Table 2.29 : Influence of spacing and different varieties on yield under ultrahigh density system of planting at CRS, Madakkathara during 2021

Treatments	Yield per tree (g)	Yield per unit area (Q/ha)
Main plot		
S ₁	284.44	4.55
S ₂	323.70	3.60
S ₃	495.56	4.05
S ₄	590.44	0.92
SE (m)±	47.77	0.35
SE (d)	67.56	0.50
CV (%)	33.84	32.47
Sub plot		
V ₁	376.40	3.13
V ₂	413.54	3.24
V ₃	480.67	3.47
SE (m)±	49.57	0.54
SE (d)	70.10	0.76
CV (%)	40.54	56.68
Main plot x sub plot		
S ₁ V ₁	299.83	4.80
S ₁ V ₂	265.50	4.25
S ₁ V ₃	288.00	4.61
S ₂ V ₁	246.76	2.74
S ₂ V ₂	371.50	4.13
S ₂ V ₃	352.83	3.92
S ₃ V ₁	526.33	4.29
S ₃ V ₂	452.83	3.70
S ₃ V ₃	507.50	4.14
S ₄ V ₁	432.67	0.68

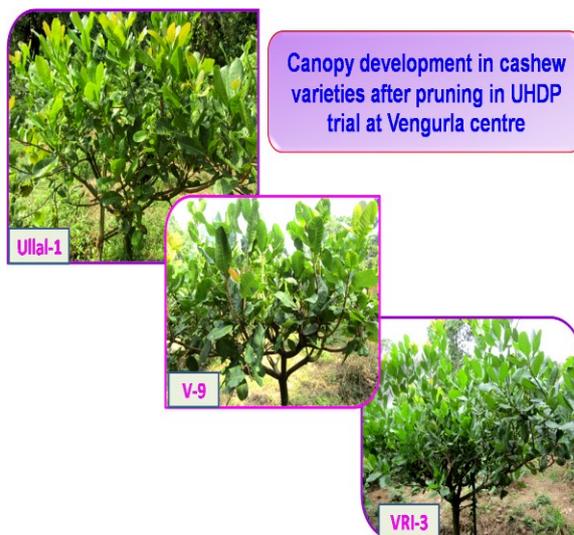
S_4V_2	564.33	0.88
S_4V_3	774.33	1.21
SE(m) (Factor A* at same level of factor B) ($\alpha=0.05$)	99.14	1.07
SE(d) (Factor A* at same level of factor B) ($\alpha=0.05$)	140.20	1.51
SE(m) (Factor B* at same level of factor A) ($\alpha=0.05$)	93.99	0.95
SE(d)(Factor B* at same level of factor A) ($\alpha=0.05$)	132.92	1.34

VENGURLE

- Date of planting : 1st 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 (Local)
- Operation to be performed after planting : 1) Removal of side sprouts up to 1.5' – 2.0' on main stem
2) Terminal bud can be knifed off at 1 m height from ground level
- Development of framework of primary branches : ➤ 3-5 major branches be allowed in different directions and later the pruning of secondary & territory branch after completion of fruiting season.
➤ Yearly to be repeated.
➤ 1% Bordeaux spray after pruning.
➤ Regular pest control measures to be followed.
- Manuring : Half of the dosage of regular spaced plants sufficient for the UHD plantation can be given in two splits. Recommended dose should be given at least 2 months before flushing and flowering.
- Irrigation : Depending on the locality, water requirement may be decided for the initial establishment. Subsequently need based irrigation to be given after flowering depending on the availability of the water and varieties planted.



UHDP - 3m x 3m



Canopy development in UHDP

The trial is initiated at AICRP-Cashew, RFRS, Vengurla centre in July, 2018. The growth of all the grafts is satisfactory. Pruning was performed by removing the secondary & tertiary branches.

Year 2020-21 is the second year of experimentation. The vegetative growth observations of the trial for the year 2020-21 (second year) was recorded. The effect of spacing, variety and their interaction showed non-significant results for vegetative growth attributes.

In present investigation, the precocity of flowering observed in variety V_1 (VRI-3) & variety V_2 (Ullal-1) and both varieties started flowering early in 1st week of November, 2020 while variety V_3 (V-9) start flowering in 2nd week of November, 2020. Variety V_1 (VRI-3) & variety V_2 (Ullal-1) was found precocious as compared to variety V_3 (V-9).

The flowering attributes of the trial was recorded during the year 2020-21. Data revealed that, effect of spacing, variety and their interactions did not significantly affect flowering duration (days), number of laterals per m^2 and flowering panicles per m^2 . However, the effect of spacing on number of laterals per m^2 and effect of variety on flowering panicles per m^2 showed significant results. S_1 spacing (2.5m x 2.5m) recorded the highest number of laterals (28.45/ m^2) and it was at par with S_2 spacing (27.57/ m^2). The highest flowering panicles (19.94 m^2) was noted in variety V_3 (V-9) and it was at par with variety V_2 (17.52 m^2).

The data also revealed that, there was a significant effect of spacing on fruit set/ m^2 , number of nuts/panicle and apple weight (g) similarly, there was significant difference among the varieties with respect to apple weight (g) and nut weight (g) however, interactions showed non-significant results.

So far as yield is concerned, different spacings, varieties and their interactions significantly affect the yield (kg/tree, kg/plot & t/ha) except interaction effect for yield

(t/ha). The highest yield was recorded in S_1 spacing (0.74 kg/tree) and at par with S_2 spacing (0.73 kg/tree). Variety VRI-3 (V_1) recorded the highest yield (0.76 kg/tree) and superior over Ullal-1 (V_2) and V-9 (V_3) varieties. The interaction effect between different spacings and varieties showed that, S_3V_1 and S_3V_3 recorded the highest yield (0.77 kg/tree) and at par with S_1V_1 (0.76 kg/tree), S_2V_1 & S_1V_2 (0.75 kg/tree) and S_1V_3 (0.72 kg/tree).

There was significant difference among the varieties with respect to shelling percentage however, showed non-significant results for spacing and interaction. The V_1 variety (VRI-3) recorded significantly the highest shelling percentage (32.73%) and superior over V_2 and V_3 varieties.

In overall, the second year yield (t/ha) is concerned, 2.5m x 2.5m (S_1) spacing (1.19 t/ha) and variety VRI-3 (0.72 t/ha) followed by Ullal-1 (0.67 t/ha) recorded the highest yield and found best however, interaction effect was observed non-significant.

Table 2.30: Effect of spacing, variety and interaction on yield parameters under UHDP at Vengurla centre during the year 2021

Treatments	Yield (kg/tree)				Yield (kg/plot)				Yield (t/ha)				Shelling (%)			
	V ₁	V ₂	V ₃	Mean	V ₁	V ₂	V ₃	Mean	V ₁	V ₂	V ₃	Mean	V ₁	V ₂	V ₃	Mean
S ₁	0.76	0.75	0.72	0.74	1.26	2.23	1.43	1.64	1.21	1.20	1.15	1.19	33.13	31.07	30.03	31.41
S ₂	0.75	0.65	0.63	0.68	2.74	2.16	2.33	2.41	0.83	0.72	0.70	0.75	32.87	31.77	29.43	31.36
S ₃	0.77	0.64	0.77	0.73	2.05	1.53	2.34	1.97	0.12	0.10	0.12	0.11	32.20	30.20	31.30	31.23
Mean	0.76	0.68	0.71	0.72	2.02	1.97	2.04	2.01	0.72	0.67	0.66	0.68	32.73	31.01	30.26	31.33
	S	V	S x V		S	V	S x V		S	V	S x V		S	V	S x V	
SEm±	0.01	0.01	0.02		0.15	0.17	0.29		0.02	0.01	0.03		0.35	0.43	0.74	
CD at 5%	0.05	0.04	0.07		NS	NS	NS		0.06	0.05	NS		NS	1.31	NS	
CV %	5.79				25.32				6.35				4.08			

Hort.12 : Pruning response of different cashew varieties

Centres: East Coast :	Jhargram and Vridhachalam
West Coast :	Madakkathara and Vengurla
Plains / others:	Hogalagere

The project aims at assessing pruning response of different varieties released by AICRP Centres

Treatment details :

Year of Start	: June, 2021
Spacing	: 7m x 7m
Design	: RBD
Replications	: 5
Treatment details	: T ₁ - Control T ₂ - 25% leader in June T ₃ - 25% lateral in June T ₄ - 50% lateral in June T ₅ - 25% leader in August T ₆ - 25% lateral in August T ₇ - 50% lateral in August T ₈ - 25% leader in September T ₉ - 25% lateral in September T ₁₀ - 50% lateral in September

Note: All the leader and laterals should be cut at 25 % and 50 % of their total length.

No. of plants/Rep.	: 2
No. of trees req./ treat/rep.	: 10
Total number of plants	: 100 (30 trees x 3 months = 90 for treatment imposition for 3 months + 10 trees for control)
Package of practices	: Uniform POP should be followed i.e. application of RDF and plant protection schedule.

HOGALAGERE

This experiment has been initiated during 2021

MADAKKATHARA

The experiment is being conducted in 10-year-old cashew trees of variety, Dhana, planted at a spacing of 5 x 5m. All the trees were maintained at a height of 3.6 m. Pruning was done in the month of August and September 2021 as per the experimental design.

VENGURLA

All the pruning treatments were imposed in the fortnight of June, August and September, 2021. Recording of flowering, fruiting and yield observations in cashew season, 2021-22 are in progress.



Pruning response trial - new vegetative growth

Pruning response trial

VRIDHACHALAM

The experiment was initiated during August, 2021 and September, 2021 month as per the technical programme.

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:	Jagdapur 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

No. of replications : 4
No. of trees per replication : 2
Design : RCBD

Treatment details:

T ₁	:	Thiamethoxam 25 WG	:	0.1 g/l
T ₂	:	Thiamethoxam 25 WG	:	0.2 g/l
T ₃	:	Carbosulfan 25 EC	:	2 ml/l
T ₄	:	Buprofezin 25 SC	:	2 ml/l
T ₅	:	<i>Beauveria bassiana</i> WP	:	1 g/l
T ₆	:	<i>Beauveria bassiana</i> WP	:	5 g/l
T ₇	:	λ – Cyhalothrin 5 EC	:	0.6 ml/l
T ₈	:	Monocrotophos 36 SL (1.6 ml/l) at flushing, Chlorpyrifos 20 EC (2.0 ml/l) at flowering and Profenofos 50 EC (1.0 ml/l) at fruit & nut development stage.		
T ₉	:	Untreated check		

Three sprays were imposed at 30-35 days interval at flushing, flowering and at fruit & nut developmental stage.

Observations :

The data on pest incidence from 8 trees per each treatment was recorded from 24 leader shoots of each tree from all the four sides in respect of leaf and blossom webber and shoot tip caterpillar at one day before spray and 30 days after each spray. In case of apple and nut borer total nuts in 24 panicles and the nuts damaged by the borer were counted at 30 days after 3rd spray. Thrips damage on nut surface was graded on 100 nuts per tree following 0 to 4 scale. Counts of spiders and ants were recorded at 30 days after 3rd spray by tapping 24 panicles per tree on 1 sq. foot card board.

During the year 2020-21, the activity of different important foliage, flower and nut feeding pests incidence was very low in all treatments. Hence treatments were not imposed during this season.

JAGDALPUR

Experimental details

Number of treatments	:	8
Number of replications	:	3
Design of experiment	:	Randomized block design
Age of tree	:	18 years
Crop stage	:	Flushing to fruit maturity

Methodology : 24 leader shoots, pre observation and post spray observation at 7 and 15 days for pests. After each spray natural enemies and pollinators' observation were carried out in cashew field. Observation on bees made randomly in 10 panicles for each replication on 15 days after spray. *Beaveria bassiana* obtained from State Bio-Control Laboratory Bilaspur (CG) from 2018-19 was also used.

The results of the insecticides against TMB revealed that, after, first, second and third spray, 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 with 1.70 damage score (DS). The results were observed in third spray after 15 days, T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) showed least (0.40) damage score followed by T₂ (Thiamethoxam 25 WG @ 0.2 g/l) with 0.70 DS and T₁ (Thiamethoxam 25 WG @ 0.1 g/l) with 1.05 DS.

The efficacy of different insecticide against thrips revealed that before spray of insecticide the mean damage score of thrips was statistically non significant including untreated control (1.30 DS). After 15 days of third spray, the damage score was lowest (0.33) in T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) which was on par with T₂ (Thiamethoxam 25 WG @ 0.2 g/l) with 0.41 damage score. The pre treatment observation of shoot tip caterpillar was non-significant including untreated control. The data recorded on 15 days after third spray of insecticides showed that the per cent leaf damage was low (0.82 %) in T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) followed by T₂ (Thiamethoxam 25 WG @ 0.2 g/l) with 1.83 per cent and T₃ (Carbosulfan 25 EC @ 2 ml/l) with 6.17 per cent.

The lowest per cent incidence (0.30 %) of leaf miner was observed in T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) which was not at par with T₂ (Thiamethoxam 25 WG @ 0.2 g/l) with 0.78 per cent and T₁ (Thiamethoxam 25 WG @ 0.1 g/l) with 3.06 per cent. Similarly, leaf folder damage per cent was minimum (0.60 %) in T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) which was at par with T₂ (Thiamethoxam 25 WG @ 0.2 g/l) with 0.80 per cent. All the treatments were statistically superior over untreated control (T₈) with 14.33 per cent incidence.

The effects of insecticides on natural enemies revealed that, the mean population of natural enemies increased with decrease of insecticide toxicity. The population trends of various natural enemies in respect of all the insecticide treatments gradually decimated the population of ants, spiders, lady bird beetle and *Brumus* after each round of insecticide spray. In the present investigation the pre - treatment mean population of ants, spiders, lady bird beetle and *Brumus* showed non-significant different among treatments including

untreated control, however the observation taken 15 days after third spray of the treatments T₅ (*Beauveria bassiana* @ 1g/l) had shown maximum mean population of ants, spider, lady bird beetle and *Brumus* with 1.27, 0.56, 0.45 and 0.61 adult/leader shoot, respectively.

In the present investigation the effect of insecticides on pollinators also observed after each spray. Pollinators' like honey bee, syrphid fly, housefly and horsefly were observed in cashew field during observation. The lowest honey bee population was observed in T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) with 2.67 which was at par with T₃ (Carbosulfan 25 EC @ 2 ml/l) with 3.00 adult per panicle. Pre treatment observation was non significant with mean 6.29 bees/panicles.

Conclusion from 6 years data (2015-16 to 2020-21)

From the data presented revealed that the lowest TMB mean damage score (0.24) was observed in T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) which was at par with T₂ (Thiamethoxam 25 WG @ 0.2 g/l) with 0.35 DS/leader shoot. However lowest thrips mean damage score was found in T₂ (Thiamethoxam 25 WG @ 0.2 g/l) with 0.39 DS which was at par with T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) with 0.81 DS/leader shoot. The lowest percent infestation of chewing insect like shoot tip caterpillar, leaf folder and leaf miner were observed in T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) followed by and at par with T₂ (Thiamethoxam 25 WG @ 0.2 g/l) with varied level of infestation.

Therefore L-cyhalothrin 5 EC @ 0.6ml/l and Thiamethoxam 25 WG @ 0.2 g/l can be used for management of TMB and foliage insect-pests of cashew under Bastar Plateau region of Chhattisgarh.

Table 3.1 : Efficacy of different insecticides on insect pests of cashew at Jagdalpur during 2020-21

Treatment		Mean damage after third spray									
		TMB		Thrips		Shoot tip caterpillar		Leaf miner		Leaf folder	
		Pre treatment D S (0-4)	Post treatment D S (0-4)	Pre treatment D S (0-4)	Post treatment D S (0-4)	Pre treatment % damage	Post treatment % damage	Pre treatment % damage	Post treatment % damage	Pre treatment % damage	Post treatment % damage
T ₁	Thiamethoxam 25 WG (0.1 g/l)	2.07 (1.75)	1.05 (1.42) ^c	1.43 (1.55)	0.60 (1.26) ^c	11.67 (3.55)	6.93 (2.81) ^d	8.33 (2.66)	3.06 (2.01) ^c	12.47 (3.67)	8.00 (3.00) ^{de}
T ₂	Thiamethoxam 25 WG (0.2 g/l)	1.64 (1.62)	0.70 (1.30) ^b	1.25 (1.49)	0.41 (1.19) ^{ab}	9.40 (3.22)	1.83 (1.67) ^b	6.22 (3.04)	0.78 (1.32) ^b	11.80 (3.57)	0.80 (1.34) ^{ab}
T ₃	Carbosulfan 25 EC (2 ml/l)	2.58 (1.89)	1.97 (1.72) ^{fg}	1.16 (1.47)	0.66 (1.29) ^{cd}	14.00 (3.87)	6.17 (2.68) ^c	9.00 (3.16)	4.81 (2.41) ^d	10.13 (3.28)	6.80 (2.79) ^c
T ₄	Buprofezin 25 SC (2ml/l)	2.03 (1.74)	1.11 (1.45) ^{cd}	1.54 (1.59)	1.04 (1.43) ^e	12.48 (3.62)	7.15 (2.85) ^{de}	8.50 (3.07)	8.33 (3.04) ^e	9.67 (3.26)	7.70 (2.88) ^d
T ₅	<i>Beauveria bassiana</i> (1g/l)	2.17 (1.77)	1.92 (1.70) ^f	1.53 (1.59)	1.45 (1.56) ^{fg}	15.00 (3.99)	11.17 (3.49) ^g	10.27 (3.35)	9.70 (3.27) ^f	14.60 (3.95)	13.00 (3.74) ^g
T ₆	<i>Beauveria bassiana</i> (5g/l)	2.33 (1.81)	1.37 (1.54) ^{de}	1.83 (1.68)	1.33 (1.52) ^f	13.00 (3.74)	10.33 (3.37) ^f	9.67 (3.26)	8.33 (3.04) ^e	13.83 (3.85)	12.17 (3.63) ^f
T ₇	L-cyhalothrin 5EC (0.6ml/l)	1.33 (1.52)	0.40 (1.18) ^a	1.16 (1.46)	0.33 (1.15) ^a	8.90 (3.13)	0.83 (1.35) ^a	8.00 (3.00)	0.30 (1.14) ^a	8.67 (3.10)	0.60 (1.26) ^a
T ₈	Untreated check	1.70 (1.64)	2.53 (1.87) ^h	1.30 (1.52)	2.47 (1.86) ^h	10.67 (3.39)	12.10 (3.62) ^h	8.50 (3.08)	10.20 (3.35) ^h	9.00 (3.16)	14.33 (3.91) ^h
	Mean	1.98	1.38	1.40	1.03	11.89	7.06	8.56	5.69	11.27	7.91
	CD (<i>p</i> =0.05)	NS	0.27	NS	0.17	NS	0.28	NS	0.38	NS	0.55
	SE(m) ±	0.12	0.09	0.06	0.06	0.26	0.09	0.15	0.13	0.20	0.18
	CV (%)	11.98	10.17	6.39	6.92	12.47	5.73	8.64	8.85	9.92	11.00

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

Source of *B. bassiana* : State bio-control laboratory Bilaspur (CG) from 2018-19

Table 3.2 : Efficacy of different insecticides on insect pests of cashew at Jagdalpur pooled over 2015-16 to 2020-21

Treatment		Mean damage of pests (six year data)				
		TMB	Thrips	Shoot tip caterpillar	Leaf miner	Leaf folder
		*Post treatment mean D S (0-4)	Post treatment mean D S (0-4)	Post treatment mean % damage	Post treatment mean % damage	Post treatment mean % damage
T ₁	Thiamethoxam 25 WG (0.1 g/l)	0.48 (1.20) ^c	0.60 (2.03) ^{cd}	8.95 (14.78) ^{def}	5.02 (9.91) ^{bc}	7.98 (13.24) ^{cdef}
T ₂	Thiamethoxam 25 WG (0.2 g/l)	0.35 (1.15) ^{ab}	0.39 (1.82) ^a	7.01 (13.15) ^b	3.58 (8.56) ^a	6.62 (12.46) ^{ab}
T ₃	Carbosulfan 25 EC (2 ml/l)	0.85 (1.34) ^{fg}	0.66 (2.13) ^{cde}	8.80 (14.02) ^{cde}	5.66 (10.43) ^{cde}	7.84 (13.10) ^c
T ₄	Buprofezin 25 SC (2ml/l)	0.59 (1.25) ^{cd}	0.54 (1.88) ^c	8.26 (14.15) ^{bcd}	5.10 (9.64) ^{bcd}	7.95 (13.32) ^{cd}
T ₅	<i>Beauveria bassiana</i> (1g/l)	0.84 (1.33) ^f	0.90 (2.23) ^{fg}	10.04 (15.36) ^{fg}	7.51 (11.84) ^{fg}	10.36 (14.58) ^g
T ₆	<i>Beauveria bassiana</i> (5g/l)	0.71 (1.29) ^e	0.81 (2.17) ^f	7.41 (12.46) ^{bc}	6.70 (11.14) ^f	7.96 (12.83) ^{cde}
T ₇	L-cyhalothrin 5EC (0.6ml/l)	0.24 (1.11) ^a	0.41 (1.95) ^{ab}	5.26 (11.18) ^a	4.29 (9.14) ^{ab}	6.17 (11.66) ^a
T ₈	Untreated check	1.44 (1.54) ^h	1.62 (2.64) ^h	18.04 (21.72) ^h	9.93 (14.80) ^h	15.74 (19.43) ^h
	Mean	0.79	0.74	9.17	5.97	8.83
	CD ($p=0.05$)	0.11	0.13	1.27	0.97	1.22
	SE(m) \pm	0.04	0.05	0.42	0.33	0.44
	CV (%)	6.55	4.67	7.51	7.28	7.92

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

MADAKKATHARA

Treatment details:

Sl. No.	Treatments
T ₁	Thiamethoxam (0.1g/L)
T ₂	Thiamethoxam (0.2g/L)
T ₃	Carbosulfan (2ml/L)
T ₄	Thicloprid (1.5ml/L)
T ₅	Thiodicarb WP (1.5 g/L)
T ₆	Alika (Lambda cyhalothrin + Thiamethoxam) (1g/L)
T ₇	<i>Beauveria bassiana</i> WP (10g/L)
T ₈	L-cyhalothrin (0.6 ml/L)
T ₉	POP, KAU (L-cyhalothrin-quinalphos-thiamethoxam)
T ₁₀	Untreated check

Influence of insecticides on tea mosquito bug damage

The trial was conducted in the early season variety, Madakkathara-1. Three sprays were given at an interval of 21 days during flowering and nut set stage. The TMB damage score on laterals recorded before spray, 7 & 15 days after each spray is presented in Table. After 7 days of first spray, all the treatments recorded significantly less damage score on laterals compared to control. At 15 DAS significant difference was observed among the treatments and all the treatments were found superior to control. At 7 days after second spray, the treatments recorded a mean damage score less than that of control. At 15 days after second spray, all treatments were found significantly superior to control.

In third spray, with respect to damage on laterals, all the treatments except T₇ recorded significantly less damage score compared to control at both 7 and 15 DAS.

Table 3.3 : Efficacy of different insecticides against TMB incidence in cashew at Madakkathara Centre (2020-21)

Treatments	TMB incidence on laterals (mean of score on 24 leader shoots) at different days after spray (DAS)						
	PRE	First spray		Second spray		Third spray	
		7DAS	15 DAS	7 DAS	15 DAS	7 DAS	15 DAS
T ₁	0.285 *(0.873)	0.000 (0.707) ^b	0.098 (0.772) ^c	0.144 (0.799) ^b	0.053 (0.742) ^b	0.000 (0.707) ^b	0.045 (0.737) ^b
T ₂	0.053 (0.744)	0.000 (0.707) ^b	0.031 (0.729) ^c	0.004 (0.710) ^c	0.000 (0.707) ^b	0.000 (0.707) ^b	0.040 (0.734) ^b
T ₃	0.008 (0.713)	0.000 (0.707) ^b	0.177 (0.822) ^c	0.000 (0.707) ^c	0.000 (0.707) ^b	0.000 (0.707) ^b	0.051 (0.741) ^b
T ₄	0.057 (0.746)	0.009 (0.713) ^b	0.018 (0.720) ^c	0.000 (0.707) ^c	0.000 (0.707) ^b	0.000 (0.707) ^b	0.018 (0.719) ^b
T ₅	0.123 (0.782)	0.097 (0.773) ^b	0.009 (0.713) ^c	0.000 (0.707) ^c	0.000 (0.707) ^b	0.000 (0.707) ^b	0.018 (0.719) ^b
T ₆	0.023 (0.723)	0.000 (0.707) ^b	0.009 (0.713) ^c	0.000 (0.707) ^c	0.000 (0.707) ^b	0.000 (0.707) ^b	0.019 (0.720) ^b
T ₇	0.026 (0.725)	0.101 (0.775) ^b	0.426 (0.961) ^b	0.731 (1.109) ^a	0.000 (0.707) ^b	0.667 (1.079) ^a	0.488 (0.987) ^a
T ₈	0.015 (0.717)	0.005 (0.711) ^b	0.155 (0.809) ^c	0.000 (0.707) ^c	0.050 (0.740) ^b	0.000 (0.707) ^b	0.163 (0.810) ^b
T ₉	0.188 (0.817)	0.027 (0.726) ^b	0.139 (0.799) ^c	0.000 (0.707) ^c	0.139 (0.791) ^b	0.000 (0.707) ^b	0.062 (0.749) ^b
T ₁₀	0.155 (0.799)	0.543 (1.021) ^a	0.727 (1.099) ^a	0.667 (1.075) ^a	0.727 (1.099) ^a	0.847 (1.156) ^a	0.462 (0.978) ^a
SEm±	0.020	0.012	0.024	0.029	0.022	0.031	0.021
CD @ 5 %	NS	0.063	0.113	0.064	0.090	0.127	0.100
CV (%)	11.680	8.43	8.105	5.636	9.287	11.334	8.956

*Figures in parentheses are $\sqrt{x+0.5}$ transformed values

Table 3.4 : Efficacy of different insecticides against TMB incidence in cashew at Madakkathara Centre (2021)

Treatments	TMB incidence on panicles (mean of score on 24 leader shoots) at different days after spray (DAS)							Yield (kg/tree)
	PRE	First spray		Second spray		Third spray		
		7DAS	15 DAS	7 DAS	15 DAS	7 DAS	15 DAS	
T ₁	0.168 *(0.814)	0.000 **(0.707) ^b	0.084 (0.764) ^b	0.151 (0.807) ^d	0.057 (0.746) ^b	0.132 (0.795) ^c	0.103 (0.776) ^{cd}	12.08 ^{bcd}
T ₂	0.052 (0.742)	0.000 (0.707) ^b	0.090 (0.767) ^b	0.136 (0.797) ^d	0.090 (0.767) ^b	0.000 (0.707) ^d	0.058 (0.746) ^d	12.68 ^{bcd}
T ₃	0.018 (0.72)	0.010 (0.714) ^b	0.220 (0.848) ^b	0.155 (0.804) ^d	0.220 (0.847) ^b	0.000 (0.707) ^d	0.227 (0.846) ^c	10.93 ^d
T ₄	0.118 (0.785)	0.009 (0.713) ^b	0.111 (0.782) ^b	0.014 (0.717) ^{de}	0.079 (0.760) ^b	0.000 (0.707) ^d	0.018 (0.719) ^d	16.82 ^a
T ₅	0.126 (0.786)	0.000 (0.707) ^b	0.078 (0.759) ^b	0.007 (0.712) ^{de}	0.000 (0.707) ^b	0.051 (0.741) ^{cd}	0.036 (0.732) ^d	14.22 ^{abc}
T ₆	0.016 (0.718)	0.007 (0.712) ^b	0.016 (0.718) ^b	0.046 (0.738) ^d	0.000 (0.707) ^b	0.000 (0.707) ^d	0.019 (0.720) ^d	14.33 ^{ab}
T ₇	0.029 (0.727)	0.006 (0.711) ^b	0.699 (1.088) ^a	1.320 (1.317) ^b	1.032 (1.206) ^a	2.36 (1.689) ^a	1.000 (1.171) ^b	7.60 ^e
T ₈	0.054 (0.743)	0.002 (0.709) ^b	0.054 (0.744) ^b	0.068 (0.753) ^d	0.054 (0.744) ^b	0.019 (0.720) ^d	0.051 (0.742) ^d	11.71 ^{cd}
T ₉	0.156 (0.805)	0.000 (0.707) ^b	0.071 (0.755) ^b	0.353 (0.910) ^c	0.071 (0.755) ^b	0.092 (0.768) ^{cd}	0.077 (0.759) ^{cd}	12.04 ^{bcd}
T ₁₀	0.144 (0.798)	0.692 (1.057) ^a	0.943 (1.182) ^a	2.118 (1.615) ^a	1.277 (1.304) ^a	2.000 (1.470) ^b	1.513 (1.411) ^a	6.98 ^e
SEm±	0.010	0.025	0.032	0.055	0.045	0.073	0.048	0.876
CD @ 5 %	NS	0.179	0.180	0.090	0.162	0.064	0.090	2.60
CV (%)	8.390	14.030	12.473	6.897	13.346	4.962	7.334	12.71

*Figures in parentheses are $\sqrt{x+0.5}$ transformed values

After 7 days of first spray, all the treatments recorded significantly less damage score compared to control. All the treatments were found superior to control. However, at 15 DAS, no significant difference was observed between the treatments except for T₇, *Beauveria bassiana* which was on par with control.

In the second spray, all the treatments were found superior to control except T₇ (*Beauveria bassiana*) during both 7 and 15 DAS.

In third spray, T₂ (Thiamethoxam 0.2g/l), T₄ (Thiacloprid 1.5 ml/L), T₅ (Thiodicarb 1.5g/l), T₆ (Lambda cyhalothrin + Thiamethoxam) and T₈ (Lambda cyhalothrin 0.6ml/L) were significantly superior to all other treatments.

Table 3.5 : Reduction in TMB damage over control in various insecticidal sprays in cashew at Madakkathara Centre (2020-21)

Treatments	Per cent damage reduction over control of various insecticides against TMB incidence on laterals and panicles at different days after spray (DAS)					
	First spray		Second spray		Third spray	
	Laterals	Panicles	Laterals	Panicles	Laterals	Panicles
T ₁	35.71	36.63	37.93	32.22	57.06	60.12
T ₂	28.76	30.21	35.67	24.95	44.03	47.13
T ₃	16.18	20.49	41.84	24.23	63.67	66.54
T ₄	29.83	32.72	54.43	44.17	58.71	66.17
T ₅	33.71	34.81	35.67	26.48	45.78	48.12
T ₆	28.30	32.49	35.67	26.38	45.78	48.97
T ₇	3.63	-1.04	35.67	-0.92	7.52	17.01
T ₈	17.97	32.4	32.67	17.18	42.94	47.41
T ₉	28.9	36.68	28.03	23.42	42.1	46.21
T ₁₀	-	-	-	-	-	-

Per cent damage reduction over control in various insecticidal sprays assessed according to the equation of Henderson and Tilton (1955) is presented in Table. Percentage damage reduction over control varied among the insecticides from 1st spray to 3rd spray. All the treatments showed an increased percentage control of TMB damage in laterals over the control except T₇ from 1st spray to 3rd spray. Lowest percentage damage of TMB over control was observed in T₇ (*Beauveria bassiana* WP (10g/L) throughout the experiment.

Benefit to cost ratio analysis

The highest benefit : cost ratio was recorded in T₄ [Thicloprid (1.5ml/L)] followed by T₆ [Lambda cyhalothrin + Thiamethoxam (1g/L)] and T₅ [Thiodicarb WP (1.5 g/L)].

Table 3.6 : Yield and economics of cashew in chemical control trial at Madakkathara centre during 2020-21

Treatments	Yield of Cashew (t/ ha)	Cost of Cultivation (Rs. /ha)	Returns (Rs. /ha)		B: C
			Total	Net	
T ₁	2.138	72399	192434	120035	1.657
T ₂	2.244	72798	201992	129194	1.775
T ₃	1.934	74400	174115	99714.9	1.340
T ₄	2.918	77940	262686	184746	2.370
T ₅	2.428	77484	218560	141076	1.821
T ₆	2.478	75100	223020	147920	1.970

T ₇	1.345	73000	121068	48068	0.658
T ₈	2.200	72560	198010	125450	1.729
T ₉	2.311	74740	208046	133306	1.784
T ₁₀	1.235	72000	111191	39191.4	0.544

Selling price of cashew @Rs. 90/kg nut

Influence of insecticides on insect pests other than tea mosquito bug

The infestation of thrips was noticed in the experimental plot. Thrips infestation was absent in trees applied with T₆ (Lambda cyhalothin + Thiamethoxam) at different intervals of observation. At 21 days after second spray all the treatments were found superior than control.

Influence of insecticides on natural enemies

Population of natural enemies was observed and recorded before and after 7 and 15 days of each spray. However, the population of natural enemies was found to be negligible.

Influence of insecticides on pollinators

Influence of insecticides on the pollinators of cashew was observed and recorded before and after 7 and 15 days after each spray. Bee activity was found in all treatments after first spray except T₄ (Thicloprid), But after second and third spray, bee activity was noticed only in treatment T₉ (POP, KAU) (L-cyhalothrin-quinalphos-thiamethoxam).

PARIA

The damage score of Tea Mosquito Bug (TMB) on shoots and panicles ranged between 1.40 to 1.57 and 1.53 to 1.72, respectively before spraying the insecticides. The TMB damage score at 7 days and 15 days after the spray were ranged from 0.58 to 1.53 and 0.12 to 1.62 on shoots and 0.68 to 1.42 and 0.21 to 1.54 on panicles. Almost all the treatments were observed to be significantly superior over the control for reducing the TMB population on shoots and panicles after fifteen days spraying the insecticides. After 15 days of spray, treatment T₄ (Buprofezin) was observed to be superior for the management of TMB on shoots and panicles and it was statistically at par with the treatments, T₃ (Carbosulfan). The maximum TMB damage score was observed in the treatment of control.

During this year the activity of thrips population was very low. The maximum nut yield (kg/plant) was observed in the treatment of buprofezin with 5.50 kg/plant and it was at par with Carbosulfan 5.14 kg/plant.

Table 3.7 : Efficacy of different insecticides against tea mosquito bug incidence in cashew at Paria centre during the year 2020-21

Treatments		On shoots (%)			On panicles (%)			Nut Yield (kg/plant)
		BS	7 DAS	15 DAS	BS	7 DAS	15 DAS	
T1	Thiamethoxam 25% WG 1g/10 lit	1.54	1.34	1.26	1.66	1.25	1.23	2.97
T2	Thiamethoxam 25% WG 2g/10 lit	1.48	1.10	0.49	1.54	1.10	0.70	3.58
T3	Carbosulfan 25% EC 20ml/10 lit	1.41	0.65	0.20	1.68	0.73	0.25	5.14
T4	Buprofezin 25% SC 20 ml/10 lit	1.57	0.58	0.12	1.65	0.68	0.21	5.50
T5	<i>Beauveria bassiana</i> 10 g/10 lit	1.52	1.36	1.30	1.72	1.30	1.40	2.87
T6	<i>Beauveria bassiana</i> 50 gm/10 lit	1.46	1.15	0.83	1.53	1.12	0.87	3.79
T7	L-Cyhalothrin 5% EC 6 ml /10 lit	1.40	0.89	0.32	1.67	0.93	0.45	4.52
T8	Untreated control	1.47	1.53	1.62	1.60	1.42	1.54	1.71
	SEm ±	0.06	0.05	0.04	0.07	0.05	0.06	0.17
	CD at 5%	NS	0.15	0.13	NS	0.17	0.18	0.51
	CV%	7.06	7.81	9.40	7.88	8.75	12.44	7.62

VENGURLE

Design : R.B.D.

No. of trees/
treatment : Two

No. of sprays : Three

Variety : Vengurla – 7

Replications : Four

Treatments : Six

T₁ - Thiamethoxam 25 WG @ 0.1 g/litT₂ - Thiamethoxam 25 WG @0.2 g/litT₃ - Carbosulfan 25 EC @ 2 ml/litT₄ - Buprofezin 25 SC @2 ml/litT₅ - λ cyhalothrin 5 EC @ 0.6 ml/litT₆ - Untreated check

No. of spray : Three

First Spray – At vegetative flush stage

Second Spray – At panicle initiation stage

Third Spray – At pea nut stage

Fifty-two shoots were selected randomly at four sides (E, W, N and S) on the trees under observation and labeled individually. The total number of laterals in the selected leader shoots were recorded. The incidence of tea mosquito bug was recorded on selected shoots/inflorescences in 0 to 4 scales as given below.

- 0 – No lesions/streaks.
- 1 – 1 to 3 necrotic lesions /streaks.
- 2 – 4 to 6 coalescing or non-coalescing lesions/streaks.
- 3 – Above six coalescing or non-coalescing lesions/ streaks.
- 4 – Lesions/streaks confluent or wilting or drying of affected Shoots / panicles.

From the data it is evident that the treatment T₂ (Thiamethoxam 25WG @ 0.2 g/lit) was found to be the most effective for management of TMB at all the stages i.e. on shoots (0.102), panicles (0.132) and fruits (0.162); however, it was at par with T₁ (Thiamethoxam 25 WG @0.1 g/lit) during shoot and panicle stage and significantly superior to all other treatments during fruit stage. The mean TMB incidence data indicated that the treatment T₂ (Thiamethoxam 25WG @0.2 g/lit) is the most effective for management of TMB with the least incidence of TMB (0.130) which was significantly superior to all other treatments.

For management of thrips, the treatment T₂ (Thiamethoxam 25WG @ 0.2 g/lit) was observed to be the most effective with the least incidence of thrips (0.173) which was significantly superior to all other treatments. Regarding the natural enemy population, the maximum spider population (0.201) was recorded in treatment T₆ (Untreated check) and the least spider population (0.031) was recorded in treatment T₃ (Carbosulfan 25 EC @ 2 ml/lit). The spider population in treatment T₂ (Thiamethoxam 25WG @0.2 g/lit) was intermediate (0.042). The treatment T₂ (Thiamethoxam 25WG @ 0.2 g/lit) recorded maximum yield (7.00 kg/tree) which was significantly superior to all other treatments. The overall results indicated that the treatment T₂ (Thiamethoxam 25WG @ 0.2 g/lit) is the most effective for management of TMB as well as thrips.

Table 3.8 : Efficacy of different insecticides against tea mosquito bug incidence and thrips in cashew at Vengurla centre during the year 2020-21

Treatment details		Incidence of TMB 15 days after spray (0-4 scale)				Incidence of thrips 15 days after spray on fruits (0-4 scale)	Population of natural enemies (spider) 30 days after last spray (spider count per panicle)	Yield (kg/tree)
		On shoots	On panicles	On fruits	Mean			
T ₁	Thiamethoxam 25 WG @ 0.1 g/lit	0.141	0.181	0.231	0.186	0.226	0.051	6.03
T ₂	Thiamethoxam 25 WG @ 0.2 g/lit	0.102	0.132	0.162	0.130	0.173	0.042	7.00
T ₃	Carbosulfan 25 EC @ 2 ml/lit	0.171	0.201	0.251	0.205	0.255	0.031	5.68
T ₄	Buprofezin 25 SC @ 2 ml/lit	0.191	0.192	0.261	0.213	0.274	0.112	5.73
T ₅	λ cyhalothrin 5 EC @ 0.6 ml/lit	0.161	0.183	0.240	0.188	0.216	0.081	5.68
T ₆	Untreated check	0.401	0.450	0.462	0.439	0.462	0.201	1.90
SEm±		0.014	0.016	0.016	0.007	0.009	0.010	0.16
C.D. at 5%		0.041	0.050	0.049	0.022	0.028	0.029	0.49
C.V.		14.22	15.16	12.25	6.53	7.03	23.52	6.18

VRIDHACHALAM

Experimental details

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

The following treatments were imposed as per approved technical programme.

T-1	: Thiamethoxam 25 WG @ 0.1g/lit. all the three sprays
T-2	: Carbosulfan 25 EC @ 2 ml/lit. all the three sprays
T-3	: Buprofezin 25 % SC @ 2 ml/lit. all the three sprays
T-4	: Lambda-Cyhalothrin 5 EC -(0.6ml/lit) all the three sprays
T-5	: Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays
T-6	: Imidachloprid 18.6 SL @0.6 ml/lit. all the three sprays
T-7	: Untreated control

As per the technical Programme, three round spray schedule of chemical insecticides was followed at flushing, flowering and fruit formation stages with maximum spray suspension used per tree was 10 lit./each spray.

The data on the pest incidence for each treatment was recorded from randomly selected fresh 24 leader shoots of each tree at four sides (East, West, North, South) on 7, 15 and 30 days after each spray on pest infestations were taken. Observations were recorded on the infestation of TMB (damage in 0-4 scale) on flushes, TMB population (adults and nymphs), leaf miner (% infestation), leaf folder (% infestation), Leaf and blossom webber (% infestation), Leaf thrips population numbers and Thrips damage on nut surface (Damage grade in 0-4 scale) (0=Healthy; 1= less than 25% corky growth on nuts; 2= 26-50% corky growth on nuts; 3= 51-75% corky growth on nuts; 4= more than 76% corky growth on nuts), apple and nut borer damage (% infestation). Natural enemies' population viz., Spiders, ants, coccinellids and cotesia were also recorded.

Field evaluation of insecticides for residual toxicity against Tea Mosquito Bug and its damage:

Residual toxicity studies of different insecticides on survival of Tea Mosquito bug after spray and damage grade on different insecticides in the cashew field was carried out. As per the technical Programme, spraying of chemical insecticides was followed at flushing stage with maximum spray suspension used per tree was 10 lit./each spray. The insecticides were sprayed on cashew plants with tender leaves. Mosquito net sleeve cages of size 35 x 25 cm were prepared for caging purpose. Field collected adults were caged on individual stout shoot on same day, Third day and seventh day after spraying @ 6 adult tea mosquito bugs / cage / replication. The survival of adults was recorded 24h after caging and cage was removed. For this, ten new leader stout shoots of each tree at four sides (East, West, North, and South) were selected randomly with four replications. Observations were recorded on the infestation of TMB (damage in 0-4 scale) (grade 0-No damage, 1= 1-3 necrotic lesion, 2= 2-6 coalescing lesions, 3=more than 6 coalescing lesions and 4= complete drying) 48 h after caging on flushes were also recorded.

Insecticidal effect on Pollinators

Studies on insecticidal effect on pollinators were made to find out the activities of bees on cashew flowers. Spray schedule of chemical insecticides as per the technical programme was followed at flowering stage with maximum spray suspension used per tree was 10 lit./each spray *i.e.*, during Flowering stage. Observation on the activity of bees on cashew flowers on 1,3,7 and 15 days after spray was recorded. Randomly 10 flowering panicles were selected for each replication and observed for 10 minutes at 10.30 a.m, 11.30 a.m, 12.30 p.m, 1.30p.m. Different bee species were also recorded.

The results of evaluation of insecticides against TMB revealed that after first, second and third spraying, the efficacy of different insecticides was observed, but statistically superior over untreated control. The pre-treatment damage score of TMB was non-significant in all treatments including the untreated control. Gradual reduction of fresh infestation was observed two weeks after each round of spray. After first spray, the damage score was low (0.850) in T4 (Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays), followed by T5 (Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays) and T1 (Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays) which was at par to each other. It was followed by T6 (Imidachloprid 18.6 SL @0.6 ml/lit. all the three sprays) with the TMB damage score of 1.95. It was followed by T2 (Carbosulfan 25 EC @ 2 ml/lit. all the three sprays) and T3 (Buprofezin 25 % SC @ 2 ml/lit. all the three sprays) which was at par with each other, ranging between 2.25 and 2.37 as against 2.65 in the control on 7 DAS. The same was observed in 15 DAS and 30 DAS also. After the second spray, the damage score ranged between 0.46 and 2.12 in different treatments as against an increased damage score of 3.22 in untreated control. Thirty days after third spray, the damage score decreased and ranged between 0.017 and 0.2 in various treatments as against an increased score of 3.71 in control and the TMB population ranged from 0.007 to 0.850. The overall efficacy ranked in the order against the incidence of TMB and its population at Vridhachalam are as follows: T4 (Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays) > T5 (Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays) > T1 (Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays) > T6 (Imidachloprid 18.6 SL @0.6 ml/lit. all the three sprays) >T2 (Carbosulfan 25 EC @ 2 ml/lit. all the three sprays) > T3 (Buprofezin 25 % SC @ 2 ml/lit. all the three sprays). However, the efficacy of different insecticides were statistically on par to control the pest, but statistically superior over untreated control.

The population trend of TMB and other foliar feeding insects was recorded. Thirty days after 3rd spray, all the insecticides are effective in controlling TMB populations to zero as against 16.65 bugs/ 24 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. Studies on insecticidal effect on pollinators on cashew flowers and the activity of pollinators viz., Indian bee, *Apis cerana indica* F., Little bee, *Apis florea* L., Stingless bee, *Tetragonula* sp. was observed. The results revealed that pollinators population was reduced in the insecticides treated when compared to the untreated control. Reduction of pollinators population was observed one day after insecticides spray which ranged from 0.001 to 0.3 during 10.30 a.m on first day after spraying.

Table 3.9 : Effect of insecticides on the incidence of TMB at Vridhachalam**(Mean of four replications)**

Treatments	Pre-treatment damage score (0-4)	Post treatment mean damage score (0-4)			Pre-treatment damage score (0-4)	Post treatment mean damage score (0-4)			Pre-treatment damage score (0-4)	Post treatment mean damage score (0-4)			
		I Spray				II Spray				III Spray			
		7 DAS	15 DAS	30 DAS		7 DAS	15 DAS	30 DAS		7 DAS	15 DAS	30 DAS	
T1	Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	2.350 (1.837)	1.600 (1.612)	0.813 (1.346)	1.350 (1.532)	2.850 (1.948)	0.900 (1.378)	0.500 (1.225)	0.450 (1.204)	3.600 (2.145)	0.500 (1.224)	0.1750 (1.084)	0.1275 (1.062)
T2	Carbosulfan 25 EC @ 2 ml/lit. all the three sprays	2.275 (1.83)	2.250 (1.803)	1.425 (1.557)	1.750 (1.658)	2.750 (1.936)	1.850 (1.688)	0.763 (1.327)	0.700 (1.304)	3.525 (2.127)	1.225 (1.491)	0.7050 (1.306)	0.5375 (1.24)
T3	Buprofezin 25 % SC @ 2 ml/lit. all the three sprays	2.425 (1.83)	2.375 (1.837)	1.813 (1.677)	2.250 (1.803)	2.725 (1.93)	2.125 (1.768)	1.250 (1.5)	0.975 (1.405)	3.500 (2.121)	1.581 (1.607)	0.8750 (1.369)	0.6500 (1.284)
T4	Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	2.550 (1.837)	0.850 (1.36)	0.525 (1.234)	0.775 (1.332)	2.700 (1.917)	0.463 (1.209)	0.263 (1.123)	0.150 (1.072)	3.550 (2.133)	0.288 (1.135)	0.0850 (1.042)	0.0175 (1.009)
T5	Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays	2.525 (1.83)	1.525 (1.589)	0.800 (1.342)	1.250 (1.5)	2.650 (1.91)	0.888 (1.374)	0.488 (1.219)	0.388 (1.178)	3.625 (2.15)	0.425 (1.194)	0.1625 (1.078)	0.1250 (1.06)
T6	Imidachlopid 18.6 SL @0.6 ml/lit. all the three sprays	2.500 (1.834)	1.950 (1.717)	1.038 (1.427)	1.500 (1.581)	2.650 (1.91)	1.375 (1.541)	0.788 (1.337)	0.775 (1.332)	3.450 (2.109)	0.825 (1.351)	0.3750 (1.172)	0.2000 (1.095)
T7	Untreated control	2.575 (1.829)	2.650 (1.91)	2.875 (1.968)	2.913 (1.978)	2.900 (1.942)	3.225 (2.055)	3.463 (2.112)	3.538 (2.13)	3.688 (2.165)	3.525 (2.127)	3.6125 (2.148)	3.7125 (2.171)
	C.D.	NS	0.033	0.044	0.043	NS	0.024	0.036	0.042	NS	0.041	0.031	0.028
	SE(m)	0.007	0.011	0.015	0.014	0.009	0.008	0.012	0.014	0.021	0.014	0.01	0.009
	SE(D)	0.01	0.015	0.021	0.02	0.013	0.011	0.017	0.02	0.03	0.019	0.015	0.013
	CV	0.794	1.293	1.929	1.76	0.947	1.018	1.725	2.051	1.98	1.871	1.595	1.483

DAS – Days After Spraying

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

Table 3.10 : Efficacy of insecticides on TMB population / 24 leader shoots at Vridhachalam**(Mean of four replications)**

Treatments	Pre-Treatment Count /24 leader shoots	Post-treatment count (Mean TMB population/24 leader shoots)			Pre-Treatment Count /24 leader shoots	Post-treatment count (Mean TMB population/24 leader shoots)			Pre-Treatment Count /24 leader shoots	Post-treatment count (Mean TMB population/24 leader shoots)			
		I Spray				II Spray				III Spray			
		7 DAS	15 DAS	30 DAS		7 DAS	15 DAS	30 DAS		7 DAS	15 DAS	30 DAS	
T1	Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	8.600 (3.097)	2.675 (1.917)	1.675 (1.635)	0.825 (1.351)	9.625 (3.248)	1.598 (1.612)	1.550 (1.596)	0.650 (1.284)	13.700 (3.834)	0.573 (1.254)	0.258 (1.121)	0.083 (1.04)
T2	Carbosulfan 25 EC @ 2 ml/lit. all the three sprays	8.475 (3.078)	4.125 (2.264)	2.250 (1.803)	1.588 (1.608)	9.600 (3.256)	3.225 (2.055)	2.575 (1.89)	2.163 (1.778)	13.825 (3.85)	2.588 (1.893)	0.650 (1.284)	0.325 (1.151)
T3	Buprofezin 25 % SC @ 2 ml/lit. all the three sprays	8.375 (3.062)	4.850 (2.419)	3.263 (2.063)	1.817 (1.668)	9.650 (3.24)	3.600 (2.145)	2.725 (1.93)	2.588 (1.894)	13.800 (3.847)	2.975 (1.994)	0.988 (1.408)	0.850 (1.36)
T4	Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	8.475 (3.078)	1.550 (1.596)	0.875 (1.369)	0.488 (1.22)	9.775 (3.237)	0.600 (1.264)	0.500 (1.223)	0.163 (1.078)	13.925 (3.863)	0.188 (1.089)	0.069 (1.034)	0.007 (1.003)
T5	Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays	8.450 (3.074)	2.538 (1.88)	1.675 (1.635)	0.800 (1.341)	9.750 (3.237)	1.513 (1.581)	1.475 (1.572)	0.638 (1.279)	13.725 (3.837)	0.450 (1.204)	0.215 (1.102)	0.070 (1.034)
T6	Imidachloprid 18.6 SL @0.6 ml/lit. all the three sprays	8.450 (3.074)	3.588 (2.141)	1.775 (1.666)	1.625 (1.619)	9.878 (3.233)	2.800 (1.949)	2.300 (1.815)	1.575 (1.603)	13.700 (3.834)	1.413 (1.552)	0.528 (1.236)	0.265 (1.125)
T7	Untreated control	8.500 (3.082)	9.350 (3.217)	9.558 (3.249)	9.650 (3.263)	9.903 (3.233)	10.588 (3.404)	12.663 (3.696)	12.750 (3.708)	13.850 (3.854)	14.625 (3.953)	15.700 (4.087)	16.650 (4.201)
	C.D.	NS	0.076	0.066	0.076	NS	0.081	0.101	0.076	NS	0.051	0.054	0.037
	SE(m)	0.02	0.025	0.022	1.128	0.008	0.027	0.034	0.025	0.009	0.017	0.018	0.012
	SE(D)	0.028	0.036	0.031	1.595	0.012	0.038	0.048	0.036	0.013	0.024	0.026	0.017
	CV	1.303	2.309	2.313	1.763	0.524	2.689	3.457	2.808	0.462	1.861	2.244	1.566

PTC – Pre Treatment Count; DAS – Days After Spraying

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

Table 3.11 : Efficacy of insecticides against foliar pests at Vridhachalam

(Mean of four observations)

Treatments		Mean damage after 3 rd spray												Yield
		TMB Damage % damage		Leaf Miner % damage		Leaf and Blossom Webber % damage		Leaf Thrips Population (Nos.)		Thrips Damage grade (0-4 Score)		Apple and Nut Borer % damage		
		PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	PTC	30 DAS	
T1	Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	4.738 (12.566)	0.450 (3.833)	6.678 (14.969)	3.925 (11.422)	9.363 (17.809)	1.925 (7.971)	9.425 (3.229)	2.325 (1.823)	1.175 (1.474)	0.525 (1.234)	1.725 (7.537)	0.525 (4.15)	6.500 (2.739)
T2	Carbosulfan 25 EC @ 2 ml/lit. all the three sprays	4.675 (12.479)	0.600 (4.38)	6.550 (14.822)	4.788 (12.634)	9.645 (18.085)	2.413 (8.931)	9.650 (3.263)	2.763 (1.94)	1.150 (1.466)	0.800 (1.342)	1.800 (7.703)	0.648 (4.606)	6.630 (2.762)
T3	Buprofezin 25 % SC @ 2 ml/lit. all the three sprays	4.850 (12.717)	0.850 (5.283)	6.575 (14.851)	4.888 (12.767)	9.650 (18.09)	2.325 (8.759)	9.725 (3.275)	2.925 (1.981)	1.175 (1.475)	0.965 (1.402)	1.850 (7.813)	0.800 (5.127)	6.700 (2.775)
T4	Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	4.675 (12.482)	0.160 (2.286)	6.475 (14.736)	3.605 (10.939)	9.775 (18.212)	1.498 (7.025)	9.578 (3.252)	1.513 (1.585)	1.138 (1.462)	0.250 (1.117)	1.825 (7.759)	0.300 (3.128)	6.188 (2.681)
T5	Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays	4.575 (12.344)	0.413 (3.67)	6.463 (14.721)	3.900 (11.385)	9.675 (18.115)	1.875 (7.865)	9.598 (3.255)	2.175 (1.782)	1.125 (1.458)	0.438 (1.198)	1.800 (7.703)	0.425 (3.731)	6.550 (2.748)
T6	Imidachloprid 18.6 SL @0.6 ml/lit. all the three sprays	4.650 (12.448)	0.450 (3.833)	6.500 (14.765)	4.775 (12.616)	9.675 (18.115)	1.900 (7.919)	9.625 (3.26)	2.513 (1.874)	1.175 (1.475)	0.650 (1.284)	1.850 (7.812)	0.625 (4.514)	6.775 (2.788)
T7	Untreated control	4.575 (12.344)	6.613 (14.894)	6.525 (14.793)	7.600 (15.995)	9.675 (18.115)	16.300 (23.8)	9.625 (3.26)	12.675 (3.698)	1.188 (1.479)	1.800 (1.673)	1.850 (7.813)	2.325 (8.765)	5.243 (2.498)
C.D.		NS	0.66	NS	0.207	NS	0.383	NS	0.036	NS	0.048	NS	0.44	0.035
SE(m)		0.098	0.221	0.067	0.069	0.085	0.128	0.011	0.012	0.013	0.016	0.131	0.147	0.012
SE(d)		0.139	0.312	0.095	0.098	0.12	0.181	0.016	0.017	0.018	0.023	0.186	0.208	0.017
C.V.		1.574	8.086	0.907	1.101	0.935	2.478	0.689	1.158	1.704	2.41	3.4	6.045	0.867

PTC- Pre Treatment Count; DAS: Days After Spraying

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

Table 3.12 : Field evaluation of insecticides for residual toxicity against Tea Mosquito Bug and its damage at Vridhachalam**(Mean of four replications)**

Treatments		No. of adults survived after 24 hours after caging on			Damage grade (0-4 scale) 48 h after caging		
		Same day	Third day	Seventh day	Same day	Third day	Seventh day
T1	Thiamethoxam 25 WG @ 0.1 g/lit. all the three sprays	0.00	1.23	4.15	1.250 (1.5)	2.450 (1.857)	3.400 (2.097)
T2	Carbosulfan 25 EC @ 2 ml/lit. all the three sprays	0.00	2.60	3.35	1.225 (1.491)	2.475 (1.864)	3.525 (2.127)
T3	Buprofezin 25 % SC @ 2 ml/lit. all the three sprays	0.00	3.13	3.50	1.175 (1.475)	2.475 (1.864)	3.325 (2.079)
T4	Lambda-Cyhalothrin 5 EC @ 0.6ml/lit. all the three sprays	0.00	1.75	3.48	1.125 (1.458)	2.250 (1.803)	3.253 (2.062)
T5	Thiamethoxam 25 WG @ 0.2 g/lit. all the three sprays	0.00	1.23	4.33	1.250 (1.5)	2.500 (1.87)	3.250 (2.061)
T6	Imidachloprid 18.6 SL @0.6 ml/lit. all the three sprays	0.00	2.23	4.63	1.200 (1.483)	2.400 (1.844)	3.250 (2.061)
T7	Untreated control	6.00	6.00	5.50	2.263 (1.806)	3.250 (2.061)	3.973 (2.230)
C.D.					0.054	0.047	0.053
SE(m)					0.018	0.016	0.018
SE(D)					0.026	0.022	0.025
CV					2.364	1.669	1.687

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

Expt.4 : Evaluation of botanicals for the control of Tea Mosquito Bug and other insect pests

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

Objective : Evaluation of botanicals for the control of foliage and floral pests of Cashew.

BAPATLA

Experimental details:

Treatments : 7 (Seven)

Treatment details:

- T₁ : Custard leaf extract @ 7.5%
- T₂ : Chilli Garlic Extract @ 2%
- T₃ : Pongamiaia seed extract @ 4%
- T₄ : Azadirachtin 10000 ppm@ 1 ml/l
- T₅ : Ajith paul botanical formulation (AAVYA Botanical pesticide) @ 4 ml/l
- T₆ : Lamda Cyahalothrin 5EC @ 0.6 ml/l
- T₇ : Water spray

Three sprays were imposed at 30-35 days interval at flushing, flowering and at fruit & nut development stages.

No. of replications	:	3
No. of trees per replication	:	2
Design	:	R.C.B.D.

Observations

The data on pest incidence from 6 trees per each treatment was recorded from 24 leader shoots of each tree from all the four sides in respect of leaf and blossom webber, shoot tip caterpillar at one day before spray and 7 days interval after each spray. In the case of apple and nut borer total nuts in 24 panicles and the nuts damaged by the borer were counted at 7 days interval after 3rd spray. Thrips damage on nut surface was graded on 100 nuts per tree following 0 to 4 scale. Counts of spiders and ants were recorded at 7 days interval after 3rd spray by tapping 24 panicles per tree on 1 sq. foot card board.

During the year 2020-21, the activity of different important foliage, flower and nut feeding pests incidence was very low in all treatments. Hence treatments were not imposed during this season.

HOGALAGERE

The damage on shoots and panicles at 7 days and 15 days after each spray was significantly reduced in treatment Lambda-cyhalothrin 5 EC (0.6 ml/l) in all the sprays with mean

score of 0.72. The Azadirachtin 1% (1 ml/l), NSKE 5% and Ajith Paul (AAVYA) (4 g/l) were found to be next best treatments (with mean damage score of 0.92 & 1.71) in reduce TMB damage both on shoots and panicles in all the sprays. Whereas, Pongamiaia seed extract 4% and Chilli-garlic extract 7.5% treatments (with mean score of 2.23 & 2.62) were found to be least effective in reducing TMB damage.

The maximum nut yield was recorded in treatment Lambda-cyhalothrin 5 EC (0.6 ml/l) (5.75 kg/tree), followed by Azadirachtin 1% (1 ml/l) with (4.76 kg/tree) and NSKE 5% (4.33 kg/tree). The results on efficacy of different treatments against apple and nut borer, thrips, aphids and mealybugs indicated similar trend in management of these pests on cashew and recording enhanced nut yield. However, the maximum spider, ladybird beetles, green lacewing, *Bracon* sp. and syrphid population was recorded in all the treatments, but population was reduced in Lambda-cyhalothrin 5EC treatment indicating toxicity of the chemical to natural enemies.

Table 3.13 : Efficacy of botanicals against Tea Mosquito Bug (TMB) incidence in cashew at HREC, Hogalagere centre during 2021

Treatments		TMB damage on shoots / inflorescences (0-4 scale) at DAS						Mean	Nut yield (Kg/tree) (4 th harvest)
		On shoots			On Inflorescence				
		BS	7 DAS	15 DAS	BS	7 DAS	15 DAS		
T ₁	NSKE 5%	2.3 (1.67)	0.77 (1.13)	1.59 (1.45)	2.53 (1.74)	0.85 (1.16)	1.86 (1.54)	1.27	4.33
T ₂	Azadirachtin 1% @ 1ml/l	2.23 (1.65)	0.75 (1.12)	0.96 (1.21)	2.23 (1.65)	0.92 (1.19)	1.05 (1.24)	0.92	4.76
T ₃	Pongamiaia seed extract 4%	2.42 (1.71)	1.86 (1.54)	2.64 (1.77)	2.22 (1.65)	2.04 (1.59)	2.38 (1.70)	2.23	3.98
T ₄	Chilli-Garlic Extract 7.5%	2.2 (1.64)	2.21 (1.65)	3.05 (1.88)	2.35 (1.69)	2.19 (1.64)	3.05 (1.88)	2.63	3.27
T ₅	*Ajith Paul (AAVYA) @4g/l	2.29 (1.67)	1.66 (1.47)	1.64 (1.46)	2.17 (1.63)	1.78 (1.51)	1.78 (1.51)	1.72	3.82
T ₆	L - Cyhalothrin 5EC@0.6ml/l	2.23 (1.65)	0.54 (1.02)	0.92 (1.19)	2.32 (1.68)	0.68 (1.09)	0.75 (1.12)	0.72	5.75
T ₇	Untreated control	2.43 (1.71)	2.69 (1.79)	2.93 (1.85)	2.7 (1.79)	2.77 (1.81)	3.07 (1.89)	2.87	3.12
	SEm +	0.04	0.03	0.03	0.03	0.02	0.03	-	0.04
	CD @ 5%	0.12	0.07	0.08	0.09	0.07	0.10	-	0.13
	CV	4.16	3.16	2.97	3.06	2.73	3.89	-	3.57

Table 3.14 : Efficacy of different botanicals against pest complex in cashew at HREC Hogalagere centre during 2021

Treatment		Incidence of different pests on shoots or inflorescence at DAS							
		Apple & Nut Borer (% damage) *		Thrips (No./shoot or panicle) **		Aphids(No. affected shoots/plant) **		Mealy bugs (No. shoots affected/plant)	
		BS	15	BS	15 DAS	BS	15 DAS	BS	15
T ₁	NSKE 5%	2.67 (1.78)	0.77 (1.13)	4.52 (2.24)	1.97 (1.57)	3.79 (2.07)	2.47 (1.72)	2.49 (1.43)	1.86 (1.54)
T ₂	Azadiracthin 1% @ 1ml/l	2.92 (1.85)	0.72 (1.10)	4.49 (2.23)	1.89 (1.55)	3.88 (2.09)	1.77 (1.51)	2.80 (1.43)	1.56 (1.43)
T ₃	Pongamiaia seed extract 4%	2.46 (1.72)	1.99 (1.58)	4.29 (2.19)	3.17 (1.91)	3.55 (2.01)	2.84 (1.83)	2.28 (1.56)	2.79 (1.81)
T ₄	Chilli-Garlic Extract 7.5%	2.49 (1.73)	2.62 (1.77)	4.26 (2.18)	3.84 (2.08)	3.49 (2.00)	2.76 (1.80)	2.32 (1.61)	2.76 (1.80)
T ₅	*Ajith Paul (AAVYA) @4g/l	2.77 (1.81)	1.98 (1.57)	4.45 (2.22)	3.09 (1.89)	3.89 (2.09)	2.60 (1.76)	2.68 (1.56)	2.08 (1.61)
T ₆	L - Cyhalothrin 5EC@0.6ml/l	2.92 (1.85)	0.50 (1.00)	4.25 (2.18)	1.68 (1.48)	3.94 (2.11)	2.10 (1.61)	2.66 (1.41)	2.80 (1.82)
T ₇	Untreated control	2.63 (1.77)	2.92 (1.85)	4.42 (2.22)	4.58 (2.25)	3.77 (2.06)	4.32 (2.19)	2.52 (1.65)	3.29 (1.95)
	SEm +	0.03	0.03	0.04	0.04	0.05	0.03	0.03	0.03
	CD @ 5%	0.09	0.08	0.10	0.11	0.15	0.10	0.08	0.09
	CV	3.05	3.39	2.81	3.66	4.21	3.31	2.76	3.30

Table 3.15 : Evaluation of botanicals safety to natural enemies in cashew during 2021 at HREC, Hogalagere

Treatment		No. of predators on shoots or inflorescence at DAS**							
		<i>Oxypessweta</i>		<i>Menochilussexmaculatus</i>		<i>Chrysoperl asp</i>		Syrphid	
		BS	15 DAS	BS	15 DAS	BS	15 DAS	BS	15 DAS
T ₁	NSKE 5%	2.35 (1.69)	3.94 (2.11)	2.44 (1.71)	3.72 (2.05)	2.33 (1.68)	3.73 (2.06)	2.42 (1.71)	3.55 (2.01)
T ₂	Azadiracthin 1% @ 1ml/l	2.03 (1.59)	3.61 (2.03)	2.23 (1.65)	3.59 (2.02)	2.47 (1.72)	3.89 (2.09)	2.21 (1.65)	3.72 (2.05)
T ₃	Pongamiaia seed extract 4%	2.43 (1.71)	3.71 (2.05)	2.54 (1.74)	3.27 (1.94)	2.64 (1.77)	3.28 (1.94)	2.65 (1.77)	3.52 (2.00)
T ₄	Chilli-Garlic Extract 7.5%	2.26 (1.66)	3.67 (2.04)	2.37 (1.69)	3.83 (2.08)	2.48 (1.73)	3.41 (1.98)	2.35 (1.69)	3.86 (2.09)
T ₅	*Ajith Paul (AAVYA) @4g/l	2.26 (1.66)	3.46 (1.99)	2.36 (1.69)	3.38 (1.97)	2.5 (1.73)	3.36 (1.96)	2.42 (1.71)	3.75 (2.06)
T ₆	L - Cyhalothrin 5EC@0.6ml/l	2.28 (1.67)	1.85 (1.53)	2.41 (1.71)	1.54 (1.43)	2.52 (1.74)	1.47 (1.40)	2.45 (1.72)	1.66 (1.47)
T ₇	Untreated control	2.34 (1.68)	4.18 (2.16)	2.37 (1.69)	4.34 (2.20)	2.64 (1.77)	3.96 (2.11)	2.45 (1.72)	4.28 (2.19)
	SEm +	0.04	0.05	0.02	0.05	0.04	0.04	0.03	0.04
	CD @ 5%	0.11	0.15	0.07	0.14	0.11	0.13	0.09	0.11
	CV	3.76	4.48	2.39	4.16	3.66	4.01	2.96	3.39

JAGDALPUR

Experimental details

Number of treatments	:	9
Number of replications	:	3
Design of experiment	:	Randomized Block Design
Age of tree	:	18 years
Crop stage	:	Flushing to fruit maturity

Details of plant material

S. No.	Plant	Plant part used	Method
1	<i>Andrographis paniculata</i>	Tender shoots +Leaves+ Flower (1kg)	Decoction
2	<i>Datura metel</i>	Leaves+fruits (1kg)	Decoction
3.	<i>Calotropis procera</i>	Leaves +flower (1kg)	Decoction
4	<i>Cleistanthus collinus</i>	Leaves (1kg)	Decoction
5	Mixed plant + cow urine	<i>Andrographis</i> (tender shoots +leaves+ flower) + <i>Calotropis</i> (leaves+flower) + <i>Cascabela</i> (leaves+fruits) + <i>Datura</i> (leaves+fruits) + <i>Cleistanthus</i> (leaves)+ <i>Pongamiaia</i> (leaves+ seed) + <i>Lantana</i> (leaves +fruit) + <i>Vitex negundo</i> (leaves) + <i>Annona squamosa</i> (leaves) + <i>Azadirachta indica</i> (leaves+ seed) (Each 100gm to prepare 1kg plant part)	Putrefaction

Methodology :

In decoction method 1 kg fresh plant part were grinded and mixed in 2 liter of water in earthen pot and boiled for 20 minutes. After 20 minutes of boiling, it is kept overnight and next day the material is again boiled for 20 minute and kept for cooling. After cooling plant extract collect in clean container after sieving and used as standard solution.

In the case of putrefaction 1 kg mixed plant part mentioned above is soaked in 8 liter *desi* cow urine and 2 liter water in earthen pot for 20 days with closed mouth. After that putrefied material was sieved and used as standard solution.

Spray: Flushing, flowering and fruiting stage of crop

Observation: Pre and post observation at 15 days after spray

Results:

It is evident from the data evaluation of botanicals against TMB revealed, after first, second and third spraying, the efficacy of different botanicals was statistically superior over untreated control. The results revealed that T₇ (L-cyhalothrin 5 EC @ 0.6ml/l) showed least (0.25) damage score (DS) followed by T₄ (*Datura metel* decoction @ 5 %) with 0.63 DS and T₂

(*Andrographis paniculata* decoction @5 %) with 0.75 damage score per leader shoot. The least efficient botanical was T₆ (*Cleistanthus Collinus* @ 3 %) with 1.33 damage score per leader shoot. The pre treatment damage score of tea mosquito bug was non -significant including untreated control (T₉) with 1.17 per cent incidence.

Table 3.16 : Efficacy of different botanicals against incidence of TMB at Jagdalpur during 2021

Treatments		Mean damage score after third spray at 15 DAS		Yield (Kg/plant)
		Pre treatment damage score (0-4 scale)	Post treatment damage score (0-4 scale)	
T ₁	<i>Andrographis paniculata</i> decoction 3 %	1.28 (1.51)	1.00 (1.41) ^{ef}	3.63 (2.14) ^d
T ₂	<i>Andrographis paniculata</i> decoction 5 %	1.38 (1.54)	0.75 (1.32) ^{bc}	4.00 (2.23) ^c
T ₃	<i>Datura metel</i> decoction 3 %	2.04 (1.74)	0.92 (1.38) ^{de}	3.07 (2.02) ^{fgh}
T ₄	<i>Datura metel</i> decoction 5 %	1.65 (1.63)	0.63 (1.27) ^b	4.27 (2.29) ^b
T ₅	<i>Calotropis gigantea</i> decoction 3 %	1.30 (1.52)	1.11 (1.45) ^{fg}	3.10 (2.02) ^{fg}
T ₆	<i>Cleistanthus collinus</i> 3 %	1.72 (1.55)	1.33 (1.36) ^{gh}	3.17 (2.04) ^{ef}
T ₇	Cow urine+ mixed plant putrefaction 3 %	1.40 (1.65)	0.85 (1.53) ^{cd}	3.37 (2.09) ^e
T ₈	L-cyhalothrin 5EC (0.6ml/l)	1.67 (1.62)	0.25 (1.12) ^a	4.95 (2.44) ^a
T ₉	Untreated check	1.17 (1.47)	2.24 (1.80) ⁱ	2.07 (1.75) ⁱ
Mean		1.51	1.01	3.51
CD ($p=0.05$)		NS	0.14	0.23
SE(m) ±		0.08	0.05	0.11
CV (%)		9.03	5.56	6.30

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

KANABARGI

Table 3.17 : Efficacy of different insecticides against tea mosquito bug (TMB) in cashew during the year 2021 at RHREC Dharwad

Sl. No.	Treatments	TMB damage on shoots / inflorescences (0-4 scale) at DAS									Mean	Nut yield (Kg/t ree)
		On shoots						On panicles				
		1 DBS	7 DAS	15 DAS	1DBS	7 DAS	15 DAS					
T ₁	NSKE 5%	1.92 (1.56)	0.69 (1.09)	1.45 (1.40)	2.05 (1.60)	0.75 (1.12)	1.71 (1.48)	1.43	2.22			
T ₂	Azadiracthin 1% @	1.84 (1.53)	0.67 (1.08)	0.89 (1.18)	1.84 (1.53)	0.81 (1.14)	0.97 (1.21)	1.17	2.41			

	1ml/l														
T ₃	<i>Pongamiaia</i> seed extract 4%	1.95	(1.56)	1.66	(1.47)	2.33	(1.68)	1.89	(1.55)	1.84	(1.53)	2.18	(1.64)	1.98	1.66
T ₄	Chilli-Garlic Extract 7.5%	1.86	(1.54)	1.97	(1.57)	2.80	(1.82)	1.95	(1.56)	1.92	(1.56)	2.77	(1.81)	2.21	1.60
T ₅	*Ajith Paul (AAVYA) @4g/l	1.91	(1.55)	1.47	(1.40)	1.52	(1.42)	1.83	(1.53)	1.57	(1.44)	1.64	(1.46)	1.66	1.93
T ₆	L - Cyhalothrin 5EC @ 0.6 ml/l	1.89	(1.55)	0.48	(0.99)	0.82	(1.15)	1.94	(1.56)	0.60	(1.05)	0.69	(1.09)	1.07	2.72
T ₇	Untreated control	2.02	(1.59)	2.42	(1.71)	2.72	(1.80)	2.19	(1.64)	2.49	(1.73)	2.78	(1.81)	2.44	1.56
	SEm±	0.37		0.05		0.10		0.12		0.10		0.13			0.09
	CD @ 5%	0.13		0.16		0.31		0.37		0.30		0.38			0.27
	CV (%)	10.01		6.17		8.91		9.61		10.64		10.95			5.04

DBS : Day Before Spray

DAS : Days After Spray

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

Table 3.18 : Evaluation of Botanicals against pest complex in cashew during the year 2020-21 at RHREC Dharwad

Sl. No.	Treatment	Incidence of different pests on shoots or inflorescence											
		Apple & Nut Borer (% damage)*				Thrips (No./shoot or panicle)**				Aphids (No. affected shoots/plant)**			
		1 DBS		15 DAS		1 DBS		15 DAS		1 DBS		15 DAS	
T ₁	NSKE @ 5%	1.46	(6.94)	0.47	(3.92)	3.66	(2.17)	1.77	(1.59)	3.10	(2.01)	2.32	(1.78)
T ₂	Azadirachtin 1% @ 1ml/l	1.57	(7.21)	0.43	(3.77)	3.65	(2.17)	1.72	(1.57)	3.27	(2.06)	1.63	(1.54)
T ₃	<i>Pongamiaia</i> seed extract @ 4%	1.33	(6.62)	1.20	(6.30)	3.53	(2.14)	2.90	(1.96)	2.90	(1.96)	2.59	(1.87)
T ₄	Chilli-Garlic Extract @ 7.5%	1.33	(6.63)	1.57	(7.21)	3.63	(2.16)	3.46	(2.12)	2.91	(1.96)	2.57	(1.86)
T ₅	*Ajith Paul (AAVYA) @ 4g/l	1.50	(7.03)	1.15	(6.16)	3.71	(2.18)	2.82	(1.93)	3.16	(2.03)	2.38	(1.80)
T ₆	L - Cyhalothrin 5EC@ 0.6ml/l	1.55	(7.15)	0.31	(3.18)	3.61	(2.16)	1.53	(1.50)	3.24	(2.05)	1.94	(1.65)
T ₇	Untreated control	1.44	(6.90)	1.77	(7.65)	3.67	(2.17)	4.25	(2.32)	3.07	(2.01)	4.04	(2.27)
	SEm±	0.09		0.27		0.22		0.24		0.16		0.18	
	CD @ 5%	NS		0.81		0.64		0.72		0.45		0.54	
	CV (%)	0.00		7.62		9.12		10.68		7.62		11.13	

DBS : Day Before Spray

DAS : Days After Spray

* Values in the parentheses are Arcsine transformed values

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

Table 3.19 : Influence of different insecticides on natural enemies in cashew at during the year 2020-21 at RHREC Dharwad

Sl. No	Treatment	No. of predators on shoots or inflorescence at DAS**															
		<i>Oxyptessweta</i>				<i>Menochilussexmaculatus</i>				<i>Chrysoperlas</i>				Syrphid			
		1 DBS		15 DAS		1 DBS		15 DAS		1 DBS		15 DAS		1 DBS		15 DAS	
T ₁	NSKE 5%	1.67	(1.47)	1.15	(1.28)	1.76	(1.50)	1.38	(1.37)	1.78	(1.51)	1.36	(1.36)	1.76	(1.50)	1.21	(1.31)
T ₂	Azadiracthin 1% @ 1ml/l	1.51	(1.42)	1.28	(1.34)	1.60	(1.45)	1.44	(1.39)	1.69	(1.48)	1.49	(1.41)	1.61	(1.45)	1.34	(1.36)
T ₃	<i>Pongamiaia</i> seed extract 4%	1.73	(1.49)	1.59	(1.45)	1.82	(1.52)	1.75	(1.50)	1.93	(1.56)	1.80	(1.52)	1.83	(1.53)	2.03	(1.59)
T ₄	Chilli-Garlic Extract @ 7.5%	1.61	(1.45)	1.69	(1.48)	1.70	(1.48)	1.85	(1.53)	1.80	(1.52)	1.90	(1.55)	1.70	(1.48)	2.20	(1.64)
T ₅	*Ajith Paul (AAVYA) @4g/l	1.63	(1.46)	1.71	(1.49)	1.72	(1.49)	1.87	(1.54)	1.82	(1.52)	1.92	(1.56)	1.73	(1.49)	2.15	(1.63)
T ₆	L - Cyhalothrin 5EC@ 0.6ml/l	1.64	(1.46)	0.28	(0.88)	1.73	(1.49)	0.23	(0.85)	1.84	(1.53)	0.39	(0.94)	1.74	(1.50)	0.54	(1.02)
T ₇	Untreated control	1.67	(1.47)	1.76	(1.50)	1.76	(1.50)	1.91	(1.55)	1.87	(1.54)	1.97	(1.57)	1.77	(1.51)	2.08	(1.61)
	SEm±	0.11		0.08		0.12		0.11		0.11		0.09		0.11		0.12	
	CD @ 5%	0.33		0.25		0.35		0.32		0.31		0.27		0.33		0.36	
	CV	8.95		7.67		8.88		8.60		7.63		7.31		8.57		9.34	

* ICAR recommendation

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

Inference of the experiment:

Evaluation of insecticides for the control of TMB and other pests: The results indicated that among the botanicals, azadiracthin 1% @ 1ml/l recorded significantly low tea mosquito bug damage on shoots (0.89) and on panicles (0.97) on 0 to 4 scale basis at 15 days after spray which is superior to other botanicals such as *Ajith Paul (AAVYA) @4g/l, *Pongamiaia* seed extract 4% and Chilli-Garlic Extract 7.5%. Further, azadiracthin 1% @ 1ml/l was on par with standard check, lambda - Cyhalothrin 5EC @ 0.6 ml/l which registered 0.82 and 0.69 tea mosquito bug damage on 0 to 4 scale basis on shoots and panicles, respectively, at 15 days after spray indicating azadiracthin 1% @ 1ml/l is effective and easily adoptable by the farming community.

Further, percent incidence of apple and nut Borer on cashew was less in both NSKE 5% (0.47%) and azadiracthin 1% @ 1ml/l (0.43%) at 15 days after spray which was on par with lambda - Cyhalothrin 5EC @ 0.6 ml/l indicating the effectiveness of neem based insecticides. Similarly, thrips and aphids damage on cashew was recorded which revealed that again neem based insecticides excelled in recording less population of thrips and aphids as compared to other botanicals and on par with standard insecticide check, lambda - Cyhalothrin 5EC @ 0.6 ml/l confirming the efficacy of neem based insecticides.

During the experimentation, the natural enemy population especially predators such as *Oxyptessweta*, *Menochilus sexmaculatus*, *Chrysoperla* sp and Syrphida were also recorded to know the safety of the different treatments in cashew ecosystem. Among the various treatments, almost all the botanical insecticides have recorded statistically higher predator population as compared to

standard insecticide check, lambda - Cyhalothrin 5EC @ 0.6 ml/l indicating that botanicals are relatively safer than insecticides.

Ultimately the effectiveness of treatments measured by the cashew nut yield per tree where both NSKE 5% (2.22 kg nuts/tree) and azadiracthin 1% @ 1ml/l (2.41 kg nuts/tree) recorded higher nut yield per tree as compared to other botanicals such as *Ajith Paul (AAVYA) @4g/l, *Pongamiaia* seed extract 4% and Chilli-Garlic Extract 7.5%. On the contrary, azadiracthin 1% @ 1ml/l and other botanicals were inferior to standard check, lambda - Cyhalothrin 5EC @ 0.6 ml/l which registered higher nut yield (2.72 kg nuts/tree) indicating the superiority of standard check. However, from the safety and residue point of view, use neem - based insecticides is advisable as compared to insecticides.

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Treatment details

Sl. No.	Treatments
T ₁	Neem Seed Kernel Extract 5%
T ₂	Desi cow urine 10%
T ₃	<i>Pongamiaia</i> oil 5%
T ₄	Cinnamon leaf extract 2%
T ₅	Cinnamon leaf extract 5%
T ₆	<i>Acorus calamus</i> rhizome powder extract 2%
T ₇	<i>Acorus calamus</i> rhizome powder extract 5%
T ₈	<i>Andrographis paniculata</i> leaf extract 2%
T ₉	<i>Andrographis paniculata</i> leaf extract 5%
T ₁₀	'Aavya' botanical formulation 4g/l
T ₁₁	POP, KAU
T ₁₂	Untreated check

Influence of insecticides on tea mosquito bug damage

The trial was conducted in the mid season variety Dhana. Four sprays were given at 21 days interval during the season. The TMB damage score was recorded before spray, and seven and 15 days after each spray. Before spraying of botanical products, the average TMB damage score was 0.103. After 7 and 15 days of first spray, T₁₁ (POP, KAU) recorded least damage score of 0.000 and 0.007 respectively.

In the second spray, treatments T₁₁ (POP, KAU), T₇ (*Beauveria bassiana* WP 10g/L), T₄ (Cinnamon leaf extract 2%) were significantly superior to all other treatments. At 15 days after second spray, T₁₁ (POP, KAU) was significantly superior to control. In third spray, T₁₁ (POP, KAU) was significantly superior to all other treatments at 7 and 15 days after sprays.

After 7 days of fourth spray, T₄ (Cinnamon leaf extract 2%), T₁₁ (POP, KAU), T₅ (Cinnamon leaf extract 5%), T₆ (*Acorus calamus* rhizome powder extract 2%) and T₇ (*Acorus calamus* rhizome powder extract 5%) recorded significantly less damage score compared to control.

There was no phytotoxicity symptom on plants after application of botanical products. Nut yield per tree was significantly highest in T₁₁ (POP, KAU) than remaining treatments.

Table 3.20 : Efficacy of different botanical products against TMB incidence in cashew at Madakkathara Centre during 2021

Treatment	Pre count	First spray		Second Spray		Third Spray		Fourth Spray	Yield
		7 DAS	15DAS	7 DAS	15DAS	7 DAS	15DAS	7 DAS	
T ₁	0.021 (0.722)	0.139 (0.798) ^{ab}	0.085 (0.763) ^{bc}	0.134 (0.71) ^{bc}	0.078 (0.759) ^{cd}	0.140 (0.800) ^{bcde}	0.108 (0.778) ^{bcde}	0.173 (0.820) ^{bc}	3.21 ^{cde}
T ₂	0.077 (0.760)	0.325 (0.906) ^a	0.407 (0.946) ^a	0.334 (0.91) ^{ab}	0.287 (0.884) ^{bc}	0.271 (0.867) ^{bcd}	0.382 (0.938) ^{ab}	0.24 (0.858) ^b	2.63 ^{ef}
T ₃	0.043 (0.737)	0.135 (0.796) ^{ab}	0.104 (0.775) ^{bc}	0.143 (0.802) ^{bc}	0.068 (0.753) ^{cd}	0.139 (0.799) ^{bcde}	0.092 (0.769) ^{cde}	0.087 (0.765) ^{bc}	3.65 ^{bcd}
T ₄	0.169 (0.808)	0.125 (0.791) ^{ab}	0.102 (0.773) ^{bc}	0.006 (0.711) ^c	0.078 (0.759) ^{cd}	0.028 (0.726) ^{de}	0.114 (0.781) ^{bcde}	0.008 (0.712) ^c	4.40 ^b
T ₅	0.145 (0.802)	0.183 (0.826) ^{ab}	0.092 (0.768) ^{bc}	0.135 (0.797) ^{bc}	0.042 (0.735) ^{cd}	0.122 (0.781) ^{bcde}	0.016 (0.718) ^{de}	0.015 (0.717) ^c	3.87 ^{bc}
T ₆	0.320 (0.883)	0.194 (0.833) ^{ab}	0.092 (0.767) ^{bc}	0.196 (0.831) ^{bc}	0.051 (0.742) ^{cd}	0.098 (0.772) ^{cde}	0.047 (0.739) ^{de}	0.019 (0.720) ^c	3.91 ^{bc}
T ₇	0.040 (0.735)	0.122 (0.788) ^{ab}	0.102 (0.775) ^{bc}	0.006 (0.711) ^c	0.025 (0.724) ^{cd}	0.044 (0.737) ^{de}	0.069 (0.753) ^{cde}	0.019 (0.720) ^c	4.14 ^b
T ₈	0.102 (0.775)	0.293 (0.890) ^a	0.260 (0.868) ^{abc}	0.428 (0.960) ^{ab}	0.467 (0.971) ^{ab}	0.324 (0.902) ^{abc}	0.341 (0.915) ^{abc}	0.247 (0.864) ^b	2.37 ^f
T ₉	0.067 (0.753)	0.381 (0.938) ^a	0.285 (0.881) ^{ab}	0.527 (1.000) ^a	0.236 (0.856) ^{bc}	0.275 (0.880) ^{bcd}	0.440 (0.963) ^a	0.207 (0.835) ^{bc}	2.78 ^{ef}
T ₁₀	0.027 (0.726)	0.412 (0.933) ^a	0.221 (0.843) ^{abc}	0.169 (0.813) ^{bc}	0.198 (0.826) ^{bc}	0.374 (0.933) ^{ab}	0.305 (0.882) ^{abcd}	0.184 (0.826) ^{bc}	3.16 ^{cdef}
T ₁₁	0.082 (0.763)	0.000 (0.707) ^b	0.007 (0.712) ^c	0.000 (0.707) ^c	0.020 (0.721) ^d	0.000 (0.707) ^e	0.010 (0.713) ^e	0.011 (0.714) ^c	5.34 ^a
T ₁₂	0.138 (0.795)	0.358 (0.926) ^a	0.411 (0.953) ^a	0.586 (1.036) ^a	0.736 (1.109) ^a	0.568 (1.029) ^a	0.455 (0.975) ^a	0.503 (0.996) ^a	2.87 ^{def}
Mean	0.103	0.222	0.181	0.222	0.190	0.199	0.204	0.143	3.528
SEm±	0.016	0.013	0.014	0.016	0.013	0.013	0.014	0.011	0.153
CD@%	NS	0.131	0.141	0.151	0.132	0.132	0.142	0.120	0.820
CV (%)	12.30	9.20	10.30	10.91	10.42	9.65	10.40	8.45	13.73

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The population of TMB on shoots and panicles ranged between 0.90 to 1.16 and 1.01 to 1.22, respectively before application of different treatments. The TMB damage score at 7 days and 15 days after the spray were ranged from 0.57 to 1.29 and 0.26 to 1.45 on shoots and 0.54 to 1.27 and 0.21 to 1.42 on panicles were recorded. Fifteen days after spraying, all the treatments were observed to be significantly superior over the control for reducing the TMB population on shoots and panicles.

Fifteen days after spraying, the least damage score 0.26 and 0.21 were recorded in T6 (L-cyhalothrin) on shoots and panicles. However, the least damage score 0.45 and 0.56 were recorded in T2 (NAU Product) among the different botanicals on shoots and panicles.

Table 3.21 : Efficacy of different botanicals against tea mosquito bug incidence in cashew at Paria centre during the year 2020-21

Treatments		On Shoots (%)			On Panicle (%)		
		BS	7 DAS	15 DAS	BS	7 DAS	15 DAS
T1	Custard apple 10%	1.02	1.10	1.19	1.18	1.27	1.26
T2	NAU Product 10%	0.98	0.73	0.45	1.01	0.76	0.56
T3	Akdo 1%	1.11	1.14	0.92	1.22	1.20	1.14
T4	Tulsi 10%	0.94	1.02	0.97	1.05	1.15	1.21
T5	Nirgudi 5%	0.99	1.03	1.15	1.06	1.12	1.20
T6	Kalmagh 10%	1.06	0.95	0.64	1.20	1.05	1.10
T7	Mr. Ajit Paul Botanical formulation 40gm/10 lit	0.90	0.96	0.97	1.09	1.14	1.15
T8	Cow urine 10%	1.16	1.10	1.02	1.11	1.16	1.12
T9	L- cyhalothrin 6ml/10 lit	1.03	0.57	0.26	1.12	0.54	0.21
T10	Untreated control	1.07	1.29	1.45	1.14	1.25	1.42
	SEm ±	0.05	0.04	0.04	0.06	0.05	0.04
	CD at 5%	NS	0.14	0.12	NS	0.15	0.12
	CV%	9.34	8.25	7.64	8.88	7.65	6.61

PILICODE

The trial was started in 2019. The variety included in the trial is Madakkathara 1. The treatment details are as follows.

1. Neem seed kernel extract 5 ml/litre (5% solution - 50 gram kernels/litre and dilute to 5% and spray)
2. Kasaragod dwarf cow urine – 100ml/litre (10%)
3. Vitex *negundo* extract – 7.5 ml/litre
4. Bougainvillea leaf extract - 5ml/litre (5 % solution has been prepared)
5. *Hyptis suaveolen* sextract – 5ml/litre (5 % solution has been prepared)
6. Standard check – Lamdaxyhalothrin – 0.6 ml/litre as per POP recommendation
7. Untreated control
8. 'Aavya' by Ajith Paul

Number of replications: 4

Time of spray: at Flushing, flowering and nut setting stage. As per the last AGM recommendation an additional spray was given during October before the flushing the stage.

Observations : Damage scoring was done using 0 – 4 scale from 52 leader shoots from a plant.

Aqueous extract of leaves was prepared by using 10g of test plant leaves. Before spraying of treatments, all the trees had statistically similar damage score and population of insects. Spraying was undertaken at three stages flushing, flowering and nut setting and an additional spraying was given as per the recommendation of last AGM before the flushing stage.

At flushing stage, lowest damage score was observed with Lamda-cyhalothrin (1.00) and NSKE treatments (1.25). Average population of Nymph + Adult was lowest in Lamda cyhalothrin (17.32) followed by NSKE treatment (18.58). Similar results were observed during flowering and nut setting stage also. When the mean of all three post treatments damage scores were compared, Lamda cyhalothrin (1.25) had the least damage score among the treatments. This was followed by NSKE treatment (1.50). Hence from this experiment, it could be concluded that NSKE @5% could effectively manage TMB and could be a possible organic alternative to chemical control. Last year, Kasaragod dwarf cow urine @10% was more effective than NSKE @5% in reducing damage score though NSKE treatment had lesser average population.

Table 3.22 : Effect of botanicals on the incidence of TMB at Pilicode during 2021

Treatment	Before spray		Flushing		Flowering		Nut setting		Post treatment mean damage score (0-4)* (Mean of three sprays)
	Pre treatment mean damage score (0-4)*	Average Population (Nymph + Adult)#**	Post treatment mean damage score (0-4)*	Average Population (Nymph + Adult)#**	Post treatment mean damage score (0-4)*	Average Population (Nymph + Adult)#**	Post treatment mean damage score (0-4)*	Average Population (Nymph + Adult)#**	
Neem seed kernel extract	2.43 (1.71)	24.48 (4.95)	1.25 (1.31)	18.58 (4.31)	1.75 (1.49)	19.75 (4.44)	1.50 (1.40)	17.11 (4.14)	1.50 (1.41)
Kasaragod dwarf cow urine	2.43 (1.71)	24.53 (4.95)	2.75 (1.79)	23.26 (4.82)	3.50 (2.00)	24.64 (4.96)	3.75 (2.06)	23.92 (4.89)	3.33 (1.96)
<i>Vitex negundo</i>	2.40 (1.70)	24.70 (4.97)	3.50 (2.00)	24.52 (4.95)	3.25 (1.92)	23.21 (4.82)	3.00 (1.86)	22.62 (4.76)	3.25 (1.93)
Bougainvillea leaf extract	2.40 (1.70)	24.63 (4.96)	2.50 (1.73)	24.81 (4.98)	3.00 (1.86)	25.43 (5.04)	2.00 (1.56)	24.43 (4.94)	2.50 (1.73)
<i>Hyptis suaveolens</i>	2.43 (1.71)	24.73 (4.97)	2.50 (1.70)	23.89 (4.89)	2.75 (1.79)	24.78 (4.98)	2.25 (1.63)	25.78 (5.08)	2.50 (1.73)
Lamda cyhalothrin	2.43 (1.71)	24.63 (4.96)	1.00 (1.23)	17.32 (4.16)	1.25 (1.31)	18.62 (4.32)	1.50 (1.40)	16.23 (4.03)	1.25 (1.32)
'Aavya' by Ajith Paul	2.38 (1.70)	24.54 (4.95)	3.75 (2.06)	24.78 (4.98)	3.00 (1.86)	25.43 (5.04)	3.50 (1.99)	23.43 (4.84)	3.42 (1.98)
Untreated control	2.46 (1.72)	25.00 (5.00)	3.25 (1.92)	25.62 (5.06)	3.25 (1.92)	24.71 (4.97)	3.75 (2.06)	25.71 (5.07)	3.42 (1.98)
F Test	NS	NS	**	**	**	**	**	**	**
SEm ±	0.006	0.017	0.109	0.023	0.109	0.027	0.118	0.019	0.054
CD	-	-	0.32	0.07	0.32	0.08	0.34	0.06	0.16
CV %	0.69	0.69	12.68	0.96	12.35	1.11	13.51	0.83	6.18

*Figures in paratheses are square root transformed values

Figures in paratheses are square root+ 0.5 transformed values

** Average population of Nymph + Adult observed in each treatment

Table 3.23 : Effect of botanicals on the average population of TMB after applying Henderson-Tilton formula for control correction at Pilicode during 2021

Treatment	Average Population (Nymph + Adult)#**		
	Flushing	Flowering	Nut setting
Neem seed kernel extract	25.94	9.17	-20.19
Kasaragod dwarf cow urine	7.45	8.93	-7.22
<i>Vitex negundo</i>	3.11	-1.96	-6.88
Bougainvillea leaf extract	1.69	5.88	-8.43
<i>Hyptis suaveolens</i>	5.71	7.01	-2.84
Lamda cyhalothrin	31.38	10.31	-19.45
'Aavya' by Ajith Paul	1.45	5.90	-13.03
Untreated control	0.00	0.00	0.00
F Test	**	**	**
SEm ±	0.936	2.049	1.611
CD	2.73	5.98	4.70
CV %	19.52	72.47	33.03

At flushing stage, Lamda cyhalothrin was most effective in bringing down the population. This was followed by NSKE and Kasaragod dwarf cow urine. At flowering stage, lamda cyhalothrin, NSKE and Kasaragod dwarf cow urine were superior and statistically on par. During nut setting all the value turned negative indicating that the sprays are not effective in bringing down population further and hence sprays can be skipped at this stage.

VENGURLA

Design : RBD
 Replication : Three
 Spray schedule : 15 days interval
 Treatments : 11

- T₁: Nirgudi (*Vitex negundo*) plant extract 5%
 T₂: Kalmagh (*Andrographis paniculata*) plant extract 5%
 T₃: Tiriphal (*Zanthoxylum piperitum*) seed extract 5%
 T₄: Datura (*Datura stramonium*) seed extract 5 %
 T₅: Custard apple leaves + Bael leaves + Ruhi leaves + Tulsi leaves + Drumstick leaves+ Hibiscus leaves + Bitter gourd juice - 5 % extract (on the basis of farmers feed back)
 T₆: Satvin (*Alstonia scholaris*) bark extract 5%
 T₇: Neem seed (*Azadirachta indica*) kernel extract 5 %
 T₈: Deshi cow urine 10%

- T₉: Standard check Lambda cyhalothrin/ Recommended spray
 T₁₀: Ajit paul botanical
 T₁₁: Untreated control

Methodology for preparation of extract : For preparation of standard solution of treatment take 1kg of plant/seed material in 10 litre water, boil it for 30 minutes, allow it to cool and keep it as such for 24 hours. Next day again boil it for 30 minutes and allow it to cool. Use this solution as a standard/stock solution. The 5 % extract be prepared from this standard/stock solution.

Methodology : 52 shoots were selected randomly at four sides (E, W, N, and S) on the trees under observation and labeled individually. The total numbers of laterals in the selected leader shoots were recorded. The incidence of tea mosquito bug was recorded on selected shoots/inflorescences in 0 to 4 scales as given below.

- 0 – No lesions/streaks.
- 1 – 1 to 3 necrotic lesions /streaks.
- 2 – 4 to 6 coalescing or non-coalescing lesions/streaks.
- 3 – Above six coalescing or non-coalescing lesions/ streaks.
- 4 – Lesions/streaks confluent or wilting or drying of affected Shoots/ panicles.

The data revealed that the treatment T₉ (standard check) is most effective for management of TMB. Among the different botanical treatments, the treatment T₁₀ (Botanical formulation “AAVYA” @ 4 g/l of water) was found to be the most effective (0.398) for management of TMB, but it was at par with T₄ (Datura seed extract @ 5 %), T₁ (Nirgudi plant extract @ 5%) and T₅ (Custard apple leaves + Bael leaves + Ruhi leaves + Tulsi leaves + Drumstick leaves+ Hibiscus leaves + Bitter gourd juice @5 % extract) after 1st and 2nd spray and with T₄ (Datura seed extract @ 5 %) after 3rd spray. From the mean TMB incidence data, it is evident that the treatment T₁₀ (Botanical formulation “AAVYA” @ 4 g/l of water) is most effective (0.406) for management of TMB, but was at par with T₄ (Datura seed extract @ 5 %).

Regarding spider population, the treatment T₁₁ (Untreated control) recorded the maximum spider population (0.18) however, it was at par with all other treatments except standard check (λ cyhalothrin).

The maximum yield (5.80kg/tree) was recorded in treatment T₉ (Standard check) which was significantly superior to all other treatments. Among the different botanicals, treatment T₁₀ (Botanical formulation “AAVYA” @ 4 g/l of water) recorded maximum yield (3.0 kg/tree) but was at par with all other treatments except T₃ (Triphal seed extract 5%).

Table 3.24 : Incidence of tea mosquito bug in 0-4 scale in different treatments (2020-21)

Treatments		Incidence of TMB in 0-4 scale after			Cumulative mean incidence of TMB (0-4 scale)	Spider population 30 days after last spray	Yield (kg/tree)
		1 st spray	2 nd spray	3 rd spray			
T ₁	Nirgudi (<i>Vitex negundo</i>) plant extract 5%	0.436	0.455	0.461	0.451	0.13	2.97
T ₂	Kalmagh (<i>Andrographis paniculata</i>) plant extract 5%	0.468	0.494	0.493	0.485	0.12	2.57
T ₃	Tiriphall (<i>Zanthoxylum piperitum</i>) seed extract 5%	0.474	0.494	0.506	0.491	0.14	2.43
T ₄	Datura (<i>Datura stramonium</i>) seed extract 5 %	0.431	0.436	0.430	0.432	0.12	2.93
T ₅	Custard apple leaves + Bael leaves + Ruhi leaves + Tulsi leaves + Drumstick leaves+ Hibiscus leaves + Bitter gourd juice - 5 % extract (on the basis of farmers feedback)	0.436	0.455	0.461	0.450	0.14	2.90
T ₆	Satvin (<i>Alstonia scholaris</i>) bark extract 5%	0.474	0.481	0.487	0.480	0.14	2.87
T ₇	Neem seed (<i>Azadirachta indica</i>) kernel extract 5 %	0.455	0.474	0.474	0.468	0.14	2.83
T ₈	Deshi cow urine 10%	0.480	0.487	0.506	0.491	0.17	2.67
T ₉	Standard check <i>Lambda cyhalothrin/</i> Recommended spray	0.160	0.237	0.192	0.196	0.07	5.80
T ₁₀	Botanical formulation "AAVYA" @ 4 g/l of water (Ajit Paul)	0.398	0.429	0.391	0.406	0.14	3.00
T ₁₁	Untreated control	0.551	0.602	0.641	0.598	0.18	1.90
SEm ±		0.01	0.01	0.01	0.00	0.01	0.15
CD at 5%		0.04	0.04	0.05	0.02	0.05	0.44
CV%		6.30	5.63	6.57	3.47	15.82	8.71

VRIDHACHALAM**Experimental details**

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

Treatments

The following treatments were imposed as per approved technical programme.

T-1	:	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem fermented for 2 days. Soaked in Mud pot with 10 litres of water.
T-2	:	NSKE 5%
T-3	:	Deshi Cow urine 100 ml/litre of water.
T-4	:	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem - Methanol Extract
T-5	:	Rhizomes of Acorus 5% soaked overnight.
T-6	:	Pongamiaia oil 5 %
T-7	:	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem - n-hexane Extract
T-8	:	Standard treated check (Spraying of Lambda Cyhalothrin 5% EC @ 0.6 ml/lit of water)
T-9	:	Untreated check

As per the technical Programme, botanicals were sprayed during flushing, flowering and fruit formation stage at the fortnight intervals before reaching ETL. Totally five round of sprays were imposed with maximum spray suspension used per tree was 10 lit./each spray.

Evaluation of phytotoxicity of botanicals on cashew

As per the technical Programme, in Botanicals field experiments, symptoms like leaf injury, wilting, vein clearing, necrosis, epinasty and hyponasty were observed in each tree at 1,3,5,7,10 and 14 days after spraying as per the protocol of Central Insecticide Board and Registration Committee (C.I.B and R.C).

Method of assessment

Leaf injury was assessed by visual rating in a 0-10 scale

Rating	Phytotoxicity (%)
0	No phytotoxicity
1	0-10
2	11-20
3	21-30
4	31-40
5	41-50
6	51-60
7	61-70
8	71-80
9	81-90
10	91-100

The per cent leaf injury was calculated using the formula,

$$\text{Per cent leaf injury} = \frac{\text{Total grade points}}{\text{Maximum grade} \times \text{Number of leaves observed}} \times 100$$

The results of evaluation of Botanical pesticides against TMB revealed that 15 days after third, fourth and fifth spraying, the efficacy of botanicals was low when compared to the standard insecticides treated check. All the botanical pesticides were sprayed in the field before reaching ETL. During the flushing period, the first and second spray was carried out prior to the TMB incidence. TMB incidence was not observed in botanical pesticides sprayed when compared to the Untreated check (the damage score observed was 2.5). The pre-treatment damage score of TMB was non-significant in all the treatments but not in the untreated check. Reduction of fresh infestation was observed 7 days after each round of spray. Standard insecticide check (Spraying of Lambda Cyhalothrin 5% EC @ 0.6ml/lit. of water) is effective in controlling the TMB incidence. Among all the botanical pesticides sprayed, spraying of combined Leaf extracts of *Adathoda*, *Datura*, *Vitex*, *Calotropis* and neem was very effective in controlling the TMB incidence (0.660 and 0.550 scale), followed by Pongamia oil 5% was very effective in controlling the TMB incidence (0.845 and 0.645 scale), followed by NSKE 5% (1.153 and 0.785 scale). The same was observed in 7 DAS and 15 DAS of fourth and fifth spraying also. After the fourth spray, the damage score ranged between 0.360 and 1.953 in different treatments as against an increased damage score of 3.345 in untreated control. Fifteen days after fifth spray, the damage score decreased and ranges between 0.515 and 2.425 in various treatments as against an increased score of 3.760 in control.

The overall efficacy ranked in the order against the incidence of TMB and its population at Vridhachalam are as follows: T9 - Standard treated check (Spraying of Lambda Cyhalothrin 5% EC @ 0.6 ml/lit of water) > T1 - spraying of combined Leaf extracts of *Adathoda*, *Datura*, *Vitex*, *Calotropis* and neem > T6- Pongamia oil 5 % > T2-NSKE 5% >T3 Deshi Cow urine 100 ml/litre of water > T5- Rhizomes of *Acorus* 5% >T4- Leaf extracts of each of 500 grams of *Adathoda*, *Datura*, *Vitex*, *Calotropis*, Neem - Methanol Extract > T7 - Leaf extracts of each of 500 grams of *Adathoda*, *Datura*, *Vitex*, *Calotropis*, Neem-n-hexane Extract.

The population trend of TMB and other foliar feeding insects was recorded fifteen days after 5th spray, all the botanical pesticides effective in controlling TMB populations to 1.7 as against 13.850 bugs/ 24 leader shoots observed in untreated control. Furthermore, the per cent damage of leaf miner (ranged from 1.375 to 2.278), leaf and blossom webber (ranged from 2,488 to 4.190) and nut borer (ranged from 1.95 to 2.688) was low in all botanicals treated trees as compared to untreated trees.

Phytotoxic effect of botanicals on cashew

The observations showed that none of the botanical treatments caused any phytotoxic symptoms such as injury to leaf tip and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty. Hence, it was concluded that these botanical treatments did not inflict any phytotoxic effect on cashew.

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

Table 3.25 : Effect of Botanicals 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)	Post treatment mean damage score (0-4)	
			III Spray			IV Spray			V Spray	
			7 DAS	15 DAS		7 DAS	15 DAS		7 DAS	15 DAS
T1	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem fermented for 15-20 days. Soaked in Mud pot with 10 litres of water	2.485 (1.867)	0.660 (1.288)	0.550 (1.245)	3.163 (2.04)	0.655 (1.286)	0.360 (1.166)	3.435 (2.106)	0.940 (1.393)	0.5150 (1.231)
T2	NSKE 5%	2.515 (1.875)	1.153 (1.467)	0.785 (1.336)	3.166 (2.041)	0.923 (1.387)	0.753 (1.324)	3.475 (2.115)	1.532 (1.591)	0.8600 (1.364)
T3	Deshi Cow urine 100 ml/litre of water	2.495 (1.869)	1.530 (1.591)	0.965 (1.402)	3.184 (2.045)	1.263 (1.504)	0.937 (1.392)	3.418 (2.102)	1.815 (1.678)	1.2950 (1.512)
T4	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem -Methanol Extract	2.530 (1.879)	1.858 (1.69)	1.253 (1.501)	3.183 (2.045)	1.565 (1.602)	1.243 (1.497)	3.450 (2.109)	2.110 (1.763)	1.6103 (1.615)
T5	Rhizomes of Acorus 5% soaked overnight.	2.533 (1.879)	2.028 (1.74)	1.540 (1.594)	3.174 (2.043)	1.755 (1.66)	1.557 (1.599)	3.460 (2.112)	2.550 (1.884)	1.8488 (1.688)
T6	Pongamia oil 5 %	2.473 (1.863)	0.845 (1.358)	0.645 (1.283)	3.181 (2.045)	0.855 (1.362)	0.555 (1.247)	3.340 (2.083)	1.475 (1.572)	0.7423 (1.32)
T7	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem - n-hexane Extract	2.525 (1.877)	2.173 (1.781)	1.158 (1.469)	3.168 (2.042)	1.953 (1.718)	1.775 (1.666)	3.418 (2.102)	2.573 (1.89)	2.4250 (1.85)
T8	Standard treated check (Spraying of Lambda Cyhalothrin 5% EC @ 0.6 ml/lit of water)	2.520 (1.876)	0.470 (1.212)	0.325 (1.151)	3.147 (2.036)	0.363 (1.167)	0.153 (1.073)	3.475 (2.115)	0.044 (1.022)	0.0055 (1.003)
T9	Untreated check	2.525 (1.877)	2.735 (1.933)	2.803 (1.95)	3.165 (2.041)	3.218 (2.054)	3.345 (2.084)	3.540 (2.131)	3.663 (2.159)	3.7600 (2.182)
C.D.		NS	0.015	0.012	NS	0.013	0.013	NS	0.057	0.06
SE(m)		0.006	0.005	0.004	0.001	0.004	0.005	0.006	0.019	0.02
SE(d)		0.009	0.007	0.006	0.002	0.006	0.006	0.008	0.028	0.029
CV (%)		0.67	0.632	0.583	0.143	0.568	0.632	0.529	2.341	2.674

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

Table 3.26 : Efficacy of Botanicals on TMB population / 24 leader shoots at Vridhachalam**(Mean of four replications)**

Treatment		Pre-Treatment Count /24 leader shoots	Post-treatment count (Mean TMB population/24 leader shoots)		Pre-Treatment Count /24 leader shoots	Post-treatment count (Mean TMB population/24 leader shoots)		Pre-Treatment Count /24 leader shoots	Post-treatment count (Mean TMB population/24 leader shoots)	
			III Spray			IV Spray			V Spray	
			7 DAS	15 DAS		7 DAS	15 DAS		7 DAS	15 DAS
T1	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem fermented for 15-20 days. Soaked in Mud pot with 10 litres of water.	9.450 (3.233)	1.733 (1.652)	1.558 (1.599)	12.325 (3.65)	1.565 (1.602)	2.688 (1.92)	13.750 (3.841)	2.243 (1.801)	1.700 (1.641)
T2	NSKE 5%	9.300 (3.209)	3.550 (2.133)	3.200 (2.049)	12.273 (3.643)	2.630 (1.905)	3.575 (2.139)	13.700 (3.834)	2.881 (1.97)	2.461 (1.86)
T3	Desi Cow urine 100 ml/litre of water.	9.550 (3.248)	3.653 (2.157)	3.750 (2.179)	12.250 (3.64)	2.875 (1.968)	3.800 (2.191)	13.632 (3.825)	3.425 (2.103)	3.588 (2.141)
T4	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem -Methanol Extract	9.526 (3.244)	4.070 (2.252)	3.833 (2.198)	12.285 (3.645)	3.525 (2.127)	4.425 (2.329)	13.529 (3.812)	3.833 (2.198)	4.350 (2.313)
T5	Rhizomes of Acorus 5% soaked overnight.	9.633 (3.261)	4.418 (2.327)	4.300 (2.302)	12.425 (3.664)	3.750 (2.179)	4.825 (2.413)	13.660 (3.829)	3.850 (2.202)	4.825 (2.413)
T6	Pongamia oil 5 %	9.523 (3.244)	2.373 (1.836)	2.675 (1.917)	12.448 (3.667)	2.393 (1.841)	2.884 (1.971)	13.706 (3.835)	2.550 (1.884)	1.850 (1.688)
T7	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem - n-hexane Extract	9.403 (3.225)	4.783 (2.408)	4.613 (2.369)	12.343 (3.653)	3.969 (2.229)	5.450 (2.539)	13.699 (3.834)	4.375 (2.318)	4.913 (2.432)
T8	Standard treated check (Spraying of Lambda Cyhalothrin 5% EC @ 0.6 ml/lit of water)	9.450 (3.233)	0.563 (1.25)	0.240 (1.113)	12.308 (3.648)	0.373 (1.172)	0.248 (1.117)	13.805 (3.848)	0.075 (1.037)	0.035 (1.017)
T9	Untreated check	9.510 (3.242)	10.678 (3.417)	10.295 (3.361)	12.550 (3.681)	13.450 (3.801)	13.675 (3.831)	13.550 (3.814)	13.800 (3.847)	13.850 (3.854)
C.D.		NS	0.044	0.043	NS	0.045	0.048	NS	0.044	0.062
SE(m)		0.013	0.015	0.015	0.011	0.015	0.016	0.009	0.015	0.021
SE(d)		0.018	0.021	0.021	0.016	0.022	0.023	0.013	0.021	0.03
CV		0.79	1.394	1.37	0.621	1.475	1.429	0.475	1.391	1.958

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

Table 3.27 : Efficacy of Botanicals against foliar pests at Vridhachalam during 2021

(Mean of four replications)

Treatment		Mean damage after 5 th spray										Yield (Kg per tree)
		TMB Damage %		Leaf Miner %		Leaf and Blossom Webber %		Apple and Nut Borer %		Leaf Thrips Population (Nos.)		
		PTC	15 DAS	PTC	15 DAS	PTC	15 DAS	PTC	15 DAS	PTC	15 DAS	
T1	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem fermented for 15-20 days. Soaked in Mud pot with 10 litres of water.	3.168 (10.247)	0.938 (5.554)	5.328 (13.339)	1.375 (6.728)	5.383 (13.409)	2.488 (9.067)	1.888 (7.893)	1.958 (8.039)	10.273 (3.357)	0.905 (1.38)	5.725 (2.593)
T2	NSKE 5%	3.200 (10.3)	1.350 (6.667)	5.450 (13.494)	1.568 (7.189)	5.253 (13.243)	2.878 (9.761)	1.890 (7.896)	2.093 (8.313)	10.550 (3.398)	1.365 (1.538)	5.545 (2.558)
T3	Desi Cow urine 100 ml/litre of water.	3.450 (10.698)	1.828 (7.764)	5.605 (13.687)	1.743 (7.582)	5.348 (13.365)	3.300 (10.455)	1.875 (7.865)	2.220 (8.565)	10.340 (3.367)	1.750 (1.658)	5.528 (2.555)
T4	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem - Methanol Extract	3.300 (10.461)	1.868 (7.851)	5.398 (13.427)	1.953 (8.029)	5.430 (13.469)	3.573 (10.891)	1.878 (7.87)	2.388 (8.885)	10.363 (3.371)	1.933 (1.712)	5.535 (2.556)
T5	Rhizomes of Acorus 5% soaked overnight.	3.340 (10.525)	1.940 (8.003)	5.223 (13.205)	2.183 (8.492)	5.410 (13.444)	3.863 (11.329)	1.930 (7.982)	2.475 (9.046)	10.675 (3.417)	2.093 (1.758)	5.665 (2.582)
T6	Pongamia oil 5 %	3.208 (10.312)	1.145 (6.14)	5.371 (13.395)	1.338 (6.638)	5.345 (13.362)	2.678 (9.41)	1.830 (7.771)	2.188 (8.502)	10.675 (3.417)	1.223 (1.491)	5.575 (2.564)
T7	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem - n-hexane Extract	3.280 (10.429)	2.300 (8.717)	5.368 (13.39)	2.278 (8.676)	5.265 (13.26)	4.190 (11.807)	1.850 (7.813)	2.688 (9.429)	10.525 (3.395)	2.383 (1.838)	5.775 (2.603)
T8	Standard treated check (Spraying of Lambda Cyhalothrin 5% EC @ 0.6 ml/lit of water)	3.223 (10.337)	0.313 (3.166)	5.430 (13.469)	1.180 (6.233)	5.380 (13.406)	0.355 (3.365)	1.883 (7.882)	0.273 (2.982)	10.423 (3.38)	0.125 (1.06)	6.595 (2.756)
T9	Untreated check	3.368 (10.568)	3.848 (11.307)	5.425 (13.462)	5.840 (13.979)	5.338 (13.352)	6.543 (14.812)	1.943 (8.008)	2.698 (9.447)	10.550 (3.398)	15.268 (4.033)	5.343 (2.518)
C.D.		NS	0.281	NS	0.15	NS	0.465	NS	0.247	NS	0.048	0.037
SE(m)		0.093	0.096	0.087	0.051	0.062	0.158	0.085	0.084	0.012	0.016	0.013
SE(d)		0.131	0.136	0.123	0.072	0.087	0.224	0.12	0.119	0.016	0.023	0.018
CV		1.774	2.648	1.3	1.248	0.92	3.137	2.146	2.065	0.684	1.784	0.984

PTC- Pre Treatment Count; DAS: Days After Spraying ; Values in the parentheses are arc sine $\sqrt{\text{per cent}}$ transformed values for per cent damage and $\sqrt{x + 0.5}$ transformed values for population numbers.

Table 3.28 : Effect of Botanical sprays on natural enemies at Vridhachalam during 2021

T. No.	Treatments	Mean number of natural enemies in 24 inflorescences 15 days after 5 th spray							
		Spiders		Ants		Coccinellids		<i>Cotesia</i>	
		PTC	15 DAS	PTC	15 DAS	PTC	15 DAS	PTC	15 DAS
T1	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem fermented for 15-20 days. Soaked in Mud pot with 10 litres of water.	15.600 (4.074)	10.725 (3.424)	18.423 (4.407)	8.423 (3.07)	9.450 (3.233)	4.575 (2.361)	12.525 (3.677)	1.800 (1.673)
T2	NSKE 5%	15.625 (4.077)	13.675 (3.831)	18.605 (4.428)	10.523 (3.394)	9.350 (3.217)	6.450 (2.729)	12.675 (3.698)	4.500 (2.345)
T3	Desi Cow urine 100 ml/litre of water.	15.750 (4.093)	13.525 (3.811)	18.508 (4.417)	12.503 (3.674)	9.710 (3.272)	8.425 (3.07)	12.803 (3.715)	5.425 (2.535)
T4	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem -Methanol Extract	15.650 (4.08)	14.350 (3.918)	18.583 (4.425)	13.778 (3.844)	9.480 (3.237)	8.120 (3.02)	12.610 (3.689)	5.675 (2.583)
T5	Rhizomes of Acorus 5% soaked overnight.	15.670 (4.083)	14.425 (3.927)	18.455 (4.411)	14.443 (3.93)	9.610 (3.257)	8.300 (3.05)	12.613 (3.689)	6.613 (2.759)
T6	Pongamia oil 5 %	15.560 (4.069)	11.425 (3.525)	18.650 (4.433)	9.440 (3.231)	9.450 (3.232)	5.575 (2.564)	12.790 (3.713)	2.450 (1.857)
T7	Leaf extracts of each of 500 grams of Adathoda, Datura, Vitex, Calotropis, Neem - n-hexane Extract	15.665 (4.082)	14.688 (3.961)	18.390 (4.403)	15.150 (4.019)	9.523 (3.244)	8.145 (3.024)	12.555 (3.682)	7.448 (2.906)
T8	Standard treated check (Spraying of Lambda Cyhalothrin 5% EC @ 0.6 ml/lit of water)	15.423 (4.052)	7.475 (2.911)	18.518 (4.418)	7.425 (2.902)	9.495 (3.24)	1.253 (1.5)	12.713 (3.703)	0.863 (1.364)
T9	Untreated check	15.400 (4.05)	15.625 (4.077)	18.678 (4.436)	21.190 (4.711)	9.475 (3.236)	10.475 (3.387)	12.575 (3.684)	14.550 (3.943)
	C.D.	NS	0.026	NS	0.035	NS	0.035	NS	0.06
	SE(m)	0.014	0.009	0.011	0.012	0.017	0.012	0.015	0.02
	SE(d)	0.02	0.012	0.016	0.017	0.025	0.017	0.021	0.029
	C.V.	0.702	0.47	0.517	0.648	1.078	0.868	0.797	1.67

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

Ent. 2: Control of cashew stem and root borer

Expt. 2. Curative control trial

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

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

BAPATLA

Experimental details:

Treatments: 5

Trt.No	Treatment	Dose
1.	Fipronil Swabbing	2 ml/l
2.	Neem oil Swabbing (5%)	50 ml/l
3.	Imidacloprid (Swabbing and Drenching)	2 ml/l
4.	Chlorpyrifos (Treated Check)	10 ml/l
5.	Untreated check (only removal of CSRB grubs)	-

Observations:

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

Table 3.29 : Efficacy of insecticides as Post extraction prophylaxies (PEP) against cashew stem and root borer at Bapatla centre

Trt No	Treatment	Total No. of trees treated	No. of trees reinfested	% trees with Reinfestation	% trees without Reinfestation
1.	Fipronil Swabbing (2 ml/l)	20	7	35.0	65.0
2.	Neem oil Swabbing (5%)	20	12	60.0	40.0
3.	Imidacloprid (2 ml/l) (Swabbing and Drenching)	20	5	25.0	75.0
4.	Chlorpyrifos (10 ml/l) (Treated Check)	20	9	45.0	55.0
5.	Un treated check (Only removal of CSRB grubs)	20	14	70.0	30.0

Table 3.30 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at Bapatla

Physical parameters		Total trees treated	No. of trees infested after PEP	% out of total trees	No. of trees not reinfested after PEP	% out of total trees
Stem girth	< 60 cm	1	0	0.0	1	100.0
	60-80cm	21	8	38.1	13	61.9
	80-100 cm	54	26	48.1	28	51.9
	>100 cm	24	13	54.2	11	45.8
Total		100	47	47.0	53	53.0
Age of the tree	< 10 years	11	3	27.3	8	72.7
	10-15 years	21	13	61.9	8	38.1
	>15years	68	31	45.6	37	54.4
Total		100	47	47.0	53	53.0
Zone of attack	C + R	29	14	48.3	15	51.7
	C + S	20	10	50.0	10	50.0
	R	8	4	50.0	4	50.0
	S	17	6	35.3	11	64.7
	C	7	5	71.4	2	28.6
	C + S + R	19	8	42.1	11	57.9
Total		100	47	47.0	53	53.0
Yellowing of canopy	Canopy yellowing	26	24	92.3	2	7.7
	Canopy not yellowing	74	23	31.1	51	68.9
Total		100	47	47.0	53	53.0
% of bark circumference damaged	<25	36	1	2.8	35	97.2
	26-50	24	11	45.8	13	54.2
	51-75	24	20	83.3	4	16.7
	>75	16	15	93.8	1	6.2
Total:		100	47	47.0	53	53.0

Table 3.31 : Two way table (Stem girth Vs Age of the tree)

Stem Girth \ Age of the tree	<60 cm	60-80 cm	80-100 cm	>100 cm	Total
<10 years	1	5	5	0	11
10-15 Years	0	7	13	1	21
>15 Years	0	9	36	23	68
Total	1	21	54	24	100

Results:

During 2021, among the insecticides evaluated as post extraction prophylaxis, Imidacloprid (Swabbing and drenching) @ 2ml/l offered protection to the tune of 75.00 % 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 40.00 percent protection without re-infestation and are superior over the control treatment which recorded 30.00 % trees without re-infestation. Preferential zone of attack is collar + root in 29.00 percent of trees (29/100) followed by collar + stem and stem + collar + root in 20.00 and 19.00 percent of trees respectively.

HOGALAGERE

The results on infestation and re-infestation of the CSRB in different treatments applied during Oct.-Nov., Jan - Feb and April - May months indicated that Fipronil (2ml/l) and Chlorpyrifos (0.2%) treatments were found most effective against grubs of CSRB with 83.33% and 75% trees without reinfestation, respectively. In treated check, where only grubs extraction was adopted indicated 33.33% of treated trees could recover from reinfestation.

Table 3.32 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at HREC, Hogalagere during 2021

Sl. No.	Treatment	No. of trees treated	No. of trees without reinfestation	% Recovery from reinfestation
1	Fipronil swabbing @ 2ml/l (during Oct.-Nov., Jan.- Feb. and April - May)	12	10	83.33
2	Neem oil swabbing 5% suspension	12	5	41.67
3	Imidacloprid 17.8 SL @ 2ml/l as swabbing and drenching	12	8	66.67
4	Chlorpyrifos 20 EC(0.2%) @ 10ml/l	12	9	75.00
5	Treated check - only removal of CSRB grubs	12	4	33.33
6	Untreated control	12	3	25.00
	Total	72	39	-

The trees having 60-100cm stem girth were found to damage maximum (94% preference for infestation), it might be due to maximum availability of cracks & crevices for CSRB oviposition.

The zone of CSRB attack was noticed maximum at collar + stem (64%) and 61 per cent of infested trees showed yellowing canopy. The plants with less than 25% bark circumference damage recorded 75 per cent recovery of the infested trees compared to severely bark damaged plants.

Table 3.33 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at HREC, Hogalagere during 2021

Physical parameters		No. plants observed	No. plants reinfested	% CSRB Preference
Stem girth	< 60 cm	9	5	55
	60-100 cm	13	12	94
	> 100 cm	9	5	63
Total		N=31	N=22	-
Age of the tree	<10 years	7	0	0
	10-15 years	5	0	0
	>15 years	8	5	61
Total		N=20	N=5	-
Zone of attack	C + R	6	1	21
	C + S	6	4	64
	C + S + R	4	1	24
Total		N=14	N=6	-
Yellowing of canopy	Canopy yellowing	6	4	61
	Canopy not yellowing	7	3	43
Total		N=13	N=7	-
% of bark circumference damaged				% Recovery from CSRB damage
	< 25	4	3	75
	26-50	4	3	67
	51-75	5	1	20
	>75	5	0	0
Total		N=18	N=7	-

JAGDALPUR

Experiment details			
Year of experimentation	: 2020-21	No. of trees	: 60
Location	: Ghatkawali, District Bastar	Treatments	: 6
Crop stage	: Flushing to fruit maturity	Design	: CRD
Age of trees	: Varied between 15 to 41 years		

Table 3.34 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Jagdalpur centre during the year 2021

Treatment	Total number of trees treated	No. of trees without reinfestation	No. of trees re-infested	% trees without reinfestation (Recovery %)	% of trees re-infested
T ₁ : Fipronil swabbing (2ml/l)	10	7	3	70.00	30.00
T ₂ : Neem oil swabbing (5%)	10	6	4	60.00	40.00
T ₃ : Imidacloprid (2 ml/l)	10	8	2	80.00	20.00
T ₄ : Chlorpyrifos (10 ml/l)	10	9	1	90.00	10.00
T ₅ : Treated check (only removal of CSRB grubs)	10	3	7	30.00	70.00
T ₅ : Botanical (<i>Cleistanthus Collinus</i> decoction)	10	6	4	60.00	40.00
Total	60	39	21		

Data indicated that the maximum recovery of 90.00 per cent was observed in T₄ (Chlorpyrifos @ 10 ml/l) of water as swabbing and drenching of CSRB infested tree followed by T₃ (Imidacloprid @ 2 ml/l) swabbing and drenching with 77.78 per cent recovery T₁ (Fipronil @ 2ml/l) swabbing lead with 83.33 per cent whereas, as minimum recovery 30.00 per cent was observed in T₅ (treated check: only removal of CSRB grubs). The overall results indicate that chlorpyrifos recorded maximum recovery, followed by Imidacloprid and Fipronil which are on par in reducing the CSRB infestation.

Table 3.35 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at Jagdalpur centre during the year 2021

Physical parameters		No. of trees treated	No. of trees reinfested after PEP	% of trees reinfested after PEP	No. of trees Without re-infestation	% of trees Without re-infestation
Stem diameter	< 19 cm	0.00	0.00	0.00	0.00	0.00
	19-32 cm	17.00	6.00	0.00	11.00	0.00
	> 32 cm	43.00	15.00	34.88	28.00	65.12
Total		60.00				
Age of the tree	<10 years	0.00	0.00	0.00	0.00	0.00
	10-15 years	0.00	0.00	0.00	0.00	0.00
	>15 years	60.00	21.00	35.00	39.00	65.00
Total		60.00				
Zone of attack	C	13.00	6.00	46.15	7.00	53.85
	S	4.00	2.00	50.00	2.00	50.00

	R	1.00	0.00	0.00	1.00	100.00
	C+S	11.00	3.00	27.27	8.00	72.73
	C+R	13.00	3.00	23.08	10.00	76.92
	R+S	3.00	2.00	66.67	1.00	33.33
	C+S+R	15.00	5.00	33.33	10.00	66.67
Total		60.00				
Yellowing of canopy	Canopy yellowing	16.00	6.00	37.50	10.00	62.50
	Canopy not yellowing	44.00	15.00	34.09	29.00	65.91
Total		60.00				
% of bark circumference damaged	< 25	14.00	3.00	21.43	11.00	78.57
	26-50	29.00	10.00	34.48	19.00	65.52
	51-75	7.00	3.00	42.86	4.00	57.14
	>75	10.00	5.00	50.00	5.00	50.00
Total		60.00				0.00

Table 3.36 : Two way table (Stem diameter VS Age of Tree)

Age of Tree Stem diameter	<10 years	10-15 years	>15 years	Total
< 19 cm	0	0	0	0
19 - 32 cm	0	0	18	18
> 32 cm	0	0	42	42
Total	0	0	60	60

Table 3.37 : Results of chi-square (X^2) test showing associations between physical parameters of tree and effect of POP treatments

Parameters	Chi square value (X^2)	Df	P value
% of bark circumference	2.32	3	0.50
Canopy	0.06	1	0.80
Zone of attack	4.09	6	0.66
Age of tree**	-	2	-
Stem diameter**	-	2	-

* $p < 0.05$ **Categories with zero reading

Conclusion from 6 years data (2015-16 to 2020-2021)

Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Jagdalpur centre during the year 2015-16 to 2020-2021 concluded that among the tested insecticides the maximum recovery of 77.96 per cent was observed in T₄ (Chlorpyriphos @ 10 ml/l) of water as swabbing and drenching of CSRB infested tree followed by T₁ (Fipronil @ 2ml/l) swabbing lead with 67.22 per cent, T₃ (Imidacloprid @ 2 ml/l) swabbing and drenching with 62.41 per cent recovery whereas, as minimum recovery was observed in T₅ (treated check: only removal of CSRB grubs). The overall results indicate that chlorpyriphos recorded maximum recovery, followed by Fipronil and Imidacloprid which nearly similar in reducing the CSRB infestation.

Table 3.38 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Jagdalpur centre during the year 2021

Recovery per cent (without reinfestation trees) Overall mean 2015-16 to 2020-21 (6 year)							
Treatment	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Overall mean
T ₁ : Fipronil swabbing (2ml/l)	77.78	66.67	61.11	44.44	83.33	70.00	67.22
T ₂ : Neem oil swabbing (5%)	55.56	38.89	33.33	16.67	61.11	60.00	44.26
T ₃ : Imidacloprid (2 ml/l) swabbing and drenching	66.67	44.44	55.55	50	77.78	80.00	62.41
T ₄ : Chlorpyriphos (10 ml/l) swabbing and drenching	72.22	72.22	66.67	77.78	88.89	90.00	77.96
T ₅ : Treated check (only removal of CSRB grubs)	44.45	33.33	27.78	11.11	33.33	30.00	30.00
T ₅ : Untreated check	33.34	22.22	22.22	-	11.11	60.00	29.78
Total plant	108	108	108	108	108	60	100
Note :- During 2020-21 in place of T ₅ (Untreated check) new treatment Botanical (<i>Cleistanthus Collinus</i> decoction) used							

Table 3.39 : Per cent of trees reinfested after PEP (post extraction prophylaxis) under PEP trial at Jagdalpur centre from the year 2015-16 to 2020-21 (6 year)

Physical parameters		2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Overall mean
Stem diameter	< 19 cm	20.00	28.57	22.22	28.57	0.00	0.00	16.56
	19-32 cm	30.56	33.33	39.13	53.97	0.00	0.00	26.17
	> 32 cm	44.00	57.14	61.90	44.74	22.22	34.88	44.15
Age of the tree	<10 years	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	10-15 years	31.03	47.06	42.10	18.18	0.00	0.00	23.06
	>15 years	27.69	50.55	51.68	48.45	22.22	35.00	39.27
Zone of attack	C	20.69	41.30	45.83	56.10	16.13	46.15	37.70
	S	20.00	65.00	55.55	50.00	30.77	50.00	45.22
	R	37.50	50.00	46.67	50.00	0.00	0.00	30.70
	C+S	0.00	33.33	25.00	36.36	18.75	27.27	23.45
	C+R	15.38	33.33	33.33	56.25	23.53	23.08	30.82
	R+S	0.00	40.00	40.00	0.00	0.00	66.67	24.45
	C+S+R	27.78	40.00	33.33	62.50	45.45	33.33	40.40

Yellowing of canopy	Canopy yellowing	15.00	70.00	40.00	91.67	27.27	37.50	46.91
	Canopy not yellowing	32.26	45.45	37.63	43.75	21.65	34.09	35.81
% of bark circumference damaged	< 25	28.00	28.57	28.57	62.26	15.15	21.43	30.66
	26-50	63.46	63.64	56.90	56.52	35.29	34.48	51.72
	51-75	40.00	41.17	36.36	37.50	41.67	42.86	39.93
	>75	20.00	26.67	33.33	66.67	18.18	50.00	35.81

MADAKKATHARA

Experimental details:

Sl. No.	Treatments	Dose
T ₁	Fipronil (swabbing)	2 ml/L
T ₂	Neem oil (swabbing)	50 ml/L
T ₃	Imidachlopid (swabbing and drenching)	2ml/L
T ₄	Chlorpyrifos (treated check)	10 ml/L
T ₅	Untreated check (only removal of CSRB grubs)	-

Among the insecticides evaluated as PEP, drenching of chlorpyrifos @ 10m/L (T₄) and swabbing with fipronil @2ml/L (T₁) have offered highest recovery with 85.71 per cent trees without reinfestation. Drenching with imidaclopid @2ml/L resulted in recovery of 80.95 per cent treated trees. The recovery in swabbing with neem oil was 66.67 per cent. Control treatment with mere extraction of the grubs recorded 38.09 per cent recovery.

Table 3.40 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Madakkathara centre (2020-21)

Treatments	Total number of trees treated	No. of trees without reinfestation / persistent attack	Trees without reinfestation / persistent attack (%)
T ₁	21	18	85.71
T ₂	21	14	66.67
T ₃	21	17	80.95
T ₄	21	18	85.71
T ₅	21	8	38.09

The maximum infestation was observed in trees with stem girth of more than 100 cm (78 trees) and diameter of 30-45 cm (44 trees) and age more than 15 years (105 trees). In most of the trees, infestation was noticed on collar, stem and root zone.

The recovery of trees after PEP is closely associated with per cent bark circumference damage as well as zone of attack. With increase in per cent damage to bark circumference, there will be gradual reduction in the per cent of trees recovered after PEP. Similarly, the per cent recovery was less in trees with damage on collar, stem and root together compared to those trees with attack only on collar or root region.

Table 3.41 : Physical parameters of treated cashew trees under post extraction prophylaxis trial at Madakkathara centre during the year 2020-21

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	Chi square value
Stem girth (cm)	< 60	1	0	0.0	1	100.0	0.52 ^{NS}
	60-80	8	2	25.0	6	75.0	
	80-100	18	8	44.4	10	55.6	
	>100	78	20	25.6	58	74.4	
Total		105	30	28.6	75	71.4	
Diameter (cm)	5-15	1	0	0	1	100.0	1.01 ^{NS}
	15-30	20	6	30.0	14	70.0	
	30-45	44	12	27.3	32	72.7	
	45-60	40	12	30.8	28	69.2	
Total		105	30	28.6	75	71.4	
Age of the tree (Years)	<10	0	0	-	-	-	0.16 ^{NS}
	10-15	0	0	-	-	-	
	>15	105	30	28.6	75	71.4	
Total		105	30	28.6	75	71.4	
Zone of attack	C + R	10	1	10.0	9	90.0	32.40*
	C	9	1	11.0	8	89.0	
	C + S + R	62	26	42.0	36	58.0	
	R	7	0	0.0	5	100.0	
	S	2	0	0.0	2	100.0	
	C + S	15	2	13.3	13	86.7	
Total		105	30	28.6	75	71.4	
Yellowing of canopy	Yellowing	0	-	-	-	-	
	no yellowing	105	30	28.6	75	71.4	
Total		105	30	28.6	75	71.4	
% of bark circumference damaged	< 25	31	0	0	31	100.0	51.72*
	25-50	13	2	15.4	11	84.6	
	50-75	24	6	25.0	18	75.0	
	>75	37	22	59.8	15	40.5	
Total		105	30	28.6	75	71.4	

VENGURLE

Design	: C.R.D.
Treatments	: Six
Treatment details	: T ₁ - Fipronil 5 EC swabbing @ 2 ml/lit T ₂ - Neem oil swabbing @ 5% T ₃ - Imidacloprid 17.8 SL swabbing and drenching @ 2 ml/lit T ₄ - Chlorpyrifos 20 EC @ 0.2 % (10ml/lit) T ₅ - Treated check (only removal of grub) T ₆ - Untreated check

The data revealed that, T₁ (Fipronil 5 EC swabbing @ 2ml/lit) was found most effective with 90 per cent trees without reinfestation followed by T₄ (Chlorpyrifos 20 EC @ 0.2 %) with 85 per cent trees without reinfestation and T₃ (Imidachloprid 17.8 SL swabbing and drenching @ 2ml/lit) with 80 per cent trees without reinfestation.

During the year 2020-21, total 120 trees were treated with different treatments for curative management of CSRB. Out of which 49 trees were found reinfested and 71 trees were found without reinfestation after application of different treatments.

The infested trees having the stem girth more than 100 cm were more prone to CSRB reinfestation (25%). The infested trees having the age, more than 15 years were more prone to CSRB reinfestation (28.33%), whereas, the trees having less than 10 years age were found to be the least damage by CSRB (0.83%) are presented in Table.

The collar + stem zone was found to be more preferred by CSRB for reinfestation. The trees having removal of more than 75 per cent bark were prone to CSRB attack (16.67%), whereas, the trees having <25 per cent bark removal were less prone to CSRB attack (5.83%).

Table 3.42 : Effect of curative treatments against Cashew Stem and Root Borer (CSRB) 2020-21

Treatments		Total number of trees treated	No. of trees without re-infestation/persistent attack	% trees without re-infestation/persistent attack	No. of reinfested trees	% reinfestation
T ₁	Fipronil swabbing @ 2ml/lit	20	18	90	2	10
T ₂	Neem oil swabbing @ 5%	20	10	50	10	50
T ₃	Imidachloprid 17.8 SL swabbing and drenching @2ml/lit	20	16	80	4	20
T ₄	Chlorpyriphos @ 10ml/lit	20	17	85	3	15
T ₅	Treated check (only removal of grub)	20	6	30	14	70
T ₆	Untreated check	20	4	20	16	80
Total			71		49	

Table 3.43 : Physical parameters of treated cashew trees under post extraction prophylaxis without reinfestation (2020-21)

Physical parameter		Reinfestation		Without Reinfestation	
		No. of trees	% out of total trees	No. of trees	% out of total trees
Stem girth	< 60 cm	2	1.67	5	4.17
	60-100 cm	17	14.17	45	37.50
	>100 cm	30	25.00	21	17.50
Total		49	40.83	71	59.17
Age of the tree	< 10 years	1	0.83	4	3.34
	10-15 years	14	11.67	22	18.33
	>15 years	34	28.33	45	37.50
Total		49	40.83	71	59.17
Zone of attack	C + R	12	10.00	25	20.84
	C + S	28	23.33	24	20.00
	C + S+ R	9	7.50	22	18.33
Total		49	40.83	71	59.17
Yellowing of canopy	Yes	8	6.67	0	0.00
	No	41	34.16	71	59.17
Total		49	40.83	71	59.17
Percentage of bark circumference damaged	<25%	7	5.83	41	34.17
	26-50%	10	8.33	22	18.33
	51-75%	12	10.00	8	6.67
	>75%	20	16.67	0	0.00
Total		49	40.83	71	59.17

VRIDHACHALAM

Treatments

- T₁ : Fipronil 5% SC Swabbing 2ml/lit.
 T₂ : Neem Oil suspension 5%.
 T₃ : Imidachloprid 17.8 SL Swabbing and Drenching 2ml/lit.
 T₄ : Chlorpyriphos 20 EC 10ml/lit.
 T₅ : Treated check (only removal of CSRB grubs followed).

Maximum recovery of 67.86% was observed in chlorpyriphos 20 EC @10 ml/lit. of water as swabbing and drenching of CSRB infested trees as against mere recovery of 10.00 in treated check (only removal of CSRB grubs). Treatments with Fipronil 5% SC swabbing @ 2ml/lit. and Imidachloprid 17.8 SL Swabbing and Drenching @ 2ml/lit. lead to 57.14 and 40.90% recovery respectively as against nil recovery in untreated check. The overall results indicate that chlorpyriphos recorded maximum recovery, followed by Fipronil and Imidachloprid which are at par in reducing the CSRB infestation, with an average cost of protection of Rs.95/-, Rs.103/- and Rs. 106/- respectively.

Table 3.44 : Efficacy of certain insecticides as curative control against CSRB at Vridhachalam

Treatment		No. of trees treated	No. of trees without reinfestation from CSRB	Mean % recovery of trees from CSRB	Frequency of treatment	Cost of treatment /tree
T ₁	Fipronil 5% SC Swabbing@ 2ml/lit.	28	16	57.14 ^b	3	103.00
T ₂	Neem Oil suspension 5% Swabbing and Drenching	20	6	30.00 ^d	3	87.00
T ₃	Imidachloprid 17.8 SL Swabbing and Drenching @ 2ml/lit.	22	9	40.90 ^b	3	106.00
T ₄	Chlorpyriphos 20 EC @ 10ml / lit. Swabbing and Drenching	28	19	67.86 ^a	3	95.00
T ₅	Treated check (only removal of CSRB grubs followed).	20	02	10.00 ^d	3	60.00
Total		118	52			

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 (70.83%) were more prone to the attack of CSRB infestation. Comparing the age of the cashew infested trees, more than 15- year- old cashew trees (59.61%) were more susceptible to attack of CSRB. Preferential zone of attack of re-infestations by CSRB in the trees were Collar + Stem +Root zone followed by Collar + Root and Collar + Stem with 74.29, 61.29 and 58.33 per cent re-infested trees respectively. Yellowing of canopy showed 83.02 per cent re-infestation. Trees with less than 25 per cent bark circumference damage had maximum re-infestation with 68.33 per cent followed by 51-75 per cent bark circumference damage (58.82% re-infestation).

Table 3.45 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) curative trial observed at Vridhachalam

Physical Parameters		Total no. of trees treated	No. of trees reinfested	% of trees reinfested	No. of trees not reinfested	% of trees not reinfested
Stem girth	< 60 cm	12	4	33.33	8	66.67
	60-80 cm	52	34	65.38	18	34.61
	80-100 cm	24	17	70.83	7	29.17
	> 100 cm	30	11	36.67	19	63.33
Total		118	66		52	
Age of the tree	<10 years	4	2	50.00	2	50.00
	10-15 years	62	33	53.23	29	46.77
	> 15 years	52	31	59.61	21	40.38
Total		118	66		52	
Zone of attack	Collar+Root	31	19	61.29	12	38.71
	Collar+Stem	24	14	58.33	10	41.67
	Root	7	0	0	7	100.00
	Stem	8	3	37.50	5	62.50
	Collar	9	4	44.44	5	59.56
	Stem+Root	4	0	0	4	100.00
	Collar+Stem+Root	35	26	74.29	9	25.71
Total		118	66		52	
Yellowing of canopy	Canopy yellowing	53	44	83.02	9	16.98
	Canopy not yellowing	65	22	33.85	43	66.15
Total		118	66		52	
% of bark circumference damaged	< 25	60	41	68.33	19	31.67
	26-50	41	15	36.59	26	63.41
	51-75	17	10	58.82	7	41.18
	> 75	0	0	0	0	0
Total		118	66		52	

Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) curative trial observed at Vridhachalam-Pooled Mean data of ten years

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 (82.76%) were more prone to the attack of CSRB infestation. Comparing the age of the cashew infested trees, more than 15- year- old cashew trees (78.86%) were more susceptible to attack of CSRB. Preferential zone of attack of re-infestations by CSRB in the trees were Collar + Stem +Root zone followed by Collar + Root and Root with 77.62, 73.72 and 64.52 per cent re-infested trees respectively. Yellowing of canopy showed 94.48 per cent re-infestation. Trees with less than 51-75 per cent bark circumference damage had maximum re-infestation with 75.96 per cent followed by 26-50 per cent bark circumference damage (60.29% re-infestation).

Table 3.46 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) curative trial observed at Vridhachalam- Pooled Mean data of ten years from 2009-2010 to 2020-2021.

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	17.4	4.7	27.01	12.7	72.99
	60-80 cm	49.1	31	63.14	18.1	36.86
	80-100 cm	26.1	21.6	82.76	4.5	82.76
	> 100 cm	33.9	22	64.89	11.9	35.10
Total		126.5	79.6		46.9	
Age of the tree	<10 years	27.8	10.5	37.77	34.6	62.23
	10-15 years	49.5	30.1	60.81	19.4	39.19
	> 15 years	49.2	38.8	78.86	10.4	21.14
Total		126.5	79.4		47.1	
Zone of attack	Collar+Root	31.2	23	73.72	8.2	26.28
	Collar+Stem	28.6	12.1	42.31	16.5	57.69
	Root	12.4	8	64.52	4.4	35.48
	Stem	13.4	7.7	57.46	5.7	42.54
	Collar	5.3	2.5	47.17	2.8	52.83
	Stem+Root	1.2	0	0	1.2	100.00
	Collar+Stem+Root	34.4	26.7	77.62	7.6	22.09
Total		126.5	80.1		46.4	
Yellowing of canopy	Canopy yellowing	45.3	42.8	94.48	2.5	6.52
	Canopy not yellowing	81.2	36	44.33	45.2	55.67
Total		126.5	78.8		47.7	
% of bark circumference damaged	< 25	62.5	30.7	49.12	31.8	50.88
	26-50	40.8	24.6	60.29	16.2	39.71
	51-75	18.3	13.9	75.96	4.4	24.04
	> 75	4.9	4.9	0	0	0
	Total		126.5	77		49.5

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 at weekly intervals and maintaining in the laboratory for observation of emergence of parasitoids was also done.

Table 3.47 : Influence of abiotic factors on the activity of pest complex of cashew

Variable	Leaf and blossom webber	Leaf miner	Leaf Folder	Shoot Tip Caterpillar	Apple and Nut borer	Spiders
X ₁ -Maximum Temp	-0.12	-0.15	-0.05	-0.02	0.01	0.20
X ₂ -Minimum Temp	0.34*	-0.30	-0.07	0.0004	-0.08	-0.26
X ₃ -RH (m)	0.07*	-0.02	-0.01	0.0004	-0.05	-0.07
X ₄ -RH (e)	-0.05*	0.01	0.01	-0.002	0.03	0.06
X ₅ -Rain fall	0.01	-0.004	-0.003	-0.0006	-0.01	-0.004
R ² Value	0.471	0.617	0.421	0.214	0.101	0.059
% Variation	47.1	61.7	42.1	21.4	10.1	5.9

*= r at 5% level of significance

Table 3.48 : Regression analysis between pests and natural enemies of cashew and weather parameters during 1st Jan, 2021 to 14th Oct, 2021

S.No.	Biotic factor	Regression equation	R ²
1.	LBW	$-6.29-0.12(X_1)+0.34*(X_2)+0.07*(X_3)-0.05*(X_4)+0.01(X_5)$	0.471
2.	LM	$15.35-0.15(X_1)-0.30(X_2)-0.02(X_3)+0.01(X_4)-0.004(X_5)$	0.617
3.	LF	$3.16-0.05(X_1)-0.07(X_2)-0.01(X_3)+0.01(X_4)-0.003(X_5)$	0.421
4.	STC	$0.97-0.02(X_1)+0.004(X_2)+0.0004(X_3)-0.002(X_4)-0.0006(X_5)$	0.214
5.	ANB	$3.42+0.01(X_1)-0.08(X_2)-0.05(X_3)+0.03(X_4)-0.01(X_5)$	0.101
6.	Spiders	$4.10+0.20(X_1)-0.26(X_2)-0.07(X_3)+0.06(X_4)-0.004(X_5)$	0.059

LBW: Leaf and blossom webber; LM: Leaf miner; LF: Leaf folder; STC: Shoot tip caterpillar; ANB: Apple and nut borer

X₁-Maximum Temperature; X₂-Minimum Temperature; X₃-Relative Humidity (m); X₄-Relative Humidity (e); X₅-Rain fall

During the year 2021; the relation between the percent pest damage (Y) and weather variables such as Max.Temp (X_1), Min.Temp.(X_2), Relative Humidity (m) (X_3), Relative Humidity (e) (X_4) and Rainfall (X_5) was worked out by subjecting the data collected over 41 standard weeks to Multiple Linear Regression Analysis.

Relationship of per cent leaf and blossom webber damaged shoots showed significant positive correlation with minimum temperature(X_2) and Relative Humidity (m) (X_3) and significant negative correlation with Relative Humidity (e). With regard to leaf miner, results revealed that all weather variables together in question accounted for 61.7 per cent variation in per cent leaf damage by leaf miner ($R^2= 0.617$).

With regard to leaf folder, all weather variables together accounted for 42.1 per cent variation in per cent leaf damage by leaf folder ($R^2= 0.421$). With regard to shoot tip caterpillar results revealed that none of the variables were found to influence the damage by Shoot tip caterpillar independently ($R^2=0.214$).

With regard to Apple and nut borer all five independent variables have accounted for 10.1% of total variation in percent nut damage by Apple and nut borer (ANB) ($R^2=0.101$).

HOGALAGERE

Among them, tea mosquito bug with intensity of 11-29% infestation, cashew stem and root borer with intensity of 8-16% infestation and apple and nut borer with intensity of 9-19% infestation and were emerging as major pests in the region.

Table 3.49 : Influence of abiotic factors on the activity of pest complex of cashew during 2021

Sl No.	Common Name	Scientific Name	Family	Plant part affected	Period of occurrence	Intensity
Order: Hemiptera						
1	Tea mosquito bug	<i>Helopeltis antonii</i> Signoret	Miridae: Hemiptera	Tender shoots, panicles, young apples & nuts	Oct.– Mar.	Moderate to high (5.11-26.29%)
2	Corid bug	<i>Aspongopus janus</i>	Pentatomidae Hemiptera	Leaf, panicle, apples& nuts	Nov. -Jan.	Low (<5%)
3	Aphid	<i>Toxoptera odinae</i>	Aphididae: Hemiptera	Tender shoots, panicles and young apples & nuts	Nov.-May	Moderate (5-11%)
4	Wiptail mealy bug	<i>Ferrisia virgata</i>	Pseudococcidae Hemiptera	Tender shoots, panicles, young apples & nuts	Feb.-May	Low (<5%)
Order: Thysanoptera						

5	Thrips	<i>Rhipiphorothrip scruentatus</i>	Thripidae: Thysanoptera	Leaf, panicles, apple & nuts	Nov. - May	Moderate to high (11-22%)
Order: Coleoptera						
6	Cashew stem and root borer	<i>Ploceoderus ferrugenus</i>	Cerambycidae: Coleoptera	Stem and root	Throughout the year	Low to moderate (8-16%)
7	Ash weevil	<i>Myloccerus discolor</i>	Curculionidae: Coleoptera	Young leaf	Throughout the year	Low (<5%)
8	Chafers	<i>Gametes versicolor</i>	Scarabaeidae: Coleoptera	Immature apples	Feb.-May	Low (<5%)
9	Blister beetle	<i>Zonabris pustulata</i>	Meloidae: Coleoptera	Immature apples	Feb.-May	Low (<5%)
Order: Lepidoptera						
10	Leaf miner	<i>Acrocercops syngamma</i>	Gracillaridae: Lepidoptera	Young leaf	May-Sep	Low (<5%)
11	Apple and nut borer	<i>Citripestis eutropha</i>	Pyralidae: Lepidoptera	Immature apple and nuts	Nov.-Jun	moderate to high (9-19%)
12	Hairy caterpillar	<i>Euproctis fraterna</i>	Lymantridae: Lepidoptera	Leaves, Inflorescence	Nov. – Mar.	Low (<5%)

Table 3.50 : Incidence of natural enemies in cashew ecosystem during 2021

	Predators	Host pest	Peak occurrence	Intensity
1	<i>Oxypes sweta</i> Order: Areneae	<i>Helopeltisantonii</i>	Oct - Mar.	Low to moderate (5-10%)
2	<i>Menochilus sexmaculatus</i> (Coccinellidae: Coleoptera)	<i>Toxopteraodinae</i> <i>Ferrisiavirgata</i>	Feb.-May	Low to moderate (5-7%)
3	<i>Chrysoperla zastrowi</i> (Chrysopidae: Neuroptera)	<i>Toxopteraodinae</i> <i>Ferrisiavirgata</i>	Jan.-May	Low (<5%)
4	<i>Paragensyer buriensis</i> (Syrphidae: Diptera)	<i>Toxopteraodinae</i> <i>Ferrisiavirgata</i>	Jan.-May	Low (<5%)
5	<i>Bracon</i> sp. (Braconidae: Hymenoptera)	ANB, other caterpillars	Jan.-May	Low to moderate (5-9%)

The correlation between the pest incidence and weather parameters revealed that Minimum Temp (+0.91), evening relative humidity (+0.59), rainfall (+0.81) and number of rainy days (+0.74) had highly significant positive correlation with the activity of TMB. Where as negative correlation was established with maximum temperature (-0.11) and morning relative humidity (-0.42). The minimum temperature (+0.57), rainfall (+0.77) and number of rainy days (+0.68) had highly significant positive correlation with the incidence of CSRB and negative correlation was noticed with maximum temperature (-0.03), morning & evening relative humidity (-0.59& -0.49), respectively.

Apple and nut borer (ANB) had significant positive correlation with maximum temperature (+0.51). The highly significant negative correlation was found with evening RH (-0.78) and significant negative correlation was exhibited with minimum temperature (-0.44) and morning relative humidity (-0.57), rainfall (-0.62) and number of rainy days (-0.59) with activity of ANB. The infestation of thrips showed significant positive correlation with maximum temperature (+0.58), evening relative humidity (+0.25) and number of rainy days (+0.17). The negative correlation was obtained with rest of the weather parameters. The aphid infestation had significant positive correlation with maximum temperature (+0.42), and significant negative correlation was observed with evening RH (-0.62), rainfall (-0.52), and number of rainy days (-0.51).

Table 3.51 : Correlation of weather parameters and different insect pests recorded on cashew during 2020-21

Weather Parameters	TMB (% damage)	CSRB (% damage)	ANB (% damage)	Thrips (No./shoot or panicle)	Aphids (No. affected shoots/plant)
X1 - Maximum	(-)0.11	(-)0.03	(+)0.51*	(+)0.58*	(+)0.42
X2 - Minimum	(+)0.91**	(+)0.57*	(-)0.44*	(-)0.48*	(-)0.28
X3 - RH (m)	(-)0.42	(-)0.59*	(-)0.57	(-)0.23	(-)0.38
X4 - RH (e)	(+)0.59*	(-)0.49	(-)0.78**	(+)0.25	(-)0.62*
X5 - Rain fall	(+)0.81**	(+)0.77**	(-)0.62*	(-)0.23	(-)0.52*
X6 - No. of rainy	(+)0.74**	(+)0.68**	(-)0.59*	(+)0.17	(-)0.51*

* Significant at 0.05% & ** highly significant at 0.01%

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

Table 3.52 : Incidence of different cashew pests during different months during 2021

Months	Incidence of major cashew pests during 2021				
	TMB (% damage)	CSRB (% damage)	ANB (% damage)	Thrips (No./shoot orpanicle)	Aphids (No. affected shoots/plant)
Aug. 2020	0.00	0.00	0.00	0.00	0.00
Sept. 2020	0.00	0.00	0.00	0.00	0.00
Oct. 2020	6.26	2.00	0.00	4.34	0.00
Nov. 2020	8.58	4.50	0.00	9.19	0.00
Dec. 2020	16.34	6.52	8.21	10.23	3.39
Jan. 2021	22.29	5.65	13.45	14.23	8.49
Feb. 2021	26.29	4.81	18.56	12.90	9.61
Mar. 2021	14.00	3.64	22.98	15.96	11.29
Apr. 2021	5.11	2.25	17.22	6.46	16.27
May 2021	0.00	0.00	8.92	1.00	6.89
Jun. 2021	0.00	0.00	0.00	0.00	0.00
Jul. 2021	0.00	0.00	0.00	0.00	0.00

JAGDALPUR

The study was conducted at weekly intervals from ten randomly selected cashew trees of variety Vengurle-4 from 24 leader shoots of each tree from all the four sides.

Table 3.53 : Records of major cashew insect-pest and their natural enemies in Jagdalpur during 2020-21

S. No.	Common name	Scientific name	Family	Order
1.	Thrips	<i>Rhipiphorothrips</i> sp.	Thripidae	Thysanoptera
2.	Tea mosquito bug	<i>Helpeltis antonii</i>	Miridae	Hemiptera
3.	Shoot tip caterpillar	<i>Hypotima heligramma</i>	Gelichiidae	Lepidoptera
4.	Leaf miner	<i>Acrocercops syngamma</i>	Gracillariidae	Lepidoptera
5.	Leaf folder	<i>Caloptilia tiselaea</i>	Gracillariidae	Lepidoptera
6.	Lady bird beetle	<i>Menochilus sexamaculata</i>	Coccinellidae	Coleoptera
7.	Spiders	<i>Argeopes</i> sp.	Araneidae	Araneae
		<i>Oxyopes</i> sp.	Oxyopidae	Araneae
8.	Black Ant	<i>Componotus</i> sp.	Formicidae	Hymenoptera
9.	Brumus	<i>Brumus</i> sp.	Coccinellidae	Coleoptera

The TMB damage score had highly significant negative correlation with wind velocity (-0.655**) and minimum temperature (-0.843**) at 1 per cent level of significance, while significant negative correlation with maximum temperature (-0.458*) and evening relative humidity (-0.499*) at 5 per cent level of significance. The significant positive correlation was found with morning relative humidity (0.421*) and bright sunshine hours with (0.441*) at 5 per cent level of significance. The damage score of thrips showed highly significant and negative correlation with minimum temperature (-0.724**) and wind velocity (-0.628**) at 1 per cent level of significance, whereas significant negative correlation with maximum temperature (-0.438*) at 5 per cent level of significance. This pest also showed significant positive correlation with morning relative humidity (0.416*) at 5 per cent level of significance.

The per cent damage of shoot tip caterpillar, leaf miner and leaf folder showed negative correlation with maximum temperature, respectively (-0.592**), (-0.586**) and (-0.550*) while, highly significant positive correlation with morning relative humidity, respectively (0.706**), (0.629**) and (0.580**) at 1 and 5 per cent level of significance.

Table 3.54 : Influence of weather parameters on the activity of pest complex of cashew at Jagdalpur during the year 2021

Weather Parameters	Y ₁ – TMB	Y ₂ – Thrips	Y ₃ – Shoot tip caterpillar	Y ₄ – Leaf miner	Y ₅ – Leaf folder
X ₁ – Maximum Temp	-0.458*	-0.438*	-0.592**	-0.586**	-0.550*
X ₂ – Minimum Temp	-0.843**	-0.724**	0.072	0.035	0.064
X ₃ – Rainfall	-0.392	-0.337	0.211	0.357	0.264
X ₄ – RH (m)	0.421*	0.416*	0.707**	0.629**	0.580**
X ₅ – RH (e)	-0.499*	-0.368	0.474*	0.458*	0.444*
X ₆ – Wind velocity	-0.655**	-0.628**	-0.017	0.050	0.005
X ₇ – Evap.	-0.381	-0.408	-0.688**	-0.620**	-0.615**
X ₈ – Sun shine hours	0.441*	0.368	-0.146	-0.194	-0.218
* Significant at 5 % level (2.007), ** significant at 1% level (2.674)					

It is evident from the data that the population of black ant, lady bird betel and Brumus were positively correlated with morning relative humidity, respectively (0.515**), (0.422*) and (0.467*) at 1 and 5 per cent level of significance whereas, significant negative correlation with maximum temperature, respectively (-0.422*), (-0.473*) and (-0.416*) at 5 per cent level of significance.

Table 3.55 : Influence of weather parameters on the activity of natural enemies of cashew at Jagdalpur centre during the year 2021

Weather Parameters	Y ₆ - Ant	Y ₇ - Spiders	Y ₈ - Lady bird beetle	Y ₉ - Brumus
X ₁ - Maximum Temp (°C)	-0.422*	-0.473*	-0.311	-0.416*
X ₂ - Minimum Temp (°C)	-0.278	-0.724**	-0.669**	-0.242
X ₃ - Rainfall (mm)	-0.104	-0.332	-0.223	0.086
X ₄ - RH (m)	0.515**	0.422*	0.293	0.467*
X ₅ - RH (e)	-0.002	-0.352	-0.374	0.077
X ₆ - Wind velocity (kmph)	-0.289	-0.582**	-0.592**	-0.129
X ₇ - Evap.	-0.443*	-0.427*	-0.290	-0.407
X ₈ - Sun shine hours	0.221	0.371	0.515**	0.054
* Significant at 5 % level (2.007), ** significant at 1% level (2.674)				

The impact of weather parameters on insect pests and natural enemies were presented in the form of multiple linear regression equation. Based on the multiple regression analysis by taking pest incidence, 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 Jun 2020 to June 2021.

Results of multiple linear regression analysis between weather parameters and incidence of TMB damage score (Y_1) revealed that the minimum temperature (X_2), morning relative humidity (X_4), evening relative humidity (X_5) had significant contribution towards the TMB damage with the R^2 value 0.801. When the minimum temperature (X_2) increased by 1°C , damage of TMB decreased by 0.049 per cent, while, 1 per cent increase of morning relative humidity (X_4) the TMB incidence increase 0.025 per cent as well. A similar trend is noticed in thrips damage with the R^2 value of 0.646 and minimum temperature (X_2) increased by 1°C , damage of thrips decreased by 0.049 per cent. With regards to the shoot tip caterpillar, leaf miner and leaf folder damage regression equation indicated that an increase in 1°C of maximum temperatures (X_1) reduced the shoot tip caterpillar, leaf folder and leaf miner incidence by 0.357, 0.108 and 0.274 per cent per leader shoot, respectively.

The multiple regression equations were developed for predicting the pests and natural enemies of cashew by using regression models. By using regression models and coefficient of determination means goodness of fit (R^2) indicated that pests observed *viz.*, TMB damage score (Y_1), thrips damage score (Y_2), shoot tip caterpillar per cent damage (Y_3), leaf miner per cent damage (Y_4), leaf folder per cent damage (Y_5) were predicted to an extent of 80, 64, 63, 47 and 46 per cent, respectively. From the results of multiple linear regression model the maximum temperature, minimum temperature and relative humidity (morning) are important for determining the development of pests and natural enemies in cashew.

Table 3.56 : Regression analysis between pest-natural enemies of cashew and weather parameters during 2021

Dependent factors	Independent factors		
	Multiple regression equation	R^2	Adjusted R^2
TMB (Y_1)	$Y_1 = 0.466 + 0.010 (X_1) - 0.049 (X_2)^* - 0.002 (X_3) + 0.025(X_4)^* - 0.017(X_5) + 0.029(X_6) - 0.195(X_7) - 0.011(X_8)$	0.801	0.764
Thrips (Y_2)	$Y_2 = 3.177 + 0.026 (X_1) - 0.049 (X_2)^* - 0.002 (X_3) - 0.008 (X_4) - 0.001 (X_5)^* - 0.069 (X_6) - 0.300 (X_7) + 0.009 (X_8)$	0.646	0.580
Shoot tip caterpillar (Y_3)	$Y_3 = 0.933 - 0.357(X_1)^* + 0.424 (X_2) - 0.008 (X_3) + 0.132 (X_4)^* - 0.023 (X_5) - 0.537 (X_6) - 0.454 (X_7)^* + 0.104 (X_8)$	0.633	0.564
Leaf miner (Y_4)	$Y_4 = 0.918 - 0.108(X_1)^* + 0.029 (X_2) + 0.001 (X_3) + 0.025 (X_4)^* + 0.005 (X_5) - 0.095 (X_6) + 0.145 (X_7)^* + 0.000 (X_8)$	0.478	0.381
Leaf folder (Y_5)	$Y_5 = 10.642 - 0.272 (X_1)^* + 0.0175 (X_2) + 0.000 (X_3) - 0.010 (X_4) + 0.003(X_5) - 0.396 (X_6) - 0.323 (X_7)^* + 0.022 (X_8)$	0.468	0.369
Black ant (Y_6)	$Y_6 = - 0.497 - 0.033 (X_1)^* + 0.048(X_2) - 0.001 (X_3) + 0.026 (X_4)^* - 0.011 (X_5) - 0.025 (X_6)^* - 0.060 (X_7) + 0.030 (X_8)$	0.392	0.279
Lady bird beetle (Y_7)	$Y_7 = 2.403 + 0.007 (X_1) - 0.027 (X_2)^* - 0.001 (X_3) - 0.011 (X_4)^* - 0.002 (X_5) - 0.016 (X_6)^* - 0.216 (X_7) + 0.018 (X_8)$	0.647	0.582
Spider (Y_8)	$Y_9 = 1.986 + 0.015 (X_1) - 0.018 (X_2)^* + 0.000 (X_3) - 0.016 (X_4)^* + 0.002 (X_5) - 0.015 (X_6)^* - 0.148 (X_7) + 0.037 (X_8)$	0.604	0.530

<i>Brumus</i> (Y_9)	$Y_8 = -0.417 - 0.001(X_1)^* - 0.003(X_2) + 0.000(X_3) + 0.006(X_4)^* + 0.000(X_5) + 0.004(X_6)^* + 0.020(X_7) - 0.002(X_8)$	0.253	0.115
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* Significant at 5 % level

X_1 - Maximum Temperature ($^{\circ}\text{C}$),

X_3 - Rainfall (mm),

X_5 - Relative Humidity (Evening %),

X_7 - Evaporation,

X_2 - Minimum Temperature ($^{\circ}\text{C}$),

X_4 - Relative Humidity (Morning %),

X_6 - Wind velocity (Kmph),

X_8 - Sunshine (Hours),

KANABARGI

Table 3.57 : Influence of abiotic factors on the activity of pest complex of cashew during the year 2021

Sl No.	Common Name	Scientific Name	Family	Plant part affected	Period of occurrence	Intensity
Order : Hemiptera						
1.	Tea mosquito bug	<i>Helopeltisantonii</i> Signoret	Miridae: Hemiptera	Tender shoots, panicles, young apples & nuts	Oct - Mar	Moderate to high (10-25%)
2.	Aphid	<i>Toxopteraodinae</i>	Aphididae: Hemiptera	Tender shoots, panicles and young apples & nuts	Nov-May	Low (<5%)
Order : Thysanoptera						
3.	Thrips	<i>Rhipiphorothripscruentatus</i>	Thripidae: Thysanoptera	Leaf, apple & nuts	Jul-Feb	Low to moderate (5-10%)
Order: Lepidoptera						
4.	Leaf miner	<i>Acrocercopssyngamma</i>	Gracillaridae: Lepidoptera	Young leaf	May-Sep	Low (<5%)
5.	Apple and nut borer	<i>Thylacoptilapanerosema</i>	Pyralidae: Lepidoptera	Apple and nuts	Jan-Mar	Low (<5%)

Table 3.58 : Natural enemies of different insect pests of cashew in Maidan parts of Karnataka observed during 2021

Sl. No.	Predators	Host pest	Month of occurrence	Intensity
1	<i>Oxypessweta</i> Order: Areneae	<i>Helopeltisantonii</i>	Oct - Mar.	Low to moderate (5-10%)
2	<i>Menochilussexmaculatus</i> (Coccinellidae: Coleoptera)	<i>Toxopteraodinae</i> <i>Ferrisia virgata</i>	Feb.-May	Low to moderate (5-10%)

3	<i>Chrysoperlazastrowi</i> (Chrysopidae: Neuroptera)	<i>Toxopteraodinae</i> <i>Ferrisia virgata</i>	Jan.-May	Low (<5%)
4	<i>Paragensyrburiensis</i> (Syrphidae: Diptera)	<i>Toxopteraodinae</i> <i>Ferrisia virgata</i>	Jan.-May	Low (<5%)

Table 3.59 : Incidence of different cashew pests during different months during 2020-21

Months	2020-21			
	TMB (% damage)	ANB (% damage)	Thrips (No./shoot or panicle)	Aphids (No. affected shoots/plant)
Aug 2020	1.69	0.00	0.00	1.17
Sep 2020	2.74	0.00	0.00	0.00
Oct 2020	3.51	0.58	0.36	0.37
Nov 2020	4.55	0.76	1.22	0.22
Dec 2020	5.57	0.58	2.16	1.04
Jan 2021	10.55	0.79	0.86	0.00
Feb 2021	19.19	2.62	2.46	3.38
Mar 2021	23.35	2.44	2.74	2.18
Apr 2021	12.45	0.00	0.00	1.25
May 2021	5.20	0.00	0.0	0.20
Jun 2021	0.00	0.00	4.76	0.00
Jul 2021	0.00	0.00	2.97	0.00

TMB -Tea mosquito bug;

ANB - Apple & nut borer

Table 3.60 : Influence of abiotic factors on the activity of pest complex of cashew during the year 2020-21

Weather Parameters	Correlation coefficient ('r' values)			
	TMB (% damage)	ANB (% damage)	Thrips (No./shoot or panicle)	Aphids (No. affected shoots/plant)
X1 - Maximum Temp (°C)	(-) 0.18	(+) 0.41*	(+) 0.84*	(+) 0.67
X2 - Minimum Temp (°C)	(+) 0.97**	(-) 0.52*	(-) 0.63*	(-) 0.38
X3 - RH (m) (%)	(-) 0.45	(-) 0.88	(-) 0.36	(-) 0.58
X4 - RH (e) (%)	(+) 0.68*	(-) 0.92**	(+) 0.34	(-) 0.76*
X5 - Rain fall (mm)	(+) 0.89**	(-) 0.56*	(-) 0.38	(-) 0.72*
X6 - No. of rainy days	(+) 0.87**	(-) 0.84*	(+) 0.23	(-) 0.79*

Significant at 0.05 level **Significant at 0.01 level

TMB -Tea mosquito bug; ANB - Apple & nut borer

Correlation study : Results indicated that TMB incidence had highly significant positive correlation with Minimum Temp (+0.97), evening relative humidity (+0.68), rainfall (+0.89) and number of rainy days (+0.87) and negative correlation with maximum temperature (-0.18) and morning relative

humidity (-0.45). Apple and nut borer (ANB) had significant positive correlation with maximum temperature (+0.41) and highly significant negative correlation with evening RH (-0.92); and significant negative correlation with minimum temperature (-0.52), morning relative humidity (-0.88), rainfall (-0.56) and number of rainy days (-0.84).

The infestation of thrips showed significant positive correlation with maximum temperature (+0.84) and number of rainy days (+0.23) and negative correlation was obtained with rest of the weather parameters. The aphid infestation had significant positive correlation with maximum temperature (+0.67), and significant negative correlation was observed with evening RH (-0.76), rainfall (-0.72), and number of rainy days (-0.79).

MADAKKATHARA

During the season, the peak infestation of leaf miner was noticed in July and August with per cent shoot infestation of 5.72 and 1.47 per cent respectively. The per cent leaf damage during these months was 25.28 per cent and 22.59 percent respectively. Incidence apple and nut borer was not observed during the season. Thrips were present only in January with a maximum damage score of 0.043.

Table 3.61 : Seasonal occurrence of insect pests at Madakkathara centre during 2021

Season	TMB (Damage score)	Leaf miner infestation (%)		Thrips (damage score)
		Shoot infestation	Leaf damage	
April	0	0	0	0
May	0	0	0	0
June	0	0	0	0
July	0.011	5.72	25.28	0
August	0.020	1.47	22.59	0
September	0	0	0	0
October	0.018	0.83	0.14	0
November	0.046	0	0	0
December	0.010	0	0	0
January	0.148	0	0	0.043
February	0.342	0	0	0
March	0	0	0	0
Mean	0.049	0.67	4.36	0.003

Seasonal occurrence of natural enemies like red ant, black ant and spiders were also recorded and natural enemy population was observed throughout the season with fluctuation in population.

Table 3.62 : Seasonal occurrence of natural enemies at Madakkathara centre during 2021

Season	Red ant	Black ant	Spider
April	0.00	0.00	0.00
May	0.70	0.02	0.11
June	1.32	0.00	0.09
July	0.00	0.00	0.14
August	0.00	0.00	0.01
September	0.00	0.04	0.00
October	0.27	0.00	0.01
November	0.00	0.00	0.00
December	0.35	0.00	0.00
January	0.00	0.02	0.00
February	0.00	0.00	0.00
March	0.00	0.00	0.00
Mean	0.22	0.01	0.03

Correlation between abiotic factors and different insect pests

The population dynamics of all these regional pests were investigated and the damage score was correlated with the average weather variables of previous week. The correlation between TMB and weather parameters revealed significant negative correlation with minimum temperature, morning and evening relative humidity. A strong negative correlation between tea mosquito bug damage and minimum temperature and evening relative humidity was established in the previous season also.

The correlation study between leaf miner population and weather parameters indicated that the incidence of leaf miner showed significant positive correlation with the weather parameters rainfall, evening relative humidity, and rainy days. In the case of thrips, significant correlation was not established with any of the weather parameters.

Table 3.63 : Correlation of weather parameters and different insect pests recorded at Madakkathara centre during 2020-21

Weather variables	TMB	Leaf miner	Thrips
T _{max}	-0.124	-0.136	-0.139
T _{min}	-0.587**	0.302	-0.147
RH _m	-0.571**	0.307	-0.224
RH _e	-0.448**	0.366*	-0.034
SSH	0.362	-0.094	-0.084
RF	-0.229	0.669**	-0.122
RD	-0.263	0.77**	-0.358

*Significant at 5 % level

** Significant at 1% level

T_{max}=Maximum temperature, T_{min}=Minimum temperature, RH_m=Morning relative humidity, RH_e=Evening relative humidity, SSH= Sunshine hours, RF=Rainfall, RD=Rainy days

Correlation between different insect pests and biotic factors

In the case of tea mosquito bugs, leaf miner and thrips, significant correlation was established with none of the biotic factors.

Table 3.64 : Correlation of biotic factors and different insect pests recorded at Madakkathara centre during 2020- 21

Biotic factors	Tea mosquito bug	Leaf miner	Thrips
Red ant	-0.107	-0.119	-0.119
Black ant	0.287	-0.084	0.236
Spider	-0.111	0.303	-0.11

PARIA

The correlation between pest incidence and weather parameters revealed that maximum temperature had highly significant negative correlation with TMB incidence but positive correlation was established with wind velocity and evaporation.

Table 3.65 : Influence of abiotic factors on the activity of TMB at Paria centre during the year 2020-21

Weather Parameters	TMB
X1 - Maximum Temp	-0.515*
X2 - RH (m)	-0.167
X3 - RH (e)	-0.167
X4 – RH (avg.)	-0.417
X5 - Bright sunshine hours	-0.011
X6 - Wind velocity	0.319
X7 -Evaporation	0.242

*= significant at 5%

VENGURLE

The observations on incidence of pests on cashew were recorded throughout the year at weekly interval which were converted into average incidence per month. During the year 2020-21 incidence of TMB was started in the month of November, 2020 and reached to the peak in the month of February, 2021 (0.577) and declined thereafter. The incidence of thrips was started from November, 2020 and reached its peak in the month of February, 2021 (0.615) and declined thereafter.

The correlation studies indicated that, the Infestation of tea mosquito bug showed significantly negative correlation with minimum temperature ($r = -0.850$), evening RH ($r = -0.815$) and rainfall ($r = -0.576$). The incidence of thrips showed significantly negative correlation with evening RH ($r = -0.718$) and rainfall ($r = -0.588$). The incidence of apple and nut borer showed significant negative correlation with evening RH ($r = -0.628$).

Sr. No.	Insect pests	Regression Equation	R ²	Adjusted R ²
1	TMB	$Y_1 = 223.901 - 2.951x_1 - 0.841x_2 - 0.395x_3 - 0.923x_4 + 0.003x_5$	0.957	0.92
2	Thrips	$Y_2 = -18.4921 + 0.3269x_1 + 0.0558x_2 + 0.0857x_3 - 0.021x_4 + 0.0005x_5$	0.750	0.542
3	ANB	$Y_3 = 173.9164 - 2.5335x_1 + 0.2792x_2 - 0.4017x_3 - 0.8007x_4 + 0.004x_5$	0.6968	0.4442

(*X₁ is maximum temp. X₂ is minimum temp. X₃ is morning RH, X₄ is evening RH and X₅ is rainfall.)

The regression equation indicates that increase in 1°C minimum temperature decreases the TMB incidence by 0.841 and increase in 1% evening relative humidity decreases TMB incidence by 0.923. Regarding flower thrips increase in 1% evening RH decreases thrips incidence by 0.021. Regarding apple and nut borer, increase in 1% evening relative humidity decreases incidence of apple and nut borer by 0.800.

Table 3.66 : Seasonal incidence of different pests (2020-21)

Month	Incidence of TMB (0-4 scale)			Incidence of Thrips (0-4 scale)			Incidence of ANB (%)		
	2018-19	2019-20	2020-21	2018-19	2019-20	2020-21	2018-19	2019-20	2020-21
April	0	0	0.038	0	0	0	0	0	1.25
May	0	0	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0	0	0
Aug.	0	0	0	0	0	0	0	0	0
Sep.	0	0	0	0	0	0	0	0	0
Oct.	0	0	0	0	0	0	0	0	0
Nov.	0	0	0.131	0	0	0.069	0	0	0
Dec.	0.09	0.134	0.308	0.076	0	0.269	0	0	0
Jan.	0.134	0.135	0.538	0.171	0.103	0.577	1.30	1.02	1.19
Feb.	0.195	0.168	0.577	0.260	0.146	0.615	2.10	1.48	4.17
Mar.	0.139	0.131	0.346	0.349	0.161	0.385	2.0	0.384	5.36

Table 3.67 : Correlation between cashew pest incidence and weather parameters (April, 2020 to March, 2021)

Weather Parameters	TMB	Flower thrips	Apple and nut borer
Maximum Temp	0.402	0.532	0.322
Minimum Temp	-0.850*	-0.423	-0.423
RH (m)	0.150	-0.002	-0.016
RH (e)	-0.815*	-0.718*	-0.628*
Rain fall	-0.576*	-0.588*	-0.388

* - Significant at 5% level of significance.

$r = 0.576$ at 5% level of significance

VRIDHACHALAM

The incidence of TMB was confined to flushing through fruiting season. Its activity was observed from first week of February 2021 to third week of April 2021. The same observation on TMB activity was recorded during first week of February 2020 to third week of April 2020 also. Maximum TMB damage was observed during the second week of March with mean damage score ranging between 7.75 and 13.6. Nut borer activity during non-bearing periods could not be traced out. Cashew leaf miner incidence is most common in new flushes during July to December reaching the peak during September – October (11%) in Cuddalore districts of Tamil Nadu, but incidence can be seen upto January at low level. During peak infestation period, 3 to 8 blisters and nine caterpillars are observed on a single leaf in Cuddalore District of Tamil Nadu. The cashew leaf folder was also observed from July 2020 - November 2020 with 15.8 % to 4.5 % leaf damage observed in young plantations. Maximum damage was noticed during August 2020 and 2021 and September 2020 and 2021. Whereas, Leaf and blossom webber damage was observed maximum during August 2020 and 2021. Cashew Leaf thrips population (19.19) was noticed in March 2021. However, shoot tip caterpillar was observed during January to February – 2021, but incidence was noticed during January 2021.

Table 3.68 : Correlation coefficient (r) for abiotic factors and insect pests of cashew at Vridhachalam

Weather Parameters	TMB Population (Y1)	Leaf and blossom webber (% damage) (Y2)	Leaf miner (% damage) (Y3)	Leaf thrips Population (Y4)	Apple and nut borer (%damage) (Y5)	Leaf folder (%damage) (Y6)	Shoot tip caterpillar (%damage) (Y7)	CSRB (% damage) (Y8)
Minimum temperature (°C) (X1)	-0.56*	0.59*	0.49	-0.24	-0.09	0.61*	0.26	0.32
Maximum temperature (°C) (X2)	-0.44	0.41	0.20	0.10	0.23	0.39	-0.27	0.43
Relative Humidity (Morning%) (X3)	0.59*	-0.39	-0.03	0.41	0.35	-0.36	0.27	-0.55*
Relative Humidity (Evening%) (X4)	-0.25	0.06	0.05	-0.58**	-0.68**	0.11	0.17	0.21
Rainfall (X5)	-0.22	0.01	0.12	-0.60	-0.54	-0.01	0.09	0.03
Rainy days (X6)	-0.35	0.16	0.20	-0.62	-0.66*	0.09	0.10	0.12
Wind speed(Km/hr.) (X7)	0.53	-0.70*	-0.65**	0.28	0.00	-0.75*	-0.15	-0.68*
Sunshine (hours) (X8)	0.33	-0.17	-0.26	0.69*	0.61	-0.19	-0.26	-0.13

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

Table 3.69 : Correlation coefficient (r) for abiotic factors and population of natural enemies on cashew at Vridhachalam

Weather Parameters	Spiders (Y9)	Ants (Y10)	Coccinellids (Y11)	Braconids (Y12)	Wasp (Y13)
Minimum temperature (°C) (X1)	0.28	-0.09	0.52**	0.55*	0.71*
Maximum temperature (°C) (X2)	0.44	0.19	0.62**	0.24	0.80**
Relative Humidity (Morning%) (X3)	0.05	0.33	0.10	0.30	-0.21
Relative Humidity (Evening%) (X4)	-0.53*	-0.66*	-0.56*	-0.29	-0.45
Rainfall (X5)	-0.67*	-0.64*	-0.45	-0.08	-0.32
Rainy days (X6)	-0.72*	-0.56	-0.47	0.01	-0.19
Wind speed(Km/hr.) (X7)	-0.55	0.22	-0.74*	-0.43	-0.56
sunshine (hours) (X8)	0.67*	0.72*	0.36	0.01	0.25*

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

The results of Correlation studies revealed that TMB population had significant negative correlation ($r = -0.56$) with the minimum temperature and an insignificant negative correlation ($r = -0.44$) with maximum temperature. Further, relative humidity in the evening ($r = -0.25$), rainfall ($r = -0.22$) and rainy days ($r = -0.35$) had negative correlation with TMB population, but relative humidity in the morning ($r = 0.59$) had significant positive correlation and wind speed ($r = 0.53$) and sunshine hours ($r = 0.33$) recorded a positive correlation.

The results of the CSRB per cent damage revealed that a positive correlation was observed with minimum ($r = 0.32$) and maximum temperature ($r = 0.43$) and a significant negative correlation with relative humidity in the morning ($r = -0.55$) and wind speed ($r = -0.68$).

Table 3.70 : Regression analysis between pests of cashew and weather parameters during June - 2020 and September - 2021 at Vrindhachalam

Sl. No.	Biotic factors	Regression equation	R ²
1.	TMB Population(Y1)	$Y_1 = 42.15 - 0.34X_1 - 0.65X_2 + 0.10X_3 - 0.16X_4 + 0.01X_5 - 1.33X_6 + 0.61X_7 - 0.66X_8$	0.84
2.	Leaf and blossom webber (% damage) (Y2)	$Y_1 = 79.45 + 0.72X_1 - 1.81X_2 - 0.33X_3 - 0.13X_4 - 0.02X_5 + 2.09X_6 - 3.99X_7 - 2.49X_8$	0.83
3.	Leaf miner (% damage) (Y3)	$Y_1 = -0.44 + 0.36X_1 - 1.8 - 1.241X_2 + 0.62X_3 + 0.01X_4 - 0.03X_5 + 1.62X_6 - 6.19X_7 + 20.15X_8$	0.78
4.	Leaf thrips Population(Y4)	$Y_1 = -178.01 - 0.90X_1 + 3.16X_2 + 0.88X_3 + 0.39X_4 - 0.03X_5 + 1.36X_6 - 4.66X_7 - 1.11X_8$	0.79
5.	Apple and nut borer (% damage) (Y5)	$Y_1 = -72.06 - 0.44X_1 + 0.00X_2 - 0.16X_3 - 0.53X_4 + 0.05X_5 - 2.36X_6 + 0.32X_7 - 1.26X_8$	0.78
6.	Leaf folder (% damage) (Y6)	$Y_1 = -8.17 + 0.71X_1 - 0.75X_2 + 0.07X_3 + 0.22X_4 - 0.04X_5 + 1.47X_6 - 4.66X_7 + 0.04X_8$	0.87
7.	Shoot tip caterpillar (% damage) (Y7)	$Y_1 = -41.59 + 0.26X_1 - 0.38X_2 + 0.62X_3 + 0.28X_4 - 0.05X_5 - 0.001X_6 - 1.35X_7 - 2.09X_8$	0.67
8.	CSRB (% damage) (Y8)	$Y_1 = -71.24 - 0.45X_1 + 1.90X_2 - 0.09X_3 - 0.67X_4 - 0.04X_5 + 2.62X_6 - 5.26X_7 + 1.86X_8$	0.73

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

Table 3.71 : Regression analysis between natural enemies of cashew and weather parameters during June - 2020 and September 2021 at Vrindhachalam

Sl. No.	Biotic factors	Regression equation	R ²
1.	Spiders(Y9)	$Y_9 = -151.19 + 0.76X_1 - 3.56X_2 - 0.41X_3 - 0.35X_4 + 0.05X_5 - 0.09X_6 - 5.69X_7 + 6.42X_8$	0.91
2.	Ants(Y10)	$Y_{10} = 95.22 + 0.43X_1 - 1.11X_2 - 0.74X_3 - 0.41X_4 + 0.03X_5 + 0.60X_6 + 1.87X_7 + 64.06X_8$	0.86
3.	Coccinellids (Y11)	$Y_{11} = 22.43 - 0.12X_1 + 0.65X_2 + 0.10X_3 - 0.34X_4 + 0.05X_5 -$	0.86

		$1.69*X_6-2.42*X_7-1.37*X_8$	
4.	Braconids (Y12)	$Y_{12}= -155.36*+0.71X_1+0.05X_2+1.61*X_3+0.21X_4-0.05X_5+2.06X_6--5.07*X_7+0.20X_8$	0.72
5.	Wasp (Y13)	$Y_{13}= -149.31*+0.06X_1+2.72*X_2+0.55*X_3+0.26X_4-0.05X_5-0.03X_6+0.82*+0.87*X_7--1.05X_8$	0.86

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

Minimum temperature (°C) (X1),

Maximum temperature (°C) (X2),

Relative Humidity (Morning%) (X3),

Relative Humidity (Evening%) (X4),

Rainfall (X5), Rainy days (X6), Wind speed (Km/hr.) (X7) and Sunshine (hours) (X8).

Results of multiple linear regression analysis between weather parameters and abundance of TMB population revealed that the maximum temperature (T_{max}) and minimum temperature (T_{min}) had significant contribution towards the TMB population with the R^2 value 0.84. When the minimum temperature (T_{min}) increased by 1°C, number of TMB population increased by 0.35 percent and 1 °C of maximum temperature (T_{max}) decreased the population by 0.66 per cent as well and when sunshine hours decreased by 1°C, number of TMB population decreases by 0.66 per cent.

With regard to CSRB per cent damage maximum (T_{max}) and minimum (T_{min}) temperature had significant contribution towards their per cent damage with the R^2 value 0.73 and a 1°C increase in maximum temperature (T_{max}), 0.45 percent increase and with 1°C decrease in minimum temperature (T_{min}), 1.95 per cent decrease in CSRB damage could be predicted.

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

Centres: East Coast :	Bapatla, Bhubaneswar, 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

Germplasm entries existing in the gene bank of Cashew Research Station, Bapatla were screened for resistance/susceptibility to major pest(s) of cashew viz,

- 1) Leaf and blossom webber (*Lamida monoculalis*)
- 2) Shoot tip caterpillar (*Cheleria haligramma*)
- 3) Leaf miner (*Acrocercops syngamme*)
- 4) Apple and nut borer (*Thylocoptila panrosema*)

Observations:

During the year 2021, among the 36 accessions screened to identify the tolerant lines against the pests of cashew, all entries were recorded very less i.e., negligible incidence of leaf and blossom webber, Leaf folder, shoot tip caterpillar and apple and nut borer. The accession ABT-3 has recorded with the highest incidence of leaf miner (4.01%) and ASRPT, T.No. 6/14 and Hy 94-T4 have observed no incidence during this season (0.00%). The accession line T.No. 6/14 has recorded with highest incidence of Apple and nut borer (5.56 %) and remaining entries were observed less incidence during this season.

Table 3.72 : Screening of cashew germplasm to locate tolerance / resistance to major pests of the region (2020-21)

S. No.	Entry	IC NO.	Leaf miner damaged leaves (%)	Leaf folder damaged leaves (%)	Shoot tip caterpillar damaged shoots (%)	Apple and nut borer damaged nuts (%)
1.	Priyanka	250140	0.94	0.64	0.00	0.00
2.	T.No.129	249784	0.29	0.00	0.00	0.00
3.	T.No.275	249982	0.62	0.00	0.15	1.14
4.	T.No.274	302488	0.68	0.68	0.17	0.00
5.	T.No.12/1	---	1.88	0.31	0.00	0.49
6.	T.No.12/8	---	0.87	0.00	0.00	4.55
7.	T.No.18/3	---	1.26	0.15	0.00	0.00
8.	ABT-3	302391	4.01	0.55	0.00	2.13
9.	ABT-2	302390	0.88	0.00	0.00	0.00
10.	T.No.3/7	--	2.16	0.28	0.00	4.08
11.	T.No.3/4	---	1.49	0.16	0.00	3.33
12.	T.No.1/1	---	1.69	0.46	0.00	0.00
13.	T.No.8/7	302437	3.52	0.16	0.16	4.00

14.	T.No.4/3	302442	2.62	0.00	0.00	2.00
15.	T.No.4/5	---	1.28	0.32	0.00	0.00
16.	T.No.30/1	302368	0.94	0.00	0.00	0.71
17.	T.No.228	302376	2.56	0.30	0.15	0.30
18.	T.No.233	302374	1.02	0.00	0.00	0.00
19.	T.No.244	302379	1.70	0.00	0.17	0.00
20.	T.No.268	302381	1.81	0.00	0.00	0.00
21.	BLA 139-1	---	0.34	0.00	0.00	0.00
22.	BLA 39/4	---	1.10	0.00	0.00	2.38
23.	T.No.5/1	250025	0.35	0.00	0.00	0.00
24.	T.No.10/2	249911	0.70	0.00	0.00	0.00
25.	T.No.71	302370	0.93	0.15	0.00	0.00
26.	T.No.277	302384	2.60	0.00	0.00	0.00
27.	T.No.2/14	302446	1.89	0.00	0.00	0.85
28.	Ch.gudem	302409	1.47	0.14	0.00	0.80
29.	ASRPT	---	0.00	0.00	0.00	0.00
30.	T.No.40/1	---	1.11	0.16	0.16	0.00
31.	T.No.6/14	302432	0.00	0.00	0.00	5.56
32.	Hy 94-T3	---	2.23	0.00	0.00	0.00
33.	T.No.2/5	302387	1.16	0.00	0.00	0.00
34.	Hy 94-T4	---	0.00	0.00	0.33	0.00
35.	Hy 95-T4	---	0.31	0.31	0.92	0.00
36.	Vetapalem	----	0.15	0.00	0.15	0.00

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, ABT-3, T.No.3/7, T.No.4/3, T.No.4/5	5.1-10%	-
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, T.No.30/1, T.No.7/12, Vetapalem, T.No.274, T.No.2/14, T.No.2/3, T.No.277, Hy 94-T4, T.No.275, T.No.12/8, T.No.3/7, T.No.4/3, T.No.4/5, BLA 39/4, T.No.129, T.No.228, T.No.233, T.No.244, T.No.268, BLA 139-1, Hy 95-T3, T.No.5/1, ASRPT, Priyanka, ABT-3, ABT-2, T.No.71, Ch.gudem, T.No.2/5, T.No.40/1, T.No.1/1, T.No.10/2, T.No.3/4, T.No.8/7, Hy 94-T3	5.1-10%	T.No.6/14

HOGALAGERE

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

Table 3.73 : Screening of MLT-II (MLT-1992) entries for tolerant/resistant to the major pests of the region during 2021

Sl. No.	Centre	Entry	Mean damage on shoots			Thrips (% damage)
			TMB (%damage)	Leaf miner (No. blotches/shoot)	Apple & nut borer (% damage)	
1	Vengurla	H-68	0.96	1.05	1.11	0.93
		H-367	1.10	0.79	0.84	1.05
		H-303 (V-9)	1.09	0.74	0.85	0.96
		H-255	1.01	0.78	1.01	0.75
		H-320	1.13	0.93	1.02	0.88
2	Vridhachalam	M-4/3	0.97	0.94	0.82	0.81
		M-15/4	1.08	0.90	0.89	0.78
3	NRCC, Puttur	NRCC-1	0.81	0.79	0.87	0.99
		NRCC-2	0.87	0.86	0.77	0.99
4	Bapatla	TN-30/1	0.82	1.09	0.69	1.18
		TN-3/33	0.99	0.95	0.92	1.13
		TN-10/19	0.93	0.91	1.08	1.04
		TN-3/28	1.21	0.94	0.77	1.02
5	Ullal	Ullal-1	0.89	1.02	1.05	1.08

Table 3.74 : Screening of MLT-III (MLT-2002) entries for tolerant/resistant to the major pests of the region at HREC, Hogalagere during 2021

Sl. No.	Centre	Entry	Mean damage on shoots		
			TMB (% damage)	Leaf miner (No. blotches/shoot)	Apple & nut borer (% damage)
1	Bhubaneswar	BH-6	1.05	0.92	0.90
		BH-85	0.85	1.01	0.71
2	Madakathara	H-1593	0.83	0.81	0.75
		K-22-1	0.99	0.95	0.80
3	Vengurla	H-662	0.85	0.83	1.17
		H-675	0.86	1.05	0.99
4	Puttur	H-32/4	1.08	1.11	0.87
		Goa-11/6	1.02	0.74	1.10
5	Vridhachalam	H-11	0.88	1.08	1.23
		H-14	0.96	0.80	1.09
6	Chintamani	Chintamani-1	0.89	0.84	1.26

JAGDALPUR

The experimental data revealed that the lowest score for thrips was recorded in NRC-191 (0.42), whereas, germplasm NRC-130 and Aakhane did not show TMB infestation. The shoot tip caterpillar infestation was ranged from 1.87 to 8.10 per cent and minimum per cent of leaf damage was reported in NRC-191 with 1.87. The lowest damage with respect to leaf miner and leaf folder was recorded in NRC-193 (0.27 %) and NRC-191 (0.78 %) respectively.

Table 3.75 : Screening of promising DCR entries for tolerance/ resistance to the major pests at Jagdalpur during the year 2021

Germplasm	TMB (mean damage score 0-4 scale)	Thrips (mean damage score 0-4 scale)	Shoot tip caterpillar (% of damaged leaves)	Leaf miner (% of mined leaves)	Leaf folder (% of damaged leaves)
NRC-130	0.00	1.50	3.30	0.43	2.63
NRC-131	0.04	1.19	2.32	2.37	2.44
NRC-136	0.19	1.06	3.51	0.79	3.12
NRC-137	0.30	1.20	4.21	4.52	3.25
NRC-138	0.11	0.55	2.70	0.45	2.51
NRC-140	0.24	0.84	3.03	0.31	1.30
NRC-190	0.28	1.18	3.30	2.38	2.61
NRC-191	1.27	0.42	1.87	0.71	0.78
NRC-192	0.11	0.95	2.46	0.70	2.39
NRC-193	0.15	0.88	2.58	0.27	1.96
VTH 711/4	0.25	0.78	2.82	0.64	1.87
Aakhane	0.00	1.40	8.10	1.00	2.21

The lowest score of thrips was recorded in germplasm CARS-4 (0.31) whereas maximum in CARS-5 (1.23). The lowest TMB infestation was reported in germplasm CARS-6 (0.10) however, maximum TMB score was reported in CARS-3 (2.05). The minimum damage of leaf caterpillar, leaf miner and leaf folder were found in CARS-6, CARS-2, 6, 7 and CARS-6, respectively.

Table 3.76 : Screening of local germplasm for tolerance/ resistance to the major pests at Jagdalpur during the year 2021

Germplasm	TMB (mean damage score 0-4 scale)	Thrips (mean damage score 0-4 scale)	Shoot tip caterpillar (% of damaged leaves)	Leaf miner (% of mined leaves)	Leaf folder (% of damaged leaves)
CARS-1	1.16	0.88	2.61	0.22	1.86
CARS-2	1.41	0.89	4.33	0.00	3.28
CARS-3	2.05	0.43	2.63	1.13	1.02
CARS-4	1.06	0.31	2.52	3.79	1.91
CARS-5	0.43	1.23	3.54	0.24	1.47
CARS-6	0.10	0.97	2.02	0.00	0.48
CARS-7	0.14	0.77	2.54	0.00	1.23
CARS-8	0.60	0.51	3.66	1.23	2.05
CARS-9	0.33	1.08	4.47	1.60	3.45
CARS-10	0.42	1.14	4.88	1.75	3.74

Lowest score of thrips was recorded in germplasm MAD-1 (0.37 DS) whereas maximum in HY-367 (2.03). The lowest TMB infestation (DS) was reported in germplasm VRI-36, 30/1 and MAD-1 with 0.00 however, maximum TMB score was reported in K-22-1 (1.84). The minimum damage per cent of leaf caterpillar, leaf miner and leaf folder were found in BPP-2, H-1598 and Ullal-1, respectively with 1.64, 0.15 and 0.70.

Table 3.77 : Screening of germplasm accession maintained at germplasm block for tolerance/ resistance to the major pests at Jagdalpur during the year 2021

Germplasm	TMB (mean damage score 0-4 scale)	Thrips (mean damage score 0-4 scale)	Shoot tip caterpillar (% of damaged leaves)	Leaf miner (% of mined leaves)	Leaf folder (% of damaged leaves)
NRCC Sel. 1	0.03	1.00	3.59	0.35	2.23
NRCC Sel. 2	0.61	1.23	2.94	0.46	2.46
Tr. No. 3/28	0.05	1.06	3.60	0.37	1.91
Tr. No. 3/33	0.29	0.94	1.77	1.32	1.35
Tr. No. 30/1	0.00	0.60	3.19	3.98	2.46
10/19	0.58	0.95	4.49	0.95	1.25
VRI-1	0.33	0.91	3.67	2.22	2.27
VRI-2	0.01	1.26	2.87	0.72	1.80
VRI-3	0.00	1.36	3.62	0.39	2.55
V-1	0.16	0.81	4.96	0.25	1.29
V-4	0.50	1.50	3.88	0.86	2.55
Ullal-1	0.89	1.16	1.86	0.74	0.70
Ullal-2	0.55	0.69	2.43	0.24	1.52
H-1598	0.28	1.33	1.88	0.15	1.55
H-1608	0.20	1.59	3.61	0.45	2.09
Chintamani-1	0.16	1.04	2.19	0.58	1.06
Bhubaneswar-1	0.91	1.02	2.10	0.52	1.24
H-1591	0.63	0.47	3.92	1.72	1.10
MAD-2	0.13	0.58	2.24	0.79	1.45
MAD-1	0.00	0.37	2.74	2.77	2.56
K-22-1	1.84	0.76	3.44	1.81	2.06
M-15/4	0.21	1.12	6.08	0.43	2.20
BPP-1	0.23	1.08	2.79	0.52	2.11
BPP-2	0.69	0.99	1.64	0.43	1.47
BPP-4	0.81	0.94	2.12	0.33	1.18
BPP-5	0.08	0.86	2.26	0.50	1.50
BPP-6	0.13	1.09	2.85	1.51	1.53
BPP-8	0.24	1.00	1.70	0.83	1.33
HY-68	0.36	0.69	3.85	0.42	2.02
HY-367	1.06	2.03	4.17	0.91	3.35
JHARGRAM-1	0.22	0.96	2.19	0.84	1.08
Bastar Sel. -1	1.69	1.26	3.48	0.64	2.40

Among the entries screened out during 2020-21 lowest TMB damage score was recorded in NRC-130, AAKHANE, VRI-3, Mad-2, 30/1 with (0.00), respectively. Whereas, germplasm CARS-3 had maximum (2.05) damage score of TMB. Thrips damage score was observed throughout the year in which maximum damage score was recorded HY-367 with 2.03 and minimum damage score was recorded MAD-1 with 0.37 DS. The minimum infestation of shoot tip

caterpillar, leaf miner and leaf folder were recorded in BPP-2, CARS-2 and CARS-6 with 1.64, 0.00, 0.48 per cent, respectively however maximum per cent of leaf damage was reported in M-15/4, 30/1, MAD-1 with 6.08, 3.98 and 2.56 per cent, respectively.

Table 3.78 : Minimum and maximum damage scores recorded in germplasm during 2020-21

Infestation by	Minimum damage	Germplasm	Maximum damage recorded	Germplasm
<i>Thrips (0-4 scale)</i>	0	-	2.03	HY-367
TMB (0-4scale)	0	NRC-130, AAKHANE, VRI-3, Mad-2, 30/1	2.05	CARS-3
Shoot tip caterpillar	0	-	8.10	AAKHANE
Leaf miner	0	CARS-2	4.52	NRC-137
Leaf folder	0	-	3.74	CARS-10

VENGURLE

During the year 2020-21, the variety V-7 recorded the lowest TMB incidence (0.131) whereas; it was the maximum in H-1155 (0.577). Regarding thrips the variety V-2 recorded the lowest thrips infestation (0.269) whereas; it was the maximum in H-1675 (0.615).

Table 3.79 : Screening of cashew germplasm against TMB and flower thrips (2020-21)

Sr. No.	Germplasm	Incidence of TMB		Incidence of thrips	
		Minimum damage in 0-4 scale	Maximum damage in 0-4 scale	Minimum damage in 0-4 scale	Maximum damage in 0-4 scale
1	V-7	0.131	-	-	-
2	Hy-1155	-	0.577	-	-
3	V-2	-	-	0.269	-
4	Hy-1675	-	-	-	0.615

VRIDHACHALAM

All the MLT entries and hybrids are prone for TMB infestation in varying degree of susceptibility. The damage score for TMB infestations in various MLT entries ranged from 2.3-3.5. The score was low in ME 20/1 with mean damage score of 2.3. In other cashew entries, the mean damage score ranged between 2.3 and 3.5.

Table 3.80 : Screening of MLT entries against major pests of cashew at Vridhachalam during 2021

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)	Leaf thrips (Population No./52 leader shoots)
H 1598	2.5	3.6	1.4	0.7
H 1600	2.4	3.4	1.1	0.5
H 1608	2.5	3.8	1.2	0.6
H 1610	2.6	3.6	2.1	0.6
H 129	2.8	3.5	2.4	0.7
H 40	3.4	3.6	2.5	0.5
H 2/15	2.6	3.6	1.2	0.5
H 2/16	3.5	2.9	2.2	0.7
H 33/3	2.4	2.9	2.4	0.6
H 44/3	2.4	2.9	1.4	0.6
M 26/2	2.4	3.2	3.2	0.7
ME 20/1	2.3	2.8	1.3	0.6
VTH 30/4	2.9	3.8	1.5	0.5
VTH 59/2	3.0	3.6	1.2	0.6
V 2	3.2	2.9	1.1	0.7
V 3	3.2	2.5	3.2	0.6
V 4	2.9	3.5	2.4	0.5
V 5	2.4	3.8	2.5	0.7

Screening of F₁ hybrids revealed that all the cross combinations were susceptible to TMB infestation. However, the damage score was low (2.4) in H 10 and H14 followed by H 16 and H17, with a mean damage score of 2.4.

Table 3.81 : 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
H 10	M 10/4 x M 26/1	2.4	4.2	2.2	2.1
H 11	M 10/4 x M 45/4	3.0	3.9	1.9	1.9
H 12	M 10/4 x M 75/3	2.8	3.9	1.9	1.5
H 13	M 26/2 x M 26/1	2.6	4.2	2.1	1.5
H 14	M 26/2 x M 45/4	2.4	5.1	1.4	1.7
H 15	M 26/2 x M 75/3	2.8	5.2	1.7	2.5
H 16	M 44/3 x M 26/1	2.5	5.1	1.6	2.4
H 17	M 44/3 x M 45/1	2.5	5.1	1.9	2.4

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

Screening of germplasm to locate tolerant/resistant cashew types to major insect pests of the region - Compilation of last 23 years data.

Table 3.82 : Screening of MLT entries against major pests of cashew at Vridhachalam-Pooled Mean data from 1997-1998 to 2019-2020.

MLT entries	TMB Damage score (mean damage score 0-4 scale in 52 leader shoots)	Leaf and blossom webber (% shoot damaged / 52 leader shoots)	Leaf miner (% of mined leaves on five laterals)	Leaf roller (% of rolled 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	1.92	11.35	3.54	11.19	0.78	1.73	0.50
H 1600	1.87	12.43	3.61	8.61	0.50	2.54	0.67
H 1608	1.82	12.76	2.99	14.01	3.34	4.65	0.48
H 1610	2.05	10.70	4.06	7.08	0.52	5.29	0.31
H 129	2.19	10.87	4.18	10.31	0.58	5.19	0.52
H 40	2.37	10.27	3.91	9.44	0.45	3.52	0.57
H 2/15	2.03	11.28	2.89	11.96	5.99	4.40	0.87
H 2/16	2.38	10.40	4.04	9.84	3.83	3.46	1.10
H 33/3	1.97	9.52	4.17	6.53	0.46	5.08	0.62
H 44/3	2.16	11.08	3.64	10.23	0.89	4.81	0.96
M 26/2	2.07	11.89	4.49	11.24	0.78	1.86	0.66
ME 20/1	1.10	10.42	1.32	1.60	0.00	1.51	0.00
VTH 30/4	2.05	10.42	3.17	9.96	2.23	4.65	0.90
VTH 59/2	1.91	10.83	2.93	9.60	0.36	2.71	0.46
V 2	2.29	12.05	3.16	8.50	0.42	4.15	0.56
V 3	2.31	12.06	4.30	8.59	0.45	3.98	0.54
V 4	2.34	11.92	3.84	11.36	3.26	3.67	0.59
V 5	2.06	10.25	4.10	8.02	0.40	3.92	0.57

Table 3.83 : Screening of F₁ hybrids for tolerance to cashew pests at Vridhachalam- Pooled Mean data from 1997-1998 to 2019-2020.

Hybrid Number	Cross combination	TMB damage score (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 roller (% of rolled leaves) on five laterals	Leaf miner (% of mined leaves) on five laterals	Leaf thrips (Population No./52 leader shoots)	Apple & Nut borer (% of apples damaged /52 panicles)
H 10	M 10/4 x M 26/1	1.93	9.72	1.18	8.83	4.29	2.66	0.66
H 11	M 10/4 x M 45/4	2.06	10.15	1.56	12.90	3.71	4.07	0.76
H 12	M 10/4 x M 75/3	2.22	10.18	3.70	14.04	4.05	2.74	0.50
H 13	M 26/2 x M 26/1	1.98	9.47	1.18	11.16	4.24	4.97	0.70
H 14	M 26/2 x M 45/4	1.87	9.59	1.33	10.04	4.04	4.22	0.30
H 15	M 26/2 x M 75/3	2.04	10.26	2.95	16.24	5.97	2.15	0.36
H 16	M 44/3 x M 26/1	1.95	9.26	2.55	15.09	5.41	3.80	0.85
H 17	M 44/3 x M 45/1	2.09	9.12	1.33	3.10	4.74	3.42	0.41

The damage score for TMB infestations in various MLT entries ranged from 1.10-2.38. The leaf and blossom webber damage ranged from 9.52- 11.92 while 1.32 to 4.49 per cent damage occurred due to damage occurred due to leaf miner, inflorescence caterpillar ranged from 0.36 to 5.99 and Leaf roller ranged from 6.53 to 11.96. Whereas leaf thrips ranged from 1.51 to 5.29 and Apple and nut borer ranged from 0.46 to 1.10.

Screening of F₁ hybrids revealed that all the cross combinations were susceptible to TMB infestation. The TMB damage score ranged from 1.87 to 2.20. The leaf and blossom webber damage ranged from 9.12- 10.26 while 3.71 to 5.97 per cent damage occurred due to damage occurred due to leaf miner, inflorescence caterpillar ranged from 1.18 to 3.70 and Leaf roller ranged from 3.10 to 16.24. Whereas leaf thrips ranged from 2.15 to 4.07 and Apple and nut borer ranged from 0.30 to 0.85.

However, none of the cashew MLT entries and F₁ hybrids showed immune or resistant reaction to TMB and incidence of other foliar feeding insects such as leaf and blossom webber, Leaf Miner, Inflorescence caterpillars, Leaf roller, Leaf thrips and Apple & Nut borer.

* * *

CHAPTER II : ORGANISATION

1. GENERAL CHARACTERISTICS OF CENTRES OF AICRP ON CASHEW

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

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

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

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

The average annual rainfall is 1200 mm. A cooperating centre in Barapani / Tura in Meghalaya region is characterized by hilly terrain and has deep black loamy soils. The average rainfall ranges between 2500 – 4000 mm spread out during the months of June to November. The cooperating centre at Goa is characterized by lateritic soils with shallow to medium depth. The centre is situated at altitude of 25-40m above the MSL. This centre receives rainfall ranging from 2800 mm to 3800 mm spread out during June to December.

2. TRANSFER OF TECHNOLOGY

BAPATLA

Training programmes conducted

- Two Training programme on cashew was organized by the centre one at Pathapatnam, Srikakulam district on 18.03.2021 wherein 150 number of farmers had participated and on 20.03.2021 at Billananduru Village, Kotananduru Mandal, Tuni Division, East Godavari district in which 150 no. of farmers had participated, which were sponsored by Directorate of Cashewnut and Cocoa Development, Cochin.
- The scientists of the Centre had conducted two webinar on Cashew in coordination with Farmers Advisory Cell of Dr. YSRHU wherein lecture was delivered on Cashew Production technology during summer months, Rejuvenation techniques in Cashew and Pest and disease management in Cashew on 06.03.2021 and 16.4.2021 at Rythu Bharosa Kendram (RBK) Bethpaudi, Bapatla mandal.
- Under SCSP Scheme two training programme on cashew production technology sponsored by ICAR - DCR, Puttur were organised, at Hira mandalam, Srikakulam district on 19.03.2021 in which around 120 number of farmers had participated and at Gangavaram village, Rajavaram Panchayat Koyyalagudem Mandal West Godavari District on 25.03.2021 in which around 100 farmers had participated.
- Under TSP Scheme, training programme on Cashew production technology was organized on 23.12.2021 at Kamayyakunta Panchayat, Koyyalagudem Mandal West Godavari District. This programme was attended by local representatives, Village Agriculture Assistants, Village Horticulture Assistants and around 100 farmers attended the programme. Dr. R.V.S.K. Reddy, Director of Research, Dr YSRHU, Dr. J. Dilip Babu, Principal Scientist (Hort.) & Head, Cashew Research Station, Bapatla, distributed the sprayers, secateurs and inputs to the beneficiaries under TSP sponsored by ICAR-DCR, Puttur.
- The scientist of the centre gave radio talk on measures to be taken during flowering and fruiting in cashew on 27.01.2021 and delivered a radio talk on “Jeedimamidilo samagra yajamanyam” on 01.12.2021 at Akasavani Kendra, Vijayawada.
- The scientists of the centre gave a RBK Phone in live programme on Pest and Disease management in cashewnut at Integrated Call Centre, Gannavaram Vijayawada on 11.01.2021, on Management practices in cashewnut, at Integrated Call Centre, Gannavaram

Vijayawada on 27.01.2021 and had attended for recording of “Jeedimaamidi Sagulo Cheedapedala Yajamyam” at Integrated Call Centre, Gannavaram for dissemination of new technologies to the farmers through RBK channel on 20.12.2021

C. Participation in training programs:

- Dr. K. Umamaheswara Rao, Senior Scientist (Hort.) participated in a training programme on cashew rejuvenation programme as a resource person organized by Department of Horticulture, Srikakulam at Reyyipadu (Vil), Vajrapukothuru mandal on 19.08.2021

D. Participation in seminars & symposia:

- Dr. K. Umamaheswara Rao, Scientist (Horticulture) & Dr. B. Nagendra Reddy, Scientist (Entomology) attended the National Conference on Cashew with a theme “Cashew development in India - Challenges and Opportunities” organized by DCCD, Cochin, Kerala at Goa, Panjim from 26-27th Feb-2021. During this conference Dr. K. Umamaheswara Rao, Scientist (Horticulture) presented invited paper on “Importance of quality planting material in augmenting production of cashew”
- Dr. K. Umamaheswara Rao, Senior Scientist (Hort.) had given a presentation on the topic “Prospectus of Cashew Cultivation in Andhra Pradesh” on 12.11.2021 under Azadiki Amrit Mahotsav program organized by ICAR- DCR, Puttur.
- Dr. B. Nagendra Reddy Scientist (Ento) attended online training programme on Remote sensing and GIS applications in Agriculture from 9th-11th Nov, 2021 organized by NIPHM, Hyderabad.
- Dr. K. Umamaheswara Rao, Senior Scientist (Hort.) & Head (FAC) attended the zoom meeting on “Cashew cultivation in South East Asian Countries” on 26.11.2021 Organized by ICAR-DCR, Puttur.
- Dr. K. Umamaheswara Rao, Senior Scientist (Hort.) & Head (FAC) and Dr. B. Nagendra Reddy Scientist (Ento) attended the Global Connect Series in collaboration with Plant Genomics and Biotechnology, West Virginia State University, USA on “Translational genomics for improvement of horticultural crops” on 27.11.2021.
- Dr. J. Dilip Babu, Principal Scientist (Hort) & Head, Dr. K. Umamaheswara Rao, Senior Scientist (Hort) and Dr. B. Nagendra Reddy, Scientist (Ento.) attended Annual Group Meeting- 2021 of AICRP on Cashew through virtually on 05.12.2021 and 06.12.2021 and presented the work done report for the year 2020-21.
- Dr. J. Dilip Babu, Principal Scientist (Hort.) & Head, Dr K. Umamaheswara Rao, Senior Scientist (Hort.) attended the Agri Tech- 2021 exhibition al RARS, Lam Farm organized by ANGRAU, from 17th -19th December, 2021 and exhibited the different varieties of Cashew.

E. Rythu Saddassus:

- The scientists of the Centre had organized the Rythu sadassu at RBK., Bethapudi (village), Bapatla (Mandal) under VC to Village programme on 18.02.2021.



Cashew Training programme at pathapatnam



Cashew Training programme at Hiramandalam



Cashew Training programme at Tuni



Cashew Training programme at Gangavaram, West Godavari



Distribution of Planting Material to the beneficiaries under SCSP



Cashew Training programme at Kamayyakunta, West Godavari



Distribution of equipments to the beneficiaries under TSP

BHUBANESWAR

- The scientists of the centre have participated and acted as resource persons in six district level seminars on cashew under MIDH Scheme organised by Odisha State Cashew Development Corporation Ltd, Bhubaneswar at Solar in Jajpur district on 20th January, 2021; Agnipur in Nawarangpur District on 11th February, 2021; Nandapur in Koraput district on 12th February, 2021; Jagatsinghpur on 08th September 2021, Pitapali in Khordha district on 18th November, 2021 and Chhattia in Jajpur district on 23th November 2021.
- Scientist of the centre had participated in the National Conference on Cashew - “Cashew development in India-Challenges and Opportunities” organised by Directorate of Cashewnut and Cocoa Development, Kochi at Panjim, Goa from 26th to 27th February, 2021.
- An exposure visit was arranged on 11.01.2021 and 16.09.2021 for 50 number of farmers from Andhra Pradesh wherein they visited the research plots and interacted with the scientists of the project.
- Three number of field visits/discussions were made on various aspects of cashew cultivation i.e. production technology, crop management and plant protection measures and suitable suggestions were provided to the farmers.
- The scientists have also given information to the students of B.Sc(Hons) Agriculture and B.Tech(Ag.Engg) on different aspects like research activities on cashew, grafting technique in cashew, nutrient and water management, cashew apple and nut processing, pest and disease management in cashew etc. in practical.
- A radio talk was given by the scientist of the centre on the topic “*Khara Dine Phala Bagichara Jatna*” and “*Kaju Badam Chasa*” in Kisan Vani Programme broadcasted by All India Radio, Puri on 18.04.2021 and 19.07.2021 respectively.

- Under SCSP Scheme, the centre has conducted two farmers' training programme on the topic "Cashew plantation and it's management" at Nabalinga village of Gondia block in Dhenkanal district on 19.02.2021 and "Improved Production technology on cashew" at Paikarapur village of Dharmasala block of Jajpur district on 27.03.2021 where 79 farmers and 21 farm women had participated. 1000 no. of cashew grafts along with inputs like manures, fertilizers, pesticides, fungicides and weedicides were supplied to seven scheduled caste farmers under area expansion programme and ten farmers were provided with small equipments.
- Under TSP Scheme, one farmers' training programme was conducted on the topic "Good Horticultural practices for increasing cashew production" at Chudakhiakateni village of Gondia block of Dhenkanal district on 28.03.2021 where 22 tribal farmers and 28 farm women had participated. 600 no. of cashew grafts along with inputs like manures, fertilizers, pesticides and fungicides were supplied to seven tribal farmers under area expansion programme and fifteen farmers were provided with small equipments.

DARISAI

Under SCSP Scheme, one day Training programme on Scientific Production Technology of Cashew was conducted at the centre on 17.11.2021 in which 43 scheduled caste farmers comprising of 18 male and 25 female farmers from East Singhbhum and Saraikela-Kharsawan districts of the Jharkhand state had participated wherein information on package of practices and technical aspects of successful cashew cultivation was provided.



SCSP Training Programme at Darisai

TSP Training Programme:

One day Training programme on Scientific Production Technology of Cashew was conducted at ZRS Darisai on 23.11.2021 in which 39 tribal farmers comprising of 32 male and 07 female

farmers from East Singhbhum and Saraikela-kharsawan districts of the Jharkhand state had participated and provided information on scientific production technologies and technical aspects of successful cashew cultivation.



TSP Training Programme

The scientist of the centre had given two radio talks at AIR Jamshedpur on “Suitable variety of Cashew for Jharkhand and package of practice for cultivation” on 24.08.2021 and on “Intercropping in Cashew” on 7.01.2022.

HOGALAGERE

The scientists of the centre have provided consultation on various aspects of cashew viz., cashew varieties for cultivation and recommended Vengurla-4, Vengurla-7 under irrigated conditions; cashew cultivation as per the POP of Cashew; cashew varieties and recommended Chintamani-1; regarding rejuvenation of cashew and explained details of rejuvenation and top working; soil testing and explained about procedure to take soil samples and recommended KVK, Kolar to analyse their samples; production technology of cashew with suitable varieties like Chintamani-1, Ullal-1 and Vengurla-4; cashew processing information and explained detailed cashew nut processing from roasting to packing; regarding new cashew plantation establishment and explained about all cultural operations, suitable varieties and other management practices to be made for cashew.

JAGDALPUR

A one-day horticulture mela on cashew production technology, plant protection and processing was conducted on 27th February 2020 at S.G. College of Agriculture and Research Station Kumhrawand, Jagdalpur, Bastar, Chhattisgarh with collaboration of Directorate of Cashewnut &

Cocoa Development (DCCD) Kochi Kerala and All India Coordinated Research Project (AICRP) on Cashew wherein about 115 farmers had participated in the training.

A one day district level seminar on “Increasing productivity of cashew through improved technologies” was conducted under financial assistance from DCCD, Cochin on 24th March 2021. The objective of this seminar was to display new technologies in cashew cultivation under Bastar region which has been tested and recommended recently in the region with special reference to small and marginal farmers. More than 150 participants attended the seminar and certificate of participation was distributed among the participants from Dept. of Horticulture, Dist. Bastar, NHM field assistants, grafters, MGNREGA workers, NRLM group members, M.Sc. Forestry students and M.Sc. Agriculture students.



The one day training program on production constraints in cashew for schedule caste farmers was organized in the village and panchayat Deoda, Block Bastar, District Bastar on 28th February 2021. The chief guest of the function was Hon. MLA of Narayapur and President, Chhattisgarh Hasth Shilp Vikas Nigam, Shri Chandan Kashyap. MLA Shri Chandan Kashyap discussed the role of cashew in upliftment of tribal womens in the Bastar and the impact of cashew in developing marketing channel and skills in womens. After which Hon MLA distributed seed kits, sprayers, garden tools to schedule caste farmers.



JHARGRAM

SCSP :

One training programme was organized under SCSP Scheme at the RRS, BCKV, Jhargram district, West Bengal in which around 53 farmers had participated. 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. The farmers were given literature on various aspects of cashew cultivation. There were field visits after lecture session. A booklet on Frequently Asked Question on Cashew was released during the training programme. At the end of every training programme, a questionnaire session was conducted and each expert asked 5 questions to the farmers on cashew cultivation aspects.

Area Expansion programme: 2.0 ha cashew plantation was developed at the Godbeta block of Paschim Medinipur district of West Bengal under SCSP project. A total number of 5 scheduled caste farmers were identified as beneficiaries for the area expansion programme. The beneficiaries were

identified with the help of Department of Horticulture, Government of West Bengal, from the list of FPO's from the website. Maximum area of 0.84 ha was allotted to one farmer, others owned land area between (0.34 – 0.50) ha. The varieties recommended for West Bengal were supplied for area expansion programme viz. BPP- 8, Vengurla- 7 and Bidhan Jhargram-2. Apart from cashew grafts, other inputs given to the farmers were Neem Cake, Single super phosphate, insecticide, fungicide, black polythene for mulching, nylon net for fencing and Bone meal. Labour cost was also met from the project fund @ Rs. 20 for digging /pit, Rs. 5 for planting/plant, Rs. 5 for poly mulching around each plant Rs. 10 for half circle trench making around each plant, Rs. 10 for fencing around each plant. Carrying cost was given to the farmers @ Rs.5 per plant. Sign board depicting implementation details of the area expansion programme was also given to each farmer for exhibiting in their respective cashew orchards. The calendar of operation for cashew cultivation was also given to every farmer under the project for timely and properly maintaining their new orchards. A demonstration programme was also conducted at the Regional Research Station for understanding the initial methods of establishing cashew plantation.

TSP

A. Area Expansion programme: 2.0 ha cashew plantation was developed at the Jamboni and Binpur blocks of Jhargram District of West Bengal under TSP project. A total number of 6 scheduled tribe farmers were identified as beneficiaries for the area expansion programme. Initially two farmers were selected, each having 1 ha of area at Jamboni block and Belpahari area of Binpur 1 block, but later on one of them denied and other one planted 66 plants in his plot. Therefore, 4 other farmers were selected in the same block but other villages for the programme.

Maximum area of 0.50 ha was allotted to one farmer, others have land area between (0.2 – 0.34) ha. The varieties recommended for West Bengal were supplied for area expansion programme viz. BPP- 8, Vengurla- 7, Dhana, Bhaskara and Bidhan Jhargram- 2. Apart from cashew grafts, other inputs given to the farmers were Neem Cake, Single super phosphate, insecticide, fungicide, black polythene for mulching, nylon net for fencing and Bone meal. Labour cost was also met from the project fund @ Rs. 20 for digging /pit, Rs. 5 for planting/plant, Rs. 5 for poly mulching around each plant Rs. 10 for half circle trench making around each plant, Rs. 10 for fencing around each plant. Carrying cost was given to the farmers @ Rs.5 per plant. Sign board depicting implementation details of the area expansion programme was also given to each farmer for exhibiting in their respective cashew orchards. The calendar of operation for cashew cultivation was also given to every farmer under the project for timely and properly maintaining their new orchards.

MADAKKATHARA

Training/seminars/programmes organized

Particulars	Number of trainees	Category	Venue	Date	Name of scientist involved
Farmers training programme on cashew production technology	52	DCCD	Athirappilly Panchayath	27-29 January 2021	Dr.JalajaS.Menon Dr.Smitha M.S Dr.Asna A.C

Cashew the cash crop	50 Male-14 Female-36	SCSP training programme	Achankovil, Kollam	6/2/2021	Dr. Jalaja S. Menon Dr. Smitha M.S
District level seminar on cashew	150	DCCD funded	Achankovil, Kollam	5/2/2021	Dr.JalajaS.Menon Dr.Asna A.C
Scientific cultivation of cashew	38 Male-33 Female-5	TSP	CRS,Madakkathara	22/3/2021	Dr.JalajaS.Menon Dr.Asna A.C
cashew cultivation	50 Male-21 Female-29	scsp	CRS,Madakkathara	24/3/2021	Dr.JalajaS.Menon Dr.Smitha M.S
Nursery worker	25	DCCD-ASCI,Skill India	CRS, Madakkathara	05/03/2021 to 29/3/2021	Dr.JalajaS.Menon Dr.Smitha M.S Dr.Asna A.C Sri.Manoj M.K
Feasible technology for cashew cultivation in Kerala- farmers of Kottayam district	21	CRS, Madakkathara & KVK Kottayam	Online	19/5/2021	Dr.JalajaS.Menon Dr.Smitha M.S Dr.Asna A.C
Advanced technologies for cashew cultivation in Kerala-Farmers of Palakkad dists	26	CRS, Madakkathara	Online	22/5/2021	Dr.JalajaS.Menon Dr.Smitha M.S Dr.Asna A.C
Prospects of cashew cultivation and scientific management practices- farmers of Kollam districts	42	CRS, Madakkathara	Online	24/5/2021	Dr.JalajaS.Menon Dr.Smitha M.S Dr.Asna A.C
Cashew cultivation- future prospects in collaboration with KVK, Malappuram	30	KVK, Malappuram		31/5/2021	Dr.JalajaS.Menon Dr.Asna A.C
Role of cashew in eco system restoration as a part of world environment day	20	CRS, Madakkathara	online	08/06/2021	Dr.JalajaS.Menon Dr.Asna A.C

Experience sharing session- to promote cashew cultivation and to motivate new entrants	260	CRS, Madakkathara	online	From 11/6/2021 to 27/08/2021 (11 session)	Dr.JalajaS.Menon Dr.Smitha M.S Dr.Asna A.C
Scope for value added products from cashew apple in collaboration with farm information bureau		Farm Information Bureau	Facebook live	22/7/2021	Dr.JalajaS.Menon
Pre flowering management of cashew –farmers of Malappuram	32	CRS, Madakkathara & KSACC	Online	23/10/2021	Dr.Jalaja S Menon Dr.NasiyaBeegum A. N

Other Extension activities

- Preparation and circulation of e poster on cashew graft planting, varieties, tea mosquito bug and CSRB management
- World environment day celebration by planting cashew grafts on 5/6/2021

PARIA

The Scientists of the centre have attended Krishi mohotsav, Khedut Din, Khedut Sibir and other activities are as below:

Sr No.	Date	Topic	Event	Place	No. of farmers		
					Male	Female	Total
1	12/01/21	Scientific cultivation of Cashew	TSP Farmer training	Dixal	25	0	25
2	20/03/21	Scientific cultivation of Cashew	TSP Farmer training	Karjun	75	34	109
3	23/05/21	After TauKTae cyclone Care	Farmer Advice	Vapi	52	37	89
4	16/06/21	Dakshin Gujaratma Kaju Ek Ashaspad Pak	Expert in Krishidarsan Phone-in-live Programme	Ahemadabad	Live – In Programme		
5	25/10/21	Scientific cultivation of Cashew	SCSP Farmer training	Mohangam, Umergam, Valsad	15	5	20
6	25/10/21	Scientific cultivation of Cashew	SCSP Farmer training	Amboli, Surat	10	5	15

7	28/10/21	Scientific cultivation of Cashew	SCSP Farmer training	AES, Paria	8	4	12
8	29/12/21	Scientific cultivation of Cashew	Farmer training	AES, Paria	27	5	32



Method Demonstration at Dixal Tal. Kaprada, Dist. Valsad



Input distribution at Karjun, Tal. Kaprada, Dist. Valsad



After TauKTae cyclone, Dr. S.J. Patil and Prof. S.G. Parmar has visited different villages of Vapi Dist. Valsad, Gujarat and advised farmers

PILICODE

The scientist of the centre had conducted 9 trainings and seminars. Under SCSP Scheme, one training programme was conducted at RARS, Pilicode in which 50 farmers had participated. Training on Cashew graft production and pruning was conducted from 24/2/2021 to 25/2/2021 in which 12 Labourers from Cashew Progeny Orchard, Department of Agriculture and Farmers welfare, Galimukha and Adhur were benefitted.

Trainings on Cashew Apple Utilization was conducted with Kannur KVK from 22/3/2021 to 23/3/2021; 24/3/2021 to 25/3/2021 and 27/3/2021 in which 75 peoples were trained.



Training programme under SCSP



Training Programme on Cashew Apple Utilization

Three days training programme on cashew production funded by DCCD, Kochi was conducted in which around 50 farmers were benefitted. The activities involved classes on cultivation, plant protection, processing and marketing of Cashew, field visits to progressive farmers' field.



Training programme on cashew production

Under TSP Scheme one day training programme was conducted on 5.3.2021 at Kiliyalam Thotti, Nileshwar Kasaragod in which 50 farmers had participated. A seminar on cashew cultivation was also conducted on 23.11.2021 at Chelannur, Kozhikode in which 50 farmers had participated.



Training to tribal farmers of Nileshwar, Kasaragod



Tribal subplan awareness seminar on Cashew cultivation

TURA

Two training programmes were organized benefitting a total of 51 farmers in which 25 were farm women.

Sl. No.	Title of training	On/ Off campus	Village	Participants		Total
				Male	Female	
1.	Calendar of operations for Cashew 30 th March 2021	Off	Rimrangapara	18	21	39
2.	Intercropping in Cashew 5 th October 2021	On	KVK Training Hall	8	4	12



Training Programme under NEH Scheme

VENGURLE

A) Extension activities

Sr. No.	Date	Title of the training programme	No. of Training	Location	Total no. of farmers/ participants		
					Male	Female	Total
1.	5 th March,	SCSP (Scheduled Caste	1	Mulde, Tal. Kudal,	35	15	50

	2021	Sub Plan) Cashew Training Programme: 01 Area expansion: 2 ha.		Dist. Sindhudurg			
2.	9 th March to 13 th March, 2021	DCCD sponsored Four training programmes on “Cashew Apple Utilization for Unemployed Women”	4	Cashew Farm, RFRS, Tal. Vengurla, Dist. Sindhudurg	-	100	100
3.	23 rd March, 2021	DCCD sponsored “District Level Seminar on Cashew”	1	Degave, Tal. Dodamarg, Dist. Sindhudurg	96	54	150
4.	15 th March, 2021	DCCD sponsored “Horticulture Fair cum Field Day on Cashew”	1	Adeli, Tal. Vengurla, Dist. Sindhudurg	40	60	100
Total			07		171	229	400

B) Demonstrations:

Sr. No.	Date	Subject	No. of Demonstr.	Location	Total no. of farmers/ participants		
					Male	Female	Total
1.	15 th March, 2021	Fertilizer application in cashew	01	Adeli, Tal. Vengurla, Dist. Sindhudurg	40	60	150
2.	23 rd March, 2021	Management of cashew stem and root borer (CSRB)	01	Degave, Tal. Dodamarg, Dist. Sindhudurg	96	54	100
Total			02		136	114	250

VRIDHACHALAM

Under TSP Scheme, one training programme on “ Improved production technology and cashew apple utilization for tribal beneficiaries” was conducted during 23.2.2021 in which around 50 no. of farmers (25 men + 25 women) had participated. Under SCSP Scheme, two training programme on “ Improved production technology and cashew apple utilization for Scheduled Caste beneficiaries” was conducted during 24.2.2021 and 25.2.2021 in which around 52 no. of farmers (28 men + 24 women) and 50 no. of farmers (34 men + 16 women) had participated.



TSP Training Programme

3. RESEARCH PUBLICATIONS

BHUBANESWAR

- Gopikrishna, K., Panda, P.K., Nayak, R.K. and Sethi, K. 2021. Effect of nutrients on yield and yield attributing characters in cashew (*Anacardium occidentale* L.). *The Pharma Innovation*, 10(1):117-119.
- Pattnaik, R.K., Panda, P.K., and Nayak, Sushrita. 2021. Influence of organic manure and biofertilizers on quantitative and qualitative traits of cashew cv.BPP-8 in Odisha condition. *Chemical Engineering*, 2(4):37-41.

Research papers presented in International and National Seminar/Symposia:

- Panda, P.K., Pattnaik, R.K. and Sethi, K. 2021. Effect of different organic sources of nutrients on yield and quality of cashew (*Anacardium occidentale* L.) cv.BPP-8. In: *9th Indian Horticulture Congress, November 18-21, 2021* at CS Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh Pp.244

Popular Article

- Panda P.K. and Sethi K. 2021. Adhika Amala Pain Manjijata Kajubadam Bagichara Parichalana. *Chasirara Sansara*, 56(2-3):31-33.

Extension Bulletins/Booklets/Leaflets:

- Panda P.K. and Sethi K. 2021. *Kajubadam Chasa* (In Odia). Published by AICRP on Cashew, OUAT, Bhubaneswar.Pp-6
- Panda P.K. and Sethi K..2021. *Kajubadam-Eka Lavajanaka Arthakari Phasala* (In Odia). Published by AICRP on Cashew, OUAT, Bhubaneswar.Pp-6

JAGDALPUR

Research Papers

- Ramteke, V., Nirala, Y. S., Nayak, M.G. and Mohana G.S. 2020. Evaluation of apple and nut characters of cashew germplasm from Bastar region, Chhattisgarh, India. *J. Plantation Crops*, 48(2):142-145. (doi: 10.25081/jpc.2020.v48.i2.6374).
- Ramteke, V., Nirala, Y. S., Kumar, H., Thakur, P. and Kashyap, S. K. 2020. Study on sensory evaluation of cashew varieties for preparation of ready to serve beverage and jam. *J. Soils Crops*, 30(2): 251-255.

Book Chapter

- Preethi, P., Savadi, S., Vanitha, K., Ramteke, V., Mangalassery, S. and Sandesh, M.S. 2020. Cashew (*Anacardium occidentale* L.) In: *Tropical fruit crops: Theory to Practical* (Ed. S. N. Ghosh and R. R. Sharma). Jaya Publishing House, New Delhi.

Technical bulletins/ Folders

- Ramteke, V., Nirala, Y.S., Kumar, H., Patra, H.K. and Thakur, P. 2021. Chhattisgarh Me Kaju Ki Unnat Kasht Avem Utpadan Taknik. TECHNICAL BULLETIN/IGKV/SGCARS/2020-21/07.

Nirala, Y. S., Ramteke, V., Kumar, H., Mandawi, N. C. and Thakur, P. 2021. "Kaju Ke Pramukh Keet Avem Unke Prabhandhan Ke Upay" Extension Folder/IGKV/SGCARS/2020-21/08.

Ramteke, V., Nirala, Y. S., Kumar, H., Patra, H. K. and Thakur, P. 2021. "Kaju Apple Ka Mulya Samvardhan" Extension Folder/IGKV/SGCARS/2020-21/09.

MADAKKATHARA

Research Papers

Jalaja S. Menon, Smitha M.S, Asna A C. 2021. Profile of women in cashew farm and processing sector and their constraints at work place a case study. *International journal of farm science* -11(3):1-5

Jalaja S. Menon, Asna A.C., Smitha M.S, Irine Chacko, Amal Babu. 2021. Influence of pre-soaking on seed nut germination in commercial cashew soft wood grafting nursery in Kerala-*Journal of Plant Development Sciences*. 13(5): 311-314.

Asna A.C, Jalaja S. Menon, Smitha M S. 2021. Phenotypic diversity and clustering of germplasm accessions of cashew for utilization and conservation. *Electronic Journal of Plant Breeding*. 12(4): 1218-1226

Conference proceedings/ Seminar Abstracts

Jalaja S. Menon and Asna A.C. 2021. Innovative ways of cashew apple utilization. Proceedings of National conference on cashew - cashew development in India – Challenges and opportunities in proceedings of seminar

Popular Articles

Dr. Jalaja S. Menon., 2021 – *Kasumavu alasa krishiyilninum aadayathilek* - Krishi jagaran (Malayalam) Vol-05 (August 2021)

Dr. Smitha M.S. 2021 - *Kasumavile pradhana keedangalum niyanthrana margangalum* - Krishi jagaran (Malayalam) Vol-05 (August 2021)

Dr. Asna A C. 2021. *Kasumavile inaperuma* - Krishi jagaran (Malayalam) Vol-05 (August 2021)

Books/Book Chapter/ Reports/Technical Bulletin/ Leaflets

CRS Technical bulletin 1- *Kasumavile sankara inangal*

CRS Technical bulletin 2- *Kasumavu krishi paripalana murakal*

CRS Technical bulletin 3- *Pinchandi parippu*

CRS Technical bulletin 4- *Kasumanga juice*

CRS Technical bulletin 5-*Kasumavile thadithurappan puzhu*

CRS Technical bulletin 6- *Theyila kothuku*

CRS Technical bulletin 7- *Kasumavu ottuthai nadeel reethi*

CRS Technical bulletin 8-*Kasumavile inaperuma*

VENGURLA

Research papers

Gajbhiye R.C., Khapare L. S., Kadam M. B., Deshmukh S. V., Pawar S. N., Sawant B .N., Salvi S. P. and Talha P.M. *Standardizing the preparation of carbonated beverage from cashew apple (Anacardium occidentale) syrup*. Crop Research 2454-1761. August, 2021; **56**(6): 317-322.

Gajbhiye R.C., Pawar S.N. and Sawant B.N. *Enhancement of cashew yield through foliar feeding of nutrients*. *Journal of Eco-friendly Agriculture* 2582-2683. December, 2021; **17**(1): 72-75

Books

Dr. A. Y. Munj, Jr. Entomologist, AICRP-Fruits, RFRS, Vengurla, Dr. M. B. Dalvi, Plant Pathologist, RFRS, Vengurla and others. '*Amba Pikawaril Kid aani Rog Wyawsthapan*'. Pub. 30th March, 2021

Participation of scientists as resource person in Seminar/ Conference/Training during 2020-21

Gajbhiye R.C. Lead lecture on "Cashew Cultivation Technology" in State Level Webinar on "Cashew Cultivation Technology and Processing" organized by Institution of Maharashtra Agriculture Technologist (IMAT), Pune held on 31/01/2021.

Gajbhiye R.C. Lead lecture on Prospects of Cashew Cultivation in Gadchiroli District in District Level Webinar on "Cashew Cultivation Technology" held on 30th November, 2021.

Munj A.Y. Lead lecture on 'Cashew Plant Protection' in Taluka Level Farmers training programme held on 1st July, 2021 at Taluka Agriculture Office, Kudal, Tal. Kudal (Online mode).

Munj A.Y. Lead lecture on 'Cashew Plant Protection' at Taluka Level Farmers training programme held on 7th July, 2021 at Principal, RAMETI, Kolhapur (Online mode)..

Munj A.Y. and Gajbhiye R.C. Lead lecture on 'Cashew Plant Protection' at Taluka Level Farmers training programme held on 24th December, 2021 at Pal, Tal. Vengurla.

Munj A.Y. and Gajbhiye R.C. Lead lecture on 'Cashew Plant Protection' at Taluka Level Farmers training programme held on 28th December, 2021 at Rewandi, Tal. Malvan.

Participation in Seminar/Webinar/Symposia/Conference

Gajbhiye R.C. and Khapare L.S. Two days National level webinar on "Canopy architecture management in perennial commercial Horticulture crops" organized by College of Horticulture, Bidar during 19th to 20th July 2021 by Virtual through Zoom Meeting.

Gajbhiye R.C. and Khapare L.S. National Level Webinar series topic on Overview of Global Cashew Scenario and India's Future Forward by Virtual mode through Zoom under the programme "Azadi ki Amrut Mahotsav" organized by ICAR – DCR, Puttur.

Gajbhiye R.C. and Khapare L.S. Lecture delivered by Dr. Jalaja S. Menon, Assistant professor and Head, Cashew research Station, Kerala, Agril. University, Madakkathara on topic 'Prospects of Cashew cultivation and its value addition in Kerala' by Virtual mode through Zoom under the programme "Azadi ki Amrut Mahotsav" organized by ICAR – DCR, Puttur on 3rd Sept., 2021.

Gajbhiye R.C. and Khapare L.S. Lecture delivered by Dr. J.D.Adiga, Principle scientist, IIHR, Bangalore on topic 'Breeding for novel traits in cashew' by Virtual mode through Google meet under the programme "Azadi ki Amrut Mahotsav" organized by SG College of Agriculture and Research Station, Jagdalpur on 15th Sept., 2021.

- Gajbhiye R.C. and Khapare L.S. Lecture delivered by Dr. M. Mohanalakshmi Menon, Assistant professor (Hort.) Regional research station, Vridhachalam, Tamilnadu agriculture University on topic “Cashew cultivation prospects in Tamil Nadu” by Virtual mode through Zoom under the programme “Azadi ki Amrut Mahotsav” organized by ICAR – DCR, Puttur on 17th Sept., 2021.
- Gajbhiye R.C. and Khapare L.S. Lecture delivered by Dr. Mini Poduval, OIC Cashew AICRP Centre, BCKV, Jhargram on topic “Prospects of Cashew Cultivation in West Bengal” by Virtual mode through Zoom under the programme “Azadi ki Amrut Mahotsav” organized by ICAR – DCR, Puttur on 1st Oct., 2021.
- Gajbhiye R.C. and Khapare L.S. Webinar on ‘Prospects of Cashew Cultivation and Processing in Southern Maidan Tracts of Karnataka’ delivered by Dr. Ramchandra R.K. Head, AICRP on Cashew and HREC, Hogalagere held on 29th October, 2021.
- Gajbhiye R.C. and Khapare L.S. Webinar on ‘Prospects of Cashew Cultivation in Andhra Pradesh’ delivered by Dr. Umamaheswara Rao, Scientist (Hort.), CRS, YSR Horticultural University, Bapatla, Andhra Pradesh under the programme “Azadi ki Amrut Mahotsav” organized by ICAR-DCR, Puttur held on 12th November, 2021.
- Gajbhiye R.C. and Khapare L.S. Webinar on ‘Cashew Cultivation in South-East Asian Countries: Case Study from Vietnam and Cambodia’ delivered by Dr. Varanashi Krishnamoorthy, Managing Trustee, Varanashi Development and Research Foundation, Adyanadka, Dakshina Kannada under the programme “Azadi ki Amrut Mahotsav” organized by ICAR-DCR, Puttur held on 26th November, 2021
- Gajbhiye R.C. and Khapare L.S. Webinar on ‘Value Addition Potential in Cashew’ delivered by Dr. Rajkumar A Dagadkhair, ICAR - DCR, Puttur under the programme “Azadi ki Amrut Mahotsav” organized by ICAR-DCR, Puttur held on 10th December 2021.
- Gajbhiye R.C. and Khapare L.S. Webinar on ‘Cashew manufacturing in India: Role of Science and Technology’ delivered by G. Giridhar Prabhu, Executive Director, Achal Cashew Pvt. Ltd. under the programme “Azadi ki Amrut Mahotsav” organized by ICAR-DCR, Puttur on 18th December 2021.

VRIDHACHALAM

National Conference/ Seminar/Symposium Abstracts

- Sathish G., Mohanalakshmi M. and Sundharaiya K. 2021. Performance of vegetable crops (as intercrop) in Cashew Plantation. In book of abstracts Of : 24th Plantation Crops Symposium (PLACROSYM XXIV) on Coping with the Pandemic & Beyond: Research & Innovation in the Plantation Crops Sector held on 14-16 Dec., at Kochi, Kerala, Pp: 158.
- Sathish G., Mohanalakshmi M. and Sundharaiya K. 2021. Effect of application of organic manures on growth and yield of Cashew Plantations. In book of abstracts Of : 24th Plantation Crops Symposium (PLACROSYM XXIV) on Coping with the Pandemic & Beyond: Research & Innovation in the Plantation Crops Sector held on 14-16 Dec., at Kochi, Kerala, Pp:157.

Jaya Prabhavathi, S., Senthil Kumar M., Mohanalakshmi M., Sathish G., and Subrahmaniyan K., 2021. Assessment of phytotoxic effect of botanicals used for the control of tea mosquito bug on Cashew. In Book of Extended Abstracts Volume I Of: TNAU Golden Jubilee International Conference on Global Perspectives in Crop Protection for Food Security (GPCP -2021) held on December 8-10, 2021 at Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore- 641 003. Pp: 237-238.(ISBN : 9 7 8 9 3 8 4 9 0 3 7 3 2).

Jaya Prabhavathi, S., M. Senthil Kumar, M. Mohanalakshmi, G. Sathish and K. Subrahmaniyan. 2021. Efficacy of newer insecticides and biopesticides against foliage pests on Cashew. In Book of Extended Abstracts Volume II Of: TNAU Golden Jubilee International Conference on Global Perspectives in Crop Protection for Food Security (GPCP -2021) held on December 8-10, 2021 at Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore- 641 003. Pp: 303-304. (ISBN:9 789384 90373623).

Tamil Booklets :

Sathish, G., Mohanalakshmi M., Jaya Prabhavathi S., Sangeetha A., and Subrahmaniyan K., 2021. Hi- tech production technology of Cashew. RRS, Vridhachalam Pp:1- (In tamil booklet)

Sathish, G., Mohanalakshmi M., Jaya Prabhavathi S., Kannan S., Sangeetha A. and Subrahmaniyan K. Value addition in Cashew. 2021. RRS,Vridhachalam Pp:1-15 (In tamil booklet).

Popular Articles:

Sathish, G. and Mohanalakshmi M., 2021. Production technology of Cashew. Krishi Jagran (Uzhavar Ulagam). 7(8): 10-16.

Sathish, G. 2021. Hi-Tech cultivation practices of Cashew. Agrobios newsletter. (September)Vol. XX. 4(1):24-26.

Sathish, G., Mohanalakshmi M., and Sundharaiya K., 2021. Cultivation techniques in Cashew. SPIC Annual Report (2021-2022) - Horticultural Crop Production Techniques - Villupuram districts, (Vaniga Rethayil Thotakalai Payirgal Sagupadi) Pp: 99-104

Jaya Prabhavathi, S., Senthil Kumar M., Mohanalakshmi M., Sathish G., and Subrahmaniyan K., 2021. Pest management in Cashew and its management. Velanmai seithi kathir. 53(9): 5-7

Leaflets/ Folders/ Pamphlets :

Sathish, G., Mohanalakshmi M., Sangeetha A., Jaya Prabhavathi S., and Subrahmaniyan K., 2021. Hi-tech Cashew cultivation stepping stone to bumper yield (Double the yield and triple the income). RRS, Vridhachalam (In Tamil & English).

Sathish, G., Mohanalakshmi M., Jaya Prabhavathi S., Sangeetha A., and Subrahmaniyan K., 2021. High Density Planting in Cashew. RRS, Vridhachalam (In Tamil).

Sathish, G., Mohanalakshmi M., Jaya Prabhavathi S., Sangeetha A., and Subrahmaniyan K., 2021. VRI (CW) Hybrid 1 Variety crop production management. RRS, Vridhachalam (In Tamil).

Mohanalakshmi, M., Sathish G., Jaya Prabhavathi S., Sangeetha A., and Subrahmaniyan K. 2021. Hi-tech production technology for maximizing high yield in Cashew. RRS, Vridhachalam (In Tamil).

Jaya Prabhavathi, S., Sathish G., Mohanalakshmi M., Sangeetha A., and Subrahmaniyan K. 2021. Pest Management in Cashew (In tamil).

4. STAFF POSITION**HEADQUARTERS****Directorate of Cashew Research****Darbe PO, PUTTUR-574 202, DK, KARNATAKA**

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Dr. Smitha M.S. (Upto 17.8.2021)

Sr. Technical Assistant : Vacant

Jr. Technical Assistant : Mr. M.K. Manoj

Grafter : Vacant

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Jr. Entomologist : Mr. S.G. Parmar
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 Jr. Breeder : Mr. L.S. Khapare (from 1.10.2020)
 Jr. Entomologist : Mrs. V.K. Zote
 Sr. Technical Assistant : Mr. S.P. Salvi
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Horticulturist : Dr. M. Mohanalakshmi (from 7.8.2020)
 Jr. Horticulturist : Dr. S. Velmurugan (Upto 6.8.2020)
 Dr. G. Sathish (from 7.8.2020)
 Jr. Entomologist : Dr. S. Jaya Prabhavathi
 Sr. Technical Assistant : Ms. L. Murugeswari
 Jr. Technical Assistant : Mr. Thiru. A. Aruldoss
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 Horticulturist : Dr. S.R. Assumi (Upto 31.1.2022)
 Dr. H.D. Talang (From 1.2.2022)

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

Phone : 0832 – 2284678 / 2284679 (O)
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 Horticulturist : Dr. A.R. Desai

5. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING THE YEAR 2021-22**Allocation****(Rs. in lakhs)**

Centre	Details of sanctioned provision					ICAR share
	Pay and Allowances	TA	Recurring contingency	Non-Recurring contingency	Grand Total	
Bapatla	61.70	1.50	22.84	1.09	87.13	65.35
Bhubaneswar	49.00	1.00	18.00	1.09	69.09	51.82
Hogalagere	49.00	1.00	24.67	1.67	76.34	57.25
Darisai	23.00	0.50	6.70	0.00	30.20	22.65
Jagdapur	23.09	1.00	21.20	1.67	46.96	35.22
Jhargram	24.00	0.80	13.33	0.00	38.13	28.60
Madakkathara	49.00	1.50	15.33	1.49	67.32	50.49
Paria	30.00	1.00	10.00	1.09	42.09	31.57
Pilicode	15.00	0.50	10.50	1.46	27.46	20.60
Vengurla	58.00	1.50	21.33	1.36	82.19	61.64
Vridhachalam	49.50	1.50	16.00	1.09	68.09	51.06
KRCCH, Arabhavi	0.00	0.50	13.50	0.00	14.00	10.50
ICAR Res. Compl. For Goa, Goa	0.00	0.00	5.84	0.00	5.84	4.38
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	1.33	0.00	1.33	1.00
Provision for RC for PC Cell	0.00	0.00	0.47	1.31	1.78	1.33
Total	431.29	12.30	201.04	13.32	657.95	493.46
ICAR Share	323.47	9.22	150.78	2.80	493.46	
Provision for SCSP						22.00
Provision for TSP						10.00
Provision for NEH						76.00
					GRAND TOTAL	601.46

Actual Expenditure

(Rs. in lakhs)

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share	SCSP	TSP
Bapatla	88.12	0.82	16.87	1.09	106.90	80.17	4.73	0.00
Bhubaneswar	53.81	0.56	17.64	0.94	72.95	54.71	1.74	1.03
Hogalagere	50.95	0.19	24.06	1.60	76.80	57.60	6.28	0.00
Darisai	21.45	0.20	5.75	0	27.40	20.55	0.40	0.40
Jagdapur	24.49	0.71	14.20	1.67	41.07	30.80	1.43	4.08
Jhargram	19.97	0.71	9.09	0	29.77	22.33	1.43	1.02
Madakkathara	55.73	0.39	15.33	1.49	72.94	54.71	1.03	1.03
Paria	34.83	0.00	9.48	0.98	45.29	33.97	0.0	0.47
Pilicode	14.94	0.21	10.04	1.46	26.65	19.99	1.20	1.03
Vengurla	53.73	0.10	21.33	0.76	75.92	56.94	0.99	0.00
Vridhachalam	72.33	0.20	21.32	0.0	93.85	70.39	1.17	0.55
KRCCH, Arabhavi	0.00	0	10.99	0	10.99	8.24	0.0	0.0
ICAR Res. Compl. For Goa, Goa	0.00	0.00	5.84	0.00	5.84	4.38	0	0
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	1.27	0.00	1.27	0.95	0.0	0.0
Provision for RC for PC Cell	0.00	0.00	0.42	1.18	1.60	1.20	0	0
Total	490.35	4.09	183.63	11.17	689.24	516.93	20.40	9.61
ICAR Share	367.76	3.07	137.72	8.38	516.93			
Provision for NEH						76.00		
GRAND TOTAL						622.94		

METEOROLOGICAL DATA OF DIFFERENT CENTRES FOR THE YEAR

BAPATLA

Month & Year	Max. temp (°C)	Min. Temp (°C)	RH (%)		Rainfall (mm)	Rainy days (No)
			(m)	(e)		
Jan - 21	30.7	19.7	85.2	57.7	0	0
Feb - 21	30.9	18.6	84.1	52.6	23.0	1
Mar - 21	33.6	21.0	83.9	55.3	0	0
Apr - 21	35.6	25.6	68.4	59.4	0.5	1
May - 21	36.8	27.4	60.5	52.8	46.8	5
June - 21	36.6	26.9	62.3	48.9	92.3	9
July - 21	33.9	25.3	76.7	62.7	175.6	10
Aug - 21	34.0	25.0	79.9	67.7	205.7	16
Sep - 21	33.3	25.0	83.7	74.0	204.5	22
Oct - 21	33.1	24.2	86.2	76.5	178.4	8
Nov - 21	29.1	22.7	87.9	83.1	276.0	20
Dec - 21	29.9	18.4	86.6	67.4	0	0
TOTAL:	33.1	23.3	78.8	63.2	1202.8	92

BHUBANESWAR

Months	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days	BSH
	Max.	Min.	Max.	Min.			
Jan - 21	30.5	16.3	93	39	0.0	0	4.2
Feb - 21	32.8	15.3	92	28	0.0	0	7.0
Mar - 21	37.7	23.0	94	33	7.5	1	6.1
Apr - 21	38.5	25.8	90	44	7.2	2	6.8
May - 21	36.5	26.1	89	58	200.3	9	7.1
June - 21	34.0	26.3	93	69	352.0	15	4.1
July - 21	33.5	26.1	93	75	265.5	14	4.4
Aug - 21	33.3	26.1	93	75	285.1	17	4.7
Sep - 21	32.4	25.5	95	80	579.4	16	3.4
Oct - 21	33.0	24.7	93	67	77.2	8	4.4
Nov - 21	30.2	21.8	87	69	82.6	4	4.4
Dec - 21	26.8	15.2	91	73	72.6	3	4.8
Total					1929.4	89	

DARISAI

Month	Cum. Rainfall (mm)	Temperature (°C)		Humidity %		Wind vel. (km/Hr)	Average Monthly SSHr	Evaporation (mm)
		Maximum	Minimum	Maximum	Minimum			
Jan - 21	0.0	30.5	2.5	85.9	68.5	2.7	265.3	0.0
Feb - 21	25.6	35.4	2.0	86.5	69.0	2.8	236.8	25.6
Mar - 21	100.8	36.8	10	86.3	69.2	2.6	263.0	100.8
Apr - 21	97.4	39.5	14.6	84.4	68.6	2.6	250.0	97.4
May - 21	96.8	39.8	17.5	85.3	68.7	3.0	207.5	96.8
June - 21	77.8	38.5	19.5	85.4	70.0	2.9	160.3	77.8
July - 21	93.1	36.5	21.4	86.0	69.6	2.4	164.1	93.1
Aug - 21	95.4	36.8	21.5	84.8	69.3	2.3	210.1	95.4
Sep - 21	81.5	35.4	21.5	85.4	69.4	2.5	183.5	81.5
Oct - 21	87.8	33.6	17.4	85.9	69.1	2.1	233.3	87.8
Nov - 21	86.1	31.5	6.2	85.2	69.1	2.2	203.9	86.1
Dec - 21	82.0	28.4	1.0	85.8	68.9	2.6	225.5	82.0
Total	924.3							

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)
Jan - 21	11.3	2	28.0	15.4	89.5	53.4	21.0
Feb - 21	44.6	2	29.7	15.6	88.1	42.9	20.1
Mar - 21	0.0	0	34.0	16.3	81.9	35.3	19.7
Apr - 21	53.5	4	35.8	19.5	87.8	33.0	20.6
May - 21	104.9	8	34.6	21.1	89.1	40.9	27.1
June - 21	4.3	1	34.6	21.2	89.0	44.0	11.3
July - 21	257.1	16	29.7	19.9	90.9	59.1	18.2
Aug - 21	238.4	13	30.3	20.2	91.0		18.7
Sep - 21	122.8	7	30.5	20.3	91.1	58.4	18.7
Oct - 21	383.5	24	30.69	20.27	91.55	61.90	18.79
Nov - 21	305.2	19	25.49	19.29	92.50	71.33	17.25
Dec - 21	13.4	2	27.47	16.65	90.48	56.81	15.75
Total	1539						

JAGDALPUR

Month	Temp (°C)		Relative Humidity (%)		Wind Vel. (Kmph)	Bright Sunshine hours	Rainfall (mm)	Rainy days
	Max.	Min.	I	II				
Jan - 21	29.1	11.8	92.0	33.0	0.3	6.5	0.0	-
Feb - 21	30.4	10.5	88.7	23.9	0.7	8.2	17.2	1
Mar - 21	35.4	17.1	77.6	22.7	0.7	6.3	0.0	-
Apr - 21	36.1	19.6	74.8	34.5	1.4	6.2	62.4	3
May - 21	34.9	22.5	73.7	44.8	4.1	10.6	90.0	6
June - 21	31.0	22.7	86.6	68.6	4.2	2.9	170.7	12
July - 21	29.8	22.4	90.0	74.3	3.5	2.4	317.6	17
Aug - 21	29.8	22.3	93.3	75.1	2.2	2.3	354.9	19
Sep - 21	29.7	22.2	92.2	71.5	2.3	3.4	188.9	12
Oct - 21	30.9	20.4	93.8	59.1	1.4	5.7	57.7	4
Nov - 21	29.2	17.8	94.1	55.2	1.7	4.9	150.5	6
Dec - 21	26.8	11.8	93.1	49.7	1.8	5.2	0.3	-
Average	31.1	18.4	88.0	51.0	2.0	5.4	117.5	-
Total							1410.20	80

JHARGRAM

Month	Temperature (°C)		Relative Humidity (%)	Max. Wind velocity (mph)	Cloud cover (%)	Rainfall (mm)	Rainy days	Average Pressure (mb)	Sun shine hours
	Maximum	Minimum							
Jan - 21	29	16	37	13.3	5	0	0	1013.4	372
Feb - 21	32	17	32	14.9	7	2.1	2	1013.0	328
Mar - 21	39	23	32	18.3	3	0	0	1008.8	372
Apr - 21	41	27	39	26.1	14	8.5	6	1005.3	357
May - 21	37	26	58	25.4	38	198.7	28	1002.5	331
June - 21	35	27	66	19.8	54	438.8	26	999.8	277
July - 21	33	26	74	18.5	64	409.8	29	1000.2	195
Aug - 21	32	26	78	15.9	62	201.3	29	1002.5	266
Sep - 21	31	25	84	17.5	63	88.4	26	1004.2	215
Oct - 21	32	24	72	14.2	31	29.1	11	1007.9	327
Nov - 21	30	20	56	12.4	19	1.4	2	1012.1	336
Dec - 21	26	16	55	14.1	20	10.1	5	1015.5	339
Total						1388.2	164		

KANABARGI

Month	Temperature		Humidity		Rain fall
Jan - 21	17.15	30.06	37.19	86.06	2.50
Feb - 21	16.91	30.73	28.11	73.36	9.00
Mar - 21	18.85	35.35	24.87	83.10	3.00
Apr - 21	20.15	34.81	28.47	90.47	75.50
May - 21	21.38	31.65	46.23	89.97	149.50
June - 21	20.27	27.27	78.07	87.73	245.00
July - 21	20.34	26.32	85.20	92.27	386.80
Aug - 21	20.14	25.55	87.03	92.77	52.60
Sep - 21	20.19	26.00	84.37	89.70	92.00
Oct - 21	20.45	26.72	80.13	89.32	66.00
Nov - 21	20.45	26.72	79.48	87.77	43.20
Dec - 21	19.50	28.01	71.81	79.90	51.20
Total					1176.30

MADAKKATHARA

Month & Year	Average Temperature (° C)		Relative Humidity (%)		Total Rainfall (mm)	Total No. of Rainy days	Total Sunshine hours (hr)
	Max.	Min.	Max.	Min.			
Jan - 21	32.52	21.48	75.6	48.4	45.7	1	6.98
Feb - 21	35.13	21.45	73	37	0	0	9.125
Mar - 21	36.6	23.3	84.75	36	31.8	1	8.49
Apr - 21	34.9	23.5	89.25	57.75	72.4	4	6.23
May - 21	32.72	23.06	93.6	72.2	561.9	17	4.89
June - 21	31.12	23.65	94.25	76	462.1	20	4.11
July - 21	29.88	23.44	96.4	75.6	659.4	26	2.26
Aug - 21	30.12	23.4	96.5	77.25	396.8	20	2.55
Sep - 21	30.67	23.87	96	70.75	271	12	3.96
Oct - 21	31.32	23.6	94.8	76.8	705.6	20	3.40
Nov - 21	31.1	23.45	90.75	70.25	270.7	11	2.7
Dec - 21	32.5	23.32	79.25	54.75	0.3	0	8.64
Total					3477.70	132	

PARIA

Month	Max. Temp.	Min. Temp.	RH (M)	RH (E)	Wind velocity	Rainfall (mm)	Sunshine hours	Evaporation (mm)
Jan - 21	30.38	10.01	81.89	47.85	1.66	4.2	7.82	2.96
Feb - 21	33.93	12.24	77.14	33.96	1.67	0.0	9.12	4.24
Mar - 21	37.36	15.13	82.95	54.17	1.99	0.0	8.82	4.89
Apr - 21	39.38	23.21	85.05	54.11	2.71	0.0	9.80	7.60
May - 21	37.38	26.01	84.69	64.86	4.44	14.4	9.08	6.72
June - 21	32.49	23.96	90.16	85.13	4.45	340.4	5.79	5.65
July - 21	31.83	24.43	93.12	84.12	5.69	557.8	3.61	5.92
Aug - 21	30.98	23.03	94.87	83.30	3.79	643.9	3.08	4.93
Sep - 21	30.24	22.51	95.04	87.40	4.30	763.2	2.23	4.38
Oct - 21	33.42	21.32	91.08	69.02	1.68	69.0	7.92	4.00
Nov - 21	34.55	17.04	88.75	57.66	1.13	24.5	7.93	4.55
Dec - 21	25.70	15.90	87.53	80.10	2.63	90.1	2.45	2.97
Total						2507.5		

PILICODE

Month & year	Temperature (°C)		Relative humidity (%)	Rainfall (Monthly cumu. mm)	No. of rainy days	BSH
	Maximum	Minimum				
Jan - 21	32.5	22.1	77.3	80.0	4	6.8
Feb - 21	33.0	21.2	73.8	11.8	2	8.5
Mar - 21	34.3	24.3	75.5	1.8	1	7.4
Apr - 21	34.3	25.2	76.0	64.0	4	6.9
May - 21	32.2	24.4	81.6	649.5	21	5.5
June - 21	30.9	23.4	84.5	553.0	27	4.3
July - 21	29.6	22.9	89.1	806.6	27	3.2
Aug - 21	29.7	23.1	86.6	598.5	27	3.7
Sep - 21	30.4	23.4	86.3	440.6	19	5.2
Oct - 21	31.0	24.0	84.8	558.0	13	5.1
Nov - 21	31.1	23.7	87.0	221.8	12	3.9
Dec - 21	32.1	21.5	81.6	19.4	3	8.8
Total				4005		

TURA

Month	Rainfall (mm)	Relative Humidity (%)		Temperature °C	
		Maximum	Minimum	Maximum	Minimum
Jan - 21	0	80	64	30	13
Feb - 21	0	87	56	36	14
Mar - 21	62.0	89	65	39	19
Apr - 21	57.3	91	70	40	19
May - 21	495.5	93	69	40	19
June - 21	457.4	88	70	37	17
July - 21	287.9	86	72	37	14
Aug - 21	494.3	87	70	37	16
Sep - 21	207.8	92	70	39	16
Oct - 21	167.6	89	61	36	16
Nov - 21	0	83	62	33	12
Dec - 21	0	80	53	31	12
Total	2229.8				

VENGURLA

Month	Temperature (°c)		Humidity (%)		Rain fall (mm)	No. of rainy days
	Maximum	Minimum	Forenoon	Afternoon		
Jan - 21	34.34	19.54	94.80	62.26	40.00	02
Feb - 21	34.87	18.28	90.43	61.00	0.00	00
Mar - 21	34.19	19.64	94.82	62.11	0.00	00
Apr - 21	35.42	23.42	78.82	64.20	2.00	01
May - 21	35.30	24.91	78.78	67.45	276.00	12
June - 21	32.96	23.97	92.16	77.80	852.00	25
July - 21	31.20	23.96	91.81	84.64	1375.40	27
Aug - 21	31.97	23.63	89.49	78.14	275.40	24
Sep - 21	31.78	23.39	94.72	83.00	609.00	27
Oct - 21	33.95	23.43	88.35	73.87	146.00	04
Nov - 21	34.37	21.93	89.11	76.39	153.00	10
Dec - 21	32.26	19.20	93.91	66.32	97.00	04
Total					3842.00	136

VRIDHACHALAM

MONTH	Temperature (°c)		Relative Humidity (%)		Sunshine (Hours)	Rainfall (mm)	Rainy Days (No.s)
	Max	Min	Morning	Evening			
Jan - 21	29.1	19.5	92.0	77.0	29.1	215.4	8
Feb - 21	31.6	19.8	90.9	64.0	31.6	7	1
Mar - 21	34.7	22.1	91.0	50.0	34.7	0	0
Apr - 21	37.1	25.7	89	50	37.1	8.6	1
May - 21	36.5	25.7	87	55	36.5	51.7	4
June - 21	36.2	25.9	86	57	36.2	44.4	4
July - 21	35.0	24.7	90	59	35.0	120.2	5
Aug - 21	35.4	26.4	89	61	35.4	83.4	4
Sep - 21	34.7	24.1	90	61	34.7	148.6	6
Oct - 21	32.5	24.2	93	73	32.5	195.4	14
Nov - 21	29.3	22.8	95	88	29.3	763.8	24
Dec - 21	30	21.6	93	75	30	52.0	5
Total						1367.00	52



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

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