ISSN 0972-2645

वार्षिक प्रतिवेदन
Annual Report
2012 - 13

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना
All India Coordinated Research Project on Cashew

भाकृअनुप
ICAR

काजू अनुसंधान निदेशालय
(भारतीय कृषि अनुसंधान परिषद)
पुत्तूर - 574 202, दक्षिण कन्नड, कनार्टक

Directorate of Cashew Research
(Indian Council of Agricultural Research)
Puttur - 574 202, Dakshina Kannada, Karnataka

ISSN 0972 - 2645

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ANNUAL REPORT

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परियोजना समन्वयकर्ता

प्रो. पी. एल. सरोज

PROJECT COORDINATOR

Prof. P.L. Saroj

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Dakshina Kannada, Karnataka

Darbe P.O., Puttur - 574 202

Correct citation

Annual Report 2012-13. All India Coordinated Research Project on Cashew
Directorate of Cashew Research, Puttur, Pages 106
ISSN 0972 - 2645

Published by

Prof. P.L. Saroj
Director
Directorate of Cashew Research, Puttur
Phone : (08251) 231530; EPABX : (08251) 230902, 236490
FAX : 08251 - 234350
E-mail: dircajures@yahoo.com, dircajures@gmail.com, dircajures@rediffmail.com

DCR Website: http://www.cashew.res.in

June 2013

Compiled and Edited by

Dr. T.N. Raviprasad
Prof. P.L. Saroj

Word-processed by

Mrs. Reshma K.

Hindi Translation by

Dr. T.N. Raviprasad
Dr. Ramkesh Meena

Printed at

M/s. Codeword Process and Printers, Mangalore - 575 001.
Phone : (0824) 2214618, 9900100818

प्राक्कथन

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की 29वीं वार्षिक प्रतिवेदन प्रस्तुत है । इस प्रतिवेदन में अप्रैल 2012 से मार्च 2013 तक की अनुसंधान उपलब्धियाँ तथा अन्य जानकारी सम्मिलित की गई है ।

इस परियोजना में चौदह केंद्र है, जैसे भारत के पूर्वी तट में चार; बापट्ला (आंध्र प्रदेश), भुवनेश्वर (उड़ीसा), झारग्राम (प.बंगाल) और वृद्धाचलम् (तमिल नाडु); पश्चिमी तट पर चार केंद्र है जैसे, माड़कत्तरा (केरळा), पिलिकोड (केरळा), वेंगुर्ला (महाराष्ट्र) तथा नवसारी (गुजरात) और मैदानी भाग में दो केंद्र, एक होगळगेरे (कर्नाटका) और दूसरा जगदलपुर (छत्तीसगड) में स्थित है । इसके अतिरिक्त अरभावी (कर्नाटका), तुरा (मेघालया) और गोवा में केंन्द्रों पर भी कार्य हो रहा है ।

प्रतिवेदन में चालू तेरह अनुसंधान परियोजनाओं कि उपलब्धियों का विषयानुसार विवरण प्रस्तुत है, जैसे जननद्रव्य संरक्षण और फसल सुधार, फसल प्रबंधन तथा फसल संरक्षण। इन विविध विषयों से संबंधित बारह अनुसंधान परियोजनाओं की उपलब्धियों को संकलित करके प्रस्तुत किया गया है।

इस प्रतिवेदन में दो प्रमुख अध्याय है, जैसे, तकनीकी : जिसमे परियोजना और क्षेत्रीय तौर पर विविध केंद्रों से प्राप्त प्रायोगिक उपलब्धियाँ, और संस्थानीय : जिसमे इतिहास, कर्मचारी विवरण, वित्तीय प्रावधान, मौसम की आँकड़े और शोध प्रकाशन शामिल हैं ।

मैं, अखिल भारतीय समान्वित काजू अनुसंधान परियोजना के सभी वैज्ञानिकों एवं स्टाफ के प्रति आभारी हूँ जिनका शोध कार्य इस वार्षिक प्रतिवेदन में समाहित किया गया है। इस वार्षिक प्रतिवेदन को तैयार करने में डॉ. टी.एन्. रविप्रसाद, प्रधान वैज्ञानिक (कृषि कीटशास्त्र) एवं परियोजना एकक प्रमुख तथा श्रीमती रेश्मा के. का भी आभारी हूँ।

(पी.एल. सरोज)
निदेशक एवं परियोजना समन्वयकर्ता

स्थान : पुत्तूर
दिनांक : 30.06.2013

PREFACE

This is the twenty nineth Annual Report of the All India Coordinated Research Project on Cashew. This report covers the research results and other information pertaining to the period from April 2012 to March 2013.

There are total fourteen centres i.e., four in the East Coast of India, namely, Bapatla (Andhra Pradesh); Bhubaneshwar (Odisha); Jhargram (West Bengal) and Vridhachalam (Tamil Nadu), four centres in the West Coast, namely, Madakkathara (Kerala) and Pilicode (Kerala); 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), Tura (Meghalaya) and Goa.

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

I express my sincere thanks to all AICRP on cashew workers for their research contribution. Thanks are also due to Dr. T.N. Raviprasad, Principal Scientist (Agri. Ent.) & Scientist- in-charge (PC Cell) and Mrs. Reshma K. for their efforts in bringing out this AICRP on Cashew Report 2012-13.

(P. L. SAROJ)
DIRECTOR & PROJECT COORDINATOR

Place : Puttur
Dated : 30.06.2013

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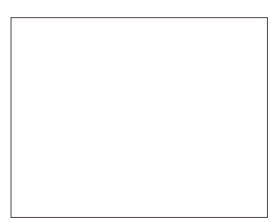


परियोजना समन्वयकर्ता की रिपोर्ट

अखिल भारतीय समन्वित मसाला व काजू अनुसंधान परियोजना 1971 में चौथी पंच वार्षिक योजना में शुरु की गई, जिसका मुख्यालय केंद्रीय रोपण फसल अनुसंधान संस्थान, कासरगोड में था । सातवी पंचवार्षिक योजना में इस परियोजना को दो स्वतंत्र परियोजनावों – एक काजू व दूसरी मसाले में विभाजित किया गया । अखिल भारतीय समन्वित काजू अनुसंधान परियोजना का मुख्यालय नव निर्मित राष्ट्रीय काजू अनुसंधान केंद्र, पुत्तूर में 1986 को स्थानांतरित किया गया । सन् 2009 में राष्ट्रीय काजू अनुसंधान केंद्र को काजू अनुसंधान निदेशालय का स्तर देकर उन्नयन किया गया ।

अखिल भारतीय समन्दित काजू अनुसंधान परियोजना के चौदह केंद्र है, जिसमें चार केंद्र 1971 में अखिल भारतीय समन्वित मसाले व काजू अनुसंधान परियोजना के शुरुवात में बापट्ला (ए.एन.जी.आर.ए.यू पहले ए.पी.ए.यू) माड़कत्तरा (केरल कृषि विश्वविद्यालय, आनक्कायम् से स्थानांतरित), वेंगुर्ले (डॉ. बाळा साहेब कोंकण कृषि विद्यापीठ) और वृद्धाचलम (तमिलनाडु कृषि विश्वविद्यालय) में प्रारंभ किया गया । पाँचवीं पंचवार्षिक योजना में एक केंद्र, भुवनेश्वर (औ.यू.ए.टी.) और छटवी पंचवार्षिक योजना में दो केंद्र, एक झारग्राम (बी.सी.के.वि.) और दूसरा होगळगेरे (यू.एच.एस.) को सम्मिलित किया गया । आठवीं योजना में एक केंद्र – जगदलपुर (आई.जी.ए.यू) और एक उपकेंद्र पिलिकोड (के.ए.यू.) प्रारंभ किया गया । 9 प्लान का इस साल में दो केंद्र शुरू किया गया जिसमें एक केंद्र पारिया (एन.ए.यू.) में और एक केंद्र दारीसाई (बी.ए.यू.) में और तीन केंद्रों – अरभावि (यू.एच.एस.), बरापानी और गोवा (बा.कृ.अनु.प.) में कार्यप्रवृत हुए ।

परियोजना का 2012–13 में बजट आबंटन रु.333.34 लाख (रु.250.00 लाख भा.कृ.अ.प. का अंश) था और व्यय रु.297.96 लाख (रु.223.32 लाख भा.कृ.अ.प. का अंश) था ।

निम्नलिखित विधियों से काजू की उत्पाद और उत्पादन क्षमता बढाना इस परियोजना के लक्ष्य है :

1. निर्यात स्तर की गुठली, रोग एवं कीट सहन / निरोधी के अधिक उपज देनेवाली प्रजातियों का विकास ।
2. विभिन्न कृषि–मौसमी परिस्थितियों में काजू फसल के लिए कृषि प्रौद्योगिकी का मानकीकरण ।
3. लागत प्रभावी, दक्ष पीडक एवं रोग प्रबंधन विधियों का विकास ।

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

फसल सुधार

झारग्राम केंद्र में सबसे कम पौध ऊँचाई (3.4 मी.) JMG–312 में देखी गई । छ: तुड़ाई का अधिकतम संचयी उपज (22.65 कि.ग्रां.) पत्तनूर में दर्ज की गई । पिलीकोड केंन्द्र में अधिकतम पुष्पगुच्छ शाँखाए (27.75 प्रति वर्ग मीटर) PLD – 62 में दाखिल हुए, जबकी वेंर्गुला में RFRS –181 (17.33 प्रति वर्ग मीटर) में पायी गई । वृध्दाचलम केंन्द्र में एक्सशन VSK–2 में सघन छत्रक एवं उत्तर पश्चिमी छत्रक फैलाव 3.0 मी. पाया गया ।

प्रजाति मूल्यांकन परीक्षण

बहुस्थानीय परीक्षण - II

झारग्राम में सबसे कम छत्रक फैलाव (40.75 मी^{2}) M –15/4 में पाया गया । माड़कत्तरा में अधिकतम गुठली वजन (9.48 ग्राम) किस्म T–3/28 में पाया गया । इसके बाद किस्म M - 44/3 में 9.08 ग्रां. पायी गई । 16 वर्षों की अधिकतम संचयी उपज (79.10 किलो प्रति पौधा) किस्म H–303 में पायी गई, इसके बाद किस्म H–320 में 70.45 कि./पौधा पायी गई । वेंर्गुला केन्द्र पर अधिकतम औसत

गुठली वजन 10.77 ग्रां और सेब वजन 104.3 ग्रां. किस्म – 367 में पाया गया ।

बहु स्थानीय परीक्षण - III

इस परिक्षण में काजू किस्म H –11 में कुल शाखाएँ और पुष्पित शाखाओं की संख्या (क्रमश: 21.4 और 19.4 प्रति वर्ग मीटर) अधिकतम पायी गई थी । मड़कत्तरा केंन्द्र में 7 वर्षों की संचयी उपज (25.78 कि./पौधा) H–1593 में दर्ज की गई । वेंर्गुला में अधिकतम औसत गुठली संख्या प्रति गुच्छ (15.40) H–675 में जबकी अधिकतम औसत गुठली वजन (9.27 ग्रां.) वेंर्गुला–7 किस्म में दर्ज किया गया ।

विमोचित किस्मों का प्रदर्शन के अंतर्गत बहुस्थानीय परीक्षण–5 में भुवनेश्वर में अधिकतम तना परिधि (46.58 से. मी,) किस्म BPP–8 में दाखिल हुआ, जिसे चिंतामणी–1 (45.83 से. मी.) अनुसरित पायी गई । झारग्राम केंन्द्र में अधिकतम पुष्प गुच्छ संख्या (20.1/वर्ग मीटर) जिसे माड़कत्तरा–1 (16.9) और एन.आर.सी.सी. सलेक्सन–2 (16.6) अनुसरित पाई गई। माड़कत्तरा में अधिकतम उपज (3.02 किलो प्रति पेड़) उळ्ळाल–4 में था जिसे भास्करा 11/6 (2.96) अनुसरित करती पायी गई ।

संकरण एवं चयन प्रयोगो में बापटला केंन्द्र में, वर्ष 1998 में रोपित संकरण किस्मो में अधिकतम तना परिधि संकर H–36 में (153.0 से.मी,), तथा H–186 में (117.0 से.मी.) और H–230 में (100.0 से.मी.) दर्ज की गई । माड़कत्तरा में 15 वर्षों की अधिकतम संचयी उपज H–73 (80.70 किलो / पेड़) जिसे H–70 (69.95) किलो /पेड़) अनुसरित पायी गई । पिलीकोड में संकरण संयोजन MDK-1 x PLD 57 से उत्पन्न संकर माता पिता की तुलना में अधिक लंभ्बा पाया गया । वेंर्गुला में अधिकतम पुष्पगुच्छ संख्या (33.0 /मी^{2}) संकर संख्या 777 (M–44/3 x BT 22) में, जबकी अधिकतम गुठली संख्या प्रति गुच्छ (14.0) संकर H–3157(H 445x BT–10 में पाया गया । वृधाचलम में बौना संकर HC–6 विकसित किया गया, और HC–17 गुच्छ फलन गुण और सघन एवं गहन शाखाओं वाला संकर उत्पन्न किया गया ।

फसल प्रबंधन

रसायनिक उर्वरको का प्रयोग के तहद बापट्ला में रसायनिक उर्वरको यानि नाईट्रोजन (100 ग्रां.), फास्फोरस (125 ग्रां.) एवं पोटेशियम (125 ग्रां.) डालने से अधिकतम संचयी उपज (93.0 किलो / पौधा) दर्ज की गई । वेंर्गुला में सघन पौध रोपण S1 (10 मी. x 5 मी.) अंतर पर रोपित पौधो की वानस्पतिक वृद्धी अन्य अंतरों पर रोपित पौधो जैसे S2 (6 x 4 मी.) और 5 x 4 मी. की तुलनात्मक रुप से बेहतर पायी गई । अधिकतम संचयी उपज (15.47 कि. ग्रां. / पेड़)10 x 5 मीटर अंतर और रसायनिक उर्वरक मात्रा, नाइट्रोजन, फास्फोरस, पोटेशियम (225:75:75 कि. ग्रां./ हेक्टयर) में पायी गई । झारग्राम केंन्द्र में अधिकतम शाखा संख्या रसायनिक उर्वरक नाईट्रोजन (500 कि. ग्रां.) फास्फोरस (125 कि. ग्रां.) और पोटेशियम (125 कि. ग्रां.) प्रति हेकटर में डालने से देखी गई ।

सघन पौध रोपण में उर्वरक का प्रयोगों में भुवनेश्वर में अधिकतम भूमि आच्छादित क्षेत्र (128.92%) पौध रोपण अंतर (6 x 4 मी.) यानि 400 पेड़ प्रति हेक्टयर में दर्ज किया गया एवं पिलीकोड़ में सघन पौध रोपण अंतर (5 x 4 मी.) यानि 600 पेड़ प्रति हेक्टयर में अधिकतम पौध वृद्धि (4.08 मी.) स्तंब परिधि (0.61 मी.) एवं भूमि आच्छाद्रित क्षेत्र (26.93 मी^{3}) पाया गया । अधिकतम फलन (9.46 मी^{2}) रसायनिक उर्वरक मात्रा नाइट्रोजन (225 कि. ग्रां.), फास्फोरस (75 कि. ग्रां.) एवं पोटेशियम (75 कि. ग्रां.), 200 पेड़ प्रति हेक्टयर डालने से दर्ज किया गया ।

वेंर्गुला केंन्द्र में बूँद – बूँद सिंचाई परीक्षण में अधिकतम फसल (89.87 फल प्रति वर्ग मीटर) 60 प्रतिशत CPE सिंचाई में पाया गया जबकि, औसत गुठली प्रति गुच्छ (16.65) 80 प्रतिशत CPE सिंचाई देने से प्राप्त हुई । वृद्धाचलम में 80 प्रतिशत CPE सिंचाई देने से जल्दी पुष्पण देखा गया ।

सघन पौधरोपण

इस अवलोकन परीक्षण के अंतर्गत बापट्ला में पौध रोपण अंतर (4 x 4 मी.) में अधिकतम पौध वृद्धि एवं छत्रक

फैलाव पाया गया । जबकि झारग्राम में अधिकतम पौध वृद्धि (3.14 मी.) छत्रक फैलाव (3.13 मी.) और छत्रक क्षेत्रफल (17.17 मी^{2}) पौध रोपण (4 x 4 मी.) की अंतर में दर्ज किया गया । बल्कि सामान्य पौध रोपण उपज (1070 कि.) की तुलना में सघन पौध रोपित परीक्षण उपज (3250 किलो) अधिकतम माड़कत्तरा में पायी गई, जो सार्थकरूप 3.03 गुना अधिक रहा ।

काजू में अन्तरफसल प्रयोगों में बापटला में गेंदा फूल की अन्तरफसल में अधिकतम उपज (5435 कि.ग्रां.) दर्ज की गई जबकि झारग्राम में अधिकतम लागत अनुपात लाभ (1.79) अन्तरफसल लौकी में पाया गया, जिसे अन्तरफसल लोबिया (1.75) अनुसरित पाई गई ।परिया में अलग - अलग उपचार से पौध विकास पर कोई प्रभाव नहीं पड़ा । वेंर्गुला में पाँच कंदीय फसलो का अन्तर सस्य मूल्यांकन किया गया, जिसमें बड़ा रतालू की अधिकतम उपज (22.5 किलो / प्लाट) एवं (2.97 टन/हेक्टयर) दर्ज की गई।

भुवनेश्वर में किये गये काजू में जैविक प्रबंधन प्रयोगों में रसायनिक उर्वरकों की शिफारित मात्रा के प्रयोग साथ 10 किलो गोबर की खाद (नियंत्रण) डालने से छत्रक आच्छादित क्षेत्र (77.01%) एवं पार्श्व शाखाएँ (18.75 प्रति वर्ग मी), हरी खाद एवं 100 प्रतिशत नाइट्रोजन डालने पर दर्ज की गई। अन्य केंन्द्र जैसे झारग्राम, माड़कत्तरा एवं वेंर्गुला में पौध वृद्धि पर जैविक प्रबंधनो का कोई प्रभाव नहीं दाखिल हुआ ।

पौध संरक्षण

चायमच्छर एवं अन्य कीटो के लिए कीटनाशकों का मूल्यांकन प्रयोगों में बापटला में L-सैहालोथ्रीन (0.003%) कि छिडकाव से चाय मच्छर का हानि स्कोर 0.11 रहा जबकी अनुपचरित फ्लाटों में हानि स्कोर 0.47 पाया गया। जगदलपुर में L-सैहालोथ्रीन के प्रयोग से TMB हानि सबसे कम रहा (0.02) जो इमिडाक्लोरोपीड़, प्रोफेनाफास और एसिटामाप्रीड़ कीटनाशी समान रुप से प्रभावी पाई गई । परिया में L-सैहालोथ्रीन के छिड़काव से अन्य गौण कीट, जैसे पत्ती सूरंग कीट का हानि प्रभाव (16.34), प्ररोह इल्ली (13.17) और पत्ता एवं पुष्नगुच्छ जालकीट (15.70) पाया गया ।

काजू तना एवं जड़ रंध्रक कीट नियंत्रण प्रयोगों में बापट्ला में क्लोरापाइरीफास (0.2%) के उपचार से कीटो का दुबारा क्षति प्रमाण 86.30 प्रतिशत नियंत्रण किया जा सका। जबकि भुवनेश्वर में क्लोरापाइरीफास और मानोक्राटोफास के छिड़काव से कीट नियंत्रण (92% से 83%) के साथ न्यूनतम लागत (60 से रु.63 / पेड़ / वर्ष) दर्ज किया गया है । जगदलपुर में क्लोरापाइरीफास (0.2%) के उपचार से 72.22 प्रतिशत तक कीटो का नियंत्रण किया जा सका। जितने भी कीटनाशियो का मूल्यांकन किया है उनमें से क्लोरापाइरीफास (0.2%) से कीटो का 90 प्रतिशत तक नियंत्रण किया जा सका । कीटो का दुबारा हानि प्रमाण, अनुपचरित नियंत्रण में 70% तक और उपचारित नियंत्रण में 75% तक माड़कत्तरा में दर्ज किया गया ।

कीट हानि में जैविक एवं अजैविक कारको का प्रभाव की प्रयोगो में भुवनेश्वर में पत्ती एवं पुष्प थ्रिप्स की संख्या का न्यूतम तापमान एवं सापेक्ष आर्द्रता के साथ नकारात्मक समन्ध पाया गया । पत्ता भुंग का सहसंबन्ध वर्षा एवं आर्द्रता के साथ सकारात्मक पाया गया और इस कीट का हानी सितंबर महीने में अधिक रहा । जगदलपुर में पत्ता इल्ली अधिक तापमान के साथ नकारात्मक संबन्ध दिखाया । परिया में चायमच्छर का हानि अधिक तापमान के साथ नकारात्मक रहा । सेब और गुठली छेदक ने अधिकतम तापमान एवं प्रात:काल सापेक्ष आर्द्रता के साथ धनात्मक संबंध दिखाया, जबकी वेंर्गुला में थ्रिप्स का अधिक तापमान के साथ धनात्मक संबंध पाया गया । वृध्दाचलम में एफिड्स का संख्या अधिकतम तापमान एवं सापेक्ष आर्द्रता के साथ धनात्मक संबंध रहा ।

प्रमुख कीटो के प्रति सहनशील एवं प्रतिरोधक जननद्रव्य का चुनाव के अंतर्गत जगदलपुर केंन्द्र में प्रविष्टियो एन आर सी-138 और एन आर सी-192 में चाय मच्छर हानि नहीं पाया गया ।जननद्रव्य मन्नार एवं कोटूकाल में वर्ष 2011-12 के दौरान चाय मच्छर की उपस्थिति एवं हानि नहीं पाया गया । क्षति स्कोर वर्ष 2012-13 में (0.039) दर्ज किया गया था वेंर्गुला में सबसे कम थ्रिप्स हानि स्कोर किस्म - H -320 में (0.105) दर्ज किया गया ।

PROJECT CO-ORDINATOR'S REPORT

The All India Coordinated Spices and Cashewnut Improvement Project (AICS & CIP) was started during the IV Five Year Plan in 1971 with its headquarters located at the Central Plantation Crops Research Institute, Kasaragod. During the VII Plan, the ongoing project (AICS & CIP) was bifurcated into two separate projects, one on Cashew and another on Spices. The headquarters of the independent All India Coordinated Research Project (AICRP) on Cashew was shifted to the newly established National Research Centre for Cashew (NRCC), Puttur in 1986. The NRCC was upgraded to Directorate of Cashew Research, Puttur in 2009.

The AICRP on Cashew has presently fourteen centres, of which four centres were started at the inception of AICS & CIP in the year 1971 [Bapatla (ANGRAU the then APAU); Madakkathara (KAU, shifted from Anakkayam); Vengurla (BSKKV the then KKV) and Vridhachalam (TNAU)]. During the V Plan, one centre at Bhubaneswar (OUAT) and in the VI Plan, two centres, one at Jhargram (BCKVV) and another at Chintamani (UAS) were added. During VIII Plan, one centre at Jagdalpur (IGAU) and a sub centre at Pilicode (KAU) were also started. During the XI Plan, two centres started functioning, one at Paria (NAU) and the other at Darisai (BAU) along with three cooperating centres at Arabhavi (UHS), Barapani and Goa under ICAR Institutes. These centres of AICRP on Cashew are located in 12 cashew-growing states of the country and are under the administrative control of different State Agricultural Universities.

The original budget allocation of the project for the year 2012-13 was Rs. 333.34 lakhs (Rs. 250.01 lakhs - ICAR Share) and the expenditure was Rs. 297.76 lakhs (Rs. 223.32 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 have been presented hereunder.

CROP IMPROVEMENT

The total number of accessions conserved so far in the Regional Cashew Field Gene Banks (RCFGBs) is 1124. In the project on germplasm collection, conservation, evaluation, characterization and cataloguing, the shortest plant height was noticed in JGM – 312 (3.4m) at Jhargram. The highest number of flowering laterals per square meter (27.75) was observed in PLD-62, at Pilicode while it was highest in case of RFRS-181 (17.33/ m^2) at Vengurla. The accession VSK 2 had a compact canopy with N-S spread of 3.0 m at Vridhachalam. Minimum canopy area under multi-location trials was observed in M - 15/4 (40.75 m^2) at Jhargram. The highest cumulative yield for 16 years was recorded by H 303 (79.10 Kg/tree) followed by H 320 (70.45 Kg/tree) at Madakkathara. The mean apple weight (104.3 g) was found to be significantly maximum in H-367 at Vengurla. The mean no. of nuts per panicle was maximum (15.40) in case of H-675 and maximum mean nut weight (9.27g) was recorded in case of V-7 at Vengurla.

The trials on performance of released varieties at Bhubhaneswar indicated maximum trunk girth in BPP-8 (46.58cm) followed by Chintamani-1 (45.83m). At Jhargram, BPP- 8 produced the maximum number of flowering laterals per square meter (20.1) followed by Madakkathara-1 (16.9) and NRCC Sel-2 (16.6).

Among the hybrids planted during 1998, the maximum trunk girth was recorded in H-36 (153.0cm), H-186 (117.0cm) and in H-230 (100.0cm) at Bapatla. The highest cumulative yield/tree for 15

years was recorded in H-73 (80.70 Kg/tree) at Madakkathara. At Pilicode, the F1 hybrids from MDK1 x PLD-57 were found to be taller than both the parents. At Vengurla, H-777 (M-44/3 x B.T.22) recorded highest panicles/m^2 (33.0) while, maximum mean no. of nuts/panicle (14.0) was observed in H-3157 (H-445 x B.T.10). The hybrid HC 6 was identified to be a dwarf at Vridhachalam.

CROP MANAGEMENT

The fertilizer dose of 1000: 125 :125g NPK/ tree recorded significantly highest cumulative nut yield of 93.0 Kg/tree at Bapatla. The maximum cumulative yield was highest (15.47 Kg/tree) in 10 x 5m spacing with 225 : 75 : 75 Kg NPK/ha. At Jhargram, the maximum flowering was noticed under 500 : 125: 1125 Kg NPK of fertilizer.

At Bhubaneswar, the maximum ground area coverage (128.92%) was recorded 6m x 4m i.e. 400 plants/ha. Closer spacing of 600 plants / ha (5m x 4 m) resulted in higher plant height (4.08m), at Pilicode. At Vengurla, the mean number of nuts per panicle was maximum (16.65) and at Vridhachalam, flowering was early in trees receiving irrigation at 80% CPE. The per hectare yield (3250 Kg) was significantly higher (3.03 times) under high density planting (5 m x 4 m) as compared to normal density (10 m x 5 m) (1070 Kg) at Madakkathara.

Under cashew based cropping systems, marigold has recorded maximum yield of 5435 Kg/ ha at Bapatla. At Jhargram, the maximum benefit cost ratio was obtained with bottle gourd (1.79) followed by cowpea (1.75).

CROP PROTECTION

The least damage score of TMB (0.11) was observed in L-cyhalothrin (0.003%) at Bapatla while at Jagdalpur, TMB mean damage score was minimum (0.02) in trials on chemical control of pest complex in cashew. The lowest percent infestation of Leaf miner, shoot tip caterpillar and leaf and blossom webber (16.34, 13.17 and 15.70 respectively) were recorded in L-cyhalothrin (0.003%) at Paria.

Chlorpyriphos 0.2% offered protection to 86.30 per cent of treated trees without re-infestation or persistent attack at Bapatla. At Bhubaneswar, chlorpyriphos (0.2%) led to maximum recovery (92.0%) with minimum cost of treatment (Rs. 60 to 63 /tree/year respectively). Chlorpyriphos (0.2%) was also found effective leading to recovery of 90% of trees without re- infestation at Madakkathara and 72.22 per cent trees without re-infestation at Jagdalpur.

At Jagdalpur, the TMB damage was not observed in entries NRC-138 and NRC-192. The accessions Mannar and Kottukkal had least TMB damage score of 0.039 during 2012-13 but were free from TMB during the previous year.

TRANSFER OF TECHNOLOGY

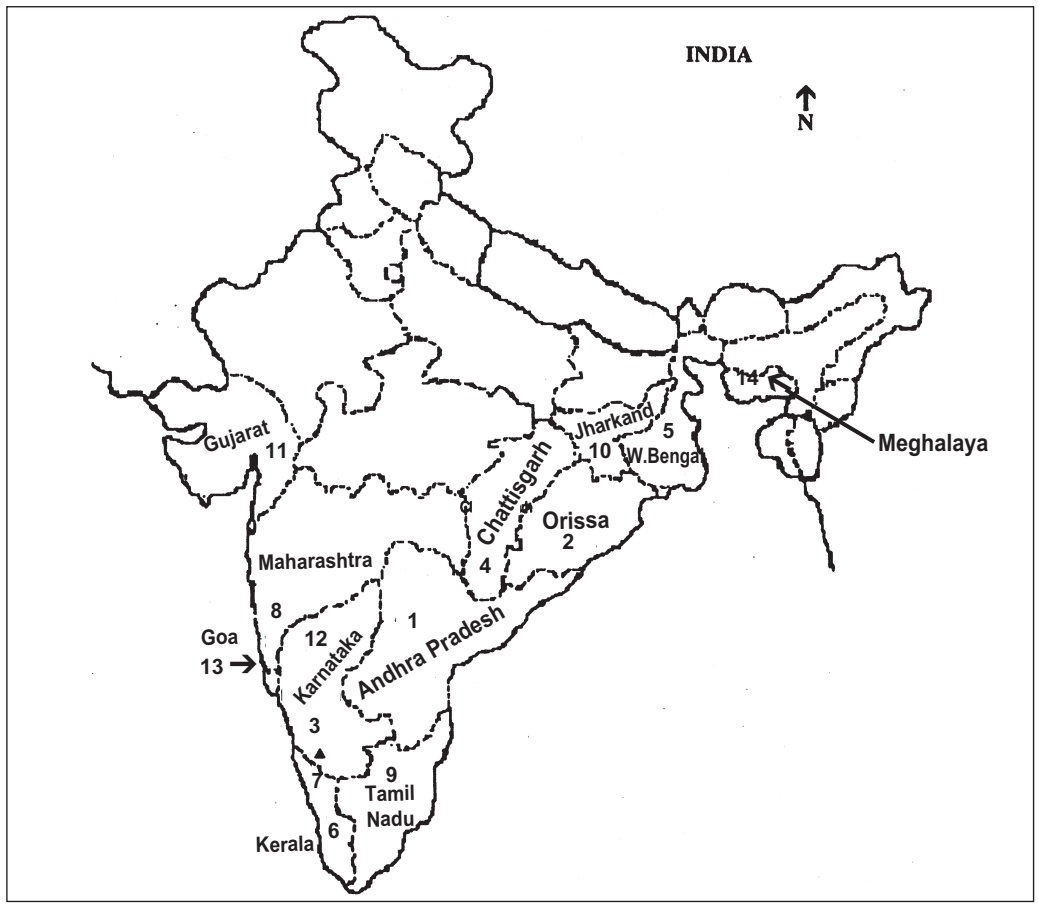
A total of 4,75,625 grafts were produced during the current year and distributed to several government and non-government organizations as well as to cashew growers.

The scientists of Bhubaneswar centre participated in the joint verification programme for evaluation of replanting by Orissa State Cashew Development Corporation and Orissa Forest Development Corporation.

The scientist of the Centre functioned as resource person in the farmers training programme on cashew cultivation technology organized by State Agricultural Department, Nari Vikas Sangha in Bankura District and Gramin Vikas Trust, KRIBHCO and Dept. of Botany, Vidyasagar University, Medinipur. The sale and display of cashew apple products produced by Madakkathara Centre received public attention during 2nd International Horti Expo, Kannur, Kerala Agri Food Pro meet, Kallor, Kochi.

The scientists of Vengurla Centre conducted demonstrations on management of cashew stem and root borer and cashew apple utilization in various villages of Dodamarg and Sawantwadi. More than 20 front line demonstration alongwith 5 Khedut Shibir were done by scientists of Paria Centre in Dharampur and Kaprada taluks. Field demonstrations on rejuvenation of old orchards has been conducted by the Barapani Centre.

DETAILS OF CENTRES OF AICRP ON CASHEW



HEADQUARTERS OF AICRP ON CASHEW

- 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, Orissa.
3. Horticultural Research Station, (UHS), Hogalagere-563 125, Kolar District, Karnataka.
4. SG College of Agricultural and Research Station, (IGAU), Jagdalpur-494 005, Chattisgarh.
5. Regional Research Station, (BCKV), Jhargram-721 507, Midnapore West District, West Bengal.
6. Cashew Research Station, (KAU), Madakkathara-680 651, Kerala.
7. Regional Agricultural Research Station, (KAU), Pilicode-671 353, Kasaragod District, Kerala.
8. Regional Fruit Research Station, (Dr. BSKKV), Vengurla-416 516, Maharashtra.
9. Regional Research Station, (TNAU), Vridhachalam-606 001, Cuddalore District, Tamil Nadu.
10. Zonal Research Station, (BAU), Darisai, East Singhbhum Dist., Jharkhand.
11. Agricultural Experimental Station (NAU), Paria-396 145, Valsad District, Gujarat.

Cooperating Centres

12. Kittur Rani Chennamma College of Horticulture (UHS), Arabhavi-591 310, Gokak Taluk, Belgaum district, Karnataka.
13. ICAR Research Complex for Goa, Ela, Old Goa, Goa-403 402.
14. ICAR Research Complex for North Eastern Hilly Regions, Tura-794 005, West Garo Hills Meghalaya.

The eleven coordinating centres and three co-operating centres are located in the East Coast, West Coast and Plains Region (plateau region) of the country.

The centres of the East Coast are located at Bapatla, Bhubaneshwar, Jhargram and Vridhachalam. This zone receives low to medium rainfall ranging from 800 mm to 2000 mm annually and is distributed over a period of 7-8 months from June to January. The soil is mainly sandy, red sandy loam, red loam and laterite. Bapatla centre is situated at an elevation of 54.9 m from mean sea level (MSL) with 40°54' latitude and 80°28' longitude. At Bapatla the annual average rainfall is 1167 mm and the temperature ranges from 17.3 to 37.8°C; the soil is sandy soil with low organic matter, medium N, low P_2O_5 and K_2O. Average water holding capacity (AWC) of soil is 100 mm and the climate is sub humid (dry).

At Bhubaneshwar average rainfall is 1550 mm and the temperature ranges from 14.3 to 37.1° C. The soil is red soil, red loamy and laterite. The climate is sub humid (dry), AWC 100 mm. The Jhargram centre is located 87° longitude and 78.8° latitude.

At Jhargram average rainfall is 1622 mm and the temperature ranges from 11.3 to 39.4°C. The soil is red, laterite, shallow depth gravels, low in organic matter, N and high in P_2O_5 and K_2O. The climate is sub humid (dry), AWC 200 mm.

At Vridhachalam average rainfall is 1215 mm and the temperature ranges from 18.7 to 35.7°C, the soil is red laterite, low in organic matter and N, medium in P_2O_5 and high in K_2O. The climate is semi arid (dry), AWC 125 mm.

The centres in the West Coast are located at Madakkathara, Pilicode, Vengurla and Navasari and a cooperating centre at Goa. This zone receives rainfall ranging from 2800 mm to 3800 mm annually and is distributed over a period of 7-9 months from April/June to December. The soil is typically sandy, sandy loam, sandy clay loam and laterite (oxisol).

Madakkathara receives an average rainfall of 3550 mm and the temperature ranges from 22.0 to 36.2°C, the soil is laterite (oxisol), medium in N, low in P and medium in K contents. The climate is per humid and AWC is 150 mm.

At Vengurla average rainfall is 2916 mm and the temperature ranges from 17.4 to 32.9°C. Centre is situated at an elevation of 90m above MSL; the soil is sandy loam to sandy clay loam with high organic matter, N, K and low in P. The climate is humid and AWC is 150 mm.

Paria centre is characterized by heavy black soils and receives an average annual rainfall of 2200mm and temperature ranged from 18.5°C to 33.0°C with a mean RH of 70.22 percent.

Maidan tract characterized by even land has Chintamani, Darisai, Jagdalpur centres and Co-operating centre at Arabhavi in this region. Hogalagere comes under Region III (Southern dry region), Eastern dry zone (zone V) of Karnataka and receives average rainfall of 789mm 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 and gravelly, deficient in N, medium in P_2O_5 and high in K_2O. The climate is semi arid (dry), AWC is 150mm.

Darisai Centre has well drained loamy soil and receives about 1200 mm of rain during June to October.

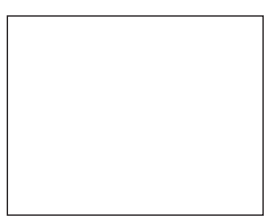
Jagdalpur is located at 17°45' to 20°34' N and 80°15' to 82°15' E longitude with altitude ranging from 550 m to 850 m above MSL with average annual rainfall ranging from 1200-1400mm. The maximum and minimum temperatures are 41°C and 6°C, respectively. Texturally soils are sandy loam to silty loam, with 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.

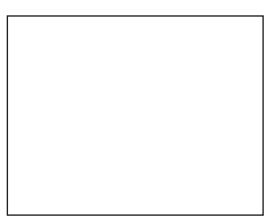
The centre in Barapani / Tura in Meghalaya region is characterized by hilly terran and has deep black loamy soils. The average rainfall ranges between 2500 – 4000mm spread out durind the months of June to November.

The 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.

EXPERIMENTAL RESULTS



I. CROP IMPROVEMENT



I. CROP IMPROVEMENT

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

Centres: East Coast

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast

Madakkathara, Pilicode and Vengurla

Plains / others

Chintamani and Jagdalpur

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, early flowering, off season flowering types etc., from different cashew growing regions and,

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

SUMMARY:

The shortest plant height was recorded in JGM – 312 (3.4m) at Jhargram. The maximum cumulative yield was recorded by Pathanoor (22.65 Kg/tree) for 6 harvests. At Pilicode, the highest number of flowering branches per square meter (27.75) was observed in PLD 62 while it was highest in RFRS-181 (17.33/m^2) at Vengurla. The accession VSK 2 had a compact canopy with N-S spread of 3.0 m at Vridhachalam.

Germplasm Collection:

During the current year, 10 germplasm accessions have been collected by different centres of AICRP on Cashew and have been planted in the respective Regional Cashew Field Gene Banks (RCFGBs). The total number of accessions conserved so far is 1124. (Table. 1.1)

Table 1.1 : Cashew germplasm holding in different centres

Centre	Earlier existing	No. of accessions collected during 2012-13	Total germplasm
East Coast			
Bapatla	132	—	132
Bhubaneshwar	101	1	102
Jhargram	121	5	126
Vridhachalam	208	—	208
West Coast			
Madakkathara	134	4	138
Pilicode	43	—	43
Vengurla	305	—	305
Plains tract/others			
Hogalagere	—	—	—
Jagdalpur	69	1	70
Total	**1113**	**11**	**1124**

Germplasm evaluation :

The details of growth and yield parameters of cashew germplasm conserved at different centres of AICRP-Cashew have been evaluated during 2012-13.

BHUBANESWAR

Till date, 102 nos. of germplasm have been collected, clonally multiplied and maintained in the Gene Bank. The growth and yield parameters are being evaluated.

JHARGRAM

The centre has 24 primary germplasm collections and 77 secondary germplasm collections. Apart from these, 126 F1 hybrids and 59 varieties are also maintained at this RCFGB. The performance of promising secondary germplasm collections maintained in the Regional Cashew Field Gene Bank from 2004 onwards is mentioned in Table 1.2.

Table 1.2 : Growth performance of promising secondary germplasm accessions at Jhargram

Accession No.	Plant Height (m)	Trunk Girth (cm)	Canopy Spread (m)	Canopy height (m)	Canopy area (m^2)	Flowering/m^2
Planted in 2004						
JGM -216	5.4	65.5	7.5	4.5	69.37	16.7
Planted in 2005						
JGM- 221	5.5	75.0	5.7	3.6	41.65	19.9
JGM- 230	4.3	62.5	4.7	2.9	27.95	16.9
JGM- 231	5.7	71.5	6.2	3.6	46.71	16.0
Planted in 2006						
JGM- 282	4.4	52.5	6.0	3.4	42.46	17.4
JGM- 287	4.9	58.0	5.4	3.7	38.76	16.6
JGM- 293	4.7	64.0	6.3	3.3	44.69	21.9
JGM- 308	4.6	57.0	6.6	3.4	49.31	17.5
JGM- 303	5.0	55.0	5.8	3.7	43.35	17.4
JGM- 298	5.0	52.0	5.9	3.5	42.05	19.0
Planted in 2007						
JGM -321	3.5	42.5	3.8	2.5	18.85	19.8
JGM -323	3.8	47.0	4.7	2.6	26.02	17.4
JGM -325	4.3	58.0	5.6	2.5	33.08	16.1

Plant height was recorded in JGM - 232 (6.3m). The shortest plant height was noticed in JGM – 312 (3.4m). Trunk girth was highest in JGM – 242 (80 cm) and the range of trunk girth was between 80 – 40 cm. Canopy spread ranged between 3.8 -7.5 m. Highest canopy area was in JGM – 216 (69.37 m^2) followed by JGM – 239 (55.78 m^2) and JGM – 290 (55.65 m^2). Minimum canopy area was with JGM – 321 (18.85 m^2). The germplasm accessions were on par with respect to plant height, trunk girth, trunk height, canopy spread and flowering /m^2, however, significant variations were recorded with respect to canopy area. Maximum canopy area was recorded in JGM – 147 (14.48 m^2) and minimum was in JGM – 151 (9.22 m^2) (Table 1.3).

Table 1.3 : Growth and flowering parameters of promising cashew primary clonal germplasm collections at Jhargram (Year of planting : 2004)

Name of selection	Accession No.	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	Trunk height (m)	Canopy area (m^2)	Mean number of flowering laterals /m^2
N –1	JGM – 147	3.2	73.0	3.3	0.97	14.48	13.2
N –2	JGM – 148	3.1	74.7	3.0	0.98	12.11	15.5
N – 3	JGM – 149	3.1	70.7	3.1	1.08	12.59	13.7
R – 1	JGM – 150	2.8	70.7	2.5	0.78	9.43	10.9
G – 34 (7)	JGM – 151	2.6	62.7	2.7	0.92	9.22	12.1
G – 34 (1)	JGM – 152	2.7	71.7	3.0	0.70	11.67	15.7
S Em ±		0.15	5.50	0.33	0.12	1.85	1.63
C.D.at 5%		0.334	12.254	0.735	0.267	4.12	3.632
CV%		6.3	9.6	13.8	16.4	19.6	14.8

MADAKKATHARA

The germplasm accession Kainur recorded maximum height (7.80 m) and highest canopy spread - EW (10.00 m) and NS (10.00 m). Accession Mannur recorded maximum girth (91.67 cm) followed by Kainur (90.00 cm). Highest annual yield was recorded by Pathanoor (3.55 Kg/tree) followed by Kunjithai (3.35 Kg/tree) during the current season. In respect of cumulative yield, the maximum yield was recorded by Pathanoor (22.65 Kg/tree) followed by Kunjithai (20.90 Kg/tree) for 6 harvests (Table 1.4).

Table 1.4 : Growth and yield characters of different accessions planted during 2002-2003 at Madakkathara

Variety	Height (m)	Girth (cm)	Canopy spread EW (m)	Canopy spread NS (m)	Nut wt. (g)	Annual yield (Kg/tree)	Cum. Yield Kg/tree (6 harvests)
KTR-1	5.01	73.00	5.00	5.33	7.10	2.56	15.69
KTR-3	5.91	76.25	7.02	7.02	7.42	2.12	12.51
Kiralur	6.38	82.66	6.75	6.53	8.10	2.60	13.08
Mannur	6.91	91.67	5.70	8.70	7.76	2.56	12.77
Kainur	7.80	90.00	10.00	10.00	7.40	2.00	16.52
Ummanoor	6.26	75.93	7.40	6.06	7.96	2.95	17.36
Kottukkal	5.40	82.00	5.20	5.30	7.40	2.50	10.72
Peechi	5.15	68.00	5.65	5.40	8.70	2.40	11.85
Kunjithai	6.25	65.50	5.45	7.17	7.65	3.35	20.90
Pathanoor	6.05	80.00	5.80	5.75	9.10	3.55	22.65
ARL-1	6.40	73.00	6.67	5.50	6.90	2.30	12.30
KTR-2	6.15	61.00	4.80	3.65	8.25	2.75	12.51
ARL-2	5.90	76.00	6.20	5.80	7.15	2.25	15.45
ODR	5.97	61.50	4.82	5.10	7.67	3.17	17.00

PILICODE

Of the 81 diverse types identified from Northern districts of Kerala 43 types were planted in the germplasm block for evaluation.

The accession, PLD 17 had the maximum plant height (9.37m). Girth was also highest in PLD 19. Both PLD 17 and PLD 20 were statistically on par regarding canopy spread in East West and North South directions. Canopy area was also highest in these two accessions. The dwarf accession PLD 57 showed lowest plant height of 2.28m (Table 1.5).

Highest number of flowering branches per square meter (27.75) was observed in PLD 62. Higher ratio of bisexual flowers to total flowers was observed in PLD 45. PLD 54 recorded highest nut set (4.83/m^2) though statistically on par with PLD 45 (4.25/m^2) and PLD 62 (4.25/m^2) (Table 1.6).

Table 1.5 : Biometric observations of cashew germplasm during 2012-13 (planted during 1998 and 2000) at Pilicode

Accession No./Variety	Plant height (m)	Collar girth (cm)	Canopy Spread (m)		Canopy area (m^2)
			E-W	N-S	
PLD 1	7.775^{abc}	0.791^{b}	7.750^{abc}	7.475^{cd}	94.722^{cd}
PLD 3	8.890^{ab}	0.824^{b}	8.685^{abc}	8.200^{bcd}	116.320^{abc}
PLD 4	7.490^{bc}	0.915^{ab}	7.100^{bc}	6.935^{cd}	84.523^{cd}
PLD 12	8.500^{ab}	1.075^{ab}	7.500^{bc}	7.250^{cd}	98.708^{cd}
PLD 15	6.225^{c}	0.800^{b}	5.935^{c}	5.935^{d}	61.066^{de}
PLD 16	7.800^{abc}	0.815^{b}	6.500^{bc}	6.565^{cd}	78.912^{cd}
PLD 17	9.375^{a}	1.050^{ab}	10.750^{a}	10.050^{ab}	153.876^{a}
PLD 18	8.300^{ab}	0.830^{b}	9.125^{ab}	8.625^{abc}	123.655^{abc}
PLD 19	8.500^{ab}	1.150^{a}	8.000^{abc}	8.000^{bcd}	109.031^{bcd}
PLD 20	8.550^{ab}	0.900^{ab}	9.250^{ab}	10.750^{a}	168.104^{ab}
PLD 57	2.285^{d}	0.421^{c}	2.801^{d}	3.053^{e}	10.775^{e}
Mean	**7.608**	**0.870**	**7.581**	**7.531**	**99.972**
F test	**	*	*	**	**
CD 0.05	**1.773**	**0.318**	**3.104**	**2.503**	**52.022**

*Means superscripted by the same letters do not differ significantly at P=0.05 by Duncan's Multiple Range Test

Table 1.6 : Biometric observations of Cashew germplasm planted during 2003 at Pilicode

Accession No./Variety	Plant height (m)	Collar girth (cm)	Canopy spread (m)	Canopy area (m^2)	No. of Panicle/ sqm	Number of branches not flowered	Bisexual: Total flowers ratio	Seed set/ m^2	Fruit set / m^2
PLD 75	4.100^{e}	0.350^{f}	3.500^{f}	43.428^{e}	2.333^{e}	12.666^{efg}	0.190^{bc}	2.666^{cd}	1.333^{c}
PLD 54	4.066^{e}	0.620^{cd}	6.983^{bc}	113.715^{cd}	7.916^{c}	21.416^{b}	0.154^{de}	4.833^{a}	2.500^{a}
PLD 44	3.500^{f}	0.340^{f}	3.500^{f}	32.658^{e}	2.250^{e}	10.500^{g}	0.229^{b}	1.000^{ef}	1.000^{c}
PLD 64	4.500^{de}	0.320^{f}	3.250^{f}	43.701^{e}	1.333^{e}	15.666^{cdef}	0.091^{fg}	0.000^{f}	1.000^{c}
PLD 62	6.000^{c}	0.770^{ab}	7.500^{b}	150.487^{b}	13.250^{a}	25.750^{a}	0.077^{g}	4.250^{ab}	1.000^{c}
PLD 40	7.750^{a}	0.820^{a}	8.875^{a}	229.905^{a}	7.000^{c}	16.250^{cde}	0.076^{g}	1.750^{cde}	1.500^{bc}
PLD 48	6.500^{b}	0.510^{e}	6.065^{cd}	115.461^{cd}	4.750^{d}	17.500^{d}	0.116^{fg}	2.750^{cd}	1.333^{c}
PLD 67	6.083^{bc}	0.703^{bc}	4.953^{e}	93.688^{d}	4.583^{d}	13.500^{defg}	0.201^{bc}	1.666^{de}	1.000^{c}
PLD 66	6.500^{b}	0.560^{de}	5.750^{de}	114.511^{cd}	4.500^{d}	17.000^{cd}	0.162^{cd}	2.000^{cde}	2.000^{ab}
PLD 45	4.625^{d}	0.560^{de}	6.185^{cd}	98.450^{d}	10.750^{b}	12.250^{fg}	0.340^{a}	4.250^{ab}	2.000^{ab}
PLD 82	6.125^{bc}	0.680^{bc}	6.875^{bc}	135.989^{bc}	7.000^{c}	17.750^{bc}	0.117^{ef}	3.000^{bc}	1.333^{c}
Mean	**5.432**	**0.567**	**5.767**	**106.545**	**5.970**	**16.386**	**0.159**	**2.560**	**1.454**
F test	**	**	**	**	**	**	**	**	**
CD @5%	**0.472**	**0.093**	**1.050**	**26.974**	**1.703**	**3.668**	**0.040**	**1.263**	**0.599**

*Means superscripted by the same letters do not differ significantly at P=0.05 by Duncan's Multiple Range Test

VENGURLA

Out of a total of 306 accessions conserved in RCFGB 170 types have been evaluated and planted in conservation block.

The growth and yield observations of 14 types collected from Thane, Raigad, Kolhapur and Sindhudurg districts are presented in Table 1.7.

Table 1.7 : Mean growth and yield attributing characters of the germplasm collected during 2001-02 at Vengurle

Accession No.	Height (m)	Plant girth (cm)	Canopy spread (m)	Panicle/m²	Fruit set/ m²	Apple wt. (g)	Nut wt (g)	Flowering Duration (days)
RFRS 171	5.65	70.00	6.50	13.50	6.00	50	9.0	108
RFRS 172	6.26	71.00	6.18	13.33	5.83	57	6.7	111
RFRS 173	6.23	69.00	6.11	11.33	7.33	60	5.0	111
RFRS 174	6.93	76.33	6.26	14.00	6.00	42	5.6	97
RFRS 175	7.16	59.60	4.78	16.00	9.00	40	5.5	98
RFRS 176	5.56	63.00	5.89	11.33	9.50	36	4.8	99
RFRS 177	5.90	77.00	6.07	16.00	12.66	50	6.3	109
RFRS 178	7.20	78.00	6.85	15.00	15.00	40	6.4	100
RFRS 179	6.53	53.33	4.49	12.33	11.33	60	9.2	90
RFRS 180	8.36	68.66	5.95	13.33	10.00	30	5.1	115
RFRS 181	6.90	56.00	4.56	17.33	8.00	40	5.8	114
RFRS 182	6.13	54.33	5.18	14.00	10.50	69	3.9	92
RFRS 183	6.70	82.00	9.95	15.00	17.00	62	4.8	102
RFRS 184	4.36	30.00	3.21	10.00	10.50	39	4.2	107

Among the 14 accessions, RFRS-184 recorded the lowest mean height (4.36 m) and mean girth (30.0 cm) the mean no. of laterals was highest in case of RFRS-179 (24.0/m²) and flowering panicles was highest in RFRS-181 (17.33/m²).

Among the 10 types, RFRS 191 recorded the lowest mean height (3.60 m). The mean number of laterals were found to be maximum (20.5/m²) in RFRS 185 while, mean number of flowering panicles were highest in RFRS 193 (16.0/m²) (Table 1.8).

Table 1.8 : Mean growth and yield characters of the germplasm collected during 2003-04 at Vengurle

Accession No.	Plant height (m)	Plant girth (cm)	Spread (m)	Laterals/ m²	Flow. panicles /m²	Fruit set / m²	No. of nuts / panicle	Apple wt. (g)	Nut wt. (g)	Flow. Duration (days)
RFRS 185	6.15	52.0	4.93	20.5	14.5	14.0	1.87	-	6.6	92
RFRS 186	5.6	41.0	4.07	17.0	9.33	11.0	1.41	-	5.7	111
RFRS 187	6.45	55.33	6.0	12.0	6.5	8.5	1.5	-	5.0	107
RFRS 188	5.95	56.0	6.65	13.0	9.0	12.25	1.37	80	6.66	113

Table 1.8 contd...

Accession No.	Plant height (m)	Plant girth (cm)	Spread (m)	Laterals/ m^2	Flow. panicles /m^2	Fruit set / m^2	No. of nuts / panicle	Apple wt. (g)	Nut wt. (g)	Flow. Duration (days)
RFRS 189	5.85	62.0	5.35	15.5	8.0	11.5	2.5	65	8.5	102
RFRS 190	5.35	5.56	6.1	16.5	10.5	11.0	1.25	20	6.2	101
RFRS 191	3.60	40.0	4.10	11.0	7.0	8.0	1.25	20	-	97
RFRS 192	4.80	40.0	4.50	17.0	13.0	12.0	1.75	20	4.3	103
RFRS 193	5.60	39.5	4.25	20.0	16.0	12.0	1.87	-	8.5	98
RFRS 194	5.20	38.5	5.38	13.5	8.5	10.0	1.25	-	-	96

VRIDHACHALAM

A total of 264 germplasm accessions were clonally multiplied and planted in the RCFGB of which 208 are presently surviving.

Cashew accession from Puduvayal, PV 1 recorded early flowering initiated during January. The accession VSK 2 had a compact canopy. Eight new accessions collected from Vridhachalam and from tsunami affected areas which were planted during 2009 are in vegetative phase (Table 1.9).

Table 1.9 : Performance of cashew germplasm accessions planted during 1999 at Vridhachalam

Acc.No.	Plant height (m)	Plant spread (m)	
		E-W	N-S
VSK	13.29	4.44	4.66
VSK	22.73	4.05	3.91
SL 1	3.33	6.29	5.81
TK 1	3.78	4.95	4.66
NK 1	3.24	4.90	4.97
KK 1	3.49	4.67	4.76
PV 1	3.32	6.06	4.81

Gen.3. Varietal Evaluation Trials

1. Multi Location Trial – II

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

The objective of this experiment is to evaluate the growth and yield performance of new high yielding varieties obtained from different centres in different agro climatic localities.

SUMMARY:

Minimum canopy area was observed in M - 15/4 (40.75 m^2) at Jhargram. The highest nut weight was recorded by variety T-3/28 (9.48 g) followed by M 44/3 (9.08 g) and the highest cumulative yield for 16 years was recorded by H 303 (79.10 Kg/tree) followed by H 320 (70.45 Kg/tree) at Madakkathara. The mean nut weight (10.77 g) and mean apple weight (104.3 g) was found to be significantly maximum in H-367 at Vengurla.

Experimental Details:

Design	:	RBD	Replications	:	Three
Bapatla	:	3/28, 3/33, 10/19, 30/1			
Vengurla	:	H 68, H 255, H 303, H 320, H 367			
Vridhachalam	:	M 15/4, M 44/3			
D.C.R., Puttur	:	VTH 107/3, VTH 40/1			
Year of Planting	:	1992 (1993 at Bapatla, 2002 at Jhargram, 1994 at Vridhachalam)			

JHARGRAM

Significant variations were recorded among the thirteen varieties with respect to plant height, trunk girth, canopy spread, canopy area and mean number of flowering /m^2. Maximum plant height was observed in H - 255 (6.1m) followed by T.No. 3/33 and H – 367 (5.6m). Trunk girth, canopy spread, canopy area and flowering laterals/ m^2 were maximum in case of H - 3/33 i.e. 80.7cm 6.8m, 55.40 m^2 and 19.0/m^2 respectively. Minimum canopy area was observed in M - 15/4 (40.75 m^2). Minimum flowering density was recorded in H - 68 (11.8 panicles/m^2) (Table 1.10).

Table 1.10 : Growth parameters of different varieties under MLT – II at Jhargram

Variety	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	Canopy area (m^2)	Mean No. of flowering laterals/ m^2
T.No. 30/1	5.2	51.3	5.5	41.70	18.5
T.No. 3/33	5.6	80.7	6.8	55.40	19.0
T.No. 10/19	5.2	67.7	5.8	44.14	14.9
T.No. 3/28	5.5	74.7	5.9	45.84	12.0
H- 68	4.8	51.7	5.3	35.44	11.8
H- 367	5.6	68.3	5.5	44.75	14.7
H- 303	5.0	60.0	4.8	41.19	12.9
H- 255	6.1	73.0	6.6	54.72	15.0
H- 320	5.1	71.3	5.6	45.82	13.1
M- 44/3	4.3	54.0	5.0	31.68	16.8
M- 15/4	5.1	59.3	6.0	40.75	18.0
NRCC-Sel-1	4.2	48.7	4.6	26.28	16.8
NRCC-Sel-2	5.0	69.3	6.1	43.43	18.6
S.Em ±	0.29	8.24	0.89	6.75	2.93
C.D at 5%	0.59	17.0	1.84	13.9	6.05

MADAKKATHARA

Maximum height was recorded by T107/3 (8.70 m) followed by H-320 (8.55 m). The highest value recorded by T 107/3 (137.71 cm) followed by H-303 (122.52 cm). Variety T 107/3 recorded highest E-W canopy spread (11.15 m) followed by H-255 (9.81 m). Variety T 107/3 recorded highest N-S canopy spread (11.15 m) followed by H-1608 (9.83 m).

The highest apple weight of 95.83 g was observed in T-40/1. The highest nut weight was recorded by variety T3/28 (9.48 g) followed by M 44/3 (9.08 g). The highest nut yield was recorded by M 44/3 (4.60 Kg/ tree/ year) followed by H-255 (3.62 Kg/tree/year). The highest cumulative yield for 16 years was recorded by H-303 (79.10 Kg/tree) followed by H-320 (70.45 Kg/tree) (Table 1.11, 1.12 and 1.13).

Table 1.11 : Vegetative characters of different genotypes under MLT II at Madakkathara

Source	Genotypes evaluated	Height (m)	Girth (cm)	Canopy spread EW (m)	Canopy spread NS (m)	Mean canopy spread (m)
Bapatla	T 30/1	7.87	112.11	8.74	9.14	8.94
	T 3/33	8.40	114.33	8.91	9.35	9.13
	T 10/19	7.93	114.66	9.36	8.70	9.28
	T3/28	8.35	116.41	7.42	8.03	7.72

Table 1.11 contd...

Source	Genotypes evaluated	Height (m)	Girth (cm)	Canopy spread EW (m)	Canopy spread NS (m)	Mean canopy spread (m)
Vengurla	H 68	8.22	114.33	8.90	8.46	8.68
	H 367	7.12	93.00	7.04	7.19	7.11
	H 303	8.34	122.52	8.62	8.99	8.80
	H 255	8.05	117.83	9.81	8.94	9.37
	H 320	8.55	111.44	9.27	8.61	8.94
Vridhachalam	M 44/3	7.50	111.83	7.50	8.42	7.96
	M 15/4	7.52	117.66	6.37	7.45	6.91
DCR, Puttur	T 107/3	8.70	137.71	11.15	11.15	11.15
	T 40/1	7.67	103.50	8.20	7.50	7.85
Check	H-1608 (Dhana)	8.26	115.22	9.01	9.83	9.42

Table 1.12 : Flowering characters of cashew genotypes in MLT II at Madakkathara

Genotypes	Duration of flowering	Flowering intensity/ m^2	No. of fruits/ panicle
T 30/1	148	5.69	4
T 3/33	114	7.16	5
T 10/19	149	6.80	5
T 3/28	147	7.59	4
H 68	118	6.31	5
H 367	119	6.79	5
H 303	117	7.56	4

Genotypes	Duration of flowering	Flowering intensity/ m^2	No. of fruits/ panicle
H 255	118	7.71	6
H 320	117	6.21	6
M 44/3	119	6.81	5
M 15/4	122	7.10	5
T 107/3	121	6.45	4
T 40/1	122	7.38	4
H1608	156	8.25	5

Table 1.13 : Yield and yield attributes of cashew genotypes in MLT II at Madakkathara

Genotypes	Nut Yield (Kg/tree)	Cum. nut yield (16 years) (Kg/tree)	Nut wt. (g)	Apple wt. (g)	Shelling %
T 30/1	3.46	33.76	7.64	47.97	24.20
T 3/33	3.35	31.10	8.13	45.33	22.90
T10/19	3.15	24.77	7.83	49.73	23.67
T 3/28	3.02	42.32	9.48	72.35	24.50
H 68	2.80	32.16	8.70	54.78	26.30
H 367	2.38	35.68	8.72	76.10	24.10

Table 1.13 contd...

Genotypes	Nut yield (Kg/tree)	Cum. nut Yield (16 years) (Kg/tree)	Nut wt (g)	Apple wt. (g)	Shelling %
H 303	2.62	79.10	8.61	68.88	21.30
H 255	3.62	32.00	8.45	60.83	22.40
H 320	3.32	70.45	8.22	69.42	22.87
M 44/3	4.60	43.16	9.08	59.29	23.40
M 15/4	2.96	50.53	8.80	55.41	24.20
T 107/3	2.78	31.89	8.86	75.00	24.30
T 40/1	3.05	39.00	8.21	95.83	24.70
H1608	2.83	59.81	7.53	71.44	23.16

VENGURLA

The hybrids/ varieties did not differ significantly, except for mean nut weight (g) and mean apple weight (g). The maximum height and canopy spread was reported in variety 30/1 (7.38 m and 10.70 m respectively); maximum stem girth was observed in H-10/19 (107.25 cm). The mean nut weight (10.77 g) and mean apple weight (104.3 g) was found to be significantly maximum in H-367. whereas the maximum cumulative yield for last nine harvests (33.22 Kg/tree) was found in H-303, this was followed by H- 30/1 (25.55 Kg/tree) and H-255 (24.85 Kg/tree) (Table 1.14 and 1.15).

Table 1.14 : Growth and yield observations under MLT-II at Vengurle

Variety /type	Mean Height (m)	Mean Girth (cm)	Mean Spread (m)		Mean Spread (m)	Mean Laterals /m²	Mean Flow. panicles /m²	Mean Flow. duration (Days)
			E.W.	N.S.				
Hy .No. 255	6.17	96.86	6.07	8.91	9.19	23.13	12.17	115
Hy. No. 303	5.43	81.75	7.80	7.69	7.74	22.06	11.32	110
Hy. No. 320	6.54	101.14	9.57	8.92	9.21	23.90	12.67	105
Hy.No.367	4.31	77.11	8.41	7.59	8.10	23.33	11.23	119
NRCC Sel.1	6.33	102.33	9.03	8.99	8.99	25.47	11.27	110
NRCC Sel.2	5.80	79.50	8.60	8.84	8.76	21.93	10.33	108
M-44/3	3.22	48.67	4.97	4.85	4.91	16.27	8.03	78
M-15/4	3.57	54.83	5.41	5.29	5.35	25.90	12.33	107
10/19	7.09	107.25	10.01	8.85	9.43	22.50	9.50	108
3/28	4.71	68.28	6.34	6.45	6.39	14.93	7.90	79
3/33	5.44	80.58	8.09	8.37	8.23	23.06	10.17	113
30/1	7.38	106.30	10.61	10.80	10.70	22.06	10.17	114
SEm ±	1.03	16.29	1.62	1.42	1.42	3.67	1.96	16.8
CD at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table 1.15 : Growth and yield observations under MLT-II at Vengurle

Variety /type	Mean Fruit set / m^2	Mean No. of nuts Per panicle	Mean Nut weight (g)	Mean Apple weight (g)	Annual Yield (Kg/tree)	Cum. Yield (Kg/tree)
H-255	32.77	7.07	9.23	73.0	5.92	24.85
H-303	30.83	8.03	7.53	68.6	5.45	33.22
H-320	19.40	3.53	7.50	64.0	5.28	20.20
H-367	27.33	8.87	10.77	104.3	6.30	20.96
NRCC Sel.1	23.73	6.67	7.37	54.7	5.31	20.70
NRCC Sel.2	22.83	3.73	7.17	51.3	3.67	14.36
M-44/3	22.76	5.60	2.93	25.0	1.12	8.88
M-15/4	19.23	5.17	5.77	51.3	2.52	11.15
10/19	24.57	9.60	6.07	25.0	5.11	17.37
3/28	11.52	3.43	4.00	35.0	1.99	10.04
3/33	27.23	7.73	6.10	47.7	3.43	15.86
30/1	32.03	10.36	6.90	58.0	6.38	25.55
SEm ±	7.06	2.09	0.80	6.92	2.17	-
CD at 5%	N.S.	N.S.	2.34	20.29.	N.S.	-

2. Multi Location Trial – III

Centres: East Coast
Bapatla, Bhubaneshwar and Vridhachalam

West Coast
Madakkathara and Vengurla

Plains / others
Chintamani

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

SUMMARY :

The number of total laterals and flowering laterals per square meter were maximum in cashew type H 11 (21.4 & 19.4, respectively). The highest cumulative yield for 7 years was recorded by genotypes H-1593 (25.78 Kg/tree) at Madakkathara.The mean number of nuts per panicle was maximum (15.40) in case of H-675 and maximum mean nut weight of 9.27g was recorded in case of V-7 at Vengurla.

Experimental Details :

The trial has been initiated in 2003. The trial comprises of 10 test varieties and one local check variety.

Sponsoring centre	Promising hybrids	TMB tolerant type
CRS, Bhubaneswar	BH 6, BH 85	—
CRS, Madakkathara	H 1597	K 22-1
RFRS, Vengurla	H 662, H 675	—
RRS, Vridhachalam	—	H 11 & H 14
DCR, Puttur	H 32/4	Goa 11/6
Total	6	4

Replications – Three
Spacing 7.5 x 7.5 m
Plot size - 4 plants per plot

BAPATLA

Among the 11 genotypes evaluated, the highest plant height was recorded in H-32/4 [4.65 m] which was followed by BPP-8 (4.06m). Maximum trunk girth and canopy spread was recorded with BPP-8 variety i.e. 74.96cm, 7.51m [E-W] and 7.34m [N-S] respectively (Table 1.16).

Table 1.16 : Performance of Cashew Varieties/Genotypes in MLT-III at Bapatla

Variety/ Genotype	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	
			E-W	N-S
Goa 11/6	3.19	68.30	6.30	6.70
H.662	2.50	50.50	4.05	4.50
H.32/4	4.65	73.50	6.96	6.51
K.22/1	3.73	70.00	6.16	5.50
H.11	3.48	61.25	5.63	5.76
H.675	3.43	58.66	4.33	4.47
H.14	3.47	59.00	5.57	5.32
BPP-8	4.06	74.96	7.51	7.34
H.1597	3.95	73.25	6.11	7.17
B.H.6	3.49	55.85	5.83	5.95
B.H.85	3.48	60.00	5.76	5.85

BHUBANESWAR

The cashew type H 32/4 recorded maximum plant height (5.23m) and trunk girth (82.5cm) among the eleven entries. The minimum plant height (2.57m) and trunk girth (23cm) were recorded in K 22-1. However, plant height and trunk girth were statistically at par in all entries except K 22-1, H 675, H 622 and H 14. These entries also exhibited significantly lower plant height and trunk girth. Canopy spread in E-W (8.3m) and N-S (8.8m) direction was maximum in the local check (H-2/16) followed by BH 85 (7.8 m E-W & 7.8 m N-S) and BH 6 (7.6 m E-W & 7.7 m N-S).

The total laterals and flowering laterals per sq. meter were maximum in cashew type H 11 (21.4 & 19.4) followed by H 1597 (21.3 & 17.7) and BH 85 (20.21 & 18.5) respectively. There was no significant difference with respect to the number of total laterals and flowering laterals per square meter (Table 1.17).

Table 1.17 : Vegetative and Flowering Characters of MLT- III at Bhubaneswar

Cashew types	Plant height (m)	Trunk girth (cm)	Canopy spread (m)		Total laterals/m^2	Flowering laterals/m^2
			E-W	N-S		
BH 6	4.79	74.5	7.6	7.7	18.8	16.6
BH 85	4.85	75.3	7.8	7.8	20.21	18.5
H 1597	4.98	80.0	7.5	7.4	21.3	17.7
K 22-1	2.57	23.0	3.0	3.0	15.8	12.9
H 662	3.73	38.9	5.0	5.0	16.7	12.3
H 675	2.60	52.4	3.8	4.1	15.2	11.8
H 11	4.70	69.3	7.3	7.5	21.4	19.4
H 14	4.76	56.7	5.8	5.9	16.8	15.2

Table 1.17 contd...

Cashew types	Plant height (m)	Trunk girth (cm)	Canopy spread (m)		Total laterals/m²	Flowering laterals/m²
			E-W	N-S		
H 32/4	5.23	82.5	7.5	7.5	16.3	15.3
Goa 11/6	4.94	72.0	7.6	6.9	18.7	16.9
H 2/16 (Local Check)	5.13	76.9	8.3	8.8	17.6	16.6
SEm ±	0.25	8.23	0.42	0.4	NS	NS
CD 5%	0.73	24.44	1.24	1.19		

MADAKKATHARA

This trial was taken up during 2003 planting season with 11 entries (10 test varieties and one local check)

Sponsoring Centres	Promising Hybrids	TMB tolerant type	Remarks
Cashew Research Station, Bhubaneswar	BH 6, BH 85		
Cashew Research Station, Madakkathara	H-1593	K 22-1	H-1597 has been changed to H-1593
RFRS, Vengurle	H 662, H 675		
RRS, Vridhachalam		H 11 & H 14	
DCR, Puttur	H 32/4	Goa 11/6	
Total	6	4	

Maximum height was recorded in H 32/4 (6.80 m) followed by H-662 (6.56 m). Maximum girth was observed in H-662 (93.08 cm) followed by Dhana (91.58 cm). Maximum canopy spread E-W was shown by the genotype H-11 (8.04m). Maximum canopy spread NS was recorded by genotype Dhana (8.28 m).

H 662 recorded maximum nut yield/ tree (5.89 Kg/tree) followed by variety H 1593 (5.28 Kg/ tree). The highest cumulative yield for 7 years was recorded by genotypes H-1593 (25.78 Kg/tree) followed by H-662 (23.34 Kg/tree) (Table 1.18 and 1.19).

Table 1.18 : Morphological and yield characters of cashew genotypes under MLT-III at Madakkathara

Genotypes	Height (m)	Girth (cm)	Canopy spread – EW (m)	Canopy spread – NS (m)	Duration of flowering	Flowering intensity (m^2)	No. of fruits/ panicle
Dhana	5.50	91.58	8.02	8.28	128	6.02	5
H-11	5.85	83.16	8.04	7.94	123	6.53	4
H-32/4	6.80	77.66	7.38	7.72	130	6.89	4
H-1593	4.94	76.08	7.52	7.51	138	7.03	5
BH-6	5.37	78.91	7.93	7.30	136	5.71	4
H-662	6.56	93.08	7.98	7.43	128	6.38	3
H-675	6.06	85.63	7.47	7.87	132	7.12	2
BH-85	6.11	82.91	7.17	7.38	133	5.70	4
K-22-1	5.29	83.16	7.14	7.59	139	6.83	4
Goa 11/6	6.01	81.41	7.21	7.64	120	6.90	5
H-14	5.46	87.16	7.69	7.73	136	7.97	5

Table 1.19 : Yield characters of cashew genotypes under MLT III at Madakkathara

Genotypes	Apple wt. (g)	Nut wt. (g)	Yield (Kg/tree/ Year)	Cumulative yield (7 years) (Kg/tree)
Dhana	58.84	8.55	4.17	20.85
H-11	66.75	8.18	4.31	19.58
H-32/4	66.56	8.37	4.00	18.40
H-1593	68.33	8.11	5.28	25.78
BH-6	71.94	7.58	4.45	16.62
H-662	50.50	6.33	5.89	23.34
H-675	60.22	8.59	4.41	18.18
BH-85	67.48	7.89	3.08	17.24
H-22-1	64.50	8.78	3.99	17.46
Goa 11/6	74.96	8.73	3.58	21.95
H-14	79.44	8.53	3.60	19.28

VENGURLA

No significant variation was observed while maximum plant height was recorded in V-7 (3.08 m) whereas, the mean stem girth was recorded to be maximum in Goa 11/6 (39.06 cm) and maximum canopy spread was observed in H-675 (5.21 m). Maximum fruit set of 521.97/m^2 was obtained in H-1593. Mean number of nuts per panicle was maximum (15.40) in case of H-675 and maximum mean nut weight of 9.27g was noted in case of V-7 (Table 1.20).

Table 1.20 : Growth observations MLT-III at Vengurla (Replanted in 2008)

Variety /Type	Mean height (m)	Mean girth (cm)	Mean spread (m)		Mean spread (m)	Mean laterals /m²	Mean flow. panicles /m²	Mean fruit set /m²	Mean No. of nuts per panicle	Mean apple weight (g)	Nut wt. (g)
			EW	NS							
Goa - 11/6	3.02	39.06	12.04	3.85	3.93	25.20	17.27	36.63	12.0	57.33	6.83
H-11	2.61	36.77	14.29	4.95	4.86	24.20	15.30	49.50	14.00	66.67	6.00
B.H.6	2.69	33.75	14.72	4.70	4.82	25.87	16.53	45.20	14.03	79.33	7.57
H-14	2.53	29.27	13.26	3.89	4.19	26.70	17.87	48.33	12.40	42.0	6.20
H-1593	2.72	34.63	11.93	4.97	4.23	26.53	19.43	51.97	13.13	75.0	6.83
K-22/1	3.05	34.30	13.19	4.47	4.44	26.30	16.33	43.33	13.53	62.67	5.57
V-7	3.08	38.73	12.05	4.11	4.06	23.77	15.63	36.97	12.67	63.33	9.27
H-662	2.94	34.17	13.19	4.21	4.30	23.63	14.87	36.53	11.77	75.00	8.13
32/14	2.65	35.87	12.86	4.35	4.32	27.17	18.43	41.17	12.83	92.33	8.37
B.H.-85	2.89	30.63	11.29	3.99	3.88	24.30	16.93	51.73	11.0	73.33	6.53
H-675	3.00	30.40	15.29	5.32	5.21	23.97	18.30	51.93	15.40	52.33	6.0
SEm ±	0.20	3.31	1.24	0.43	0.40	1.01	1.58	3.08	0.98	13.31	0.30
CD at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

VRIDHACHALAM

The mean plant height ranged from 2.14 m to 2.98 m among the types. The trunk girth ranged from 33.0 cm to 39.4 cm. The mean range of canopy spread was found between 3.24 to 3.98 m (Table 1.21).

Table 1.21 : Performance of cashew varieties/ genotypes in MLT III (MLT 2002)

Variety/ Genotypes	Plant height (m)	Trunk girth (cm)	Canopy spread (m)
BH 6	2.98	33.0	3.24
BH 85	2.78	34.0	3.48
H 1593	2.36	37.8	3.98
K 22-1	2.62	35.8	3.64
H 662	2.72	34.2	3.68
H 675	2.14	39.4	3.68
H 11	2.68	35.2	3.36
H 14	2.36	35.6	3.66
H 32/4	2.64	36.2	3.64
Goa 11/6	2.66	34.6	3.58
VRI 2	2.72	34.8	3.62
VRI 3	2.58	34.0	3.40
CD 5%	0.23*	0.38**	

Gen. 3. Performance of Released Varieties

3. Multi Location Trial – V

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara, Pilicode and Vengurla

Plains / others :

Chintamani 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.

SUMMARY :

At Bhubhaneswar, the trunk girth was maximum in variety BPP-8 (46.58cm) followed by Chintamani-1 (45.83m) and Jhargram-1 (45.58m). At Jhargram, BPP- 8 produced the maximum number of flowering laterals per square meter (20.1) followed by Madakkathara-1 (16.9) and NRCC Sel-2 (16.6). The highest yield was recorded by Ullal-4 (3.02 Kg/tree) followed by Goa 11/6 (2.96 Kg/tree) at Madakkathara.

Treatments :

This trial on MLT-V has been planted afresh during 2006 using the following 25 selected varieties.

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

BHUBANESWAR

Maximum plant height was recorded in variety Kanaka (4.08m) followed by Jhargram-1 (3.9m) and UN 50 (3.84m). Trunk girth was maximum in variety BPP 8 (46.58cm) followed by Chintamani-1 (45.83m) and Jhargram-1 (45.58m). Maximum canopy spread in E-W direction was recorded in Chintamani-1 and BPP 8 (5.32 m each) followed by Vengurla 1 (5.19 m). Canopy spread in N-S direction was maximum in Dhana (5.44 m) followed by Chintamani-1 (5.42 m). Jhargram-1 recorded significantly higher number of total laterals (21.66/m^2) and flowering laterals (20.16/m^2) (Table 1.22).

Table 1.22 : Vegetative and flowering parameters of cashew types in MLT-V during 2013- Bhubaneswar

Cashew types	Plant height (m)	Trunk girth (cm)	Canopy Spread (m)		No. of laterals /m²	No. of flowering laterals/m²
			E–W	N– S		
BPP-4	3.24	35.33	4.03	3.62	15.06	12.83
BPP-6	3.68	36.42	4.59	4.50	12.38	9.53
BPP-8	3.77	46.58	5.32	5.32	17.18	14.66
Bhubaneswar-1	3.11	37.08	3.82	3.89	16.16	14.92
Chintamani-1	3.8	45.83	5.32	5.42	17.49	16.20
Jhargram-1	3.9	45.58	5.18	5.24	21.66	20.16
Madakkathara-1	3.69	41.27	3.94	3.72	17.67	15.67
Madakkathara-2	3.39	39.40	3.23	3.54	17.38	15.25
K-22-1	3.11	37.80	3.88	3.94	17.22	14.20
Dhana	3.72	45.02	5.02	5.44	16.38	14.20
Kanaka	4.08	42.30	4.39	4.54	15.37	14.37
Priyanka	3.15	34.83	4.26	4.39	14.60	11.00
Amrutha	2.67	28.40	3.01	3.24	13.98	12.48
Vengurla-1	3.36	41.63	5.19	4.89	17.14	14.83
Vengurla-4	3.20	34.13	3.88	3.88	16.95	16.95
Vengurla-6	3.07	34.75	3.35	3.43	12.98	11.90
Vengurla-7	3.28	38.08	3.88	3.94	15.47	11.58
VRI-3	2.74	35.10	3.65	4.00	17.10	16.85
NRCC Sel-2	3.58	39.75	4.55	4.04	19.74	16.74
Ullal-1	3.82	42.10	4.85	5.21	14.97	12.30
Ullal-3	3.63	34.73	4.52	4.34	12.42	10.26
Ullal-4	2.58	24.17	3.05	3.15	10.38	8.88
UN-50	3.84	40.40	3.74	3.89	15.81	13.81
Goa-1	3.04	36.63	3.53	3.55	16.12	13.31
Bhaskara	3.59	42.83	4.35	4.34	17.16	15.62
Sem±	0.18	2.88	0.33	0.34	0.75	0.82
CD(5%)	0.53	8.41	0.98	1.01	2.2	2.4

JHARGRAM

All the varieties were found to be on par with respect to growth characters. Significant differences were recorded with respect to flowering/m². BPP- 8 produced maximum flowering laterals per square meter (20.1) followed by Madakkathara - 1 and NRCC Sel-2 which produced 16.9 and 16.6 panicles per square meter respectively (Table 1.23).

Table 1.23 : Growth performance of released cashew varieties under multilocation trial at Jhargram

Variety	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	Canopy area (m^2)	Flowering / m^2
Bhaskara	2.9	22.5	2.9	14.65	9.8
Madakkathara II	2.5	22.3	2.7	11.53	10.6
Bhubaneswar I	2.7	21.0	2.6	11.93	12.9
K-22-1	2.4	21.5	3.0	13.54	13.2
Chintamani- I	2.4	21.8	3.0	13.15	9.9
Ullal – 4	2.5	20.8	2.9	12.99	13.5
Vengurla – 7	2.5	23.3	3.4	16.30	12.4
VRI- 3	2.6	23.3	3.2	15.33	15.0
BPP- 6	2.6	23.5	3.1	14.96	12.8
Amrita	2.8	24.3	2.9	14.60	12.8
Vengurla- 4	2.5	21.3	2.6	11.10	10.4
Goa – 1	2.5	22.0	2.9	13.03	11.8
Madakkathara- I	2.0	17.0	2.1	7.58	16.9
Priyanka	1.8	15.5	1.9	6.17	10.8
BPP- 8	2.4	23.3	2.6	10.99	20.1
Kanaka	2.5	19.5	2.9	13.03	14.8
Vengurla- 1	2.8	21.8	2.7	13.15	13.5
Vengurla- 6	2.6	22.3	2.8	12.60	10.9
Ullal- 3	2.4	23.3	2.9	12.75	11.9
Dhana	2.4	20.8	2.8	12.09	12.4
BPP- 4	2.6	23.5	2.7	12.35	12.8
UN- 50	2.5	22.8	2.7	12.05	11.9
Jhargram- 1	2.5	21.8	3.3	15.15	13.5
NRCC-Sel-2	2.8	25.8	2.9	14.60	16.6
Ullal- 1	2.9	23.8	3.2	16.18	15.3
S.Em±	0.23	2.02	0.32	2.27	1.67
C.D at 5%	0.46	4.03	0.64	4.53	3.33
CV%	11.1	11.3	14.0	21.6	15.6

MADAKKATHARA

Madakkathara - 2 recorded the maximum height (5.00 m) followed by UN-50 (4.97 m). Variety K-22-1 recorded highest girth (58.80 cm) followed by Madakkathara-1 (57.80 cm). With respect to canopy spread (EW), the variety Ullal-3 recorded maximum spread (7.24 m) followed by Ullal - 4 (6.98 m). With respect to canopy spread (NS) the variety, Amrutha recorded maximum spread (6.89 m) followed by Ullal-4 (6.78 m). Highest yield was recorded by Ullal-4 (3.02 Kg/tree) followed by Goa 11/6 (2.96 Kg/tree). The highest cumulative yield was recorded by variety Goa 11/6 (3.76 Kg/tree) followed by Ullal-4 (3.66 Kg/tree) (Table 1.24).

Table 1.24 : Morphological characters of cashew varieties under multilocation trial at Madakkathara

Variety	Height (m)	Girth (cm)	Canopy spread - EW (m)	Canopy spread - NS (m)	Nut yield (Kg/tree)	Cumulative yield 2 yrs. (Kg/tree)
Goa 11/6	4.80	45.80	6.87	5.95	2.96	3.76
UN 50	4.97	43.40	6.06	6.73	2.12	2.90
Ullal-4	4.76	47.60	6.98	6.78	3.02	3.66
Ullal -3	4.66	43.00	7.24	6.60	2.44	3.28
Ullal-I	4.98	41.20	6.33	6.48	1.94	2.80
DCR sel-2	4.10	41.20	5.64	5.31	2.18	3.04
V6	4.58	49.80	5.61	5.51	1.84	2.72
V4	4.38	41.40	4.87	6.28	1.46	2.54
V1	4.70	49.60	5.84	6.21	2.08	2.80
Jhargram	4.44	54.40	6.33	6.66	2.28	3.28
Chinthamani	4.88	49.80	6.71	6.74	1.60	2.36
BPP-4	4.96	50.20	5.13	6.41	1.38	2.32
Akshaya	4.18	45.20	4.69	4.62	1.66	2.94
Anagha	4.02	45.40	4.73	4.71	1.76	2.82
Damodar	4.58	42.60	4.13	4.27	1.08	2.28
Raghav	4.20	45.80	4.50	4.39	1.64	2.37
Dharasree	4.22	47.75	5.37	5.00	1.52	2.49
Sulabha	4.32	48.00	4.99	5.31	2.08	3.05
Anakkayam-1	4.64	49.00	4.65	5.10	2.18	3.42
Priyanka	4.56	50.00	5.79	6.01	2.14	3.24
Dhana	4.22	53.00	5.34	5.30	2.24	3.01
Amrutha	4.86	48.75	6.91	6.89	1.35	2.80
Vridhachalam-3	4.58	56.60	4.76	6.35	1.34	2.48
K-22-1	4.79	58.80	6.31	5.59	1.04	2.22
Madakkathara-2	5.00	52.00	5.40	5.34	1.52	2.51
Kanaka	4.60	51.20	4.87	5.21	1.45	2.49
Madakkathara-1	4.53	57.80	2.84	5.04	1.48	2.40
Poornima	4.35	52.20	5.88	5.50	1.58	2.02

PILICODE

The varieties NRCC-Sel-2, Amritha, UN-50 and Priyanka had nut weight exceeding 10g and Amritha had the highest apple weight of 89.67g followed by NRCC-Sel-2 which had 84.6g fruit weight (Table 1.25).

Table 1.25 : Yield parameters in different varieties under MLT-V at Pilicode

Variety	Apple Wt (g)	Nut Wt (g)
NRCC Sel-2	84.60	11.20
MDK1	50.50	7.20
Ullal1	49.60	7.00
MDK 2	60.00	7.10
Bhaskara	52.20	8.80
V4	53.50	7.40
Kanaka	62.50	8.00
VRI 3	50.00	6.10
Amritha	89.67	11.00

Variety	Apple Wt (g)	Nut Wt (g)
Amritha	89.67	11.00
Ullal3	70.00	7.30
V 7	47.20	9.60
K-22-1	47.20	8.20
UN 50	62.33	10.60
Bhuvaneswar 1	75.00	5.20
BPP-6	60.00	6.00
Priyanka	57.00	11.40
Dhana	59.00	8.00

The highest plant height of 4.25m was recorded in VRI-3 followed by K-22-1 which had 4.18m. Highest plant girth of 0.39m was recorded in Kanaka, MDK-2 and Bhaskara. Highest canopy area of 39.78 m^2 was recorded in V-7 and the highest ratio of bisexual flowers 1.76 was recorded in VRI-3.

The highest fruit set of 5.25/m^2 was recorded in Kanaka followed by BBP-6 (4.50/m^2) and V-7 (4.43/m^2) (Table 1.26).

Table 1.26 : Biometric observations under MLT-V at Pilicode

Accession No./ Variety	Plant Height (m)	Collar Girth (cm)	Canopy Spread (m)	Canopy area (m^2)	No. of Panicle/ m^2	Bisexual : total flowers ratio	Seed set/ m^2
NRCC Sel-2	2.57^{defg}	0.28^{bc}	2.94^{abcd}	24.56^{abcd}	5.75^{abc}	0.09	2.41^{def}
MDK 1	2.91^{cdef}	0.31^{abc}	2.77^{abcde}	25.37^{abcd}	8.66^{a}	0.19	4.27^{abcd}
Goa 1	1.98^{fg}	0.24^{cd}	1.91^{efg}	11.95^{cde}	5.37^{abc}	0.12	2.50^{cdef}
Ullal 1	3.70^{abc}	0.33^{ab}	3.44^{ab}	38.40^{a}	3.53^{bcd}	0.09	2.20^{ef}
MDK 2	4.09^{ab}	0.39^{a}	3.03^{abc}	38.31^{a}	6.28^{ab}	0.18	2.75^{bcdef}
Bhaskara	2.64^{defg}	0.39^{a}	2.64^{bcde}	27.82^{abc}	6.91^{ab}	0.15	3.06^{bcdef}
V4	1.75^{g}	0.18^{de}	1.71^{fg}	12.58^{cde}	4.58^{abc}	0.14	1.72^{fg}
Kanaka	3.30^{bcde}	0.39^{a}	3.11^{abc}	30.13^{ab}	6.29^{ab}	0.08	5.25^{a}
VRI 3	4.25^{a}	0.31^{abc}	3.12^{abc}	37.94^{a}	3.50^{bcd}	1.76	1.50^{fg}
Amritha	3.39^{abcde}	0.27^{bc}	2.72^{bcde}	28.15^{abc}	6.64^{ab}	0.15	2.87^{bcdef}
Ullal 3	3.37^{abcde}	0.25^{bcd}	2.75^{abcde}	27.26^{abcd}	1.87^{cd}	0.08	2.00^{ef}
V7	3.71^{abc}	0.32^{abc}	3.45^{ab}	39.78^{a}	5.68^{abc}	0.08	4.43^{abc}
K-22-1	4.18^{ab}	0.34^{ab}	3.65^{a}	28.01^{abc}	8.06^{a}	0.16	3.75^{abcde}
UN 50	3.62^{abc}	0.31^{abc}	2.54^{cdef}	19.44^{bcde}	3.45^{bcd}	0.08	2.75^{bcdef}
Bhubaneshwar 1	3.50^{abcd}	0.34^{ab}	3.12^{abc}	20.27^{bcde}	6.25^{ab}	0.08	2.25^{ef}

Accession No./ Variety	Plant Height (m)	Collar Girth (cm)	Canopy Spread (m)	Canopy area (m^2)	No. of Panicle/ m^2	Bisexual : total flowers ratio	Seed set/ m^2
BPP 8	1.85^{g}	0.14^{e}	1.40^{g}	7.32^{e}	0.00^{d}	0.00	0.00^{g}
BPP 6	2.05^{fg}	0.29^{ab}	2.06^{defg}	12.56^{cde}	4.75^{abc}	0.16	4.50^{ab}
Priyanka	2.55^{efg}	0.32^{abc}	2.94^{abcd}	24.27^{abcd}	5.73^{abc}	0.16	3.87^{abcde}
Dhana	2.08^{fg}	0.23^{cd}	1.90^{efg}	10.86^{de}	2.75^{bcd}	0.13	1.25^{fg}
Mean	3.029	0.300	2.699	24.477	5.059	0.21	2.809
F Test	**	**	**	**	*	NS	**
CD @ 5%	0.935	0.093	0.902	16.867	4.255	-	1.976

*Means superscripted by the same letters do not differ significantly at P=0.05 by Duncan's Multiple Range Test

VRIDHACHALAM

The varieties were evaluated for morphological characters; the height ranged from 2.10 m to 3.10 m. The canopy spread of the evaluated ranged from 3.16 m to 3.82m (Table 1.27).

Table 1.27 : Performance of released varieties of Cashew at Vridhachalam

Varieties	Plant height (m)	Trunk girth (cm)	Canopy spread (m)
BPP-4	2.86	32.0	3.20
BPP-6	2.66	34.2	3.28
BPP-8 (H 2/16)	2.26	36.8	3.80
Bhubaneshwar-1	2.54	34.8	3.44
Chintamani-1	2.64	36.2	3.48
Jhargram-1	2.82	38.0	3.82
Madakkathara-1	3.10	40.2	3.64
Madakkathara-2	2.10	38.4	3.48
K-22-1	2.56	36.2	3.16
Dhana	2.24	36.6	3.46
Kanaka	2.58	36.2	3.64
Priyanka	2.58	34.6	3.28
Amrutha	2.64	34.8	3.42

Varieties	Plant height (m)	Trunk girth (cm)	Canopy spread (m)
Vengurla-1	2.84	34.6	3.84
Vengurla-4	2.48	34.0	3.20
Vengurla-6	2.46	39.8	3.44
Vengurla-7	2.44	34.0	3.48
VRI-3	2.48	34.6	3.48
NRCC Sel-2	2.98	38.0	3.16
Ullal-1	2.88	34.8	3.46
Ullal-3	2.44	36.0	3.64
Ullal-4	3.14	34.0	3.64
UN-50	2.86	32.8	3.82
Goa -1	2.92	33.6	3.64
Bhaskara	2.66	32.0	3.28
CD(0.05%)	0.20	0.40	NS

Gen.4. Hybridization and Selection

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY:

Among the hybrids planted after 1998, the maximum trunk girth was recorded in H-36 (153.0cm) followed by, H-186 (117.0cm) and in H-230 (100.0cm) at Bapatla. The highest cumulative yield/tree for 15 years were given by H 73 (80.70 Kg/tree) followed by H 70 (69.95 Kg/tree) at Madakkathara. At Pilicode, the hybrids from the cross MDK1 x PLD-57 was found to be taller than both the parents. At Vengurla, hybrid No. 777 (M-44/3 x B.T.22) recorded highest panicles/m^2 (33.0) while, maximum mean no. of nuts/panicle (14.0) was observed in H-3157 (H-445 x B.T.10). HC 6 is a dwarf hybrid developed at Vridhachalam while HC 17 is cluster bearing with compact and intensive branching.

BAPATLA

Based on the evaluation of hybrids T.No.10/19 and T.No. 30/1 were found to be promising. A total number of 780 crosses have been made between the cross combinations.

Among the different hybrids planted in 1997, maximum plant height (7.70m) was recorded in H-49 which was closely followed by H 65 (7.30m). Maximum trunk girth and canopy spread was recorded with H 36 variety i.e. 153.0cm, 14.40m [E-W] and 12.00m [N-S] respectively (Table 1.28).

Table 1.28 : Performance of cashew hybrids planted during 1997

Hybrid No.	Cross Combination	Plant height (mt)	Plant girth (cm)	Spread	
				E-W (cm)	N-S (cm)
H12	TNO 2/22X T NO 228	4.00	75.0	6.40	6.00
H36	FNO 3 XT NO 30/1	7.00	153.0	14.40	12.00
H45	T NO 228X T NO 30/1	3.60	58.0	3.00	3.50
H49	BPP8XT NO 2/22	7.70	125.0	11.90	13.50
H65	T NO 71X T NO 273	7.30	150.0	13.00	9.60
H76	T NO 71X T NO 273	7.20	120.0	7.80	12.40

Among the different hybrids of 1998 planting, maximum plant height (8.00m) was recorded in H 110 which was closely followed by H 124 (7.80m). Maximum trunk girth was recorded with H 95 i.e. 105.00 cm, and canopy spread was maximum with H 85 7.90m [E-W] and 8.40m [N-S] (Table 1.31).

Table 1.31 : Performance of cashew hybrids planted during 1998

Hybrid No.	Cross Combination	Plant height (mt)	Plant girth (cm)	Spread	
				E-W (cm)	N-S (cm)
H81	T No.71 X T No.273	7.10	59.0	4.20	3.50
H82	T No.71 X T No.273	7.20	90.0	7.50	5.10
H85	BPP-8 X T No. 228	7.50	100.0	7.90	8.40
H88	BPP-8 X T No. 228	2.00	43.0	0.50	0.50
H90	BPP-8 X T No. 228	1.60	56.0	0.50	0.50
H92	Priyanka X VRI-2	7.30	78.0	7.00	6.50
H95	T No. 273 X T No. 2/22	5.50	105.0	8.30	7.00
H107	T No. 228 X Priyanka	2.00	43.0	4.0	3.00
H110	Priyanka X BPP-8	8.00	65.0	5.50	6.00
H124	FNo. 5 X TNo. 228	7.80	80.0	6.80	4.50

Maximum plant height (7.80m) was recorded in H142. Maximum trunk girth and canopy spread was recorded with H 136 i.e. 93.0 cm, 6.40m [E-W] and 7.90m [N-S] respectively and 1994 planted hybrids (Table 1.32).

Table 1.31 : Performance of cashew hybrids planted during 1998

Hybrid No.	Cross Combination	Plant height (mt)	Plant girth (cm)	Spread	
				E-W (cm)	N-S (cm)
H81	T No.71 X T No.273	7.10	59.0	4.20	3.50
H82	T No.71 X T No.273	7.20	90.0	7.50	5.10
H85	BPP-8 X T No. 228	7.50	100.0	7.90	8.40
H88	BPP-8 X T No. 228	2.00	43.0	0.50	0.50
H90	BPP-8 X T No. 228	1.60	56.0	0.50	0.50
H92	Priyanka X VRI-2	7.30	78.0	7.00	6.50
H95	T No. 273 X T No. 2/22	5.50	105.0	8.30	7.00
H107	T No. 228 X Priyanka	2.00	43.0	4.0	3.00
H110	Priyanka X BPP-8	8.00	65.0	5.50	6.00
H124	FNo. 5 X TNo. 228	7.80	80.0	6.80	4.50

Among the different hybrids obtained during 2000 maximum plant height (6.30mt) was recorded in H-180. Maximum trunk girth and canopy spread was recorded with H-186 i.e. 117.0cm, 10.7m [E-W] and 12.50m [N-S] respectively (Table 1.33).

Table 1.32 : Performance of cashew hybrids planted during 1999

Hybrid No.	Cross Combination	Plant height (mt)	Plant girth (cm)	Spread	
				E-W (cm)	N-S (cm)
H126	BPP8 X T No.2/22	7.20	84.0	6.40	5.60
H136	T No. 71 X TNO 273	6.50	93.0	6.40	7.90
H145	BPP9 X T NO 2/22	7.80	73.0	4.10	4.0
H155	BPP5 X BPP8	7.00	73.0	4.10	3.40
H160	T No. 30/1 X T No. 228	1.40	48.0	0.50	0.60
H171	T No. 30/1 X T No. 228	3.10	71.0	4.50	3.70
H172	T No. 30/1 X T No. 228	3.20	75.0	6.80	7.0

Evaluation of 2001 planted hybrids revealed that maximum plant height (5.70mt) was recorded in H-231. Maximum trunk girth and canopy spread was recorded with H-230 i.e. 100.0cm, 9.00m [E-W] and 8.50m [N-S] respectively (Table 1.34).

Table 1.33 : Performance of cashew hybrids planted during 2000

Hybrid No.	Cross Combination	Plant height	Stem girth	Spread	
				E-W (cm)	E-W (cm)
H180	BPP-6X T No. 2/22	6.30	100.0	9.00	10.10
H186	T No. 228X T No. 273	5.70	117.0	10.70	12.50
H189	T No. 228X T No. 273	3.50	47.0	3.10	3.0
H194	T No. 228XF No. 5	5.60	116.0	9.0	8.10
H203	T No. 30/1 X T No. 228	3.30	66.0	4.70	5.10
H218	Priyanka X T No. 30/1	5.10	89.0	9.40	8.00

Table 1.34 : Performance of cashew hybrids planted during 2001

Hybrid No	Cross Combination	Plant height (mt)	Plant girth (cm)	Spread	
				E-W (cm)	N-S (cm)
H226	BPP9X T NO 2/22	5.50	95.0	10.30	7.10
H230	T NO 228XPriyanka	5.60	100.0	9.00	8.50
H231	T NO 228XPriyanka	5.70	78.0	7.10	8.00
H244	T NO 228XPriyanka	3.80	51.0	4.40	5.10

Table 1.35 : Performance of cashew hybrids planted during 2006

Hybrid No.	Cross Combination	Plant height (mt)	Plant girth (cm)	Spread	
				E-W (cm)	N-S (cm)
H308	BPP6 X ULLAL 4	2.20	28.0	2.10	2.50
H314	BPP8 X NRCC Sel 2	6.00	82.0	8.10	7.50
H319	BPP6 X NRCC Sel 2	4.20	80.0	8.30	8.10
H330	BPP-8 X ULLAL-4	2.50	38.0	2.50	2.30
H331	BPP-8 X ULLAL-4	2.60	51.0	5.10	4.80
H332	BPP-8 X ULLAL-4	2.80	41.0	3.90	5.20
H333	BPP-8 X ULLAL-4	2.50	40.0	3.60	3.30
H343	T NO 228 X BPP8	5.50	50.0	4.10	4.30
H355	BPP8X T NO 10/19	4.70	70.0	8.10	7.80
H360	BPP8 X BPP3	2.80	43.0	3.70	3.80
H363	BPP8 X BPP3	2.80	46.0	3.10	3.50
H369	T NO 228 X BPP-8	5.00	60.0	5.20	5.00
H372	T NO 228 X BPP-8	2.80	35.0	3.00	2.20

Among the different hybrids evaluated from 2006 planting maximum plant height (6.00 m) was recorded in H-314. Maximum trunk girth was recorded with H-314 i.e. 82.0.0 cm, and canopy spread was recorded with H 319 i.e 8.40 m [E-W] and 8.10m [N-S] respectively (Table 1.35).

Table 1.36 : Performance of cashew hybrids planted during 2007

Hybrid No.	Cross Combination	Plant height (mt)	Plant girth (cm)	Spread	
				E-W (cm)	N-S (cm)
H377	BPP-8 X T NO. 10/19	4.20	40.0	3.50	3.00
H387	BPP-8 X H 255	4.10	46.0	5.60	4.70
H390	BPP-8 X H 255	4.10	55.0	5.70	6.00
H399	PRIYANKA X BPP-8	2.20	32.0	2.40	2.90
H404	BPP 8 X M 15/4	2.60	36.0	3.10	3.10
H412	T NO 228 X BPP-8	4.00	50.0	5.80	6.30
H415	BPP-6 X T N0 30/1	3.50	60.0	5.10	4.70
H416	BPP-6 X T N0 30/1	2.50	32.0	3.50	3.80
H419	BPP-8 X H-367	2.40	36.0	3.50	3.60
H420	BPP8 X PRIYANKA	2.40	34.0	3.00	3.10

Among the different hybrids of 2007 evaluated; maximum plant height (4.20mt) was recorded in H 377. Maximum trunk girth was recorded with H 415 i.e. 60.00cm, and canopy spread was recorded with H 412 i.e 5.80m [E-W] and 6.30m [N-S] respectively (Table 1.36).

BHUBANESWAR

Hybrid D1 recorded maximum plant height (7.5m) and trunk girth (97cm) and hybrid A6 registered maximum canopy spread (10m in E-W and 11m in N-S) among the four identified promising hybrids of 1995 planting.

In 1997 planted hybrid block two promising hybrids i.e A 85 and A105. Hybrid A 85 recorded maximum with respect to trunk girth (75cm) and canopy spread (7.5m in E-W & 7.0m in N-S) whereas maximum plant height was recorded in hybrid A105 (6.3m).

One hybrid has been identified as promising in 1998 planted hybrid block. The vegetative characters recorded for the hybrid B2-32 were 6.5m, 81cm and 9.0m in E-W & 10m in N-S for plant height, trunk girth and canopy spread respectively among 1998 hybrids.

Hybrid D3-11 recorded plant height, trunk girth and canopy spread of 5.5m, 60cm and 6.3m in E-W and 5.0 in N-S direction respectively in 1999 planted hybrid block.

Among the four hybrids, identified to be promising in 2000 planted hybrid block D4-6 registered maximum plant height (6.3m), trunk girth (69cm) and canopy spread (8.5m in E-W & 6.3m in N-S) followed by F4-7 (6m, 58cm, 6.2m in E-W & 6.0m in N-S) and F4-18 (5.5m, 58cm, 6.2m in E-W & 7m in N-S) respectively.

Hybrid E5-20 recorded maximum with respect to the all vegetative parameters (5.4m, 70cm, 5.5m in E-W direction for plant height, trunk girth and canopy spread) except canopy spread in N-S direction. Hybrid J5-13 recorded maximum canopy spread in N-S direction (6.5m) among 2001 hybrid.

Among 2002 planted hybrids, J6-6 and J6-12 recorded maximum plant height of 3m each. Trunk girth was maximum in H6-8 (79cm), canopy spread in E-W direction was maximum in J6-14(2.8m) and in N-S direction hybrids H6-6 and H6-8 registered maximum (3.3m each).

Hybrid C2-6 recorded maximum plant height (3.5m), trunk girth (79cm) and canopy spread (3.3m) in E-W direction and in N-S direction it was maximum in hybrid E7-6(3m) among 2003 planted hybrids (Table 1.37).

Table 1.37 : Performance of Promising Cashew Hybrids during 2013

Hybrid no.	Year of planting	Cross Combinations	Plant height(m)	Girth (cm)	Canopy spread (m)	
A6	1995	Bhubaneswar C-2 x VTH 711/4	6.0	93.0	10.0	11.0
A9		Bhubaneswar C-2 x VTH 711/4	6.5	95.0	9.0	9.5
D1		Bhubaneswar-1 x Kankady	7.5	97.0	9.0	7.0
E1		Bhubaneswar C2 x Kankady	7.3	86.0	8.0	7.0
A1-85	1997	Bhubaneswar-1 x H2/16	6.0	82.0	7.5	7.0
A1-105		Bhubaneswar-1 x H2/16	6.3	68.0	6.0	6.5
B2-32	1998	H 2/16 x M 44/3	6.5	81.0	9.0	10.0
D3-11	1999	M 44/3 x H 2/15	5.5	60.0	6.3	5.0
D4-6	2000	H 2/16 x M44/3	6.3	69.0	8.5	6.3
F4-7		M 44/3 x H 2/15	6.0	58.0	6.2	6.0
F4-18		M 44/3 x H 2/15	5.5	58.0	6.2	7.0
F4-24		M 44/3 x H 2/15	4.0	53.0	6.0	6.0
E5 20	2001	BPP 30/1 x H 2/16	5.4	70.0	5.5	5.5
J5 13		Bhubaneswar -1 x VTH 711/4	5.5	68.0	5.0	6.5
B6 27	2002	RP-1 x VTH 711/4	2.7	68.0	2.5	2.4
H6-6		M44/3 x Kalyanpur bold nut	2.8	63.0	2.7	3.3

H6-8		M44/3 x Kalyanpur bold nut	2.8	79.0	2.7	3.3
J6-6		BPP 30/1 x Kalyanpur bold nut	3.0	71.0	2.5	2.6
J6-12		BPP 30/1 x Kalyanpur bold nut	3.0	72.0	2.7	2.5
J6-13		BPP 30/1 x Kalyanpur bold nut	2.8	68.0	2.7	2.8
J6-14		BPP 30/1 x Kalyanpur bold nut	2.5	68.0	2.8	2.5
C2-6	2003	RP 2 x Kankady	3.5	79.0	3.3	2.6
E7-2		OC 56 x VTH 711/4	2.3	70.0	3.0	2.3
E7-6		OC 56 x VTH 711/4	2.7	70.0	2.6	3.0
J1-13		RP -1 x OC 22	3.0	56.0	2.2	2.0

JHARGRAM

The tallest hybrid plant was recorded in H - 64 (7.0 m) followed by H - 70 and H - 130 (6.9 m) and H - 119 (6.8m). The range of height was between 4.5m – 7m. H - 70 hybrid had maximum girth (105 cm) and spread (8.7m). Minimum girth was with H - 153 (44 cm) and spread was minimum in H - 9 (4.4m). The range in canopy area of different hybrids was in between (25 - 86) m^2 and flowering density was between (9.3 - 22.5)/m^2. Highest flowering density was noticed in H - 37 (22.5) followed by H - 110 (20.5) and H - 3 (20.3) (Table 1.38).

Table 1.38 : Growth performance of cashew hybrids at Jhargram centre

Year of planting	Cross Combination	Hybrid No.	Plant height (m)	Trunk girth (cm)	Canopy Spread (m)	Flowering /m^2
2002	Local X 2/9 Dicherla	H-37	6.0	85	7.9	22.5
2002	Local X 2/9 Dicherla	H-39	5.3	65	7.3	16.0
2002	Local X 2/9 Dicherla	H-30	5.4	69	5.8	16.3
2004	JGM– 216 X Yellow Hazari	H110	6.1	60	5.8	20.5
2002	Local X 2/9 Dicherla	H-35	6.1	82	7.3	18.8
2005	JGM– 216 X Yellow Hazari	H-156	5.2	49	5.6	16.5
2004	JGM– 216 X BLA	H-140	6.0	64	7.8	18.5
2002	JGM– 216 X BLA	H-3	6.0	77	7.0	20.3
2002	Red Hazari X WBDC – V	H-42	6.4	59	5.8	16.0
2002	KC-1 X BLA – 39-4	H-12	5.5	52	4.9	15.0
2005	JGM– 216 X Yellow Hazari	H-171	5.5	45	4.8	10.5
2002	KC-1 X BLA – 39-4	H-9	4.7	46	4.4	11.3
2003	BLA – 39-4 X Red Hazari	H-84	5.2	46	4.9	12.8
2004	JGM– 216 X Yellow Hazari	H-139	6.0	52	4.8	15.8

MADAKKATHARA

Hybridisation was initiated from 1993 with available materials. In total, 1678 hybrid plants were produced and 750 plants are maintained in the field during 1993-2013.

1993 hybrids

Out of the 56 hybrids planted in 1993, the highest yield was recorded by H 21 (17.00 Kg/tree) followed by H 44 (14.00 Kg/tree). Highest cumulative yield for 16 years was recorded by H 21 (137.75 Kg/tree) (Table 1.39).

Table 1.39 : Performance of hybrids planted during 1993 at Madakkathara

Hybrid No.	Cross combination	Year of planting	Duration of flowering	No. of fruits / panicle
10	BLA -139-1 X P-3-2	1993	116	5
21	BLA -39-4 X P-3-2	1993	118	3
22	BLA -39-4 X P-3-2	1993	117	4
30	V-5 X H-1591	1993	103	3
35	V-5 X H-1591	1993	114	2
36	V-5 X H-1591	1993	117	3
44	V-5 X H-1591	1993	104	4
49	V-5 X H-1591	1993	121	5
50	V-5 X H-1591	1993	114	3
51	V-5 X H-1591	1993	117	2

1994 hybrids

Out of 26 hybrids planted in 1994, highest annual yield/ tree were given by H 70 (8.60 Kg/tree). The highest cumulative yield/tree for 15 years were given by H 73 (80.70 Kg/tree) followed by H 70 (69.95 Kg/tree) (Table 1.40).

Table 1.40 : Performance of hybrids planted during 1994 at Madakkathara (2012-13)

Hybrid No.	Cross combination	Year of plantin	Duration of flowering	No. of fruits/ panicle
69	BLA -39-4 x P-3-2	1994	117	4
70	BLA -39-4 x P-3-2	1994	108	5
72	BLA -39-4 x P-3-2	1994	126	3
73	BLA -39-4 x P-3-2	1994	124	6

1995 hybrids

Out of the 92 hybrids planted during 1995, H 97 recorded the highest yield (9.40 Kg/tree). The highest cumulative yield H 97(61.70 Kg/tree) followed by H 95 (52.25 Kg/tree).

Table 1.41 : Performance of hybrids planted during 1995 at Madakkathara (2012-13)

Hybrid No.	Cross combination	Year of planting	Duration of flowering	No. of fruits / panicle
91	V-5 x H-1591	1995	118	4
95	BLA -39-4 x P-3-2	1995	109	3
97	BLA -39-4 x P-3-7	1995	107	2
107	BLA -139-1 x P-3-2	1995	111	2

Performance of selected hybrids

The highest cumulative yield /tree for 16 years was recorded by H21 (137.75 Kg/tree).

Table 1.42 : Performance of selected F1 hybrids planted during 1993 at Madakkathara

Hy. No.	Cross combinations	Annual yield (Kg/tree)	Cum yield (Kg/tree) (16 years)	Apple wt. (g)	Nut wt. (g)	Shelling %
	1993					
21	BLA -39-4 x P-3-2	17.00	137.75	86.10	8.70	27.40
30	V-5 x H-1591	4.90	57.82	49.00	9.80	26.90
35	V-5 x H-1591	5.00	104.00	100.00	8.00	26.38
44	V-5 x H-1591	14.00	72.58	63.00	8.00	26.30
49	V-5 x H-1591	11.00	84.30	52.00	8.10	27.80
50	V-5 3.26 x H-1591	12.00	86.77	48.00	9.00	29.60
51	V-5 x H-1591	9.00	61.05	50.00	9.00	28.40

Table 1.43 : Performance of selected F1 hybrids planted during 1994 at Madakkathara

Hy. No.	Cross combinations	Annual yield (Kg/tree)	Cum yield (15 years) (Kg/tree)	Apple wt. (g)	Nut wt. (g)	Shelling %
69	BLA -39-4 X P-3-2	3.90	50.00	48.00	9.60	29.70
70	BLA -39-4 X P-3-2	8.60	69.95	68.00	8.40	27.20
72	BLA -39-4 X P-3-2	7.00	56.10	64.00	9.20	26.50
73	BLA -39-4 X P-3-2	7.90	80.70	86.30	7.00	24.30

Table 1.44 : Performance of selected F1 hybrids planted during 1995 at Madakkathara

Hy. No.	Cross combinations	Annual yield (kg/tree)	Cum yield (14 years) (kg/tree)	Apple wt. (g)	Nut wt. (g)	Shelling %
91	V-5 X H-1591	7.90	44.15	72.00	7.00	27.90
95	BLA -39-4 x P-3-5	8.00	52.25	83.00	7.20	27.21
97	BLA -39-4 x P-3-7	9.40	61.70	76.00	8.20	25.50
107	BLA -139-1 x P-3-2	8.20	40.45	68.00	9.10	21.98

Hybridization during 2012-13

A total of 130 pollinations were done during 2012-13 with 4.6 percentage of nut set.

PILICODE

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

Among the characteristics recorded the plant height, trunk girth, tree spread, number of panicles/ sqm and number of branches that are not flowered found to vary significantly among the hybrids as well as parents and PLD 57 graft. The hybrids from the cross MDK1 X PLD-57 was found to be taller than both the parents. Regarding sex ratio and seed set, hybrids and the parents were statistically on par. Higher number of flowering laterals per unit area was observed in PLD 57 grafts. PLD 57 (OP) was the shortest with lowest canopy area.

Table 1.45 : Mean of growth characteristics of different crosses involving PLD-57

Hybrid	Plant height (m)	Girth (m)	Canopy spread (m)	Canopy area (m^2)	No. of panicle /sqm	Number of branches not flowered	Sex ratio sqm	Seed set/
PLD 57 graft	2.997^{c}	0.452^{d}	3.216^{c}	15.010^{c}	19.000^{a}	17.935^{b}	0.122	1.453
PLD 57 (OP)	1.600^{d}	0.400^{d}	2.700^{c}	8.404^{d}	13.500^{ab}	15.000^{b}	0.141	1.059
PLD 57 x ANK-1	5.375^{ab}	0.750^{a}	6.375^{ab}	57.535^{ab}	5.500^{c}	26.000^{a}	0.176	2.500
ANK-1 x PLD 57	5.500^{ab}	0.530^{c}	4.125^{c}	34.561^{cd}	7.250^{c}	20.000^{ab}	0.153	1.500
MDK-1 x PLD 57	5.685^{a}	0.755^{a}	7.367^{a}	74.781^{a}	8.685^{bc}	25.250^{a}	0.159	1.750
MDK-1	5.000^{c}	0.600^{b}	4.500^{bc}	34.933^{bc}	5.750^{c}	17.750^{b}	0.143	1.666
Mean	4.360	0.581	4.714	37.537	9.948	20.323	0.149	1.655
F test	**	**	*	*	**	*	NS	NS
CD 0.05	0.671	0.054	1.997	31.070	5.680	6.819	-	-

*Means superscripted by the same letters do not differ significantly at P=0.05 by Duncan's Multiple Range Test

VENGURLA

So far more than 3000 F1 seedlings have been planted at Cashew Farm since 1999, These F1 hybrid seedlings are growing satisfactorily. All the growth and yield observations of these F1 seedlings were recorded. 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, 55 F1 hybrid seedlings during the year 2012-13 screened initially as promising hybrids. Out of 3000 F1 hybrids 2094 F1 hybrids are in fruiting stage.It was noticed that hybrid No. 777 (M-44/3 x B.T.22) recorded highest panicles/m^2 (33.0). Maximum average no. of nuts/panicle (14.0) was found in case of H-3157 (H-445 x B.T.10).

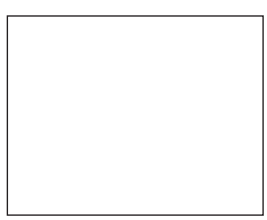
In all, 303 hermaphrodite flowers were crossed and from these crossed flowers 177 fruits were set. Out of 177 fruit set, finally 93 fruits were retained. Thus, the fruit retention percentage was 52.5

VRIDHACHALAM

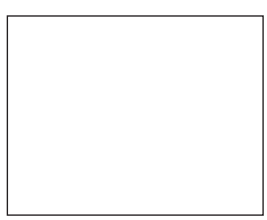
The hybrids planted during 2005, 2006 and 2008 are being evaluated for characteristics namely high yield, cluster bearing, good fruit set, high % of bisexual flowers, bold nuts and easy to peel testa. Many promising hybrids were identified and data recorded. Among the hybrids evaluated HC1, HC 6, HC 10, HC17, HC 24, HC 25, HC 27 and HC 30 are promising. HC 1, HC 5, HC10, HC 24, HC 25 are cluster bearing, HC6 is a dwarf hybrid which is valued for breeding high yielding dwarf hybrids, HC 17 is cluster bearing with a compact and unique intensive branching habit, HC 27 and HC 30 are bold nut types with more than 8.0 grams single nut weight. (Table 1.46)

Table 1.46 : Performance of cashew hybrids at Vridhachalam

Hybrid No.	Cross combinations	Year of planting	Plant height	Stem girth (m)	Mean canopy (cm)	No. of fruits spread (m)	Nut weight /panicle	Apple weight
HC1	VRI2 x VRI 3	2005	3.70	50.20	4.50	8	6.0	28.2
HC2	VRI 3 x VSK 2	2005	4.10	48.50	3.95	4	6.5	34.5
HC3	VRI 3 x TK 1	2005	3.80	45.50	5.85	4	6.8	40.25
HC4	VRI 3 x SL 1	2005	4.50	48.20	5.60	5	7.0	46.50
HC 5	VRI 3 x VRI 2	2005	4.20	44.50	5.10	5	7.2	43.25
HC6	VRI 3 x KGN 1	2005	3.00	42.80	3.20	2	6.0	37.50
HC8	VRI 3 x PKP 1	2005	4.85	43.00	5.20	6	6.8	55.10
HC9	VRI 3 x PKP 2	2005	5.20	52.55	6.00	5	6.2	42.10
HC10	RI 3 x KK 1	2006	3.50	32.00	3.30	8	7.4	29.80
HC 17	VRI 3 x AM 1	2006	3.20	28.50	3.00	9	6.5	33.40
HC 22	VRI 3 x TK 1	2008	3.00	31.50	3.30	4	8.0	60.10
HC 24	VRI3 x M 33/3	2008	2.80	29.55	3.50	10	7.6	32.60



II. CROP MANAGEMENT



II. CROP MANAGEMENT

Hort.1: NPK Fertilizer Experiment

Centres : East Coast :

Bapatla, Jhargram and Vridhachalam

West Coast :

Madakkathara

Plains / others :

Chintamani

The main objective of this project is to study the response of cashew to different doses of NPK fertilizers.

SUMMARY:

The fertilizer dose of 1000 : 125 :125 g NPK / tree / year recorded significantly highest cumulative nut yield of 93.0 Kg/tree for 12 harvests at Bapatla. At Vengurla, spacing of S1 (10m x 5m) was significantly superior over S2 (6m x 4m) and S3 (5m x 4m) with respect to vegetative parameters.The maximum cumulative yield per tree was highest (15.47 Kg/tree) in 10 x 5m spacing with 225 Kg N : 75 Kg P_2O_5 : 75 Kg K_2O/ha. At Jhargram, the maximum flowering was noticed under 500 : 125: 125 g NPK / tree of fertilizer.

Experimental Details :

Design	:	Three factorial confounded design with 27 treatment combinations
Replications	:	Two
Treatments	:	N = 0, 500 and 1000 g/plant
		P = 0, 125 and 250 g/plant
		K = 0, 125 and 250 g/plant
No. of plants per plot	:	Six

BAPATLA

The fertilizer dose of 1000 : 125 :125 g NPK / tree (N2P1K1) recorded significantly highest cumulative nut yield of 93.0 Kg/tree and was found to be promising for higher yields (Table 2.1).

Table 2.1 : Effect of NPK Fertilizer and their interaction on yield of cashew

Treatment	Plant height (m)	Trunk girth (cm)	Canopy surface area (m^2)	Duration of flowering (Days)	Nut weight (g)	Nut yield (Kg/tree)	Cumulative nut yield (Kg/tree) (12 no.of harvests)
N0P0K0	4.45	81.58	64.67	108	5.77	15.0	56.1
N0P0K1	3.68	67.35	34.27	114	6.62	8.0	49.1
N0P0K2	4.14	82.78	52.66	118	5.62	9.7	43.7
N0P1K0	3.10	58.08	38.88	121	5.41	6.1	38.0
N0P1K1	4.60	80.75	73.13	103	6.15	7.4	44.7
N0P1K2	4.61	78.65	95.79	107	5.59	11.3	50.9

Treatment	Plant height (m)	Trunk girth (cm)	Canopy surface area (m^2)	Duration of flowering (Days)	Nut weight (g)	Nut yield (Kg/tree)	Cumulative nut yield (Kg/tree) (12 no.of harvests)
N0P2K0	4.50	78.21	77.92	104	6.13	11.8	52.4
N0P2K1	4.14	76.50	49.82	124	5.95	8.9	43.4
N0P2K2	4.91	86.73	49.80	109	5.77	11.1	56.4
N1P0K0	5.19	82.04	64.67	104	5.56	18.4	79.0
N1P0K1	5.20	107.21	31.40	104	5.34	19.14	77.4
N1P0K2	5.14	99.38	53.07	107	5.83	12.4	65.2
N1P1K0	4.68	89.75	32.19	104	5.05	10.2	58.1
N1P1K1	2.10	42.50	19.73	102	5.05	5.4	58.2
N1P1K2	4.69	103.88	38.88	107	5.53	17.6	72.3
N1P2K0	4.91	88.10	95.79	114	5.42	18.0	70.2
N1P2K1	4.57	88.25	52.66	108	5.42	15.8	76.3
N1P2K2	5.16	97.00	81.61	105	5.86	19.8	80.7
N2P0K0	4.42	77.42	34.27	110	5.96	11.9	50.9
N2P0K1	5.03	76.17	34.43	110	5.61	15.1	65.6
N2P0K2	4.82	95.42	33.84	102	5.47	8.8	67.5
N2P1K0	5.33	97.67	19.73	107	5.48	15.7	71.7
N2P1K1	5.07	97.08	95.79	122	6.20	14.6	93.0
N2P1K2	3.85	77.25	77.92	104	5.48	14.5	64.1
N2P2K0	4.63	80.17	81.61	102	6.27	16.0	76.5
N2P2K1	5.40	100.08	73.13	103	5.35	14.3	87.7
N2P2K2	5.05	114.00	49.80	108	6.48	18.0	80.9
CD at 5%	NS	NS	NS	NS	NS	NS	2.26

JHARGRAM

There were no significant differences among the treatments in terms of their response on plant height, trunk girth, canopy spread and canopy area. However, flowering/m^2 showed differences significantly among the treatments. Maximum flowering (16.50/m^2) was noticed with a minimum dose of fertilizer (Table 2.2).

Table 2.2 : Growth and yield characters of cashew variety BPP –8 under different fertilizer treatments (On farm trial by Jhargram Centre)

Treatment	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	Canopy area (m^2)	Flowering /m^2
$N_{500}P_{125}K_{125}$	5.40	49.70	5.00	42.75	16.50
$N_{1000}P_{250}K_{250}$	5.07	48.60	5.40	44.44	15.40
$N_{1500}P_{250}K_{375}$	5.00	46.30	5.20	40.80	14.70
S. Em +	NS	NS	NS	NS	0.26
C.D at 5%					0.73

VENGURLE

A spacing of S1 (10m x 5m) was significantly superior over S2 (6m x 4m) and S3 (5m x 4m) in terms of mean height, mean spread, mean canopy height and mean canopy area. However, the mean height, mean spread, mean canopy height and mean canopy area was significantly superior in S3 (5m x 4m) spacing than S2 (6m x 4m).

The growth characters were not influenced significantly due to fertilizer levels. However, M2 (150 Kg N : 50 Kg P_2O_5 : 50 Kg K_2O/ha) was superior than M_1 (75 Kg N : 25 Kg P_2O_5 : 25 Kg K_2O/ha) and M3 (225 Kg N : 75 Kg P_2O_5 : 75 Kg K_2O/ha) in respect of mean height, mean girth, mean spread, mean canopy height and mean canopy area (Table 2.3 and 2.4).

Table 2.3 : Effect of spacing and fertilizer on growth and yield of cashew at Vengurla

Treatments	Mean height (m)	Mean girth (cm)	Mean spread (m)	Mean canopy height (m)	Mean canopy area (m^2)	Mean canopy surface area (m^2)
S1 200 plants/ha (10m x 5m)	7.34	103.03	9.94	6.83	80.19	134.64
S2 400 plants/ha (6m x 4 m)	4.04	89.51	3.48	3.52	9.91	21.8
S3 500 plants/ha (5m x 4m)	6.19	98.15	5.61	5.74	25.28	56.80
SE m±	0.28	4.45	0.28	0.21	5.36	7.02
CD at 5%	1.1	N.S	1.1	0.80	21.03	27.56
M1 75 Kg N : 25 Kg P_2O_5 : 25 Kg K_2O/ha	5.60	93.89	6.24	5.19	36.77	67.72
M2 150 Kg N : 50 Kg P_2O_5 : 50 Kg K_2O/ha	6.02	99.81	6.56	5.51	40.78	74.97
M3 225 Kg N : 75 Kg P_2O_5 : 75 Kg K_2O/ha	5.96	96.99	6.23	5.40	37.83	70.55
SEm±	0.12	2.28	0.25	0.11	3.45	4.60
CD at 5%	N.S	N.S	N.S	N.S	N.S	N.S

The interaction effect between spacing and fertilizer levels, with respect to yield was non-significant.

Table 2.4 : Interaction effect of spacing and fertilizer on growth and yield of cashew at Vengurla

Treat.	Mean height (m)	Mean girth (cm)	Mean canopy spread (m)	Mean No. of panicle / m^2	Mean flowering duration (days)	Mean No. of nuts per panicle	Mean fruit set/ m^2	Mean nut wt. (g)	Mean apple wt. (g)	Cumulative yield for harvest Kg/tree	
S1M1	2.22	100.97	9.91	18.03	107	2.83	27.80	10.87	72.0	12.29	For 9th harvest
S1M2	7.48	107.23	10.32	18.57	112	3.43	27.20	10.40	77.0	10.54	
S1M3	7.31	100.89	9.61	17.83	112	4.13	25.37	10.07	68.67	15.47	
S2M1	3.45	84.19	3.54	17.73	108	2.97	22.00	10.10	70.67	4.68	For 8th harvest
S2M2	4.45	91.49	3.63	18.37	111	3.83	27.83	10.07	72.33	5.10	
S2M3	4.23	92.85	3.26	16.53	104	5.27	28.50	10.63	72.00	6.16	
S3M1	6.11	96.51	5.27	17.10	111	5.07	30.80	10.40	75.00	7.08	For 8th harvest
S3M2	6.14	100.72	5.72	17.30	104	4.50	25.77	10.60	70.33	6.82	
S3M3	6.32	97.22	5.83	17.30	107	3.73	28.70	10.43	71.67	7.07	
SEm±	0.21	3.95	0.43	0.73	0.65	0.61	2.89	0.31	2.79	—	
CD at 5%	N.S	N.S.	N.S.	N.S	N.S	N.S	N.S.	N.S.	N.S.	N.S.	

Note: Plants from S2 treatment were pruned in the month of November, 2010 hence the yield was not obtained in different combinations of S2 during the year 2010-11.

Hort. 2 : Fertilizer application in high density cashew plantations

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara, Pilicode and Vengurla

Plains / others :

Chintamani, Jagdalpur

This trial envisages identification of optimum firtilizer doses in high density plantings for region specific cashew varieties.

SUMMARY:

At Bhubaneswar, the maximum ground area coverage (128.92%) was recorded 6m x 4m i.e. 400 plants/ha. Closer spacing of 600 plants / ha (5m x 4 m) resulted in higher plant height (4.08m), stem girth (0.61m) as well as significantly higher ground coverage of 26.93m^2 at Pilicode. Higher seed set (9.46 / m^2) was observed with 225 : 75 : 75 Kg NPK / ha and 200 plants / ha.

Experiment Details :

Design	:	Split plot		
Main plot : Plant density	:	S1 200 plants/ha (10m x 5m)		
		S2 400 plants/ha (6m x 4m)		
		S3 600 plants/ha (5m x 4m)		
Sub-plot : Fertilizer dose/ha	:	M1 75 Kg N, 25 Kg P_2O_5, 25 Kg K_2O		
		M2 150 Kg N, 50 Kg P_2O_5, 50 Kg K_2O		
		M3 225 Kg N, 75 Kg P_2O_5, 75 Kg K_2O		
Total area	:	2.5 ha		
Fertilizers application level	:	1st year	:	1/5th
		2nd year	:	2/5th
		3rd year	:	3/5th
		4th year	:	4/5th
		5th year	:	Full dose

BAPATLA

The trees planted at 5m x 4m led to higher plant height, trunk girth and canopy height. However, trees planted at 10m x 5m have given higher canopy surface area (75.46 m^2) over trees planted at closer densities (Table 2.5).

Table 2.5 : Effect of tree density and fertilizer levels on growth and yield of cashew at Bapatla

Treatment	Plant height (m)	Trunk girth (cm)	Mean canopy diameter (m)	Canopy height (m)	Canopy surface area (m^2)
S1M1	4.87	94.3	8.03	4.44	75.46
S1M2	4.32	83.50	6.95	3.96	57.48
S1M3	4.10	63.45	6.80	3.78	54.27
S2M1	4.15	70.42	6.13	3.73	46.46
S2M2	4.00	65.22	5.65	3.70	41.29
S2M3	3.66	61.00	5.47	3.33	37.00
S3M1	5.26	94.65	6.58	4.88	60.80
S3M2	4.82	85.54	5.61	4.48	46.55
S3M3	4.70	59.86	4.12	4.28	30.72

BHUBANESWAR

The spacing of S1 (10 m x 5 m i.e. 200 plants / ha) had significantly superior trunk girth (83.30 cm). Though the plant height and ground area coverage by canopy were non-significant. However, maximum ground area coverage by canopy was recorded in S2 (128.92 %) at 6m x 4m i.e. 400 plants / ha. There was no significant difference on total number of laterals / m^2 and flowering laterals / m^2.

There was no significant difference on plant height, plant girth and ground area coverage by canopy due to various doses of fertilizers. However, M2 ($N_{150}P_{50}K_{50}$ Kg /ha) recorded maximum plant girth (75.81 cm) and M3 ($N_{225}P_{75}K_{75}$ Kg/ha) recorded maximum plant height (6.03 m) and ground area coverage by canopy (132.96%). Maximum total number of laterals/m^2 (18.75) and flowering laterals/m^2 (16.50) were recorded in M3 (225:75:75 NPK Kg/ha).

Table 2.6 : Interaction effect between spacing and fertilizer on growth characters of cashew at Bhubaneswar centre

Treatments		Plant height (m)	Plant girth (cm)	Ground area coverage by canopy (%)	Total number of laterals / m^2	Flowering laterals / m^2
S1 (10mX5m) – 200plants/ha	M1 ($N_{75}P_{25}K_{25}$ Kg/ha)	6.44	83.33	126.24	17.51	15.79
	M2 ($N_{150}P_{50}K_{50}$ Kg/ha)	6.36	84.62	121.49	17.64	15.88
	M3 ($N_{225}P_{75}K_{75}$ Kg/ha)	5.98	81.96	118.85	17.43	14.83
S2 (6mX4m) – 400plants/ha	M1 ($N_{75}P_{25}K_{25}$ Kg/ha)	5.93	71.46	118.62	16.95	15.96
	M2 ($N_{150}P_{50}K_{50}$ Kg/ha)	6.09	72.03	132.40	18.89	17.12
	M3 ($N_{225}P_{75}K_{75}$ Kg/ha)	6.10	71.42	135.73	20.35	18.38
S3 (5mX4m) – 500plants/ha	M1 ($N_{75}P_{25}K_{25}$ Kg/ha)	5.58	66.04	109.56	19.00	17.33
	M2 ($N_{150}P_{50}K_{50}$ Kg/ha)	5.53	70.79	131.83	17.09	15.47
	M3 ($N_{225}P_{75}K_{75}$ Kg/ha)	6.00	70.65	144.29	18.47	16.30
F' test		NS	NS	NS	NS	NS
SEM ±		0.141	1.691	8.875	0.918	0.999

S1M1 recorded maximum plant height (6.44 m), which was at par with S1M2 (6.36 m), S2M3 (6.10 m) and S2M2 (6.09 m). No significant difference on trunk girth, ground area coverage by canopy, total number of laterals / m^2 and flowering laterals / m^2 were recorded due to interaction effect of spacing and doses of fertilizers. The ground area coverage by canopy exceeds the limit in all treatments, which indicates that the plants require pruning (Table 2.6).

JHARGRAM

No significant differences were noticed among the treatments with respect to plant height and canopy height. The vegetative parameters were higher with wider spacing compared to the lowest spacing. Application of different doses of fertilizers did not show any positive impact on the growth characters. Canopy area was recorded to be maximum at 200 plants /ha followed by 400 plants/ ha (Table 2.7).

Table 2.7 : Growth and flowering parameters of high density planting at Jhargram

Spacing (density)	Fertilizer Dose N-P-K (Kg/ha)	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	Canopy height (m)	Canopy area (m^2)	Flowering /m^2	Biomass removed (Kg/tree)
S1: 10m x 5m (200 Plants)	M1: 75-25-25	6.1	71.7	6.6	4.4	57.40	15.1	6.3
	M2: 150-50-50	6.1	72.0	6.8	4.3	59.73	14.9	8.8
	M3: 225-75-75	6.0	68.6	6.8	4.2	57.73	16.0	5.4
S2: 6m x 4m (400 Plants)	M1: 75-25-25	5.8	69.7	5.5	3.8	40.97	11.9	10.3
	M2: 150-50-50	6.0	71.0	5.9	4.1	47.07	12.4	11.9
	M3: 225-75-75	5.7	63.6	5.8	3.8	43.67	11.6	13.5
S3: 5m x 4m (500 Plants)	M1: 75-25-25	6.1	66.9	5.4	4.0	42.10	12.4	17.7
	M2: 150-50-50	6.2	64.1	5.4	4.1	41.17	11.7	17.1
	M3: 225-75-75	5.9	63.2	5.5	4.1	42.87	12.4	15.8
S.Em ±		NS	4.50	0.34	NS	4.42	0.81	1.86
CD at 5%			9.81	0.74		9.63	1.76	4.05

The ground area coverage was beyond 100% of the specified area for each plant i.e. 20 square meter area under the spacing of 5m x 4m. With higher doses of fertilizer application more than 100% ground area coverage was recorded. In case of plants spaced at 10m x 5m, only 69 – 74% area had been utilized by each plant (Table 2.8).

Table 2.8 : Effect of tree density and fertilizer application on ground coverage by canopy (%) at Jhargram

Treatment	Ground Coverage by Canopy (%)			
MP/SP	M1: 75-25-25	M2: 150-50-50	M3: 225-75-75	Mean
S1: 10m x 5m (200 Plants)	69.09	73.84	72.33	71.75
S2: 6m x 4m (400 Plants)	99.35	114.87	111.10	108.44
S3: 5m x 4m (500 Plants)	118.0	113.2	106.9	112.7
Mean	95.48	100.64	96.78	
SEm ±		9.63		
CD at 5%		20.98		

MADAKKATHARA

The tree densities, fertilizer doses and their interactions did not significantly influence any of the growth parameters except the tree densities on EW and NS canopy spread and interaction effects on girth.

Maximum height (5.47m) was recorded at 500 trees/ha. Maximum stem girth (91.00cm) and canopy spread (7.42 NS and 7.66 EW), were recorded at 200 trees/ha.

The fertilizer doses tested were M1 - 75: 25: 25 Kg NPK/ ha, M2- 150: 50: 50 Kg NPK/ ha, M3 - 225: 75: 75 Kg NPK/ ha. The effects of fertilizer doses on vegetative characters, height, girth, canopy spread NS and EW were not statistically significant.

Among interaction effects, statistically significant treatment S1M1 recorded the highest stem girth of 95.00 cm which was significantly higher than S2M1 (Table 2.9, 2.10 and 2.11).

Table 2.9 : Effect of tree densities and fertilizer doses on the growth and yield of cashew at Madakkathara

Treatments	Height (m)	Girth (cm)	Canopy spread NS (m)	Canopy spread EW (m)
Densities				
S1 - 200	5.18	91.0	7.42	7.66
S2 -400	5.22	82.0	5.78	5.88
S3 -500	5.47	85.0	5.93	5.88
CD (0.05)	NS	NS	0.57	1.08
SEm	0.18	0.42	0.16	0.21
Fertilizer doses				
M1- 75:25:25	5.32	87.0	6.29	6.24
M2- 150:50:50	5.22	86.0	6.33	6.61
M3- 225:75:75	5.37	85.0	6.51	6.57
SEm ±	0.08	0.18	0.12	0.12
CD (0.05)	NS	NS	NS	NS

Table 2.10 : Interaction effect between tree densities and fertilizer doses on growth and yield of cashew at Madakkathara

Treatments	Height (m)	Girth (cm)	Canopy spread NS (m)	Canopy spread EW (m)
S1 M1	5.23	95.0	7.68	7.45
S1 M2	4.83	85.0	7.23	7.75
S1 M3	5.48	83.0	7.35	7.78
S2 M1	5.18	77.0	5.68	5.65
S2 M2	5.15	85.0	5.55	6.18
S2 M3	5.32	84.0	6.13	5.80
S3 M1	5.55	89.0	5.53	5.63
S3 M2	5.55	88.0	6.23	5.90
S3 M3	5.32	79.0	6.05	6.13
SEm ±	0.14	0.03	0.22	0.21
CD (0.05)	NS	0.18	NS	NS

Table 2.11 : Effect of plant density and fertilizer application on ground area coverage by canopy (%) at Madakkathara

Treatments	Ground area coverage by canopy (%)			Mean
	M1	M2	M3	
S1	89.9	88.1	89.9	89.3
S2	104.9	112.5	116.4	111.3
S3	122.2	152.3	145.5	140
Mean	105.7	117.6	113.5	

PILICODE

With the evaluation of plant height and canopy area the fertilizer doses did not influence the other vegetative and yield characteristics significantly. The tallest plants were observed with higher fertilizer dose (225 Kg N : 75 Kg P_2O_5: 75 Kg K_2O) though it was on par with lower fertilizer dose (75 Kg N : 25 Kg P_2O_5: 25 Kg K_2O). Canopy area and fertilizer dose exhibited a positive correlation.

Spacing influenced vegetataive characters viz., plant height, stem girth, canopy area and per cent ground cover. Closer spacing 600 plants / ha (5m x 4 m) resulted in higher plant height, stem girth as well as significantly higher ground coverage.

The interaction effect of fertilizer dosage and plant density did not significantly influence vegetative and reproductive characteristics. Higher seed set was observed with M3S1 [225 Kg N : 75 Kg P_2O_5: 75 Kg K_2O, 200 plants / ha (10 m x5m)] which was on par with M3S2 [225 Kg N : 75 Kg P_2O_5: 75 Kg K_2O, 400 Plants / ha (6 m x 4 m)] and M2S1 [150 Kg N : 50 Kg P_2O_5: 50 Kg K_2O, 200 plants / ha (10 m x 5m)] (Table 2.12, 2.13 and 2.14).

Table 2.12 : Effect of Fertilizer on vegetative characters and yield of Cashew variety MDK-1

Treatments	Plant height (m)	Girth (m)	Spread of the plant (m)	Canopy area (m^2)	% Ground cover by canopy	No of flowering panicle per m^2	Bisexual: total flowers ratio	Seed set/ m^2
M1	3.847a	0.563	3.847	22.765b	86.205	13.109	0.107	5.632
M2	3.598b	0.557	3.948	22.813b	90.927	12.548	0.096	6.397
M3	3.962a	0.586	4.235	26.142a	103.002	13.815	0.093	7.692
F Test	*	NS	NS	*	NS	NS	NS	NS
CD @5%	0.187	-	-	1.946	-	-	-	-

*Means superscripted by the same letters do not differ significantly at p=0.05 by Duncan's Multiple Range Test

Table 2.13 : Effect of spacing on vegetative characters and yield of cashew variety MDK-1 at Pilicode.

Treatment	Plant height (m)	Girth (m)	Canopy area (m^2)	% Ground cover by canopy	No. of flowering panicle per m^2	Bisexual: total flowers ratio	Seed set/ m^2
S1	3.616b	0.584b	22.149b	46.061b	13.372	0.094	7.878
S2	3.711b	0.511c	22.632b	99.851ab	12.583	0.102	6.259
S3	4.080a	0.612a	26.939a	134.223a	13.518	0.099	5.584
F test	**	**	*	**	NS	NS	NS
CD @ 5%	0.246	0.053	2.650	44.660	-	-	-

*Means superscripted by the same letters do not differ significantly at P=0.05 by Duncan's Multiple Range Test

Table 2.14 : Interaction effect of spacing and doses of fertilizer application on growth and yield of cashew variety MDK -1 at Pilicode.

Treatment	Plant Height (m)	Girth (m)	Canopy area (m^2)	% Ground coverage by canopy	No of flowering panicle per m^2	Bisexual: total flowers ratio	Seed set/ m^2
M1S1	3.83	0.56	24.25	49.58	13.69	0.09	5.257b
M1S2	3.64	0.50	20.44	90.81	12.82	0.12	5.167b
M1S3	4.07	0.61	23.59	118.22	12.80	0.11	6.473ab
M2S1	3.18	0.52	16.52	35.44	11.69	0.09	8.917a
M2S2	3.60	0.50	23.04	98.29	11.60	0.10	5.280b
M2S3	3.99	0.64	28.87	139.04	14.34	0.09	4.993b
M3S1	3.82	0.66	25.67	53.16	14.72	0.10	9.460a
M3S2	3.88	0.51	24.40	110.44	13.31	0.08	8.331a
M3S3	4.17	0.57	28.34	145.39	13.40	0.09	5.287b
Mean	3.80	0.56	23.90	93.37	13.15	0.09	6.574
F test	NS	NS	NS	NS	NS	NS	*
CD @ 5%	-	-	-	-	-	-	3.660

*Means superscripted by the same letters do not differ significantly at P=0.05 by Duncan's Multiple Range Test

Hort. 3: Drip irrigation trial

Centres : East Coast :

Vridhachalam

West Coast :

Vengurla

Plains / others :

Chintamani

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.

SUMMARY

At Vengurle, the fruit set/m^2 was maximum (89.87/m^2) in the treatment with Irrigation at 60% CPE while the mean number of nuts per panicle was maximum (16.65) in Irrigation at 80% CPE. Flowering was early in trees receiving irrigation at 80% CPE at Vridhachalam.

Experimental Details :

Treatments : 5
- T1 : No Irrigation
- T2 : Irrigation 20% of cumulative pan evaporation (CPE).
- T3 : Irrigation 40% of cumulative pan evaporation (CPE).
- T4 : Irrigation 60% of cumulative pan evaporation (CPE).
- T5 : Irrigation 80% of cumulative pan evaporation (CPE).

Spacing = 7 x 7m

Planting material = Softwood grafts

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

VENGURLA

The growth and yield attributing characters did not vary significantly among the treatments. The fruit set/m^2 was maximum (89.87/m^2) in case of Irrigation @ 60% CPE. Mean number of nut panicle was maximum (16.65) in case of Irrigation @ 80% CPE. Cumulative yield for nine harvests was maximum 29.84 Kg/tree in the irrigation treatment at 40 percent C.P.E. (Table 2.15 and 2.16).

Table 2.15 : Effect of drip irrigation on growth and yield attributing characters of cashewnut at vengurla

Treatment	Mean plant height (m)	Mean stem girth(cm)	Mean canopy spread (m)	Mean canopy area (m^2)	Mean No. of laterals/m^2	Mean No. of flow. panicle /m^2
T1 : No Irrigation	7.30	86.24	7.64	46.84	31.90	15.97
T2 : Irrigation 20% CPE	7.11	91.08	8.27	54.44	31.60	17.23
T3 : Irrigation 40% CPE	7.47	90.83	8.34	55.15	30.30	16.62

Treatment	Mean plant height (m)	Mean stem girth(cm)	Mean canopy spread (m)	Mean canopy area (m^2)	Mean No. of laterals/m^2	Mean No. of flow. panicle /m^2
T4 : Irrigation 60% CPE	7.41	85.41	7.83	48.72	32.0	17.95
T5 : Irrigation 80% CPE	7.14	91.91	8.03	51.49	28.93	16.80
SEm±	1.19	2.96	0.34	4.17	1.11	0.42
CD at 5%	N.S.	N.S.	N.S.	N.S.	N.S	N.S

Table 2.16 : Effect of drip irrigation on yield attributing characters of cashewnut at vengurla

Treatment	Mean Flow. duration (days)	Mean fruit set /m^2	Mean No. of nut/ panicle	Mean apple wt. (g)	Mean nut weight (g)	Cum. yield for 9th harvest (Kg/tree)
T1 : No Irrigation	102	69.07	14.77	66.0	9.75	26.81
T2 : Irrigation 20% CPE	105	79.37	15.20	67.75	9.17	28.30
T3 : Irrigation 40% CPE	108	76.55	14.67	70.0	9.22	29.84
T4 : Irrigation 60% CPE	110	89.87	15.55	67.75	9.10	26.46
T5 : Irrigation 80% CPE	101	84.65	16.65	69.0	9.00	28.74
SEm±	5.45	4.50	1.08	2.09	0.20	-
CD at 5%	N.S	N.S	N.S	N.S	N.S	-

VRIDHACHALAM

Irrigating the cashew plants at 80% of cumulative pan evaporation enhanced plant height, trunk girth, canopy spread and canopy surface area. The flowering was early in trees receiving irrigation at 80% CPE (Table 2.17).

Table 2.17 : Effect of drip irrigation on growth of cashew at Vridhachalam

Treatments	Plant height (m)	Trunk girth (cm)	Mean canopy diameter (m)	Canopy height (m)	Canopy surface area (m^2)
T1 - No irrigation	3.42	40.5	2.46	2.22	9.65
T2 - Irrigating 20% of CPE	3.98	42.2	2.82	2.76	14.50
T3 - Irrigating 40% of CPE	4.12	44.0	3.44	3.02	18.68
T4 - Irrigating 60% of CPE	4.56	45.8	3.92	3.34	23.86
T5 - Irrigating 80% of CPE	4.91	52.2	4.60	3.70	32.49
CD (0.05%)	0.18	0.26	0.64	0.32	5.12

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

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY:

The plant height and canopy height were higher at 4m x 4m spacing at Bapatla. At Jhargram the maximum plant height (3.14m), canopy spread (3.13m) and canopy area (17.17m^2) were recorded in 4m x 4m spacing. The per hectare yield was significantly higher (3.03 times) under high density planting (3250 Kg) as compared to normal density (1070 Kg) at Madakkathara.

Experimental Details :

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

BAPATLA

Maximum values for growth parameters were recorded with 4m x 4m density level. The plant height and canopy height were higher at 4m x 4m spacing where as trunk girth, mean canopy diameter and canopy surface area were higher with trees at 8m x 8m spacing (Table 2.18).

Table 2.18 : Growth parameters of high density planting and normal planting at Bapatla

Spacing	Plant height (m)	Trunk girth (cm)	Mean canopy diameter (m)	Canopy height (m)	Canopy surface area (m^2)
4m x 4m	4.10	55.44	4.29	3.83	29.58
8m x 8 m	3.27	58.24	5.16	3.07	33.48

JHARGRAM

There were significant differences between the two different spacings with respect to plant height, canopy spread and canopy area. The stem girth of the plants under the normal spacing and high density spacings were on par. Maximum plant height (3.14m), canopy spread (3.13m) and canopy area (17.17m^2) were recorded in 4m x 4m spacing (Table 2.19).

Table 2.19 : Growth and flowering attributes of high density observational trial of cashew at Jhargram

Treatment	Plant height (m)	Stem girth (cm)	Canopy spread (m)	Canopy area (m^2)	Flowering /m^2
4m x 4m	3.14	24.25	3.13	17.17	13.06
8m x 8m	2.38	21.00	2.46	10.13	13.54
S.Em +	0.15	1.99	0.27	1.88	NS
C.D. at 5%	0.33	4.38	0.59	4.14	
CV %	6.7	10.8	11.8	16.8	

MADAKKATHARA

All vegetative characters such as plant height (m), stem girth (cm) and canopy spread NS and EW were higher under normal density of planting than high density planting at the age of 16 years. The mean canopy spread indicated that there was overlapping of canopy under high density planting leading to shading.

The yield per tree was higher under normal density (6.85 Kg) to the tune of 31.73%, as compared to high-density planting system (5.20 Kg) during the sixteenth year of planting. The trend was reverse with respect to the yield at the plantation level. The per hectare yield was significantly higher (3.03 times) under high density planting (3250 Kg) as compared to normal density (1070 Kg).

The cumulative yield per tree of thirteen harvests was higher under normal density planting by 7.6 Kg (58.71 vs 51.11) over high density planting. The cumulative per ha yield for twelve harvests was considerably high under high density system as compared to normal density planting (29133 v/s 8313 Kg/ha) which was worked 3.50 times than that of normal density planting (Table 2.20).

Table 2.20 : Effect of high density planting on growth and yield attributes and yield of cashew during fifteenth year at Madakkathara

Parameters	High density planting (4m x 4m)			Normal planting (8m x 8m)
	Max.	Min.	Mean	
Tree height (m)	7.8	6.3	6.78	7.35
Trunk girth (cm)	140.0	70.0	97.1	102.8
Canopy spread - NS (m)	12.5	5.3	8.42	9.68
Canopy spread - EW (m)	12.0	5.0	7.44	9.50
Yield (Kg/tree/annum)	8.30	3.60	5.20	6.85
Yield (Kg/ha/annum)			3250	1070
Cumulative yield (Kg/ tree) in twelve harvests			51.11	58.71
Cumulative yield (Kg/ha) in thirteen harvests			29133	8313

VENGURLA

Under high density planting the mean plant height was 6.40m and canopy area was 20.63 m^2. The mean cumulative yield for 7 harvests was 6.64 Kg/plant (Table 2.21 & 2.22).

Table 2.21 : Growth and flowering of high density planting at Vengurla

Mean height (m)	Mean girth (cm)	Mean No. of laterals / m^2	Canopy height (m)	Mean canopy area (m^2)	Mean No. of flow. panicle /m^2	Mean flowering duration (days)	Mean canopy surface area (m^2)
6.40	83.44	24.19	5.72	20.63	12.19	111.5	50.48

Table 2.22 : Yield and yield attributing characters of high density planting at Vengurla

Mean fruit set /m^2	Mean No. of nut panicle	Mean apple wt. (g)	Mean nut weight (g)	Cumulative yield Kg/plant (For 7 harvest)
22.47	1.76	69.4	9.35	6.64

Hort.6: Intercropping in Cashew

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

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.

SUMMARY :

Marigold recorded the maximum yield of 5435 Kg/ha at Bapatla. At Jhargram, the maximum benefit cost ratio was obtained with bottle gourd (1.79) followed by cowpea (1.75). In different treatments the plant growth parameters did not show any significant differences at Paria. At Vengurla, out of five different tuber crops evaluated as intercrop greater yam recorded significantly higher yield (22.5 Kg/plot and 2.97 t/ha)

Experimental Details :

Main plot : 4 Sub plots : 3

F0 = No additional fertilizer to the intercrop

F1 = Additional fertilizer to the intercrop as per the state recommendation

F2 = 50% of additional fertilizer applied to the intercrop

No. of replications : 3 Design : Split plot

BAPATLA

Marigold has recorded maximum yield of 5435 Kg/ha leading to higher cost benefit ratio 3.81. The net return was Rs.40503/ha in case of cluster bean with a cost benefit ratio of 1.47. (Table 2.23)

Table 2.23 : Yield and net returns of intercrops and main crop in cashew inter crop trial at Bapatla

Treat-ment	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 + Intercrop	Total	Net	
T1	Cashew+Marigold	34.72	54.25	9.2	5.86	23000	110675	87675	3.81
T2	Cashew+Cluster bean	25.09	39.20	8.9	5.76	27500	68003	40503	1.47
T3	Cashew +Hibiscus	37.87	59.17	10.3	6.63	16500	47943	31443	1.90
T4	Cashew+Amaranthus	31.00	48.43	10.2	6.48	16800	59,664	22864	1.36
T5	Cashew Alone	——	——	10.3	6.63	11000	33150	22150	2.01

Sale price (Rs./Kg)

Raw cashew nuts 50=00 Cluster bean 10=00 Marigold 20=00

Amaranthus 1=60 Gogu 2=50

JHARGRAM

Maximum benefit cost ratio was obtained with bottle gourd (1.79) followed by cowpea (1.75) which gave a net return of Rs. 29,310/ha (Table 2.24).

Table 2.24 : Intercropping of Cashew at Jhargram

Treatments	Cost of cultivation (Rs/ha)			Yield of intercrop Q/ha	Return from intercrop (Rs/ha)	Net return (Rs/ha)	Benefit : Cost
	Cashew	Intercrop	Total				
Cashew + Green gram	28,458	7623	36081	7.44	44,640	8559	1.24
Cashew + Cowpea	28,458	10632	39090	68.40	68,400	29310	1.75
Cashew + Bottle gourd	28,458	12500	40958	146.88	73,440	32482	1.79

Price of intercrop (Rs./Kg) : Green gram - Rs. 60.00 Cowpea - Rs. 10.00
Bottle gourd - Rs. 5.00

MADAKKATHARA

All growth attributes of cashew except girth, height, and canopy spread (NS and EW) recorded marginal increases in their values in intercropped plots over the pure crop of cashew (Table 2.25).

Table 2.25 : Growth of cashew as influenced by intercropping at Madakkathara

	With intercropping	Without intercropping
Height of tree (m)	2.12	1.77
Girth of tree (cm)	20.0	20.0
Canopy spread (NS) (m)	2.24	1.88
Canopy spread(EW) (m)	2.36	1.80

PARIA

The highest trunk girth of 35.33cm was noted in cashew + cowpea followed by a trunk girth of 28.67cm in cashew+okra. The plant height varied from 1.78 to 3.28m in different treatments and plant growth parameters did not show any significant differences (Table 2.26).

Table 2.26 : Plant growth parameters of cashew as influenced by intercropping at Paria

Treatments	Trunk girth (cm)	Plant height (m)	Mean canopy diameter (m)
T1: Cashew + Pigeon pea (Vaishali)	24.00	1.78	2.67
T2: Cashew + Okra (GO-2)	28.67	2.20	2.70
T3: Cashew + Indian bean (GW-2)	25.50	2.29	2.44
T4: Cashew + Indian bean (NPS-1)	27.50	2.10	3.05
T5: Cashew + Cowpea (GC-4)	35.33	3.28	3.37
T6: Cashew alone	18.33	1.52	1.46
SEm ±	3.24	0.28	
C.D.@ 5%	NS	NS	

VENGURLA

Out of five different tuber crops, evaluated as intercrop greater yam recorded significantly higher yield (22.5 Kg/plot and 2.97 t/ha) which was followed by elephant foot yam (20.0 Kg/plot & 2.64 t/ha). The main crop of cashew recorded a mean yield of 8.64 Kg/tree and 1.35 t/ha (Table 2.27).

Table 2.27 : Yield observations of Intercrops in cashew at Vengurla

Treat.	Inter Crops	Spacing (cm)	Plot size sq.m.	Yield (Kg/Plot)	Yield / plot (t/ha)	Local Market (Rs/Kg)	Income (Rs/ha)
T1	Lesser Yam (Kangar)	60 x 60	24	7.0	0.92	40/-	36,960/-
T2	Greater Yam (Ghorkand)	60 x 75	24	22.5	2.97	40/-	1,18,800/-
T3	Aerial Yam (Karanda)	100 x 60	24	10.25	1.35	40/-	54,120/-
T4	Elephant foot Yam (Suran)	75 x 75	24	20.0	2.64	25/-	6,000/-
T5	Tapioca	100 x 60	24	9.5	1.26	4/-	5,040/-
	SEm±			0.75			
	CD at 5%			2.32			
Yield of Cashew (V-1)		8m x 8m		8.64 Kg/tree	1.35	100/-	1,35,000/-

VRIDHACHALAM

Intercropping with vegetable such as brinjal, tomato, coriander, bhendi, amaranthus, fenugreek, snakegourd has been initiated during February 2013 in the interspaces of the new hybrid plot.

Hort.7: Organic Management of Cashew

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY:

At Bhubaneswar, the maximum ground area coverage by canopy (77.01 %), was observed in recommended doses of fertilizer + 10 Kg FYM (Control) and total number of laterals / m^2 (18.75) were recorded with *in situ* green manuring / green leaf manuring to meet 100 % N. There were no significant differences among growth parameters at Jhargram, Madakkathara and Vengurla.

Treatments:

T1 - 100% N as FYM

T2 - 100% N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g

T3 - 50% N as FYM + Bio-fertilizers (200 g)

T4 - 100% N as Vermicompost + Bio-fertilizers (200 g)

T5 - Recycling of organic residue with the addition of 20% cow dung slurry (20.0% weight of organic residue as cow dung)

T6 - *In situ* green manuring / green leaf manuring to meet 100% N

T7 - 25% N as FYM + Recycling of organic residue + *In situ* green manuring / green leaf manuring + Bio-fertilizers (200 g)

T8 - Recommended doses of fertilizer + 10 Kg FYM (Control)

BHUBANESWAR

No significant difference due to various organic treatments was observed in plant height, plant girth, ground area coverage by canopy, total number of laterals / m^2 and flowering laterals / m^2 during 2012-13. However, maximum plant height (5.18 m) and flowering laterals / m^2 (17.33) was recorded in T7 with 25% N as FYM + Recycling of organic residue + *in situ* green manuring / green leaf manuring + Bio-fertilizers (200g). Maximum ground area coverage by canopy (77.01%), was observed in recommended doses of fertilizer + 10 Kg FYM (Control) and total number of laterals / m^2 (18.75) were recorded with *In situ* green manuring / green leaf manuring to meet 100% N (Table 2.28).

Table 2.28 : Vegetative and flowering characters of organic cashew plant at Bhubaneswar

Treatments		Plant height (m)	Plant girth (cm)	Ground area coverage (%)	Total number of laterals / m^2	Flowering laterals / m^2
T1	100 % N as FYM	4.58	62.50	73.85	17.67	15.92
T2	100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200g	4.33	59.17	71.66	18.42	16.92
T3	50% N as FYM + Bio- fertilizers (200 g)	4.47	61.17	72.28	17.00	15.42
T4	100% N as Vermicompost + Bio-fertilizers (200 g)	4.26	54.02	62.12	16.73	15.82
T5	Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	4.32	57.08	62.34	18.68	15.95
T6	In situ green manuring / green leaf manuring to meet 100% N	4.62	56.42	66.41	18.75	16.33
T7	25% N as FYM + Recycling of organic residue + *In situ* green manuring / green leaf manuring + Bio-fertilizers (200 g)	5.18	59.25	65.42	18.58	17.33
T8	Recommended doses of fertilizer + 10 Kg FYM (Control)	4.75	60.42	77.01	18.17	17.00
	F' test	NS	NS	NS	NS	NS
	SEM ±	0.273	2.458	5.990	1.589	1.725

JHARGRAM

The treatments were on par with respect to their response on different growth and flowering attributes studied (Table 2.29).

Table 2.29 : Growth and yield attributes of cashew variety BPP – 8 under organic management at Jhargram

Treatments	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	Canopy area (m^2)	Flowering / m^2
T1 – 100% N as FYM	4.4	52.7	5.1	36.8	14.3
T2 – 100% N as FYM + BF	4.1	46.3	5.2	35.4	16.7
T3 – 50% N as FYM + BF	3.9	49.0	4.9	33.1	17.3
T4 – 100% N as VC + BF	3.7	52.3	4.7	29.6	15.9
T5 – Recycling organic residues	3.5	41.3	4.1	22.7	16.2
T6 – Green leaf/ green manuring	3.6	48.3	4.5	26.5	17.2
T7 – 25% N as FYM + recycling organic residues + green leaf/green manuring +BF	3.9	41.7	4.3	26.3	16.6
T8 – RDF + 10 Kg FYM (Control)	4.1	45.7	4.8	29.6	14.9
S.Em +	0.293	5.72	0.53	6.88	1.51
C.D. at 5%	NS	NS	NS	NS	NS
CV %	9.19	14.9	11.9	24.1	10.9

MADAKKATHARA

None of the growth parameters viz., height, girth and canopy spread (NS and EW) of young cashew trees showed significant variation among treatments (Table 2.30).

Table 2.30 : Effect of treatments on the growth parameters in organic management trials at Madakkathara

Treatments	Height (m)	Girth (cm)	Canopy spread NS (m)	Canopy spread EW (m)
T1 – 100% N as FYM	3.23	40.0	3.58	3.53
T2 – 100% N as FYM + BF	3.38	39.8	3.88	3.79
T3 – 50% N as FYM + BF	3.53	40.02	3.94	3.86
T4 – 100% N as VC + BF	3.27	41.0	3.81	3.60
T5 – Recycling organic residues	3.42	44.16	4.12	3.85
T6 – Green leaf/ green manuring	3.44	43.50	4.45	4.40
T7 – 25% N as FYM + recycling organic residues + green leaf/green manuring + BF	3.54	40.69	4.46	4.42
8 – RDF + 10 Kg FYM (Control)	3.32	38.94	4.28	3.77
CD (0.05)	NS	NS	NS	NS

VENGURLA

There was no significant difference among the various treatments in respect of vegetative parameter attributes. However, treatment T8 (RDF+10 Kg FYM – control) recorded higher mean plant height (3.86 m), mean canopy spread (4.26 m^2), mean canopy area (14.86 m^2). Mean Fruit set/m^2 was maximum in case of T5 (Recycling organic residue + 20% cow dung slurry) (43.47/m^2) (Table 2.31 and 2.32).

Table 2.31 : Growth observations of organic farming trial in cashew at Vengurla

Treatments	Mean plant ht. (m)	Mean stem girth (cm)	Mean canopy spread (m)	Mean canopy area (m^2)
T1 - 100% N as FYM	3.24	40.75	3.73	11.84
T2 - 100% N as FYM + Biofertilizers (Azatobacter + Azospirillum + PSB*)	3.45	41.92	3.81	11.98
T3 - 50% N as FYM + Biofertilizers	3.07	41.08	3.31	8.79
T4 - 100% N as Vermicompost +Biofertilizers	3.26	40.33	3.70	11.43
T5 - Recycling of organic residues with addition of 20% cow dung slurry	3.28	42.08	3.32	10.02
T6 - In situ green manuring/green leaf manuring to meet 100% N	3.80	44.25	4.05	13.32
T7 - 25% N as FYM + Recycling of organic residues + *In situ* green manuring/green leaf manuring + Biofertilizers	2.88	42.00	3.48	11.41
T8 - RDF + 10 Kg FYM (Control)	3.86	43.33	4.26	14.86
SEm±0.30	2.67	0.34	1.92	
CD at 5% phosphate solubilising bacteria	N.S.	N.S.	N.S.	N.S.

Table 2.32 : Yield attribution characters of organic farming trial in cashew at Vengurla

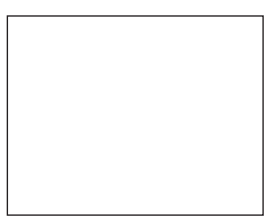
Treatments	Mean No. of Flow. panicle /m²	Mean flowering duration (days)	Mean fruit set/m²	Mean nut wt (g)	Mean apple wt. (g)
T1 - 100% N as FYM	15.33	109	39.40	8.23	63.53
T2 - 100% N as FYM + Biofertilizers (Azatobacter + Azospirillum + PSB*)	15.03	110	40.30	8.57	68.00
T3 - 50% N as FYM + Biofertilizers	15.90	120	37.13	8.20	64.26
T4 - 100% N as Vermicompost + Biofertilizers	14.63	121	40.97	7.57	68.50
T5 - Recycling of organic residues with addition of 20% cow dung slurry	13.57	119	43.47	7.70	70.10
T6 - In situ green manuring/green leaf manuring to meet 100% N	15.37	119	38.0	8.03	64.97
T7 - 25% N as FYM + Recycling of organic residues + *In situ* green manuring/ green leaf manuring + Biofertilizers	15.53	106	40.20	8.33	63.30
T8 - RDF + 10 Kg FYM (Control)	16.07	110	38.87	8.33	65.00
SEm±	0.957	3.08	1.66	0.33	2.49
CD at 5% phosphate solubilising bacteria	N.S.	9.33	N.S.	N.S.	N.S.

VRIDHACHALAM

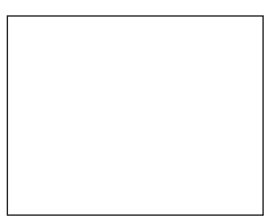
The highest trunk girth of 52.8cm was recorded in 100% N as FYM + Biofertilizers (Azatobacter + Azospirillum + PSB) followed by 51.5cm in recycling of organic residues with addition of 20% cow dung slurry.

Table 2.33 : Effect of organic treatments on growth of cashew variety VRI 3 at Vridhachalam

Treatments	Plant height (m)	Trunk girth cm)	Canopy spread (m)	
			E-W	N-S
T1	4.4	48.5	4.8	5.5
T2	4.0	52.8	6.3	5.5
T3	4.2	48.5	5.9	5.2
T4	3.5	47.0	5.5	5.5
T5	4.6	51.5	5.5	5.8
T6	4.5	45.0	5.8	5.8
T7	4.0	48.5	6.0	5.8
T8	4.3	44.5	5.6	6.5



III. CROP PROTECTION



III. CROP PROTECTION

Ent. 1: Chemical Control of pest complex in cashew

Expt. 3. Evaluation of insecticides for control of TMB and other insect pests

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara, Vengurla and Paria

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY:

At Bhubaneswar the least damage score of TMB (0.11) was observed in L-cyhalothrin (0.003%) as compared to control (0.47). At Jagdalpur, TMB mean damage score was also minimum in L cyhalothrin (0.03%) which was on par with imidachloprid, profenophos and acetamaprid. The lowest per cent infestation of leaf miner, shoot tip caterpillar and leaf and blossom webber (16.34, 13.17 and 15.70 respectively) was recorded in L-cyhalothrin (0.003%) at Paria.

Experimental details:

T1 - Neem oil soap (4%) followed by L- Cyhalothrin (0.6ml/l) followed by neem oil soap

T2 - Imidacloprid (0.6ml/lt)

T3 - Acetamaprid 20SP(0.5 g/l)

T4 - L-cyhalothrin 0.003%

T5 - Monocrotophos 0.05% at flushing, chlorpyriphos 0.05% at flowering and carbaryl 0.1% at fruit & nut development stage.

T6 – Untreated Control

BHUBANESWAR

All the insecticidal treatments recorded significantly lower insect pest infestation as compared to control. The least damage score of TMB (0.11) was observed in L-cyhalothrin (0.003%) followed by recommended spray schedule (0.12) as compared to control (0.47). These two treatment also recorded lowest damage severity in case of shoot tip caterpillar (0.6%) and thrips incidence (0.13%) as compared to control (4.5%) (Table 3.1).

Table 3.1 : Evaluation of insecticides for the control of TMB and other insect pests at Bhubaneswar

	Treatment	% damage by STC after first spray	% damage by STC after second spray	Damage grade (0- 4 scale) IT	TMB (0-4 scale) after 3rd spraying	Spider population /52 shoots	Coccinallid population /52 shoots	Black ant population /52 shoots
T1	Neem oil soap (4%) followed by L-cyhalothrin (0.003%) followed by neem oil soap (4%)	1.6 (1.44)	0.7 (1.09)	0.27 (0.88)	0.30 (0.89)	3.4 (1.97)	2.2 (1.64)	5.8 (2.51)
T2	Imidacloprid 17.8 SL (0.6ml/l) all three sprays	1.3 (1.34)	0.6 (1.04)	0.20 (0.84)	0.22 (0.85)	3.2 (1.92)	1.6 (1.45)	5.6 (2.47)
T3	Acetamaprid 20 SP (0.5g/l) all the three sprays	1.2 (1.31)	0.5 (1.00)	0.19 (0.83)	0.18 (0.82)	3.0 (1.87)	1.9 (1.55)	5.3 (2.41)
T4	L-cyhalothrin (0.003%)- (0.6ml/l) all the three sprays	1.1 (1.26)	0.6 (1.04)	0.14 (0.80)	0.11 (0.78)	2.1 (1.61)	1.5 (1.41)	3.8 (2.07)
T5	L-cyhalothrin (0.003%) followed by Profenophos 50EC (0.05%) followed by L-cyhalothrin (0.003%)	1.0 (1.22)	0.6 (1.04)	0.13 (0.79)	0.12 (0.79)	2.2 (1.64)	1.9 (1.55)	4.9 (2.32)
T6	Untreated control	6.4 (2.62)	4.5 (2.22)	0.64 (1.07)	0.47 (0.98)	6.60 (2.66)	7.0 (2.74)	8.80 (3.05)
	CD @5%	0.43	0.53	0.08	0.05	0.74	0.77	1.59

TMB = Tea mosquito bug STC = Shoot tip caterpillar IT = Infloresence thrips

JAGDALPUR

All the treatments were significantly superior over untreated control. The TMB mean damage score was minimum in L-cyhalothrin (0.003) which was on par with imidachloprid, profenophos and acetamaprid. In panicle stage also, these treatments were on par (Table 3.2).

Leaf folder and leaf caterpillar damage was least (38.15 & 38.29%) in acetamaprid (0.5/lt) treatment which was on par with L-cyhalothrin & Imidacloprid treatments. L-cyhalothrin could effectively minimize leaf miner damage (33.53%) and was on par with profenophos, acetamaprid and imidacloprid (Table 3.3 and 3.4).

Table 3.2 : Efficacy of different insecticides against major pests of cashew at Jagdalpur

TMB (Tea mosquito bug) Mean Damage Score 0-4 scale on 52 leader shoots					
Treatments	Shoot			Panicle	
	Pre-Treatment spray	30 DAS after Ist spray	30 DAS after IInd spray	30 DAS after Ist spray	30 DAS after IInd
T-1: Neem oil soap (4%) followed by L- cyhalothrin (0.6ml/l) followed by Neem oil soap	0.04 (0.01)	0.36 (1.16)b	0.14 (1.06)b	0.45 (1.20)bc	0.25 (1.11)b
T-2 : Imidacloprid 17.8 SL (0.6ml/l)	0.02 (0.01)	0.11 (1.05)a	0.03 (1.01)a	0.15 (1.07)a	0.06 (1.02)a
T-3 : Acetamaprid 20 SP (0.5g/l)	0.05 (0.02)	0.06 (1.02)a	0.06 (1.02)ab	0.33 (1.15)ab	0.04 (1.01)a
T-4: L-cyhalothrin 0.003%	0.02 (0.01)	0.02 (1.01)a	0.03 (1.01)a	0.22 (1.10)ab	0.10 (1.04)ab
T-5 : Profenophos 0.05%	0.01 (0.01)	0.06 (1.03)a	0.09 (1.04)ab	0.42 (1.19)abc	0.06 (1.02)a
T-6 : Unsprayed check	0.03 (0.02)	0.61 (1.26)c	0.80 (1.34)c	0.67 (1.28)c	0.75 (1.32)c
CD at 5%	NS	0.07	0.04	0.12	0.07

*Figure in parentheses are Square root transformed values

Table 3.3 : Damage due to minor pests under insecticides at Jagdalpur

Treatment	Percent incidence of minor pest of Cashew								
	% Leaf caterpillar damage			% Leaf Folder damage			% Leaf miner damage		
	Pre-treatment	30 DAS after Ist spray	30 DAS after IInd spray	Pre-treatment	30 DAS after Ist spray	30 DAS after IInd spray	Pre-treatment	30 DAS after Ist spray	30 DAS after IInd spray
T-1: Neem oil soap (4%) followed by L- cyhalothrin (0.6ml/l) followed by Neem oil soap	35.33 (36.00)	41.89 (40.29)bcde	46.63 (43.01)de	38.16 (38.08)	53.15 (46.81)e	40.19 (39.27)ab	22.08 (27.67)	36.39 (37.08)bcd	32.77 (34.90)a
T-2 : Imidacloprid 17.8 SL (0.6ml/l)	39.73 (38.86)	36.98 (37.40)bcd	38.80 (38.49)abc	31.77 (34.18)	46.77 (43.15)cd	48.86 (44.33)c	20.74 (26.76)	39.03 (38.64)d	35.44 (36.51)a
T-3 : Acetamaprid 20 SP (0.5g/l)	38.75 (38.48)	35.98 (36.60)b	38.29 (38.15)a	33.95 (35.29)	32.79 (34.82)ab	38.15 (38.04)a	15.89 (23.34)	31.94 (34.37)abc	33.62 (35.40)a
T-4: L-cyhalothrim 0.003%	37.00 (37.10)	25.36 (26.90)a	38.59 (38.38)ab	31.30 (33.96)	42.13 (40.41)bc	39.64 (39.00)ab	19.67 (26.30)	25.97 (30.53)a	30.58 (33.53)a
T-5 : Profenophos 0.05%	44.72 (41.91)	36.53 (37.15)bc	43.12 (41.02)abcd	32.73 (34.87)	29.35 (32.60)a	47.57 (43.57)c	15.13 (22.76)	30.45 (33.45)ab	32.40 (34.62)a
T-6 : Unsprayed check	36.60 (36.90)	44.90 (42.06)e	51.55 (45.87)e	32.32 (34.63)	45.75 (42.54)cd	52.20 (46.24)c	18.42 (25.34)	39.03 (39.20)d	46.76 (43.11)b
CD at 5%	NS	4.61	3.59	NS	5.93	4.23	NS	3.99	2.98

*Figure in parenthesis are angular transformed values

Table 3.4 : Efficacy of insecticides against different natural enemies of insect pest of cashew at Jagdalpur

Treatments	Mean number of natural enemies of insect pest of cashew at 30 DAS after IInd spray				
	Ant	Brumus	Spider	Mirid bug	Predatory Fly
T-1: Neem oil soap (4%) followed by L-cyhalothrin (0.6ml/l) followed by Neem oil soap	0.75	0.00	0.13	0.07	0.10
T-2 : Imidacloprid 17.8 SL (0.6ml/l)	1.00	0.03	0.13	0.16	0.06
T-3 : Acetamaprid 20 SP (0.5g/l)	0.00	0.01	1.38	0.06	0.00
T-4: L-cyhalothrin 0.003%	0.88	0.00	0.35	0.00	0.07
T-5 : Profenophos 0.05%	1.50	0.00	0.13	0.03	0.00
T-6 : Unsprayed check	1.13	0.00	0.13	0.05	0.03

MADAKKATHARA

The damage score in the treated and untreated plots was not significant as the population of TMB was very low (Table 3.5).

Table 3.5 : Effect of different insecticides against damage by tea mosquito bug in cashew at Madakkathara

Treatments	Incidence of TMB (Tea mosquito bug) Mean score for 52 leader shoots (0-4 scale)						Nut yield (Kg/tree/yr) Up to Feb, 2013
	Shoot			Panicle			
	Pre-treatment	30 days after		Pre-treatment	30 days after		
		1st spray	2nd spray		1st spray	2nd spray	
T-1: Recommended spray schedule (KAU)	0.083	0.029	0.029	0.092	0.584	0.092	2.92
T-2: Chlorpyriphos	0.071	0.017	0.013	0.142	0.783	0.142	2.35
T-3: Triazophos	O.213	0.105	0.009	0.092	1.080	0.092	1.15
T-4: L- cyhalothrin	0.101	0.050	0.038	0.150	0.462	0.150	1.59
T-5: Profenophos	0.071	0.121	0.025	0.200	0.838	0.200	1.91
T-6: Control	0.163	0.171	0.000	0.229	1.113	0.229	2.32
DMRT*	NS	NS	NS	NS	NS	NS	

* Duncan's multiple range test

Observations on insect pests other than TMB viz., leaf miner (LM), leaf and blossom Webbers (LBW) and apple & nut borers (ANB) revealed that the treatments did not bring any significant variation in the damage by these insect pests (Table 3.6).

Pests like aphids, mealy bugs, weevil and thrips were observed in isolated cases only.

Table 3.6 : Efficacy of different chemicals against minor pests of cashew at Madakkathara

Treat-ments	Leafminer (LM)			Leaf & blossom webbers (LBW)			Nut borers (NB)		
	30 days after each spraying (pest infestation in percentage)								
	Pre-treatment	1st	2nd	Pre-treatment	1st	2nd	Pre-treatment	1st	2nd
T-1: POP	4.361	0.460	0.00	0.00	0.375	0.375		0.00	17.95
T-2: Chlor.	2.918	1.885	0.00	0.25	0.375	0.00		0.00	30.40
T-3: Triazo.	6.483	1.488	0.00	0.00	0.125	0.00		0.00	30.85
T-4: Cyhalo.	4.241	1.641	0.00	0.38	0.875	0.00	NA	0.00	11.46
T-5: Profeno.	4.568	2.039	0.00	0.25	0.625	0.00		0.00	21.10
T-6: Control	5.534	3.443	0.00	0.13	1.50	0.00		0.00	16.43
F-test	NS	NS		NS	NS	NS		NS	NS

PARIA

After first spray, the least damage score due to TMB (0.68) was recorded in the treatment of L-cyhalothrin (0.003%), however, it was statistically at par with acetamiprid 20 SP, clothianiidin 50% WDG and B-cyfluthrin 20 SC. A similar trend of efficacy of insecticides was noticed after second spray.

The lowest infestation percent (16.34, 13.17 and 15.70) respectively caused by LM, STC and LBW was recorded in L-cyhalothrin (0.003%) which was on par with acetamiprid and B-cyfluthrin. Similarly, the least infestation (13.50) due to ANB was observed in L-cyhalothrin @ 0.003%, which was statistically at par with acetamiprid, cyfluthrin and clothianiidin (Table 3.7 and 3.8).

Table 3.7 : Efficacy of different insecticides against TMB in cashew (V-4) at Paria

Treatments	TMB rating during first spray			TMB rating during second spray		
	Before Spray	7 days after spray	15 days after spray	Before Spray	7 days after spray	15 days after spray
Acetamiprid 20 SP @ 0.004 % ; 0.2g/lit	1.18 (1.40)	0.89 (0.80)	0.77 (0.60)	1.29 (1.67)	1.03 (1.06)	0.73 (0.53)
Clothianiidin 50 % WDG @0.003 %; 0.06ml/lit	1.05 (1.13)	0.95 (0.93)	0.80 (0.67)	1.39 (1.93)	1.03 (1.13)	0.85 (0.73)
Trizophos 40 EC @ 0.04 % ;1ml/lit	1.03 (1.07)	0.96 (0.93)	0.89 (0.80)	1.39 (1.93)	1.23 (1.53)	1.06 (1.13)
L-Cyhalothrin 5 EC @ 0.003 %; 0.6ml/lit.	1.06 (1.13)	0.77 (0.60)	0.68 (0.47)	1.31 (1.73)	1.00 (1.00)	0.68 (0.47)
Profenophos 50EC @ 0.05 % ; 1ml/lit	1.08 (1.20)	1.00 (1.00)	0.89 (0.80)	1.34 (1.80)	1.15 (1.33)	1.00 (1.00)
ß-Cyfluthrin 20 SC @ 0.012% ; 0.6ml/lit	1.06 (1.13)	0.96 (0.93)	0.82 (0.67)	1.34 (1.80)	1.06 (1.13)	0.86 (0.73)
Endosulfan 35 EC @ 0.07 %; 2 ml/lit	1.03 (1.07)	1.00 (1.00)	0.93 (0.87)	1.41 (2.00)	1.26 (1.60)	1.03 (1.07)
Control	1.05 (1.13)	1.26 (1.60)	1.34 (1.80)	1.46 (2.13)	1.50 (2.27)	1.55 (2.40)
SEm ±	0.08	0.08	0.06	0.06	0.06	0.05
C.D.(0.05)	NS	0.25	0.20	NS	0.18	0.14

* Figures in parenthesis are mean values of square root transformation

Table 3.8 : Efficacy of different insecticides against various pests in cashew V-4 at Paria

Treatments	% Infestation due to LM			% Infestation due to STC			% Infestation due to LBW			% Infestation due to ANB
	1st Spray		2nd Spray	1st Spray		2nd Spray	1st Spray		2nd Spray	2nd Spray
	BS	AS	AS	BS	AS	AS	BS	AS	AS	AS
Acetamiprid 20 SP @ 0.004 % ; 0.2g/lit	17.01 (8.59)	12.19 (4.51)	17.07 (8.64)	15.64 (7.29)	11.82 (4.22)	14.32 (6.14)	15.71 (7.35)	13.14 (5.20)	16.43 (8.01)	15.11 (6.85)
Clothianiidin 50% WDG @0.003 %;0.6ml/lit	16.73 (8.36)	14.54 (6.34)	19.77 (11.47)	15.37 (7.09)	14.65 (6.45)	16.16 (7.77)	16.63 (8.21)	15.54 (7.20)	17.36 (8.93)	15.80 (7.43)
Trizophos 40 EC @ 0.04 % ; 1ml/lit	17.13 (8.75)	16.39 (8.02)	20.62 (12.49)	15.04 (6.79)	14.35 (6.18)	15.80 (7.45)	16.43 (8.01)	15.83 (7.45)	18.03 (9.61)	17.16 (8.78)
L-Cyhalothrin 5 EC @ 0.003 %; 0.6ml/lit.	17.50 (9.29)	11.70 (4.28)	16.34 (7.98)	15.87 (7.50)	11.63 (4.09)	13.17 (5.21)	16.53 (8.13)	12.30 (4.57)	15.70 (7.33)	13.50 (5.49)
Profenophos 50EC @ 0.05 % ; 1ml/lit	17.09 (8.68)	14.55 (6.35)	20.15 (11.92)	15.63 (7.34)	14.61 (6.44)	15.63 (7.29)	16.31 (7.91)	15.25 (6.94)	17.99 (9.60)	16.06 (7.66)
ß-Cyfluthrin 200 SC @ 0.012%; 0.6ml/lit	17.35 (9.01)	14.42 (6.33)	16.75 (8.33)	15.37 (7.08)	12.04 (4.39)	13.74 (5.67)	16.47 (8.04)	12.44 (4.67)	16.49 (8.12)	13.56 (5.54)
Endosulfan 35 EC @ 0.07 %; 2 ml/lit	16.38 (8.02)	16.04 (7.69)	20.14 (11.90)	16.31 (7.92)	15.27 (6.99)	15.89 (7.52)	16.34 (7.98)	15.51 (7.17)	18.33 (9.92)	16.69 (8.26)
Control	17.27 (8.88)	21.39 (13.32)	24.09 (16.69)	17.10 (8.68)	19.42 (11.08)	19.57 (11.24)	16.48 (8.17)	18.44 (10.08)	21.92 (13.95)	20.44 (12.23)
S.Em.+	1.36	1.17	0.80	0.78	0.80	0.64	0.72	0.66	0.64	0.78
C.D.(0.05)	NS	3.56	2.43	NS	2.43	1.94	NS	2.00	1.94	2.35
CV%	13.78	13.40	7.16	8.58	9.74	7.14	7.61	7.71	6.23	8.38

BS = Before spary AS = After spary LM = leaf miner

STC = shoot tip caterpillar LBW = leaf & blossom webber ANB = apple and nut borer

* Figures in parenthesis are mean values of arc-sin transformation.

VENGURLA

It is observed that all the insecticidal treatments significantly reduced the incidence of TMB over control in cashew. Among the insecticidal treatments, treatment (T4) L-cyhalothrin (0.003%) was observed significantly superior over rest of the treatments after third spray, followed by neem oil (0.09) + L-cyhalothrin (0.20) and acetamaprid (Table 3.9).

Table 3.9 : Incidence of tea-mosquito bug in various treatments at Vengurla

Sr. No.	Treatment details	TMB damage 0-4 scale			
		Pre treatment damage	TMB damage after third spray	Thrips damage after third spray	Yield Kg/tree
T1	First spray with Neem oil soap (4%) followed by L-cyhalothrin (0.003%) as second spray within 15 days followed by neem oil soap (4%) as third spray	0.36	0.20	0.16	0.976
T2	Imidachloprid 17.8 SL (0.6ml/l) all the three sprays	0.48	0.22	0.22	0.746
T3	Acetamaprid 20 SP (0.5 g/l) all the three sprays	0.28	0. 21	0.14	0.377
T4	L-cyhalothrin (0.003%-0.6ml/l) all the three sprays	0.14	0.09	0.11	1.06
T5	Recommended spray schedule for the region	0.44	0.22	0.26	0.260
T6	control	0.33	0.63	0.47	0.150
	S.E.m±	0.12	0.78	0.39	
	C.D. at 5%	NS	0.24	0.112	

VRIDHACHALAM

The incidence of TMB was absent in Vridhachalam hence, the scheduled insecticidal trials could not be conducted.

Ent. 2: Control of cashew stem and root borer

Expt. 2. Curative control trial

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani 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.

SUMMARY:

Chlorpyriphos 0.2% gave protection to 86.30 per cent of treated trees without re-infestation or persistent attack at Bapatla. At Bhubaneswar, chlorpyriphos and monocrotophos treatment led to maximum recovery (92% to 83% respectively) with minimum cost of treatment (Rs. 60 to 63 /tree/year respectively). Chlorpyriphos (0.2%) led to maximum recovery of 72.22 per cent trees without re-infestation at Jagdalpur. Among the insecticides evaluated, chlorpyriphos (0.2%) was found effective with 90% of trees without re-infestation while, the percent of trees without reinfestation was lower in untreated check (70%) and treated check (75%) at Madakkathara.

Treatments :

T1 = Carbaryl (1%)
T2 = Chlorpyriphos (0.2%)
T3 = Monocrotophos (0.2%)
T4 = Lindane (0.2%)
T5 = *Metarhizium anisopliae* fungus spawn 250gm/tree + 500gm neem cake
T6 = Control (only removal of CSRB stages)

BAPATLA

Chlorpyriphos (0.2%) offered protection to 86.30 percent of treated trees followed by monocrotophos (0.2%) leading to 63.63 percent of treated trees without re-infestation or persistent attack. Treated check with neem oil has offered 31.80 percent protection without re-infestation or persistent attack and control treatment recorded 54.54% trees without re-infestation or persistent attack (Table 3.10).

Preferential zone of attack was collar in 38.63 percent of trees (34/88) followed by root in 31.82 percent of trees (28/88) followed by collar + root 21.59 percent (19/88) (Table 3.11).

Table 3.10 : Efficacy of insecticides as curative control against cashew stem and root borer at Bapatla

Treatment	% trees without reinfestation / persistant attack
Carbaryl 1.0%	**
Chlorpyriphos 0.2%	86.30
Monocrotophos 0.2%	63.63
Lindane 0.2%	**
Treated check with most effective treatment under prophylactic trails	31.80
Untreated check (only removal of CSRB grubs)	54.54

** = this treatment was not evaluated due to non-availability of insecticide.

Table 3.11 : Physical parameters of cashew trees after treatment with insecticides as curative measures at Bapatla

Parameters		Total trees treated	No. of trees in each category	
			Without reinfestation	With re- infestation / persistant infestation
Stem girth (cm.)	< 60	8	6	2
	60-80	16	12	4
	80-100	20	12	8
	> 100	44	30	14
	Total	**88**	**60**	**28**
Age (Years)	< 5	0	0	0
	5-10	0	0	0
	10-15	33	19	14
	> 15	55	41	14
	Total	**88**	**60**	**28**
% Bark circumference damaged	< 25	62	43	19
	25-50	17	13	4
	50-75	6	3	3
	> 75	3	1	2
	Total	**88**	**60**	**28**
Zone	C+R	19	14	5
	C+S	3	2	1
	R	28	17	11
	S	0	0	0
	C	34	26	8
	C+R+S	4	1	3
	Total	**88**	**60**	**28**
Canopy yellowing	a) Yellowed	5	0	5
	b) Not yellowed	83	60	23
	Total	**88**	**60**	**28**

BHUBANESWAR

Maximum recovery (92%) was obtained from chlorpyriphos (0.2%) followed by monocrotophos (0.2%) treatment (83%). Maximum cost of treatment (Rs. 90/ treatment / year) was involved in neem oil treatment with a recovery of only 33.0 percent. In control treatment i.e., only in phyto-sanitation the cost is less however frequency of extraction of grub is maximum (5 times) which is detrimental for the tree. So both in chlorpyriphos and monocrotophos treatment maximum recovery (92% to 83% respectively) with minimum cost (Rs. 60 to 63 / treatment/year respectively) was recorded (Table 3.12).

The stem girth of 60-80 cm had higher re-infestation and < 60 cm stem girth exhibited least re-infestation. The plants in age group of 5 to 10, had lower reinfestation (Table 3.13).

Table 3.12 : Efficacy of insecticides on post extraction prophylaxis (PEP) against CSRB affected tree under curative trial at Bhubaneswar

Treatments		Mean recovery of trees (%)	Total number of treatment	Cost of treatment (Rs.)
T1	Carbryl (1.0%)	76	3	61
T2	Chlorpyriphos (0.2%)	92	3	60
T3	Monocrotophos (0.2%)	83	3	63
T4	Untreated check (only removal of immature grubs)	25	5	75
T5	Neem oil (5%)	33	4	90
	Total	-	-	-

Table 3.13 : Physical parameters of cashew stem and root borer infested trees observed in curative trials at Bhubaneswar

Physical parameters		No. of trees treated	No. of trees Infested	% of trees infested	No. of trees not Infested	% of trees not Infested
Stem girth (cm)	< 60	14	2	14.3	12	85.7
	60 -80	25	6	24.0	19	76.0
	80 -100	30	9	30.0	21	70.0
	>100	27	13	48.1	14	51.9
	Total	96	30	-	66	-
Age of the tree (in years)	<5	8	0	0	8	100
	5 -10	22	4	18.2	18	81.8
	10 -15	31	11	35.5	20	64.5
	>15	35	15	42.9	20	57.1
	Total	96	30	-	66	-

Physical parameters		No. of trees treated	No. of trees Infested	% of trees infested	No. of trees not Infested	% of trees not Infested
Zone of attack	C+R	15	3	20.2	12	80.0
	C+S	27	6	22.2	21	77.8
	R	12	2	16.7	10	83.3
	S	20	9	45.0	11	55.0
	C+S+R	22	10	45.5	12	54.5
	Total	96	30	-	66	-0
Yellowing of canopy	Yellowed	9	9	100	0	75.9
	Not yellowed	87	21	24.1	66	-
% of bark circumference damaged	<25	96	30	-	66	97.0
	25 -50	33	1	3.0	32	91.9
	50 -75	37	3	8.1	34	0
	>75	17	17	100	0	0
	9	9	100	0	-	
	96	30	66			

JAGDALPUR

Chlorpyriphos (0.2%) led to maximum recovery of 72.22 per cent trees without re-infestation. The cashew trees having 60-100 cm of stem girth were more prone to attack of CSRB. More than 15-year-old cashew trees were more susceptible to attack of this pest (Table 3.14).

Preferential zone of attack by cashew stem and root borers in the tree were collar zone followed by collar + stem zone with 12.22 and 10.00 per cent re-infested trees, respectively. The pest re-infestation was maximum (17.78%) in which bark circumference damage was 25-50 per cent followed by 25 per cent bark circumference damaged tree (8.89%) (Table 3.15).

Table 3.14 : Efficacy of certain insecticides as curative control against CSRB at Jagdalpur

Treatment	% of trees without re-infestation/ persistent attack
T1 : Carbaryl (1.0%)	66.67
T2 : Chlorpyriphos (0.2%)	72.22
T3 : Monocrotophos (0.2%)	55.56
T4 : Chlorpyriphos (0.1%)	61.11
T5 : Untreated check (only removal of CSRB grubs followed)	33.33

Table 3.15 : Physical parameters of trees observed under curative control against CSRB at Jagadalpur

Physical parameters		No. of trees re-infested	Percentage of total trees treated	No. of trees not re-infested	Percentage of total trees treated
Stem girth	<60 cm	2	2.22	6	6.67
	60-100 cm	18	20.00	29	32.22
	>100 cm	12	13.33	23	25.56
Total		32	35.56	58	64.44
Age of tree	<10 years	0	0.00	0	0.00
	10-15 years	27	30.00	18	20.00
	>15 years	33	36.67	12	13.33
Total		60	66.67	30	33.33
Zone of attack	C	11	12.22	17	18.89
	C+R	5	5.56	10	11.11
	C+S	9	10.00	14	15.56
	R	0	0.00	5	5.56
	S	4	4.44	12	13.33
	S+R	1	1.11	1	1.11
	C+S+R	0	0.00	1	1.11
Total		30	33.33	60	66.67
Canopy yellowing	a) Canopy Yellowed	13	14.44	12	13.33
	b) Canopy not yellowed	26	28.89	39	43.33
Total		39	43.33	51	66.67
% of bark circumference damaged	<25	8	8.89	17	18.89
	25-50	16	17.78	27	30.00
	50-75	5	5.56	12	13.33
	>75	1	1.11	4	4.44
Total		30	33.33	60	66.67

*Zone of attack:

a) C+R :- Collar + Root, b) C+S : - Collar + Stem

c) C+R+S :- Collar + Root + Stem d) S : - Only Stem

e) R : - Only Root

MADAKKATHARA

Among the insecticides evaluated, chlorpyriphos (0.2%) was found effective with 90 per cent of trees without re-infestation, followed by monocrotophos (0.2%) showing 85 per cent trees without re-infestation. Chlorpyriphos (0.1%) and Carbaryl (1%) showing 80 per cent trees without re-infestation. The per cent of trees without reinfestation was lower in untreated check (70%) and treated check (75%) (Table 3.16).

In few cases canopy yellowing was observed.

Table 3.16 : Efficacy of different insecticides for curative control against CSRB (post prophylaxis treatments) at Madakkathara

Treatments		Percentage trees without re-infestation/ persistent attack
T-1	Carbaryl (1%)	80
T-2	Chlorpyriphos (0.2%)	90
T-3	Monocrotophos (0.2%)	85
T-4	Chlorpyriphos (0.1%)	80
T-5	Untreated check (grub-extraction only)	70
T-6	Maximum prophylactic control (neem oil 5% swabbing + 75 g Sevidol 8% tree)	75

Pest reinfestation was higher in trees having 80 – 100cm trunk girth while age did not influence reinfestation. Maximum reinfestation occurred in trees having 50-75% bark circumference damaged while the most preferred zone of attack for reinfestation was collar + root + stem (Table 3.17).

Table 3.17 : Physical parameters of trees observed at Madakkathara

Parameters		No. of trees each category	
		Without re- infestation	With re- infestation
Stem girth (cm)	<60	7	1
	60 - 80	29	4
	80 – 100	40	10
	>100	27	2
Total		103	17
In yrs	< 5	-	-
	5 -10	43	6
	10 – 15	33	7
	>15	5	6
Total		101	19
% of bark circumferences damaged	< 25	28	3
	25 – 50	24	7
	50 – 75	37	9
	>75	9	3
Total		98	22

Parameters		No. of trees each category Without re- infestation	With re- infestation
Zone	C + R	19	4
	C + S	30	6
	R	7	-
	S	29	1
	C + R + S	16	8
Total		101	19
Canopy yellowing	Yellowed	11	4
	Not yellowed	85	20
Total		96	24

VENGURLA

Chlorpyriphos (0.2%) recorded 86.66 per cent trees without reinfestation followed by chlorpyriphos (0.1%) having 80.00 per cent trees without reinfestation. Percentage of trees without reinfestation was least (53.33%) in untreated check (Table 3.18).

Table 3.18 : Effect of curative treatments against Cashew Stem and Root Borer (CSRB) at Vengurla

Treatment	% trees without reinfestation
T1- Carbaryl (1%)	73.33
T2- Chlorpyriphos (0.2%)	86.66
T3- Monocrotophos (0.2%)	66.66
T4 Chlorpyriphos (0.1%)	80.00
T5- Effective treatment in prophylactic trial (Swabbing Neem oil 5% during Oct.- Nov., Jan. – Feb. and April - May)	66.66
T6- Removal of Grubs - Control	53.33

VRIDHACHALAM

Maximum recovery of 44.00 per cent was noted in dichlorvas (0.2%) treated trees, which was on par with chlorpyriphos (0.2%) treated trees with 40.30 per cent recovery. Treatment with carbaryl (1.0%), Lindane (0.2%) and neem oil (5.0%) lead to 37.5, 30.0 and 35.0 per cent recovery, respectively as against lowest recovery of 5.55 per cent in untreated control, which involved only the removal of grubs (Table 3.19).

Table 3.19 : Efficacy of certain insecticides as curative control against CSRB at Vridhachalam

Treatment		No. of trees treated	No. of trees without reinfestation	Mean % recovery of trees from CSRB	Frequency of treatment	Cost of treatment/ tree
T1	Carbaryl (1%)	24	09	37.50 b	3	72.0
T2	Chlorpyriphos (0.2%)	27	11	40.30a	3	60.0
T3	Dichlorvas (0.2%)	25	11	44.00 a	3	60.0
T4	Lindane (0.2%)	20	06	30.00d	3	60.0
T5	Untreated check (removal of grubs)	18	01	05.55e	3	30.0
T6	Treated check (Neem oil 5%)	20	07	35.00c	3	65.0
	Total	134	45	-	-	-

Trees having less than 25 per cent damaged bark circumference, resulted in 63.9 per cent having no reinfestation while trees with 51-75 per cent and more than 75 per cent bark damage with yellowing of canopy had 100 per cent reinfestation (Table 3.20).

Table 3.20 : Details of physical parameters of treated cashew trees with re-infested/ without re-infestation 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 (cm)	< 60	27	08	29.6	19	70.4
	60-80	32	20	62.5	12	37.5
	80-100	34	27	79.4	07	20.6
	> 100	41	34	82.9	07	17.1
Total		134	89	-	45	-
Age of the tree (years)	< 5	27	05	18.5	22	81.5
	5- 10	30	17	56.6	13	43.4
	10-15	37	31	83.3	06	16.7
	> 15	40	36	90.0	04	10.0
Total		134	89	-	45	-
Zone of attack	C+R	27	20	74.0	07	26.0
	C+S	32	08	25.0	24	75.0
	R	24	20	83.3	04	16.7
	S	23	17	73.9	06	26.1
	C+S+R	28	24	85.7	04	14.3
Total		134	89	-	45	-
Yellowing of canopy	Canopy yellowed	42	42	100.0	0.0	0.0
	Canopy not yellowed	92	47	51.1	45	48.9
Total		134	89	-	45	-
% of bark circumference damaged	< 25	61	22	36.1	39	63.9
	26-50	37	31	83.8	06	16.2
	51-75	24	24	100.0	00	0.0
	>75	12	12	100.0	00	0.0
Total		134	89	-	45	-

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

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY:

At Bhubaneswar, incidence of inflorescence thrips had significant negative correlation with minimum temperature and RH. Leaf beetle was observed to have positive correlation with rainfall and RH and had a peak activity during September. At Jagdalpur, maximum temperature negatively influenced the occurrence of leaf caterpillar. At Paria, TMB population was negatively correlated with maximum temperature. The apple and nut borer showed positive correlation with maximum temperature and morning humidity, while the incidence of thrips showed positive correlation with maximum temperature at Vengurla. At Vridhachalam, aphid population had positive correlation with relative humidity and minimum temperature.

BHUBANESWAR

The maximum activity of shoot tip caterpillar (*Hypatima haligramma*) was 10.7 % in October and had positive significant correlation with the BSH.

Inflorescence thrips (*Frantliniclla schultzii* T *Haplothrips ceylonicus* Sch.) population was active during the flowering period. Minimum temperature and RH had significant negative correlation with incidence of the pest.

Leaf miner (*Acrocercops syngramma*) population was maximum 10.5 % during October. Both temperature and rainfall had negative correlation with the pest incidence.

The activity of apple and nut borer (*Nephopteryx* sp.) coincided with the fruiting stage during May. Maximum temperature had positive significant correlation with the pest incidence.

Leaf and blossom webber (*Lamida moncusalis*.) activity was limited to April to June with maximum population in May. Maximum Temperature and RH had positive significant correlation with the incidence of the pest.

Leaf beetle (*Monolepta longitarsus*) was observed only during rainy season with peak activity during September. Rainfall and RH had positive and bright sunshine hour had negative significant correlation towards incidence of the pest.

The activity of cashew stem and root borer (*Plocaederus ferrugineus*) was observed throughout the year but its activity was negligible during colder months; during December and January. Maximum temperature had positive significant correlation with pest infestation (Table 3.21).

Table 3.21 : Correlation of weather parameters with the pests of regional importance at Bhubaneswar

Name of the pest observed	Temperatures		RH		Rainfall in (mm)	BSH (%)
	Maximum	Minimum	Maximum	Minimum		
	X1	X2	X3	X4	X5	X6
STC (Y1)	-0.609	-0.432	0.415	0.039	-0.292	0.311
YT (Y2)	0.466	-0.150	-0.652	-0.689	-0.475	0.482
BT (Y3)	0.380	-0.215	-0.600	-0.647	-0.404	0.456
LM (Y4)	-0.570	-0.326	0.407	0.147	-0.186	0.224
A & NB (Y5)	0.881	0.493	-0.699	-0.309	-0.248	0.357
L&BW (Y6)	0.950	0.506	-0.856	-0.345	-0.241	0.227
LB (Y7)	-0.073	0.583	0.431	0.879	0.554	-0.730
CSRB (Y8)	0.884	0.699	-0.616	-0.015	-0.163	0.084

* = 'r' at 5 % level of significance

STC: Shoot tip caterpillar, YT: Yellow thrips, BT: Black thrips

LM: Leaf miner, A & NB: Apple and nut borer

L & BW: Leaf and blossom webber

LB: Leaf beetle, CSRB: Cashew stem and root borer

JAGDALPUR

The TMB damage in shoot ranged from 0.04 – 1.11 per cent during October to June with maximum in November; in panicle TMB damage was maximum in February to May. The minimum temperature significantly negatively influenced (r= -0.689) the activity of TMB on shoot. Maximum temperature significantly positively influenced (r= 0.454) the TMB damage on panicle.

Cashew stem and root borer infestation was observed round the year with a maximum infestation of 13.57 per cent. Rainfall significantly negatively influenced (r= -0.442) the infestation of CSRB. Whereas, Relative humidity (morning) significantly positively influenced (r= 0.452) the infestation of CSRB.

The leaf damage by leaf caterpillar was maximum in December. Maximum temperature significantly negatively influenced (r= -0.751) while RH had a positive influence (r=0.57) the incidence of the leaf caterpillar.

Leaf folder damage was observed through out the year with damage range from 30.12 to 51.35 per cent. Maximum temperature significantly negatively influenced (r= - 0.495) the activity of this pest.

The incidence of leaf miner damage was maximum during of November. Minimum temperature, relative humidity (morning) and wind velocity significantly negatively influenced (r= -0.682, -0.406 and -0.598, respectively) the activity of incidence of leaf miner (Table 3.22).

Table 3.22 : Correlation of weather parameters with the pests of regional importance at Jagdalpur

Weather Parameters	Correlation coefficient values (r) of pests of regional importance									
	Max.	Min.	Rainfall	Relative Humidity		Evaporation		Wind Vel.	Evap.	Bright Sunshine
	Temp ^{0}C	Temp ^{0}C	mm	I	I	I	II	Kmph	mm	hours
% Shoot TMB	-0.242	-0.689**	0.306	0.272	0.079	0.284	0.029	0.609**	-0.504**	-0.045
% Panicle TMB	0.454*	-0.139	0.206	0.025	0.232	-0.160	0.087	0.588**	0.335	0.009
% LC	-0.751**	0.115	0.256	0.326	0.517**	0.061	0.311	0.192	-0.726**	-0.291
% LF	-0.495*	0.091	0.132	-0.320	0.226	-0.019	0.114	0.019	-0.335	-0.208
% LM	-0.391	-0.682**	-0.283	-0.406*	-0.226	-0.220	-0.324	-0.598**	0.200	0.452*
% CSRB	0.061	0.014	-0.442*	0.452*	-0.316	0.102	-0.334	-0.472*	-0.177	-0.058

Note: LC = Leaf caterpiller LF = Leaf folder LM = Leaf miner CSRB = Cashew stem and root borer

* *Value of 'r' significant at 5% level.

* **Value of 'r' significant at 5% level.

PARIA

The correlation study indicated that the TMB rating was significantly negatively correlated with maximum temperature (r = -0.5178), whereas the LBW and LM respectively was significantly negatively correlated with minimum temperature (r = -0.5385 & -0.3146 respectively), maximum temperature and evaporation rate. (Table 3.23).

Table 3.23 : Correlation coefficient of weather parameters and insect-pest of Cashew at Paria

WP/ Insects	TMB	Thrips	LBW	LM	ANB
Max-T	-0.51789 **	-0.16249	-0.45302	-0.49546 **	-0.15313
Min-T	-0.38472	-0.09293	-0.53855 **	-0.31460	-0.42668
RH%	0.18272	-0.04056	0.36019	0.25779	0.00659
SSH	0.04625	0.01045	0.18836	-0.09200	0.28105
Evapo. Rate	-0.35894	-0.14711	-0.34660	-0.49386 **	0.41834

CD 1% : + 0.38958 CD 5% : + 0.45429

VENGURLA

The incidence of thrips started from November and reached its peak in the month of February and continue up to march.

The incidence of apple and nut borer was noticed in month of January with setting of apples and nuts and it was maximum in the month of February.

The TMB infestation showed positive correlation with maximum temperature (r = 0.482) & negative significant correlation with minimum temperature (r = -0.849) evening humidity & negative correlation with rainfall and rainy days (r =- 0.408 & -0.477 respectively).

The apple and nut borer showed positive correlation with maximum temperature (r = 0.264) & morning humidity (r = 0.305). The incidence of thrips showed positive correlation with maximum temperature (r = 0.296) & morning humidity negative significant correlation with minimum temperature evening humidity & negative correlation with rainfall & no. of rainy days (r = -0.361 & -0.361 respectively). (Table 3.24).

Table 3.24 : Correlation between the pest incidence and weather parameters at Vengurla

	TMB	ANB	Thrips
Maximum Temperature	0.482	0.264	0.296
Minimum Temperature	-0.849**	-0.514	-0.664*
Morning Humidity	0.340	0.305	0.366
Evening Humidity	-0.784**	-0.247	-0.639*
Rain fall	-0.408	-0.247	-0.361
Rainy days	-0.477	-0.294	-0.361

r = 0.553 at 5% level of significance

r = 0.684 at 1% level of significance

VRIDHACHALAM

The activity of TMB was absent in Vridhachalam and its surrounding areas. Similarly, apple and nut borer activity was also nil during the reporting period. Cashew leaf miner was found from August to March with a maximum of 2.3% leaf damage during first fortnight of February. Cashew leaf folder was also observed from August-March with 1.4% leaf damage observed in young plantations.

Aphid population had positive correlation with relative humidity (r = 0.430) and minimum temperature. Similarly, leaf and blossom webber, leaf miner, leaf roller and shoot tip caterpillar have negative correlation with maximum temperature (r = -0.46, -0.44 and -0.24 respectively) (Table 3.25).

Table 3.25 : Correlation coefficient (r) for abiotic factors and insect pests at Vridhachalam

Insect-pests	Temperature		Relative Humidity		Rainfall (mm)	Rainy days	Sunshine hours
	Max	Min	AM	PM			
Leaf and blossom webber (Y_2)	-0.46*	0.32	-0.28*	-0.25	-0.22	-0.26	0.41
Apple and nut borer (Y_3)	0.32	0.30	0.30	-0.22	-0.20	-0.30	0.26
Leaf miner (Y_4)	0.22	0.26	0.30	0.33	0.42	0.31*	-0.33
Leaf roller (Y_5)	-0.44*	-0.30	-0.32*	-0.22	-0.32	-0.31	0.32
Shoot tip caterpillar (Y_6)	-0.24	0.23	0.32	0.33	0.42	0.40	-0.43
Aphids (Y_7)	-0.26	0.24*	0.32*	0.43*	0.40	0.42*	-0.41
Cashew Stem and Root Borer (Y_8)	0.48*	0.43	-0.20	-0.32	-0.36	-0.35	0.39

* = Significant at 0.05 level

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 :

Chintamani, Jagdalpur

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

SUMMARY:

At Jagdalpur, the TMB damage was not observed in entries NRC-138 and NRC-192. Absence of TMB damage was observed in accessions viz., Mannar and Kottukkal during 2011-12, these accessions had least TMB damage score of 0.039 during 2012-13. At Vengurla, the lowest incidence of thrips was observed on H – 320 (0.105).

BHUBANESWAR

All the accessions were observed to be infested by both shoot tip borer (0-5%) and leaf and blossom webber (0-5 %). Inflorescence thrips (Yellow thrips and black thrips) population was with a range of 0-10 numbers/ inflorescence. None of the entries were free from TMB infestation (Table. 3.26).

Table 3.26 : Screening of germplasm to locate tolerant / resistant types to pest incidence at Bhubaneswar

Pest	Germplasm	Min. occurrence	Germplasm	Max. Occurrence
STC	OC10, OC75, OC83,OC65,OC148	0.5 to 1.5%	OC67,OC70, OC71,OC74,OC56,OC147	>2 to 5%
IT ,	OC4,OC8,OC40,OC39 OC12,OC41, OC58,OC64,OC92	0.5 to 5 No. / panicle	OC29,OC22, OC65,OC68,OC78	> 5 to 10 No / panicle
LBW	OC5,OC9,OC28, OC29,OC46,OC92	0.5 to2.0%	OC8,OC61, OC81,OC82,OC108	> 2 to 5 %

STC = Shoot tip caterpiller IT = Inflorescene thrips LBW = Leaf and blossom webber

JAGDALPUR

It was observed that the TMB damage did not occur in entries NRC-138 and NRC-192. However, the incidence of leaf caterpillar, leaf folder and leaf miner was recorded in all entries.

MADAKKATHARA

Absence of TMB damage in accessions viz., Mannar and Kottukkal was reported during 2011-12, these accessions had least TMB damage score of 0.039 and 0.034 respectively during 2012-13. The leaf miner infestation varied between 0.975 (in ODR) to 7.029 (in K-3). Leaf & blossom webber incidence per tree in Ummannoor was lowest 0.030. Leaf & blossom webber incidence was absent in Kainoor accession (Table 3.27).

Table 3.27 : Screening of accessions to locate tolerant / resistant types to major insect pests of the region at Madakkathara

Accession	TMB damage score	Leaf & blossom webber / tree	Leaf miner	Leaf Caterpillar
K-1	0.166	0.076	3.051	0.000
K-3	0.107	0.318	7.029	0.023
K-5	0.065	0.230	3.884	0.000
Mannar	0.039	0.181	3.625	0.000
Kainoor	0.068	-	6.611	0.000
Ummannoor	0.101	0.030	3.137	0.000
Kottukkal	0.034	0.288	3.420	0.000

Accession	TMB damage score	Leaf & blossom webber / tree	Leaf miner	Leaf Caterpillar
Peechi	0.150	0.061	3.409	0.030
Kunjithai	0.143	0.273	5.303	0.000
Pathannur	0.039	0.182	2.448	0.000
ARL-1	0.049	0.182	3.892	0.045
K-2	0.033	0.061	2.401	0.000
ARL-2	0.068	0.136	2.463	0.045
ODR	0.109	0.045	0.975	0.000

The variety K-22-1 had leaf caterpillar incidence during 2012-13 whereas, it was free from leaf caterpillar incidence during 2009 – 10 and 2010-11.

VENGURLA

Vengurla – 3 recorded lowest TMB infestation (0.019) followed by Vengurla-2 (0.038) whereas, the maximum damage was recorded in 3/33 (0.318). The lowest incidence of thrips was observed on H – 320 (0.105) followed by variety NRCC Sel-2 (0.133) where as it was maximum in variety 30/1 (0.283) (Table 3.28).

Table 3.28 : Screening of cashew varieties against TMB and other pests at Vengurla

Varieties	TMB (0-4 scale)	Varieties	Thrips (0-4 scale)
Vengurla -1	0.067	Vengurla -1	0.236
Vengurla -2	0.038	Vengurla -2	0.224
Vengurla -3	0.019	Vengurla -3	0.198
Vengurla -4	0.186	Vengurla -4	0.240
Vengurla -5	0.155	Vengurla -5	0.236
Vengurla -6	0.182	Vengurla -6	0.153
Vengurla -7	0.227	Vengurla -7	0.153
Vengurla -8	0.230	Vengurla -8	0.224
H – 320	0.207	H – 320	0.105

Varieties	TMB (0-4 scale)	Varieties	Thrips (0-4 scale)
H-303	0.076	H-303	0.206
M- 44/3	0.121	M- 44/3	0.192
30/1	0.227	30/1	0.283
10/19	0.131	10/19	0.167
3/28	0.061	3/28	0.217
NRCC Sel- 1	0.101	NRCC Sel- 1	0.134
NRCC Sel- 2	0.078	NRCC Sel- 2	0.133
3/33	0.318	3/33	0.134
15/4	0.074	15/4	0.215

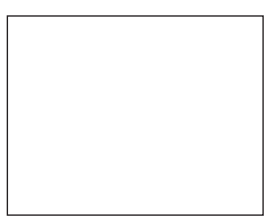
VRIDHACHALAM

All the MLT entries and F1 hybrids were free from TMB infestation possibly due to prevalence of unfavouable weather conditions. Foliage damage caused by leaf and blossom webber, leaf roller, leaf miner and inflorescence caterpillars ranged between 1.0 and 3.0 per cent in different accessions. None of the cashew entries have shown resistence to pest infestation (Table 3.29).

Table 3.29 : Screening of F1 hybrids for tolerance to cashew pests at Vridhachalam

Hybrid Number	Cross combination	TMB mean damages core 0-4 scale in 52 leader shoots	Leaf & blossom webber % shoot damaged / 52 leader shoots	Leaf roller (% of rolled leaves) on five laterals	Leaf miner (%of mined leaves) on five laterals	Apple & nut borer (% of apples damaged / 52 panicles)
H 10	M 10/4 x M 26/1	0.0	2.8	2.0	1.2	0.0
H 11	M 10/4 x M 45/4	0.0	3.0	2.8	1.0	0.0
H 12	M 10/4 x M 75/3	0.0	3.0	2.3	0.0	0.0
H 13	M 26/2 x M 26/1	0.0	2.6	2.1	1.0	0.0
H 14	M 26/2 x M 45/4	0.0	3.0	2.3	1.0	0.0
H 15	M 26/2 x M 75/3	0.0	3.8	2.3	1.6	0.0
H 16	M 44/3 x M 26/1	0.0	3.6	2.0	2.0	0.0
H 17	M 44/3 x M 45/1	0.0	3.8	2.4	1.0	0.0

CHAPTER II : ORGANISATION



1. HISTORY, OBJECTIVES, GROWTH AND SALIENT ACHIEVEMENTS

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

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 Chintamani 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.

The first Workshop of All India Coordinated Spices and Cashew nut Improvement Project was held at Kasaragod in October 1971 in which the research programmes were drawn up, identifying the problems and fixing the priorities. Subsequently, the progress of work was reviewed and research programmes modified/added as per the need in the Workshops held in Trivandrum, Kerala (1972); Coimbatore, Tamil Nadu (1975); Panjim, Goa (1978); Trissur, Kerala (1981); Calicut, Kerala (1983); Trivandrum, Kerala (1985); Bhubaneswar, Orissa (1987); Coimbatore, Tamil Nadu (1989); Bangalore, Karnataka (1993); Kasaragod, Kerala (1995) and Dapoli, Maharashtra (1997); Bhubaneswar, Orissa (1999); and Puttur, Karnataka (2001), National Group discussion in lieu of X Biennial Workshop was held at Kasaragod, Kerala (1991). As per the ICAR directives National Group Meetings are to be organized in place of Workshops. Accordingly, the National Group Meeting of Scientists of AICRP on Cashew was held in NRCC, Puttur, Karnataka during 2004 and in Kerala Agricultural University, Vellanikkara, Thrissur, Kerala in 2005, in ICAR Research Complex for Goa, Goa in 2007 and in Tamil Nadu Agricultural University, Coimbatore in 2009. The National Group Meeting of Scientists of AICRP-Cashew was held at Directorate of Cashew Research during December 2011 in continuation of the Silver Jubilee Celebrations of this Directorate.

Two group discussions were also held, one in horticulture at CPCRI, Regional Station, Vittal (1986) and another in entomology at Trichur (1988). One group discussion was held at Cashew Research Station, Madakkathara during the year 2000, to discuss about high density planting with different levels of fertilizer and pruning in cashew plantation and soil fertility based fertilizer recommendations.

ACHIEVEMENTS :

Significant Achievements of AICRP on Cashew

- Since its inception, a total of 29 high yielding cashew varieties have been developed and released to the farmers by different centres of AICRP Cashew.
- Collected local germplasm materials with desirable characters such as high yield, cluster bearing habit, bold sized nuts, short duration of flowering, off season flowering types from different cashew growing regions and are being vegetatively multiplied and field planted in different centres. Number of cashew accessions so far collected and conserved by the Coordinating Centres in Regional Cashew Field Gene Bank comes to 1225.
- At Bhubaneswar, 47 accessions had bold nut character with a nut weight ranging from 7.00g to 15.00 g (OC-128), 81 accessions had shelling percentage ranging from 28.00 to 38.50 (OC-110). At Jagdalpur, the accession NRC-131 had a high shelling percentage of 32.72
- At Vengurla, accessions RFRS 173 and RFRS 177 had higher number of panicles/m^2 being 17.33 and 16.50 respectively.
- A local collection, CARS-10 was found to be tolerant to short spells of low temperature (2.0ºC - 2.5ºC) at Jagdalpur Centre, which had no leaf shedding as in other collections.
- Four cashew trees indicating possible tolerance to salt water inundation have been identified from Tsunami affected plantations at Cuddalore and Nagapattinam.
- Multi-location trials of cashew have been laid out at different centres to study the yield and other parameters of varieties developed and its suitability at different regions.
- Under spacing trials the cumulative yield for 5 years was highest in 600pl/ha (83.4q/ha) followed by 400pl/ha (74.68q/ha) and 200pl/ha (38.39q/ha) at Bhubaneswar.
- A package of practices has been developed for fertilizer application, spacing and thinning. Application of 500g N; 125g P_2O_5 and K_2O each per tree per year was found to be suitable.
- Intercropping with ginger, turmeric, cluster bean, black gram, horse gram, ground nut, vegetables such as colocasia, tapioca, brinjal, bhindi, cucumber, chillies and medicinal plants with cashew as main crop during the initial stage of orchard development were evaluated and recommended for the economic upliftment of farmers at different locations.
- Under intercropping trials conducted at Bhubaneswar, total net returns per hectare from inter-crops as well as main crop after 4 years revealed that maximum return was received from colocasia (Rs 66,216/-) followed by bhindi (Rs. 58,155/-), while in control it was Rs 40,075/-.At Jhargram, the benefit cost ratio of 2.44 in cashew + bottle gourd which was the most profitable followed by cashew + amaranths (1.93).
- Under hybridization trials, H-68 performed the best at Bhubaneswar by yielding 38kg/tree for 9 harvests during 2004-05 while H-7 and H-17 yielded 76.44 Kg/tree and 71.35kg/tree for 13 harvests at Madakkathara centre during 2005-06.
- L-cyhalothrin (0.003%), Profenophos (0.05%), Triazopohos (0.1%) could effectively check the damage by tea mosquito bug, leaf and blossom webber, leaf miner, apple and nut borer as well as thrips in most of the centres.
- Chlorpyriphos was the best post extraction treatment resulting in consistently more than 70 per cent of the treated trees without reinfestation at Vengurla, Jhargram, Bhubaneswar, Chintamani and Jagdalpur. Chlorpyriphos 0.2% resulted in 83.33% trees without re-infestation or persistent attack as post extraction prophylaxis at Bapatla, while maximum recovery (90%) was obtained at Bhubaneswar,
- The centres have also been producing quality-planting materials for the respective regions to meet the requirement of farmers and developmental agencies.

- At Vridhachalam, there was 55.20% reduction in number of internodes and 68.75% reduction in internodal length in HC 6 hybrid when compared to HC 9, the tallest hybrid.
- There was an increase in nut yield of 28.34 to 41.68 % in all the treatments over the control plot with maximum increase in L-cyhalothrin spray (41.60%) at Bapatla.
- Highest net returns was recorded by intercropping with amorphophallus (Rs.1,39,639), followed by tapioca (Rs. 1,29,992) at Madakkathara during initial cropping period of cashew.

Salient achievements of the Project during 2012-13 :

- The highest number of flowering branches per square meter (27.75) was observed in PLD 62 at Pilicode while it was highest in RFRS-181 (17.33/ m^2) at Vengurla in germplasm evaluation trials.
- The highest nut weight in multi-location trial-II was recorded by variety T-3/28 (9.48 g) and the highest cumulative yield for 16 years was recorded by H 303 (79.10 Kg/tree) at Madakkathara.
- Among the hybrids developed at various Centres, HC 6 was found to be a dwarf hybrid at Vridhachalam.
- At Bhubaneswar, the maximum ground area coverage (128.92%) was recorded 6m x 4m i.e. 400plants/ha.
- Advancement of initiation of flowering was observed in trees receiving irrigation at 80% CPE at Vridhachalam.
- The per hectare yield was significantly higher (3.03 times) under high density planting (3250 Kg) as compared to normal density (1070 Kg) at Madakkathara.
- The lowest percent infestation of Leaf miner, shoot tip caterpillar and leaf anb blossom webber (16.34, 13.17 and 15.70 respectively) was recorded in L-cyhalothrin (0.003%) at Paria in trials on management of TMB and other pests.
- Chlorpyriphos (0.2%) as post extraction treatment against cashew stem and root borer offered protection of treated trees without re-infestation or persistent attack to the tune of 92.0 per cent at Bhubaneswar, 90.0 percent at Madakkathara, 86.30 percent at Bapatla, and 72.22 per cent at Jagdalpur.

2. TRANSFER OF TECHNOLOGY :

A total of 4,75,625 grafts were produced during 2012-13 and distributed to several government and non-government organizations as well as to cashew cultivators. The centre wise production of cashew grafts is given below:

Centre	No. of grafts produced
Bapatla	6250
Bhubaneswar	6300
Jagdalpur	147935
Jhargram	2000
Madakkathara	30876
Pilicode	22000
Vengurla	103865
Vridhachalam	156399
Paria	00
Darisai	00
TOTAL	**475625**

BAPATLA

The scientist of this centre participated in State level training programme to cashew growers on cashew production technology organized by the ITDA and KVK-Pandirimamidi at Rampachodavaram-East Godavari district and conducted diagnostic survey of cashew plantations in various villages of Prakasam and Guntur districts. A front line technology demonstration on cashew was organized at farmers fields in Prakasam, Krishna, West Godavari and East Godavari districts with the financial assistance from NHM. Three training programmes on cashew production technology were conducted in Prakasam and Guntur districts.

Further, 2 radio talks, 5 telecasts pertaining to cashew production and a leaflet in Telugu covering various aspects of cultivation, plant

protection and value addition were also undertaken as extension activity by the scientist of the Centre.

BHUBANESWAR

The scientist of AICRP on Cashew, Bhubaneswar evaluated the registered private and State Corporation owned cashew nurseries and evaluated replanting of senile cashew plantations by OSCDC and OFDC.

The scientists of this centre were involved in conducting trainings on cashew production in collaboration with OSCDC and SRISTI (NGO). Clonal multiplication of cashew varieties, Jagannath (BH-6) and Balabhadra (BH-85) and other commercial varieties were also undertaken by the Centre. Two booklets viz., "Cashew Research in Odisha" and "Cashewnut: a profitable cash crop" (in Odiya) as well as four popular articles were published.

JHARGRAM

The scientist of the Centre functioned as resource person in the farmers training programme on cashew cultivation technology organized by State Agricultural Department, Nari Vikas Sangha in Bankura District and Gramin Vikas Trust, KRIBHCO and Dept. of Botany, Vidyasagar University, Medinipur. The scientist of the Centre participated in the PLACROSYM-XX organized by UPASI at Coimbatore

MADAKKATHARA

The scientists of this Centre participated in various short term training programmes on cashew plantations in high elevation areas, nursery management, pest management and cashew apple processing. Scientists of the Centre participated in the National seminar on value addition and product diversification. The research achievements of the station as well as for the sale and display of cashew apple products and cashew grafts were taken up during 2nd International Horti Expo, Kannur, Kerala Agri Food Pro meet, Kallor, Kochi and in District Level Cashew Seminar.

Radio talks and TV programmes on scientific cashew cultivation, planting and establishment of cashew and sericulture in cashew plantations as an additional source of income and integrated pest management were presented by the Scientists of this Centre.

PILICODE

The scientist of the Centre has been involved in conducting 15 trainings and seminars on various aspects of cashew cultivation. The scientist of the centre has functioned as resource person in resolving the several field problems of cashew growers in more than 15 different locations. Demonstration and training on cashew apple utilization was conducted at at RARS, Pilicode.

VENGURLA

The scientists of this Centre conducted demonstrations on management of cashew stem and root borer and cashew apple utilization in various villages of Dodamarg and Sawantwadi.

VRIDHACHALAM

The Centre has laid out 10 front-line technology demonstration on TMB management sponsored by DCCD to popularize the production in cashew to improve the productivity. Training on cashew production technology was organized at the Centre in which more than 100 farmers and rural women participated. District level seminars on cashew were organized to promote cashew productivity by dissemination of latest production technologies in which 150 beneficaries participated.

PARIA

More than 20 front line demonstration were done in Dharampur and Kaprada taluks alongwith 5 Khedut Shibir for providing improved cashew production technologies. On-farm training and telephonic guidance were also provided by the scientists of the Centre.

BARAPANI

The scientist of this Centre has conducted trainings on propogation of cashew by grafting, nursery management of cashew and rejuvenation of cashew for about 120 farmers. Also field demonstrations on rejuvenation of old orchards has been conducted by the Centre.

3. STAFF POSITION

HEADQUARTERS

Project Coordinator	:	Dr. M. Gopalakrishna Bhat (upto 30.06.2012)
		Dr. P. L. Saroj (from 01.09.2012)
Scientist-in-charge	:	Dr. T.N. Raviprasad
Personal Assistant	:	Smt. Reshma K.

PROJECT CENTRES

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

Horticulturist	:	Dr. K.T.Venkata Ramana (24.3.2012)
		Dr. S. Suryakumari (From 29.3.2012)
Asstt. Horticulturist	:	Vacant
Asstt. Entomologist	:	Mr. Ch.Chinnabbai
Sr. Technical Assistant	:	Sri. M. Sambasiva Rao
Jr. Technical Assistant	:	Mr. Samuel
Grafter	:	Mr. V. Kantha Rao

Cashew Research Station, (OUAT), Bhubaneswar 751 003, Orissa.

Horticulturist	:	Dr. A.K. Pattnaik
Jr. Horticulturist	:	Mrs. Kabita Sethi
Jr. Entomologist	:	Dr. P.C. Dash
Sr. Technical Assistant	:	Sri. A. Mansingh
Jr. Technical Assistant	:	Sri. S. Barik
Grafter	:	Sri. D. Almango (From 3.9.2011)

Horticulture Research Station, (UHS), Hogalagere-563 125, Srinivaspura Taluk, Kolar District, Karnataka.

Horticulturist	:	Dr. Honnabyraiah M.K.
Jr. Horticulturist	:	Vacant
Entomologist	:	Vacant
Sr. Technical Assistant	:	Vacant
Sr. Technical Assistant	:	Vacant
Grafter	:	Mr. M.V. Srinivasa

Zonal Research Station, (BAU), Darisai, East Singhbhum Dist., Jharkhand

Horticulturist	:	Dr. Prashant Kumar

SG College of Agricultural and Research Station, (IGAU), Jagdalpur 494 005, Chattisgarh

Jr. Horticulturist	:	Mr. M.S. Paikra (From August 2010)
Jr. Entomologist	:	Dr. Khoobi Ram Sahu (Upto 7.9.2012)
		Dr. A.K. Gupta (From 7.9.2012)
Sr. Technical Assistant	:	Vacant
Grafter	:	Mr. Jagdev

Regional Research Station, (BCKV), Jhargram 721 507, Midnapore West District, West Bengal

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

Cashew Research Station, (KAU), Madakkathara 680 651, Kerala

Horticulturist	:	Dr. Jose Mathew
Jr. Breeder	:	Mr. Gregory Zachariah
Jr. Entomologist	:	Dr. Gavas Ragesh (from 5.5.2010)
Sr. Technical Assistant	:	Dr. A. Sobhana
Jr. Technical Assistant	:	Mr. M.K. Manoj
Grafter	:	Vacant

Agricultural Experimental Station, (NAU), Paria, Valsad-396 145, Gujarat

Horticulturist	:	Dr. J.P. Makati
Jr. Entomologist	:	Dr. R.B. Patel

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

Jr. Horticulturist	:	Dr. Meera Manjusha A.V.
Jr. Technical Assistant	:	Ms. Sajina K.V. (From 13th August 2011)

Regional Agricultural Research Station, (KKV), Vengurla 416 516, Maharashtra.

Horticulturist	:	Mr. R.C. Gajbhiye (From 16.4.2010)
Jr. Breeder	:	Mr. R.T. Bhingarde
Jr. Entomologist	:	Mrs. V.K. Zote (From 7.4.2010)
Sr. Technical Assistant	:	Mr. S.P. Salvi (From 2.8.2011)
Jr. Technical Assistant	:	Mr. N.R. Parab

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

Horticulturist	:	Dr. S. Jeeva
Jr. Horticulturist	:	Dr. M. S. Aneesa Rani
Jr. Entomologist	:	Dr. V. Ambethgar
Sr. Technical Assistant	:	Mr. M.K. Sendilnayagam (1.7.2011)
Jr. Technical Assistant	:	Mr. C. Jayachandran
Grafter	:	Mr. C. Gopalakrishnan

CO-OPERATING CENTRES OF AICRP-CASHEW

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

Horticulturist	:	Dr. N.K. Hegde
Plant Breeder	:	Dr. R.C. Jagadeesh

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

Horticulturist	:	Dr. A.S. Singh

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

Horticulturist	:	Dr. A.R. Desai

4. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2012-13

Allocation **(Rs. in lakhs)**

Centre	Details of sanctioned provision					ICAR share
	Pay and Allowances	TA	Recurring contingency	Non-Recurring contingency	Grand Total	
Bapatla	9.36	0.75	6.50	—	16.61	12.46
Bhubaneshwar	48.00	0.95	7.25	—	56.20	42.15
Chintamani	20.10	0.75	3.50	—	24.35	18.26
Jagdalpur	19.39	0.60	4.50	—	24.49	18.37
Jhargram	14.00	0.75	3.50	—	18.25	13.69
Madakkathara	46.00	0.75	6.50	—	53.25	39.94
Pilicode	3.89	0.40	2.50	—	6.79	5.09
Vengurla	24.63	0.95	7.20	—	32.78	24.59
Vridhachalam	28.80	0.75	6.50	—	36.05	27.04
Paria	18.15	0.50	3.50	—	22.15	16.61
Darisai	10.87	0.50	3.50	—	14.87	11.15
Pay arrears of a few centres if any, due to the 6th CPC Recommendation	15.00	0.00	0.00	—	15.00	11.25
KRCCH, Arabhavi	0.00	0.50	2.35	—	2.85	2.13
ICAR Res. Compl. for Goa, Goa	0.00	0.50	4.35	—	4.85	3.64
ICAR Res. Compl. for NEH Region, Barapani	0.00	0.50	4.35	—	4.85	3.64
Total	**258.19**	**9.15**	**66.00**	**—**	**333.34**	**250.01**

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

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency *	Total	ICAR Share
Bapatla	20.91	0.26	3.34	—	24.51	18.38
Bhubaneshwar	39.87	0.30	7.25	—	47.42	35.565
Jagdalpur	15.67	0.50	4.70	—	20.87	15.65
Jhargram	9.31	0.31	3.50	—	13.12	9.84
Madakkathara	63.38	0.70	5.72	—	69.80	52.35
Paria	13.54	0.15	3.06	—	16.75	12.56
Pilicode	6.73	0.00	0.72	—	7.45	5.59
Vengurla	33.82	0.29	5.88	—	39.99	29.99
Vridhachalam	45.14	0.74	3.19	—	49.07	36.80
Cooperating Centres KRCCH, Arabhavi	0.00	0.21	2.10	—	2.31	1.73
ICAR Res. Compl. for Goa, Goa	0.00	0.24	4.10	—	4.34	3.26
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	2.13	—	2.13	1.60
Total	**248.37**	**3.70**	**45.69**	**—**	**297.76**	**223.315**

5. MONITORING OF PROJECT BY PROJECT COORDINATOR

The Project Coordinator reviewed the progress of ongoing research programmes by the Centres through regular receipt of reports, correspondence and discussion with the scientists of each Centre. The following AICRP-Cashew centres were also visited.

Date	Centre Visited
16.09.2012	SGCARS, Jagadalpur
22.11.2012	RARS, Pilicode
29.09.2012	AES, Paria

6. FUNCTIONING OF EACH CENTRE

BAPATLA

The centre has been established during 1971. At present there are three scientists working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist respectively. Presently three projects in Crop Improvement; five in Crop Management and four in Crop Protection are being carried out. The scientists organized front-line technology demonstration on cashew in farmers fields located in Prakasam, Krishna, West Godavri and East Godavari Districts with the financial assistance from the Directorate of Cashew and Cocoa Development-Cochin under NHM.

BHUBANESWAR

The centre has been established in 1975. Presently, there are three scientists working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. The training programmes based on different themes such as “production technology, crop management, plant protection measures, value addition and post harvest management” of cashew were organised by the Centre.

The scientist of AICRP on Cashew, Bhubaneswar were involved in evaluation of replanting of senile cashew plantations of Odisha State Cashew Development Corporation (OSCDC) and Odisha Forest Development Corporation (OFDC).

The Centre is involved in multiplication of grafts of variety; Jagannath and Balabhadra and other varieties for distribution to cashew growers of Odisha.

JAGDALPUR

The centre has been established in 1993. At present there are two scientists working under the posts of Jr. Horticulturist and Jr. Entomologist under the project. Presently there are three projects in Crop Improvement, two in Crop Management and four in Crop Protection, which are allotted to the centre.

JHARGRAM

The centre has been established in 1982. At present there are two scientists working under the project in the posts of Junior Horticulturist and Junior Entomologist. One post of Horticulturist and one post of Junior Entomologist is lying vacant. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. The scientist of the Centre functioned as resource person in the farmers training programme on cashew cultivation technology organized by State Agricultural Department, Nari Vikas Sangha in Bankura District and Gramin Vikas Trust, KRIBHCO and Dept. of Botany, Vidyasagar University, Medinipur.

MADAKKATHARA

The centre has been established in 1972. At present there are three scientists working under the project in the posts of Horticulturist, Junior Breeder and Junior Entomologist. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. Scientists of the Centre participated in the National seminar on value addition and product diversification. The research achievements of the station as well as for the sale and display of cashew apple products and cashew grafts were taken up during 2nd International Horti Expo, Kannur, Kerala Agri Food Pro meet, Kallor, Kochi and in District Level Cashew Seminar.

PILICODE

The centre has been established in 1993. At present there is one scientist working under the project in the post of Junior Horticulturist. Presently

three projects, two in Crop Improvement and one in Crop Management. The scientist of the centre has functioned as resource person in resolving the several field problems of cashew growers in more than 15 different locations. Demonstration and training on cashew apple utilization was conducted at at RARS, Pilicode.

VENGURLA

The centre has been established in 1970. At present there are three scientists working under the project in the posts of Horticulturist, Junior Breeder and Junior Entomologist. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out.

The scientists of this Centre conducted demonstrations on management of cashew stem and root borer and cashew apple utilization in various villages of Dodamarg and Sawantwadi.

VRIDHACHALAM

The centre has been established in 1971. At present three scientists are working as Horticulturist, Junior Horticulturist and Junior Entomologist. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. The Centre has laid out 10 front-line technology demonstration on TMB management sponsored by DCCD to popularize the production in cashew to improve the productivity. Training on cashew production technology was organized at the Centre in which more than 100 farmers and rural women participated. District level seminars on cashew were organized to promote cashew productivity by dissemination of latest production technologies in which 150 beneficaries participated.

PARIA

This new centre has been started at Agricultural Experiment Station, Paria, Pardi Taluk, Valsad District in Gujarat under Navsari Agricultural University during 2009. There are two scientists working in this centre as Junior Horticulturist and Junior Entomologist. Three projects under Crop Improvement and two projects under Crop Management and two projects under Crop Protection are being carried out in this Centre.

More than 20 front line demonstration were done in Dharampur and Kaprada taluks alongwith 5 Khedut Shibir for providing improved cashew production technologies. On-farm training and telephonic guidance were also provided by the scientists of the Centre.

DARISAI

This Centre has been started at Zonal Research Station (ZRS) during 2010 during XI Plan, under Birsa Agricultural University. There are two scientists working in this centre as Junior Horticulturist and Junior Entomologist. Three projects under Crop Improvement and three projects under Crop Management and two projects under Crop Protection are being carried out in this Centre.

CO-OPERATING CENTRES

ARABHAVI

This Co-operating Centre is functioning at Kittur Rani Chennamma College of Horticulture, Arabhavi, Karnataka since 2009. There are two scientists working in this centre as Horticulturist and Plant Breeder. Three projects under Crop Improvement and Three projects under Crop Management and one project under Crop Protection are being carried out in this Centre.

BARAPANI

This Co-operating Centre is functioning at ICAR Research Complex for NEH, Tura, Meghalaya since 2009. There is one Horticulturist working in this centre. Three projects under Crop Improvement and two projects under Crop Management are being carried out in this Centre. The scientist of this Centre has conducted trainings on propogation of cashew by grafting, nursery management of cashew and rejuvenation of cashew for about 120 farmers. Also field demonstrations on rejuvenation of old orchards has been conducted by the Centre.

GOA

This Co-operating Centre is functioning at ICAR Research Complex for Goa, Ela Old Goa, Goa since 2009. There is one Horticulturist working in this centre. Three projects under Crop Improvement is being carried out in this Centre.

7. METEOROLOGICAL DATA OF DIFFERENT CENTRES FOR THE YEAR 2012-13

BAPATLA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days
			(Max)	(Min)		
Apr.12	34.7	26.3	82	78	—	—
May 12	40.0	27.9	71	65	25.7	3
Jun.12	39.9	27.5	65	51	77.9	4
Jul. 12	34.6	25.4	79	66	126.6	11
Aug.12	35.1	25.4	78	65	86.6	10
Sep.12	34.4	25.5	80	73	186.0	11
Oct. 12	32.4	23.5	85	72	155.7	8
Nov.12	30.4	20.8	88	71	265.8	5
Dec.12	30.2	19.2	90	70	—	—
Jan.13	30.7	18.7	91	67	—	—
Feb.13	31.2	19.4	88	64	69.4	1

BHUBANESWAR

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days	BSH
			(Max)	(Min)			
Apr.12	38.2	24.3	84.8	49.9	85.9	5	6.4
May 12	39.3	27.2	88.2	49.3	12.2	2	7.9
Jun.12	37.6	26.0	85.1	57.4	117.2	11	3.0
Jul. 12	32.2	25.1	94.4	81.6	405.5	22	3.2
Aug.12	32.0	25.2	93.7	81.8	255.3	20	3.6
Sep.12	32.4	25.3	93.7	78.7	110.6	17	3.9
Oct. 12	32.1	22.6	91.4	68.6	61.6	7	6.4
Nov.12	29.7	19.1	93.2	62.2	134.9	6	6.1
Dec.12	29.9	15.3	93.0	44.0	-	-	7.6
Jan.13	29.7	15.1	91.5	43.1	-	-	6.1
Feb.13	32.3	16.7	89.9	37.6	2.8	2	7.1

JAGDALPUR

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	BSH
			(Max)	(Min)		
Apr.12	35.8	20.3	86.1	45.3	87.7	8.1
May 12	39.1	38.5	69.6	25.8	25.8	6.7
Jun.12	33.6	23.7	69.4	46.5	157.2	4.8
Jul. 12	26.8	21.4	91.9	74.8	399.8	1.4
Aug.12	31.0	21.0	91.7	74.6	466.7	2.0
Sep.12	28.4	21.2	90.6	64.7	424.8	3.5
Oct. 12	30.4	18.5	90.3	48.3	54.4	7.2
Nov.12	28.6	14.9	89.9	47.0	20.9	6.4
Dec.12	29.4	10.8	88.6	35.0	0.0	8.9
Jan.13	29.4	11.8	88.6	43.2	0.0	7.6
Feb.13	30.7	11.0	89.0	38.9	2.1	7.8
Mar.13	35.1	16.8	86.7	27.0	0.0	6.6

JHARGRAM

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	RH (%)	Rainfall (mm)	No. of rainy days
			Average		
Apr.12	15.7	15.8	45	108	4
May 12	15.4	16.9	53	72	8
Jun.12	19.8	18.2	71	105	14
Jul. 12	13.9	21.5	82	258	20
Aug.12	24.4	17.3	83	234	20
Sep.12	25.5	19.6	85	654	15
Oct. 12	25.9	18.3	76	0	8
Nov.12	24.0	17.9	68	21	1
Dec.12	21.1	12.4	65	0	0
Jan.13	26.0	11.0	60	0	0
Feb.13	30.0	14.0	53	13	2
Mar.13	35	18.0	45	6	1

MADAKKATHARA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%) (Avg.)	Rainfall (mm)	No. of rainy days	BSH
Apr.12	34.7	24.8	73	101.9	8	199.2
May 12	32.6	25.3	76	117.3	5	185.5
Jun.12	30.1	23.9	85	551.5	23	84.1
Jul. 12	30.0	23.7	85	375.8	19	99.5
Aug.12	29.2	23.0	86	616.5	18	90.7
Sep.12	30.4	23.3	83	191.8	14	137.4
Oct. 12	32.1	23.5	77	145.6	10	192.1
Nov.12	32.5	22.7	69	46.7	3	224.9
Dec.12	33.0	23.2	58	19.8	2	252.4
Jan.13	34.1	22.3	52	0.0	0	270.9
Feb.13	34.7	23.3	57	84.4	2	241.4
Mar.13	34.7	24.8	73	101.9	8	199.2

PILICODE

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%) (Avg.)	Rainfall (mm)	No. of rainy days
Apr.12	33.3	23.7	76.2	2.2	4
May 12	32.7	24.8	73.9	1.6	6
Jun.12	29.7	23.4	87.8	35.6	28
Jul. 12	29.3	22.9	90.8	33.8	30
Aug.12	29.8	23.2	90.5	25.0	29
Sep.12	29.9	22.8	84.7	19.0	22
Oct. 12	31.6	23.0	78.6	9.2	15
Nov.12	32.6	21.5	75.4	4.3	9
Dec.12	33.1	19.4	71.1	0.2	1
Jan.13	32.7	20.1	73.7	0.0	0.0
Feb.13	33.3	22.0	74.1	21.1	2

VENGURLA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days
			(Max)	(Min)		
Apr.12	33.18	23.91	85.00	61.23	0	0
May 12	33.3	26.04	78.42	68.04	0	0
Jun.12	31.25	24.75	88.5	78.0	926	27
Jul. 12	30.1	24.87	87.85	79.25	781.16	34
Aug.12	29.72	25.27	88.65	79.42	497.6	23
Sep.12	30.91	23.52	89.49	75.31	176.8	18
Oct. 12	32.81	25.13	84.65	66.65	133.4	8
Nov.12	33.59	19.24	87.42	57.03	0	0
Dec.12	34.44	18.3	87.5	52.94	0	0
Jan.13	33.17	17.084	89.37	50.166	0	0
Feb.13	33.41	18.44	89.35	50.03	31	1
Mar.13	33.18	23.91	85.00	61.23	0	0

VRIDHACHALAM

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	RH (%)		Rainfall (mm	No. of rainy days
			Max.	Min		
Apr.12	41.38	24.57	86.83	55.70	8.0	1
May 12	43.11	26.10	76.81	69.90	53.8	2
Jun.12	42.42	25.58	71.73	54.23	-	-
Jul. 12	40.40	24.80	79.60	63.70	95.8	6
Aug.12	39.53	23.83	84.65	65.42	107.8	8
Sep.12	39.53	23.66	82.83	61.40	129.6	7
Oct. 12	34.43	23.18	88.00	65.47	284.8	12
Nov.12	34.73	18.50	72.97	39.35	66.4	1
Dec.12	33.70	18.30	87.30	59.50	5.6	0
Jan.13	33.58	18.35	87.55	59.45	-	-
Feb.13	34.44	19.45	86.42	55.00	24	2

PARIA

Month & Year	Max. Temp. (°C)	Min.Temp. (°C)	Mean RH (%)	Rainfall (mm)	No. of rainy days
Apr.12	36.96	20.37	59.60	0	0
May 12	34.81	24.43	66.31	0	0
Jun.12	34.12	25.57	69.72	139.4	6
Jul. 12	30.90	25.05	88.11	577.6	23
Aug.12	30.14	24.57	87.32	348.1	22
Sep.12	30.64	23.69	85.95	512.9	16
Oct. 12	35.28	20.43	66.23	19.2	1
Nov.12	33.91	12.98	61.13	0	0
Dec.12	32.64	12.48	63.00	0	0
Jan.13	30.55	9.29	63.44	0	0
Feb.13	32.43	12.65	60.98	0	0

BARAPANI

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	RH (%)		Rainfall (mm)	No. of rainy days
			Max.	Min.		
Jan. 12	27	10	94	70	16.6	3
Feb. 12	29	10	86	58	0	0
Mar. 12	34	17	76	45	0	0
Apr.12	35	15	79	43	818.8	12
May 12	30	25.52	81	69	410	7
Jun.12	23.85	21.50	76	69	110.4	9
Jul. 12	27.99	25.30	96	84	448.5	19
Aug.12	28.53	24.58	92	83	702	24
Sep.12	26.57	23.44	86	85	740	5
Oct. 12	28.78	22.78	85	69	155	5
Nov.12	27.3	23.63	83	68	2.7	1
Dec.12	24.4	16.20	84	71	0	0

8. RESEARCH PUBLICATIONS

BHUBANESWAR

"Cashewnut: a profitable cash crop" (in Odiya) Technical Brochure AICRP-Cashew, OUAT, Bhubaneswar.

MADAKKATHARA

Mini, C., Jose Mathew, Augustine, A. and Sheeba, M.S. 2012. Home scale preparation of wine from cashew apple. The Cashew and Cocoa Journal, January-March-2012, 1(1): 34-36.

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Ambethgar, V. 2012. Endophytic fungal entomopathogens in insect pest management systems. In: Biopesticides in Environment and Food Security: Issues and Strategies (Eds) Opender Koul, G.S. Dhaliwal, Sucheta Khokhar and Ram Singh. Scientific Publishers (India). pp. 336-373, ISBN: 978-81-7233-797-1.

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9. LIST AND ADDRESSES OF CENTRES OF AICRP ON CASHEW

HEADQUARTERS

Directorate of Cashew Research
Darbe PO, PUTTUR-574 202, DK, KARNATAKA
Phone No.: 08251-231530, 233490 (R) and 230992 (R)
EPABX : 08251-230902, 236490
FAX No. : 08251-234350
E-mail : dircajures@yahoo.co.in dircajures@gmail.com
dircajures@rediffmail.com
Website : http://www.cashew.res.in

UNIVERSITY CENTRES - EAST COAST

1. Cashew Research Station,
Dr. Y.S.R. Horticultural University,
BAPATLA - 522 101, Guntur Dist,
Andhra Pradesh
Phone No. : 08643 - 225304
FAX No. : 08643 - 225304
E-mail : headcrs_bapatla@drysrhu.edu.in

2. Cashew Research Station,
Department of Horticulture,
Orissa University of Agriculture and Technology
BHUBANESWAR - 751 003, Orissa.
Phone No. : 0674-2397383
FAX No. : 0674-2397780
E-mail : aicrpcashew_bbsr@yahoo.co.in

3. Regional Research Station,
Tamil Nadu Agricultural University
VRIDHACHALAM - 606 001,
Cuddalore Dist., Tamil Nadu.
Phone No. : 04143-238231
FAX No. : 04143-238120
E-mail : arsvri@tnau.ac.in, rrsvri@tnau.ac.in

4. Regional Research Station,
Bidhan Chandra Krishi Vishwa Vidyalaya
Jhargram Farm Post,
JHARGRAM - 721 507,
Midnapore (West) District, West Bengal.
Phone No. : 03221-205500
E-mail : poduvalmini@gmail.com
poduval_mini1971@rediffmail.com

UNIVERSITY CENTRES - WEST COAST

1. Cashew Research Station,
Kerala Agricultural University
MADAKKATHARA - 680 651,
Thrissur District, Kerala.
Phone No. : 0487-2370339
FAX No. : 0487-2370019
E-mail : crsmadakkathara@kau.in

2. Regional Agricultural Research Station,
Kerala Agricultural University
PILICODE - 671 353,
Kasaragod District, Kerala.
Phone No. : 0467-2260450
FAX No. : 0467-2260554
E-mail : adrrarspil@rediffmail.com
cashewnaik@yahoo.com

3. Regional Fruit Research Station,
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
VENGURLA - 416 516,
Sindhudurg District, Maharashtra.
Phone No. : 02366-262234
FAX No. : 02366-262234
E-mail : adrrfrsvengurle@yahoo.com

4. Agricultural Experimental Station,
Navsari Agricultural University,
Paria, Pardi Taluk, Valsad Distt.,
GUJARAT
Phone No. : 0260 2337227
FAX No. : 0260 2337227
E-mail. : aesnau@yahoo.co.in

UNIVERSITY CENTRES-PLAINS TRACT / OTHERS

1. Horticultural Research Station,
   University of Horticultural Sciences
   HOGALAGERE - 563 125,
   Srinivaspura Taluk, Kolar District, Karnataka.
   Phone No. : 08157 - 245022
   E-mail : hrshogalagere@gmail.com

2. SG College of Agriculture and Research Station
   Indira Gandhi Agricultural University
   Kumharwand, JAGDALPUR- 494 005,
   Bastar District,
   Chhattisgarh.
   Phone No. : 07782-229360, 229150
   FAX No. : 07782-229360
   E-mail : zars_igau@rediffmail.com

3. Zonal Research Station,
   Birsa Agricultural University,
   Darisai
   East Singhbhum
   JHARKHAND
   Phone No. : 0651-2450060
   FAX No. : 0651-2450060
   E-mail : drprshntkumar@yahoo.com

CO-OPERATING CENTRES

1. KRC College of Horticulture,
   Arabhavi - 591 310,
   Gokak Taluk, Belgaum Distt.
   Karnataka
   Phone No. : 08332 - 284 502 (O)
   FAX No. : 08332 - 284684
   Email : dikrccha@yahoo.co.in

2. ICAR Research Complex for NEH Region
   Barapani - 793 103
   Meghalaya
   Phone No. : 03651 - 222535
   E-mail : director@icarneh.ernet.in
   kvkwestgarohills@rediffmail.com

3. ICAR Research Complex for Goa,
   Ela, Old Goa, Goa-403 402.
   Phone No. : 0832 - 2284678 / 2284679 (O)
   E-mail : director@icargoa.res.in

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Sl. No.	Publication	Price Rs.
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2	Softwood grafting and nursery management in cashew	35.00
3	a) Annotated Bibliography on Cashew (1985-1994)	75.00
	b) Annotated Bibliography on Cashew (1995-2007)	205.00
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	Germplasm accessions - I	165.00
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