



अखिल भारतीय समन्वित
काजू अनुसंधान परियोजना

All India Coordinated
Research Project on Cashew

वार्षिक प्रतिवेदन
ANNUAL REPORT
2010 - 11



काजू अनुसंधान निदेशालय

(भारतीय कृषि अनुसंधान परिषद्)

पुत्तूर - 574 202, दक्षिण कन्नड, कर्नाटक

Directorate of Cashew Research

(Indian Council of Agricultural Research)

Puttur - 574 202, Dakshina Kannada, Karnataka

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परियोजना समन्वयकर्ता
डा. एम. गोपालकृष्ण भट

PROJECT COORDINATOR
Dr. M. Gopalakrishna Bhat



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प्राक्कथन

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की सत्ताईसवीं वार्षिक प्रतिवेदन प्रस्तुत है। इस प्रतिवेदन में अप्रैल 2010 से मार्च 2011 तक की अनुसंधान उपलब्धियाँ तथा अन्य जानकारी सम्मिलित की गई है।

इस परियोजना में दस केंद्र तथा एक उपाकेंद्र है, जैसे भारत की पूर्व तट में चार; बापट्ला (आंध्र प्रदेश), भुवनेश्वर (उड़ीसा), झारग्राम (प. बंगाल) और वृद्धाचलम् (तमिलनाडु); पश्चिम तट पर तीन केंद्र और एक उपकेंद्र. जैसे माडक्करा केंद्र (केरळ) और पिलिकोड उपकेंद्र (केरळ) तथा वेंगूलें केंद्र (महाराष्ट्र); नवसारी (गुजरात); मैदानी भाग में तीन केंद्र, एक चिंतामणि (कर्नाटक), दूसरी जगदलपुर (छत्तीसगड) तीसरा दारीसाई (झारखण्ड) में स्थित है और इस परियोजना का अनुसंधान कार्यसूची को कार्यान्वयन करते हैं।

इसके अतिरिक्त तीन सहयोगी केन्द्रों भी अ.भा.स.अनु.प. (काजू) के अंतर्गत कार्य कर रहे हैं। प्रत्येक अरबावी (कर्नाटका), बारापानी (मेघालया) और गोवा में।

प्रतिवेदन में चालू तेरह अनुसंधान परियोजनाओं कि उपलब्धियों की क्षेत्रीय स्तर पर विषयानुसार, जैसे फसल सुधार (3), फसल प्रबंध (6), और फसल संरक्षण (4) के विविध विषयों को संबंधित बारह अनुसंधान परियोजनाओं की उपलब्धियों को संकलित करके प्रस्तुत की गई है।

इस प्रतिवेदन में दो अध्याय हैं. जैसे,

1. तकनीकी : जिसमें परियोजना और क्षेत्रीय तौर पर प्राप्त तकनीकी प्रायोगिक उपलब्धियाँ, और
2. संस्थानीय : जिसमें इतिहास, कर्मचारी, वित्तीय प्रावधान, मौसम की आँकड़े और शोध प्रकाशन शामिल हैं।

रम. गोपालकृष्ण भट
(एम गोपालकृष्ण भट)
निदेशक एवं परियोजना समन्वयकर्ता

पुत्तुर : 574 202

दिनांक : 14.11.2011



ABOUT THIS REPORT

This is the twenty seventh Annual Report of the All India Coordinated Research Project on Cashew. This report covers the research results and other information pertaining to the period from April 2010 to March 2011.

There are ten project centres and one sub centre, four in the East Coast of India, namely, Bapatla (Andhra Pradesh); Bhubaneshwar (Orissa); Jhargram (West Bengal) and Vridhachalam (Tamil Nadu), three centres and one sub centre in the West Coast, namely, Madakkathara (Kerala) and Pilicode (Kerala) (Sub centre); Vengurla (Maharashtra), Navsari (Gujarat) and one each in Plains Region, namely, Chintamani (Karnataka), Jagdalpur (Chhattisgarh) and Darisai (Jharkhand) which are implementing the research programmes. Further, 3 cooperating centres are also functioning under AICRP-Cashew one each in Arabhavi (Karnataka), Barapani (Meghalaya) and Goa.

There are thirteen research projects pertaining to different disciplines such as Crop Improvement (3) Crop Management (6) and Crop Protection (4). The results reported by each centre are compiled region-wise and discipline wise and presented in this report.

This report consists of two chapters, they are:

1. Technical : consisting of project wise and region wise experimental results from different centres and
2. Organisation: consisting of history, staff, budgetary provisions, functioning, meteorological data and research publications.

(M. GOPALAKRISHNA BHAT)
DIRECTOR & PROJECT COORDINATOR

Puttur 574 202

Dated : 14.11.2011



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CHAPTER 1 : TECHNICAL



परियोजना समन्वयकर्ता की रिपोर्ट

अखिल भारतीय समन्वित मसाला व काजू अनुसंधान परियोजना 1971 में चौथा पंच वार्षिक योजना में शुरु की गई, जिसका मुख्यालय केंद्रीय रोपण फसल अनुसंधान संस्थान कासरगोड में था। सातवीं पंच वार्षिक योजना में इस परियोजना को दो स्वतंत्र परियोजनाओं - एक काजू पर व दूसरा मसाला पर विभाजित किया गया। अखिल भारतीय समन्वित काजू अनुसंधान परियोजना का मुख्यालय नव निर्मित राष्ट्रीय काजू अनुसंधान केंद्र पुत्तूर में 1986 को स्थानांतरित किया गया।

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना के आठ केंद्र और एक उपकेंद्र हैं, जिसमें चार केंद्र 1971 में अखिल भारतीय समन्वित मसाले व काजू अनुसंधान परियोजना के शुरुवात में बपट्टला (ए.एन.जी.आर.ए.यू पहले ए.पी.ए.यू) माडक्करा (केरल कृषि विश्वविद्यालय, आनक्कायम् से स्थानांतरित), वेंगुर्ले (डॉ. बाला साहेब कोंकण कृषि विद्यापीठ) और वृद्धाचलम (तमिलनाडु कृषि विश्वविद्यालय) में प्रारंभ किया गया। पाँचवीं पंचवार्षिक योजना में एक केंद्र भुवनेश्वर (उ.यू.ए.टी.) और छठवीं पंचवार्षिक योजना में दो केंद्र, एक झारग्राम (बी.सी.के.वि.) और दूसरा चिंतामणि (यू.ए.एस) को सम्मिलित किया गया। आठवीं योजना में एक केंद्र - जगदलपुर (आई.जी.ए.यू) और एक उपकेंद्र पिलिकोड (के.ए.यू.) में प्रारंभ किया गया। 9 वीं प्लान में दो केंद्र जिसमें एक केंद्र परिया (एन.ए.यू.) में और एक केंद्र दारीसाई (बी.ए.यू.) में और तीन सहायक केंद्रों यानि, अरभावी (यु.एच.एस.) बारापानि और गोवा (भा.कृ.अनु.प) में कार्यप्रवृत्त हुए।

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना के इन केंद्रों 12 काजू उगानेवाले राज्यों में स्थित हैं और यह विभिन्न राज्य कृषि विश्वविद्यालयों के प्रशासनिक नियंत्रण में हैं।

परियोजना का 2010-11 में बजट आवंटन ₹ 266.66 लाख (₹ 200.00 लाख भा.कृ.अ.प. का अंश) था और व्यय ₹ 286.42 (₹ 214.82 लाख भा.कृ.अ.प. का अंश) था।

निम्न लिंकित विधियों से काजू की उत्पाद और उत्पादन क्षमता बढ़ाना इस परियोजना के लक्ष्य हैं :

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 परिणाम, विविध विभागों में प्रस्तुत है।

फसल सुधार :

अब तक विविध प्रादेशिक क्षेत्रीय काजू जीन बैंकों में, कुल 1238 जननद्रव्य एक्सशनों संरक्षित किया है। जननद्रव्य मूल्यांकन में संचयी उपज BLA 39/4 में अत्यधिक रहा (66.48 कि.ग्रा./पेड) जिसे 5/1 ने 60.40 कि.ग्रा./ पेड देकर अनुसरित किया। भुवनेश्वर में मूल्यांकित 94 एक्सशनों में 60 से अधिक एक्सशनों ने बड़ा गुटली (7.0 से 16.0 ग्रां तक) और अधिक छिलकन प्रतिशत (28.0 से 36.0 तक) गुण दिखाया। चिंतामणि में आशाजनक एक्सशनों में 44/1-ARSC (वेगुर्ला-5) ने अत्यधिक संचयी उपज (359.23 कि.ग्रा. / पेड) दिया। नौकटाईयों में, अत्यधिक संचयी उपज 37.03 कि.ग्रां. / पेड वृद्धाचलम में TK-1 में दाखिल हुआ।

बापट्टला में प्रचालित बहुस्थलीय प्रयोगों में अत्यंत कम पुष्पण अवधि (121.0 दिन) T.No.3/33 में पाया गया। प्रति मीटर में अत्यधिक प्ररोह संख्या (27.0) तथा पुष्प गुच्छ संख्या (23.0) भुवनेश्वर में H-255 में दाखिल हुआ। जगदलपुर में H-367 में गरिष्ठ गुटली वजन (9.93 ग्रां.) और सेब का वजन (62.93 ग्रां) पाया गया। बापट्टला में बहुस्थलीय प्रयोग-III में H-32/4 में अत्यंत कम पुष्पण अवधि (117 दिनों) था जिसे H-662 (119 दिनों) अनुसरित किया। चिंतामणि में अत्यधिक गुटली उपज (9.29 ग्रां) BH-6 में मिला जो H-1593 (9.19 ग्रां) से अनुसरित था।

विमोचित किस्मों का प्रदर्शन प्रयोगों में, बापट्टला में छत विस्तार अत्यधिक (BPP-3) में (12.0 तथा 12.0 मी पू.- प. तथा उ.- द.) था, जो वेगुर्ला-3 (11.93 मी तथा 10.7 मी, पू.प. तथा उ.-द) से अनुसरित रहा। इसी केंद्र में सेब का वजन 22.5 ग्रां (उल्लाळ-1) से 72.5 ग्रां (उल्लाळ-5) में रहा।

बापट्टला में संकरण प्रयोगों में, वार्षिक गुटली उपज नौवा कटाई में H-67 में अत्यधिक (38.80 कि.ग्रां / पेड) रहा जिसे H-73 ने 34.25 कि.ग्रां / पेड देकर अनुसरित किया। चिंतामणि में -191 में पुष्पण सांद्रता अत्यधिक (16.75 / मी²) और H-81 में प्रत्येक गुच्छ की फल संख्या अत्यधिक (6.17) रहा। वृद्धाचलम में अत्यंत लम्बाईवाला हैब्रीड HC-9 के तुलना में HC-6 में अन्तरगांठ संख्या में 55.20 प्रतिशत



का कटौती हुआ और अन्तरगांठ दूरी में 68.75 प्रतिशति की कमी आयी ।

फसल प्रबंधन:

बापट्ला में उर्वरक प्रयोगों में, अत्यधिक वार्षिक गुटली उपज (42.50 कि.ग्रा./पेड) 500:125:125 ग्रां / पेड का उपचार में, दाखिल हुआ । खेती स्तर की प्रयोगों में अत्यधिक संचयी उपज (41.29 कि.ग्रां / पेड) माडकत्तरा में, 750:325:750 ग्रां / पेड का उपचरण में पाया गया ।

अधिक धनत्व रोपण पद्धति में उर्वरक प्रमाण के प्रयोगों में 200 पेड / हे (10मी. x 5मी.) +150:50:50 कि.ग्रां / हे में अत्यधिक संचयी उपज (24.17 कि.ग्रां. / पेड) बापट्ला में मिला । भूवनेश्वर में आिक धनत्व रोपण (200 पेड / हे = 10 x 5 मी.) में पुष्पगुच्छ संकया (17.11 / मी²) तथा नौ साल की संचयी गुटली उपज (40.60 कि.ग्रां./ पेड) (सार्थकरूप से अधिक रहा ।

झारग्राम में अत्यधिक औसत प्रति मीटर की पुष्प संख्या (18.10) 10 x 5 मी. अंतर में पाया गया । प्रति हेक्टर की गुटली उपज अधिक धनत्व रोपण में (2841 कि.ग्रां.) मिला जो माडकत्तरा में साधारण धनत्व रोपण (880 कि.ग्रां.) से 3.23 गुना ज्यादा राहा । वेगुर्ला में बूँद सिंचन प्रयोगों में 60% में सिंचाई करने से अत्यधिक फलन प्रति मी²(31.60) और अत्यधिक गुटली उपज 1.90 कि.ग्रां. / पेड वृद्धाचलम् में दाखिल हुआ ।

काजू में अन्तराल फसल की रूप में अत्यधिक कुल आय, अमारफोफलास से (₹ 139639 / हे) था, जिसे टापियोका (₹ 1,29,992 / हे) ने माडकत्तरा में अनुसरित किया । परिया में अत्यधिक कुल लाभ (₹ 1,01,402) / हे) भिंडी की अन्तराल फसल से मिला ।

फसल संरक्षण:

बापट्ला में प्रचालित रासायनिकों से काजू कीट संकीर्ण नियंत्रण प्रयोगों में सभी उपचारों में नियंत्रण प्लाटों की तुलना में 28.34 से 41.68 प्रतिशत तक की अधिक गुटली उपज मिला, जिनमें L- सैहालोथ्रीन फूहार से अत्यधिक बडोंत्री मिली । माडकत्तरा में शिफारित फुहार में वार्षिक गुटली उपज 3.36 कि.ग्रां. / पेड था जबकी नियंत्रित प्लाट में 1.09 कि.ग्रां. / पेड का उपज पाया गया ।

निष्कर्षणोत्तर रोगनिरोधन प्रयोगों में अत्यंत कम पुनर्बाधा या सतत हानि क्लोरोपैरीफॉस (0.2%) में; बापट्ला (90.9%), भुवनेश्वर (93.0%), जगदलपुर (870.0%), माडकत्तरा (90.0%) और वेगुर्ला (93.3%) में देखा गया । सूँडियों का निष्कासन नियंत्रण प्लाटों में 9 बार रहा जब की क्लोरोपैरीफॉस उपचरित प्लाटों में सिर्फ 4 बार था ।

जब विविध केंद्रों में काजू कीट संकीर्ण हानि पर जैविक और अजैविक घटकों का प्रभाव दाखिल किया गया, तब चाय मच्छर का बाधा कनिष्ठ तापमान, सायंकाल नमी, बारिश तथा बारिश का दिन संख्या से ऋणात्मक रूप से प्रभावित पाया गया ।

तकनिकी हस्तांतरण:

इस साल 3,49,535 कलमों को तैयार करके सरकारी और गैर सरकारी संस्थानों को बाँटा गया । बापट्ला के विज्ञानियों ने प्रकाशम, कृष्णा, पश्चिम गोदावरी और पूर्व गोदावरी की कृषकों का प्लाटों में “फ्रंट लाइन प्रदर्शनी” की व्यवस्था किया । भुवनेश्वर की विज्ञानियों ने उडीसा राज्य काजू विकास मंडली तथा उडिसा वन विकास मंडली की सहयोग में काजू पुनर्रोपण कार्यक्रम को जाँच किया । चिंतामणि केंद्र का विज्ञानियों ने चिक्कबळ्ळापुर और कोलार जिल्लो में राज्य कृषि विभाग तथा राज्य बागवानी विभाग से आयोजित प्रशिक्षणों में विचार मंडन किये । “काजू उत्पादन प्रौद्योगिकी” के बारे में NAIP के अंतर्गत आयोजित कृषकों का प्रशिक्षण कार्यक्रम में झारग्राम के विज्ञानि भाग लिया ।

माडकत्तरा केंद्र ने तीन नये काजू उत्पादन यानि काजू सेब सोडा, काजू सेब विनेगर और काजू सेब चाकलेट को व्यापारिक स्तर पर प्रारंभ किया है । काजू उत्पादन प्रौद्योगिकी, काजू संस्करण तथा काजू सेब उपयोग जैसे विभिन्न विषयों पर प्रशिक्षणों और सेमिनारों को पिलिकोड केंद्र से आयोजित था । वेगुर्ला केंद्र का विज्ञानियों ने काजू मृदुकांड कलमन, काजू से पोषकांश प्रबंधन काजू पुष्प संरक्षण, CSRB प्रबंधन तथा काजू सेब का मौल्यवर्धन जैसे विचारों पर प्रशिक्षण-प्रदर्शनी किये । वृद्धाचलम केंद्र के विज्ञानियों “सुधारित काजू उत्पादन तकनिकी” पर फ्रंट - लाइन प्रदर्शनियों तथा “ काजू में सघन रोहण” के बारे में जिल्ला स्तर की सेमिनार आयोजित किये थे ।



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, Puttur in 1986.

The AICRP on Cashew has presently eleven centres, one sub-centre and three co-operating centres; of which four were started at the inception of AICS & CIP in the year 1971 [Bapatla (ANGRAU the then APAU); Madakkathara (KAU, shifted from Anakayam); 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 2010-11 was ₹ 266.66 lakhs (₹ 200.00 lakhs - ICAR Share) and the expenditure was ₹ 286.42 lakhs (₹ 214.82 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, under different projects initiated to fulfill these objectives have been presented hereunder under the following sections.

CROP IMPROVEMENT

The total number of accessions conserved so far in the Regional Cashew Field Gene Banks (RCFGBs) is 1238. Under germplasm evaluation, cumulative nut yield recorded was found to be highest in BLA 39/4 (66.48 kg /tree) followed by accession- 5/1 [60.40 kg /tree] at Bapatla. Out of 94 accessions evaluated at Bhubhaneswar, more than 60 accessions had bold nut (7.0 g to 16.0g) and high shelling percentage (28.0 to 36.0). Among the promising accessions 44/1-ARSC (Vengurla -5) recorded highest cumulative nut yield of 359.23 kg/tree at Chintamani. At Vridhachalam, the accession TK 1 recorded the highest cumulative nut yield of 37.03 kg/ tree in nine harvests.

In the Multilocation trial-II, at Bapatla, the lowest flowering duration was recorded in T.No 3/33 (121days). At Bhubhaneswar, H 255 recorded maximum number of vegetative laterals (27) as well as flowering laterals (23) per sq. m. The nut weight (9.93g) as well as apple weight (62.93g) was highest for H-367 at Jagdalpur. In the Multilocation trial-III, at Bapatla, the duration of flowering was shortest in H-32/4 [117days] followed by H-662 [119 days]. The highest nut weight was recorded in BH-6 (9.29 g) followed by H-1593 (9.19 g) in Chintamani.

In the trial on performance of released varieties, at Bapatla, the canopy spread was highest in BPP-3 [12 and 12.0 m EW & NS] followed by Vengurla-3 [11.93 and 10.7m EW & NS] and weight of the apples ranged from 22.50 g [Ullal-1] to 72.50 g [Ullal-5].

In the hybridization trial, annual nut yield at 9th harvest was highest with H-67 [38.80 kg/tree] followed by H-73 with 34.25 kg/tree at Bapatla. At Chintamani, the flowering intensity was highest in H-191 (16.75) and the mean number of fruits per panicle was highest in H-81 (6.17). At Vridhachalam, there was 55.20% reduction in



number of internodes and 68.75% reduction in internodal length in HC 6 hybrid in comparison to HC 9, the tallest hybrid.

CROP MANAGEMENT

Under NPK fertilizer experiment trial, the highest annual nut yield of 42.50 kg/tree was recorded with the treatment 500:125:125 NPK (g/pl.) at Bapatla. Highest cumulative nut yield of 41.29 kg/tree under on-farm trials was obtained in 750 : 325 : 750 g NPK / tree / annum at Madakkathara. Under fertilizer application in high density cashew plantations, highest cumulative nut yields were obtained in 200 plants/ha (10m x 5m) + 150:50:50kg NPK/ha [24.17 kg/tree] at Bapatla. The number of flowering panicles / sq. m. was significantly highest (17.11) and the cumulative nut yield /plant for 9 years was maximum (40.60 kg) in 200pl/ha (10x5m) at Bhubaneswar. At Jhargram, the maximum mean number of flowers /sq.m. (18.10) was observed under 10m x 5m spacing.

Under high density planting, the nut yield per hectare was significantly higher (3.23 times) under high density planting (2841 kg) as compared to normal density (880 kg) at Madakkathara. Under drip irrigation trial, irrigation at 60% CPE led to the maximum fruit set/m² (31.6) at Vengurla and maximum nut yield (kg/tree) (1.90) at Vridhachalam. Under intercropping in cashew, highest net returns was recorded by amorphophallus (₹ 139639), followed by tapioca (₹ 129992) at Madakkathara. The highest net profit of (₹ 1,01,402 /ha) at Paria, was found in intercropping with okra.

CROP PROTECTION

Trials on chemical control of pest complex in cashew indicated 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. At Madakkathara, the annual nut yield data in recommended spray schedule was 3.36, while it was 1.09 kg/tree in control. -Among the insecticides evaluated as post extraction prophylaxis, least re-infestation or least persistent attack was in case of chlorpyrifos 0.2% at Bapatla (90.9 %) Bhubaneswar

(93.0%), Jagdalpur (80.0%) Madakkathara (90.0%) and in Vengurla (93.33%). The extraction of grubs was maximum in untreated control (9 times) as compared to chlorpyrifos treatment (4 times). The TMB infestation showed negatively significant correlation with minimum temperature, evening humidity, rainfall and rainy days when the influence of biotic and abiotic factors on the incidence of pest complex of cashew was recorded at different centres.

TRANSFER OF TECHNOLOGY

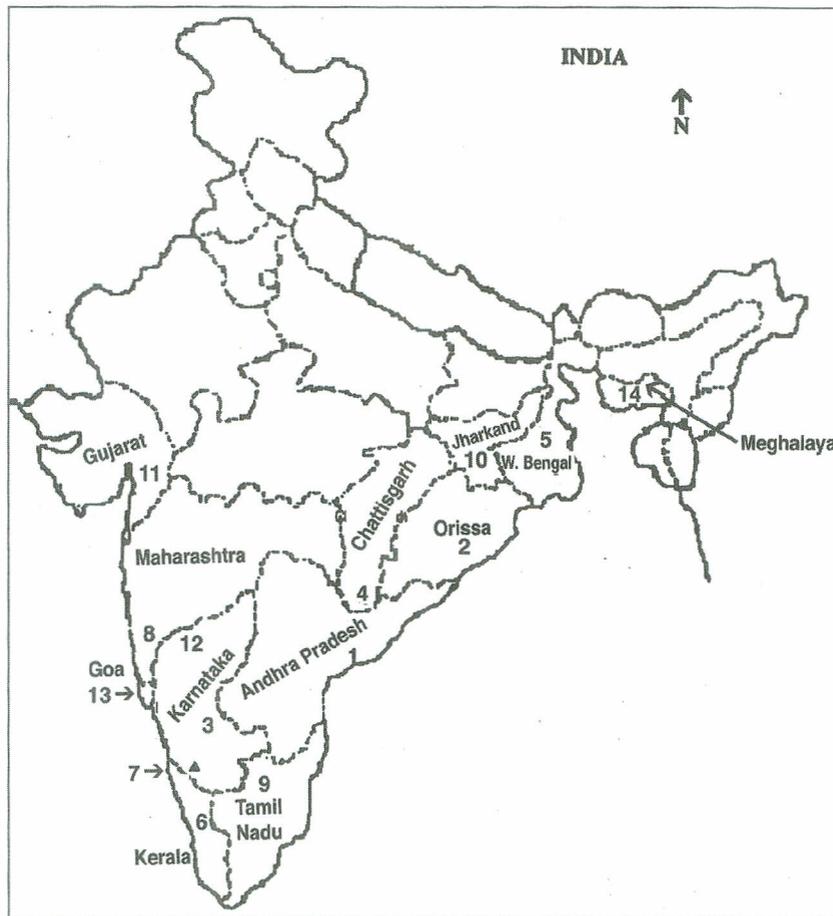
A total of 3,49,535 grafts were produced during the current year and distributed to several government and non-government organizations as well as to cashew.

The scientists of Bapatla Centre organized front-line technology demonstration on cashew in farmers fields located in Prakasam, Krishna, West Godavri and East Godavari Districts. 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 scientists of Chintamani Centre delivered lectures in the training programmes organized by State Department of Agriculture and Horticulture in Chikballapur and Kolar districts. The scientist of the Jhargram Centre functioned as resource person in the farmers training programme on cashew cultivation technology organized by NAIP under Jhargram block.

The Madakkathara Centre has launched commercially the following three new cashew apple products viz., cashew apple soda, cashew apple vinegar and cashew apple chocolate. The scientists of the Pilicode centre have conducted trainings and seminars on various aspects of cashew viz., cashew production technology, cashew processing and cashew apple utilization. The scientists of Vengurla Centre conducted demonstrations on cashew softwood grafting, nutrient management in cashew, cashew blossom protection, management of CSRB and value addition of cashew apple. The Vridhachalam Centre has conducted front-line technology demonstrations and state level seminars on "Improved production technologies in cashew and district level seminars on "High Density Planting in Cashew".



CENTRES OF AICRP ON CASHEW



HEADQUARTERS OF AICRP ON CASHEW

- ▲ *Directorate of Cashew Research, Puttur 574 202*
AICRP on cashew Centres:

1. Cashew Research Station, (APHU), Bapatla, 522 101, Guntur District, Andhra Pradesh
2. Cashew Research Station, (OUAT), Bhubaneswar 751 003, Orissa
3. Agricultural Research Station, (UAS), Chintamani 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, Barapani / Tura-794 005, West Garo Hills Meghalaya.



GENERAL CHARACTERISTICS OF CENTRES OF AICRP ON CASHEW

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

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

The centres in the West Coast are located at Madakkathara, Pilicode, Vengurla and 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 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 2100mm.

Maidan tract characterized by even land has Chintamani, Darisai, Jagdalpur centres and Co-operating centre at Arabhavi in this region. Chintamani comes under Region III (Southern dry region), Eastern dry zone (zone V) of Karnataka and receives average rainfall of 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, deficient in N, medium in P₂O₅ and high in K₂O. 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. A cooperating centre in Barapani / Tura in Meghalaya region is characterized by hilly terrain and has deep black loamy soils. The average rainfall ranges between 2500 4000mm spread out during the months of June to November. The cooperating centre at Goa is characterized by lateritic soils with shallow to medium depth. The centre is situated at altitude of 25-40m above the MSL. This centre receives rainfall ranging from 2800 mm to 3800 mm spread out during June to December.

EXPERIMENTAL RESULTS

I. CROP IMPROVEMENT



I. CROP IMPROVEMENT

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

Centres: East Coast

Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast

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, duration of flowering, off season flowering types from different cashew growing regions and,
- (c) To establish clonal germplasm conservation blocks in different centres

SUMMARY:

The cumulative nut yield recorded was found to be highest in BLA 39/4 (66.48 kg /tree) followed by accession- 5/1 [60.40 kg /tree] at Bapatla. Out of 94 accessions evaluated at Bhubaneswar, 61 accessions were bold nut types (7.0 g to 16.0g) and high shelling percentage (28.0 to 36.0) was noticed in 69 accessions. Among the promising accessions 44/1-ARSC (Vengurla -5) recorded highest cumulative nut yield of 359.23kg/tree at Chintamani. At Jagdalpur, mean nut weight was found to be the highest in NRC-140 (8.4g) followed by NRC-138 and NRC-130. The cashew accessions JGM - 272, JGM - 247, JGM - 279 and JGM - 235 had shelling percentage above 30 percent at Jhargram. At Vridhachalam, the accession TK 1 recorded the highest cumulative nut yield of 37.03 kg/ tree in nine harvests.

Germplasm Collection:

During the current year, 7 germplasm collections have been done 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 1238. (Table. 1.1)

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

Centre	No. of accessions		
	Earlier existing	Collected during 2010-11	Existing
East Coast			
Bapatla	132	-	132
Bhubaneswar	100	-	100
Jhargram	119	1	120
Vridhachalam	208	-	208
West Coast			
Madakkathara	132	2	134
Pilicode	43	--	43
Vengurla	302	3	305
Plains tract/others			
Chintamani	128	--	128
Jagdapur	67	1	68
Total	1231	7	1238

Germplasm Evaluation :

The growth and yield parameters of cashew germplasm available at different AICRP-Cashew Centres have been evaluated during 2010-11 and the relevant results are reported here

BAPATLA

Among the accessions, Hy-94-3 recorded highest plant height (7.77 m) followed by H-95-4 (7.70 m). Maximum trunk girth was recorded

in Priyanka (138 cm) which is followed by T. 275 (126 cm). Mean canopy spread recorded was maximum in the T. 275 (13.03 m) followed by H-95-4 (11.20 m) and mean nut yield per tree during the year was in T.275 (26.15 kg) followed by T. 228 (14.78 kg). However, cumulative nut yield recorded was found to be highest in BLA 39/4 (66.48 kg /tree) followed by accession- 5/1 [60.40 kg/tree]. Apple weight ranged from 25.0 g to 125.0 g across the accession (Table 1.2).

Table 1.2 : Performance of promising cashew accessions at Bapatla

Accession No	Plant Height [m]	Spread [m]		Nut Yield/tree [kg]	Cum. yield (10 hvsts.) [kg]	Apple weight [g]
		E-W	N-S			
T.NO-129	5.40	6.70	9.60	10.50	57.27	50.00
T.NO 268	6.67	10.13	8.47	5.00	52.21	55.00
T.NO 5/1	7.00	10.67	9.37	9.78	60.40	52.50
BLA 39-4	5.60	11.20	8.80	10.80	66.48	50.00

BHUBANESWAR

Out of 94 accessions, 61 accessions were bold nut types having nut weight ranging from 7.0 g to 16.0g (OC 85). Shelling percentage ranging from 28.0 to 36.0 was noticed in 69 accessions. During the reporting year at 5th harvest cumulative nut yield (kg/plant) ranged from 6.50 (OC 107) to 8.50 (OC 92) in 5 nos. of accession, at 4th harvest yield ranged from 3.70

(OC 131) to 5.40 kg/plant (OC120) in 6 nos. of accessions. Again during the year, the promising yielders (kg/plant) were OC 56 & OC 92 (3.00 kg/plant), OC 129 (2.20 kg/plant) and OC 148 (1.50 kg/plant) and OC155 (0.90 kg/plant) which were planted during the year 2002, 2003, 2004 and 2005 respectively (Table 1.3).


Table 1.3 : Performance of promising germplasm accessions at Bhubaneswar

Planting Year	Accession No.	No. of nuts/panicle	Nut weight (g)	Nut yield (kg/plant)	Cumulative nut yield (Kg/plant)	Shelling (%)
2002					5th harvest	
	OC55	3	6.80	2.80	7.90	27
	OC56	5	7.00	3.00	8.10	30
	OC78	5	4.50	2.20	7.70	35
	OC92	5	6.00	3.00	8.50	30
	OC37	2	10.00	0.90	1.60	29
	OC22	3	9.00	1.80	4.40	27
	OC59	1	15.00	1.10	3.10	-
	OC69	2	11.00	1.50	5.70	28
	OC71	1	10.00	1.00	3.60	35
	OC94	3	9.20	1.70	3.50	27
	OC85	1	16.00	0.70	1.20	25
	OC107	5	5.20	1.60	6.50	30
	OC108	6	5.20	2.00	5.60	35
2003					4th harvest	
	OC120	5	5.00	1.50	5.40	30
	OC121	4	7.40	1.80	5.30	32
	OC129	2	11.00	2.20	5.10	32
2004					3rd harvest	
	OC144	3	6.00	1.10	2.00	26
	OC146	3	7.60	1.00	2.40	30
	OC147	4	7.80	1.30	2.80	35
	OC148	3	8.00	1.50	3.20	34
2005					2nd harvest	
	OC153	3	7.4	0.70	1.00	33
	OC155	3	5.2	0.90	1.20	29

CHINTAMANI

Out of 128 germplasm accessions, 110 accessions are yielding and remaining are yet to yield.

The tree height ranged from 4.5 to 6.1 m, stem girth (95-158 cm), canopy spread in E-W and

N-S directions ranged from 8.9 to 14.6 and 6.9 to 16.3 m. The highest number of flowering laterals per m² were observed in Vengurla-5 (34.0) and number of fruits per panicle was observed in 5/37 Manjeri (7.3) (Table 1.4).

**Table 1.4 : Growth performance of promising germplasm accessions at Chintamani**

Accession	Year of planting	Tree ht. (m)	Girth (cm)	Canopy spread (m)		Flowering laterals (m ²)
				E-W	N-S	
3/108 Gubbi (2/6 ARSC)	1982	4.50	95	9.80	9.50	18.25
Vetore-56 (27/1 ARSC)	1983	4.50	119	10.80	8.00	25.75
5/23 Kundapur (03/1ARSC)	1982	6.00	96	10.80	10.40	18.5
5/37 Manjeri (41/3 ARSC)	1985	5.80	140	14.60	16.30	24.25
Vengurla - 5 (44/1 ARSC)	1985	6.10	158	13.60	13.70	34.0
K-3-C (56/1 ARSC)	1993	4.60	100	8.90	6.90	17.75

Among the promising accessions, 41/3 ARSC (5/37- Manjeri) recorded highest nut yield of 48.50 kg/tree followed by 44/1- ARSC (Vengurla-5) which recorded nut yield of 40.10 kg/tree. The accession 27/1- ARSC (Vetore-56) recorded highest nut weight of 7.8 g with 31.6 shelling per cent followed by accession 41/3 - ARSC (5/37 - Manjeri) recorded 7.5 g nut

weight and 30.3 per cent shelling. Among the promising accessions of the germplasm collections 44/1-ARSC (Vengurla -5) recorded highest cumulative nut yield of 359.23kg/tree followed by 41/3-ARSC (5/37 Manjeri) and 2/6-ARSC (3/108-Gubbi) recorded 339.69 kg/tree and 285.17 kg/tree, respectively (Table 1.5).

Table 1.5 : Yield performance of promising germplasm accessions at Chintamani

Accession	Year of planting	Nut Yield (kg/tree)	Cum. nut yield (kg/tree)	Nut weight(g)	Shelling (%)	Yield (kg/m ²)
3/108 Gubbi (2/6 ARSC)	1982	14.40	285.17 (25hvts)	6.10	30.90	0.11
Vetore-56 (27/1 ARSC)	1983	35.00	185.79 (24hvts)	7.80	31.60	0.31
5/23 Kundapur (03/1ARSC)	1982	10.00	203.70 (25hvts)	7.50	30.60	0.09
5/37 Manjeri (41/3 ARSC)	1985	48.50	339.69 (22hvts)	7.50	30.30	0.22
Vengurla - 5 (44/1 ARSC)	1985	40.10	359.23 (22hvts)	5.60	30.40	0.24
K-3-C (56/1 ARSC)	1993	18.50	128.21 (14hvts)	7.20	30.40	0.35

JAGDALPUR

The centre has 65 cashew germplasm accessions of which 17 are local germplasm and one promising germplasm, which has bold nut and is tolerant to winter rains & TMB infestation. The nut yield/tree was highest for NRC-137 (8.80 Kg), followed by

NRC138 (8.50 Kg). The cumulative nut yield for 12 harvests was highest in NRC-137 (55.85 Kg). Mean nut weight was found highest in NRC-140 (8.4g) followed by NRC-138 and NRC-130. Shelling per cent was found to be the highest in NRC-131 (30.40%) (Table 1.6).

**Table 1.6 : Performance of germplasm obtained from DCR at Jagdalpur**

Accession	Year of planting	Yield during 2009-10 (Kg)	Cum. yield Kg/Plant (12 No. of harvests)	Mean weight/nut (g)	Shelling (%)
NRC- 130	1996-97	5.80	24.98	8.10	28.50
NRC- 131	1996-97	3.50	25.58	7.90	30.40
NRC- 136	1996-97	3.75	23.95	7.60	28.25
NRC- 137	1996-97	8.50	55.85	8.00	29.26
NRC- 138	1996-97	8.80	45.48	8.20	29.60
NRC- 140	1996-97	3.25	29.55	8.40	28.65
NRC- 190	1996-97	3.46	19.25	6.80	28.10
NRC- 191	1996-97	4.50	36.11	7.30	29.48
NRC- 192	1996-97	3.00	22.09	7.00	28.15
NRC- 193	1996-97	6.43	39.68	7.50	30.20

JHARGRAM

The centre is maintaining 23 primary germplasm collections, 77 secondary germplasm collections, 126 F1 hybrids and 59 varieties, totaling 285 accessions.

JGM-231, JGM - 266 and JGM - 286 had nut weight above 7.0 g. JGM - 272, JGM - 247, JGM - 279 and JGM - 235 had shelling

percentage above 30 percent however, these germplasm produced nuts below 6 g. Highest yield was recorded with JGM 234 (3.45 Kg/tree) followed by JGM 231 (3.34 Kg/tree) . The maximum cumulative yield of three harvests (10.5 Kg/tree) was obtained in JGM-231 followed by JGM 251 (8.69 Kg/tree) and JGM 245 (7.49 Kg/tree) (Table 1.7).

Table 1.7 : Performance of germplasm accessions at Jhargram

Accession No.	Mean nut wt (g)	Shelling %	Ann. Nut Yield (kg/tree)	Yield/m ² (g)	Cum. yield (kg/tree) 3 harvests
JGM - 221	6.70	27.90	1.34	0.05	3.86
JGM - 223	5.50	29.60	0.98	0.06	5.87
JGM - 231	7.30	25.40	3.34	0.12	10.50
JGM - 234	5.00	28.60	3.45	0.14	5.56
JGM - 235	5.50	30.60	1.55	0.06	4.36
JGM - 238	5.50	29.60	0.96	0.05	4.45
JGM - 245	5.30	27.40	2.88	0.09	7.49
JGM - 247	6.50	31.60	1.16	0.05	2.39
JGM - 251	6.90	27.60	2.08	0.08	8.69
JGM - 265	6.20	27.80	1.90	0.13	2.92
JGM - 266	7.30	24.30	1.71	0.15	2.36
JGM - 267	5.20	28.70	1.58	0.1	2.12
JGM - 272	5.50	32.00	1.73	0.14	4.68
JGM - 279	5.60	31.00	2.03	0.1	3.24
JGM - 280	6.20	29.70	0.90	0.07	1.35
JGM - 286	7.00	28.60	1.16	0.08	1.66



The germplasm were at par with respect to plant height, trunk girth and trunk height. Significant differences were observed with respect to canopy spread and canopy area. Maximum canopy spread was observed in JGM 147 (5.40m) followed by JGM-148 (5.30m). Canopy area was highest with JGM 147 (33.80 m²) followed by JGM 148 (32.56 m²). Maximum flowering density was noticed with JGM 152 (15.70 panicles/m²) followed by JGM 149 (13.70 panicles/m²). Duration of flowering was maximum in JGM -148 (91 days) followed

by JGM-147 (81 days) and JGM 149 (80 days). JGM 148 had highest no. of nuts/m² (33.90 nuts) followed by JGM 149 (23.30 nuts/m²) and JGM 147 (16.30 nuts/m²). JGM 148 had also highest number of nuts/panicle (11 nuts) and each nut weighed 6.59 g. Though JGM 148 had nut weight lesser than JGM 151 and JGM 152, the yield and cumulative yield (7.40 Kg/tree and 25.90 Kg/tree respectively) were far more better than other germplasm. The shelling percentage of JGM 148 was also very promising i.e. 30.9% (Table 1.8, 1.9 & 1.10).

Table 1.8 : Growth parameters of promising cashew germplasm collections at Jhargram

Name of Selection	Accession No.	Plant height (m)	Trunk girth (cm)	Trunk Height (m)	Canopy Spread (m)
N -1	JGM - 147	4.30	58.30	1.40	5.40
N -2	JGM - 148	4.40	59.00	1.60	5.30
N - 3	JGM - 149	4.00	61.30	1.30	5.10
R - 1	JGM - 150	4.30	58.00	1.10	4.30
G - 34 (7)	JGM - 151	3.90	54.30	0.70	4.10
G - 34 (1)	JGM - 152	3.60	57.30	1.40	3.90
S Em ±		0.14	NS	0.25	0.33
C.D.at 5%		0.31		0.55	0.75
CV%		5.9		34.6	12.3

Table 1.9 : Yield attributes of promising cashew germplasm collections at Jhargram

Name of Selection	Accession No.	Duration of Flowering (Days)	Flowering /m ²	Nuts/ m ²
N -1	JGM - 147	81	14.60	16.30
N -2	JGM - 148	91	12.00	33.90
N - 3	JGM - 149	80	13.70	23.30
R - 1	JGM - 150	76	10.90	4.92
G - 34 (7)	JGM - 151	77	12.10	7.08
G - 34 (1)	JGM - 152	71	15.70	7.33
S Em ±			1.06	3.30
C.D.at 5%			2.39	7.43
CV%			13.9	36.9



Table 1.10 : Yield attributes of promising cashew primary clonal germplasm collections at Jhargram

Name of Selection	Accession No.	Nut weight (g)	Yield (Kg/tree)	Shelling %	Cum. Yield Kg/tree (3 rd harvest)
N -1	JGM - 147	5.92	3.30	29.90	11.80
N -2	JGM - 148	6.59	7.40	30.90	25.90
N - 3	JGM - 149	5.50	4.10	31.90	10.60
R - 1	JGM - 150	6.50	0.90	36.80	4.12
G - 34 (7)	JGM - 151	7.13	1.20	30.20	10.10
G - 34 (1)	JGM - 152	7.65	1.00	25.00	6.51
S Em ±		0.07	0.02	0.42	2.41
C.D.at 5%		0.16	0.04	0.95	5.41
CV%		1.9	30.5	2.7	36.2

MADAKKATHARA

Out of the total of 134 accessions, evaluation was completed for 118 trees planted in 1988 and limb pruning was done for the maintenance of these trees.

Accession Kainur recorded maximum height (7.25 m) followed by Mannur (6.41m). Accession Mannur recorded maximum girth (84.00 cm) followed by Kainur (80.00 cm).

Accession Kainur recorded highest canopy spread - EW (8.10 m) while Mannur recorded highest canopy spread NS (8.37 m). Highest annual yield was recorded by Pathanoor (4.15 kg/tree) followed by Kunjithai (3.70 kg/tree) during the current season. The maximum cumulative yield was recorded by Pathanoor (16.00 kg) followed by Kunjithai (14.60 kg) (Table 1.11).

Table 1.11 Growth and yield characters of accessions of the germplasm collection 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 (5 hvsts.)
KTR-1	4.36	62.75	4.22	5.57	7.09	2.68	10.83
KTR-3	5.18	68.00	6.55	6.47	7.23	2.39	8.74
Kiralur	5.95	75.00	5.53	6.93	7.96	2.53	8.38
Mannur	6.41	84.00	6.20	8.37	7.10	2.28	8.19
Kainur	7.25	80.00	8.10	8.00	7.00	2.70	12.02
Ummanoor	5.68	72.25	7.85	5.92	8.21	3.11	11.96
Kottukkal	4.53	57.60	5.43	5.00	7.12	2.11	6.56
Peechi	4.75	62.00	5.36	5.73	7.90	2.05	7.45
Kunjithai	5.25	56.00	5.10	6.05	8.35	3.70	14.60
Pathanoor	5.37	64.00	4.45	5.25	9.10	4.15	16.00
ARL-1	5.58	69.00	4.90	4.93	6.80	2.90	6.10
KTR-2	5.00	55.00	5.05	4.65	7.48	2.36	7.51
ARL-2	5.12	67.50	5.25	4.20	6.15	3.25	11.30
ODR	5.00	51.50	4.35	4.02	8.03	3.33	10.93


PILICODE

The accession PLD-4 was found to be superior in yield (7.26 Kg/plant) and cumulative nut yield (22.63kg) followed by PLD-12 (49.35). The

density of panicles per unit area was highest in PLD-15. The dwarf variety, PLD-57 was utilized for hybridisation programmes with varieties MDK-1 and ANK-1 (Table 1.12 & 1.13).

Table 1.12 : Biometric observations of cashew germplasm during 2010 -11 (planted during 1998 and 2000) at Pilicode

Accession No./Variety	Plant height (m)	Collar Girth (cm)	Canopy Spread(m)		Yield of nuts/plant (Kg)	Cum. nut yield per plant (Kg)
			E-W	N-S		
PLD 57	3.97i	0.48b	4.75i	5.00i	0.47g	1.02g
PLD-12	7.97dcb	1.13a	10.00a	10.72a	6.41b	19.35b
PLD-20	8.22b	0.98ab	8.43bc	8.47b	3.21e	4.66e
PLD-17	9.12a	1.12a	10.00a	9.75a	2.50f	3.82f
PLD-18	8.10cb	0.79bcdef	9.00ab	7.97bcde	2.92ef	5.23e
PLD-19	6.75g	0.89bcd	8.31bc	8.25bc	2.96ef	4.72e
PLD-16	7.62cdef	0.69cdefg	6.78def	6.91defgh	4.25d	11.78c
PLD-4	7.38ef	0.86bcde	6.75defg	8.02bcd	7.26a	22.63a
PLD-3	9.17a	0.74bcdefg	7.22de	6.79gh	5.24c	12.03c
PLD-1	7.82bcde	0.93bc	7.50cd	7.85bcdef	6.21b	18.71b
PLD 15	5.87h	0.71cdefgh	6.25efgh	7.10cdefg	2.95ef	6.70d
Mean	7.457	0.850	7.728	7.896	4.035	10.059
F test	**	**	**	**	**	**
CD 0.05	0.490	0.243	1.067	1.152	0.65	0.67

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

Table 1.13 : Biometric observations of Cashew germplasm planted during 2003 at Pilicode

Accession No./Variety	Plant height (m)	Collar Girth (cm)	Canopy Spread(m)		Male: Bisexual flowers ratio
			E-W	N-S	
PLD 75	4.50cd	30.00f	2.50h	3.50h	2.75a
PLD 54	4.50cd	64.33c	7.50a	6.00cde	1.64defgh
PLD 44	3.00e	28.00fg	3.00gh	4.00gh	1.75def
PLD 64	4.00d	27.00g	2.50h	2.75i	1.92cd
PLD 62	6.33a	78.66a	6.33bcd	6.50bc	1.60defghi
PLD 40	5.66b	65.00c	5.66def	5.00f	1.43fghij
PLD 48	6.50a	22.00h	3.58g	7.48a	2.20c
PLD 67	6.87a	70.66b	5.30f	6.16cde	1.70efg
PLD 66	6.58a	53.00e	6.00cde	5.00f	1.30hij
PLD 45	4.75c	30.00f	6.50bc	6.33cd	1.84de
PLD 82	7.00a	58.00d	7.00ab	6.50bc	1.25j
Mean	5.428	47.879	5.080	5.385	1.763
F test	**	**	**	**	**
CD @5%	0.670	2.479	0.686	0.707	0.336

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



VENGURLA

At present, there are total 305 accessions in the gene bank. Out of these, 170 types have been evaluated and planted in conservation block at the spacing of 4m x 4 m and 7 m x 7 m.

Among the 14 types RFRS 184 recorded the lowest mean height (3.9m) and mean girth (24.6cm) whereas, mean laterals and flowering panicles per sq.m. were highest in RFRS 171 type i.e. 30.5 and 20.0 per sq.m. respectively. As

far as yield is concern RFRS 173 recorded the highest yield i.e. 2.53 Kg /plant. Among the germplasm, RFRS 191 recorded the lowest mean height (3.20m) and mean girth (32.0cm). The mean laterals per sq.m. were maximum (35.0 per sq.m.) in RFRS 188 while, mean flowering panicles per sq.m. were highest in RFRS 190 (Table 1.14 & 1.15).

Table 1.14 : Growth and yield observations for the year 2010-11 of the germplasm collected during 2001-02 at Vengurle

Name of the type	Mean Plant Height (m)	Mean Plant Girth (cm)	Mean Spread (m)		Mean Panicles /Sq. m	Fruit set / m ²	Mean Yield (Kg)	Mean Nut weight (g)
			E.W.	N.S.				
RFRS 171	5.20	63.50	6.00	6.70	20.00	37.50	1.10	9.40
RFRS 172	5.90	65.60	6.70	5.50	17.30	39.00	1.78	8.00
RFRS 173	5.70	61.30	5.60	6.00	19.30	29.00	2.53	4.60
RFRS 174	6.50	69.30	6.40	5.70	17.60	19.60	0.90	6.60
RFRS 175	6.70	52.60	4.60	4.50	19.30	17.60	0.64	5.90
RFRS 176	5.10	58.00	6.50	5.00	17.00	28.50	0.20	5.40
RFRS 177	5.40	58.50	5.90	5.80	18.00	14.00	0.15	5.50
RFRS 178	6.70	68.50	6.10	7.20	19.50	32.00	0.33	7.50
RFRS 179	6.00	46.60	4.30	4.20	19.30	15.30	0.22	5.80
RFRS 180	8.00	61.60	6.40	5.20	19.30	13.60	0.26	7.00
RFRS 181	6.20	49.60	4.60	4.10	11.60	13.00	0.25	6.30
RFRS 182	5.60	49.00	5.00	5.00	15.00	24.00	0.22	5.50
RFRS 183	6.10	74.00	10.30	9.60	15.60	19.30	0.06	6.20
RFRS 184	3.90	24.60	2.60	3.40	9.00	22.00	0.40	5.60

Table 1.15 : Growth and yield observations of the germplasm collected during 2003-04 at Vengurle

Name of the type	Mean Plant Height (m)	Mean Plant Girth (cm)	Mean Spread (m)		Mean Panicles /Sq. m	Fruit set / m ²	Mean Yield (Kg)	Mean Nut weight (g)
			E.W.	N.S.				
RFRS 185	5.05	39.00	4.75	4.75	15.0	4.0	0.057	6.0
RFRS 186	4.87	33.30	4.13	3.53	10.0	-	-	-
RFRS 187	4.93	43.30	5.66	5.50	14.7	13.0	0.057	5.5
RFRS 188	5.70	55.00	5.70	6.50	24.0	6.0	0.050	9.2
RFRS 189	5.05	54.00	5.50	4.40	21.0	18.0	0.025	6.2
RFRS 190	4.70	48.50	6.70	4.95	26.0	12.0	0.060	7.0
RFRS 191	3.20	32.00	3.50	3.70	10.0	-	-	-
RFRS 192	4.10	36.00	3.50	5.30	21.0	13.0	0.060	8.0
RFRS 193	4.55	34.00	3.40	4.10	16.5	16.6	0.045	8.5
RFRS 194	4.60	32.50	4.85	5.20	20.0	21.3	0.060	7.9

**VRIDHACHALAM**

Cashew accession from Tirukattupalli, TK 1 recorded the highest cumulative nut yield of 37.034 kg/ tree in nine harvests. The accession KK 1 from Kanyakumari District recorded the

highest nut weight of 7.2g and the highest shelling percentage of 28.8 (Table 1.16).

Table 1.16 : Performance of cashew germplasm accessions at Regional Research Station, Vridhachalam

Acc. No	Nut yield / plant(Kg)	Cum. nut yield/ plant(Kg) (9 th harvest)	Mean weight/ nut (g)	Shelling %
VSK 1	6.95	33.13	6.20	27.60
VSK 2	6.56	33.36	7.00	27.40
SL 1	6.85	34.52	7.00	27.40
TK 1	7.65	37.03	6.20	27.60
NK 1	6.54	31.76	6.40	28.10
KK 1	6.22	29.59	7.20	28.80
PV 1	6.05	30.03	6.20	27.70
AM	6.25	29.51	6.20	26.40



However, cumulative nut yield recorded was highest in T.No-10/19 which yielded 121.59 kg/tree which was followed by M 44/3 which gave 90.54 kg/tree. Among the genotypes

weight of the apple was highest in H-367 [99.0 g] followed H-68 with 78.75 g. Incidence of Tea Mosquito was not noticed on the genotypes during the season (Table 1.17 & 1.18).

Table 1.17 : Performance of cashew varieties/ genotypes in MLT-II at Bapatla

Variety/Genotype	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	
			E-W	N-S
Hy-3/28	5.65	99.17	9.55	9.88
T.No.3/33	6.36	120.33	12.05	12.78
T.No.10/19	5.21	102.34	10.02	11.07
T.No.30/1	5.02	77.00	8.40	9.25
H-68	6.06	117.13	12.69	10.77
H-367	5.16	101.08	9.56	9.49
H-303	5.14	103.63	11.03	10.5
H-255	5.15	98.50	8.45	8.60
H-320	5.96	113.95	13.70	11.85
M-44/3	4.66	87.04	8.00	7.96
M-15/4	3.95	79.25	6.58	6.98
T.No.107/3	4.82	88.43	8.85	7.92
T.No. 40/1	5.08	91.00	10.31	9.42

Table 1.18 : Yield and yield attributing characters in MLT-II at Bapatla

Variety/Genotype	Duration of Flowering	Number of panicles/ m ²	Ann. Nut Yield/ tree (kg)	Cum. Nut Yield/ tree (6 hvsts) (kg)
Hy-3/28	135	23.50	18.45	72.45
T.No.3/33	121	23.70	12.22	66.20
T.No.10/19	123	24.20	26.85	121.58
T.No.30/1	141	20.40	6.75	77.82
H-68	134	19.40	12.52	62.42
H-367	123	18.80	14.57	61.14
H-303	137	17.00	29.95	72.23
H-255	141	24.50	10.39	47.08
H-320	137	20.40	37.02	80.65
M-44/3	127	21.10	16.88	90.53
M-15/4	129	17.30	7.47	71.02
T.No.107/3	144	20.50	6.63	50.45
T.No. 40/1	146	20.50	27.07	78.47

BHUBANESWAR

H 255 recorded maximum plant height (7.1 m), trunk girth (132.0 cm), plant spread in E-W (11.9m) and N-S (11.2m) directions, number of

lateral (27) as well as flowering lateral (23) per sq. m. M 44/3 recorded the least in all the parameters except the no. of lateral (21) and



flowering laterals (20) / sq. m (Table 1.19).

Out of the 13 cashew types tested in MLT II highest nut yield (kg/plant) was recorded in NRC Selection-2 (10.0) followed by H 303 (9.2) and H 68 (8.0) with highest cumulative yield (kg/plant) in H303 (98.2) followed by NRCC Selection-2 (90.0) and H 68 (85.5) at 14th

harvest. These three cashew types recorded, nut weight ranging from 8.2g (H303) to 9.0 g (NRCC Sel -2), shelling percentage ranging from 30 to 32 and the nuts per panicle varies from 2 to 3. NRCC Selection-2, H 303 and H 68 was recorded significantly superior nut yield (kg/plant) than other entries (Table 1.20 & 1.21).

Table 1.19 : Vegetative & flowering characters of cashew types in MLT- II at Bhubaneswar

Cashew types	Height of plant (m)	Girth of trunk (cm)	Canopy spread (m)		No. of flowering laterals/m ²
			E - W	N- S	
NRCC Sel-1	5.60	71	9.70	8.30	19
NRCC Sel-2	5.80	103	10.50	9.50	20
M 44/3	4.30	55	6.00	6.80	20
M 15/4	5.40	95	8.80	8.60	17
BPP 3/33	6.80	115	10.10	9.20	21
BPP 10/19	6.40	106	10.00	11.10	17
BPP 30/1	5.80	104	10.30	9.40	17
BPP 3/28	6.20	108	10.90	10.00	18
H 303	5.90	96	9.20	9.40	19
H 320	5.90	98	10.50	9.90	21
H 255	7.10	132	11.90	11.20	23
H 367	5.00	97	9.30	9.00	20
H 68	5.50	98	10.80	9.80	21

Table 1.20 : Yield and yield attributing characters of cashew types in MLT - II at Bhubaneswar

Cashew types	Yield	Cum. yield at 14th harvest	Nut weight (g)	Shelling %
NRCC Sel-1	4.70	39.60	8.60	31
NRCC Sel-2	10.00	90.00	9.00	32
M 44/3	3.50	36.10	5.50	30
M 15/4	3.20	34.00	7.20	29
BPP 3/33	3.90	56.40	7.20	32
BPP 10/19	3.60	42.10	6.80	30
BPP 30/1	3.90	42.40	6.70	27
BPP 3/28	3.70	52.80	8.50	30
H 303	9.20	98.20	8.20	31
H 320	4.00	80.10	8.70	30
H 255	2.40	39.50	9.80	32
H 367	4.00	64.60	10.20	27
H 68	8.00	85.50	8.80	30
SEM ₊	0.284			
CD (5 %)	0.830			

**Table 1.21 : Yield and yield attributing characters of promising cashew types in MLT- II at Bhubaneswar**

Cashew types	Yield	Cum. Yld. at 13 th harvest	Nut weight (g)	Shelling %
NRCC Sel-2	10.00	90.00	9.00	32
H 303	9.20	98.20	8.20	31
H 68	8.00	85.50	8.80	30

CHINTAMANI

No significant variation in tree height, trunk girth and canopy spread was observed among the entries. The highest tree height was recorded in the entries NRCC-1 (6.17 m) and H-255 (6.16 m) followed by M-15/4 (6.00 m) and H320 (5.92 m). The stem girth varied from 77.12 to 109.20cm. The highest girth was recorded by NRCC Sel - 1 (109.20 cm) followed by Ullal-1 (104.10 cm) and the minimum girth was observed in NRCC Sel - 2 (77.12 cm). However, the highest E-W spread was noticed in NRCC-1 (9.80m) and N-S spread was noticed in NRCC Sel - 1 (10.70m). The lowest canopy spread in E-W and N-S directions were noticed in NRCC Sel - 2 (7.01 m & 7.01 m, respectively). The highest number of flowering laterals/m²

were observed in M-44/3 (26.10) followed by NRCC Sel - 1 (25.30). The least number of flowering laterals was recorded by H-303 (15.50). The nut yield per tree varied significantly. Highest nut yield of 13.00 kg/tree was noticed in H-320 followed by M-44/3 (12.34 kg/tree) and lowest was in TN-10/19 (5.06 kg/tree) followed by H-68 (5.17 kg/tree). Over a period of 16 harvests, H-320 recorded highest cumulative yield (144.85 kg/tree) followed by the entries NRCC Sel - 2 (127.34 kg/tree) and M-44/3 (112.30 kg/tree). The H-320 & TN-3/33 recorded highest nut weight of 8.8 g followed by H-68 and H-367 with nut weight of 8.7g each. The shelling percentage was highest in TN-10/19 (32.1%) followed by M-44/3 (31.9%) and H-320 (31%) (Table 1.22 & 1.23).

Table 1.22 : Growth characters of cashew in MLT-II at Chintamani

Cashew entries	Tree ht. (m)	Trunk Girth (cm)	Canopy spread(m)		No. of flowering laterals/m ²
			E-W	N-S	
H - 68	5.68	99.12	7.34	8.24	18.60
H - 367	5.27	91.00	8.10	7.54	20.20
H - 303	5.14	99.70	8.39	8.49	15.50
H - 255	6.16	103.10	9.66	10.09	22.50
H - 320	5.92	92.20	8.56	8.65	22.40
M -44/3	5.04	79.52	7.19	7.33	26.10
M -15/4	6.00	97.00	8.29	8.51	23.20
NRCC Sel-1	6.17	109.20	9.80	10.70	25.30
NRCC Sel-2	5.76	77.12	7.01	7.01	21.90
TN- 30/1	5.14	89.20	8.29	8.30	21.40
TN -3/33	5.78	97.30	8.56	9.18	20.10
TN -10/19	5.64	94.78	8.86	8.46	21.70
TN -3/28	5.55	97.04	8.76	10.19	16.80
Ullal - 1	5.74	104.10	9.10	9.21	18.70
S.Em ±	0.29	9.65	0.63	0.90	1.53
C.D @ 5%	NS	NS	NS	NS	5.00



Table 1.23 : Yield and yield attributing characters of cashew entries in MLT-II at Chintamani

Cashew entries	Nut Yield (Kg/tree)	Cumulative yield (kg/tree) 16 harvests	Nut weight (g)	Shelling (%)
H -68	5.17	52.01	8.70	30.90
H-367	7.00	84.46	8.70	30.70
H- 303	6.10	98.18	8.10	27.70
H- 255	5.63	85.85	8.30	29.50
H- 320	13.00	144.85	8.80	31.00
M- 44/3	12.34	112.30	6.00	31.90
M -15/4	10.10	110.56	7.70	29.50
NRCC Sel-1	6.50	88.30	8.10	30.20
NRCC Sel-2	10.40	127.34	8.10	30.20
TN -30/1	9.70	96.62	6.80	28.20
TN -3/33	5.60	74.77	8.80	30.10
TN -10/19	5.06	72.14	5.30	32.10
TN -3/28	8.40	95.25	7.50	30.60
Ullal - 1	10.20	93.00	7.20	30.80
S.Em ±	0.66	-	-	-
C.D @5%	1.92	-	-	-

JAGDALPUR

The maximum plant height (4.42 m) as well as trunk girth (58.25cm) was recorded in H 68 followed by 3/33, H-303 and V-4. Canopy spread in V-4 was maximum (E-W/N-S = 4.97/4.93m). Nut yield (kg/tree) was highest for H-68 (4.37 kg) followed by V-4, H-303 and

H-367. The cumulative yield (Kg/ tree) was highest for H-68 (18.81 kg) with eight harvests. Nut weight (9.93g) as well as apple weight (62.93g) was highest for H-367. The Shelling per cent was maximum for NRCC Sel-1 (31.63%) (Table 1.24 & 1.25).

Table 1.24 : Performance of different varieties under MLT- II at Jagdalpur

Varieties/ Genotype	Plant height (m)	Girth (cm)	Canopy Spread (m)	
			E-W	N-S
3/28	3.53	54.53	4.15	4.22
3/33	3.92	51.90	4.27	4.82
30/1	3.13	46.40	3.85	4.25
10/19	3.73	51.10	4.00	4.13
VRI-1	2.90	42.73	3.38	3.25
VRI-2	2.35	34.73	2.67	2.60
H-68	4.42	58.25	4.28	4.68
H-255	3.52	54.07	4.27	4.67
H-367	3.23	51.87	4.71	4.87
H-320	3.33	47.33	4.22	4.67
H-303	3.74	50.50	4.02	4.18
NRCC Sel-1	3.50	52.60	4.33	4.20
NRCC Sel-2	2.85	38.10	3.88	3.95
V-4	3.98	53.37	4.97	4.93
SE(m)	0.25	2.56	0.26	0.24
CD 5%	0.73	7.45	0.78	0.72



Table 1.25 : Performance of different varieties under MLT- II at Jagdalpur

Varieties/ Genotype	Nut yield (Kg/tree) 8 Harvests	Cum. Nut yield (No. of harvests 08)	Nut weight (g)	Shelling %
3/28	2.00	9.06	7.60	29.72
3/33	2.17	10.05	6.93	30.30
30/1	2.20	10.94	7.10	27.93
10/19	2.17	11.50	5.50	30.90
VRI-1	1.53	8.03	6.40	31.40
VRI-2	2.07	10.24	6.53	30.73
H-68	4.37	18.81	9.08	30.40
H-255	3.10	11.80	9.03	30.00
H-367	3.60	13.83	9.93	30.57
H-320	3.33	13.05	8.83	28.20
H-303	3.97	17.85	8.53	29.57
NRCC Sel-1	1.57	9.17	7.78	31.63
NRCC Sel-2	2.67	13.38	7.80	30.70
V-4	4.27	17.69	9.13	31.53
SE(m)	0.32	-	0.23	0.73
CD 5%	0.95	-	0.65	2.13

JHARGRAM

The varieties were found to be at par with respect to plant height, trunk girth and trunk height. Significant differences were noticed with respect to canopy spread, canopy area, flowering /m², vegetative flush /m², nuts/m², nuts/panicle, nut yield, apple weight etc.

All the varieties had a plant height ranging between 3.5m to 5.0m. Highest spreading plants were H- 255 (6.2m) followed by T.No. 10/19 (6.0m) and T.No. 3/28 (5.8m). Canopy area was maximum with the variety H- 255 (48m²) followed by T.No 10/19 (42.93 m²) and H 320 (42.33 m²). M- 15/4, H- 255 and H 367 were the early flowering varieties. M- 44/3 and NRCC Sel 2 flowered in early February. Flowering duration was maximum in H-367 (77 days) followed by H- 255 (76 days) and T.No. 10/19 (75 days). Flowering density was maximum with NRCC Sel-2 (19.2 flower panicles/ m²) followed by T.No. 3/33 (18.4 flowering laterals/ m²). It was observed

M- 44/ 3 and NRCC Sel - 2 were the most intensive type of branching habit.

Nuts/ m² was maximum in M- 15/4 (25.8 nuts/ m²) followed by T.No 3/28 (24 nuts /m²) and T.No. 30/1 (23.2 nuts/m²). T.No. 3/28 produced maximum nuts/panicle (6.8). H- 255, H- 68 and NRCC Sel 1 had more than 7g nut weight. T.No. 10/19, H- 320 and H 303 had more than 6g nut weight. Yield was highest in variety H- 255 (6.8 Kg/tree) followed by T.No. 3/28 (5.4 Kg/tree) and T.No. 30/1 and H- 320 both produced 4.9 Kg/tree). Cumulative yield was maximum (16.2 Kg/tree) in the variety H- 255 followed by H- 303 (12.9 Kg/tree), M-44/3 (12.5 Kg/tree) and M-15/4 (11.8 Kg/tree). Except T.No. 10/19, T.No. 30/1 and H-320 all other varieties had more than 28 % shelling. Highest percentage of shelling was recorded with NRCC Sel-1 and M- 44/3 (38.5%) (Table 1.26 & 1.27).



Table 1.26 : The growth parameters of different varieties under MLT II at Jhargram

Variety	Plant Height (m)	Trunk Girth (cm)	Trunk Height (m)	Canopy Spread (m)	Duration (Days)	Flowering/m ²
T.No.30/1	3.90	53	0.90	5.40	67	16.30
T.No.3/33	4.20	65	1.00	4.50	73	18.40
T.No.10/19	4.60	66	1.00	6.00	75	10.40
T.No.3/28	4.10	57	1.00	5.80	68	11.30
H - 68	3.70	39	1.00	3.60	69	9.42
H - 367	4.40	55	0.90	5.10	77	12.60
H - 303	4.20	47	1.20	4.60	66	10.60
H - 255	5.00	68	1.20	6.20	76	7.67
H - 320	4.80	63	1.00	5.70	70	10.30
M - 44/3	3.50	47	1.00	4.20	70	16.10
M - 15/4	4.10	57	1.10	5.10	69	16.70
NRCC Sel-1	3.70	49	0.90	4.20	70	1.00
NRCC Sel-2	4.30	51	0.90	4.80	76	19.20
S. Em (+)	0.30	6.84	NS	0.52	NS	2.27
C.D. at 5%	0.630	14.12		1.07		4.68

Table 1.27 : The yield parameters of different varieties under MLT - II at Jhargram

Variety	Nuts/m ²	Nut weight (g)	Yield (Kg/tree)	Cum. Yield (Kg/tree) 3 harvests	Shelling %
T.No.30/1	23.20	5.00	4.90	7.10	27.00
T.No.3/33	21.40	5.40	3.30	8.70	30.60
T.No.10/19	16.30	6.20	4.30	9.50	26.70
T.No.3/28	24.00	5.80	5.40	11.30	34.90
H - 68	18.70	7.50	2.60	5.70	30.00
H - 367	16.30	5.30	2.90	6.80	36.30
H - 303	20.40	6.80	3.70	12.90	32.20
H - 255	17.80	7.70	6.80	16.20	28.80
H - 320	18.70	6.30	4.90	8.60	27.70
M - 44/3	21.20	5.30	2.40	12.50	38.50
M - 15/4	25.80	5.10	4.10	11.80	28.50
NRCC Sel-1	1.00	7.20	0.20	3.50	39.20
NRCC Sel-2	13.80	5.60	2.60	10.20	32.10
S. Em (+)	4.20	0.20	1.00	1.50	2.50
C.D. at 5%	8.60	0.50	2.10	3.20	5.10

MADAKKATHARA

Maximum height was recorded by T 107/3 (7.92 m) followed by HY- 320 (7.77 m). The highest value of stem girth was recorded by T 107/3 (132.00 cm) followed by HY 255 (123.88 cm).

Variety T 107/3 recorded highest canopy spread (10.67 m) followed by Hy 68 (9.34 m). Variety T 107/3 recorded highest canopy spread (9.65 m) followed by T 30/1 (9.45 m). T 40/1 recorded the



highest apple weight (104 g) followed by Hy 367 (79.33 g). The highest nut weight was recorded by variety T3/28 (9.09 g) followed by Hy- 320 (8.68 g). The highest yield was recorded by Hy

303 (9.24 kg per tree per year) followed by Hy 320 (8.10 kg). The highest cumulative yield for 14 years was recorded by Hy 303 (68.14 kg) followed by Hy 320 (59.47 kg) (Table 1.28 & 1.29).

Table 1.28 : Vegetative characters of different genotypes under MLT II at Madakkathara

Source	Genotypes	Tree height (m)	Stem girth (cm)	Canopy spread -		Duration of flowering	Flowering intensity/m ²
				EW (m)	NS (m)		
Bapatla	T 30/1	7.06	106.66	9.06	9.45	118	6.05
	T 3/33	7.70	102.22	9.31	8.84	109	6.72
	T 10/19	7.30	99.16	8.98	8.33	117	7.27
	T3/28	7.49	110.00	8.60	7.96	106	7.32
Vengurla	HY 68	7.49	107.16	9.34	9.01	114	5.00
	HY 367	6.43	88.00	7.98	7.64	123	6.86
	HY 303	7.47	118.75	8.52	8.65	111	10.60
	HY 255	7.73	123.88	9.27	9.37	115	8.04
	HY 320	7.77	102.63	8.63	8.19	113	6.55
Vridhachalam	M 44/3	6.42	105.66	7.87	6.60	121	6.49
	M 15/4	6.76	109.41	8.04	7.23	115	6.69
DCR, Puttur	T 107/3	7.92	132.00	10.67	9.65	111	7.33
	T 40/1	7.05	97.76	8.03	8.39	117	5.92
Check (Dhana)	HY 1608	7.25	114.03	9.05	8.26	125	8.47
CD (0.05)		1.03	20.09	NS	NS	0.943	1.17

Table 1.29 : Yield and yield attributes of cashew genotypes in MLT II at Madakkathara

Genotypes	Annual Nut Yield (kg/tree)	Cum. nut yield (14 years) (kg/tree)	Nut wt (g)	Shelling %
T30/1	3.25	27.40	7.65	24.20
T 3/33	2.91	25.40	8.04	22.90
T 10/19	2.75	19.00	7.77	23.67
T 3/28	3.29	36.25	9.09	24.50
H 68	2.99	26.63	8.39	26.30
H 367	3.81	30.03	8.52	24.10
H 303	9.24	68.14	8.16	21.30
H 255	2.84	25.72	8.26	22.40
H 320	8.10	59.47	8.68	22.87
M 44/3	3.74	34.98	8.57	23.40
M 15/4	4.14	43.22	8.61	24.20
T 107/3	2.85	26.55	8.11	24.30
T 40/1	3.61	32.66	7.67	24.70
H1608	6.26	51.53	7.85	23.16
CD (0.05)	0.132		NS	



VENGURLA

Performance of the varieties did not differ significantly, except for mean yield (kg/tree & t/ha), mean nut weight (g) and mean apple weight (g). The maximum height and spread were reported in variety 30/1 (6.8 m, and 10.1 m respectively). Where as maximum girth was observed in NRCC Sel.1/ T.No.107/3 (101.2 cm).

H-303 produced significantly highest mean yield of 8.16 kg/tree and 1.63 t/ha and was

found significantly superior over other treatments, this was followed by H-320 (3.88 kg/tree & 0.77 t/ha). The mean nut weight was found maximum (9.70 g) in H-303 whereas H-367 recorded maximum mean apple weight (99.8g). The maximum cumulative yield for eight harvests (27.77 Kg/tree) was found in the H-303, which was followed by 30/1 (19.17 Kg/tree) and H-255 (18.93 Kg/tree) (Table 1.30).

Table 1.30: Growth and yield observations MLT-1992 at Vengurle

Variety /type	Mean Flowering duration (Days)	Mean Fruit set /m ²	Mean Yield (kg/tree)	Mean Yield (t/ ha)	Cum. Yield kg/ tree (8 th harvest)	Mean Nut weight (g)	Mean Shelling (%)	Cum. Yld. (8 hvsts)
H .No. 255	115.50	28.70	2.23	0.44	18.93	9.40	29.33	18.93
H. No. 303	113.50	65.50	8.16	1.63	27.77	9.70	29.00	27.77
H. No. 320	116.00	39.80	3.88	0.77	14.92	8.40	29.00	14.92
H. No.367	115.60	27.80	2.77	0.55	14.66	8.60	28.70	14.66
NRCC Sel.1	112.20	32.60	2.88	0.57	15.39	9.20	31.33	15.39
NRCC Sel.2	115.60	32.30	1.98	0.40	10.69	7.20	30.00	10.69
M-44/3	111.80	25.10	1.13	0.23	7.76	5.10	30.00	7.76
M-15/4	111.70	22.00	1.27	0.25	8.63	8.00	27.33	8.63
10/19	116.60	34.70	2.68	0.54	12.26	6.60	30.00	12.26
3/28	72.10	24.50	1.44	0.29	8.05	4.20	22.00	8.05
3/33	114.40	45.20	1.53	0.31	12.43	6.70	31.30	12.43
30/1	113.40	26.30	3.12	0.29	19.17	5.70	26.70	19.17
SEm ±	10.70	9.91	1.09	0.20	-	0.95	3.43	-
CD at 5%	N.S.	N.S.	3.22	0.60	-	2.79	N.S.	-

VRIDHACHALAM

The 13 entries collected from Bapatla, Vengurla, Vriddhachalam and DCR, Puttur were evaluated for their performance.

The maximum plant height was recorded by T 10/19 (5.22 m) and maximum stem girth was observed in M107/3 (68.42cm). A consistent

higher annual nut yield was observed in M 44/3 and M 15/4 types of Vridhachalam. H 320 recorded the highest nut weight of 7.6 g. Highest shelling percentage of 28.4 was recorded in M 107/3 from NRCC, Puttur and H 367 from Vengurla (Table 1.31 & 1.32).



Table 1.31: Vegetative characters of cashew types in MLT II at Vridhachalam

Variety/Genotype	Plant Height (m)	Trunk Girth (cm)	Canopy spread (m)	Duration of flowering	Flowering intensity / m ² (mean of all 4 sides)
BAPATLA					
T. 30/1	4.72	54.44	4.90	75	16.12
T. 3/33	3.96	50.46	5.00	72	15.08
T.10/19	5.22	62.24	6.60	74	13.44
T. 3/28	4.36	58.16	6.20	74	19.22
VENGURLA					
H 68	4.22	54.46	6.30	67	15.64
H 367	4.16	59.22	6.200	63	19.54
H 303	5.10	64.64	6.40	68	18.84
H 255	4.62	58.62	5.30	70	19.26
H 320	4.46	49.84	6.30	61	19.24
VRIDHACHALAM					
M 44/3	4.68	52.46	6.00	65	18.86
M 15/4	4.88	66.24	6.80	64	19.24
DCR, PUTTUR					
107/3	5.14	68.42	6.40	65	18.24
40/1	4.44	58.16	6.00	62	18.64
SEd	0.27	0.06			
CD 5%	0.79	0.13	NS		

Table 1.32: Yield and yield attributing characters of cashew types in MLT II at Vridhachalam

Variety/ Genotypes	Yield (kg/tree)	Cum. Yield (kg/tree) (13 harvests)	Nut weight (g)	Shelling (%)
BAPATLA				
T. No. 30/1	8.56	42.68	7.20	27.80
T. No. 3/33	9.24	41.91	7.20	28.20
T. No. 10/19	8.25	40.69	7.00	28.00
T. No. 3/28	7.98	42.78	6.60	28.20
VENGURLA				
H 68	9.24	43.96	6.80	27.60
H 367	8.85	43.53	7.00	28.40
H 303	8.42	45.50	7.20	28.00
H 255	9.25	41.88	7.40	28.20
H 320	9.54	47.96	7.60	28.20
VRIDHACHALAM				
M 44/3 vri 2	8.54	50.00	5.80	28.00
M 15/4 vri 4	8.68	48.51	6.80	28.20
DCR, PUTTUR				
M 107/3	9.21	42.17	7.00	28.40
M 40/1	8.52	46.15	7.20	28.20
CD 5%	0.26		0.42	NS



Table 1.31 : Vegetative characters of cashew types in MLT II at Vridhachalam

Variety/Genotype	Plant Height (m)	Trunk Girth (cm)	Canopy spread (m)	Duration of flowering	Flowering intensity/ m ² (mean of all 4 sides)
BAPATLA					
T. 30/1	4.72	54.44	4.90	75	16.12
T. 3/33	3.96	50.46	5.00	72	15.08
T.10/19	5.22	62.24	6.60	74	13.44
T. 3/28	4.36	58.16	6.20	74	19.22
VENGURLA					
H 68	4.22	54.46	6.30	67	15.64
H 367	4.16	59.22	6.200	63	19.54
H 303	5.10	64.64	6.40	68	18.84
H 255	4.62	58.62	5.30	70	19.26
H 320	4.46	49.84	6.30	61	19.24
VRIDHACHALAM					
M 44/3	4.68	52.46	6.00	65	18.86
M 15/4	4.88	66.24	6.80	64	19.24
DCR, PUTTUR					
107/3	5.14	68.42	6.40	65	18.24
40/1	4.44	58.16	6.00	62	18.64
SEd	0.27	0.06			
CD 5%	0.79	0.13	NS		

Table 1.32 : Yield and yield attributing characters of cashew types in MLT II at Vridhachalam

Variety/ Genotypes	Yield (kg/tree)	Cum. Yield (kg/tree) (13 harvests)	Nut weight (g)	Shelling (%)
BAPATLA				
T. No. 30/1	8.56	42.68	7.20	27.80
T. No. 3/33	9.24	41.91	7.20	28.20
T. No. 10/19	8.25	40.69	7.00	28.00
T. No. 3/28	7.98	42.78	6.60	28.20
VENGURLA				
H 68	9.24	43.96	6.80	27.60
H 367	8.85	43.53	7.00	28.40
H 303	8.42	45.50	7.20	28.00
H 255	9.25	41.88	7.40	28.20
H 320	9.54	47.96	7.60	28.20
VRIDHACHALAM				
M 44/3 vri 2	8.54	50.00	5.80	28.00
M 15/4 vri 4	8.68	48.51	6.80	28.20
DCR, PUTTUR				
M 107/3	9.21	42.17	7.00	28.40
M 40/1	8.52	46.15	7.20	28.20
CD 5%	0.26		0.42	NS



2. Multi Location Trial III

Centres: East Coast

Bapatla, Bhubaneswar 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 :

At Bapatla, the duration of flowering was shortest in H-32/4 [117days] followed by H-662 [119 days]. The accessions BH 85, BH 6 and H 32/4 were identified as cluster bearers (3 - 4 nuts/panicle) with high shelling percentage (30.0 to 33.0) and bold nut (7.3 g to 8.5 g) at Bhubaneswar. The highest nut weight was recorded in BH-6 (9.29 g) followed by H-1593 (9.19 g) in Chintamani.

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

Plot size - 4 plants per plot

Spacing 7.5 x 7.5 m

BAPATLA

Among the 11 genotypes evaluated, plant height recorded was highest in BPP-8 [3.68 m] which is closely followed by 30.67 in H-11. Maximum Stem Girth and canopy spread was recorded with BPP-8 variety i.e. 58.4 cm, 6.4m [E-W] and 6.5m [N-S] respectively. Duration of flowering was found to be shortest in H-32/4 [117days] followed by H-662 [119 days]. Number of panicles produced per square meter canopy area was highest with K- 22-1 which

had 21.63 panicles followed by H-14 with 20 panicles.

Mean nut yield per tree during the year was highest in BPP-8 [11.38kg] followed by BH-6 [7.56kg]. Cumulative nut yield per tree was also highest in BPP-8 which has given 17.90 kg/tree at 4th harvest and was followed by H-32/4 with 9.53 kg/tree. Mean weight of the apple was highest in H-1597 [71.17g] which was followed by BPP-8 with 69.67g (Table 1.33 & 1.34).

**Table 1.33 : 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	3.62	58.00	6.39	6.34
H -662	2.70	41.00	4.55	4.60
H- 675	3.44	55.22	5.09	5.29
H 32/4	3.63	61.11	5.54	6.22
K- 22-1	3.20	55.00	4.90	4.87
H -11	3.67	57.61	6.20	6.23
H -14	3.29	69.00	5.07	5.38
H -1597	3.48	57.92	5.60	5.19
BH- 6	3.08	50.80	5.36	5.52
BH -85	2.98	52.25	5.18	5.98
BPP- 8	3.68	63.76	8.27	8.26

Table 1.34 : Yield parameters in MLT-III at Bapatla

Variety/ Genotype	Duration of Flowering	Flowering Intensity/m ²	Nut yield /tree (4 th harvest) (kg)	Cum. nut yield/tree (4 harvests) (kg)
Goa-11/6	146	12.94	6.76	8.92
H -662	119	15.25	0.25	2.43
H -675	124	16.46	3.05	4.77
H 32/4	117	16.04	5.69	9.53
K -22-1	148	21.63	0.99	4.31
H -11	151	18.13	2.64	5.06
H -14	165	20.00	4.74	7.94
H -1597	135	18.88	3.60	6.76
BH -6	130	19.46	7.56	8.33
BH -85	146	15.88	4.85	6.10
BPP -8	137	18.24	11.38	17.90

BHUBANESWAR

Maximum plant height of (4.2 m) and trunk girth (59.4cm) were recorded both in BH 85 & H32/4. Minimum plant height (2.6m) and trunk girth (22.1cm) were recorded in H662. Maximum plant spread was obtained in BH 85 and H 32/4. Maximum no. of laterals (23) and flowering laterals (20) per sq. m. was recorded in BH85.

Out of 11 cashew types along with the local check H 2/16, highest nut yield (kg/plant) was recorded in BH85 (3.1) followed by Goa 11/6 and BH6 (2.4). The highest cumulative nut

yield (kg/plant) was recorded in BH 85 (8.7) followed by BH 6 (8.2) and H 32/4 (7.5) at 4th harvest. These 3 types are cluster bearers (3 - 4 nuts/panicle) with shelling percentage ranging from 30 to 33 per cent and bold nut types with nut weight ranging from 7.3 g to 8.5 g.

The cashew types BH 6, BH 85, H - 1597, H-32/4 and Goa 11/6 proved significantly superior with respect to nut yield (kg/plant) compared to the local check H-2/16 (Table 1.35 & 1.36).



Table 1.35 : Vegetative and flowering characters of cashew types in MLT - III at Bhubaneswar

Cashew types	Plant height (m)	Girth of trunk (cm)	Canopy spread (m)		No. of flowering laterals/m ²
			E - W	N- S	
BH 6	4.1	48.7	5.7	5.8	15
BH 85	4.2	53.9	6.1	5.9	20
H 1597	3.9	52.0	6.0	5.8	15
K 22-1	3.8	38.2	3.9	3.9	14
H 662	2.6	22.1	2.3	2.1	10
H 675	3.8	40.2	4.2	4.0	16
H 11	3.8	48.7	6.0	5.6	18
H 14	3.3	37.2	4.2	4.4	17
H 32/4	4.2	59.4	6.1	5.9	18
Goa 11/6	3.9	53.7	5.3	5.7	17
H 2/16 (Local Check)	4.1	51.3	5.9	5.4	18
SEM±	0.164	0.953	0.266	0.319	1.130
CD (5 %)	0.486	2.813	0.785	0.941	3.336

Table 1.36 : Yield and yield attributing characters of cashew types in MLT- III at Bhubaneswar

Cashew types	Yield	Cum. at 4th harvest	Nut weight (g)	Shelling %
BH 6	2.4	8.2	8.5	33
BH 85	3.1	8.7	7.3	30
H 1597	2.1	5.7	8.1	31
K 22-1	0.3	3.2	7.6	29
H 662	0.1	3.0	7.0	31
H 675	0.3	2.4	4.8	30
H 11	1.1	5.4	6.0	30
H 14	1.2	3.5	5.5	31
H 32/4	2.3	7.5	8.0	31
Goa 11/6	2.9	6.8	7.0	31
H 2/16 (Local check)	1.5	5.3	8.1	28
SEM±	0.142			
CD (5 %)	0.420			

CHINTAMANI

Significantly highest plant height was recorded in H-32/4 (5.13m) followed by Bhaskara (5.07m) and least plant height was recorded in H-14 (3.62 m) followed by H-675(4.05 m).

Significant variation in the trunk girth was observed among the entries. The highest trunk girth was recorded in H-32/4 (79.28 cm) followed by Bhaskara (74.83 cm).

The lowest trunk girth was observed by H-14 (51.82 cm). Canopy spread of plants significantly varied among entries. The highest E-W & N-S spread was recorded by H-32/4 (8.20 and 8.01m. respectively). The lowest E-W and N-S spread was recorded by H-14 (5.31 and 5.45 m. respectively).

Significantly highest nut yield was recorded by H-32/4 (13.67 kg/tree) followed by H-1593 (12.28 kg/tree) and lowest nut yield was recorded by H-



14 (3.52 kg/tree). The cumulative yield of five years recorded highest in H-1593 (26.55 kg/plant) followed by H-32/4 (26.06 kg/plant) and lowest was in H-14 (10.56 kg/plant). The highest nut weight was recorded in BH-6 (9.29

g) followed by H-1593 (9.19 g) and lowest was recorded by H-662 & H-675 (4.8 g.). The shelling percentage of entries ranged from 30.9 to 32.8 per cent (Table 1.37).

Table 1.37 : Growth and yield performance of cashew entries MLT-III at Chintamani

Entries	Plant ht. (m)	Trunk girth (cm)	Canopy spread (m)		Nut yield (kg/tree)	Cum. yield (kg/tree) of 5 harvests	Nut Wt. (g)	Shelling (%)
			E-W	N-S				
BH - 85	4.37	73.50	7.30	6.64	10.07	20.86	9.2	32.0
H - 1593	4.47	71.77	6.62	6.63	8.57	19.36	7.3	32.0
H - 662	4.33	71.23	6.95	7.03	12.28	26.55	9.1	32.2
H - 675	4.30	61.70	6.94	6.95	11.27	20.54	4.8	30.9
H - 32/4	4.05	59.93	6.27	6.28	5.50	13.75	4.8	32.8
K - 22/1	5.13	79.28	8.20	8.01	13.67	26.06	8.8	31.9
H - 11	4.57	69.43	6.50	6.67	11.43	20.88	6.0	31.7
H - 14	4.43	71.17	7.30	6.97	9.11	18.36	6.3	31.8
Bhaskara	3.62	51.82	5.31	5.45	3.52	10.56	5.3	31.1
Chintamani-1	5.07	74.83	6.98	6.84	8.45	21.94	8.4	31.5
S.Em ±	4.50	70.25	6.94	7.15	12.23	23.72	7.4	31.2
C.D @ 5%	0.20	4.17	0.34	0.35	1.36	-	-	-
	0.60	11.66	1.01	1.04	4.01	-	-	-

MADAKKATHARA

Maximum height was recorded in H-662 (5.43 m) followed by BH 85 (5.26 m). Maximum girth was recorded in H -11 (76.00 cm) followed by K 22-1 (75.41 cm). Maximum canopy spread - EW and NS was recorded by the H - 14 (7.38 and 6.91 m) and H- 662 (7.25 and 6.89 m). There was significant difference among the entries for

annual nut yield, H 1593 gave maximum nut yield/ tree (3.50 kg) followed by variety Goa 11/6 (3.36 kg). The highest cumulative yield for 5 years was recorded in H-1593 (15.57 kg) followed by Goa 11/6 (15.33 kg) (Table 1.38).

Table 1.38 : Growth and yield characters of cashew genotypes under MLT III at Madakkathara

Entries	Height (m)	Nut wt. (g)	Yield (kg/tree/year)	Cum. Yld (5 yrs) (kg/tree)
Dhana	4.84	8.61	2.74	12.57
H-11	5.12	8.74	2.91	10.91
H-32/4	5.11	8.50	2.44	11.14
H-1593	4.10	8.45	3.50	15.57
BH-6	4.24	7.62	1.46	7.96
H-662	5.43	7.84	2.49	12.05
H-675	5.06	8.30	2.85	10.02
BH-85	5.26	8.79	2.99	11.72
K-22-1	4.38	8.90	1.89	9.57
Goa 11/6	4.80	8.91	3.36	15.33
H-14	5.03	8.87	2.62	12.39
CD (0.05)	0.54	NS	0.29	



VENGURLA

The mean height was in the range of 1.32 m (B.H. 6) to 1.66 m (H-675) whereas the mean girth was found in the range of 7.3 cm (Goa -

11/6) to 16.7 cm (H-11). The mean spread of the 11 varieties/ type was in the range of 1.6 m to 2.0 m (Table 1.39).

Table 1.39 : Growth and yield observations MLT-III replanted in 2008 at Vengurle

Variety /Type	Mean Height (m)	Mean Girth (cm)	Mean Spread (m)	
			EW	NS
B.H.6	1.32	13.4	2.0	2.0
B.H.85	1.45	11.6	1.8	2.0
H-1593	1.55	11.0	1.6	1.7
H-662	1.44	12.1	1.8	2.1
H-675	1.66	7.4	1.7	1.7
H-32/14	1.44	8.2	1.9	1.8
K-22-1	1.52	13.5	1.9	2.0
H-11	1.53	16.7	2.0	2.0
H-14	1.46	14.8	1.6	1.8
Goa 11/6	1.43	7.3	1.5	1.7
Local check i.e. V-7	1.61	11.5	1.6	1.8
<small>SEM ±</small>	0.14	2.37	0.20	0.19
CD at 5%	N.S.	N.S.	N.S.	N.S.

VRIDHACHALAM

The trial has been taken up with 11 entries as details below. The trial has been replanted

during 2008 and the crop is at initial stage of growth (Table 1.40).

Table 1.40 : Performance of cashew genotypes under MLT III at Vridhachalam

Variety/ Genotypes	Plant height (m)	Trunk Girth (cm)	Canopy spread (m)
BH 6	1.82	23.0	2.22
BH 85	1.98	23.0	2.48
H 1593	1.44	26.0	2.75
K 22-1	1.88	23.2	2.24
H 662	1.96	23.8	2.62
H 675	1.24	26.2	2.52
H 11	1.82	25.2	2.02
H 14	1.40	24.8	2.58
H 32/4	1.88	24.0	2.64
Goa 11/6	1.88	22.4	2.12
VRI 2	1.86	22.6	2.22
VRI 3	1.62	22.8	2.12



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

Centres : East Coast :

Bapatla, Bhubaneswar, 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 Bapatla, the canopy spread was highest in BPP-3 [12 and 12.0 m EW & NS] followed by Vengurla-3 [11.93 and 10.7m EW & NS] and weight of the apples ranged from 22.50 g [Ullal-1] to 72.50 g [Ullal-5]. The canopy spread in E-W & N-S directions ranged from 1.05 to 4.73 m and 1.05 to 5.00 m, respectively after 4 years after planting at Chintamani. The variety Amrutha recorded maximum canopy spread (EW) (5.15 m) and maximum canopy spread (NS) (6.92 m) at Madakkathara.

Treatments:

The earlier trial on performance of released varieties was planted in 1997. This trial on MLT-V has been planted afresh during 2006 using the following 25 selected varieties. The new trial with 25 varieties is in the initial stages of growth.

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



BAPATLA

Among the 23 released varieties evaluated (old set), plant height recorded was maximum in Vengurla-3 [6.13m] followed by Vengurla-5 [5.55m]. Vengurla-3 has also showed maximum stem girth of 113.67m followed by BPP-3 [111.cm]. Canopy spread was highest in BPP-3 [12 and 12.0 m] followed by Vengurla-3 [11.93 and 10.7m].

Duration of flowering was shortest in the variety Vengurla -5 [98 days] followed by Jhargram and VRI-2 with 112 days and 113 days respectively. Highest number of flowering panicles per square meter canopy area was

recorded in Vengurla-2 which had 23.63 panicles followed by BPP-9 with 23.38 numbers.

Mean annual nut yield per tree was highest in BPP-6 [29.40 kg] followed by BPP-3 [24.90 kg] and Vengurla -5 [24.52 kg] where as, cumulative nut yield was highest in Vengurla-5 [60.98 kg/tree] followed by BPP-3 [52.43 kg] and Vengurla-4 [50.77 kg]. Lowest cumulative nut yield was recorded with Chintamani variety which gave 6.450 kg/tree followed by Ullal-5 with 8.04 kg/tree. Weight of the apples ranged from 22.50 g [Ullal-1] to 72.50 g [Ullal-5] (Table 1.41 & 1.42)

Table 1.41 : Performance of cashew released varieties planted during 1997 at Bapatla

Variety/ Genotype	Plant height (m)	Trunk Girth (cm)	Canopy spread (m)	
			E-W	N-S
BPP-1	4.95	105.50	10.15	9.55
BPP-2	4.73	101.75	9.68	9.70
BPP-3	5.20	111.00	12.00	12.00
BPP-4	2.60	56.00	8.10	7.20
BPP-5	4.63	98.25	7.95	9.08
BPP-6	4.60	90.00	10.00	9.00
BPP-8	4.50	85.00	7.50	8.20
BPP-9	3.70	75.45	7.45	7.75
Kanaka	4.10	97.00	7.68	7.63
Dhana	4.08	84.75	8.43	8.80
Priyanka	4.05	80.50	8.43	8.08
Vengurla -2	3.80	78.00	6.55	7.35
Vengurla -3	6.13	113.67	11.93	10.70
Vengurla -4	5.15	99.25	9.13	9.00
Vengurla -5	5.55	110.50	9.80	9.50
BBSR -1	4.55	80.00	6.95	7.80
VRI- 2	4.63	92.67	10.03	10.23
Chintamani	3.50	55.00	5.50	11.90
Ullal -1	3.50	79.50	7.25	7.10
Ullal -4	4.15	84.50	8.85	9.45
Ullal -5	5.23	92.75	9.60	9.75
Jhargram	3.80	72.67	7.80	7.57



Table 1.42: Yield parameters under MLT-V at Bapatla

Variety/ Genotype	Duration of Flowering	Flowering Intensity/m ²	Nut yield /tree (Harvest No.11) (kg/tree)	Cum. Nut Yield/ tree (10 hrvsts) (kg/tree)
BPP-1	137	18.88	11.07	27.24
BPP-2	119	21.25	14.96	40.83
BPP-3	117	22.25	24.90	52.43
BPP-4	123	17.00	0.85	24.46
BPP-5	110	20.25	11.85	41.98
BPP-6	131	19.50	29.40	38.92
BPP-8	148	21.00	18.57	41.61
BPP-9	125	23.38	15.50	42.14
Kanaka	137	22.63	18.65	41.78
Dhana	125	18.88	5.61	21.72
Priyanka	123	18.63	10.87	26.17
Vengurla -2	128	23.63	7.60	14.15
Vengurla -3	130	19.88	21.18	38.58
Vengurla -4	120	18.75	22.33	50.77
Vengurla -5	98	16.88	24.52	60.98
BBSR -1	150	19.00	7.15	25.45
VRI- 2	113	19.13	14.55	45.00
Chintamani	149	18.25	0.80	6.45
Ullal -1	133	21.13	6.48	14.97
Ullal -4	138	20.38	8.25	20.55
Ullal -5	140	17.50	0.97	8.04
Jhargram	112	17.50	19.00	40.97

BHUBANESWAR

The experiment is laid out with 25 numbers of released varieties, where twelve numbers of plants of each variety were planted in two rows having six plants in each row observing 8 m x 8 m spacing. During the reporting period both the vegetative and yield data have been recorded and the nut yield obtained per plant was negligible.

The plant height was maximum in variety Ullal - 4 (2.9 m), whereas trunk girth and canopy spread (in E-W and N-S direction) were maximum in variety Amrutha (10.5cm) and NRCC Sel-2 (4.0 & 3.0m) respectively (Table 1.43).

The experiment has been planted during 2008 and the plants are in the initial stages of growth.



Table 1.43 : Vegetative characters of promising cashew types in MLT -V at Bhubaneswar

Cashew types	Plant height (m)	Trunk girth (cm)	Canopy Spread (m)	
			E - W	N- S
BPP-4	1.6	7.5	3.0	2.6
BPP-6	1.7	8.0	2.2	2.6
BPP-8	1.5	7.0	1.6	1.4
Bhubaneswar-1	1.7	9.0	3.0	2.8
Chintamani-1	1.5	9.0	2.3	2.0
Jhargram-1	1.2	6.0	1.1	1.0
Madakkathara-1	1.6	5.5	1.1	1.3
Madakkathara-2	2.1	9.5	2.6	3.0
K-22-1	1.8	8.0	2.3	2.0
Dhana	1.5	5.5	1.0	1.5
Kanaka	2.0	8.0	2.3	2.5
Priyanka	1.6	8.0	1.6	2.1
Amrutha	2.1	10.5	2.6	2.7
Vengurla-1	1.8	7.5	1.7	2.0
Vengurla-4	1.5	7.0	1.1	1.8
H 68	1.2	5.5	1.0	1.2
H 255	1.7	7.5	1.6	2.0
VRI-3	1.7	8.5	2.3	2.5
NRCC sel-2	2.0	9.0	4.0	3.0
Ullal-1	1.8	7.0	2.4	1.5
Ullal-3	2.0	8.5	2.0	2.0
Ullal-4	2.9	10.0	2.4	2.6
UN-50	1.6	7.5	2.5	1.8
Goa-1	1.7	9.5	3.0	2.3
Bhaskar	1.5	8.0	2.5	2.1

CHINTAMANI

This trial has been planted during 2007 with a spacing of 8x8 m. The growth parameters viz., plant height ranged from 1.50 to 3.40 m and stem girth varied from 33.00 to 49.00 cm. The

canopy spread in E-W & N-S directions ranged from 1.05 to 4.73 m and 1.05 to 5.00 m, respectively (Table 1.44).

**Table 1.44 : Growth performance of released varieties at Chintamani**

Varieties	Pl. ht (m)	Stem girth (cm)	Canopy spread (m)	
			E-W	N-S
BPP-4	2.77	36.0	3.23	3.4
BPP-6	2.70	45.0	3.30	3.87
BPP-8 (2/16)	3.40	47.0	4.50	4.9
Chintamani -1	2.80	41.5	3.93	3.83
Chintamani -2	3.20	41.00	2.70	2.8
Madakkathara-2 (NDR-2-1)	2.95	34.0	3.80	4.3
K-22-1	2.57	36.7	3.73	3.93
Dhana	2.70	45.0	4.40	5.0
Amrutha	3.20	44.0	4.55	5.2
Vengurla -1	2.70	41.33	3.83	3.83
Vengurla -4	2.80	40.67	4.40	3.93
NRCC-2	3.20	49.0	4.10	4.9
Ullal-1	3.00	41.67	4.73	4.8
Ullal-3	2.65	34.0	2.70	3.1
Ullal-4	3.10	40.0	4.6	4.97
UN-50	3.45	43.0	4.35	4.23
Bhaskara	2.70	33.0	4.0	3.1
V - 6	1.90	46.0	1.80	1.5
V - 7	2.67	33.33	1.27	1.33
V - 8	1.60	36.00	1.10	1.2
Kanaka	1.80	40.00	1.30	1.2
Priyanka	1.50	34.00	1.05	1.1
Goa -1	1.60	35.00	1.12	1.15
Bhubaneshwar- 1	1.55	34.00	1.10	1.1
Jhargram	1.67	38.00	1.25	1.25
Madakkathara - 1	1.70	40.00	1.30	1.3
(BLA - 39 - 4)				
VRI - 3 (M-26/2)	1.54	35.00	1.15	1.15

JHARGRAM

The trial has been initiated during 2010 and hence plants are in the initial stage of vegetative growth.

MADAKKATHARA

UN 50 recorded maximum height (4.43 m) followed by Ullal -4 (4.25 m). Poornima recorded highest girth (35.40 cm) followed

by Madakkathara-1 (35.00 cm). With respect to canopy spread (EW), the variety Amrutha recorded maximum spread (5.15 m) followed by Ullal -4 (4.32 m). With respect to canopy spread (NS) the variety Amrutha recorded maximum spread (6.92 m) followed by Vridhachalam -3 (4.90 m). Highest yield was recorded by Amrutha (8.57 kg/tree) (Table 1.45).



Table 1.45 : Morphological characters of cashew varieties under MLT V at Madakkathara

Variety	Height (m)	Girth (cm)	Canopy spread - EW (m)	Canopy spread - NS (m)	Nut yield (kg/tree)
Goa -1	4.20	32.80	3.97	3.69	1.300
UN 50	4.43	33.00	3.70	3.52	1.350
Ullal-4	4.25	34.80	4.32	4.21	2.100
Ullal -3	4.15	30.00	4.09	3.94	1.800
Ullal-I	4.05	29.60	3.27	3.90	2.100
DCR sel-2	3.35	30.20	3.48	3.22	2.200
V6	3.60	31.00	3.71	3.17	1.500
V4	3.70	27.60	3.94	3.89	3.350
V1	3.55	28.00	3.19	3.23	3.600
Jhargram	3.80	33.20	3.81	3.61	1.300
Chinthamani	3.75	29.40	3.86	4.18	1.800
BPP-4	3.75	32.00	3.54	3.58	3.600
Akshaya	3.65	30.00	3.98	3.64	2.300
Anagha	3.10	26.40	3.16	2.80	2.500
Damodar	3.25	28.20	3.16	2.50	2.500
Raghav	2.80	28.20	3.34	3.30	1.800
Dharasree	3.18	29.50	3.52	3.27	5.300
Sulabha	3.16	28.00	3.00	3.14	2.000
Anakkayam-1	3.50	31.60	3.58	3.52	5.700
Priyanka	3.55	30.60	3.76	4.04	5.960
Dhana	3.35	32.20	3.88	4.14	6.000
Amrutha	4.01	33.25	5.15	6.92	8.570
Vridhachalam-3	3.60	34.60	3.54	4.90	5.500
K-22-1	3.40	33.40	3.87	4.12	3.000
Madakkathara-2	3.65	31.20	4.22	3.43	4.000
Kanaka	3.55	31.40	3.66	3.39	4.600
Madakkathara-1	3.81	35.00	3.28	3.71	5.000
Poornima	3.61	35.40	3.65	3.39	7.000

PILICODE

The plant height, collar girth and north-south spread of plants differ significantly

between varieties. Tallest plants were observed in variety, Bhaskara (Table 1.46).

**Table 1.46 : Biometric observations of cashew varieties at Pilicode**

Accession No./ Variety	Plant Height (m)	Collar Girth (cm)	Canopy Spread (m)	
			E-W	N-S
NRCC Sel 2	2.77 cdefg	21.27 abcdef	3.28	3.27 abcde
MDK 1	3.21 bc	26.37 a	3.43	3.27 abcd
Goa 1	2.85 bcdef	19.33 cdefgh	2.91	3.33 abc
Ullal 1	3.67 b	26.18 ab	3.03	3.51 ab
MDK 2	3.14 bcd	22.52 abcd	2.52	2.83 abcdefghi
Bhaskara	4.41 a	21.41 abcde	2.82	3.18 abcdef
V4	1.93 kl	12.33 l	1.87	1.85 ijklmn
Kanaka	2.68 cdefghi	23.00 abc	2.48	2.96 bcdefgh
VRI 3	2.52 cdefgh	18.75 cdefghijk	3.05	3.81 a
Amritha	2.66 cdefghij	19.25 cdefghi	2.45	2.62 bcdefghijk
Ullal 3	3.12 bcde	16.75 defghijkl	2.25	2.65 bcdefghij
V7	2.16 ghijkl	16.15 defghijkl	2.46	2.33 defghijklmn
K-22-1	2.30 ghijkl	17.31 cdefghijkl	1.91	2.47 cdefghijklm
UN 50	2.31 ghijkl	15.00 hijkl	1.91	2.33 defghijklmn
Bhubaneshwar 1	2.75 cdefgh	19.00 cdefghij	2.62	2.55 cdefghijkl
BPP 8	1.83 kl	12.37 l	1.20	1.85 ijklmn
BPP 6	1.75 l	14.50 hijkl	2.10	2.25 fghijklmn
Priyanka	2.43 fghijk	20.53 cdefg	2.70	3.10 abcdefg
Dhana	1.75 l	14.17 hijkl	1.62	1.43 n
Mean	2.595	18.749	-	2.718
F Test	**	**	NS	**
CD @ 5%	0.623	5.274		0.99

VRIDHACHALAM

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

There was no significant difference among the different varieties during early stage of growth (Table 1.47)



Table 1.47 : Performance of released varieties of Cashew at Vridhachalam

Varieties	Plant Height (m)	Stem Girth (cm)	Canopy spread (m)
BPP-4	1.50	23.5	1.52
BPP-6	1.50	24.0	1.54
BPP-8 (H 2/16)	1.55	22.6	1.60
Bhubaneshwar-1	1.80	24.7	1.82
Chintamani-1	1.50	23.0	1.56
Madakkathara-2	1.45	23.1	1.50
K-22-1	1.53	21.0	1.50
Dhana	2.10	26.0	2.20
Kanaka	1.95	24.0	2.00
Priyanka	1.75	23.5	1.80
Amrutha	1.73	23.6	1.82
Vengurla-4	1.95	24.6	2.00
Vengurla-6	2.10	26.2	2.18
Vengurla-7	2.30	26.4	2.42
VRI-3	1.40	22.0	1.52
NRCC Sel-2	2.00	26.0	2.12
Ullal-1	1.33	22.8	1.46
Ullal-3	1.48	23.2	1.56
Ullal-4	1.64	24.0	1.88
Bhaskara	1.66	24.0	1.78
CD(0.05%)	0.45	NS	0.82



Gen.4. Hybridization and Selection

Centres : East Coast :

Bapatla, Bhubaneswar, 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 to combine desirable traits such as high yield, bold nut, cluster bearing habit, compact canopy, short flowering period, late synchronized flowering and high shelling percentage in single genotype.

SUMMARY:

Annual nut yield at 9th harvest was highest with H-67 [38.80 kg/tree] followed by H-73 with 34.25 kg/tree at Bapatla. The highest cumulative nut yield (kg/plant) for 9 harvests was recorded in A1-85 (68.7) at Bhubaneswar. All bold nut types had nut weight ranging from 7.4g to 10.0g, no. of nuts per panicle (2 to 4) and shelling percentage (28 to 35); the hybrid J5-13 recorded highest cumulative nut yield (14.7 kg/plant) for 5 harvests at Bhubaneswar Centre. At Chintamani, the flowering intensity was highest in H-191 (16.75) and the number of fruits per panicle was highest in H-81 (6.17). The highest cumulative yield/tree for 12 years at Madakkathara was obtained in H 74 (79.75 kg/tree) followed by H 73 (76.80 kg/tree). 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.

BAPATLA

Based on results of crossing programme and evaluation T.No.10/19 and T.No. 30/1 are proposed for release during the year.

Among the different hybrids of 1997 evaluated duration of flowering ranged from 106 days in H-64 to 176 days in H-69 and H-72. Annual nut yield at 9th harvest is highest with H-67 [38.80 kg/tree] followed by H-73 with 34.25 kg/tree. However cumulative nut yield was found highest with hybrid H-36 which has given 68.30

kg/tree and closely followed by H-67 [66.05 kg/tree]. Lowest cumulative nut yields were recorded in H-6 and H-3 which have given 13.88 and 14.66 kg/tree respectively (Table 1.48).

Among the hybrids of 1998 duration of flowering ranged from 91 to 162 days. Annual nut yield and cumulative nut yields were found highest in H-94 [11.70 kg/tree] followed by H-85 [9.77 kg/tree] (Table 1.49).

Table 1.48 : Performance of cashew hybrids planted during 1997 at Bapatla

Hybrid No	Cross Combination	Duration of Flowering	Annual Nut yield @ 9 th harvest	Cum. nut yield/tree 9 hvsts [kg]
H-9	T 273 x T 72	132	28.35	51.53
H-10	T 273 x T 73	145	17.75	43.78
H-14	T 228 x T2/22	120	26.92	50.22
H-36	F.No 3 x T 30/1	135	29.00	68.30
H-64	T 71 x T 273	106	24.05	46.30
H-67	T 71 x T 273	147	38.80	66.05
H-73	T 71 x T 273	138	34.25	50.52

**Table 1.49 : Performance of cashew hybrids planted during 1998 at Bapatla**

Hybrid No	Cross Combination	Duration of Flowering (days)	Annual Nut yield @ 9 th harvest	Cum. nut yield/tree (9 hvsts) 2010-2011 [kg]
H-82	T.NO 71 x T.NO 273	114	6.80	6.80
H-85	BPP-8 x 228	119	9.77	9.77
H-86	BPP-8 x 228	144	6.50	7.90
H-89	BPP-8 x 228	103	6.90	8.50
H-92	Priyanka x VRI-2	174	7.90	7.90
H-93	Priyanka x VRI-2	120	5.75	5.75
H-94	Priyanka x VRI-2	114	11.70	11.70
H-104	T.No 228 x T.No 30/1	156	6.55	7.55
H-108	T.No228 x Priyanka	105	5.05	5.05
H-110	Priyanka x BPP-8	140	5.15	7.15
H-112	BPP-8 x Priyanka	119	3.30	7.30

BHUBANESWAR

In 1995 hybrid block, highest cumulative nut yield (kg/plant) was recorded in A6 (72.7) followed by A9 (46.5), E₁ (37.9) and D1 (30.7) at 11th harvest. All are bold nut types with nut weight ranging from 7.4g to 10.0g, no. of nuts per panicle varies from 2 to 4 with shelling percentage (%) 28 to of 35. The nut yield ranged from 10.30 (A6) to 8.80 (A9) kg/plant.

Among the promising hybrids planted in the year 1997 at the 9th harvest highest cumulative nut yield (kg/plant) was recorded in A1-85 (68.7) followed by A1-16 (49.8) and A1-105 (42.3) with shelling percentage (%) of 33, 28 and 28 respectively. A1-16 recorded highest nut yield of 10.5 (kg/plant) during the reporting period.

Hybrid A2-13 recorded highest cumulative nut yield (kg/plant) followed by A1-22 (22.6) and B2-32 (21.2). All the hybrids produce bold nut ranging from 8.50g (B2-22) to 9.50g (A2-13). Shelling percentage was recorded to be 32, 30 and 29 for the hybrids A2-22, A2-13 and B2-32 respectively.

D3-11 and F3-13 were promising among 1999 planted hybrids. At 7th harvest maximum cumulative nut yield (kg/plant), nut yield per plant and nos. of nuts per panicle were observed in D3-11 (34.5, 9.0 & 4 respectively). Hybrid F3-13 reported maximum nut weight (11.0g).

Among the hybrids planted during 2000, F4-24 and F4-18 recorded cumulative nut yield (18.00 & 24.10 kg/plant), nut yield (6.30 & 7.40 kg/plant), nut weight (8.00 & 8.20 g) and shelling percentage (30 & 28%) respectively at 6th harvest.

E5-20, I5-24, J5-13, L5-27 and P5-8 were the promising hybrids reported from 2001 planting. Hybrid J5-13 recorded highest cumulative nut yield (14.7 kg/plant) at 5th harvest. Shelling percentage was maximum (33%) in hybrid P5-8.

All the 2002 planted hybrids reported recorded bold nut types (nut weight 7.0g to 11.0g), shelling percentage (28 to 37 %), nut yield varied from 1.5 (D6-44) to 4.0 (J6-14) kg/plant.

Out of 2003-year planted hybrids, 15 hybrids were promising with respect to nut weight (6.0 to 10.5g), shelling percentage (24 to 37 %), nut yield per plant (1.3 to 3.3kg) with cumulative nut yield (kg/plant) ranging from 2.8 to 7.3 at 3rd harvest (Table 1.50).



Table 1.50 : Yield and yield attributing traits of cashew hybrids at Bhubaneswar

Year of planting	Hybrid no.	Cross Combinations	Apple weight (g) & colour	Nut weight (g)	Shelling (%)	Nut Yield (kg/plant)	Cum. nut yield (kg/plant)
1995	11 harvests						
	A6	Bhubaneswar C-2 x VTH 711/4	56	10.0	29	10.3	72.7
	A9	Bhubaneswar C-2 x VTH 711/4	55	8.0	35	8.8	46.5
	E1	Bhubaneswar C2 x Kankady	61	7.4	31	7.5	37.9
1997	9 harvests						
	A1-16	Bhubaneswar-1 x H2/16	45	7.2	28	10.5	49.8
	A1-85	Bhubaneswar-1 x H2/16	60	7.4	33	10.0	68.7
	A1-105	Bhubaneswar-1 x H2/16	75	8.1	28	3.3	42.3
1998	8 harvests						
	A2-13	M 44/3 x H 2/16	44	9.5	30	8.8	29.2
	A2-22	M 44/3 x H 2/16	67	9.0	32	4.1	22.6
	B2-32	H 2/16 x M 44/3	51	8.5	29	4.0	21.2
1999	7 harvests						
	D3-11	M 44/3 x H 2/15	57	10.0	29	9.0	34.5
	F3-13	H 2/16 x M 44/3	43	11.0	29	6.2	20.9
2000	6 harvests						
	F4-18	M 44/3 x H 2/15	42	8.0	30	6.3	18.8
	F4-24	M 44/3 x H 2/15	87	8.2	28	7.4	24.1
2001	5th harvest						
	E5-20	BPP30/1 x H2/16	32	8.2	29	3.6	14.4
	J5-13	Bhubaneswar- x VTH 711/4	50	7.6	32	4.0	14.7
	L5-27	M 44/3 x VTH 711/4	38	7.4	30	4.4	14.1
	P5-8	.	40	8.0	33	1.6	8.1



2002	4 th harvest						
C6-43	RP2 x Kankady	75	9.5	31	2.3	8.5	
G6-8	RP2 x Kalyanpur bold nut	60	8.6	32	2.5	7.8	
H6-8	M44/3 x Kalyanpur bold nut	32	8.0	26	3.3	9.8	
J6-13	BPP 30/1xKalyanpur bold nut	32	8.4	24	3.8	12.6	
J6-14	BPP 30/1xKalyanpur bold nut	35	8.0	26	4.0	12.0	
N6-3	Lokipur x Kalyanpur bold nut	60	7.0	30	2.5	8.5	
2003	3 harvests						
C2-6	RP-2 x Kankady	92	10.5	31	2.4	6.4	
C2-25	RP-2 x Kankady	94	10.0	31	2.1	6.1	
E6-3	OC 56 x OC 60	44	8.0	29	2.1	6.9	
F4-8	M44/3 x OC 50	30	6.0	30	3.3	7.3	

CHINTAMANI

During 2010-11, selected three female and two male parents were used for crossing. In these cross combinations 95 nuts were obtained and out of these 70 F₁ seedlings have been raised and will be planted for evaluation.

The female parents used are 2/97- Kottarakar, 8/7 Sompet and M 16/4. The male parents used are Kankadi and G₁-C (Table 1.51).

Table 1.51 : Performance of Cross combinations done at Chintamani

Cross Combinations	No. of nuts obtained	No. of F ₁ Seedlings raised
2/97- Kottarakar x Kankadi	14	10
2/97- Kottarakar x G ₁ -C	17	12
8/7 Sompet x Kankadi	12	9
8/7 Sompet x G ₁ -C	17	13
M - 16/4 x Kankadi	16	11
M - 16/4 x G ₁ -C	19	15
Total	95	70

The growth parameters of selected F₁ hybrids during 2010-11 showed plant height ranging from 3.6 to 5.8 m and stem girth varied from 31.00 to 104.00 cm. The canopy spread in E-W & N-S directions ranged from 2.5 to 9.8 m and 2.3 to 7.8 m, respectively.

The flowering intensity was highest in H-191 (16.75) and the number of fruits per panicle was highest in H-81 (6.17) (Table 1.52).

**Table 1.52: Growth performance of selected F₁ Hybrids at Chintamani**

Hybrid No. & Cross combination	Year of planting	Plant ht. (m)	Stem girth (cm)	Canopy spread (m)		Flowering intensity/m ²
				E-W	N-S	
H-01 (Ullal-3 x Kankady 7/6)	2001	5.40	93	7.10	7.80	12.50
H-81 (Ullal-3 x Vetore-56)	2002	5.60	104	9.80	7.30	13.75
H-151 (NRCC Sel -2xVetore-56)	2002	3.60	31	2.50	2.30	14.75
H-188 (V-5 x Vetore-56)	2002	4.60	63	6.40	7.30	15.50
H-191 (Ullal-3 x Vetore-56)	2002	4.50	64	6.40	6.80	16.75
H-216 (2/77-Tuni x Vetore-56)	2002	5.80	90	9.60	7.70	14.50

Among the F₁ progenies, the hybrids planted during 2001 and 2002, H-01(Ullal-3 x Kankadi), H-81 (Ullal-3 x Vetore-56), H-151 (NRCC Sel-2 x Vetore-56), H-188 (V-5 x Vetore-56), H-191 (Ullal-3 x Vetore-56) and H-216 (2/77- Tuni x Vetore-56) recorded an yield of 4.32, 4.75, 0.85, 4.74, 4.25 and 4.52 kg/tree, during the second and fifth year of harvest and

cumulative yield of five harvests recorded highest by H-216 (12.75 kg/plant) and lowest was in H-151 (2.59 kg/plant). The average nut weights were 7.6, 11.9, 9.9, 8.9, 10.9 and 12.2 g respectively and recorded shelling per cent of 30.1 to 32.6 (Table 1.53).

Table 1.53: Yield performance of selected F₁ Hybrids at Chintamani.

Hybrid No. & Cross combination	Year of planting	Nut wt. (g)	Cu. Yield (Kg/tree) of 5 hvts	Yield (kg/tree)	Shelling (%)	Apple Wt. (g)
H-01 (Ullal-3 x Kankady 7/6)	2001	7.60	8.12 (II hvt.)	4.32	32.60	64.60
H-81 (Ullal-3 x Vetore-56)	2002	11.90	8.67 (II hvt.)	4.75	31.50	62.00
H-151 (NRCC Sel -2xVetore-56)	2002	9.90	2.59	0.85	31.20	36.10
H-188 (V-5 x Vetore-56)	2002	8.90	12.67	4.74	31.00	39.20
H-191 (Ullal-3 x Vetore-56)	2002	10.90	12.03	4.25	30.20	51.30
H-216 (2/77-Tuni x Vetore-56)	2002	12.20	12.75	4.52	30.10	68.50



JHARGRAM

The plant height ranged between 4.4-5.8 m. H-41 had highest trunk girth (77 cm). The canopy spread was maximum with H-69 (7.3 m) followed by H-70 (7.1 m) and H-6 (6.9 m). The canopy area was maximum with H-70 (64.59 m²) followed by H-69 (61.95 m²).

The precocious flowering hybrids were H-35, H-165, H-80 and H-6 while the late flowering one was H-1. The hybrids with long flowering duration were H-35 & H-6 while the hybrids with short flowering duration were H-25, H-59, H-37, H-12 & H-117.

All the hybrids were cluster-bearing types. Maximum number of nuts/panicle was noticed with H-1 (14.3 nuts/panicle) followed by H-28, H-117 and H-70 which had 10.5 nuts/panicle. H-28 had the maximum number of

nuts / m² (57.5 nuts / m²) followed by H-35 (47.8 nuts / m²) and H-1 (44.3 nuts / m²). H-165 produced bold nuts with a nut weight of 8.3 g. Some other hybrids like H-33 and H-117 held nuts with 7.1 g weight. H-6 and H-59 had nuts of more than 6g weight. The shelling percentage was maximum with the hybrid H-1 (36.7%) followed by H-36 (35.4%) and H-33 (34.2%).

All the hybrids in the table were having more than 28 % shelling recovery. Maximum yield /tree was found in the hybrid H-28 (15.1 Kg/tree) followed by H-36 (12.1 Kg/tree) and H-35 (11.8 Kg/tree). Other high yielding hybrids were H-33, H-41, H-70, H-1 and H-117 which had been reported more than 8 Kg yield/tree (Table 1.54 & 1.55).

Table 1.54 : Growth and yield performance of promising cashew hybrids at Jhargram centre

Hybrid No.	Plant height (m)	Trunk Girth (cm)	Canopy spread (m)	Duration of flowering	Nuts/m ²
H-1	4.60	62	5.60	75	44.30
H-165	4.50	41	4.00	73	32.30
H-28	5.00	69	6.40	70	57.50
H-33	4.80	50	6.60	72	32.50
H-35	5.00	73	6.00	77	47.80
H-37	5.00	70	6.00	64	52.00

Table 1.55 : Yield performance of promising cashew hybrids at Jhargram centre

Hybrid No.	Year of planting	Nut weight (g)	Apple Weight (g)	Yield Kg/tree	Shelling %
H-28	2002	5.30	52.00	15.10	30.20
H-33	2002	7.10	40.00	11.30	34.20
H-35	2002	5.40	50.00	11.80	31.00
H-36	2003	5.20	50.00	12.10	35.40
H-41	2002	6.00	43.00	10.30	32.80
H-70	2003	5.80	62.00	11.70	31.00

**MADAKKATHARA**

Out of the 56 hybrids planted in 1993, the highest yield was recorded by H 36 (6.00 kg/tree) followed by H44 (4.80 kg/tree).

Highest cumulative yield for 14 years was recorded by H 21 (145.92 kg) (Table 1.56).

Table 1.56 : Performance of promising hybrids planted during 1993 at Madakkathara

Hybrid No.	Cross combination	Duration of flowering	Annual yield (kg/tree)	Cum yield (kg/tree) (14 years)	Apple wt. (g)	Nut wt. (g)	Shelling %
21	BLA -39-4 x P-3-2	118	2.00	145.92	33	10.10	27.40
22	BLA -39-4 x P-3-2	120	2.30	81.90	48	10.20	25.86
35	V-5 x H-1591	117	3.50	110.10	49	10.10	26.38
36	V-5 x H-1591	124	6.00	107.28	42	9.50	25.30
49	V-5 x H-1591	127	3.80	63.15	55	7.00	27.80
50	V-5 x H-1591	125	4.10	63.22	55	8.10	29.60
70	BLA -39-4 x P-3-2	136	7.00	65.70	62	9.80	27.20
72	BLA -39-4 x P-3-2	118	1.00	60.25	68	7.50	26.50
73	BLA -39-4 x P-3-2	139	1.90	76.80	35	8.00	24.30
74	BLA -39-4 x P-3-2	142	2.50	79.75	52	8.10	29.68
91	V-5 x H-1591	127	2.50	26.77	68	5.20	27.90

Out of 26 hybrids planted in 1994, highest annual yield/ tree were given by H 70 (7.00 kg/tree). The highest cumulative yield/tree for 12 years were given by H74 (79.75 kg/tree).

Out of the 92 hybrids planted during 1995, H 97 recorded the highest yield (5.30 kg/ha). The highest cumulative yield/tree for 12 years was recorded by H97 (59.03 kg/tree).

During 2001, the parents identified for the crosses were A1, V-56, Kilianthara, K-30-1, V5, K 22-1, Sulabha, MDK-1 and M 44/3. The

highest annual yield was recorded by hybrid No. 21 (3.10 kg/tree).

During 2002, 135 hybrid seedlings were field planted. The parents identified were Amrutha, Ullal-3, UN-50, Kanaka, Ullal-4, K 22-1, Anakkayam-1, KGN, VTH 711/4, NRCC Sel-2, Dhana, MDK-1, Priyanka and Sulabha. The highest annual yield was recorded by Hybrid No. 27 (2.95 kg/tree).

A total of 350 pollinations were done during 2010-11 with 4.86 percentage of nut set (Table 1.57).

Table 1.57: Details of crossing programme at Madakkathara

Cross Combinations	No. of pollinations	No. of nuts set	No. of nuts harvested	% of nut harvested
Amrutha x Anakkayam	80	25	1	1.25
Dhana x Anakkayam	100	38	3	3.00
Sulabha x Madakkathara -1	100	60	12	12.00
Amrutha x Dhana	70	20	1	1.43
Total	350	143	17	4.86

PILICODE

The dwarf type PLD-57 was used for hybridization with ANK-1 and MDK-1 to obtain hybrids 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 vegetative branches varied significantly among the hybrids as well as parents and PLD 57 graft. The hybrids from the cross MDK1 x PLD-57 was taller than both the parents (Table 1.58).



Table 1.58 : Mean of growth characteristics of different crosses involving PLD-57 at Pilicode

Hybrid	Height (m)	Girth (cm)	Tree spread(m)		Male : Bisexual flowers ratio
			N-S	E-W	
PLD 57 graft	3.00b	43.10b	4.46c	4.11c	2.41b
PLD 57 (OP)	1.33c	28.00c	3.50d	3.25d	1.49d
PLD 57 x ANK-1	4.90a	66.00a	6.25b	7.00a	2.28b
ANK-1 x PLD 57	4.90a	64.00a	6.62b	5.75b	3.07a
MDK-1 x PLD57	5.40a	66.00a	7.50a	7.50a	1.90c
MDK-1	4.60a	48.00b	6.50b	5.50b	1.24d
F test	**	**	**	**	**
CD 0.05	1.051	6.090	0.855	0.740	0.247

*Mean values superscripted by the same letters do not differ significantly

VENGURLA

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 hybrids were promising. The hybrid No. 778 (M-44/3 x B.T.22) recorded highest yield (4.28 kg/plant)

The percent fruit set was 45.74 per cent. Out of 242 fruits set, finally 85 fruits were retained. Thus, the fruit retention percentage was 35.12 per cent (Table 1.59).

Table 1.59 : Growth and yield performance of new promising hybrids at Vengurle Centre

Hybrid No.	Cross combination	Plant Height (m)	Plant Girth (Cm)	Mean Spread (m)	Fruit set %	Av. Nut wt. (g)	Yield (kg/tree)
3063	C.Y.T.176 x B.T.65	5.00	48.00	5.70	43.00	8.00	3.85
3156	Hy-445 x B.T.10	3.60	39.00	4.80	22.00	10.10	3.44
778	M-44/3 x B.T.22	7.50	97.00	9.20	33.00	7.50	4.28
1306	Hy-2/16 x V-4	5.60	71.00	8.20	52.00	8.40	3.10
969	V-4 x Hy. 2/16	8.00	88.00	6.45	28.00	9.50	3.81
958	V-4 x Hy. 2/16	10.20	190.00	7.20	22.00	8.20	3.52

VRIDHACHALAM

The F₁ hybrid HC1 exhibited hybrid vigour in terms of increased number of nuts per m². The hybrid HC 6 hybrid showed the lowest values for growth characteristics. The leaf area in HC 6 was nearly half (36.8 cm² leaf area) of that of

HC 9 (77.5cm²). There was 55.20% reduction in number of internodes and 68.75% reduction in internodal length in HC 6 hybrid when compared to HC9, the tallest hybrid among the hybrids evaluated.

II. CROP MANAGEMENT



II. CROP MANAGEMENT

Agr.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 highest annual nut yield of 42.50 kg/tree was recorded with the treatment 500:125:125 NPK (g/pl.) at Bapatla. Significant variations were observed among the treatments with respect to nut weight and yield at Jhargram with highest nut weight of 78.00g and highest yield of 1.70 kg/tree with 500:125:125 NPK (g/pl.). The maximum yield was recorded in 750 : 325 : 750 g NPK / tree / annum which also led to highest cumulative nut yield of 41.29 kg/tree under on-farm trials at Madakkathara.

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 highest annual nut yield of 42.5 kg/tree was recorded with the treatment N1P0K1 followed by treatment N1P2K2 19.8 kg/tree. Further the treatment N0P0K1 has also given

highest cumulative nut yield of 100.3 kg/tree followed by the treatment N2P1K1 (93.0 kg/tree) and lowest cumulative yield was with treatment N0P2K1 (43.4 kg/tree) (Table 2.1).



Table 2.1 : Effect of NPK fertilizer and their interaction on yield of cashew at Bapatla

Treatment	Plant Height (M)	Trunk Girth (cm)	Canopy Diameter (m)	Duration of Flowering (Days)	Nut Yield (Kg/tree)	Cum. nut yield (kg/tree) (12 no.of harvests)
N0P0K0	4.45	81.58	7.49	108	15.00	56.10
N0P0K1	3.68	67.35	5.60	114	8.00	49.10
N0P0K2	4.14	82.78	7.26	118	9.70	43.70
N0P1K0	3.10	58.08	5.76	121	6.10	38.00
N0P1K1	4.60	80.75	8.48	103	7.40	44.70
N0P1K2	4.61	78.65	9.43	107	11.30	50.90
N0P2K0	4.50	78.21	8.22	104	11.80	52.40
N0P2K1	4.14	76.50	6.60	124	8.90	43.40
N0P2K2	4.91	86.73	6.97	109	11.10	56.40
N1P0K0	5.19	82.04	7.49	104	18.40	79.00
N1P0K1	5.20	107.21	5.13	104	42.30	100.30
N1P0K2	5.14	99.38	6.72	107	12.40	65.20
N1P1K0	4.68	89.75	5.37	104	10.20	58.10
N1P1K1	2.10	42.50	2.93	102	5.40	58.20
N1P1K2	4.69	103.88	5.76	107	17.60	72.30
N1P2K0	4.91	88.10	9.43	114	18.00	70.20
N1P2K1	4.57	88.25	7.26	108	15.80	76.30
N1P2K2	5.16	97.00	8.93	105	19.80	80.70
N2P0K0	4.42	77.42	5.60	110	11.90	50.90
N2P0K1	5.03	76.17	5.29	110	15.10	65.60
N2P0K2	4.82	95.42	5.45	102	8.80	67.50
N2P1K0	5.33	97.67	2.93	107	15.70	71.70
N2P1K1	5.07	97.08	9.43	122	14.60	93.00
N2P1K2	3.85	77.25	8.22	104	14.50	64.10
N2P2K0	4.63	80.17	8.93	102	16.00	76.50
N2P2K1	5.40	100.08	8.48	103	14.30	87.70
N2P2K2	5.05	114.00	6.97	108	18.00	80.90

CHINTAMANI

During fifth year after limb pruning variation in plant height, trunk girth and canopy spread for nitrogen, potash and for 2 way and 3 way

interactions were non-significant except for phosphorus levels (Table 2.2 and 2.3).



Table 2.2: Performance of Cashew in response to NPK fertilizer treatments at Chintamani.

Treatments	Plant ht (m)	Trunk girth(cm)	Canopy spread (m)		Yield (kg/tree)	Cu. Yield (Kg/tree) 10 hvst.
			E-W	N-S		
N ₀ P ₀ K ₀	4.35	93.0	6.50	6.70	3.61	19.65
N ₀ P ₀ K ₁	4.10	101.50	6.60	6.45	3.85	25.33
N ₀ P ₀ K ₂	4.65	104.50	7.35	7.30	3.98	29.05
N ₀ P ₁ K ₀	4.30	114.50	6.75	7.10	4.04	29.28
N ₀ P ₁ K ₁	4.70	110.50	7.10	7.35	4.10	30.53
N ₀ P ₁ K ₂	4.15	102.00	7.15	7.05	4.23	30.74
N ₀ P ₂ K ₀	4.55	118.00	7.30	7.25	4.08	25.20
N ₀ P ₂ K ₁	4.80	103.50	6.80	7.70	4.16	24.90
N ₀ P ₂ K ₂	4.90	125.5	7.70	7.40	4.23	35.84
N ₁ P ₀ K ₀	3.95	102.5	6.20	6.15	4.10	29.57
N ₁ P ₀ K ₁	4.05	102.5	6.55	6.60	4.25	29.43
N ₁ P ₀ K ₂	4.40	92.5	7.05	6.30	4.36	26.34
N ₁ P ₁ K ₀	4.70	112.00	7.55	7.35	4.63	28.83
N ₁ P ₁ K ₁	3.95	99.50	7.05	7.35	5.06	31.30
N ₁ P ₁ K ₂	4.70	98.00	6.80	7.20	5.14	44.41
N ₁ P ₂ K ₀	4.75	103.50	7.80	7.50	5.23	31.18
N ₁ P ₂ K ₁	4.15	109.50	7.40	7.30	5.37	32.81
N ₁ P ₂ K ₂	4.55	104.50	7.35	7.65	5.56	51.03
N ₂ P ₀ K ₀	4.00	97.50	5.80	6.15	5.41	35.46
N ₂ P ₀ K ₁	4.30	113.00	6.95	6.60	5.11	36.40
N ₂ P ₀ K ₂	4.60	91.50	6.50	6.40	5.19	38.23
N ₂ P ₁ K ₀	4.35	99.00	6.90	6.95	5.73	35.29
N ₂ P ₁ K ₁	4.60	96.00	7.25	7.00	5.78	37.07
N ₂ P ₁ K ₂	4.35	105.00	7.10	7.05	5.83	49.34
N ₂ P ₂ K ₀	4.80	105.50	7.40	7.50	5.95	37.49
N ₂ P ₂ K ₁	4.60	119.50	7.15	6.80	5.65	40.00
N ₂ P ₂ K ₂	4.50	100.00	7.50	6.55	5.80	54.48
S.Em ± P	0.09	2.44	0.15	0.13	0.05	-
C.D @ 5% N/P/K	0.25	7.09	0.44	0.37	0.13	-

The nut yield showed significant variation for nitrogen, phosphorus, potash levels and for NP interactions. Whereas, NK, PK, NPK interactions showed non significant variation for yield. The NPK levels showed, highest cumulative yield of 10 years (54.48 kg)

at N-1000g, P₂O₅-250g and K₂O-250g. The cost benefit ratio was highest in N-500g, P₂O₅-250g and K₂O-250g which recorded an yield of 51.03 kg.


Table 2.3 : Effect of NPK levels on yield of cashew at Chintamani

	P ₀	P ₁	P ₂	Mean	K ₀	K ₁	K ₂	Mean
N ₀	3.81	4.12	4.15	4.03	3.91	4.04	4.14	4.03
N ₁	4.24	4.94	5.38	4.85	4.65	4.89	5.02	4.85
N ₂	5.50	5.78	5.80	5.69	5.70	5.64	5.74	5.69
Mean	4.52	4.95	5.11	-	4.75	4.86	4.97	-
K ₀	4.37	4.80	5.09	4.75				
K ₁	4.54	4.98	5.06	4.86				
K ₂	4.64	5.07	5.19	4.97				
Mean	4.52	4.95	5.11	-				
		N	P	K	NP	NK	PK	NPK
S.Em ±		0.045	0.045	0.045	0.078	0.078	0.078	0.14
C.D @ 5%		0.13	0.13	0.13	0.23	NS	NS	NS

JHARGRAM

Plant height was maximum under the treatment of 1500-250-375g NPK / Plant/ year. No significant variation was noticed among the treatments in terms of their response on trunk girth and per square meter flowering density.

Also the treatments were at par in terms of their response on canopy spread, trunk height and yield / tree. Significant variations were observed among the treatments with respect to nut weight and apple weight (Table 2.4).

Table 2.4 : Growth and yield characters of cashew variety BPP8 under different fertilizer treatments (On farm trial at Jhargram)

Treatment	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	Trunk height (m)	Nut weight (g)	Yield Kg/tree
500:125:125 NPK	2.90	22.70	3.30	0.91	7.00	1.70
1000:250:250 NPK	2.90	21.30	3.40	1.12	6.50	1.30
1500:250:375 NPK	3.20	20.00	4.10	0.86	6.50	1.20
S.Em ±	0.06	NS	0.12	0.09	0.17	0.39
C.D. at 5%	0.17		0.33	0.69	0.47	1.08
C.V%	3.30		5.70	15.40	4.30	49.00

MADAKKATHARA

None of the growth or yield characters viz., height of trees, girth of trees and canopy spread of trees (both East West and North South) were significantly influenced by the application of graded levels of N, P or K or their 2-way or 3-way interactions.

Marginal increases in tree height were observed with increasing levels of N up to 1000g/tree, whereas in the case of K, the

increasing trend was observed only up to the level of 125 g K₂O. An increasing trend in tree girth was observed in respect of N and K up to 1000 and 125 g/ tree/ annum respectively. Canopy spread in east west direction showed an increasing trend up to the medium levels of application of N and K, i.e. 500g N and 125 g K₂O per annum. Canopy spread in north south direction, showed the same trend, as that of east west direction, in respect of N and K₂O, with the maximum value recorded by the



application of medium levels of each nutrient.

No significant variation in nut yield was observed among the levels of N, P or K or their 2-way or 3-way interactions. However, marginal increases in nut yield were observed, with increasing levels of N, P and K. Among the N levels, the maximum annual yield was recorded by 500 and 1000 g N/tree while no N control recorded lower yield. In respect of P_2O_5 and K_2O , an increasing trend in nut yield was observed with increasing levels of P_2O_5 and K_2O and the highest yield were recorded by the highest levels of phosphorous and potash application i.e. 250 g P_2O_5 and K_2O /tree/annum (Table 2.5).

No significant variation in cumulative nut yield was observed due to the direct effect of N, P or K or their 2- way or 3- way interactions, as revealed by statistical analysis. However, an increasing trend in cumulative nut yield was observed with increasing levels of N up to 1000 g/tree and up to 250 g K_2O in respect of K_2O . In respect of P_2O_5 , highest yield was recorded by 250 g P_2O_5 /tree. However 125 g P_2O_5 /tree yielded marginally less than no P control (Table 2.6).

In respect of N and K, the lowest yields were recorded by control whereas in respect of P_2O_5 , lowest and similar yields were recorded by control and 125 g P_2O_5 /tree. The highest yield

was recorded by the application of 1000 g N/tree and 250 g P_2O_5 and K_2O / tree, with respect to N, P_2O_5 and K_2O , respectively.

With respect to N x P interaction, it was observed that increasing levels of P_2O_5 increased the yield at zero and 500 g N/tree but a decreasing trend was observed at 1000 g N/tree. Similarly, increasing levels of N increased the yield at zero and 125 g P_2O_5 / tree but a decreasing trend was observed at 250 g P_2O_5 /tree when the N level was increased to 1000 g/tree. With respect to N x K interaction, increasing levels of K increased the yield up to 250 g K_2O /tree at 1000 g N/ha but the increase was only up to 125 g K_2O /ha at zero N level. At 500 g N, no consistent trend was observed. Increasing levels of N increased the yield upto 1000 g N at 250 g K_2O / tree but only upto 500 g N at zero K. No definite trend was observed at 125 g K_2O / tree.

With respect to P x K interaction, increasing levels of P generally increased the yield up to 250 g P_2O_5 / tree at 250 g K_2O /tree but a declining trend was observed at no K control. No definite trend was observed at 125 g K_2O /ha. Increasing levels of K showed a general increasing trend up to 250 g K_2O /tree at 125 g P_2O_5 /ha and up to 125 g K_2O / tree at 250 g P_2O_5 /tree, but a declining trend was noted at no P control (Table 2.7).

Table 2.5: Yield of nuts (kg/ tree/ annum) of cashew as influenced by graded levels of N, P and K and their 2 and 3-way interactions at Madakkathara

Treatments	Levels of P_2O_5				Levels of K_2O		
	P_0 (0)	P_1 (125)	P_2 (250)	Mean	K_0 (0)	K_1 (125)	K_2 (250)
Levels of N							
N_0 (0)	2.15	3.32	3.55	3.01	2.02	4.20	2.80
N_1 (500)	3.19	3.93	3.90	3.67	3.72	2.92	4.38
N_2 (1000)	4.59	2.80	3.61	3.67	2.70	3.63	4.36
Mean	3.31	3.35	3.69		CD (0.05)		SEm
Levels of K					N /P/K	NS	0.71
K_0 (0)	2.61	3.08	2.76	2.81	NP/NK/PK	NS	1.23
K_1 (125)	3.42	3.25	4.40	3.69	NPK	NS	2.13
K_2 (250)	3.90	3.72	3.91	3.84			



Table 2.6 : Cumulative yield of nuts (kg/ tree) of cashew as influenced by graded levels of N, P and K and their 2 -and 3-way interactions at Madakkathara

Treatments	Levels of P ₂ O ₅				Levels of K ₂ O		
	P ₀ (0)	P ₁ (125)	P ₂ (250)	Mean	K ₀ (0)	K ₁ (125)	K ₂ (250)
Levels of N							
N ₀ (0)	29.489	29.877	38.346	32.571	32.480	36.612	28.621
N ₁ (500)	31.328	35.473	40.596	35.799	35.115	31.405	40.876
N ₂ (1000)	43.868	38.302	35.407	39.193	34.369	40.733	42.476
Mean	34.895	34.551	38.117	35.854	CD (0.05)		SEm
Levels of K					N/P/K	NS	2.188
K ₀ (0)	36.481	32.910	32.573	33.988	NP/NK/PK	NS	3.790
K ₁ (125)	33.902	32.804	42.044	36.250	NPK	NS	6.564
K ₂ (250)	34.301	37.938	39.733	37.324			

Table 2.7 Effect of 3-way interactions of graded levels of N, P and K on growth and yield characters and yield at Madakkathara

Treatment	Tree height (m)	Trunk girth (m)	Canopy spread-EW (m)	Canopy spread - NS (m)	Yield (kg/tree/annum)	Cumulative yield (kg/tree)
N ₀ P ₀ K ₀	5.35	120.00	9.59	9.08	1.95	68.25
N ₀ P ₀ K ₁	6.28	104.17	7.88	8.03	2.48	58.88
N ₀ P ₀ K ₂	5.82	90.00	7.17	6.72	2.02	49.78
N ₀ P ₁ K ₀	3.52	60.83	4.63	4.90	1.62	52.08
N ₀ P ₁ K ₁	4.72	68.33	5.62	6.07	3.88	57.87
N ₀ P ₁ K ₂	6.67	100.83	8.97	9.10	4.47	69.31
N ₀ P ₂ K ₀	4.92	74.17	5.58	6.18	2.50	74.53
N ₀ P ₂ K ₁	6.88	128.33	9.81	9.33	6.23	102.91
N ₀ P ₂ K ₂	3.52	52.83	3.60	3.93	1.92	52.63
N ₁ P ₀ K ₀	5.18	107.50	9.10	9.48	2.37	67.65
N ₁ P ₀ K ₁	3.68	61.00	4.27	4.02	2.33	54.59
N ₁ P ₀ K ₂	3.90	52.50	4.65	4.82	4.86	65.72
N ₁ P ₁ K ₀	5.67	92.83	7.32	6.95	5.23	74.56
N ₁ P ₁ K ₁	4.53	65.00	5.33	6.13	2.32	54.06
N ₁ P ₁ K ₂	4.60	81.17	6.18	6.22	4.25	84.21
N ₁ P ₂ K ₀	6.98	119.67	9.93	9.47	3.57	68.48
N ₁ P ₂ K ₁	6.03	109.17	8.09	8.18	4.12	79.77
N ₁ P ₂ K ₂	7.47	122.50	8.85	9.62	4.02	95.31
N ₂ P ₀ K ₀	5.07	83.17	5.90	6.15	3.52	82.97
N ₂ P ₀ K ₁	6.08	101.67	7.70	7.85	5.43	89.93
N ₂ P ₀ K ₂	6.00	106.17	7.68	7.75	4.83	90.29
N ₂ P ₁ K ₀	4.73	78.00	6.50	6.15	2.38	70.81
N ₂ P ₁ K ₁	7.07	121.67	9.98	9.56	3.57	84.89
N ₂ P ₁ K ₂	5.98	120.00	7.02	8.33	2.45	74.10
N ₂ P ₂ K ₀	3.42	52.50	3.57	4.18	2.20	52.42
N ₂ P ₂ K ₁	4.43	80.00	7.12	6.48	2.85	69.57
N ₂ P ₂ K ₂	5.73	95.00	7.40	7.46	5.79	90.45
SEm						
CD (0.05)	NS	NS	NS	NS	NS	NS



On-farm trial

The fully organic dose recorded the lowest yield. The highest yield was recorded by 150% DCR dose (750 : 187.5 : 187.5) followed by KAU dose (750 : 325 : 750). The lowest yield was recorded by the farmers' practice (fully organic dose), followed by 200 % DCR dose. The maximum yield was recorded by the KAU dose of 750 : 325 : 750 g NPK/tree/annum which also lead to highest cumulative nut yield

of 41.29kg/tree for 6 harvests which was followed by 150 per cent DCR dose (36.362kg/tree). The treatments receiving 200 and 150 percent of the dose of 500 : 125 : 125 g NPK/tree/annum recommended by DCR led to annual nut yield of 7.23kg/tree. The farmers' practice of organic manure application recorded marginal yield increase over DCR dose (Table 2.8).

Table 2.8 Nut yield (kg/tree/annum) of cashew under on - farm fertiliser trial at Madakkathara

Fertilizer schedule (g NPK/tree)	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Cum. nut yield
T ₁ - 500:125:125 (DCR)	2.50	2.77	5.03	6.47	9.55	7.23	33.57
T ₂ - 750:187.5: 187.5 (150% DCR)	2.73	3.06	3.61	8.18	11.35	7.40	36.36
T ₃ - 1000: 250: 250 (200% DCR)	2.80	3.10	3.81	5.89	10.75	8.01	34.39
T ₄ - 750: 325: 750 (KAU)	3.95	4.17	4.55	6.85	12.52	9.24	41.29
T ₅ - Fully organic	2.45	2.94	3.42	5.61	9.28	7.30	31.03

**Agr.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 population density for cashew and suitable fertilizer doses at different high density plantings for specific regional variety.

SUMMARY :

Highest cumulative nut yields were obtained in 200 plants/ha (10m x 5m) + 150 kg N, 50 kg P₂O₅, 50 kg K₂O [24.17 kg/tree] and 200 plants/ha (10m x 5m) +75 kg N, 25 kg P₂O₅, 25 kg K₂O [23.18 kg/tree] at Bapatla. Similarly, the number of flowering panicles / sq. m. was significantly highest (17.11) and the cumulative nut yield / plant for 9 years was maximum (40.60 kg) in 200pl/ha (10x5m) at Bhubaneswar. At Jhargram, the maximum number of flowers/sq.m (18.10) was observed under 10m x 5m spacing. The ground area coverage under 10m x 5m spacing was at par with the plants under 6m x 4m spacing (47.51%) at Jhargram. The vegetative parameters under spacing of 10m x 5m were at par with 6m x 4m at Vengurla which were significantly superior over the vegetative parameters recorded in 5m x 4m. The yield in 5 x 4 m spacing was 2250 kg/ha at higher fertilizer level with a benefit cost ratio (BCR) of 3.5.

Experiment Details :

Design	:	Split plot
Main plot : Plant density	:	S ₁ 200 plants/ha (10m x 5m) S ₂ 400 plants/ha (6m x 4m) S ₃ 600 plants/ha (5m x 4m)
Sub-plot : Fertilizer dose/ha:	M ₁ 75 kg N, 25 kg P ₂ O ₅ , 25 kg K ₂ O M ₂ 150 kg N, 50 kg P ₂ O ₅ , 50 kg K ₂ O M ₃ 225 kg N, 75 kg P ₂ O ₅ , 75 kg K ₂ O	
Total area	:	2.5 ha
Fertilizers application level	:	1 st year : 1/5 th 2 nd year : 2/5 th 3 rd year : 3/5 th 4 th year : 4/5 th 5 th year : Full dose

BAPATLA

Trees planted at closer densities i.e. 5m x 4m gave higher plant height, trunk girth, canopy diameter and canopy height. Annual nut yield per tree was highest 11.79 kg per tree in 10 x 5m spaced trees receiving a fertilizer

dosage 75:25:25 kg/ha [S1M1] (11.79 kg/tree) which is followed by treatment S1M2 [9.79 kg/tree]. Cumulative nut yields are also highest in the same treatments i.e. S1M2 [24.17 kg/tree] and S1M1 [23.18 kg/tree] (Table 2.9).



Table 2.9: 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)	Duration of flowering (days)	Nut yield (Kg/tree)	Cum. nut yield (Kg/tree) (4 no. of harvests)
S ₁ M ₁	4.08	66.00	6.72	3.74	124	11.79	23.18
S ₁ M ₂	3.91	66.10	6.60	3.50	78	9.79	24.17
S ₁ M ₃	3.26	49.66	5.45	2.87	108	4.84	13.16
S ₂ M ₁	3.51	56.28	5.29	3.19	110	7.40	16.14
S ₂ M ₂	3.35	52.07	5.37	2.72	110	8.95	20.45
S ₂ M ₃	3.39	49.33	5.13	2.93	105	5.63	12.80
S ₃ M ₁	4.85	74.36	6.90	4.43	108	9.67	18.76
S ₃ M ₂	4.36	68.29	5.63	4.03	108	7.80	18.81
S ₃ M ₃	4.26	64.29	5.33	4.01	110	8.20	14.96

BHUBANESWAR

There was significant effect on all the vegetative characters due to spacing. Plant population of 200 nos. / ha (S₁) was significantly superior to S₂ (400 plants / ha) and S₃ (500 plants / ha) in respect of plant height (6.10 m), trunk girth (75.38 cm) and spread of the plant in both the directions of E-W (7.63 m) and N-S (10.43 m). The spread of the plant was comparatively more in N-S direction as compared to E-W.

No significant variation was observed in the vegetative characters like plant height, trunk girth and plant spread in both the directions due to different doses of fertilizer during 2010-11. However, M₃ i.e. manure dose of N₂₂₅P₇₅K₇₅ kg/ha recorded maximum plant height (5.45 m) and plant spread both in E-W (6.12 m) and N-S (7.37 m) direction. But M₂ i.e. N₁₅₀P₅₀K₅₀ kg/ha recorded maximum trunk girth (70.38 cm) (Table 2.10).

Table 2.10: Effect of fertilizer and spacing on vegetative character at Bhubaneswar

a). Effect of spacing (Main plot)				
Treatment	Plant Height (m)	Girth (cm)	Spread (m)	
			E-W	N-S
S ₁	6.10	75.38	7.63	10.43
S ₂	5.34	67.21	5.14	6.17
S ₃	4.79	64.69	4.74	5.31
F 'test'	S	S	S	S
SE (m) ±	0.119	1.121	0.146	0.249
CD 5%	0.415	3.880	0.508	0.862
b) Effect of doses of fertilizer (sub plot)				
Treatment	Plant Height (m)	Girth (cm)	Spread (m)	
			E-W	N-S
M ₁	5.38	69.42	5.70	7.19
M ₂	5.41	70.38	5.70	7.35
M ₃	5.45	67.48	6.12	7.37
F 'test'	NS	NS	NS	NS
SE (m) ±	0.068	1.114	0.205	0.193
CD5%				



No significant variation was observed in trunk girth and plant spread in both E-W and N-S direction due to interaction effect of spacing and doses of fertilizer. However, S₁M₂ treatment recorded maximum trunk girth (77.45 cm) and plant spread (10.88 m) in N-S direction but maximum plant spread (7.93 m) in E-W direction was recorded in S₁M₃ treatment, whereas minimum plant height (4.68 m), trunk

girth (63.9 cm) and plant spread both in E-W (4.43 m) and N-S (4.98 m) direction was recorded in S₃M₁ treatment. But significant variation in plant height was observed in S₁M₁ (6.30 m) due to interaction effect of spacing and doses of fertilizer, which is at par with S₁M₂ (6.10 m) (Table 2.11).

Table 2.11 : Effect of fertilizer and spacing on vegetative character at Bhubaneswar

Treatment	Plant Height (m)	Girth (cm)	Spread (m)	
			E-W	N-S
S ₁ M ₁	6.30	74.88	7.75	10.48
S ₁ M ₂	6.10	77.45	7.23	10.88
S ₁ M ₃	5.90	73.83	7.93	9.95
S ₂ M ₁	5.15	69.48	4.93	6.13
S ₂ M ₂	5.35	67.63	5.20	5.83
S ₂ M ₃	5.53	64.53	5.30	6.55
S ₃ M ₁	4.68	63.90	4.43	4.98
S ₃ M ₂	4.78	66.08	4.68	5.35
S ₃ M ₃	4.93	64.10	5.13	5.60
F 'test'	S	NS	NS	NS
SE (m) _±	0.119	1.929	0.355	0.333
CD5%	0.355			

The number of flowering panicles / sq. m. was significantly more in S₁ (17.11) [200pl/ha (10x5)] compared to S₂ (14.59) [400pl/ha (6x4)] and S₃ (13.33) [500 pl/ha (5x4)]. The number of nuts per panicle was maximum in S₁ (8.1) and minimum in S₃ (7.2). The apple weight was maximum in S₁ compared to S₂ and S₃. The yield per plant due to spacing was found significant. Significant highest yield was recorded in S₁ (11.17 kg/plant).

The cumulative nut yield per plant for 9 years was found maximum in S₁ (40.60 kg) followed by S₂ (27.81 kg). Highest cumulative yield per hectare was recorded in S₃ (12117.07 kg / ha) followed by S₂ (11127.97 kg / ha). The percentage of increase in yield per ha in S₃ was 46.10% over S₁ and 8.90% over S₂. The increase in yield in S₂ was 36.90% more as compared to S₁.

The maximum number of flowering panicles / m² was recorded in M₂ (15.95). The number of nuts per panicle was maximum in recommended doses of fertilizer, M₂ (8.0) followed by M₁ (7.5). The apple weight was maximum in M₂ (60.7 g) and minimum in M₁ (54.3 g). The nut weight was highest in M₂ (8.0 g) followed by M₁ (7.8 g) and M₃ (7.5 g).

As regards the yield of nut per plant with varying doses of fertilizer application, significant highest yield was obtained in M₂ (8.48 kg / plant). Cumulative yield at 9th harvest was highest in M₂ (11524.2 kg / ha) and minimum in M₁ (9365.1 kg / ha) (Table 2.12).



Table 2.12 : Effect of doses of fertilizer and spacing on flowering and yield attributes at Bhubaneswar

a) Effect of spacing (Main plot)						
Treatments	No. of Flowering Panicles / m ²	Nut weight (g)	Yield (kg/plant)	Cum. Yield (kg) 9 th harvest	Yield (kg/ha)	Cum. yield (kg/ha)
S ₁	17.11	8.20	11.17	40.60	2233.33	8127.33
S ₂	14.59	7.90	5.22	27.81	2086.67	11127.97
S ₃	13.33	7.50	4.63	24.24	2316.67	12117.07
F 'test'	S		S		NS	
SE (m) ±	0.188		0.930		230.766	
CD 5%	0.650		3.220			
b) Effect of doses of fertilizer (Subplot)						
Treatments	No. of Flowering Panicles / m ²	Nut weight (g)	Yield (kg/plant)	Cum. Yield (kg) 9 th harvest	Yield (kg/ha)	Cum. yield (Q)
M ₁	14.54	7.80	5.32	27.26	1702.50	9365.10
M ₂	15.95	8.20	8.48	34.49	2669.17	11524.17
M ₃	14.54	7.50	7.23	31.11	2265.00	10471.20
F 'test'	S		S		S	
SE (m) ±	0.129		0.406		125.399	
CD 5%	0.383		1.206		372.595	

Treatment S₁M₂ produced significantly maximum flowering panicles / m² (18.53) and yield per plant (13.63 kg). The cumulative yield

per hectare was maximum in S₃M₂ (13885.50 kg/ha) for 9 harvests (Table 2.13).

Table 2.13 : Effect of doses of fertilizer and spacing on flowering and yield attributes at Bhubaneswar

Treatment	No. of Flowering panicles/m ²	Nut weight (g)	Yield (kg/plant)	Cum. Yield (kg) 9 th harvest	Yield (kg/ha)	Cum. Yield (kg/ha) 9 th harvest
S ₁ M ₁	15.98	7.90	8.20	34.03	1640.00	7044.00
S ₁ M ₂	18.53	8.50	13.63	47.35	2725.00	9737.00
S ₁ M ₃	16.83	8.20	11.68	40.44	2335.00	8440.00
S ₂ M ₁	14.78	8.10	4.08	25.76	1630.00	10838.00
S ₂ M ₂	15.20	8.20	6.18	29.74	2470.00	12438.00
S ₂ M ₃	13.80	7.30	5.40	27.97	2160.00	11905.00
S ₃ M ₁	12.88	7.40	3.68	22.00	1837.50	11667.30
S ₃ M ₂	14.13	8.00	5.63	26.43	2812.50	13885.50
S ₃ M ₃	13.00	7.10	4.60	24.30	2300.00	12949.50
F 'test'	S		NS		NS	
SE (m) ±	0.223		0.702		217.199	
CD 5%	0.663					



The leaf nitrogen % was maximum in S_1 (2.26%) and M_3 recorded maximum leaf Nitrogen 2.16%. However, with respect of

fertilizer dosage M_3 (125:75:75 NPK/kg/ha) resulted in highest leaf nitrogen content of 2.29% (Table 2.14).

Table 2.14 : Leaf Nitrogen content (%) due to the effect of spacing and levels of fertilizer at Bhubaneswar

	M_1	M_2	M_3	Average
S_1	2.31	2.18	2.29	2.26
S_2	2.01	2.13	2.17	2.10
S_3	1.65	1.82	2.03	1.83
Mean	1.99	2.04	2.16	

The leaf P_2O_5 content increased with decrease in spacing. S_1 recorded 0.039 %, where as S_2 and S_3 recorded 0.043 % P_2O_5 content. The

P_2O_5 content increased with increased doses of P_2O_5 and maximum was recorded in M_3 (0.043 %) (Table 2.15).

Table 2.15 : Leaf phosphorous content (%) due to the effect of spacing and levels of fertilizer at Bhubaneswar

	M_1	M_2	M_3	Average
S_1	0.03	0.04	0.03	0.039
S_2	0.04	0.04	0.04	0.043
S_3	0.04	0.04	0.04	0.043
Mean	0.04	0.042	0.043	

Maximum K_2O % was recorded in S_2 (0.45 %), and in M_3 (0.41%). S_2M_2 recorded

highest K_2O % (0.46 %) followed by S_2M_3 (0.45 %) and minimum in S_1M_1 (0.21 %) (Table 2.16).

Table 2.16 : Leaf Potassium content (%) due to the effect of spacing and levels of fertilizer at Bhubaneswar

	M_1	M_2	M_3	Average
S_1	0.21	0.31	0.35	0.29
S_2	0.44	0.46	0.45	0.45
S_3	0.33	0.38	0.44	0.38
Mean	0.33	0.38	0.41	

CHINTAMANI

The plant height did not vary significantly, whereas the trunk girth and N-S canopy spread varied significantly among the different plant densities. The nut yield per plant varied significantly among the plant densities. The highest nut yield per plant was recorded in S_1 (7.74 kg/plant) and lowest in S_3 (4.61 kg/plant). The highest nut yield per ha. was recorded in S_3 (23.04 q/ha) and lowest was recorded in S_1 (15.49 q/ha). The plant height,

stem girth and canopy spread recorded did not vary significantly among the different levels of fertilizers.

However, yield (kg/plant) & yield (q/ha) varied significantly among fertilizer levels. The highest yield kg/plant was noticed in M_2 (6.04 kg) and highest yield (q/ha) was recorded in M_2 (20.36 q/ha) (Table 2.17).



Table 2.17 : Effect of Plant density and fertilizer levels on growth and yield of Cashew at Chintamani

Treatments	Trunk girth (cm)	Canopy spread (m)		Yield (Kg/plant)	Cu. Yield (Kg/tree) of 6 hvts.	Yield (Q/ha.)
		E-W	N-S			
Densities	-	-	-	-	-	-
S ₁ - 200	71.45	6.54	7.67	7.74	28.15	15.49
S ₂ - 400	64.90	5.82	6.39	5.23	20.93	20.91
S ₃ - 500	60.00	5.10	5.42	4.61	18.98	23.04
...	1.29	0.35	0.24	0.11	-	0.31
C.D at 5%	4.45	NS	0.84	0.38	-	1.06
Fertilizer levels	-	-	-	-	-	-
M ₁ - 75 : 25 : 25	66.17	5.89	6.42	5.69	22.12	19.34
M ₂ - 150 : 50 : 50	66.39	5.81	6.46	6.04	23.07	20.36
M ₃ - 225 : 75 : 75	62.97	5.76	6.59	5.85	22.90	19.70
S. Em ±	2.33	0.19	0.24	0.06	-	0.19
C.D at 5%	NS	NS	NS	0.20	-	0.67

Interaction effect of densities and fertilizers did not vary significantly among growth parameters. The yield (kg/plant) and yield (q/ha.) varied significantly among interactions. The highest yield was obtained in

S₁ M₂ (8.10 kg/plant) followed by S₁M₃ (7.80kg/plant) and lowest was in S₃ M₁ (4.37 kg). The highest yield (q/ha) was obtained in S₃ M₂ (23.91q.) and lowest was in S₁ M₁ (14.60q.) (Table 2.18).

Table 2.18 : Interaction effect between plant density and fertilizer levels on growth and yield of Cashew at Chintamani

Interactions	Stem girth (cm)	Canopy spread (m)		Yield (kg/plant)	Cu. yield (kg/plant) of 5 hvts.	Yield (q/ ha.)
		E-W	N-S			
S ₁ M ₁	72.63	6.70	7.69	7.31	27.04	14.60
S ₁ M ₂	74.22	6.86	7.61	8.10	28.28	16.20
S ₁ M ₃	67.50	6.06	7.71	7.80	27.21	15.64
S ₂ M ₁	64.64	5.71	5.95	5.38	20.25	21.53
S ₂ M ₂	65.10	5.72	6.64	5.24	21.91	20.96
S ₂ M ₃	60.11	6.03	6.59	5.06	20.79	20.23
S ₃ M ₁	61.24	5.26	5.63	4.37	17.72	21.88
S ₃ M ₂	57.45	4.85	5.14	4.78	19.00	23.91
S ₃ M ₃	61.29	5.20	5.48	6.67	21.51	23.32
S.Em ±	4.04	0.34	0.42	0.10	-	0.31
C.D at 5%	NS	NS	NS	0.30	-	1.00

JHARGRAM

Maximum height of the plant (5.4m) was with a fertilizer dose of 150-50-50 Kg N-P-K /ha /year and a density of 500 plants /ha. No significant differences were noticed with respect to trunk girth and trunk height as an effect of fertilizer or density. Canopy area was maximum with 6m x 6m spaced plants followed by 10m x 5m spacing.

An increase in canopy area was noticed in 200 plant density with an increase in fertilizer dose and canopy area was also highest under this density. Higher number of flowers per square meter was observed in case of high dose of fertilizer application in all the densities. Maximum number of flowers per square meter was observed under 10m x 5m spacing (18.1) (Table 2.19).


Table 2.19 : Growth 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)	Flowering /m ²	Biomass Removed (Kg/tree)
S1: 10m x 5m (200plant/ha)	M1: 75-25-25	4.90	61.80	5.62	15.80	20.50
	M2: 150-50-50	5.10	62.20	5.53	17.00	16.50
	M3: 225-75-75	4.60	55.10	5.70	18.10	18.70
S2: 6m x 4m (400plant/ha)	M1: 75-25-25	5.30	61.70	5.57	12.60	39.50
	M2: 150-50-50	5.20	64.00	5.63	14.10	32.00
	M3: 225-75-75	5.30	61.90	5.48	15.20	45.00
S3: 5m x 4m (500plant/ha)	M1: 75-25-25	5.30	59.80	5.00	13.90	45.20
	M2: 150-50-50	5.40	61.60	4.93	14.30	34.80
	M3: 225-75-75	5.20	58.40	5.16	14.50	42.20
S.Em ±		0.12	NS	0.16	0.62	
C.D. at 5%		0.27		0.34	1.36	

Maximum number of nuts per square meter (27.5) was found with 10m x 5m spacing with higher doses of fertilizers. Nut weight was at par in all the densities. Considering the individual tree yield significant differences were noticed between the plants under 500 plant/ha density and the other two densities.

Yield / tree was maximum in the plants spaced at a distance of 10m x 5 (3.70 to 4.50 Kg /tree) followed by 6m x 4m spaced plants (3.60 to 3.80kg/ tree). The ground area coverage under 10m x 5m spacing was at par with the plants under 6m x 4m spacing (47 51%) (Table 2.20).

Table 2.20 : Yield attributes of high density planting at Jhargram

Spacing (Density)	Fertilizer Dose N-P-K (Kg/ha)	Duration of flowering	Nuts/m ²	Nut Weight (g)	Yield (Kg/Tree)	Ground coverage by canopy (%)
S1: 10m x 5m (200plant/ha)	M1: 75-25-25	67	24.70	3.80	3.70	49.67
	M2: 150-50-50	65	24.40	4.10	3.90	48.28
	M3: 225-75-75	70	27.50	4.10	4.50	51.11
S2: 6m x 4m (400plant/ha)	M1: 75-25-25	75	20.10	4.30	3.60	48.75
	M2: 150-50-50	70	21.00	4.20	3.80	49.82
	M3: 225-75-75	65	21.00	4.40	3.80	47.15
S3: 5m x 4m (500plant/ha)	M1: 75-25-25	67	17.80	4.00	2.40	39.30
	M2: 150-50-50	67	19.20	3.80	2.50	38.21
	M3: 225-75-75	62	17.70	3.50	2.30	41.93
C.D. at 5%			2.31	0.18	0.46	2.99
S.Em ±			5.04	0.38	1.00	1.37



Yield per hectare was maximum under 6m x 4m spacing (112.6q/ha). There was an increase in the yield /ha with an increase in

fertilizer dose. The plant density of 500 plants /ha with fertilizer dose (150 : 50 : 50 kg NPK/ha) led to maximum yield of 76.20q/ha) (Table 2.21).

Table 2.21 : Effect of tree density and fertilizer application on cumulative nut yield at Jhargram

Treatments MP/SP	Cumulative nut yield (Q/ha) (5 harvests)			Mean
	M1: 75-25-25	M2: 150-50-50	M3: 225-75-75	
S1: 10m x 5m (200plant/ha)	52.50	40.70	36.60	43.27
S2: 6m x 4m (400plant/ha)	97.60	80.00	112.60	96.73
S3: 5m x 4m (500plant/ha)	73.40	76.20	72.50	74.03
Mean	74.50	65.60	73.90	
MP/SP- S.Em ±	5.09			
C.D. at 5%	11.09			

MADAKKATHARA

The maximum height (5.20m) was recorded by the highest tree density of 500 trees/ha. The lowest density of 200 trees/ha recorded the highest stem girth (82.40cm). Tree density of 200 trees/ha had highest canopy spread (6.77m).

The maximum nut yield was recorded in 400 trees/ha (3.34kg/plant). The per hectare nut yield from 500 trees /ha was highest (1455kg) which was (121%) as compared to 200 trees/ha. The maximum cum. yield of 11.426 kg/tree was recorded by the medium tree density of 400 trees/ha. The treatment having

500 trees/ha recorded cumulative an increase of 5493 kg/ha (142 %) over the treatment having 200 trees/ha in the cumulative yield.

The maximum annual nut yield was recorded in 225: 75: 75 kg NPK/ha (3.53kg/tree & 1274kg/ha). The cumulative yield for six years during 2004-11 showed only marginal variation among the fertilizer schedules, with 225: 75: 75 kg NPK/ha recording the highest yield (11.59kg/tree). An increasing trend was observed with increasing fertilizer levels, with the maximum cumulative yield recorded by 225 : 75 : 75 kg NPK/ha (4306 kg/ha) (Table 2.22 and 2.23).

Table 2.22 : 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)	Annual yield (2010-11)		Cumulative yield (2004-11) (6 years)	
					kg/tree	kg/ha	kg/tree	kg/ha
Densities	5.08	82.4	6.27	6.77	3.29	659	11.33	2267
S ₁ - 200	4.96	79.4	5.44	5.67	3.34	1338	11.42	4570
S ₂ -400	5.20	74.7	5.55	5.84	2.91	1455	10.98	5493
S ₃ -500	NS	NS	0.57	0.86	NS	253	NS	423
CD (0.05)	0.05	2.79	0.17	0.25	0.192	73	0.259	122
SEm								
Fertilizer doses								
M ₁ - 75:25:25	5.13	77.5	5.63	6.02	3.12	1109	11.12	3971
M ₂ - 150:50:50	5.12	80.1	5.69	6.12	2.89	1069	11.02	4052
M ₃ - 225:75:75	5.00	78.9	5.93	6.14	3.53	1274	11.59	4306
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
SEm	0.09	2.30	0.17	0.28	0.232	87	0.392	143


Table 2.23 : 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)	Annual yield (2010-11)		Cum. yield (2004-11)	
					Kg/tree	Kg/ha	Kg/tree	Kg/ha
S ₁ M ₁	5.12	84.20	6.31	7.01	3.53	708	12.31	2462
S ₁ M ₂	4.95	77.20	6.05	6.67	2.83	567	10.93	2186
S ₁ M ₃	5.18	85.80	6.44	6.63	3.50	702	10.75	2151
S ₂ M ₁	4.96	77.10	5.16	5.32	2.98	1192	10.75	4034
S ₂ M ₂	5.12	85.10	5.61	5.62	2.77	1108	11.01	4406
S ₂ M ₃	4.82	76.00	5.56	6.06	4.28	1713	12.50	5002
S ₃ M ₁	5.31	71.30	5.44	5.74	2.85	1426	10.29	5148
S ₃ M ₂	5.28	78.00	5.42	6.07	3.06	1533	11.12	5565
S ₃ M ₃	5.01	74.90	4.79	5.72	2.81	1408	11.53	5766
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
SEm	0.15	3.98	0.30	0.48	0.401	151	0.678	274

PILICODE

The plant height was highest with closer spacing of 5m x 4 m (600 plants / ha) (4.40m). Maximum canopy spread (5.57 NS) (5.35 EW) was recorded in S₁ 200pl/ha which also recorded maximum bisexual flowers ratio of

1:8.26. Maximum yield per plant (8.91kg) and per ha (3463kg) was recorded in S₃ 500pl/ha. Interaction effect of spacing and fertilizer dosages were not significant in all combinations (Table 2.24, 2.25 & 2.26).

Table 2.24 : Effect of spacing on vegetative characters and yield of Cashew variety MDK-1 at Pilicode

Treatment	Plant Height (m)	Girth (cm)	Spread of the plant		Male: Bisexual flowers ratio	Yield (kg) per plant	Yield per ha (Q)
			E-W (m)	N-S (m)			
S ₁	3.97b	51.38	5.35a	5.57	8.26b	7.94ab	1394.11
S ₂	3.98b	54.56	5.20a	5.26	5.62c	7.41b	3340.77
S ₃	4.40a	53.62	4.93b	4.73	9.33a	8.91a	3463.00
F test	**	NS	**	NS	**	**	NS
CD@ 5%	0.333	-	0.185	-	0.414	1.206	-

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

Table 2.25 : Effect of Fertilizer on vegetative characters and yield of Cashew variety MDK-1 at Pilicode

Treatment	Plant height (m)	Girth (cm)	Spread of the plant		Male: Bisexual flowers ratio	Yield per plant (kg)	Yield per ha (Q)
			E-W (m)	N-S (m)			
M ₁	3.83b	48.54	5.21	5.30	8.06	7.34	2578.88
M ₂	4.10a	55.71	5.08	5.30	7.63	8.04	2507.11
M ₃	4.41a	55.32	5.18	4.97	7.51	8.89	3111.88
F test	**	NS	NS	NS	NS	NS	NS
CD @ 5%	0.574	-	-	-	-	-	-

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



Table 2.26 : Interaction effect of spacing and doses of fertilizer application on growth and yield of cashew variety MDK -1 at Pilicode

Treatment	Plant height (m)	Trunk Girth (cm)	Spread of the plant		Male: Bisexual flowers ratio	Yield per plant (kg)	Yield/ha (Q)
			E-W (m)	N-S (m)			
S1M1	3.71	45.43b	5.53	5.62ab	7.01e	7.12bcde	1453.33fg
S1M2	3.33	46.20b	4.97	5.40abcd	6.82e	7.06bcde	2700.00de
S1M3	4.45	54.00a	5.15	4.87def	10.37a	7.83bcde	3583.33abc
S2M1	3.72	52.43a	4.76	5.75a	9.35ab	7.69bcde	1332.33g
S2M2	4.21	59.50a	5.31	5.50abc	4.37g	6.00e	3200.00cd
S2M3	4.38	55.20a	5.19	4.67f	9.19b	10.43a	2989.00de
S3M1	4.48	56.30a	5.76	5.36abcde	8.43bcd	9.02abc	1396.67g
S3M2	4.40	58.00a	5.32	4.88def	5.67fg	9.19ab	4122.33a
S3M3	4.36	51.66a	4.47	4.66f	8.43bcd	8.46abcd	3816.67ab
F test	NS	**	NS	**	**	**	**
CD @ 5%	-	10.601	-	0.600	1.110	2.165	557.02

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

VENGURLE

The spacing S₁ of (10m x 5 m) was at par with S₂ (6m x 4m) and they were significantly superior over S₃ (5m x 4m) in respect of mean height and mean canopy height of the plant, mean spread, mean canopy area and mean canopy surface area.

None of the growth characters were influenced significantly due to fertilizer levels. M₂ (150 kg N : 50 kg P₂O₅ : 50 kg K₂O/ha) resulted in highest mean height, mean girth, mean spread, mean canopy height, mean canopy area and mean canopy surface area. (Table 2.27 & 2.28)

Table 2.27 : Effect of spacing and fertilizer on growth and yield of cashew at Vengurle

Treatments	Mean Height (m)	Mean Girth (cm)	Mean Spread (m)	Mean Canopy height (m)
S ₁	6.40	95.90	9.60	5.90
S ₂	6.30	78.00	7.00	5.80
S ₃	4.90	90.50	5.10	4.50
--	0.21	5.00	0.44	0.26
CD at 5%	0.83	N.S.	1.74	1.05
M ₁	5.70	85.30	7.10	5.30
M ₂	6.10	92.70	7.40	5.50
M ₃	5.80	86.40	7.20	5.30
SEm±	0.12	2.18	0.26	0.14
CD at 5%	N.S.	N.S.	N.S.	N.S.



Table 2.28: Interaction effect of spacing and fertilizer on growth and yield of cashew at Vengurle

Treat.	Mean Flowering duration (days)	Mean Fruit set/ m ²	Mean Nut wt. (g)	Mean Yield kg/ tree	Mean Yield (t/ha)	Mean Yield (kg/ Plot)	Cum. yield (kg/ tree)	
S ₁ M ₁	113.00	20.00	9.10	1.52	0.31	9.12	8.80	For 8 harvests
S ₁ M ₂	115.00	16.30	9.90	0.37	0.07	2.20	7.47	
S ₁ M ₃	114.00	20.70	11.70	1.89	0.36	11.32	12.33	
S ₃ M ₁	104.00	18.20	9.70	1.22	0.61	7.30	5.84	For 7 harvests
S ₃ M ₂	112.00	20.60	9.70	1.26	0.63	7.56	5.37	
S ₃ M ₃	113.00	24.20	10.50	1.04	0.52	6.24	5.05	

Note : Trees in S2 treatment were pruned in 2010 as per decision taken in NGM-2009

VRIDHACHALAM

The results showed that the trees in the closer spacing yielded on par with the trees of wider spacing. The highest yield in 6 x 4m spacing is 1600 kg/ha which was higher than the yield in 10 x 5 m spacing. The yield in 5 x 4 m

spacing was 2250 kg/ha at higher fertilizer level. The benefit cost ratio revealed that 5 x 4m spacing recorded a BCR of 3.5 at higher fertilizer level (Table 2.29).

Table 2.29: Effect of fertilizer application and spacing on vegetative characters and yield of cashew at Vridhachalam

Treatments	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	Estimated Yield /ha(kg)	BCR
S ₁ M ₁	8.50	46.50	6.50	800	1.80
S ₁ M ₂	8.70	46.50	6.80	800	1.50
S ₁ M ₃	8.75	46.80	6.80	800	1.50
S ₂ M ₁	8.65	44.20	6.50	1600	2.80
S ₂ M ₂	8.60	44.50	6.85	1800	2.80
S ₂ M ₃	8.70	46.50	6.85	1800	2.50
S ₃ M ₁	4.85	40.50	4.20	2000	2.50
S ₃ M ₂	5.00	42.50	4.25	2250	3.00
S ₃ M ₃	5.50	43.00	4.25	2250	3.50
CD (0.05%)					
M	2.11	0.47**	0.14**		
S	NS	0.20**	0.05**		
M at S	NS	0.54**	0.14**		
S at M	NS	0.35**	0.08**		



Agr.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

The maximum fruit set/m² was the highest (31.6) at Vengurla and maximum nut yield (kg/tree) (1.90) at Vridhachalam in irrigation at 60% CPE. This level of irrigation resulted in maximum cumulative yield of 3.14kg/tree for 2 harvests 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

CHINTAMANI

Among different levels of irrigation, irrigating the crop at 80% CPE (I₅) recorded significantly highest plant height (5.11 m) and stem girth (88.08 cm). There was no significant difference in canopy spread among irrigation levels. Maximum E-W & N-S spread was recorded in I₅ (8.36 m & 8.42 m). Nut yield

varied significantly among the treatments. The highest nut yield of 14.75 kg/tree with a nut weight of 7.4 g. and shelling per cent of 32.1 and cumulative yield of 5 harvests (54.55 kg) was observed in 80% CPE (I₅) (Table 2.30).


Table 2.30: Effect of Drip irrigation on growth and yield of Cashew at Chintamani

Treatments	Plant ht. (m)	Stem girth (cm)	Nut yield (kg/tree)	Cu. yield (kg/tree) of 5 harvests	Nut Wt. (g)	Shelling (%)
I ₁ : No irrigation	4.42	78.54	8.25	31.81	6.9	29.5
I ₂ : Irrigation at 20% CPE	4.61	79.46	10.10	39.00	7.1	30.10
I ₃ : Irrigation at 40% CPE	4.67	85.67	12.85	44.91	7.2	31.4
I ₄ : Irrigation at 60% CPE	5.03	86.83	14.2	51.63	7.2	31.3
I ₅ : Irrigation at 80% CPE	5.11	88.08	14.75	54.55	7.4	32.1
S. Em ±	0.10	0.94	0.94	-	-	-
C.D. at 5%	0.3	2.90	2.89	-	-	-

VENGURLA

Maximum fruit set/m² was the highest in irrigation at 60% CPE (31.6) and maximum mean yield (t/ha) was obtained in irrigation at

40% CPE and cumulative yield for 8 harvests was maximum in the irrigation treatment at 40 percent C.P.E. i.e. 22.56 Kg/tree (Table 2.31).

Table 2.31: Effect of drip irrigation on growth and yield of Cashewnut at Vengurle

Treatment	Mean Flowering duration (days)	Mean Fruit set/m ²	Mean Yield kg/tree	Mean Yield t/ ha	Cumulative yield for 8 harvests	Mean Nut Weight (g)
T ₁ : No Irrigation	111.80	31.30	0.45	0.18	19.94	9.20
T ₂ : Irrigation 20% CPE	106.50	23.70	0.45	0.18	20.08	8.60
T ₃ : Irrigation 40% CPE	110.00	30.30	1.15	0.46	22.56	8.40
T ₄ : Irrigation 60% CPE	107.80	31.60	0.60	0.24	20.79	9.00
T ₅ : Irrigation 80% CPE	107.50	26.30	1.00	0.40	21.45	10.10
SEm±	1.57	2.89	0.27	0.11	-	0.37
CD at 5%	N.S.	N.S.	N.S.	N.S.	-	N.S.

VRIDHACHALAM

Irrigating the cashew plants at 80% of cumulative pan evaporation favoured the growth parameters (plant height (3.46m),

Trunk girth (24.8cm), Canopy spread (7.40m). The nut yield (kg/tree) was maximum (1.90) in irrigation at 60% CPE which also led to maximum cumulative yield of 3.14kg/tree (Table 2.32).

Table 2.32 : Effect of drip irrigation on growth of cashew at Vridhachalam

Treatments	Plant Height (m)	Trunk Girth (cm)	Canopy spread (m)	Mean Weight/ nut (g)	Yield (kg/tree)	Cum.yield (kg/tree) (2 Har.)
T1 - No irrigation	2.42	21.20	2.06	7.20	1.50	2.24
T2 - Irrigating 20% of CPE	2.78	22.60	2.24	7.20	1.62	2.46
T3 - Irrigating 40% of CPE	2.96	23.40	2.44	7.30	1.70	2.62
T4 - Irrigating 60% of CPE	3.20	24.40	2.52	7.30	1.78	2.72
T5 - Irrigating 80% of CPE	3.46	24.80	2.60	7.40	1.90	3.14
CD (0.05%)	0.18	0.26	0.64	NS		



Agr.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:

Highest cumulative nut yield of 2006 kg/ha was recorded with high density planting plot compared to the normal density plot (529 kg/ha.) at Bapatla. The nut yield per hectare was significantly higher (3.23 times) under high density planting (2841 kg) as compared to normal density (880 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

During the year 2010-11, maximum values for growth parameters were recorded with 4x4 density level and yields are higher in normal spacing i.e. 8 x 8 m.

Highest cumulative yield of 2006 kg/ha was recorded with high density plot compared to the normal density plot where the yield obtained was only 529 kg/ha in the initial year of plantation (Table 2.33).

Table 2.33: Data on growth and yield parameters of high density planting and normal planting at Bapatla

	4m x 4 m	8m x 8m
Plant height (m)	3.26	2.84
Trunk girth (cm)	45.73	44.00
Mean canopy diameter (m)	8.18	7.47
Canopy height (m)	3.80	3.35
Duration of flowering (days)	111	107
Nut yield (Kg/tree)	1.20	1.70
Cum. yield (Kg/tree) (4 no. of harvests)	3.21	3.39
Cum. yield (Kg/ha)	2006	529

**BHUBANESWAR**

The annual nut yield recorded at Cashew Research Station, Bhubaneswar was 3892.0 kg / ha during the year 2010-11 and the cumulative yield at 10th harvest is 18430.0 kg.

The yield in the farmers' field at Dhenkanal under high-density planting with the variety Vengurla-4 recorded 3312.5 kg/ha on 10th harvest.

CHINTAMANI

The mean yield per plant was lower under high density planting (0.35 kg/tree during 10th harvest) compared to normal planting (8.98 kg/tree during 10th harvest). The mean nut yield (218.80kg/ha) and mean cumulative nut yield (6520 kg/ha) were higher in high density planting compared to normal planting (1400 and 6380 kg/ha). The yield per plant in high density planting was reduced drastically since two years due to overlapping of canopy (Table 2.34).

Table 2.34 : Effect of high density planting on growth and yield of Cashew at Chintamani

Parameters	High density planting (4 x 4m)	Normal planting (8 x 8m)
Plant height (m)	4.29	5.65
Stem girth (cm)	58.00	89.50
Canopy spread (m)	E - W	8.58
	N - S	8.45
Yield (kg/tree)	0.35	8.98
Yield (kg/ha)	218.8	1400
Cumulative Yield of 10 harvests		
Kg/tree	10.43	40.90
Kg/ha	6520	6380

The yield per unit area (1363 kg/ha.) and the B:C ratio (3.14) were highest under high density planting up to 7th harvest compared to normal density (975 K/ha. and B:C ratio of

2.46). After 7th harvest the yield and B:C ratio decreased under high density and increased in normal density (Table 2.35).

Table 2.35 : Yield and B:C ratio of high density Cashew at Chintamani

Harvest/year	Yield (kg/ha.)		Net returns (Rs/ha.)		B:C ratio	
	H.D. (4X4 m)	N.D. (8X8 m)	H.D. (4X4 m)	N.D. (8X8 m)	H.D. (4X4 m)	N.D. (8X8 m)
1 st harvest	325	172	4,400	1,004	1.73	1.22
2 nd harvest	525	296	10,350	4,064	2.38	1.68
3 rd harvest	594	429	10,384	6,444	1.94	1.72
4 th harvest	831	647	18,409	13,233	2.31	1.68
5 th harvest	975	830	23,950	19,860	2.41	2.32
6 th harvest	1269	956	40,912	27,888	3.05	2.55
7 th harvest	1363	975	49,239	30,675	3.14	2.46
8 th harvest	1000	1014	30,000	32,784	2.15	2.37
9 th harvest	344	1095	-6,984	43,080	0.76	2.60
10 th harvest	219	1400	-14,232	85,800	0.52	3.36

Selling price: Rs. 32, 34,36,39,42,48,53,56, 64 & 72 per kg of nuts respectively for each harvest



JHARGRAM

The experiment is in the initial stage of growth.

MADAKKATHARA

The yield per tree was higher under normal density (5.64 kg) to the tune of 24.1%, as compared to high-density planting system (4.54 kg) during the fourteenth year of planting. The per hectare yield was significantly higher (3.23 times) under high density planting (2841 kg) as compared to normal density (880 kg). This is a direct reflection of the increased tree number. However, the mean data under normal

planting indicated canopy spread values (7.30 and 7.03m) lower than the spacing, indicating absence of shading. Tree height, tree girth and canopy spread were significantly high in normal density planting (Table 2.36).

The cumulative yield per tree for eleven harvests was higher under normal density planting by 5.589 kg (47.704 vs 42.115) over high density planting. The cumulative yield per hectare for eleven harvests was considerably high under high density system as compared to normal density planting (26322 vs 7442 kg/ha). The increase of yield in high density was 3.54 times than that of normal density planting.

Table 2.36 : Effect of high density planting on growth and yield attributes and yield of cashew during fourteenth year at Madakkathara

Parameters	High density planting			Normal planting
	Max.	Min.	Mean	
Tree height (m)	6.60	4.80	6.00	7.02
Trunk girth (cm)	114.00	86.00	96.00	98.30
Canopy spread - NS (m)	7.60	4.80	5.70	7.30
Canopy spread - EW (m)	6.30	3.90	5.21	7.03
Yield (kg/tree/annum)	5.75	3.90	4.54	5.64
Yield (kg/ha/annum)			2841.00	880.00
Cum. yield (kg/ tree) 11hvsts			42.115	47.70
Cum. yield (kg/ ha) 11hvsts			26322.00	7442.00

VENGURLA

Average height of the plant was 5.0 m and canopy area was 37.57 m². The mean cumulative yield for 6 harvests was 4.90

kg/plant. Presently the plot has been pruned and hence no yield was obtained during 2010 (Table 2.37).

Table 2.37 : Growth and yield observations of high density planting at Vengurla

Vegetative Parameters	Plant Height (m)	Stem Girth (cm)	Canopy Diameter (m)	Canopy Height (m)
Range	79.50 - 94.00	4.10 - 5.0	4.10 - 5.00
Mean values	5.00	85.86	4.63	4.53

**Agr.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:

Highest net returns was recorded by amorphophallus (₹ 1,39,639), followed by tapioca (₹ 1,29,992) at Madakkathara. Out of five different tuber crops, greater yam (Ghorkand) recorded significantly higher yield of 51.50 kg/plot and 21.45 t/ha at Vengurla. Highest net profit of ₹. 45,500 was obtained with *Aloe vera* followed by *Ocimum sanctum* (₹. 40,500/-) at Vridhachalam. The highest net profit of (₹. 1,01,402 /ha at Paria, was found in intercropping with okra.

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

MADAKKATHARA

All the growth attributes of cashew viz., height, girth and canopy spread (NS and EW) recorded marginal increase in intercropped plots over the sole crop of cashew (Table 2.38).

Table 2.38 : Growth of cashew as influenced by intercropping at Madakkathara

	With intercropping	Without intercropping
Height of tree (m)	2.71	2.65
Girth of tree (cm)	26.7	26.0
Canopy spread (NS) (m)	2.64	2.53
Canopy spread (EW) (m)	2.64	2.51

In terms of tuber yield, tapioca recorded the maximum yield (18.706 t/ha) followed by amorphophallus (18.083 t/ha). Highest total returns and net returns was recorded by amorphophallus, followed by tapioca. The highest cost of cultivation was in

amorphophallus, lowest cost of cultivation was recorded by tapioca. The highest C: B ratio (2.38) was recorded by tapioca followed by coleus (1.89). The lowest net return (Rs. 70080) and C: B ratio (1.67) was recorded by sweet potato.



The experiment revealed that tapioca, coleus, amorphophallus, colocasia and sweet potato could be cultivated profitably as intercrop in

young cashew plantations. Amorphophallus ranked first in net income while tapioca recorded the highest C: B ratio (Table 2.39).

Table 2.39 : Economics of intercropping of tuber crops in cashew at Madakkathara

Name of intercrop	Tuber mean yield		Cost of cultivation (Rs/ha)	Total return from intercrop (Rs./ ha)	Net profit (Rs./ha)	C: B ratio
	(Kg/ plot of 22.68 m ²)	t/ ha *				
Coleus	31.00	12.88	102120	193305	91185	1.89
Colocasia	32.00	13.30	115250	199530	84280	1.73
Tapioca	45.00	18.70	94480	224472	129992	2.38
Sweet potato	27.89	11.59	103830	173910	70080	1.67
Amorphophallus	43.50	18.08	185855	325494	139639	1.75

* Area planted with inter crops/ha: 9428m² Price of produce (Rs/ kg):

Coleus - 15, Colocasia - 15 Tapioca - 2 Sweet potato - 15 Amorphophallus - 18

PARIA

Significantly the highest yield/ha (4001 kg/ha) was recorded in T₂ (Okra (GO₂) + Cashew) which was followed by T₅ cowpea (1829kg) and T₁ pigeonpea (1715 kg) in gaining higher yield

of intercrops. The highest net profit of Rs. 1,01,402 ha⁻¹ was found in T₂ Okra and it was followed by T₁ Pigeon pea (Table 2.40).

Table 2.40 : Yield and economics of intercropping in cashew at Paria

Treatments	Yield		Total Returns from Intercrops (Rs/ha)	Net Profit (Rs/ha)
	kg/ha	kg/plot		
T ₁ : Pigeon pea (Vaishali) + Cashew	1715	3.75	51,450	35,312
T ₂ : Okra (GO ₂) + Cashew	4001	8.75	1,20,030	1,01,402
T ₃ : Indian bean (GW-2) + Cashew	1257	2.75	20,112	8,083
T ₄ : Indian bean (NPS-9) + Cashew	1372	3.00	24,696	12,667
T ₅ : Cow pea (GC-4) + Cashew	1829	4.00	27,435	16,656
T ₆ : Cashew alone	0000	0.00	00000	0000
S.Em ±	116.58			
C.D.	359.24			

VENGURLA

Tubers of lesser yam (Kangar) *Dioscorea esculanta*, Greater Yam (Ghorkand) *Dioscorea alata*, aerial yam (Karanda) *Dioscorea bulbifera*, Elephant foot Yam (Suran) *Amorphophallus piniifolius*, and tapioca (*Manihot esculanta*) were procured and were planted for multiplication to have required quantity for replicated trials. Replicated trial is laid in June

2010 in cashew orchards of Vengurla-1.

Out of five different tuber crops, greater yam (Ghorkand) was recorded significantly higher yield of 51.50 kg/plot and 21.45 t/ha and this was followed by elephant foot yam (36.50 kg/plot & 15.20 t/ha) and tapioca (35.50 kg/plot & 14.79 t/ha). In addition to this, the main crop cashew recorded the average yield of 10.0 kg/tree and 1.56 t/ha (Table 2.41).


Table 2.41 : Yield observations of intercrops in cashew at Vengurle

Treat.	Inter Crops	Spacing (cm)	Yield Kg/plot	Yield t/ha	Local Market Rate Rs/Kg	Income Rs/ha
T1	Lesser Yam (Kangar)	60 x 60	14.50	6.04	50/-	300200
T2	Greater Yam (Ghorkand)	75 x 60	51.50	21.45	40/-	841800
T3	Aerial Yam (Karanda)	100 x 60	20.75	8.64	60/-	483840
T4	Elephant foot Yam (Suran)	75 x 75	36.50	15.20	30/-	450600
T5	Tapioca	100 x 60	35.50	14.79	4/-	59160
			1.58	0.66		
CD at 5%			4.89	2.03		
Yield of Cashew (V-1)		8m x 8m	10.00kg/tree	1.56	85/-	132600

VRIDHACHALAM

Ocimum and *Aloe* recorded higher BCR values of 3.0 and 2.9 respectively performing better as intercrops in cashew. Highest net profit of ₹45,500 was obtained with *Aloe vera* followed

by *Ocimum sanctum* (₹40,500/-). *Ocimum* showed sustained performance for three years and *Aloe vera* for two consecutive years (Table 2.42).

Table 2.42: Performance of intercrops in cashew at Vridhachalam

Treatments	Yield from intercrops		Total cost of production for intercrops/cashew (Rs./ha)	Total returns From intercrops/cashew (Rs./ha)	Net profit (Rs/ha)	BCR	Sole crop yield of intercrops (t/ha)
	Plot yield (kg/25 m ²)	Estimated yield (t/ha as intercrop)					
<i>Ocimum sanctum</i> (leaves and stem)	9.20	3.60	13500	54000	40500	3.00	10.00
<i>Catharanthus roseus</i> (leaves and stem)	5.00	1.80	13000	18000	5000	0.30	6.50
<i>Phyllanthus niruri</i> (leaves and stem)	7.00	2.00	8250	16000	7750	0.90	6.00
<i>Aloe vera</i> (leaves)	17.00	6.10	15500	61000	45500	2.90	20.00
Cashew alone	2.00	0.38	8000	17325	9325	1.40	2.00
SEd CD(0.05)	0.022 0.048**						



Agr.7: Organic Management of Cashew

Centres : East Coast :

Bapatla, Bhubaneswar, 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:

The cumulative nut yield per hectare, was maximum (483.4 kg) in recommended doses of fertilizer + 10 kg FYM (Control) followed by 50 % N as FYM + Bio-fertilizers (200 g) (446.90 kg) at Bhubaneswar. Maximum shelling percentage (45.6%) was recorded in (25 % N as FYM + Recycling of organic residue + 20 % cow dung slurry + Green Leaf Manure + Biofertilizers (Azospirillum + Azotobacter+ PSB) at Jhargram.

Treatments:

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

BHUBANESWAR

The plant height, trunk girth and plant spread due to various organic treatments during 2010-11. In the treatment (T₈) recommended doses of fertilizer + 10 kg FYM (Control) exhibited maximum plant height (3.8 m), trunk girth (43.7 cm) and spread of the plant in both the directions of

E-W (5.7 m) and N-S (6.0 m) was observed followed by T₃ i.e. 50 % N as FYM + Bio-fertilizers (200 g), in which plant height and trunk girth were exhibited 3.6 m, 40.7 cm respectively. But T₁ i.e. 100 % N as FYM resulted maximum plant spread in both the directions of E-W (5.4 m) and N-S (5.5 m) (Table 2.43).

**Table 2.43 : Vegetative characters in different organic treatments at Bhubaneswar**

Treatment		Plant Height (m)	Trunk girth (cm)	Spread (m)	
				E-W	N-S
T ₁	100 % N as FYM	3.50	40.50	5.40	5.50
T ₂	100 % N as FYM + Bio -fertilizers (Azatobacter + Azospirillum + PSB) 200 g	3.40	39.30	5.40	5.20
T ₃	50 % N as FYM + Bio -fertilizers (200 g)	3.50	40.10	5.30	5.20
T ₄	100 % N as Vermicompost + Bio-fertilizers (200 g)	3.20	35.80	4.50	4.70
T ₅	Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	3.40	38.80	5.00	5.00
T ₆	In situ green manuring / green leaf manuring to meet 100 % N	3.20	34.40	4.70	5.00
T ₇	25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	3.60	40.70	5.30	5.40
T ₈	Recommended doses of fertilizer + 10 kg FYM (Control)	3.80	43.70	5.70	6.00
F 'test'		NS	NS	NS	NS
SEM± CD (0.05)		0.170	2.237	0.316	0.293

Significantly maximum number of panicles / sq. m. (17.6) was observed in T₈ i.e. Recommended doses of fertilizer + 10 kg FYM (Control) which was at par with T₇ i.e. 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g) (15.8). Similar trend with respect to nuts / panicle was also recorded in T₈

(4.3) and T₇ (4.0). However highest nut weight (8.7) was recorded in T₃ i.e. 50 % N as FYM + Bio-fertilizers (200 g). Significantly highest nut yield per ha. was recorded in T₈ (430.0 kg/ha), which was at par with T₇ (386.7 kg/ha) and T₃ (368.3 kg/ha). The cumulative nut yield per hectare, was maximum in T₈ (483.4 kg) followed by T₃ (483.4) (Table 2.44).



Table 2.44: Yield characters of organic cashew plant at Bhubaneswar

Treatment		No. of panicles /sq. m.	Nut weight (g)	Nut yield (kg/plant)	Cum. Nut yield (kg/plant)	Nut Yield (kg/ha)	Cum. Nut yield (kg/ha)
T1	100 % N as FYM	14.90	8.30	1.27	1.49	254.20	298.20
T2	100 % N as FYM + Bio - fertilizers (Azatobacter + Azospirillum + PSB) 200 g	14.40	8.40	1.45	1.59	290.80	318.80
T3	50 % N as FYM + Bio - fertilizers (200 g)	14.80	8.70	1.84	2.23	368.30	483.40
T4	100 % N as Vermicompost + Bio - fertilizers (200 g)	13.50	8.10	0.58	0.74	116.70	148.70
T5	Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	14.70	8.20	1.34	1.67	267.50	334.90
T6	In situ green manuring / green leaf manuring to meet 100 % N	15.40	8.10	0.74	0.9	148.30	180.30
T7	25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio - fertilizers (200 g)	15.80	8.10	1.93	2.16	386.70	432.70
T8	Recommended doses of fertilizer + 10 kg FYM (Control)	17.60	8.20	2.15	2.42	430.00	483.40
F 'test'		S		S		S	
SEM _±		0.706		0.205		40.928	
CD (0.05)		2.140		0.620		124.155	

JHARGRAM

The treatments were at par in terms of their effect on plant height, trunk girth, canopy spread, canopy area, flowering/m², nuts/m², nut weight, and apple weight as well as nut yield. Maximum shelling percentage

was recorded in (T7) (25 % N as FYM + Recycling of organic residue + 20 % cow dung slurry + Green Leaf Manure + Biofertilizers (Azospirillum + Azotobacter+ PSB) (45.6%) followed by T8 (Control) (40.6%) (Table 2.45).


Table 2.45: Growth and yield attributes of cashew under organic management at Jhargram

Treatment	Plant height (m)	Trunk girth (cm)	Trunk height (m)	Canopy spread (m)	Nut weight (g)	Yield Kg/tree)	Shelling %
T 1	2.30	23.70	0.70	2.30	6.30	0.25	33.70
T 2	1.90	19.00	0.40	1.90	6.90	0.02	34.80
T 3	2.30	27.70	0.40	2.50	6.70	0.27	35.20
T 4	1.90	20.30	0.50	1.80	6.70	0.07	39.10
T 5	1.90	19.30	0.60	1.80	6.60	0.08	35.90
T 6	2.00	21.30	0.60	2.30	6.90	0.06	36.70
T 7	2.00	22.70	0.70	2.10	6.60	0.04	45.60
T 8 (Control)	2.10	21.00	0.60	1.90	6.70	0.07	40.30
S.Em ±	0.24	2.99	NS	0.36	0.14	NS	1.44
C.D.at 5%	0.51	6.41		0.77	0.30		3.09
C.V%	20.8	23.6		29.5	3.6		6.85

MADAKKATHARA

Tree height, girth and canopy spread (NS and EW) of young cashew trees did not vary significantly. The maximum height was recorded by T7 (25% N as FYM + recycling organic residues + green leaf/ green manuring

+ biofertilisers). T6 (Green leaf / green manuring) recorded the maximum girth (37.5cm) and canopy spread (both NS and EW) (3.67 and 3.50m respectively) (Table 2.46).

Table 2.46 : Effect of organic treatments on vegetative parameters at Madakkathara

Treatments	Height (m)	Girth (cm)	Canopy spread- NS (m)	Canopy spread- EW (m)
T1 - 100 % N as FYM	2.53	32.40	2.80	2.87
T2 - 100% N as FYM + BF	2.47	28.00	2.87	2.87
T3 - 50% N as FYM + BF	2.57	33.60	3.00	2.90
T4 - 100% N as VC + BF	2.47	31.70	2.57	3.07
T5 - Recycling organic residues	2.67	34.40	2.97	3.03
T6 - Green leaf/ green manuring	2.63	37.50	3.67	3.50
T7 - 25% N as FYM + recycling organic residues + green leaf/ green manuring + BF	2.70	30.90	2.83	3.30
8 - RDF + 10 kg FYM (Control)	2.33	29.70	2.87	3.33
CD (0.05)	NS	NS	NS	NS



VENGURLA

The treatment T₈ (RDF+10 Kg FYM control) recorded more mean height (3.08 m), mean canopy height (2.72 m) and mean canopy surface area (19.68 m²) whereas, stem girth (31.8

cm), mean canopy spread (3.62 m) and mean canopy area (10.80 m²) was observed maximum in treatment T₆ (In situ green manuring/green leaf manuring to meet 100% N) (Table 2.47).

Table 2.47: Growth observations in organic farming trial in cashew at Vengurla

Treatments	Mean Plant Height (m)	Mean Stem Girth (cm)	Mean Canopy Spread (m)	Canopy height (m)
T ₁ - 100% N as FYM	2.74	28.50	3.32	2.38
T ₂ - 100% N as FYM + Biofertilizers (Azatobacter + Azospirillum + PSB*)	2.50	29.40	3.13	2.20
T ₃ - 50% N as FYM + Biofertilizers	2.54	28.20	2.97	2.15
T ₄ - 100% N as Vermicompost + Biofertilizers	2.68	28.10	3.46	2.26
T ₅ - Recycling of organic residues with addition of 20% cow dung slurry	2.49	28.50	3.05	2.15
T ₆ - In situ green manuring/green leaf manuring to meet 100% N	3.02	31.80	3.62	2.65
T ₇ - 25% N as FYM + Recycling of organic residues + In situ green manuring/green leaf manuring + Biofertilizers	2.18	26.80	2.77	1.94
T ₈ - RDF + 10 kg FYM (Control)	3.08	30.80	3.61	2.72
SEm±	0.24	2.76	0.23	0.23
CD at 5%	N.S.	N.S.	N.S.	N.S.

VRIDHACHALAM

Green manure crop (sun hemp) was raised for addition of green leaf manure in the treatments T₉, T₁₀ and T₁₁. *Sesbania grandiflora* was planted as border crop around the trial to use the green leaves as

manure in specific treatments. The vegetative parameters, percentage of bisexual flowers and yield (kg/tree) did not vary significantly (Table 2.48).

Table 2.48: Effect of organic treatments on growth of cashew at Vridhachalam

Treatments	Plant height (m)	Trunk girth (cm)	Canopy spread (m)		Percentage of bisexual flowers	Yield kg/ tree
			E-W	N-S		
T ₁	3.50	39.50	4.50	5.20	20.50	1.00
T ₂	3.20	38.50	5.50	5.00	20.00	2.00
T ₃	3.50	38.00	5.00	5.50	21.50	2.50
T ₄	3.50	43.50	5.00	4.90	21.50	2.00
T ₅	3.00	38.00	5.20	5.50	25.60	2.20
T ₆	3.50	44.00	5.60	5.10	32.50	2.00
T ₇	3.20	42.50	5.00	5.00	20.50	2.20
T ₈	3.50	40.50	4.50	5.00	20.50	1.50
CD @ 5.0%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

III. CROP PROTECTION

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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:

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. The thrips mean damage grade at 30 days after 3rd spray was significantly lowest (0.38 mean damage score) in Chlopyriphos 0.05% at Jagdalpur. At Jhargram, leaf and blossom webber damage was reduced to 0.2-0.6% in treated plots while it was 5.6% in control. At Madakkathara, the annual nut yield in recommended spray schedule was 3.36 kg/tree, while it was 1.09 kg/tree in control. Overall efficacy for managing foliage pests was recommended spray schedule > Profenophos (0.05%) > L-cyhalothrin (0.003%) at Vridhachalam.

Experimental details:

T1 = Recommended sprays for the region

T2 = Chlorpyriphos 0.05%

T3 = Triazophos 0.1%

T4 = L-cyhalothrin 0.003%

T5 = Profenophos 0.05%

T6 = Control

BHUBANESWAR

The results indicated that the shoot tip caterpillar incidence was 7.60 to 7.93% before spray and there was no significant difference among treatments. It was observed that 30 days after 1st spray the pest incidence was reduced in all the treatments (1.30 to 6.75%). L-cyhalothrin exhibited minimum pest incidence of 1.30%, as compared to recommended spray (1.65%). Again 30 days after second spray the pest incidence was further reduced to 0.36 to 5.60% with minimum incidence (0.36) in L-cyhalothrin treatment. The apple and nut borer incidence was very low (0.33 to 2.76 %) 30 days after 3rd spray.

The minimum damage score (0.19) was recorded in L-cyhalothrin treatment, which was significantly lower than recommended spray. 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%) followed by Triazophos (0.1%) and recommended spray (36.14%). The profit was maximum (Rs.142.10 per tree over control) in L-cyhalothrin treated plot while it was (Rs.123.20 per tree over control) in Triazophos and recommended spray schedule (Table 3.1).



Table 3.1 : Evaluation of insecticides on different insect pests of cashew of Bhubaneswar

Treatment	% Shoot damage by STC Before spray	% Damage by STC after 1 st spray	% Damage by STC after 2 nd spray	Damage by apple & nut borer after 3 rd spray	Damage grade by inflorescence thrips after 3 rd spray	Average nut yield per tree in kg	% Increase over control	Profit per tree over control in Rs.
T ₁	7.93 (2.89)	1.65 (1.46)	0.61 (1.05)	0.57 (1.03)	0.36 (0.93)	7.63	36.14	123.20
T ₂	8.01 (2.93)	1.75 (1.49)	0.50 (1.04)	0.64 (1.06)	0.34 (0.91)	7.50	33.47	114.10
T ₃	7.85 (2.89)	1.77 (1.50)	0.41 (0.95)	0.60 (1.05)	0.29 (0.89)	7.63	36.14	123.20
T ₄	7.63 (2.94)	1.30 (1.34)	0.36 (0.93)	0.33 (0.91)	0.19 (0.83)	7.88	41.68	142.10
T ₅	7.81 (2.88)	1.80 (1.52)	0.55 (1.02)	0.63 (1.06)	0.33 (0.89)	7.25	28.34	96.60
T ₆	7.60 (2.85)	6.75 (2.69)	5.60 (2.47)	2.76 (1.82)	0.63 (1.06)	5.88	-	-
Sem(+)	0.05	0.07	0.11	0.04	0.02	0.30		
CD (5%)	NS	0.21	0.61	0.14	0.05	0.91		

There was significant reduction of natural enemy and pollinators population in all the treated trees than the control plot. The different natural enemies were spiders (*Argeopes* sp.

Oxyopes sp.), Ladybird beetle (*Vigna cinta*, *Menochilus sexmaculata*), pollinations like black ant *Campanotus* sp. and honeybees (*Apis cerana indica*)

CHINTAMANI

The population of TMB ranged between 0.11 to 3.17, 0.07 to 3.22 and 0.03 to 3.25 at 30 days after 1st, 2nd and 3rd spray, respectively. Lambda Cyhalothrin was significantly superior over other treatments and recorded lowest population of TMB in all the three sprays. The

recommended spray for the region (1.69) and Triazophos (2.87) performed next to L-cyhalothrin (0.03) in terms of damage score. The spray with chlorpyriphos and profenofos were least effective in controlling the TMB and were on par with unsprayed check (Table 3.2).

Table 3.2 : Effect of insecticides on the incidence of TMB at Chintamani

Treatments	30 Days after I spray(0-4)	30 Days after II spray (0-4)	30 Days after III spray (0-4)	Yield Kg/tree
Recommended spray for the region	1.64 ^b	1.66 ^b	1.69 ^b	6.25
Chloropyriphos 0.05 %	2.98 ^d	3.02 ^d	3.11 ^d	3.82
Triazophos 0.1 %	2.78 ^c	2.81 ^c	2.87 ^c	5.20
L.Cyhalothrin 0.003 %	0.11 ^a	0.07 ^a	0.03 ^a	8.12
Profenofos 0.05 %	3.10 ^d	3.16 ^d	3.21 ^d	3.01
Unsprayed check	3.17 ^d	3.22 ^d	3.25 ^d	2.49
C.D @ 5%	0.74	0.03	0.22	-



Thrips damage on immature apple and nuts was found to be low in all the treatments compared to control. The lowest damage score of 0.24 on apple and 0.35 on nuts was recorded in Lambda Cyhalothrin treated trees and it was significantly superior over the rest of treatments.

With respect to aphids and mealy bugs, all the treatments were significantly superior over control. The lowest damage of aphids (0.24%) was recorded in recommended spray for the region and mealy bugs (0.84%) in

Lambda Cyhalothrin treatments. All the treatments were significantly superior over control in reducing the incidence of leaf miner, apple and nut borer. The lowest damage of 0.84 per cent (leaf miner) and 0.28 per cent (apple and nut borer) was recorded in Lambda Cyhalothrin.

The yield data showed that Lambda Cyhalothrin spray recorded the highest yield (8.12 kg/tree) followed by recommended spray for the region (6.25 kg/tree) and triazophos (5.20 kg/tree) spray for the region (Table 3.3).

Table 3.3 : Evaluation of insecticides for the control of other insect pests of cashew at Chintamani

Treatments	Thrips		Aphids (%)	Meal y bugs (%)	Leaf miner (%)	Apple and nut borer (%)
	Apple	Nut				
Recommended spray for the region	2.49 ^b	1.78 ^c	0.24 ^a	1.02 ^c	0.89 ^a	0.44 ^b
Chlorpyriphos 0.05 %	3.23 ^d	2.47 ^d	0.87 ^d	1.08 ^d	1.22 ^b	1.14 ^c
Triazophos 0.1 %	2.61 ^c	1.59 ^b	0.64 ^c	0.91 ^b	1.59 ^e	2.05 ^e
L.Cyhalothrin 0.003 %	2.24 ^a	1.35 ^a	0.52 ^b	0.84 ^a	1.48 ^c	0.28 ^a
Profenofos 0.05 %	3.81 ^e	2.59 ^e	1.02 ^e	1.31 ^e	1.54 ^d	1.22 ^d
Unsprayed check	4.12 ^f	3.01 ^f	1.98 ^f	2.99 ^f	6.84 ^f	3.02 ^f
C.D at 5%	0.020	0.11	0.09	0.05	0.016	0.07

JAGDALPUR

The thrips mean damage grade at 30 days after 3rd spray was significantly lowest (0.38 mean damage score) in T2 on nut which was at par with T4 and T5. The per cent Leaf Miner damage was significantly low in T2 followed by T1 and T3 in all three sprays. The yield was highest (364.46 kg/ha) in T5 which was at par

with T2 (269.23 kg/ha) (Table 3.4, 3.5 and 3.6).

The population of ants was maximum (1.13 numbers) in T2 treated plots followed by T4 and T5 and the population of spiders was recorded to be maximum (0.22 numbers) in T2 treated plots


Table 3.4 : Efficacy of different insecticides against major pest of cashew at Jagdalpur

TMB (Tea mosquito bug) Mean Damage Score on				Nut yield (Kg/ha)
Treatment	Shoot		Panicle	
	Pre- treatment	30 DAS after III rd spray	30 DAS after III rd spray	
T-1: Monocrotophos 0.05% at flushing, Endosulfan 0.05% at flowering and Carbaryl 0.1% at fruiting stage.	0.14 (0.79)*	0.10 (0.77) a	0.66 (1.08) abcde	208.62bc
T-2 : Chlorpyriphos 0.05%	0.16 (0.80)	0.10 (0.77) a	0.28 (0.87) abc	269.23 ab
T-3 : Triazophos 0.1%	0.00 (0.71)	0.19 (0.82) abc	0.07 (0.75) ab	170.88 bcde
T-4 : L-cyhalothrin 0.003%	0.17 (0.81)	0.12 (0.78) ab	0.06 (0.74) a	178.58 bcd
T-5 : Profenophos 0.05%	0.26 (0.86)	0.59 (1.01) abcd	0.36 (0.90) abcd	364.46 a
T-6 : Unsprayed check	0.27 (0.84)	0.83 (1.14) d	1.09 (1.22) e	56.74 f
CD at 5%	(NS)	(0.27)	(0.30)	109.65

*Figure in parentheses are square root transformed values

Table 3.5 : Damage due to minor pests under insecticides at Jagdalpur

Treatment	Percent incidence of minor pest of Cashew			
	% Leaf Caterpillar damage		% Leaf Folder damage	
	Pre-treatment	30 DAS after III rd spray	Pre-treatment	30 DAS after III rd spray
T-1: Monocrotophos 0.05% at flushing, Endosulfan 0.05% at flowering and Carbaryl 0.1% at fruiting stage.	39.48 (38.88)*	23.33 (28.39) ab	42.85 (40.80)	20.30 (26.26) a
T-2 : Chloropyriphos 0.05%	40.63 (39.37)	35.49 (36.32) abcd	47.70 (43.68)	34.99 (35.28) ab
T-3 : Triazophos 0.1%	37.82 (37.19)	23.15 (28.50) abc	50.17 (45.09)	33.50 (34.98) ab
T-4 : L-cylohexthrin 0.003%	45.08 (42.13)	22.71 (26.87) a	46.86 (43.14)	36.78 (37.13) ab
T-5 : Profenophos 0.05%	32.30 (34.60)	30.08 (33.18) abcd	34.89 (36.20)	40.93 (39.46) b
T-6 : Unsprayed check	29.95 (33.13)	43.24 (41.10) d	33.46 (34.58)	47.98 (43.84) b
CD at 5%	NS	(9.76)	NS	(9.99)

*Figure in parentheses are angular transformed values



Table 3.6 : Efficacy of insecticides against minor insect pest of cashew at Jagdalpur

Treatments	Percent incidence of minor pest of Cashew		
	Nut thrips Mean damage grade at 30 days after 3 rd spray (0-4 scale) *	% Leaf Miner damage **	
		Pre-treatment	30 DAS after III rd spray
T-1: Monocrotophos 0.05% at flushing, Endosulfan 0.05% at flowering and Carbaryl 0.1% at fruiting stage.	0.88 (1.17) ^{bcd}	18.48 (25.36)	1.56 (3.62)
T-2 : Chloropyriphos 0.05%	0.38 (0.93) ^a	20.89 (26.62)	3.65 (5.61)
T-3 : Triazphos 0.1%	0.94 (1.19) ^{bcd}	25.56 (29.91)	2.03 (4.14)
T-4 : L-cyhalothrin 0.003%	0.76 (1.12) ^{ab}	39.48 (38.23)	2.81 (4.90)
T-5 : Profenophos 0.05%	0.84 (1.14) ^{abc}	28.79 (32.08)	1.04 (2.95)
T-6 : Unsprayed check	1.41 (1.38) ^d	25.69 (29.81)	4.17 (6.02)
CD at 5%	0.48 (0.21)	NS	(NS)

* Figure in parenthesis are square root transformed values

** Figure in parenthesis are angular transformed values

JHARGRAM

The percentage occurrence of shoot tip caterpillar was in the range of 7.3-14.8% before spraying. Later on thirty days after first spray it reduced to 5.1-9.9%. The treatments T1, T2, T3, T4, and T5 were at par even after third spray

with respect to their effect on shoot tip caterpillar. In case of leaf and blossom webber damage initially the damage ranged between 4.7-8.4% and was reduced to 0.2-0.6% after 1st spray while it was 5.6% in control (Table 3.7).

Table 3.7 : Evaluation of insecticides for control insect pests at Jhargram

Treatment	Mean % Shoot tip caterpillar damage		Leaf and blossom webber damage		Mean % leaf miner damage		Mean % leaf folder	
	Before spray	After III spray	Before spray	After III spray	Before spray	After III spray	Before spray	After III spray
T1	7.9 (16.32)	2.5 (9.10)	6.5 (14.77)	0.6 (4.44)	5.5 (13.56)	3.1 (10.14)	7.2 (15.56)	2.2 (8.53)
T2	10.4 (18.81)	1.8 (7.71)	8.4 (16.85)	0.4 (3.63)	11.4 (19.73)	2.5 (9.10)	12.5 (20.70)	2.6 (9.28)
T3	14.8 (22.63)	3.6 (10.94)	7.9 (16.32)	0.4 (3.63)	9.8 (18.24)	3.0 (9.98)	9.3 (17.76)	1.5 (7.04)
T4	7.9 (16.32)	3.4 (10.63)	7.3 (15.68)	0.2 (2.56)	2.7 (9.46)	3.9 (11.39)	5.1 (13.05)	1.2 (6.29)
T5	7.9 (16.32)	1.9 (7.92)	6.8 (15.12)	0.4 (3.63)	11.9 (20.18)	3.4 (10.63)	4.0 (11.54)	1.4 (6.80)
T6	7.3 (15.68)	10.1 (18.53)	4.7 (12.52)	5.6 (13.69)	5.3 (13.31)	9.9 (18.34)	5.8 (13.94)	5.5 (13.56)
S.Em ±	2.67	2.04	1.26	0.75	2.04	0.89	1.54	0.61
C.D.at 5%	5.69	4.35	2.69	1.60	4.35	1.90	3.28	1.30


Table 3.7 : Evaluation of insecticides for control insect pests at Jhargram

Treatment	Mean % Shoot tip caterpillar damage		Mean % Leaf and blossom webber damage		Mean % leaf miner damage		Mean % leaf folder	
	Before spray	30 days After III spray	Before spray	30 days After III spray	Before spray	30 days After III spray	Before spray	30 days After III spray
T1	7.9 (16.32)	2.5 (9.10)	6.5 (14.77)	0.6 (4.44)	5.5 (13.56)	3.1 (10.14)	7.2 (15.56)	2.2 (8.53)
T2	10.4 (18.81)	1.8 (7.71)	8.4 (16.85)	0.4 (3.63)	11.4 (19.73)	2.5 (9.10)	12.5 (20.70)	2.6 (9.28)
T3	14.8 (22.63)	3.6 (10.94)	7.9 (16.32)	0.4 (3.63)	9.8 (18.24)	3.0 (9.98)	9.3 (17.76)	1.5 (7.04)
T4	7.9 (16.32)	3.4 (10.63)	7.3 (15.68)	0.2 (2.56)	2.7 (9.46)	3.9 (11.39)	5.1 (13.05)	1.2 (6.29)
T5	7.9 (16.32)	1.9 (7.92)	6.8 (15.12)	0.4 (3.63)	11.9 (20.18)	3.4 (10.63)	4.0 (11.54)	1.4 (6.80)
T6	7.3 (15.68)	10.1 (18.53)	4.7 (12.52)	5.6 (13.69)	5.3 (13.31)	9.9 (18.34)	5.8 (13.94)	5.5 (13.56)
S.Em +	2.67	2.04	1.26	0.75	2.04	0.89	1.54	0.61
C.D.at 5%	5.69	4.35	2.69	1.60	4.35	1.90	3.28	1.30

The population of apple and nut borer was in the range of 4.8-9.2% and of thrips was between 1.5-10.2% after third spray which was significantly lower than control. Chlorpyrifos

0.05% was the best insecticide spray against apple and nut borer over the control. Profenphos 0.05% was found to be the best insecticide spray against thrips (Table 3.8).

Table 3.8 : Evaluation of insecticides for control insect pests at Jhargram

Treatment	% of apples and nuts damaged by ANB (30 days after II spray)	No. of apples and nuts damaged by ANB (30 days after III spray)	No. of nuts showing thrips damage (30 days after II spray)	No. of nuts showing thrips damage (30 days after III spray)
T1	4.8 (12.66)	3.6 (10.94)	1.5 (7.04)	1.7 (7.49)
T2	7.3 (15.68)	1.1 (6.02)	2.3 (8.72)	1.3 (6.55)
T3	9.2 (17.66)	2.0 (8.13)	8.0 (16.43)	2.6 (9.28)
T4	8.3 (16.74)	3.4 (10.63)	5.0 (12.92)	1.6 (7.27)
T5	8.7 (17.16)	3.2 (10.31)	2.6 (9.28)	0.3 (3.14)
T6	7.2 (15.56)	9.7 (18.15)	10.2 (19.63)	13.7 (21.72)
S.Em +	1.68	1.3	1.53	1.74
C.D.at 5%	3.58	2.8	3.26	3.71

ANB = Apple and nut borer

* Figures followed by same alphabet in a column did not differ significantly.



MADAKKATHARA

Significant damage potential of TMB was observed only after 2nd spray in the case of panicle. Among the insecticides tested recommended spray schedule (T-1) was effective followed by Lcyhalothrin (T-4) and

chloryriphos (T-2). The TMB population (no. per 52 leader shoots) ranged between 0.53 to 2.58 in second round of spray and was nil during last spray. The annual yield data in T-1, T-2 and T-4 was 3.36, 2.30 and 2.46 kg/tree respectively. In control, the yield was lowest (1.09 kg/tree) (Table 3.9).

Table 3.9: 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)
	Shoot		Panicle		
	Pre-treatment	30 days after 3rd spray	Pre-treatment	30 days after 3rd spray	
T-1: POP	0.024	0.227	0.151	0.855	3.36
T-2: Chlorpyriphos	0.021	0.126	0.00	0.875	2.30
T-3: Triazophos	0.044	0.219	0.033	0.892	1.10
T-4: L-cyhalothrin	0.021	0.185	0.024	0.847	2.46
T-5: Profenophos	0.045	0.295	0.0225	0.839	1.23
T-6: Control	0.024	0.114	0.161	0.729	1.09
DMRT	NS	NS	--	NS	

Figures are adjusted mean of four replicates

PARIA

The least TMB infestation score (0.49) was found in L-cyhalothrin and Acetamiprid 20 SP, however, they were statistically at par with Clothianidin 50 WDG.

The lowest infestation percent due to leaf miner was recorded in the treatment of β -Cyhalothrin 5 EC (8.83) which was on par with

β -Cyfluthrin 200 SC and Profenophos 50 EC. The lowest STC damage (7.08) and lowest (6.44) percent damage of ANB was observed in the treatment of L-Cyhalothrin 5 EC. The treatment of L-Cyhalothrin 5 EC has also recorded the highest nut yield (818 kg/ha) (Table 3.10).


Table 3.10 : Field efficacy of different insecticides against pest complex of cashew (V- 4) at Paria

Treatments	TMB score 15 days after spray	Per cent Damage due to				Yield (Kg/ha)
		LM After Spray	LBW After Spray	STC After Spray	ANB After Spray	
Trizophos 40 EC @ 0.04 % ; 1ml/lit	0.89 (0.79)	17.75 (10.22)	17.85 (10.28)	13.42 (7.71)	13.27 (7.63)	682
L-Cyhalothrin 5 EC @ 0.003 % ; 0.6ml/lit	0.49 (0.24)	15.35 (8.83)	15.24 (8.77)	12.33 (7.08)	11.21 (6.44)	818
Profenophos 50EC @ 0.05 % ; 1ml/lit	0.92 (0.85)	17.60 (10.14)	17.44 (10.04)	14.37 (8.26)	14.40 (8.28)	609
Control	1.56 (2.43)	25.34 (14.68)	24.85 (14.39)	17.72 (10.21)	19.12 (11.02)	359
S.Em.	0.037	0.47	0.36	0.656	0.58	20.85
C.D.(0.05)	0.106	1.35	1.03	1.86	1.68	63.24

VENGURLA

All the insecticidal treatments significantly reduced the incidence of TMB over control in cashew. Amongst the insecticidal treatments, the treatment (T4) L-cyhalothrin (0.003%) was observed significantly superior over rest of the treatments after first, second and third spray. Profenophos (T5) was found to be the second best treatment.

The results indicated that all the treatments significantly reduced the incidence of inflorescence thrips and apple and nut borer over control. In case of Inflorescence thrips, treatment T4 (L-cyhalothrin 0.003%) was found to be significantly superior over rest of the treatments, when observations recorded on Apple and nut. In case of apple and nut borer, the treatment T4 (L-cyhalothrin 0.003%) was found significantly superior over rest of the treatments (Table 3.9 and 3.11).

Table 3.11 : Incidence of tea-mosquito bug in various treatments at Vengurle

Sr. No.	Treatment details	Per cent incidence 30 days after		
		First spray	Second spray	Third spray
T1	Recommended spray schedule	5.16 (13.07)	5.04 (12.90)	6.00 (14.04)
T2	Chlorpyriphos 0.05%	5.52 (13.33)	5.40 (13.80)	6.12 (14.21)
T3	Triazophos 0.01%	5.64 (13.65)	4.56 (12.22)	5.88 (14.06)
T4	L-cyhalothrin 0.003%	3.24 (10.16)	1.92 (7.85)	3.60 (10.82)
T5	Profenophos 0.05%	4.08 (11.48)	3.84 (10.64)	5.28 (13.20)
T6	Triazophos, Profenophos, Carbaryl.	6.36 (14.54)	4.80 (12.52)	5.88 (14.05)
T7	Control	8.53 (16.91)	7.69 (16.03)	7.93 (16.29)
	S.E.±	0.50	0.51	0.50
	C.D. at 5%	1.50	1.51	1.49

Figures in parenthesis are arcsine values



Table 3.12 : Incidence of minor pests in various treatments in cashew at Vengurle

Sr. No.	Treatment details	Thrips		Apple and Nut borer
		30 days after 3 rd spray		30 days after 3 rd spray
		Apple	Nut	
T1	Recommended spray schedule	5.88 (13.96)	4.92 (12.63)	4.37 (12.06)
T2	Chlorpyriphos 0.05%	6.12 (14.21)	4.68 (12.31)	3.75 (11.15)
T3	Triazophos 0.01%	6.72 (14.94)	5.16 (12.84)	3.77 (11.18)
T4	L-cyhalothrin 0.003%	3.12 (10.06)	1.92 (6.64)	1.81 (7.65)
T5	Profenophos 0.05%	4.68 (12.31)	2.88 (9.65)	2.47 (9.02)
T6	Triazophos, Profenophos, Carbaryl.	6.97 (15.24)	4.32 (11.88)	4.12 (11.69)
T7	Control	8.42 (16.87)	7.45 (15.80)	5.05 (12.98)
	S.E.±	0.535	0.717	0.330
	C.D. at 5%	1.590	2.128	0.981

•Figures in parenthesis are arcsine values

VRIDHACHALAM

The pre-treatment damage score of TMB was non-significant in all treatments including the untreated control. After first spray, the damage score was low (0.43) in T1 (the recommended spray) and T5 (Profenophos 0.05%) followed by T4 (L-cyhalothrin 0.003%), T3 (Triazophos 0.1%), and T2 (Chlorpyriphos 0.05%) ranging between 0.46 and 0.48 as against 1.20 in the control. After the second spray, the

damage score ranged between 0.13 and 0.18 in different treatments as against an increased damage score of 1.23 in untreated control. The damage score was nil after 3rd spray in all insecticidal treatments as against an increased score of 3.50 in control. The overall efficacy ranked in the order: recommended spray schedule > Profenophos (0.05%) > L-cyhalothrin (0.003%) > Triazophos (0.1%) > Chlorpyriphos (0.05%) (Table 3.13).

Table 3.13 : Effect of insecticides on the incidence of TMB at Vridhachalam

Treatment	Post treatment mean damage score (0-4)		Yield (kg/tree)
	Pre-treatment damage score (0-4)	30 days after II spray	
Recommended spray for the region	0.66a	0.13a	6.80
Chlorpyriphos 0.05%	0.63a	0.18a	6.10
Triazophos 0.1%	0.63a	0.16a	6.20
L-Cyhalothrin 0.003%	0.66a	0.15a	6.10
Profenophos 0.05%	0.60a	0.14a	6.30
Untreated check	0.66a	1.23b	1.40
CD	0.63	0.43	

Means followed by same letter are significantly different by DMRT (P=0.05)



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

Centres : East Coast :

Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

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:

Among the insecticides evaluated as post extraction prophylaxis, least re-infestation or least persistent attack was in case of chlorpyrifos 0.2% at Bapatla (90.9%), Bhubaneswar (93.0%), Jagdalpur (80.0%), Madakkathara (90.0%) and in Vengurla centres (93.33%). Treatments with carbaryl (1.0%), Lindane (0.2%) and neem oil (5.0%) lead to 34.78, 31.57 and 33.3% recovery respectively as against 6.5% recovery in untreated control at Vridhachalam. All the early-infested trees recovered in chlorpyrifos treatment while in other treatments the recovery was 33 to 78% at Bhubaneswar, wherein the frequency of extraction of grub was maximum in control (9 times) as compared to chlorpyrifos treatment (4 times). Trees aged 5 to 10 years and with bark circumference damage less than 25% had lower re-infestation by the pest.

Treatments :

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

BAPATLA

Among the insecticides evaluated as post extraction prophylaxis, chlorpyrifos 0.2% led to 90.9 percent trees without re-infestation or persistent attack followed by monocrotophos 0.2% with 64.0 percent trees without re-infestation or persistent attack. The other treatments viz., carbaryl 1.0%, and treated

check with neem oil offered 52.94 and 52.63 percent protection without re-infestation or persistent attack and were superior over the control treatment which recorded 40.0 percent trees without re-infestation or persistent attack (Table 3.14).



Table 3.14 : Efficacy of insecticides as curative control post extraction prophylaxis) against cashew stem and root borer at Bapatla

Treatment	Percent trees without reinfestation / persistant attack
Carbaryl 1.0%	52.94
Chlorpyriphos 0.2%	90.90
Monocrotophos 0.2%	64.00
Un treated check (only removal of CSRB grubs)	40.00
Treated check with most effective treatment under prophylactic trails	52.63

BHUBANESWAR

Maximum recovery (93 %) was obtained in chlorpyriphos (0.2%) treatment. All of the early-infested trees recovered in chlorpyriphos treatment while in other treatments the recovery was 33 to 78 %. Maximum cost Rs. 15 / tree / treatment (pesticide + application cost) was involved in chlorpyriphos (0.2%) treatment. The frequency of extraction of grub was maximum in control (9 times) as compared to chlorpyriphos

treatment (4 times) which is detrimental for recovery of the trees.

Higher stem girth of i.e., 60-80 cm led to more re-infestation and < 60 cm stem girth exhibited least re-infestation. Plants aged of 5 to 10 years had less infestation. The bark circumference damage less than 25 % damage had lower re-infestation. As regards the zone of attack, the stem and collar affected plants recovered quickly whereas the collar + root + stem attack resulted in maximum re-infestation (Table 3.15 and 3.16).

Table 3.15 : Efficacy of insecticides on percentage recovery of CSRB affected trees under curative trial at Bhubaneswar

Treatments	Average % of trees without reinfestation / persistence of attack
T ₁ - Carbaryl (1 %)	70.0
T ₂ - Chlorpyriphos (0.2 %).	93.0
T ₃ - Monocrotophos (0.2 %).	78.0
T ₄ - Chlorpyriphos (o.1%)	77.0
T ₅ - Untreated check (only removal of CSRB grubs)	12.0
T ₆ - Neem oil (5%)	33.0

**Table 3.16 : Physical parameter of cashew stem and root borer in curative trials at Bhubaneswar**

Physical parameters		No. of trees in each category	
		Without re-infestation	With re-infestation
Stem girth (cm)	<60	95	0
	60-80	8	20
	80-100	1	15
	>100	0	2
	Total	104	37
Age (Years)	<5	0	0
	5 -10	75	1
	10-15	20	13
	> 15	9	23
	Total	104	37
% Bark circumference damaged	<25	87	3
	25-50	14	24
	50-75	2	8
	>75	1	2
	Total	104	37
Zone of attack	C+R	1	3
	C+S	88	5
	R	3	3
	S	11	9
	C+R+S	1	17
	Total	104	37
Canopy yellowing	Yellow	0	10
	Not yellow	104	27
	Total	104	37

*Zone of attack: C= Collar

S = Stem

R = Root

CHINTAMANI

Trees with 60-100 cm stem girth, showed highest per cent of damage (52.31%), with respect to age of trees, the trees of more than 15 years were prone to damage. The zone of attack was noticed at collar+root+stem and

canopy yellowing of trees was observed in 10.77 per cent of treated trees. The bark circumference damage was less than 25 per cent in 53.85 per cent of the infested trees (Table 3.17).



Table 3.17 : Physical parameters of treated cashew trees re - infested/without re - infestation under curative control trial at Chintamani

Physical parameters		No. of trees infested	% of total trees treated	No. of trees not reinfested	% of total trees not reinfested
Stem girth	< 60 cm	11	16.92	5	10.00
	60-100 cm	34	52.31	28	56.00
	> 100 cm	20	30.77	17	34.00
Total		65	-	50	-
Age of the tree	<10 years	-	-	-	-
	10-15 years	-	-	-	-
	>15 years	65	100.00	50	100
Total		65	-	50	-
Zone of attack	C + R	13	20.00	08	16.00
	C + S	45	69.23	35	70.00
	C + S + R	07	10.77	07	14.00
Total		65	-	50	-
Yellowing of canopy	Yellowing	07	10.77	06	12.00
	No yellowing	58	89.23	44	88.00
Total		65	-	50	-
% of bark circumference damaged	< 25	35	53.85	33	66.00
	26-50	12	18.46	10	20.00
	51-75	07	10.77	03	06.00
	>75	11	16.92	04	08.00
Total		65	-	50	-

Infestation and reinfestation of the grubs were observed in the trees treated with the chemicals. Chlorpyrifos (0.2%) proved effective with 94.21% trees without reinfestation. However, the other treatments also maintained their superiority in

suppressing the population over control. In treated check, where only grub extraction was adopted, it was observed that 62.45% trees could recover (Table 3.18).

Table 3.18 : Efficacy of certain insecticides as curative treatment against CSRB at Chintamani

Treatments	Trees without re-infestation/persistent attack (%)
Carbaryl 1.0%	85.73
Chlorpyrifos 0.2%	94.21
Monocrotophos 0.2%	79.84
Chlorpyrifos 0.1%	89.73
Treated check	87.50
Untreated check	62.45



JAGDALPUR

The chlorpyrifos-0.2% (T₂) led to maximum recovery 80.00 per cent trees without re-infestations. 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 by CSRB.

Preferential zone of attack was collar + stem zone followed by collar zone with 12.96 and

6.17 per cent re-infested trees, respectively. The canopy of majority of cashew trees infested by CSRB was not yellowed. This pest re-infestation was maximum (22.86 %) in trees wherein bark circumference damage was 25-50 per cent followed by 25 per cent bark circumference damaged tree (13.33%) (Table 3.19 and 3.20).

Table 3.19 : Physical parameters of trees observed under curative control against CSRB at Jagdalpur

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	5	4.76	3	2.86
	60-100 cm	26	24.76	29	27.62
	>100 cm	16	15.24	26	24.76
Total	105	47	44.76	58	55.24
Age of tree	<10 years	0	0.00	0	0.00
	10-15 years	0	0.00	0	0.00
	>15 years	58	55.24	47	44.76
Total	105	58	55.24	47	44.76
Zone of attack	C	10	6.17	21	20.00
	C+R	4	2.47	7	6.67
	C+S	21	12.96	14	13.33
	R	0	0.00	1	0.95
	S	8	4.94	11	10.48
	S+R	3	1.85	2	1.90
	C+S+R	1	0.62	2	1.90
	Total	105	47	29.01	58
Canopy yellowing	a) Canopy Yellowed	6	5.71	11	10.48
	b) Canopy Not yellowed	47	44.76	58	55.24
Total	105	53	50.48	69	42.59
% of bark circumference damaged	<25	14	13.33	19	18.10
	25-50	24	22.86	30	28.57
	50-75	4	3.81	7	6.67
	>75	5	4.76	2	1.90
	Total	105	47	44.76	58

*Zone of attack: C= Collar S = Stem R = Root



Table 3.20 : 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 : Chlorpyrifos (0.2%)	80.00
T3 : Monocrotophos (0.2%)	60.00
T4 : Chlorpyrifos (0.1%)	60.00

JHARGRAM

Minimum reinfestation was noticed in case of swabbing neem oil 5% + chloropyrifos (0.2%).

Trees with more than 80 cm stem girth, 15 years of age were mostly reinfested irrespective of treatments applied. It was also noticed that plants with more than 50% bark circumference damage experienced reinfestation of CSRB. The

treatments T2 and T4 were found to be effective against CSRB when 50-75% bark circumference damage was noticed. Attack by the pest on stem alone indicated T6 : (Swabbing neem oil 5% + chloropyrifos 0.03%) as the best treatment while collar + stem zone showed treatment with chlorpyrifos 0.2% as most effective (Table 3.21).

Table 3.21 : Efficiency of different curative treatments at Jhargram

Treatment	% of trees without reinfestation/ persistent attack (Persistent)
T1 : Carbaryl (1%)	50
T2 : Chlorpyrifos (0.2%)	50
T3 : Monocrotophos (0.2%)	100
T4 : Lindane (0.2%)	50
T5 : Untreated check (only grub extraction)	100
T6 : Treated check (Swabbing neem oil 5% + chloropyrifos 0.03%)	25

MADAKKATHARA

Among the insecticides chlorpyrifos (0.2%) was found effective with 90 percent of trees without re-infestation followed by chlorpyrifos (0.1%), Monocrotophos (0.2%) and treated check neem oil swabbing 5% with application of 75g sevidol led to 80 percent of

trees without re-infestation. However T1 (Carbaryl 1%) and untreated check showed repeated re-infestation. Percentage trees without re-infestation were least with carbaryl (1%) treatment (70%) and untreated check (60%) (Table 3.22).

**Table 3.22 : 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%)	70%
T-2	Chlorpyriphos (0.2%)	90%
T-3	Monocrotophos (0.2%)	80%
T-4	Chlorpyriphos (0.1%)	80%
T-5	Untreated check (grub-extraction only)	60%
T-6	Treated check (neem oil swabbing plus sevidol application)	80%

VENGURLA

The treatment T2 (Chlorpyriphos 0.2%) recorded 93.33 per cent trees without reinfestation followed by Chlorpyriphos (0.1%) T4 (Chlorpyriphos 0.1%) (80.00 per cent) and T1 (Carbaryl 1%) recorded (73.33 per cent) trees without reinfestation. Reinfestation was more

in T6 Control (33.33 %) followed by T5 (untreated check grub extraction only) and the most effective treatment in prophylactic trial (viz., Swabbing Neem oil 5% during Oct.- Nov., Jan. Feb. and April-May) (53.33 %) and T3 (Monocrotophos 0.2%) (66.66 %) (Table 3.23).

Table 3.23 : Effect of curative treatments against cashew stem and root borer (CSRB) at Vengurle

Treatment	% tree without reinfested
T1- Carbaryl (1%)	73.33
T2- Chlorpyriphos (0.2%)	93.33
T3- Monocrotophos (0.2%)	66.66
T4 Chlorpyriphos (0.1%)	80.00
T5- Effective treatment in prophylactic trail (Swabbing Neem oil 5% during Oct.- Nov., Jan. - Feb. and April-May)	53.33
T6. Mechanical Control	33.33

VRIDHACHALAM

Maximum recovery of 41.66 percent was noted in chlorpyriphos (0.2%) treated trees, which was on par with monocrotophos (0.2%) treated trees with 40.90 percent recovery. Treatments

with carbaryl (1.0%), Lindane (0.2%) and neem oil (5.0%) lead to 34.78, 31.57 and 33.3% recovery respectively as against mere 6.5% recovery in untreated control (Table 3.24).



Table 3.24 : Efficacy of certain insecticides as curative control against CSRB at Vridhachalam

Treatment		No. of trees treated	Mean % recovery of trees from CSRB	Frequency of treatment	Cost of treatment/tree
T ₁	Carbaryl (1%)	23	34.78	3	48.0
T ₂	Chlorpyrifos (0.2%)	24	41.66	3	46.0
T ₃	Monocrotophos (0.2%)	22	40.90	3	46.0
T ₄	Lindane (0.2%)	19	31.57	3	46.0
T ₅	Untreated check	16	06.50	3	30.0
T ₆	Treated check (Neem oil 5%)	18	33.33	3	54.0

The overall results indicate that chlorpyrifos and monocrotophos are at par in reducing the CSRB infestation, with an average cost of protection of Rs.46/= per tree.

Trees with more than 50% bark circumference resulted in nil recovery of treated trees. Trees having <60cm stem girth and < 5 years showed high recovery of 72.0 and 80.8 percent respectively (Table 3.25).

Table 3.25 : 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	25	07	28.0	18	72.0
	60-80	29	18	62.1	11	37.9
	80-100	32	26	81.3	06	18.7
	> 100	36	31	86.1	05	13.9
Age of the tree (years)	< 5	26	05	19.2	21	80.8
	5- 10	28	16	57.1	12	42.9
	10-15	33	28	84.8	05	15.2
	> 15	35	33	94.3	02	05.7
Zone of attack	C+R	24	19	79.2	05	20.8
	C+S	28	07	25.0	21	75.0
	R	26	20	77.0	06	23.0
	S	20	15	75.0	05	25.0
	C+S+R	24	21	87.5	03	12.5
Yellowing of canopy	Yellowed	36	36	100.0	0.0	0.0
	Not yellowed	86	46	53.5	40	46.5
% of bark circumference damaged	< 25	58	25	43.1	33	56.9
	26-50	34	30	93.8	04	6.2
	51-75	22	22	100.0	00	0.0
	>75	08	08	100.0	00	0.0
	Total	122	82	*	40	*



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

Centres : East Coast :

Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast :

Madakkathara 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 it to prevalent weather parameters.

SUMMARY:

Among the abiotic factors, minimum temperature showed negative significant influence ($r = -0.27302^*$) on the incidence of leaf miner at Bapatla. The RH had positive significant correlation with the incidence of shoot tip caterpillar at Bhubaneswar. Relative humidity was significantly positively correlated ($r = -0.303$) with the activity of leaf folder at Jagdalpur. The TMB infestation showed negatively significant correlation with minimum temperature, evening humidity, rainfall and rainy days at Vengurla. At Vridhachalam, the aphid population had positive correlation with relative humidity and minimum temperature.

BAPATLA

The maximum temperature ($r = -0.269223$) and minimum temperature ($r = -0.00381$) relative humidity (m) ($r = -0.3582$), (e) ($r = -0.28922$) and rainfall ($r = -0.07746$) were found to have no influence on the activity of leaf and blossom webber.

Among the abiotic factors, minimum temperature showed negative significant influence ($r = -0.27302^*$) on the incidence of leaf miner

The weather parameters maximum and minimum temperature showed significant negative influence ($r = 0.58033$ and $r = -0.81451$) on the activity of the pest whereas the relative humidity (m) ($r = 0.52333$), (e) ($r = -0.30065$) showed significant positive influence of shoot tip caterpillar (Table 3.26).

Table 3.26 : Influence of abiotic factors on the complex of cashew at Bapatla

Weather Parameters	Pests					
	Lbw	Anb	Lm	Stc	Lt	It
	0.02468	0.006006	-0.11683	-0.58033*	-0.40947*	0.17969
Min. temp°C	-0.09544	-0.22586	-0.27302*	-0.81451*	-0.30039*	-0.00156
R. H (%) m	0.05654	0.07296	0.194475	0.52333*	0.276712*	-0.21452
R. H (%) e	0.154815	-0.14654	-0.12578	0.30065*	0.140703	-0.09538
Rainfall(mm)	-0.07746	-0.10412	-0.09418	-0.14824	0.030865	-0.11945



BHUBANESWAR

The pest was active from August to January. But maximum activity was restricted during October (5.0%). The RH had positive significant correlation with the incidence of shoot tip caterpillar.

Yellow thrips population was (6.5 to 9.5 no. / 10 panicles) as compared to the Black thrips population was (5.0 to 8.5 no. / 10 panicles) during February and March. Evening RH had significant negative correlation with incidence of **inflorescence thrips**; yellow thrips: *Frankliniella schultzei* T. and black thrips: *Haplothrips ceylonicus* Sch.

The infestation of 7.5 % during October and temperature had negative correlation with the incidence of leaf miner. Maximum Temperature had positive significant correlation with the incidence of apple and nut borer. Maximum Temperature had positive and morning RH had negative significant correlation with the incidence of the leaf and blossom webber. Rainfall and RH had positive and Bright Sunshine Hour had negative significant correlation towards incidence of leaf beetles.

CHINTAMANI

Maximum temperature (0.239) and sunshine hours (0.516) had a positive relation with the activity of TMB, but negative correlation was established with morning and evening relative humidity (-0.327 & -0.402) and rainfall (-0.369).

The activity of CSRB showed positive correlation with maximum temperature (0.721).

Mealy bug had negative correlation with minimum temperature (-0.776), evening relative humidity (-0.489) and rainfall (-0.484). Apple and nut borer had negative correlation with evening relative humidity (-0.585) and rainfall (-0.588). Leaf miner showed the positive correlation with morning and evening relative humidity (0.485 and 0.179 respectively) and sunshine hours (0.302) but negative correlation with maximum and minimum temperature (-0.034 and -0.662) and rainfall (-0.381).

The infestation of thrips showed negative correlation with minimum temperature (-0.301), evening relative humidity (-0.369) and rainfall (-0.382) and positive correlation with maximum temperature (0.005) and morning relative humidity (0.905) and sunshine hours (0.380) (Table 3.27).

Table 3.27 : Correlation between the pest incidence and weather parameters at Chintamani

Weather parameters	Correlation coefficients (r) for pests					
	TMB	CSRB	MB	ANB	LM	Thrips
Max. Temp. °C	0.239	0.721	0.042	0.023	-0.034	0.005
Min. Temp. °C	-0.174	0.493	-0.776*	0.864*	-0.662*	-0.301*
Relative humidity (Morning) (%)	-0.327	-0.432	0.256	0.229	0.485	0.905
Relative humidity (Evening) (%)	-0.402	-0.285	-0.489	-0.585*	0.179	-0.369
Rainfall (mm)	-0.369	-0.341	-0.484	-0.588*	-0.381	-0.382
Bright Sunshine hours	0.516	0.434	0.551*	0.630*	0.302	0.380*

TMB-Tea Mosquito Bug; CSRB-Cashew Stem and Root Borer; MB-Mealy Bug
 ANB: Apple and Nut Borer; LM-Leaf Miner * Significant at 0.05

JAGDALPUR

The maximum temperature was significantly negatively influenced ($r = -0.352$) and relative humidity (evening) was significantly positively influenced ($r = 0.489$) the activity of TMB on panicle; whereas, no any weather parameters influenced the incidence of TMB damage on shoot.

Min. temperature, relative humidity (evening) and Vapour pressure (I & II) were significantly negatively influenced ($r = -0.292$, -0.377 , -0.319 and -0.451 , respectively) on infestation of CSRB.

The incidence of panicle thrips ranged 0.02 to 1.32 numbers with maximum activity in May.



The maximum & minimum temperature and RH (II) were negatively influenced ($r = -0.33$, -0.353 and -0.299 , respectively); whereas, relative humidity (evening) was the positively correlated ($r = 0.287$) with the incidence of this thrips.

The abiotic factors min. temp., rainfall and RH were significantly positively influenced the activity of leaf caterpillar. Only the relative humidity (evening) was significantly positively correlated ($r = -0.303$) with the activity of leaf folder (Table 3.28).

Table 3.28 : Correlation of weather parameters with the pests of regional importance at Jagdalpur

Weather Parameters	Correlation coefficient values (r) of pests of regional importance					
	Max. Temp	Min. Temp	Rainfall	Relative Humidity		Wind Vel.
	0C	0C	mms	I	II	Kmph
% Shoot TMB	-0.187	-0.038	-0.115	0.160	0.194	-0.265
% Panicle TMB	-0.352*	-0.220	-0.044	0.230	0.348**	-0.337*
Panicle Thrips	-0.333*	-0.353*	-0.155	0.211	0.287*	-0.194
% Nut thrips	-0.178	-	-0.193	-0.117	-0.112	-0.270
% LC	-0.002	0.284*	0.384**	0.173	0.116	0.173
% LF	-0.232	0.137	0.218	0.194	0.303*	-0.133
% LM	-0.086	0.079	0.216	0.229	0.130	0.074
% CSRB	0.114	-0.292*	-0.235	-0.012	-	0.377**

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

PARIA

The correlation study indicated that TMB was significantly negatively correlated with weather parameters viz. maximum temperature, minimum temperature and evaporation rate, where as thrips was significantly negatively correlated with sunshinehours, rainfall and evaporation rate.

The infestation of LBW and LM were

significantly negatively correlated with maximum temperature, minimum temperature and evaporation rate. The infestation of ANB was negatively correlated with minimum temperature, relative humidity and evaporation rate (Table 3.29).

Table 3.29 : Correlation coefficient of weather parameters and insect-pest of cashew at Paria

Weather Parameters	TMB	Thrips	LBW	LM	ANB
Max. Temp.	-0.57143**	-0.35482	-0.54481**	-0.48047**	-0.17273
Min. Temp.	-0.55904**	-0.35302	-0.72887**	-0.80516	-0.52798**
RH%	0.13229	0.14353	0.07072	-0.05211	-0.50976**
Rainfall	-0.30183	-0.45849**	-0.21559	-0.12730	0.23976
Rainy days	0.36276	0.43963**	-0.31947	0.20167	-0.50740
Evaporation	0.04212	0.19953	-0.06768	-0.06070	-0.36507
BSH	-0.72787**	-0.66901**	-0.08562	-0.70158**	-0.02423



VENGURLA

The TMB infestation showed negatively significant correlation with minimum temperature, evening humidity, rainfall and rainy days. Positive relationship with maximum temperature negative relationship with morning humidity. The infestation of thrips show negative significant correlation with minimum temperature, evening humidity and rainy days where as it shows positive relationship with maximum temperature negative relationship with morning humidity and rainfall.

The leaf miner had negative relationship with maximum temperature, minimum temperature, rainfall and rainy days and positive relationship with morning and evening humidity. In case of apple and nut borer, negative significant relationship with minimum temperature, evening humidity, rainfall and rainy days was observed. Positive relationship with maximum temperature and negative relationship with morning humidity was recorded for apple and nut borer. (Table 3.30).

Table 3.30 : Correlation between the pest incidence and weather parameters at Vengurle

	TMB	Thrips	Leaf miner	Apple & nut borer	Aphids	Mealy bug
Max. Temp	0.320	0.364	-0.006	0.337	0.210	0.197
Min. Temp	** -0.863	** -0.799	-0.012	** -0.825	** 0.832	** 0.835
Morning R. H	-0.024	-0.050	0.043	-0.080	0.003	-0.0145
Evening R. H	** -0.829	* -0.826	0.149	** -0.819	** 0.689	** 0.718
Rainy days	* -0.561	-0.536	-0.245	* -0.575	-0.379	-0.429
Rainfall	** -0.681	* -0.668	-0.113	** -0.691	-0.468	-0.521

VRIDHACHALAM

Simple correlation studies with regard to TMB revealed that maximum temperature, relative humidity and sunshine had a positive relation with the activity of *H. antonii*, but negative correlation was established with

rainfall. Aphid population had positive correlation with relative humidity and minimum temperature. Similarly, blossom webber, leaf miner, leaf roller and shoot tip caterpillar have negative correlation with maximum temperature (Table 3.31).

Table 3.31 : Correlation coefficient (r) for abiotic factors and insect pests at Vridhachalam

Insect-pests	Temperature		Relative Humidity		Rainfall	Rainy days	Sunshine hours
	Max	Min	AM	PM			
Tea mosquito bug (population)	0.56*	0.21	0.21	*0.25	-0.31	0.43	*0.36
Leaf and blossom webber	-0.69*	-0.39	-0.30*	-0.22	-0.22	-0.26	0.49
Apple and nut borer	0.53	0.36	0.55	-0.30	0.26	-0.35	0.41
Leaf miner	0.21	0.32	0.40	0.45	0.53	0.40*	-0.44
Leaf roller	-0.54*	-0.31	-0.33*	-0.21	-0.32	-0.32	0.43
Shoot tip caterpillar	-0.27	0.24	0.37	0.36	0.40	0.37	-0.45
Aphids	-0.24	0.26*	0.33*	0.48*	0.48	0.45*	-0.41
Cashew Stem and Root Borer	0.62*	0.49	-0.20	-0.41	-0.42	-0.41	0.47



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:

Among the different germplasm lines screened against leaf miner, Priyanka was infested with the highest leaf miner incidence (15.75%) at Bapatla. None of the entries have showed immune or resistant reactions to TMB infestation under field condition in any of the Centres.

BAPATLA

Among the important foliage and flower feeders, the incidence of leaf and blossom webber was observed at low level (0.35 to 5.31 percent) in different germplasm entries. The highest incidence of 5.31% was recorded on T.No.275 and the lowest in T.No.2/14.

Among the different germplasm lines screened against leaf miner, Priyanka was infested with the highest leaf miner incidence (15.75%) followed by M15/4 (13.03%) , T.No.275 (11.87%).The germplasm line Priyanaka has recorded the highest leaf folder

damage of 8.00 per cent followed by T.No.129

and T.No.275. With regard to Apple and nut borer damage, the germplasm line T.No.274 has recorded with the high infestation by the ANB (14.44%) followed by T.No.18/3 (13.51%).

BHUBANESWAR

All the accessions were 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 (Table 3.32).

Table 3.32 : Screening of germplasm to locate tolerant / resistant to major pests of the region at Bhubaneswar

Pest	Germplasm	Min. occurrence	Germplasm	Max. Occurrence
STC	OC8, OC75, OC65	0.5 to 1.5%	OC22,OC70, OC74, OC80,OC56	>02 to 5%
IT	OC4, OC39, OC12, OC12, OC58,OC64	0.5 to 5 No. / panicle	OC29,OC22, OC44,OC68,OC72,	> 5 to 10 No / panicle
LBW	OC5, OC22, OC9, OC29, OC46	0.5 to2.0%	OC58,OC61, OC81,OC22,OC49	> 2 to 5 %



CHINTAMANI

The damage score for TMB infestation ranged from 0.82 to 3.01. The accession H-320 recorded lowest TMB infestation (0.82). The maximum per cent damage was recorded in M-15/4 (3.01). Among 104 germplasm, 40 accessions showed low occurrence, 18 accessions showed moderate occurrence and 46 accessions showed high occurrence of TMB. However, none of the entries have shown resistance to TMB infestation.

JAGDALPUR

Twelve released varieties, ten DCR germplasm and ten locally collected germplasm were screened against tea mosquito bug incidence, incidence of panicle thrips and mean number of myllocerus beetle. It was observed that the TMB mean damage was not observed in entries CARS-17 whereas its least incidence was observed only on nuts of CARS-10, K-22, VRI-1 and VRI-2 entries.

MADAKKATHARA

TMB damage score varied from 0.43 (Damodar) to maximum 0.98 in Ullal-3. The leaf miner infestation was moderate to severe throughout the season (Sept-Dec) coinciding the bud break and flushing. Mean percentage infestation (April- Mar) varied between <0.1

(minimum in Amrutha) to 13.15 (maximum in BPP-4). Shoot webber incidence per tree recorded were within the range of 0.01 (many varieties) to 0.66 (Jhargram and Chinthamani). Leaf caterpillar incidence was within the range of 0.02 (in most of the varieties) to 0.15 (Dhana). The pest incidence was absent in Chintamani, Damodar, Anakkayam, Amrutha, Vridhachalam, K-22-1, MDK-2 and Poornima.

VENGURLA

The variety Hy-303 recorded lowest TMB infestation (3.40%) followed by Vengurla-1(3.78%) whereas the maximum per cent damage was recorded in Vengurla-4 (5.48%) followed by 10/19 (5.25%).

VRIDHACHALAM

The damage score for TMB infestations in various MLT entries ranged from 1.03.6. The score was low in ME 20/1 with mean damage score of 1.0. In other cashew entries, the mean damage score ranged between 2.0 and 3.6. However, none of the entries have expressed immune or resistant reactions to TMB infestation under field condition.

In the case of F_1 hybrids, all the cross combinations were susceptible to TMB infestation. However, the damage score was low in H 10 and H14 followed by H 16 and H17 with a mean damage score of 2.2 and 2.3 respectively.

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 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.

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 to discuss about high density planting with different levels of fertilizer and pruning in cashew plantation and soil fertility based fertilizer recommendations during the year 2000.



ACHIEVEMENTS:

Significant Achievements of AICRP on Cashew (in brief) since inception:

- 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/m² being 17.33 and 16.50 respectively.
- A local collection, CARS-10 was found to be tolerant to short spells of low temperature (2-2.5°C) 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 P₂O₅ and K₂O 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 76.44kg/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.



Salient achievements of the Project during 2010-11 :

1. Out of 94 germplasm accessions evaluated at Bhubaneswar, more than 60 accessions had bold nut (7.0 g to 16.0g) and high shelling percentage (28.0 to 36.0).
2. Among the hybrids evaluated at Chintamani, the flowering intensity was highest in H-191 (16.75) and the number of fruits per panicle was highest in H-81 (6.17).
3. 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.
4. Under high density trials, the maximum number of flowering panicles /sq.m (18.10) was observed under 10m x 5m spacing at Jhargram.
5. Highest net returns was recorded by intercropping with amorphophallus (

1,39,639), followed by tapioca (1,29,992) at Madakkathara during initial cropping period of cashew.

6. 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.
7. Among the insecticides evaluated as post extraction prophylaxis, least re-infestation or least persistent attack was in case of chlorphyriphos 0.2% in Vengurla (93.33%).

2. TRANSFER OF TECHNOLOGY:

A total of 3,49,535 grafts were produced during 2010-11 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	7000
Bhubaneswar	22000
Chintamani	12000
Jagdapur	23825
Jhargram	2000
Madakkathara	75000
Pilicode	37000
Vengurla	54060
Vridhachalam	116650
TOTAL	349535



BAPATLA

The scientists of this centre participated in the District level training programme on cashew production technology organized by the ITDA and KVK-Pandirimamidi at Rampachodavaram-East Godavari District. 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 scientists of this centre involved in various training programmes on cashew conducted at OUAT, Bhubaneswar which was funded by DCCD, Kochi, Kerala. These training programmes were based on different themes such as "production technology, crop management, plant protection measures, value addition and post harvest management" of cashew. Cashew farmers from Khurda, Nayagarh, Dhenkanal and Angul districts attended the training programme. Field visits to the Cashew Research Station (OUAT), Ranasinghpur and Cashew Nursery of OSCDC, Ghatikia, Bhubaneswar were organised. Scientists of Cashew research station participated in the joint verification programme for evaluation of replanting by Orissa State Cashew Development Corporation and Orissa Forest Development Corporation.

The Centre also organized training and demonstration programme at OUAT, Bhubaneswar for farm women on cashew apple utilization during which the participants prepared Syrup, RTS (Ready-to-serve), Jam and Squash of cashew apple.

CHINTAMANI

The scientists of the Centre attended Zonal Research and Extension programme at GKVK, Bangalore and presented information pertaining to Cashew limb pruning technology for inclusion in POP.

The scientists delivered radio talks in Kannada on "Improved cultivation of cashew" and "Insect pests of Cashew". The scientists of the centre displayed stalls and explained the activities of AICRP (Cashew) during 11th to 14th November 2010 at the Krishi Mela of UAS (Bengaluru).

The scientists of cashew has functioned as resource person and delivered 12 lectures in the training programmes organized by State Department of Agriculture and Horticulture in Chikballapur and Kolar districts. More than 66 field visits/discussions were made on various aspects of cashew and the solutions were provided to the farmers.

JAGDALPUR

The Scientists of the Centre delivered TV talk on "Improved Cashew production technology for Chhattisgarh" at June, 26 2010 and on "Sampling of Insect pest of Cashew and other fruit crops especially for Cashew stem and root borer" at November, 24, 2010.

JHARGRAM

The scientist of the Centre functioned as resource person in the farmers training programme on cashew cultivation technology organized by NAIP, BCKV at Lodhasuli and Kalyani during 2010. The scientist has also acted as a Co-PI in National Agricultural Innovation Project for establishing cashew based livelihood development among the farmers of Patashimul under Jhargram block.

MADAKKATHARA

The scientists of this Centre participated in various training programmes on nursery management, cashew varieties for Kerala, cultivation and processing of cashew, pest management in cashew and cashew apple processing, post harvest technology, value addition and marketing. The station has launched commercially the following three new cashew apple products viz., cashew apple soda, cashew apple vinegar and cashew apple chocolate. They participated in the various exhibitions to depict the research achievements of the station as well as for the sale and display of cashew apple products and cashew grafts.

The Centre organized "Cashew Day" and a state level farmers' seminar on cashew as part of the celebration. District level cashew seminar was organized at Palakkad district. Radio talks on achievements of Cashew Research Station, Madakkathara was broadcast by AIR, Kozhikode.



PILICODE

The scientists of the centre have conducted 16 trainings and seminars on various aspects of cashew and other crops. The scientist of the centre has functioned as resource person in the training programme for cashew production and processing at Manjeswara and Iritty. Demonstration and training on cashew apple utilization was conducted at RARS, Pilicode.

VENGURLA

The scientists of this Centre conducted demonstrations on cashew softwood grafting, nutrient management in cashew, cashew blossom protection, management of CSRB and value addition of cashew apple. DCCD Sponsored training on Cashew apple Utilization for Unemployed woman was also undertaken by the Centre. DCCD Sponsored District level Workshop on Cashew Production Technology (6 nos.) were organized by the scientists of this Centre.

VRIDHACHALAM

The Centre has conducted front-line technology demonstration in cashew to popularize the production in cashew to improve the productivity. Trainings on cashew apple utilization were organized in order to popularize the use of cashew apple for various edible preparations among the cashew farming community. State level seminars on "Improved production technologies in Cashew and District level seminars on "High Density Planting in Cashew" were conducted at RRS, Vridhachalam and field days on Cashew Production technologies and Plant Protection in Cashew were conducted by the Centre.

The new centres in Navasari in Gujarat and Darisai in Jharkhand and three cooperating centre would be starting the Transfer of Technology programmes shortly.

3. STAFF POSITION HEADQUARTERS

Project Coordinator : Dr. M. Gopalakrishna Bhat
Scientist-in-charge : Dr. T.N. Raviprasad

PROJECT CENTRES

Cashew Research Station, (APHU), Bapatla, 522 101, Guntur District, Andhra Pradesh.

Horticulturist : Dr.K.T.Venkata Ramana
Asstt. Horticulturist : Dr. T. Padmalatha (Upto 13.8.2010)
Dr. Y.P. Venkatasubbaiah (Upto 30.3.2011)
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 : Vacant (since May 2011)

**Agricultural Research Station, (UAS), Chintamani 563 125, Kolar District, Karnataka**

Horticulturist	: Mr. M.N. Narasimha Reddy
Jr. Horticulturist	: Dr. K.M. Rajanna
Entomologist	: Ms. Vidya Mulimani
Sr. Technical Assistant	: Mr. Babu V.
Sr. Technical Assistant	: Mr. G.V. Narayanaswamy
Grafter	: Mr. R. Lokesh Babu

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

Horticulturist	: Dr. Prashant Kumar
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SG College of Agricultural and Research Station, (IGAU), Jagdalpur 494 005, Chattisgarh

Jr. Horticulturist	: Mr. L.S. Verma (Upto August 2010) Mr. M.S. Paikra (From August 2010)
Jr. Entomologist	: Mr. Khoobi Ram Sahu
Sr. Technical Assistant	: Vacant
Grafter	: Mr. Jagdev

Regional Research Station, (BCKV), Jhar gram 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. S.Y. Patel
Jr. Entomologist	: Dr. R.S. 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 13 th August 2011)



4. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2010-11

Allocation

(Rs. in lakhs)

Centre	Details of sanctioned provision					ICAR share
	Pay and Allowances	TA	Recurring contingency	Non-Recurring contingency	Grand Total	
Bapatla	19.28	0.35	3.00	2.60	25.23	18.92
Bhubaneshwar	23.62	0.70	4.30	5.60	34.22	25.66
Chintamani	21.71	0.35	3.00	4.04	29.10	21.83
Jagdapur	13.06	0.25	2.00	4.19	19.50	14.63
Jhargram	8.14	0.35	3.00	7.70	19.19	14.38
Madakkathara	22.56	0.35	3.00	4.10	30.01	22.51
Pilicode	9.80	0.20	1.00	1.40	12.40	9.30
Vengurla	21.14	0.75	4.50	4.54	30.93	23.19
Vridhachalam	21.32	0.35	3.00	3.50	28.17	21.13
Paria	11.28	0.25	1.90	2.15	15.58	11.69
Darisai	11.28	0.25	1.90	2.15	15.58	11.69
KRCCH, Arabhavi	0.00	0.25	2.00	0.00	2.25	1.69
ICAR Res. Compl. For Goa, Goa	0.00	0.25	2.00	0.00	2.25	1.69
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.25	2.00	0.00	2.25	1.69
Total	183.19	4.90	36.60	41.97	266.66	200.00

**Actual Expenditure**

(Rs. in lakhs)

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	27.77	0.35	3.00	0.00	31.12	23.34
Bhubaneswar	33.64	0.26	3.00	1.30	38.20	28.65
Chintamani	30.30	0.16	2.96	4.03	37.45	28.09
Jagdapur	17.41	0.32	2.00	2.32	22.05	16.54
Jhargram	10.27	0.13	2.99	4.00	17.39	13.04
Madakkathara	33.67	0.18	3.16	3.09	40.10	30.08
Pilicode	5.39	0.10	0.90	0.00	6.39	4.79
Vengurla	26.43	0.31	3.00	3.19	32.93	24.69
Vridhachalam	33.44	0.35	3.00	2.63	39.42	29.56
Paria	11.31	0.11	1.96	1.27	14.65	10.99
Cooperating Centres						
KRCCH, Arabhavi	0.00	0.25	1.97	0.00	2.22	1.67
ICAR Res. Compl. For Goa, Goa	0.00	0.25	2.00	0.00	2.25	1.69
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.25	2.00	0.00	2.25	1.69
Total	229.63	3.02	31.94	21.83	286.42	214.82

5. MONITORING OF PROJECT BY PROJECT COORDINATOR

Project Coordinator reviewed the progress made by the Centres by correspondence and discussion and surveyed the northern coastal area of Andhra Pradesh as part of Team to recommend to ICAR for shifting Bapatla Centre and visited the newly established AICRP-Cashew Centre at Agricultural Experimental Station under Navsari Agricultural University, Paria, Valsad, Gujarat and reviewed the ongoing research programmes.

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; six in Crop Management and four in Crop Protection are

being carried out. The scientists of this centre participated in the District level training programme on cashew production technology organized by the ITDA and KVK-Pandirimamidi at Rampachodavaram-East Godavari District. The scientists organized front-line technology demonstration on cashew in farmers fields located in Prakasam, Krishna, West Godavri and East Godavari Districts

BHUBANESWAR

The centre has been established in 1975. At present 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.

Scientists of this centre participated in the joint



verification programme for evaluation of replanting by Orissa State Cashew Development Corporation and Orissa Forest Development Corporation.

The Centre also organized training and demonstration programme for farm women on cashew apple utilization during which the participants prepared Syrup, RTS (Ready-to-serve), Jam and Squash of cashew apple.

CHINTAMANI

The centre has been established in 1980. At present there are three scientists working under the project in the posts of Horticulturist, Jr. Horticulturist and Jr. Entomologist. Presently three projects in Crop Improvement, six in Crop Management and four in Crop Protection are being carried out. The scientists delivered radio talks in Kannada on "Improved cultivation of cashew" and "Insect pests of Cashew". The scientists of the centre displayed stalls and explained the activities of AICRP (Cashew) during 11th to 14th November 2010 at the Krishi Mela of UAS (Bengaluru). More than 66 field visits / discussions were made on various aspects of cashew and the solutions were provided to the farmers.

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. The Scientists of the Centre delivered TV talk on "Improved Cashew production technology for Chhattisgarh" and "Insect pests of Cashew and other fruit crops especially for Cashew stem and root borer" at November, 24, 2010.

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 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 NAIP, BCKV at Lodhasuli and Kalyani during 2010.

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. The station has launched commercially the following three new cashew apple products viz., cashew apple soda, cashew apple vinegar and cashew apple chocolate.

The Centre organized "Cashew Day" and a state level farmers' seminar on cashew as part of the celebration. District level cashew seminar was organized at Palakkad district. Radio talks on achievements of Cashew Research Station, Madakkathara was broadcast by AIR, Kozhikode.

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. Training and seminars have been conducted on cashew propagation, cashew cultivation techniques. The scientist of the centre has functioned as resource person in the training programme for cashew production and processing at Manjeswara and Iritty. Demonstration and training on cashew apple utilization was conducted 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 cashew softwood



grafting, nutrient management in cashew, cashew blossom protection, management of CSRB and value addition of cashew apple. Training on Cashew apple Utilization for Unemployed woman and District level Workshops on Cashew Production Technology (6 nos.) were organized by the scientists of this Centre.

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 conducted front-line technology demonstration to improve the productivity of cashew. State level seminars on "Improved production technologies in Cashew" and "High Density Planting in Cashew" and field days on Cashew Production technologies and Plant Protection in Cashew were conducted by the Centre.

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.

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.

ICAR RESEARCH COMPLEX FOR 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 2010-11

BAPATLA

Month & Year	Max. Temp.	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days
			(Max)	(Min)		
Apr.10	35.2	27.6	79	78	0	--
May 10	37.2	28.2	74	67	149.5	3
Jun.10	39.0	28.5	76	68	172.8	8
Jul.10	32.6	25.1	85	80	364.6	16
Aug. 10	33.3	25.1	85	77	346.8	12
Sep. 10	33.1	25.9	87	77	350.3	13
Oct. 10	32.4	24.6	87	78	179.5	12
Nov. 10	30.4	23.1	90	82	119.0	7
Dec. 10	28.9	18.9	90	72	170.3	3
Jan. 11	29.8	17.2	92	66	0	--
Feb. 11	31.1	18.7	89	64	29.9	2
Mar.11	33.0	29.1	85	67	0	--

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days	BSH
			(Max)	(Min)			
Apr.10	39.2	26.7	88.2	47.9	-	-	8.6
May 10	37.0	27.6	90.3	63.3	-	-	7.5
Jun. 10	36.1	26.8	90.8	70.0	190.9	9	6.2
Jul. 10	33.0	26.2	92.0	74.1	209.2	18	5.4
Aug. 10	33.3	26.5	91.9	75.4	285.9	15	4.8
Sep. 10	32.8	25.7	94.1	73.2	286.2	18	5.2
Oct. 10	32.8	25.3	94.8	71.6	186.8	12	5.2
Nov. 10	31.0	21.5	91.5	60.7	52.6	4	5.7
Dec. 10	27.9	15.4	93.6	53.9	41.5	6	6
Jan. 11	28.7	13.9	87.4	37.0	-	-	6.9
Feb. 11	31.9	17.6	92.4	42.5	24.6	2	6.9
Mar.11	35.3	21.9	89.2	43.0	1.8	1	8.0

**CHINTAMANI**

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days	BSH
			(Max)	(Min)			
Apr.10	35.13	21.34	57.50	32.90	64.20	5	7.99
May 10	33.50	22.19	63.71	43.94	146.00	6	7.7
Jun.10	30.28	21.10	71.97	58.20	73.80	3	5.10
Jul. 10	28.24	20.05	75.00	61.97	157.00	8	3.19
Aug. 10	34.95	18.56	80.10	65.19	157.20	6	3.62
Sep. 10	36.55	19.29	75.90	64.70	99.40	3	3.13
Oct. 10	28.45	17.64	78.45	62.39	45.60	3	4.47
Nov. 10	25.82	16.06	79.97	72.43	185.00	7	3.47
Dec. 10	25.08	13.07	81.58	58.26	19.00	2	4.22
Jan. 11	27.42	10.62	54.10	35.03	-	-	7.92
Feb. 11	30.63	13.16	50.43	31.36	2.4	-	8.36
Mar. 11	33.64	15.74	41.55	26.61	-	-	8.25

JAGDALPUR

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	BSH
			(Max)	(Min)		
Apr.10	38.6	21.34	75.5	27.7	30.9	8.6
May 10	36.7	22.19	75.2	41.2	88.30	8.1
Jun. 10	33.7	21.10	80.6	59.0	391.0	5.4
Jul. 10	28.2	20.05	91.0	79.3	417.6	2.6
Aug. 10	29.0	18.56	92.7	73.8	646.8	4.0
Sep. 10	29.3	19.29	90.5	73.3	315.6	3.7
Oct. 10	29.0	17.64	91.2	69.5	5.2	5.7
Nov. 10	23.0	16.06	81.0	63.0	0.0	0.0
Dec. 10	17.5	13.07	78.0	58.0	0.0	0.0
Jan. 11	26.9	10.62	90	57	0.0	10.3
Feb. 11	29.3	13.16	91	48	14.6	8.0
Mar. 11	32.9	15.74	87.4	38.7	6.4	7.7



JHARGRAM

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days
			(Max)	(Min)		
Apr.10	37.56	21.90	79.56	38.3	47.4	4
May 10	37.03	21.54	82.90	50.16	250.6	10
Jun. 10	37.08	23.31	86.33	54.5	98.4	6
Jul. 10	32.87	23.33	91.25	74.58	218.9	18
Aug. 10	33.7	25.5	89.3	68.0	120.8	9
Sep. 10	33.13	24.5	89.43	70.16	181.0	11
Oct. 10	32.09	22.31	89.70	70.74	46.8	6
Nov. 10	31.11	18.03	87.93	48.53	1.0	-
Dec. 10	25.56	10.21	87.61	47.35	19.0	2
Jan. 11	22.85	10.66	81.45	27.78	3.2	1
Feb. 11	27.58	12.05	82.24	38.75	7.8	1
Mar. 11	34.79	19.43	82.0	33.90	36.8	4

MADAKKATHARA

Month & Year	Max. Temp.	Min. Temp. (°C)	Mean RH (%) (Avg.)	Rainfall (mm)	No. of rainy days	BSH
Apr.10	35.1	21.4	72.5	103.6	7	221.7
May10	33.1	22.7	79.0	123.8	7	166.5
Jun. 10	30.4	22.7	86.5	700.4	24	89.7
Jul. 10	29.2	21.8	88.0	552.0	25	56.8
Aug. 10	29.3	21.2	86.5	224.1	16	78.6
Sep. 10	30.5	21.3	82.5	326.7	17	125.6
Oct. 10	29.7	21.0	85.0	667.6	18	129.5
Nov. 10	30.4	20.9	81.0	282.8	11	120.5
Dec. 10	30.9	19.4	70.0	24.5	2	206.7
Jan. 11	32.7	18.2	59.5	0.0	0	263.0
Feb. 11	33.7	18.3	55.0	77.5	3	239.1
Mar. 11	34.8	21.3	62.0	10.0	2	268.9

**PILICODE**

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%) (Avg.)	Rainfall (mm)	No. of rainy days
Apr.10	34.7	25.6	76.3	22.3	5
May10	34.2	25.1	74.0	97	13
Jun. 10	30.4	24.1	86.7	1000.6	24
Jul. 10	29.1	23.2	90.8	1221.7	29
Aug. 10	28.8	23.4	89.6	739.7	27
Sep. 10	30.2	23.3	86.4	391.7	24
Oct. 10	30.8	23.2	82.8	472.1	24
Nov. 10	31.3	22.8	81.4	215.2	17
Dec. 10	31.5	20.7	74.5	23.6	5
Jan. 11	31.8	18.9	72.0	0	-
Feb. 11	32.4	18.8	66.4	0	-
Mar. 11	33.4	22.1	71.7	0	-

VENGURLA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days
			(Max)	(Min)		
Apr.10	33.73	24.84	84.42	66.52	0.28	1
May10	34.48	27.72	82.53	67.38	42.2	2
Jun. 10	32.47	25.92	85.08	78.01	1247.02	20
Jul. 10	28.42	24.65	91.81	84.71	1493.8	30
Aug. 10	29.80	27.32	92.24	89.25	762.40	28
Sep. 10	30.42	23.87	91.95	88.05	456.60	28
Oct. 10	32.15	25.36	88.99	82.24	226.00	13
Nov. 10	31.90	23.10	88.65	74.87	112.40	7
Dec. 10	31.32	18.22	86.82	62.82	0.00	2
Jan. 11	32.53	16.18	87.85	52.88	0.00	0
Feb. 11	33.07	19.08	88.92	57.28	0.00	0
Mar. 11	32.42	20.08	88.35	61.03	0.00	0



VRIDHACHALAM

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days
			(Max)	(Max)		
Apr.10	39.59	24.57	72.80	55.73	0	0
May10	39.71	26.10	84.03	54.81	21.00	2
Jun. 10	38.48	25.58	83.83	59.53	33.80	6
Jul. 10	36.86	24.77	85.34	65.42	48.40	4
Aug. 10	35.51	23.73	86.09	73.31	147.60	6
Sep. 10	35.44	23.66	83.28	64.88	181.60	7
Oct. 10	38.90	23.18	78.00	67.00	168.80	10
Nov. 10	30.51	18.50	91.12	82.48	654.90	18
Dec. 10	30.47	18.35	88.26	77.26	296.50	13
Jan. 11	32.19	18.35	89.16	85.27	10.10	1
Feb. 11	32.96	19.45	90.18	81.30	45.20	1
Mar. 11	36.96	22.40	89.06	65.42	0	0

PARIA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)	Rainfall (mm)	No. of rainy days	BSH
Apr.10	37.38	20.81	62.15	0.0	00	-
May10	36.05	25.48	70.76	0.0	00	-
Jun. 10	33.86	25.64	80.70	85.5	09	-
Jul. 10	30.71	24.55	86.02	825.0	23	-
Aug. 10	29.85	24.02	90.60	861.5	24	-
Sep. 10	31.27	23.72	86.02	568.2	15	-
Oct. 10	33.70	21.98	79.79	71.5	05	-
Nov. 10	33.77	20.16	81.85	60.3	04	-
Dec. 10	33.65	16.00	74.31	0.0	00	-
Jan. 11	33.80	9.39	70.02	0.0	00	-
Feb. 11	36.64	11.80	55.14	0.0	00	-
Mar. 11	36.27	14.05	50.60	0.0	00	-

8. RESEARCH PUBLICATIONS

BHUBANESWAR

Pattnaik, A.K.; Mohapatra, K. C.; Sethi K and Mohanty, A. (2011). Studies on cashew based cropping system with vegetable crops. National Seminar on "Bio-diversity and sustainability of tropical and sub-tropical fruit crops" organized by The Orissa Horticulture Society, Bhubaneswar on 25th 27th February 2011. pp. 27-28.

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Vidya M., Narasimha Reddy M.N., Rajanna K. M. and Babu, V., Management of Cashew stem and Root Borer (CSRB), *Plocaederus ferrugineus* L. by curative control trial. In National Symposium on Emerging Trends in Pest Management Strategies under Changing Climatic Scenario from 20th to 21st December, 2010 at Department of Entomology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar.

Vidya M., Rajanna K. M., Narasimha Reddy M.N. and Babu, V., Evaluation of Insecticides against Tea Mosquito Bug (TMB), *Helopeltis antonii* Signoret (Heteroptera:Miridae) on Cashew. In National Symposium on Emerging Trends in Pest Management Strategies under Changing Climatic Scenario from 20th to 21st December, 2010 at Department of Entomology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar.

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Sobhana, A., Jose Mathew and Mini, C. 2010. Utilization of cashew apple in food industry. Proc. 2nd International Cashew Conference on "Cashew, people and environment", Kampala, Uganda, 27-29 April 10



Jose Mathew, Sobhana A., Gregory Zachariah and Gavas Ragesh. 2010. Intercropping in cashew for improved resource management". In : Extended summaries, National Symposium on "Resource management approaches towards livelihood security", December 2-4, 2010, Bengaluru, pp. 360

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VRIDHACHALAM

Ambethgar, V. 2010. Field assessment of Delivery methods for fungal pathogens and insecticides against Cashew stem and root borer *Placoderous ferruginus* L. (Cerambycidae, Coleoptera.) Journal of Biopesticides. 3: 121-125



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10. LIST OF DCR PUBLICATIONS

Sl. No.	Publication	Price Rs.
1	Cashew Production Technology (Revised)	50.00
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
4	Catalogue of Minimum Descriptors of Cashew	
	Germplasm accessions - I	165.00
	Germplasm accessions -II	125.00
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5	Status of Cashew Germplasm Collection in India (Bulletin)	
6	Compendium of Concluded Research Projects (1986-2001)	
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8	Nutritive Value of Cashew - Revised (Brochure)	
9	Database on Cashewnut Processing in India (2003)	100.00
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11	Process Catalogue on Development of an Economically viable On-farm Cashewnut Processing	45.00
12	Cashew Cultivation Practices (Pamphlet)	
13	Soil and water management in cashew plantations	30.00
14	Biochemical characterisation of released varieties of Cashew	85.00

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