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

वार्षिक प्रतिवेदन  
ANNUAL REPORT  
2014-15

परियोजना समन्वयकर्ता  
प्रो. पी. एल. सरोज

PROJECT COORDINATOR  
Prof. P. L. Saroj



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

ICAR - DIRECTORATE OF CASHEW RESEARCH  
Darbe P.O., Puttur - 574 202  
Dakshina Kannada, Karnataka



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**Prof. P.L. Saroj**

Director

ICAR-Directorate of Cashew Research, Puttur

Phone : (08251) 231530; EPABX : (08251) 230902, 236490

FAX : 08251 - 234350

E-mail: dircajures@gmail.com

**DCR Website:** <http://www.cashew.res.in>

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### **Compiled & Edited by**

Dr. T.N. Raviprasad

### **Word-processed by**

Dr. T.N. Raviprasad

Mrs. Reshma K.

### **Hindi Translation by**

Dr. T.N. Raviprasad

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## प्राक्कथन

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की 31वीं वार्षिक प्रतिवेदन प्रस्तुत है। इस प्रतिवेदन में अप्रैल 2014 से मार्च 2015 तक की अनुसंधान उपलब्धियाँ तथा अन्य जानकारी सम्मिलित की गई है।

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

इसके अतिरिक्त 3 सहयोगी केंद्रों भी काजू के अंतर्गत कार्य कर रहा है (प्रत्येक अरबावी (कर्नाटका), बारापानी (मेधालया) और गोवा में एक - एक।

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 किया गया है।

इस प्रतिवेदन में दो अध्याय है, जैसे,

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

( पी.एल. सरोज )

निदेशक एवं परियोजना समन्वयकर्ता

स्थान : पुत्तूर-574 202

दिनांक : 20.08.2015



## ABOUT THIS REPORT

This is the thirty first 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 2014 to March 2015.

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

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

( P. L. SAROJ )

DIRECTOR & PROJECT COORDINATOR

Place : Puttur

Dated : 20.08.2015



## परियोजना समन्वयकर्ता की रिपोर्ट

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

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना के आठ केंद्र और एक उपकेंद्र है, जिसमें चार केंद्र 1971 में अखिल भारतीय समन्वित मसाले व काजू अनुसंधान परियोजना के शुरुवात में बापट्ला (ए.एन.जी.आर.ए.यू पहले ए.पी.ए.यू) माडकत्तरा (केरल कृषि विश्वविद्यालय, आनक्कायम् से स्थानांतरित), वेंगुर्ले (डॉ. बाळा साहेब कोंकण कृषि विद्यापीठ) और वृद्धाचलम (तमिलनाडु कृषि विश्वविद्यालय) में प्रारंभ किया गया। पाँचवीं पंचवार्षिक योजना में एक केंद्र, भुवनेश्वर (औ.यू.ए.टी.) और छठवीं पंचवार्षिक योजना में दो केंद्र, एक झारग्राम (बी.सी.के.वि.) और दूसरा चिंतामणि (यू.एच.एस.) को सम्मिलित किया गया। आठवीं योजना में एक केंद्र - जगदलपुर (आई.जी.ए.यू) और एक उपकेंद्र पिलिकोड (के.ए.यू.) प्रारंभ किया गया।

9वीं प्लान में दो केंद्र जिसमें एक केंद्र पारिया (एन.ए.यू.) में और एक केंद्र दारीसाई (बी.ए.यू.) में और तीन सहायक केंद्रों यानि अरभावि (यू.एच.एस.), बरापानी और गोवा (भा.कृ.अनु.प.) में कार्यप्रवृत्त हुए। अखिल भारतीय समन्वित काजू अनुसंधान परियोजना के यह केंद्र 12 काजू उगानेवाला राज्यों में स्थित है और यह विभिन्न राज्य कृषि विश्वविद्यालयों के प्रशासनिक नियंत्रण में है।

परियोजना का 2014-15 में बजट आबंटन रु.373.33 लाख (रु.205.00 लाख भा.कृ.अ.प. का अंश) था और व्यय

रु.297.76 लाख (रु.223.32 लाख भा.कृ.अ.प. का अंश) था।

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

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

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

### फसल सुधार

जर्मप्लासम मूल्यांकन परीक्षणों में, बापट्ला केन्द्र में BLA-39/4 अत्यधिक फूल शाखाओं का औसत संख्या (29.00 प्रीत वर्ग मीटर (29.00) तथा अत्यधिक औसत फल संख्या प्रति वर्ग मीटर (58.0) दाखिल किया। प्रियांका में अधिकतम औसत गुठली वजन (10.55 ग्राम) पाया गया बारदेज-9 में अधिकतम सेब वजन (106.0 ग्राम.), गोवा में दर्ज की गई थी। होगलगेरे में सबसे ज्यादा छिलकन प्रतिशतता (32.14) गुब्बी-3/108 में रहा।

जगदलपुर में प्रचालित, किस्मो का मूल्यांकन परीक्षणों MLT-II में, H-255 अधिकतम गुठली वजन (10.13 ग्राम.) दाखिल किया जबकी, H-367 अधिकतम सेब वजन (72.67 ग्राम.) दाखिल किया। H-255 ने झारग्राम में अत्यधिक वजनदार गुठली (8.10 ग्राम.) पाया गया, जबकी माडकत्तरा में अधिकतम गुठली वजन (9.70 ग्राम.) T-3/28



में रहा जिसे 9.25 ग्रां. गुटली वजन देकर, T-107/3, अनुसरित किया। भुवनेश्वर में M-44/3, M-15/4 BPP-30/1 और BPP-3/28 को जल्दी फलन प्रकार, के रूप में पहचाना गया है, जबकी H-303, NRCC Sel-2 तथा H-68 को 80 ग्रां. से अधिक गुटली वजन, गुच्छ फलन और 28.0 से अधिक छिलकन प्रतिशतता वाले के रूप में पहचाना गया। झारग्राम में कम से कम पुष्पण अवधि T-3/28 (611 दिन) व H-303 (62.9 दिन) में दिखाई पडी।

होगलगेरे में किस्म मूल्यांकन परीक्षणों (MLT-III) में 8 साल का अधिकतम संचयी उपज H-32/8 (48.10 किग्रां./पेड) और H-1597 (4.59 किग्रां./पेड) में दर्ज हुआ। माडकत्तरा में अधिकतम गुटली उपज (9.74 ग्रां.) पाया गया। वृद्धाचलम में जीनोटैप H-14 अधिकतम पुष्पगुच्छ संख्या प्रति वर्ग मीटर (22.2) और औसत गुटली संख्या प्रति वर्ग मीटर (38.2) दर्ज किया। MLT-V परीक्षणों में अधिकतम वार्षिक गुटली उपज वेंगुर्ला-7 में 6.05 कि.ग्रां. प्रति पेड रहा और 4 साल का अधिकतम संचयी गुटली उपज, BPP-8 में 11.86 कि. ग्रां. प्रति पेड भुवनेश्वर में पाया गया। वृद्धाचलम में, छिलकन प्रतिशतता 26.2 (BPP-4) से लेकर 30.2 (V-4) तक रहा।

बापट्ला से विकसित हैब्रिडों में अधिकतम छिलकन प्रतिशतता (33.91) H-169 में और 5 फसल के लिए अधिकतम संचयी उपज (64.32 कि.ग्रां./पेड) H-239 में मिला है। B-2-32 ने 11.30 कि.ग्रां. का वार्षिक गुटली उपज तथा 11 साल का संचयी उपज (53.0 कि.ग्रां./पेड) देकर आशाजनक पाया गया। गोवा में संकर H-31/5 प्रति पेड का अधिकतम उपज (14.56 कि.ग्रां.) दिया। झारग्राम में अधिक छिलकन प्रतिशतता देनेवाले संकर थे, H-179 (35.9%) H-125(35.3) और H-180 (35.1%), माडकत्तरा में 17 फसलों का अधिकतम संचयी उपज H-21 (155.95 कि. ग्रां./पेड) द्वारा दर्ज हुआ है।

### फसल प्रबंधन

धन सांघ्र रोपण में उर्वरक परीक्षणों में, 600 पेड/हेक्टेर

के साथ 75:25:25 कि.ग्रां. NPK/हेक्टेर उपचार से भूक्षेत्र का अधिकतम चंदवा कवरेज (218.80%) बापट्ला में दाखिल हुआ। इसी उपचार से झारग्राम में अत्यधिक संचयी लाभ, रु.3,98,350 प्रति हेक्टेर और संचयी असली लाभ रु.2,11,460 प्रति हेक्टेर जिसमें लागत पर लाभ अनुपात 1.0:2.13 रहा। पिलिकोड में, 400 पेड/हेक्टेर (64 मा) अंतर में प्रति पेड का अधिकतम उपज (5.41 कि.ग्रां.) तथा प्रति हेक्टेर का उपज (2165.16) कि.ग्रां.) पाया गया।

80 प्रतिशत CPE में सिचाई देने से वेंगुर्ला में अधिकतम औसत फल /मी<sup>2</sup> (65.00) तथा 11 साल का संचई उपज (45.92 कि.ग्रां. प्रति पेड) दाखिल हुआ। कणबर्गी में प्रचालित अंतराल रोपण से अधिकतम असली लाभ कोलीयस में (रु.61,370/हेक्टेर) मिला जिसे हल्दी (रु.56,950/हेक्टेर) अनुसरित किया। झारग्राम में 5 फसलो का अधिकतम संचई उपज (16.58 कि.ग्रां./पेड) 100%N को FYM के रूप में डालने से प्राप्त हुआ।

भुवनेश्वर में काजू सेब RTS का अधिकतम समग्र स्वीकरण 4.58 जगन्नाथ किस्म में था।

### फसल संरक्षण:

बापट्ला में L-सैहालोथ्रीन (0.003%) पत्ता और पुष्प जालकीट तथा प्ररोह इल्ली का नियंत्रण में अत्यंत प्रभावी रहा। झारग्राम में असिटमाप्रिड (0.5 ग्रां./लीटर) छिडकाव में पत्ता और पुष्प जालकीट का न्यूनतम हानि दाखिल हुआ। काजू कांड और जड छेदक का नियंत्रण के लिए क्लोरपैरीफास (0.2%) का उपयोग से बिना पनर्बाधित पेड का अधिकतम प्रतिशतता, बापट्ला में 91.66%, भुवनेश्वर में 82.00%, जगदलपुर में 83.34%, झारग्राम में 90.00% और वेंगुर्ला में 93.33% पाया गया।

स्थानीय कीटों का हानि का सहिष्णुता वा प्रतिरोधकता के बारे में जर्मण्लासम परखने से जगदलपुर में उल्लाळ-1 तथा V-4 पत्ता सुरंग कीट को सहिष्णुता दिखाई और वेंगुर्ला में NRCC Sel-2 ने थ्रिप्स को सहिष्णुता दिखाई।



### तकनिकी हस्तांतरण:

कूल 294300 कलमबन्धों उत्पादित होकर सरकारी और गैरसरकारी संस्थाओं तथा काजू कृषको को वितरित किया गया। काजू में कीट और रोग नियंत्रण सिंचाई तथा फूल और फल प्रबंधन, के बारे में डी.डी - सप्तगिरी और डी डी ओडियाँ में प्रसारित कार्यक्रमों में क्रमशः बापट्ला और भुवनेश्वर के वैज्ञानिको भाग लिया। डेंकनाल और जाजपुर में आयोजित जिला सेमिनार में भुवनेश्वर का वैज्ञानिको ने भाग लिए। बस्तर प्रांत में अल्प प्रमाण काजू संस्करण इकाईयो व काजू सेब मूल्य वर्धन से जनजातियों का आय वृद्धि के बार में TSP के तहद दो प्रशिक्षणों में जगदलपुर के वैज्ञानिकों ने भाग लिये। माडकतरा केंद्र के वैज्ञानिकों द्वारा काजू बगानो में अन्तराल फसल के रूप

में काला मिर्च (पणीयूर-5) लाभदायक पाया गया। पिलिकोड केंद्र का वैज्ञानिक ने काजू सेब संस्करण के विषय पर पाँच प्रशिक्षण और सेमिनार आयोजित किया।

वेंगुर्ला केंद्र का वैज्ञानिकों ने काजू उत्पादन के बारे में 3 राज्य स्तर का सेमिनार और 3 दिन का प्रशिक्षण - काजू उत्पादन व संस्करण तकनिकी, काजू सेब उपयोग, तथा काजू कांड और जड छेदक नियंत्रण के बारे में आयोजित किया। वृद्धाचलम का वैज्ञानिको ने काजू उत्पाद तकनिकी और अधिक उपजवाली किस्मो के बारे में तीन प्रशिक्षण आयोजित किया। काजू नर्सरी तकनिकी और काजू सेब उपयोग के विषय पर उध्यमियों तथा खेत महिलाओं के भलाई के लिए एक दिन का प्रशिक्षण आयोजित था।

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## PROJECT CO-ORDINATOR'S REPORT

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

The AICRP on Cashew has presently fourteen centres, of which four Centres were started at the inception of AICS & CIP in the year 1971 [Bapatla (ANGRAU the then APAU); Madakkathara (KAU, shifted from Anakayam); Vengurla (BSKVV 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, the latter was shifted to Hogalagere (UHS) during the XI Plan. 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 2014-15 was Rs. 373.33 lakhs (Rs. 205.00 lakhs - ICAR Share) and the expenditure was Rs. 297.76 lakhs (Rs. 223.32 lakhs - ICAR Share)

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

1. Evolving high yielding varieties with good kernel quality and tolerance to biotic and abiotic stresses.
2. Standardizing agro techniques for the crop under different agro-climatic conditions; and

3. Evolving cost effective and efficient pest and disease management practices.

The salient findings during the period under report, in different projects have been presented hereunder.

### CROP IMPROVEMENT

In Bapatla Centre in the trials on evaluation of germplasm, BLA-39/4 had highest mean number of flowering laterals per square meter (29.00) and the maximum mean number of nuts per m<sup>2</sup> (58.0). The maximum mean nut weight was recorded in Priyanka (10.55g). At Goa centre maximum apple weight of 106.0g was observed in Bardez 9 in germplasm evaluation trials. At Hogalagere, the shelling percentage was highest (32.14%) in 3/108 Gubbi.

The maximum nut weight (10.13g) was recorded in H-255 and the maximum apple weight (72.67g) was recorded in H-367 in the Varietal Evaluation Trials (MLT-II) at Jagdalpur. At Jhargram H-255 yielded nuts with maximum weight (8.1g), while at Madakkathara the highest nut weight was observed in T3/28 (9.70 g) followed by T 107/3 (9.25 g). At Bhubaneswar M 44/3, M 15/4, BPP 30/1 and BPP 3/28 were identified as early bearing types, while H-303, NRCC Sel. 2 and H-68 had bold nut weighing more than 8.0 g, cluster bearing habit and shelling percentage of more than 28.0. At Jhargram, the shortest duration of flowering was noticed in T.No. 3/28 (61.1 days) and H-303 (62.9 days).

At Hogalagere, in Varietal Evaluation Trials (MLT-III) maximum cumulative nut yield for 8 harvests was recorded in H-32/4 (48.10 kg/tree) and H-1597 (43.59 kg/tree). The maximum nut weight was recorded by Dhana (9.74 g) at Madakkathara. The genotype H14 of Vridhachalam recorded highest number of panicles/m<sup>2</sup> (22.2) and mean number of nuts/m<sup>2</sup> (38.2).

In the MLT-V trials, the maximum annual nut yield was 6.05 (kg/tree) in Vengurla-7 while cumulative nut yield was 11.86 kg/tree in BPP-8 for 4 harvests at Bhubaneswar. At Vridhachalam, shelling ranged from 26.2 % (BPP-4) to 30.2 % (Vengurla-4).



Among the hybrids developed at Bapatla the highest shelling percentage was obtained in H-169 (33.81) while H-239 had a maximum cumulative nut yield (64.32 kg/tree) for 5 harvests. B-2-32 showed promising performance by recording annual nut yield of 11.30kg/tree and cumulative nut yield of 53.0kg/tree for 11 harvests. The hybrid H-31/05 recorded the highest yield of 14.56kg per tree at Goa. At Jhargram, the hybrids recording highest shelling percentage were H-179 (35.9%) followed by H-125 (35.3%) and H-180 (35.1%). The highest cumulative yield /tree for 17 years was recorded by H21 (155.95 kg/tree) at Madakkathara.

### CROP MANAGEMENT

In the trials on fertilizer application in high density cashew plantation, the percentage of ground area coverage by canopy was found to be maximum (218.80%) at 600 pl/ha receiving 75:25:25kg NPK/ha at Bapatla. The same treatment resulted in maximum cumulative total returns of Rs. 3,98,350/- per ha and cumulative net returns of Rs. 2,11,460/- with highest C:B ratio of 1:2.13 at Jhargram. At Pilicode, the highest yield per plant (5.41kg) and yield per ha (2165.16kg) was observed at medium spacing of 400 plants / ha (6 m x 4 m).

At Vengurla, mean fruit set/m<sup>2</sup> (65.00/m<sup>2</sup>) as well as cumulative yield (11 harvests) was maximum in irrigation at 80 percent C.P.E. (45.92 kg/tree). In intercropping trials at Kanabargi, highest net profit from intercrop was maximum in coleus (Rs. 61,370/ha) followed by turmeric (Rs. 56,950/ha). Minimum net profit was recorded in cowpea (Rs. 17,730/ha). At Jhargram, the cumulative nut yield /tree for 5 harvests was significantly highest (16.58 kg/tree) when 100% N was applied as FYM. The highest overall acceptability of cashew apple RTS was 4.53 in variety Jagannath at Bhubaneswar.

### CROP PROTECTION

At Bapatla, L-cyhalothrin 0.003% was found to be most effective in managing leaf and blossom webber as well as shoot tip caterpillar. At Jhargram, the least damage by the leaf and blossom webber was observed in Acetamiprid (0.5 g/l) treatment. For management of cashew stem and root borer by adopting post extraction prophylaxis (PEP) treatment with chlorpyrifos (0.2%) led to maximum protection with 91.66% trees without reinfestation at Bapatla, 82.0% at Bhubaneswar,

83.34% at Jagdalpur, 90% at Jhargram, 93.33% at Vengurle.

Among the germplasms screened for tolerance or resistance to regional pests, Ullal-1 and V-4 had tolerance to leaf miner at Jagdalpur and NRCC-Sel-2 showed tolerance to thrips at Vengurla.

### TRANSFER OF TECHNOLOGY

A total of 294300 grafts were produced during the current year and distributed to several government and non-government organizations as well as to cashew growers. Scientists of Bapatla and Bhubaneswar Centre participated in Doordarshan programmes on cashew Pest and Disease management, irrigation and flower and fruit set management which was broadcast by DD-Saptagiri and on the topic "Insect pest management in cashew" broadcast on DD-Odiya respectively. Scientists of Bhubaneswar Centre participated in District level seminars at Dhenkanal and at Jajapur organized by OSCDC, Govt. of Odisha.

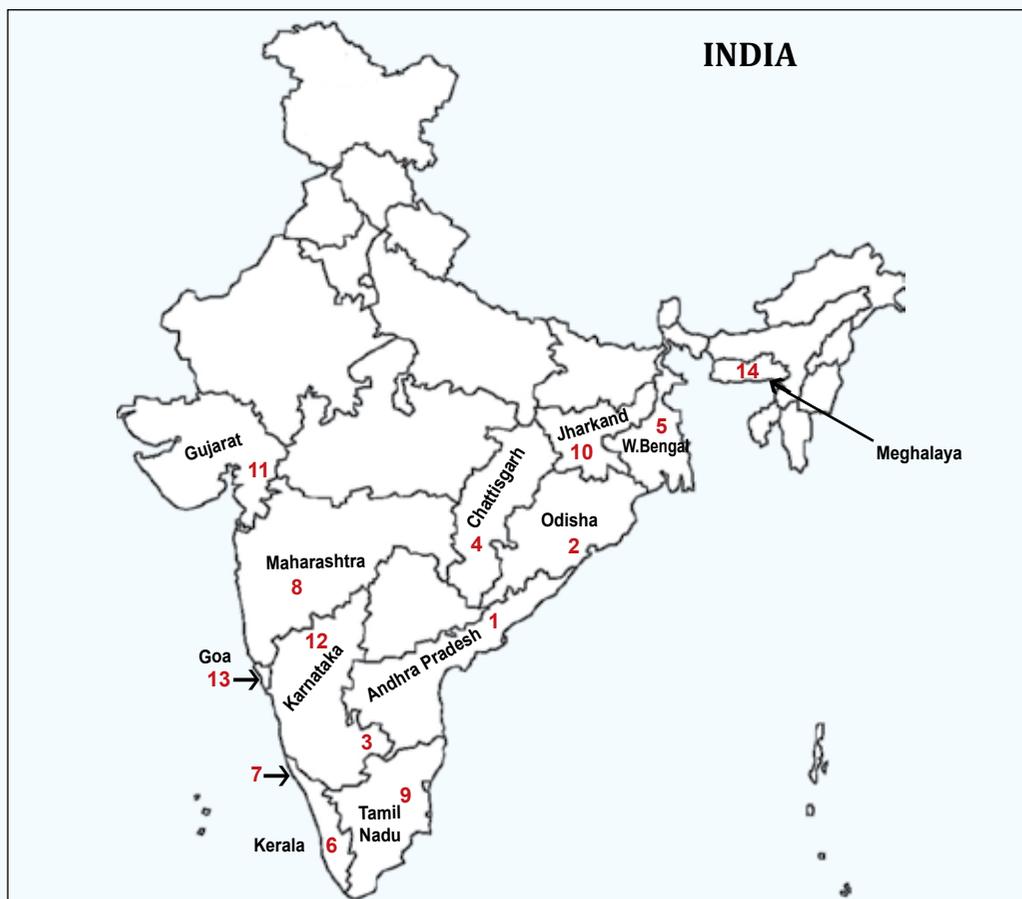
The scientists of Jagdalpur centre conducted 2 trainings on cashew processing under TSP programme in the project 'Enhancement of tribals' income through small scale cashew nut & cashew apple processing in Bastar region of Chhattisgarh". A training programme on 'Cashew Production, Plant Protection and Processing technologies' was conducted for benefit of new cashew farmers in Bastar region and cashew field workshop was also organized to create awareness about cashew production. The scientists of Madakkathara Centre confirmed that pepper (Panniyur-5) was a remunerative intercrop in cashew plantations. The scientist of Pilicode Centre organised five trainings and seminars on cashew apple processing. A radio talk on "Climate change and population crops" was broadcast from AIR, Kannur.

The scientists of Vengurla Centre conducted 3 state level seminars on cashew and 3 days training programme on cashew production and processing technology, cashew apple utilization, as well as method demonstrations on cashew stem and root borer management.

The scientists of Vridhachalam Centre conducted three trainings on cashew production technology and high yielding varieties in cashew. One day training on Cashew Nursery Technology and Training on Cashew Apple Utilization was organized for benefit of enterpreneurs and farm women.



## DETAILS OF CENTRES OF AICRP ON CASHEW



### HEADQUARTERS OF AICRP ON CASHEW

□ Directorate of Cashew Research, Puttur 574 202, Dakshina Kannada, Karnataka.

#### AICRP on cashew Centres:

1. Cashew Research Station, (Dr. YSRHU), Bapatla-522 101, Guntur District, Andhra Pradesh.
2. Cashew Research Station, (OUAT), Bhubaneswar-751 003, Odisha.
3. Zonal Research Station, (BAU), Darisai - 832 304, Barakhursi, East Singhbhum Dist., Jharkhand.
4. ICAR Research Complex for Goa, Ela, Old Goa, Goa-403 402.
5. Horticulture Research Station, (UHS), Hogalagere - 563 138, Srinivasapura, Kolar Dist., Karnataka.
6. SG College of Agriculture and Research Station, (IGAU), Jagdalpur-494 005, Chattisgarh.
7. Regional Research Station, (BCKV), Jhargram-721 507, Midnapore West Dist., West Bengal.
8. Horticulture Research Station, (UHS), Kanabargi - 590 016, Belagavi Dist., Karnataka.
9. Cashew Research Station, (KAU), Madakkathara-680 651, Thrissur Dist., Kerala.
10. Agricultural Experimental Station (NAU), Paria-396 145, Valsad Dist., Gujarat.
11. Regional Agricultural Research Station, (KAU), Pilicode-671 353, Kasaragod Dist., Kerala.
12. Regional Fruit Research Station, (Dr. BSKKV), Vengurla-416 516, Sindhudurg Dist., Maharashtra.
13. Regional Research Station, (TNAU), Vridhachalam-606 001, Cuddalore Dist., Tamil Nadu.
14. ICAR Research Complex for North Eastern Hilly Regions, 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 P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O. Average water holding capacity (AWC) of soil is 100 mm and the climate is sub humid (dry). At 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 P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O. The climate is sub humid (dry), AWC 200 mm. At Vridhachalam average rainfall is 1215 mm and the temperature ranges from 18.7 to 35.7° C, the soil is red laterite, low in organic matter and N, medium in P<sub>2</sub>O<sub>5</sub> and high in K<sub>2</sub>O. The climate is semi arid (dry), AWC 125 mm.

The centres in the West Coast are located at Madakkathara, Pilicode, Vengurla and Navasari and a cooperating centre at Goa. This zone receives rainfall ranging from 2800 mm to 3800 mm annually and is distributed over a period of 7-9 months from April/June to December. The soil is typically sandy, sandy loam, sandy clay loam and laterite (oxisol). Madakkathara receives an average rainfall of 3550 mm and the temperature ranges from 22.0 to 36.2°C, the soil is laterite (oxisol), medium in N, low in P and medium in K contents. The climate is per humid and AWC is 150 mm. At Vengurla average rainfall is 2916 mm and the temperature ranges from 17.4 to 32.9° C. Centre is situated at an elevation of 90m above MSL; the soil is sandy loam to sandy clay loam with high organic matter, N, K and low in P. The climate is humid and AWC is 150 mm. Paria centre is characterized by heavy black soils and receives an average annual rainfall of 2200mm and temperature ranged from 18.5°C to 33.0°C with a mean RH of 70.22 percent.

Maidan tract characterized by even land has Chintamani, Darisai, Jagdalpur centres and Co-operating centre at Arabhavi in this region. 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 P<sub>2</sub>O<sub>5</sub> and high in K<sub>2</sub>O. 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

The objectives of the project are:

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

#### Germplasm Collection:

During the current year, 19 germplasm accessions have been collected by different centres of AICRP on Cashew and have been conserved in the respective

Regional Cashew Field Gene Banks (RCFGBs). The total number of accessions conserved so far is 1369 (Table 1.1).

**Table 1.1 : Cashew germplasm accessions conserved in different Centres**

Centre	No. of accessions		
	Earlier existing	collected during 2014-15	Existing
<b>East Coast</b>			
Bapatla	132	--	132
Bhubaneswar	104	2	106
Jhargram	150	--	150
Vridhachalam	208	--	208
<b>West Coast</b>			
Goa	89	--	89
Madakkathara	140	--	140
Paria	--	--	--
Pilicode	43	--	43
Vengurla	306	--	306
<b>Plains tract/others</b>			
Darisai	--	17	17
Hogalagere *	128	--	108
Kanabargi	--	--	--
Jagdapur	70	--	70
Tura	--	--	--
<b>Total</b>	<b>1370</b>	<b>19</b>	<b>1369</b>

\* Conserved at Chintamani



### Germplasm evaluation :

The cashew germplasm accessions conserved at different centres of AICRP-Cashew have been evaluated for growth and yield parameters during 2014-15.

#### BAPATLA

The maximum mean plant height was recorded in T.No.4/5 (7.78m) while, the lowest mean plant height was recorded in BLA-139-1

(4.43 m). T.No.4/5 had the highest mean canopy height (7.44 m) and the lowest mean canopy height was recorded in BLA 139-1 (4.13 m). The highest mean trunk girth was noticed in T.No.275 (140.0 cm) which was on par with Priyanka (140.0 cm). The highest mean canopy spread was recorded in H 95-T4 (12.10 m) while, the lowest mean canopy spread was recorded in BLA 139-1 (5.73 m) (Table 1.2).

**Table 1.2 : Growth parameters of promising cashew germplasm at Bapatla centre**

Accession No.	Plant Height (m)	Canopy Height (m)	Trunk Girth (m)	Mean canopy spread (m)	Canopy surface area (m <sup>2</sup> )
Planted during 1997					
Priyanka	5.80	5.50	140.0	10.85	131.5
T.No.129	5.50	5.20	79.0	8.45	88.73
T.No.275	5.75	5.60	140.0	11.15	62.38
T.No.12/1	6.65	6.45	97.50	7.67	90.28
T.No.18/3	6.51	6.26	108.2	8.25	97.10
T.No.3/4	7.25	6.75	102.0	7.75	94.75
T.No.8/7	7.58	7.30	113.2	8.87	118.76
T.No.4/5	7.78	7.44	113.2	8.17	108.61
T.No.30/1	5.50	5.30	114.0	7.85	81.19
T.No.228	6.15	5.80	117.0	9.25	107.59
T.No.268	6.76	6.40	109.6	9.78	123.72
BLA 139-1	4.43	4.13	77.6	5.73	45.12
T.No.17/5	7.10	6.65	112.5	9.55	87.10
BLA 39/4	6.10	5.90	101.0	10.45	129.10
T.No.5/1	5.83	5.50	108.0	9.40	106.80
Ch.gudem	5.60	5.26	104.0	9.09	98.45
H.95-T4	7.10	6.90	130.0	12.10	132.34
T.No.2/14	6.45	6.00	101.0	6.72	47.52

The flowering duration ranged from 76.0 days to 133.0 days and lowest flowering duration (76.0 days) was recorded in Ch.Gudem and longest flowering duration was recorded in accession T.No.30/1 (133.0 days). The mean number of flowering laterals per square meter was found to

be highest in BLA-39/4 (29.00). The highest sex ratio (hermaphrodite to male flower) was recorded in BLA-139-1 (0.216). The mean number of nuts per m<sup>2</sup> was highest in BLA 39-4 (58.0) while mean number of nuts per panicle was highest in case of T.No.17/5 (13.00) (Table 1.3).


**Table 1.3 : Yield parameters of promising cashew germplasm (planted during 1997) at Bapatla Centre**

Accession No.	Duration of Flowering (days)	Mean no Flowering laterals/m <sup>2</sup>	Sex Ratio	Mean Nut/ m <sup>2</sup>	Mean Nuts/ Panicle
Priyanka	93.0	20.0	0.11	8.0	2.25
T.No.129	85.0	26.5	0.11	34.0	1.50
T.No.275	88.0	27.75	0.17	33.0	5.37
T.No.12/1	77.0	26.50	0.15	20.75	25.0
T.No.18/3	94.0	26.33	0.09	18.33	2.33
T.No.3/4	107.0	26.0	0.12	19.75	3.00
T.No.8/7	96.0	23.25	0.20	21.60	2.20
T.No.4/5	104.0	27.60	0.19	28.6	3.80
T.No.30/1	133.0	26.5	0.11	53.0	4.50
T.No.228	110.0	28.25	0.116	38.0	4.50
T.No.268	106.0	26.0	0.089	27.3	2.66
BLA 139-1	119.0	26.3	0.216	25.3	4.66
T.No.17/5	77.0	25.0	0.197	46.0	13.00
BLA 39/4	112.0	29.00	0.158	58.0	3.50
T.No.5/1	97.0	23.60	0.150	54.0	5.00
Ch.gudem	76.0	27.0	0.123	26.0	3.75
H.95-T4	97.0	26.0	0.088	15.0	9.75
T.No.2/14	113.0	23.75	0.186	19.75	3.0

The maximum mean nut weight was recorded in Priyanka (10.55g) followed by T.No.30/1 (6.38g). The mean apple weight ranged from 25.0g (T.No.275) to 125.0g (Priyanka). The nut yield per tree at 13<sup>th</sup> harvest was highest in Priyanka

(25.30 kg/tree). The cumulative nut yield for 13 harvests was highest in BLA-39/4 (103.10 kg/tree). Highest shelling percentage was obtained in Priyanka (31.34%) followed by H 95-T4 (31.23%) (Table 1.4).

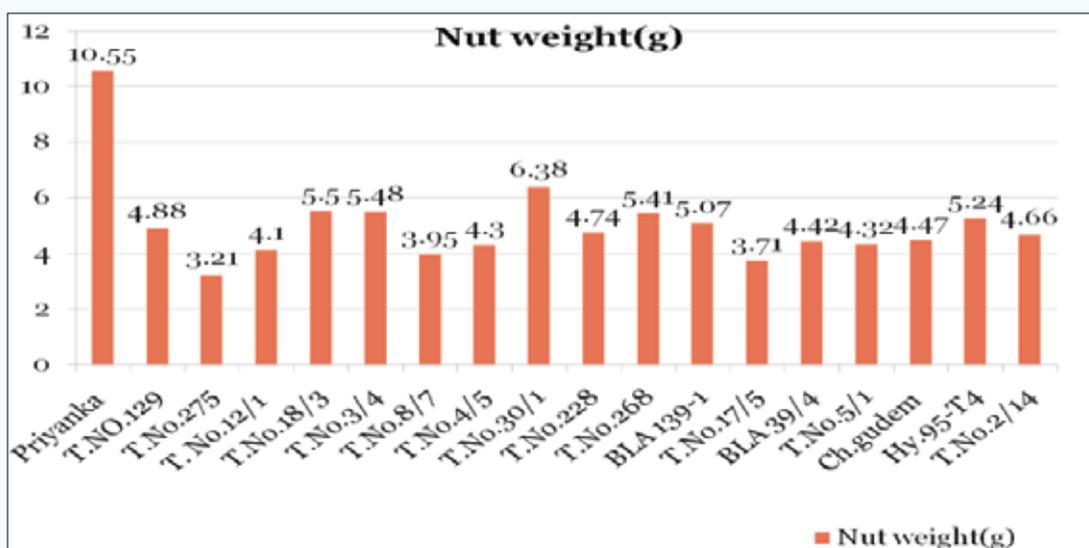
**Table 1.4 : Yield parameters of promising cashew germplasm (planted during 1997) at Bapatla Centre**

Accession No.	Mean Nut weight (g)	Mean Apple weight (g)	Shelling (%)	Nut yield / tree (kg) 2014	Avg. Nut Yield (Kg/tree)	Cum. Nut Yield (kg/tree) 13 hvsts.
Priyanka	10.55	125.0	31.34	25.30	5.63	73.24
T.No.129	4.88	65.00	27.53	23.40	7.50	97.57
T.No.275	3.21	25.00	28.81	21.05	6.85	89.12
T.No.12/1	4.10	35.00	27.63	10.65	4.23	55.11
T.No.18/3	5.5	42.00	28.32	6.20	3.27	42.59
T.No.3/4	5.48	53.70	27.91	2.78	3.76	48.99
T.No.8/7	3.95	48.00	29.23	3.30	3.62	47.08



Table 1.4 contd...

T.No.4/5	4.30	29.40	31.02	3.30	4.00	52.05
T.No.30/1	6.38	35.00	28.63	12.00	4.17	54.24
T.No.228	4.74	43.0	24.56	16.45	6.96	90.56
T.No.268	5.41	31.0	26.83	3.90	5.17	67.29
BLA 139-1	5.07	39.0	29.02	4.96	3.67	47.70
T.No.17/5	3.71	39.0	27.93	6.00	4.60	59.92
BLA 39/4	4.42	33.0	31.04	4.45	7.93	103.10
T.No.5/1	4.32	48.0	30.34	5.46	5.95	77.47
Ch.gudem	4.47	51.00	27.53	10.60	4.47	58.12
Hy.95-T4	5.24	48.0	31.23	14.40	6.06	78.83
T.No.2/14	4.66	61.5	28.71	4.40	3.47	45.50

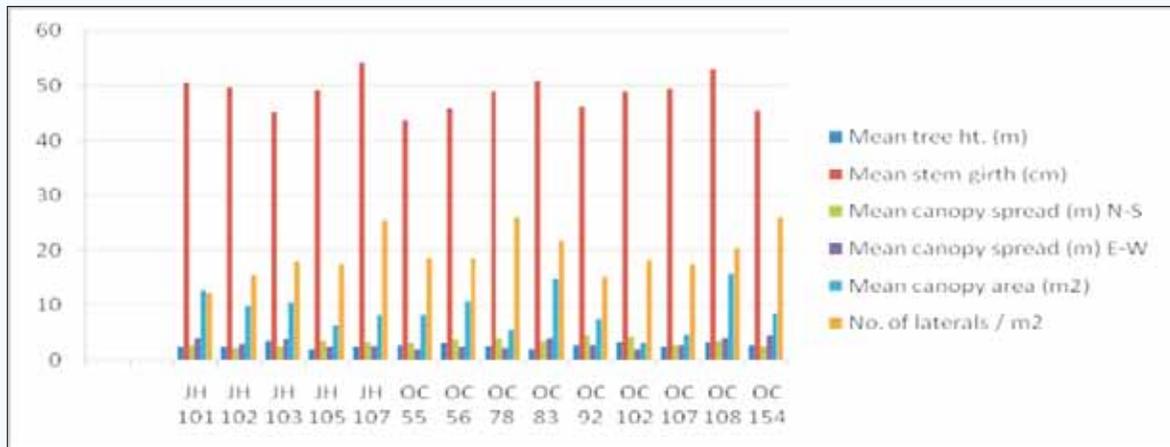


Mean nut weight of different cashew germplasm at Bapatla centre

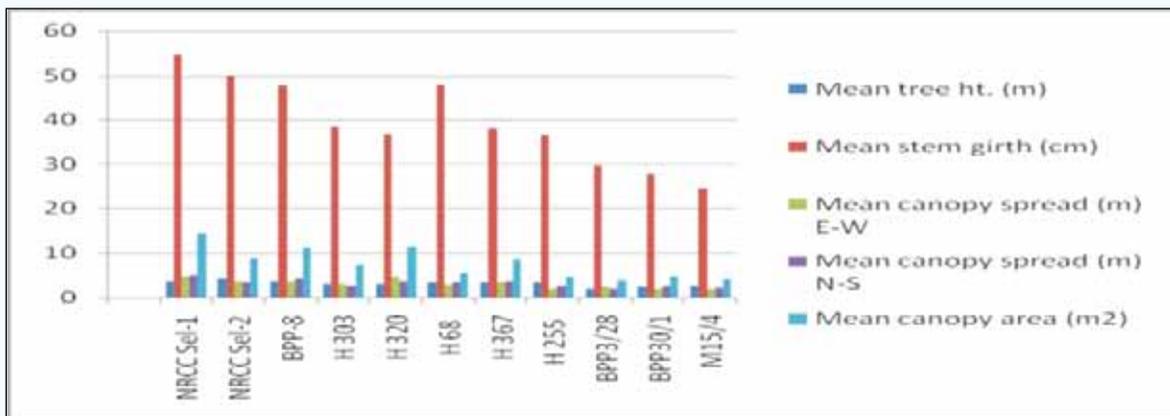
## BHUBANESWAR

Out of 100 germplasm evaluated, 59 accessions had bold nut (7.0 g – 14.0 g), 71 accessions recorded shelling percentage  $\geq 28.0$ . Six accessions gave a mean annual nut yield of 7.0 kg to 10.5 kg/tree.

OC 85 recorded the maximum nut weight (14.0g) and highest shelling percentage occurred in OC 71 (36.4%). OC 148 recorded the highest mean annual nut yield (10.4kg/plant) as well as cumulative nut yield (28.9kg/plant) for 7 harvests.



**Vegetative parameters of promising germplasm at Bhubaneswar Centre**



**Vegetative parameters of promising germplasm at Bhubaneswar Centre**

**DARISAI**

No significant differences were observed among different cashew germplasms with respect to vegetative parameters. However, highest mean tree height (3.56m) was found in germplasm JH-103 followed by 3.46m in OC-108.

Highest mean canopy spread in E-W (4.53m) was observed in germplasm OC-154 which was at par with germplasm JH-101, OC-83, OC-108 and JH-103 but significantly superior to all

other germplasms. Highest mean canopy area of 15.76 m<sup>2</sup> was observed in OC-108 followed by 14.86m<sup>2</sup> in OC-83. Lowest mean canopy area of 3.26m<sup>2</sup> was observed in germplasm OC-102. On vegetative parameters, highest number of laterals /m<sup>2</sup> (26.03) was observed in OC-78 followed by OC-154 and JH-107. All the three germplasms were at par with each other but significantly superior to other germplasm in terms of number of laterals/m<sup>2</sup> (Table 1.5).



Table 1.5 : Vegetative parameters of promising cashew germplasm at Darisai Centre

Accession	Year of planting	Mean tree ht. (m)	Mean stem girth (cm)	Mean canopy spread (m)		Mean canopy area (m <sup>2</sup> )	No. of laterals / m <sup>2</sup>
				N-S	E-W		
JH 101	2011	2.53	50.43	2.83	4.2	12.67	12.2
JH 102	2011	2.56	49.56	2.36	3.13	9.83	15.6
JH 103	2011	3.56	45.06	2.6	3.93	10.54	18.2
JH 105	2011	2.2	49.3	3.53	2.53	6.54	17.5
JH 107	2011	2.5	54.1	3.4	2.73	8.19	25.5
OC 55	2012	2.8	43.63	3.26	2.23	8.34	18.6
OC 56	2012	3.2	45.8	3.83	2.5	10.86	18.7
OC 78	2012	2.7	48.8	4.16	2.26	5.64	26.03
OC 83	2012	2.13	50.86	3.56	4.13	14.86	21.7
OC 92	2012	2.9	46.13	4.56	2.83	7.54	15.2
OC 102	2012	3.4	48.93	4.23	2.23	3.26	18.25
OC 107	2012	2.6	49.46	2.9	2.96	4.74	17.5
OC 108	2012	3.46	53.06	3.53	4.13	15.76	20.5
OC 154	2012	2.9	45.53	2.76	4.53	8.56	26.0
SEm±		0.464	5.355	0.526	0.359	3.318	1.203
CD at 5%		NS	NS	NS	1.050	3.318	3.517
CV%		28.491	19.077	26.820	19.633	21.613	10.747

## GOA

Eight new accessions were identified for their higher nut yield trends, bold nut and bigger apple size (Table 1.6).

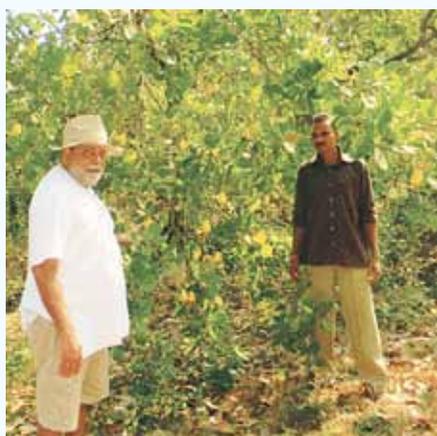
Table 1.6 : Characteristics of eight new accessions identified during 2013 at Goa Centre

Accession	Nut / bearing	Approx. age (yrs)	Nut yield (kg/tree) (2013)	Mean Nut wt. (g)	Mean Apple wt. (g)	Colour	TSS (°B)
Sukheja-1	Bold nut	>22	18.5	8.8	85.6	Yellow	10.4
Sukheja-2	Bold nut	15	12.5	8.3	81.4	Yellow	11.0
Sukheja-3	Bold nut	>20	8.4	9.0	98.6	Yellow with red tinge	11.2
Sukheja-4	Medium nut cluster bearing	>16		7.3	68.0	Red	10.8
Bhars-1	Bold nut	>28	22.5	8.8	71.5	Yellow	10.6
Bhars-2	Bold nut	>25	20.4	8.4	80.5	Red	11.2
Kindalghatta-1	Bold nut	>40	28.0	8.5	85.5	Yellow	11.8
Kindalghatta-2	Bold nut	>35	33.0	8.6	83.4	Yellow	10.6

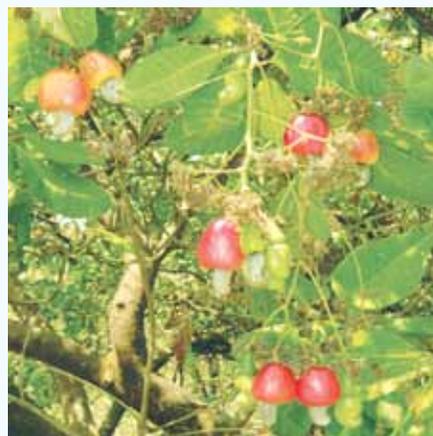


All the eight collections had bold nut (> 8g) and bigger apple size except in (Sukheja-4) which had the medium nut size, with cluster bearing habit. With addition of these 7 bold nut types and one cluster bearing type, a total of 89 germplasm accessions representing the following groups are being conserved.

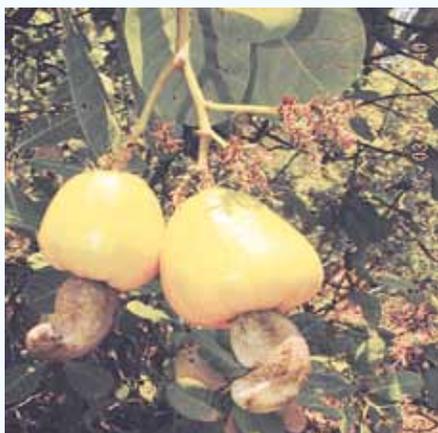
- Jumbo bold nut types : 14 accessions
- Bold nut types: 29 +7 = 36 accessions
- Medium nut and high yielders : 12 + 1 = 13 accessions
- Remaining 23 : high yielders/ cluster bearers irrespective of nut size
- Dwarf canopy types : 3 accessions
- Total germplasm collection : 89



**Sukheja-1**



**Sukheja-4**



**Bhars-1**



**Bhars-2**

Characterization of 14 genotypes namely, Valpoi-1, Valpoi-2, Valpoi-3, Bardez-3, Bardez-9, Tiswadi-7, Tudal-1, Tudal-3, Mayem-1, BKL-1, BKL-2, FMGDI-1, Tiswadi-3 and Balli-1/ Goa-1 (Check) revealed that Valpoi-3 showed vigorous growth with maximum tree height of 4.9m with collar

girth of 52cm. All the accessions excepting Valpoi-3 and Bardez 8/98, recorded the mean nut weight of more than 8g. Tiswadi-3 recorded the jumbo nut size of > 10g. Apple weight varied from 71.50g (Bardez 8/98) to 106.50g in Bardez 9 accession (Table 1.7).

**Table 1.7 : Performance of bold-nut genotypes of cashew at Goa Centre**

Genotype (m)	Height (cm)	Girth (kg/tree)	Nut yield Wt (g)	Mean nut Wt. (g)	Mean apple	TSS (°B)
Valpoi-1	3.5	40	0.38	8.4	85.5	11.2
Valpoi-2	4.2	66.0	0.52	9.88	98.0	10.6
Valpoi-3	4.9	52.0	0.76	7.6	104.5	10.8
Bardez-8/98	3.7	43.8	1.06	7.5	71.5	11.4
Bardez-9	3.5	41.0	0.80	9.9	106.5	11.0
Tiswadi-3	3.6	43.0	0.68	10.1	99.5	11.4
Tiswadi-7	3.9	38.0	0.88	8.3	78.0	10.8
Tudal-1	3.2	34.0	0.55	8.8	92.5	10.7
Tudal-3	3.5	35.0	0.68	8.9	88.6	11.0
Mayem-1	4.0	41.0	0.84	8.0	71.5	10.9
BKL-1	3.4	42.0	1.1	8.1	88.8	10.8
BKL-2	3.0	39.0	0.86	8.1	79.6	11.6
FMGDI-1	2.9	44.0	0.53	8.9	82.5	11.1
Goa-1 (Check)	3.8	47.0	0.95	7.6	76.4	11.8
SEm±	0.18	0.15	0.05	0.38	7.3	0.13
CD (5%)	0.76	0.68	NS	1.41	26.91	NS

Raw nut yield varied from 0.38kg/tree (Valpoi-1) to 1.1kg/tree (BKL-1), although not significant as against 0.95kg / tree recorded in Goa-1 (check).

### HOGALAGERE

The highest numbers of flowering laterals/m<sup>2</sup> were observed in Vengurla-5 (14.30) and maximum mean canopy area (m<sup>2</sup>) was observed in 5/37 Manjeri (258.17). The maximum mean flowering duration was observed in Vengurla - 5 (84.84 days) and least flowering duration in 3/108 Gubbi (65.68 days). Maximum mean number of

panicles/m<sup>2</sup> (12.20) was noticed in Vengurla - 5 and least number of panicles/m<sup>2</sup> in 3/108 Gubbi (8.44). The mean number of nuts/m<sup>2</sup> was highest in K-3-C (23.33) and mean number of nuts/panicle was highest in Vengurla - 5 (3.50).

The mean nut weight was maximum (7.61g) in Vetore-56, while mean apple weight was highest in Vengurla - 5 (51.40g). The shelling percentage was higher (32.14%) in 3/108 Gubbi. The maximum mean annual nut yield (11.31 kg/tree) and highest cumulative nut yield (412.14 kg/tree) was recorded in Vengurla - 5 (Table 1.8).


**Table 1.8 : Yield parameters of promising cashew germplasm at Chintamani Centre**

Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree)
3/108 Gubbi (2/6 ARSC)	5.72	36.80	32.14	3.79	300.71 (28 harvests)
Vetore-56 (27/1 ARSC)	7.61	47.30	29.46	6.57	216.34 (27 harvests)
5/23 Kundapur (03/1ARSC)	6.45	44.80	31.42	3.85	222.87 (28 harvests)
5/37 Manjeri (41/3 ARSC)	6.81	46.60	31.65	9.41	386.48 (25 harvests)
Vengurla - 5 (44/1 ARSC)	5.83	51.40	31.04	11.31	412.14 (25 harvests)
K-3-C (56/1 ARSC)	6.52	41.70	30.51	4.49	150.16 (16 harvests)
Sem ±	0.58	4.59	2.37	0.58	-
CD at 5%	1.83	14.45	7.47	1.81	-
CV%	15.50	17.75	13.23	15.18	-

### JAGDALPUR

The mean annual nut yield/tree was highest for NRC- 138 (9.50 kg), followed by NRC-137 (9.20 kg). The cumulative nut yield was

highest in NRC- 137 (81.15 kg) for 15 harvests. Mean nut weight was found to be highest for NRC-138 (8.60g) followed by NRC-140 and NRC-130. Shelling per cent was highest in NRC-131 (30.40%) (Table 1.9).

**Table 1.9 : Yield parameters of promising cashew germplasm at Jagdalpur centre**

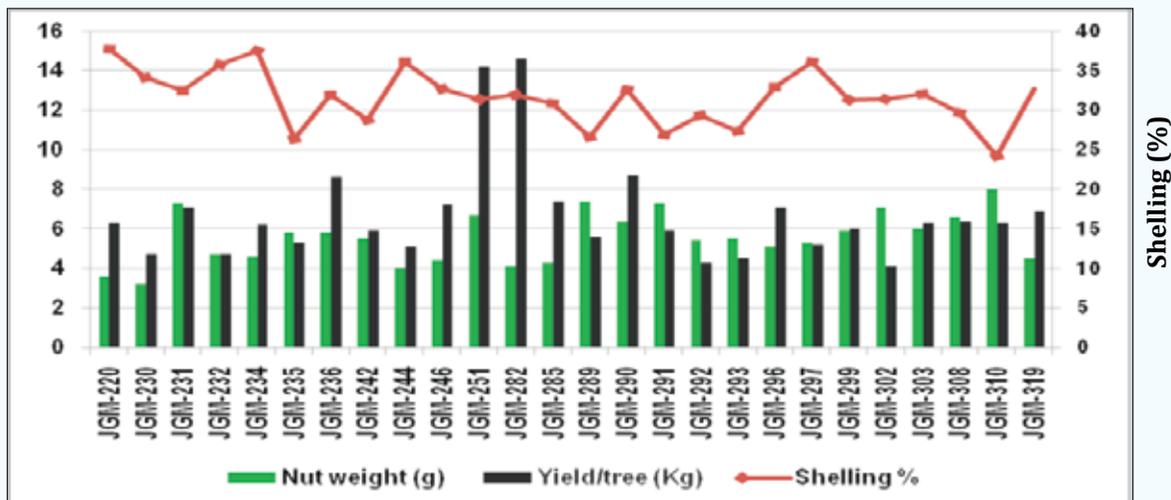
Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (For 15 Harvests)
Planted during 1996-97					
NRC- 130	7.50	60.10	27.60	6.40	42.58
NRC- 131	7.80	48.50	30.40	5.20	38.13
NRC- 136	6.50	53.50	28.40	4.90	36.35
NRC- 137	7.90	45.30	30.10	9.20	81.15
NRC- 138	8.60	59.10	29.40	9.50	72.08
NRC- 140	8.30	85.50	29.50	5.30	42.55
NRC- 190	7.40	56.40	27.20	4.90	31.25
NRC- 191	7.20	50.40	29.80	8.40	58.26
NRC- 192	7.60	52.20	28.50	5.60	35.39
NRC-193	7.10	57.50	29.30	7.80	60.57



### JHARGRAM

Out of 26 germplasm evaluated, 17 germplasms had more than 5m plant height. JGM-235 was the tallest one with 6.5m height. The canopy area was maximum with JGM-235 (68.9 m<sup>2</sup>). JGM-293 had the maximum flowering intensity (48.3 /m<sup>2</sup>) and JGM-282 produced highest number of nuts/m<sup>2</sup> (70.1).

The cluster bearing types were JGM-282 (10.5 nuts/panicle), JGM-242 (9.9) and JGM-246 (8.9). 21 germplasms had > 28.0 percent shelling. The yield was maximum in JGM-282 (14.6 kg/tree). Cumulative yield was maximum in JGM-282 and JGM-299 both had 39.7 kg/tree yield for 6 harvests (Table 1.10).



Yield attributes of promising cashew germplasms at Jhargram Centre

Table 1.10 : Yield parameters of promising cashew germplasm (Planted during 2005) at Jhargram Centre

Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree)
					6 harvests
JGM-220	3.6	42.5	37.8	6.3	38.3
JGM-231	7.3	42.5	32.5	7.1	38.8
JGM-234	4.6	36.5	37.5	6.2	24.9
JGM-242	5.5	50.5	28.8	5.9	27.1
JGM-244	4.0	44.6	36.1	5.1	25.1
JGM-251	6.7	60.0	31.4	14.2	33.0
					5 harvests
JGM-282	4.1	34.5	32.0	14.6	39.7
JGM-285	4.3	54.0	30.9	7.4	30.3
JGM-289	7.4	44.3	26.6	5.6	28.6
JGM-290	6.4	67.7	32.6	8.7	36.4
JGM-293	5.5	42.8	27.4	4.5	19.8
JGM-296	5.1	37.6	32.9	7.1	29.5
JGM-297	5.3	58.2	36.1	5.2	23.3
JGM-299	5.9	37.6	31.3	6.0	39.7
JGM-303	6.0	37.5	32.1	6.3	25.8
JGM-308	6.6	48.7	29.7	6.4	31.0
JGM-310	8.0	36.8	24.3	6.3	32.1



## MADAKKATHARA

Among 14 germplasm evaluated, Kainur recorded maximum height (8.00 m) followed by Mannur (7.33 m). Mannur recorded maximum girth (94.33 cm) followed by Kainur (92.00 cm). Maximum sex ratio of 0.421 was recorded in

Mannur. ARL-1 recorded highest annual yield (4.50 kg/tree) followed by ODR (4.22 kg/tree). Highest cumulative yield was recorded by Pathanoor (25.50 kg/tree) followed by Kunjithai (24.75 kg/tree) for 7 harvests (Table 1.11).

**Table 1.11: Yield characters of accessions of the germplasm collection (planted during 2002-2003) at Madakkathara Centre**

Accessions	No. of Flowering laterals /m <sup>2</sup>	Ratio of bisexual: total flowers	Nut wt. (g)	Annual yield kg/tree	Cum. Yield (kg/tree) 7 hvsts.
KTR-1	6.86	0.400	7.10	3.13	18.82
KTR-3	6.90	0.393	7.87	2.80	15.31
Kiralur	8.00	0.410	8.46	3.20	16.28
Mannur	7.42	0.421	8.16	3.60	16.37
Kainur	7.42	0.463	6.90	6.90	23.42
Ummanoor	7.00	0.362	8.33	3.65	21.01
Kottukkal	8.90	0.356	7.70	3.40	14.12
Peechi	9.00	0.362	9.50	3.60	15.45
Kunjithai	12.00	0.381	9.05	3.85	24.75
Pathanoor	9.80	0.322	8.80	2.75	25.50
ARL-1	12.00	0.358	8.15	4.50	16.80
KTR-2	11.00	0.352	8.25	3.65	16.16
ARL-2	10.90	0.353	7.15	3.60	19.05
ODR	11.90	0.384	7.92	4.22	21.22

## PILICODE

PLD 17 had the highest plant height, higher canopy spread and canopy area. The accession PLD 57 retained the shortest plant height. Highest mean nut weight of 13.1g was recorded in PLD 20 and highest shelling percentage of 35.85% was recorded in PLD 1. Mean annual nut yield (6.80kg/tree) and cumulative yield (46.93 kg/tree) for 10

harvests were highest in PLD 4. Higher number of flowering branches per m<sup>2</sup> was observed in PLD 40 (5.50). Higher ratio of bisexual flowers to total flowers was observed in PLD 67 (0.20). PLD 62 recorded highest nut set/m<sup>2</sup> (5.75) (Table. 1.12).

**Table 1.12 : Yield parameters of cashew germplasm (Planted during 2001) at Pilicode Centre**

Accession No.	Mean nut wt (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) 10 Hvsts
PLD1	7.84	35.85	6.13	39.78
PLD 3	8.30	29.23	4.40	27.81
PLD 4	6.74	31.94	6.80	46.93
PLD 12	9.99	25.89	6.53	41.08
PLD 15	8.18	27.94	3.00	16.55
PLD 16	8.55	25.89	4.55	29.74
PLD 17	8.55	27.28	2.45	15.37
PLD 18	9.01	30.53	2.82	14.07
PLD 19	8.50	28.43	2.83	14.68
PLD 20	13.10	19.35	2.73	16.73
PLD 57	3.03	29.10	1.20	4.22
SEm +	0.08	0.18	-	-
CD at 5%	0.14	0.32	0.48	-
CV%	0.69	0.45	13.37	-

**VENGURLA**

RFRS 171 recorded the lowest mean height (5.7 m) in RFRS 176 and mean girth (35.3 cm) in RFRS 184. The mean flowering panicles/m<sup>2</sup> was highest in RFRS 181 (16.67). The maximum fruit set/m<sup>2</sup> (20.33/m<sup>2</sup>) and maximum nut yield (1.18 kg/tree) were recorded in RFRS 172. Maximum

nut weight of 11.2g and maximum apple weight of 58.0g were recorded in RFRS 186 and RFRS 182, respectively. (Table 1.13).

Among the 10 types, RFRS 191 recorded the lowest mean height (4.00 m), the mean laterals/m<sup>2</sup> were maximum (26.0 /m<sup>2</sup>) in RFRS 194 while, mean flowering panicles/m<sup>2</sup> were highest in RFRS 194 (16.50 /m<sup>2</sup>) (Table 1.14).

**Table 1.13 : Yield characters of germplasm accessions at Vengurle Centre (2001-02 collections)**

Accession No.	Fruit set/m <sup>2</sup>	Apple wt. (g)	Nut wt. (g)	Flowering Duration	Yield (kg/plant)	Shelling (%)
RFRS 171	12.00	52.0	10.9	87.00	0.55	25.0
RFRS 172	20.33	49.0	9.7	90.00	1.18	28.5
RFRS 173	19.33	53.0	5.7	90.00	1.11	30.0
RFRS 174	13.00	40.0	4.5	91.00	0.17	30.0
RFRS 175	12.67	35.0	6.0	92.30	0.95	29.0
RFRS 176	12.50	36.0	5.0	90.50	0.56	32.5
RFRS 177	11.00	35.7	5.3	96.50	0.25	31.5
RFRS 178	6.000	48.2	10.0	92.50	0.39	28.0
RFRS 179	12.33	54.5	6.1	94.00	0.65	32.0
RFRS 180	11.33	44.5	5.7	97.00	0.53	30.0
RFRS 181	9.00	41.0	6.2	91.30	0.33	32.0
RFRS 182	9.00	58.0	5.7	92.00	0.41	31.7
RFRS 183	12.00	38.0	4.0	96.00	0.45	26.0
RFRS 184	9.5	45.0	5.9	88.30	0.31	30.0

**Table 1.14 : Yield characters of germplasm accessions at Vengurle Centre (2003-04 collections)**

Accession No.	Flow Panicles /m <sup>2</sup>	Fruit set / m <sup>2</sup>	Apple wt. (g)	Nut wt. (g)	Flow Duration	Yield kg/plant	Shelling (%)
RFRS 185	10.50	11.00	48.0	5.3	89.0	0.64	31.5
RFRS 186	10.33	12.67	35.00	11.2	88.7	0.85	29.5
RFRS 187	12.33	14.00	47.50	6.8	92.0	1.00	27.0
RFRS 188	10.00	23.00	51.00	6.1	90.0	0.44	28.5
RFRS 189	14.00	15.50	49.00	6.3	90.5	0.68	27.0
RFRS 190	14.00	11.00	53.00	4.3	90.0	0.78	30.5
RFRS 191	13.00	18.00	39.00	5.2	93.0	0.48	32.0
RFRS 192	10.00	21.00	30.50	6.0	101.0	0.36	32.5
RFRS 193	12.50	6.50	35.00	5.1	88.50	0.74	31.0
RFRS 194	16.50	12.50	47.00	5.6	90.50	0.40	30.5

### VRIDHACHALAM

The mean tree height (m) and trunk girth (cm) were found to be maximum in IC 302361 (6.50m & 69.3 cm). Highest canopy spread (both EW & NS), mean canopy area was recorded in IC 302366 (6.5m & 6.6m and 54.6 respectively).

Flowering duration varied from 63 days (IC 302361) to 72 days (IC 302366). The number of panicles/m<sup>2</sup> varied from 10.4 in IC 302366 to 19.2 in IC 302361 among the promising accessions.

Mean number of nuts/m<sup>2</sup> and number of nuts/panicle were maximum in IC 302361 (38.5 and 5.9 respectively).

The accession IC302361 recorded the highest mean nut weight (7.6 g), apple weight (66.8 g), nut yield (8.68 kg/tree) and overall cumulative nut yield of 62.01 kg/tree in 12 harvests. The accession IC 302360 (KK 1) performed consistently for nut weight and IC 302361 (TK1) for nut yield which are being utilized in evolving hybrids viz., HC 10 (VRI 3 x KK1) and HC 22 (VRI 3 x TK1).



## Gen 1: Germplasm collection, conservation, evaluation, characterization and cataloguing (Centres wherein trial concluded)

### VENGURLA

The trial was initiated during 2004 with 14 germplasm accessions planted at 6x6m spacing. Among the 14 germplasm, the maximum mean height (6.34 m) was recorded in RFRS 180 while minimum height (3.17 m) was in RFRS 184. The maximum mean girth (64.77 cm) and mean canopy spread (7.58 m) was recorded in RFRS 183. The production of laterals per m<sup>2</sup> during the period under reporting (2004-05 to 2013-14) recorded

maximum in RFRS 174 (27.56/m<sup>2</sup>) followed by RFRS 172 (27.53/m<sup>2</sup>). The maximum flowering panicles per m<sup>2</sup> were recorded in RFRS 177 (18.30/m<sup>2</sup>) followed by RFRS 183 (17.73/m<sup>2</sup>). The minimum mean flowering duration (98.81 days) was recorded in RFRS 182 while, the maximum mean flowering duration (109.75 days) was noted in RFRS 172 (Table 1.15).

**Table 1.15 : Vegetative and yield parameters of 14 germplasm accessions at Vengurle centre (planted during 2001-02)**

Accession No.	Mean flowering duration (6 years)	Mean laterals/m <sup>2</sup> (10 years)	Mean flowering panicles/m <sup>2</sup> (10 years)	Mean fruit set/m <sup>2</sup> (9 years)	Mean nut wt. (g) (10 years)	Mean apple wt. (g) (10 years)	Cum. yield (kg/tree) 10 hvsts
RFRS 171	104.50	27.10	16.45	19.11	10.71	51.16	8.24
RFRS 172	109.75	27.53	17.00	25.19	9.81	55.84	13.33
RFRS 173	106.69	27.46	16.24	22.55	5.86	49.40	12.38
RFRS 174	100.96	25.75	14.71	14.23	5.97	45.37	5.41
RFRS 175	102.46	24.95	15.34	14.85	6.10	36.14	4.90
RFRS 176	104.79	25.08	14.12	17.31	6.78	37.66	5.37
RFRS 177	106.00	27.02	18.30	17.27	7.20	40.38	5.05
RFRS 178	102.81	27.55	17.70	19.25	7.02	61.62	9.67
RFRS 179	101.87	24.34	14.33	16.82	8.64	60.31	4.44
RFRS 180	104.79	25.15	16.36	14.46	6.69	41.57	5.52
RFRS 181	102.22	22.64	14.66	11.45	5.86	42.25	2.74
RFRS 182	98.81	23.56	14.80	22.42	5.72	59.14	6.04
RFRS 183	103.50	27.50	17.73	18.38	5.82	52.55	6.89
RFRS 184	107.90	22.43	13.52	14.42	5.67	43.14	3.68

The highest fruit set/m<sup>2</sup> (25.19/m<sup>2</sup>) recorded in RFRS 172 while, lowest fruit set/m<sup>2</sup> (11.45/m<sup>2</sup>) recorded in RFRS 181. The maximum number of nuts/panicle (3.22) recorded in RFRS 182. The maximum mean nut weight (10.71 g) was observed in RFRS 171 followed by RFRS 172

with 9.81 g. Among the 14 cashew types the maximum apple weight (61.62 g) was recorded in RFRS 178 followed by RFRS 179 with 60.31 g. The maximum mean yield of 1.48 kg/tree was recorded in RFRS 172 followed by RFRS 173 with 1.38 kg/tree while, minimum mean nut yield



recorded in RFRS 181 (0.34 kg/tree) whereas, maximum cumulative yield was recorded in RFRS 172 (13.33 kg/tree). The highest shelling per cent (32.44 %) was recorded in RFRS 181 while, the lowest shelling per cent recorded in RFRS 171 with 26.33 per cent (Table 1.16).

### Conclusion :

It could be concluded that out of 14 types evaluated from 2004-05 to 2013-14, RFRS 172 performed well and recorded maximum mean nut yield 1.48 kg/tree and cumulative yield of 13.33 kg/tree (for 10 harvests).

**Table 1.16 : Shelling percentage of 14 germplasm accessions planted at AICRP-Cashew Vengurle centre.**

Accession No.	Shelling (%)			
	2011-12	2012-13	2013-14	Mean for 3 years
RFRS 171	26.00	28.00	25.00	26.33
RFRS 172	28.00	33.00	28.50	29.83
RFRS 173	26.00	32.00	30.00	29.33
RFRS 174	28.00	30.00	30.00	29.33
RFRS 175	28.00	29.00	29.00	28.66
RFRS 176	26.00	27.00	32.50	28.50
RFRS 177	31.00	30.00	31.50	30.83
RFRS 178	22.00	33.00	28.00	27.66
RFRS 179	25.80	29.00	32.00	28.93
RFRS 180	28.00	31.00	30.00	29.66
RFRS 181	33.33	32.00	32.00	32.44
RFRS 182	27.50	34.00	31.70	31.06
RFRS 183	27.00	28.00	26.00	27.00
RFRS 184	26.60	32.00	30.00	29.53



## Gen.3. Varietal Evaluation Trials

### 1. Multi Location Trial - II

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

#### Experimental Details:

Varieties	:	No. of entries - 13
Bapatla	:	3/28, 3/33, 10/19, 30/1
Vengurla	:	H 68, H 255, H 303, H 320, H 367
Vridhachalam	:	M 15/4, M 44/3
D.C.R., Puttur	:	VTH 107/3, VTH 40/1
Design	:	RBD
Replications	:	Three
Year of Planting	:	1992 at all centres except (1993 at Bapatla, 2002 at Jhargram, 1994 at Vridhachalam)

#### JAGDALPUR

The maximum tree height (5.97m) was recorded in V-4, whereas the maximum stem girth (87.83cm) was recorded in H-68. The canopy spread in V-4 had maximum canopy coverage in E-W (6.50m) whereas, in N-S the hybrid H-367 recorded maximum coverage (6.47m). The maximum no. of flowering

laterals/m<sup>2</sup> (16.75) as well as nuts/m<sup>2</sup> per panicle (6.40) was recorded in H-303. Nut yield (kg/tree) was highest for H-68 (7.27kg) followed by V-4 & H-367. The maximum nut weight (10.13g) was recorded in H-255 and the maximum apple weight (72.67g) was recorded in H-367. The shelling percent was maximum for V-4 (30.93 %) (Table 1.17).

**Table 1.17 : Yield parameters of cashew genotypes in MLT-II at Jagdalpur centre**

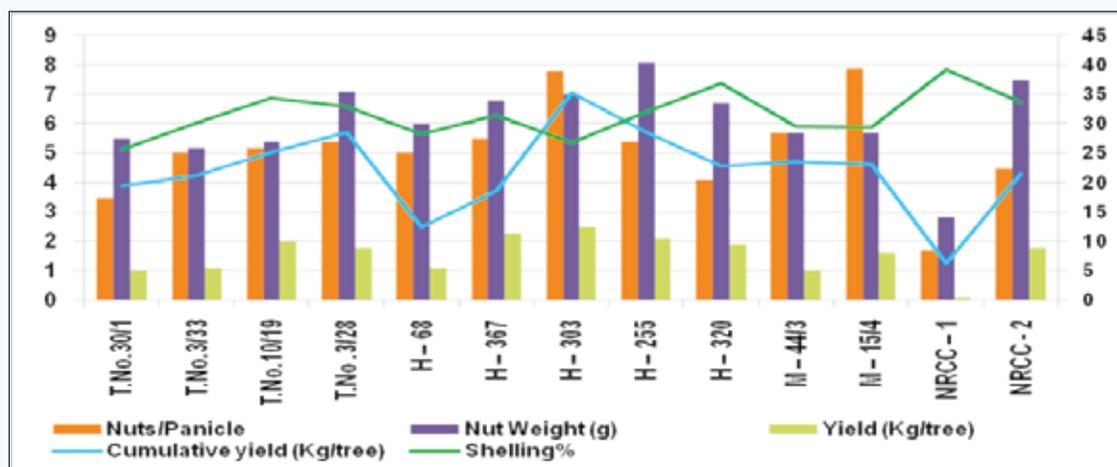
Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) 11 Hvsts
T.No. 30/1	6.10	44.32	27.70	3.97	20.24
T.No. 3/33	6.50	49.23	29.97	3.72	19.34
T.No. 10/19	5.57	51.63	28.83	4.23	21.40
T.No. 3/28	7.25	51.27	29.70	3.63	18.09
H- 68	8.60	59.57	30.17	7.27	37.33
H- 255	10.13	69.37	29.57	5.07	24.77
H- 303	7.37	53.10	29.47	5.68	32.96
H- 320	8.23	53.03	29.73	5.32	26.53
H- 367	9.67	72.67	29.83	5.83	29.58
M- 15/4	6.23	48.87	30.47	2.93	15.03
M- 44/3	5.83	49.27	29.77	3.73	19.44
NRCC-Sel-1	7.73	52.37	30.10	3.17	16.77
NRCC-Sel-2	8.62	45.40	29.97	4.75	25.36
V-4	8.03	59.40	30.93	6.63	35.08
SEm ±	0.20	1.79	0.50	0.30	-
CD at 5%	0.58	5.21	1.45	0.89	
CV%	4.63	5.72	2.91	11.27	



## JHARGRAM

Maximum trunk girth was observed in H-367 (78.7 cm). Maximum canopy spread was recorded in H-320 (3.9m). NRCC Sel-1 had lesser panicles per unit area of canopy (3.1/m<sup>2</sup>). Maximum nuts/m<sup>2</sup> were recorded in H-303 (19.7 nuts/m<sup>2</sup>) and M-15/4 (19.6 nuts/m<sup>2</sup>) which were on par.

Maximum nuts/panicle was recorded in M-15/4 (7.9 nuts/panicle) and H-303 (7.8 nuts/panicle) which were on par. H-255 produced the boldest nut (8.1g). The annual nut yield was highest in case of H-303 (9.30 kg/tree) followed by T 30/1 (6.77 kg/tree). Cumulative yield was maximum in H-303 (32.80 kg/tree) followed by T.No. 3/28 (26.7 kg/tree for 8 harvests) (Table 1.18).



Yield attributes of different varieties under MLT - II at Jhargram

Table 1.18 : Yield parameters of cashew genotypes in MLT-II at Jhargram centre

Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 8 Hvsts)
T.No. 30/1	4.87	31.3	28.70	6.77	18.5
T.No. 3/33	4.70	43.3	33.75	4.86	20.1
T.No. 10/19	5.04	44.5	33.28	5.41	23.2
T.No. 3/28	5.59	39.5	34.50	5.36	26.7
H-68	5.42	30.5	33.28	1.78	11.4
H-255	5.96	27.3	35.23	3.26	16.3
H-303	5.91	35.0	33.34	9.30	32.8
H-320	6.74	36.7	33.08	4.20	26.4
H-367	6.10	38.8	28.81	5.47	21.0
M-15/4	4.62	32.0	32.29	4.08	22.6
M-44/3	4.84	26.8	33.76	4.19	21.4
NRCC-Sel-1	5.76	27.5	38.43	1.60	6.3
NRCC-Sel-2	6.17	26.2	31.12	3.59	19.8
SEm ±	0.15	1.2	0.54	0.45	1.3
CD at 5%	0.31	2.44	1.10	0.92	2.64
CV%	10.8	11.4	15.4	5.6	28.6



## MADAKKATHARA

Maximum tree height was recorded by H-68 and H-320 (9.17 m) followed by T 40/1 (9.07 m). The maximum stem girth was recorded by T 107/3 (139.43 cm) followed by H- 303 (125.32 cm). T-107/3 recorded maximum number of flowering days (158) followed by T-3/33 (156) days. Highest sex ratio was recorded by T40/1 (0.580) followed by T-30/1 (0.423). T 40/1 recorded the highest apple

weight (96.88 g) followed by H-1608 (81.40 g).

The highest nut weight was recorded in genotype T3/28 (9.70 g) followed by T 107/3 (9.25 g). M 44/3 recorded the highest annual yield (5.56 kg/tree) and highest cumulative yield was recorded by H- 303 (83.35 kg/tree) followed by H-320 (74.98 kg/tree). Based on the previous two years data genotypes H-303 and H-320 performed well compared to other genotypes (Table 1.19).

**Table 1.19 : Yield and yield attributes of cashew genotypes in MLT-II at Madakkathara Centre.**

Genotypes	Nut wt (g)	Apple wt. (g)	Shelling %	Nut Yield 2013-14 (kg/tree)	Cum. nut Yield (kg/tree) (17 years)
T30/1	8.54	49.28	24.20	3.83	37.59
T 3/33	7.86	45.83	22.90	5.00	36.10
T 10/19	8.33	50.66	23.67	4.43	29.20
T 3/28	9.70	71.58	24.50	4.18	46.50
Hy 68	8.23	56.83	26.30	4.25	36.41
Hy 367	8.98	78.66	24.10	3.69	39.37
Hy 303	8.98	68.77	21.30	4.25	83.35
Hy 255	8.93	71.39	22.40	4.84	36.84
Hy 320	8.80	70.68	22.87	4.53	74.98
M 44/3	9.14	60.41	23.40	5.56	48.72
M 15/4	8.81	55.25	24.20	3.55	54.08
VTH 107/3	9.25	76.80	24.30	3.87	35.76
VTH 40/1	8.45	96.88	24.70	3.95	42.95
H1608	8.97	81.40	23.16	4.21	64.02
CD@0.05		17.73			

## VENGURLA

The maximum height and spread was observed in T. No. 30/1 (7.57 m and 10.7 m respectively), whereas, maximum girth was observed in T. No. 10/19 (112.5 cm). The mean nut weight (9.73 g) and mean apple weight (107.66 g) was found to be maximum in H-367 whereas the

maximum cumulative yield for eleven harvests (40.26 kg/tree) was recorded in H-303, which was followed by 30/1 (33.26 kg/tree) and H-255 (32.60 kg/tree). Maximum shelling percentage of 30.66 was recorded in H-255 followed by 29.66 in NRCC Sel-1 (Table 1.20).



**Table 1.20 : Growth and yield observations in MLT- II at Vengurle Centre**

Variety / type	Mean Flow Durtn. (Days)	Mean fruit set / m <sup>2</sup>	Mean Nut weight (g)	Mean Apple weight (g)	Mean yield (kg/ tree)	Mean yield (t/ha)	Cum. Yield kg/tree (11 hvsts)	Shelling %
H-255	99.00	54.50	9.40	65.33	3.29	0.67	32.60	30.66
H-303	100.40	46.33	8.90	62.00	3.29	0.67	40.26	28.50
H-320	96.40	54.43	9.00	66.00	3.95	0.80	26.97	29.83
H-367	98.16	53.25	9.73	107.66	4.76	0.97	29.58	28.16
NRCC Sel.1	101.56	47.75	8.33	61.66	2.68	0.54	25.81	29.66
NRCC Sel.2	101.66	42.61	7.03	65.33	2.43	0.49	18.08	28.00
M-44/3	69.73	30.78	2.66	21.00	0.50	0.10	10.30	33.00
M-15/4	68.33	34.92	5.00	37.33	2.01	0.41	15.42	27.75
10/19	102.90	53.92	5.56	54.33	3.05	0.62	24.88	29.50
3/28	67.53	32.08	4.13	37.33	1.61	0.32	13.37	29.25
3/33	97.43	51.33	7.00	51.00	2.98	0.60	21.02	29.50
30/1	103.46	49.58	6.76	53.66	3.20	0.65	33.26	27.33
SEm ±	17.49	10.35	1.19	9.80	1.68	0.34	-	0.78
CD at 5%	NS	NS	3.49	28.73	NS	NS	-	2.29





### Gen. 3. Multi Location Trial - II (Centres wherein trial concluded)

#### BHUBANESWAR

Thirteen cashew varieties released from different centers were evaluated for fourteen years (1997 - 2011).

The mean number of nuts/ panicle ranged from 1.70 (H 255) to 4.20 (H 303). The mean nut weight was maximum in H 367 (9.7 g). Nine out of 13 varieties had bold nut recording more than 7.0 g nut weight. The apple weight ranged from 30.25 g (M 44/3) to 92.56 g (H 376). The duration of flowering varied from 59 days in NRCC Sel.-2 to 96 days in BPP 30/1. The varieties viz., M 44/3, M 15/4, BPP 30/1 and BPP 3/28 were found as early bearing types. Shelling percentage of varieties ranged from 28.78 (H 367) to 31.68 (H 255). Seven out of 13 varieties had shelling percentage of more than 30 viz., M15/4 (30.43%), H-303 (30.2%), H-68 (30.01%), NRCC-Sel.-2 (30.63%), BPP3/33 (31.12%), NRCC-Sel.-1 (31.6%) and H 255 (31.68%) (Table 1.21).

The results indicated that the nut yield stabilized from 9<sup>th</sup> harvest onwards. The nut yield (kg/plant) at 9<sup>th</sup> harvest and cumulative nut yield (kg/plant) for fourteen harvests was maximum in H 303 (10.00 and 106.81 respectively) followed by NRCC Sel.-2 (10.50 and 100.01 respectively).

#### Conclusion :

The nut yield over fourteen harvests in cashew indicated that H 303 followed by H 320 produced consistent nut yield. Consistent and significantly higher nut yield (kg/plant) as well as higher cumulative nut yield (kg/ plant) was obtained in H 303, NRCC Sel. 2 and H 68 which are also bold nut types having nut weight more than 8.0 g, cluster bearing habit and higher shelling percentage of more than 28.0.

**Table 1.21 : Yield attributing traits of promising cashew genotypes (1997-2011).**

Cashew types	Nuts / panicle	Nut weight(g)	Apple wt.(g)	Shelling (%)
NRCC Sel. 1	2.3	7.7	63.83	31.60
NRCC Sel. 2	3.3	8.7	65.77	30.63
M44/3	4.2	5.4	30.25	30.68
M15/4	2.3	7.1	60.71	30.43
BPP 3/33	3.1	6.5	55.63	31.12
BPP 10/19	3.0	6.2	52.88	29.96
BPP 30/1	4.1	6.3	40.64	28.89
BPP3/28	3.5	7.5	60.47	30.56
H 303	4.2	8.1	59.94	30.20
H 320	3.3	8.2	64.31	29.04
H 255	1.7	9.5	67.40	31.68
H 367	2.2	9.7	92.65	28.78
H 68	3.7	8.1	61.77	30.01



## HOGALAGERE

The trial was planted during 1992 with identified released varieties. The mean plant height ranged from 5.42 m to 6.76 m, with highest plant height in H-303 (6.76 m), followed by H-320 (6.59 m). The mean stem girth ranged from 60.26 cm to 82.51 cm and significantly highest stem girth was observed in H-303 (82.51 cm), followed by H-320 (78.25 cm). The maximum canopy spread was observed in cashew varieties H-303 (8.48m), followed by H-320, H-68 and TN-10/19 (7.85m each) which were on par. The mean number of flowering laterals (m<sup>2</sup>) in different cashew varieties ranged from 6.9 to 40.3. The higher number of flowering laterals (m<sup>2</sup>) was observed in H-303 (40.3). There was a significant difference among different cashew varieties with respect to number of flowering laterals/m<sup>2</sup> (Table 1.22a).

The highest number of nuts per panicle was recorded in H-303 (19.6), followed by H-320 (18.1) and H-68 (17.9). The highest nut weight was observed in H-303 (8.20g), followed by H-320 (7.60g). The maximum apple weight was observed

in H-303 (89.7 g), followed by H-320 (85.2 g). The mean nut weight and mean apple weight in different cashew varieties differed significantly with each other .

The highest number of nuts (m<sup>2</sup>) was observed in cashew variety H-303 (7.32). The highest shelling percentage was observed in H-303 (30.4%), followed by H-320 (30.1%) and H-68 (30.0%). The highest nut yield (kg/tree) was recorded in H-303 (8.20kg/tree). The mean cumulative nut yield (kg/tree) in different cashew varieties ranged from 54.2 to 147.3kg/tree. The maximum cumulative nut yield (kg/tree) was recorded in H-303 (147.3kg/tree) followed by H-320 (129.1kg/tree). There was a significant difference among different cashew varieties with respect to mean cumulative nut yield (kg/tree) (Table 1.22b).

### Conclusion:

From the above trials, it can be concluded that the cashew varieties; H-303, H-320 and M-44/3 can be recommended for its cultivation in maidan parts (Eastern dry Zone) of Karnataka.

**Table 1.22a: Mean growth and yield parameters of different cashew accessions under MLT-II (MLT-1992) from 1992 to 2013 at ARS, Chintamani**

Accession No.	Mean Plant height (m)	Mean stem girth (cm)	Mean canopy spread (m)	Mean flowering laterals/ m <sup>2</sup> (Nos)
T.No. 30/1	6.10	76.39	7.75	23.10
T.No. 3/33	5.97	72.12	7.58	31.90
T.No. 10/19	5.68	76.58	7.85	29.00
T.No. 3/28	6.15	60.26	8.33	25.30
H- 68	6.31	71.58	7.85	21.50
H- 255	5.42	61.45	6.93	17.50
H- 303	6.76	82.51	8.48	40.30
H- 320	6.59	78.25	7.85	36.40
H- 367	5.96	76.85	7.81	19.90
M- 15/4	5.80	69.22	7.41	24.40
M- 44/3	6.52	72.87	7.08	24.60
NRCC-Sel-1	6.15	72.41	7.79	6.90
NRCC-Sel-2	6.14	71.47	7.79	19.90
Ullal-1	5.94	70.74	7.79	25.10
Sem ±	0.03	0.46	0.03	0.05
CD at 5%	0.08	1.40	0.10	0.18



**Table 1.22b: Mean growth and yield parameters of different cashew accessions under MLT-II (MLT-1992) from 1992 to 2013 at ARS, Chintamani**

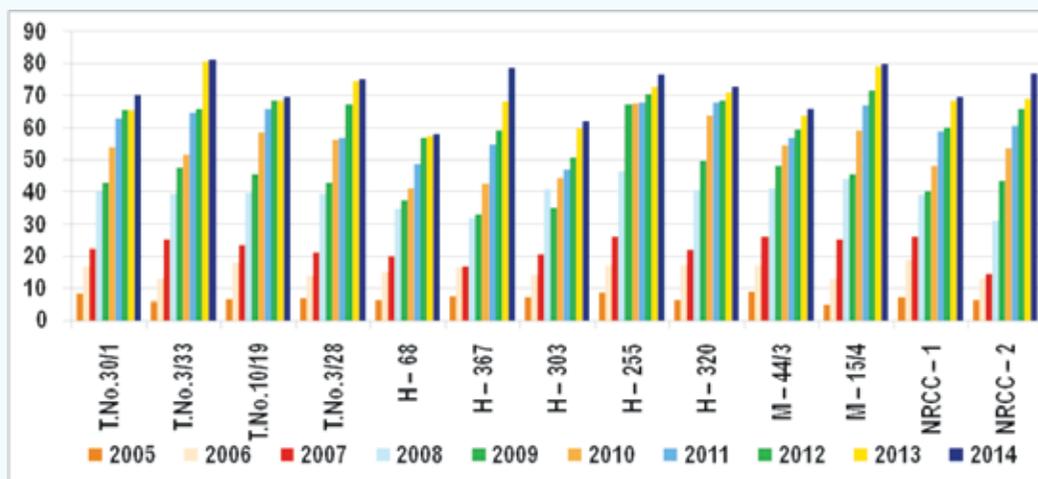
Accession No.	Mean Nuts/ m <sup>2</sup> (Nos)	Mean shelling (%)	Mean Nut weight (g)	Mean Cumulative yield (kg/tree)
T.No. 30/1	4.82	27.10	7.10	100.6
T.No. 3/33	5.03	29.10	5.40	75.8
T.No. 10/19	5.71	26.70	4.80	72.9
T.No. 3/28	5.66	29.10	6.60	97.8
H- 68	5.60	30.00	4.90	54.2
H- 255	6.22	29.30	5.40	86.5
H- 303	7.32	30.40	8.20	147.3
H- 320	7.11	30.10	7.60	129.1
H- 367	5.23	29.80	6.50	85.3
M- 15/4	4.55	29.00	6.80	112.9
M- 44/3	4.69	29.10	5.80	116.8
NRCC-Sel-1	6.76	29.80	6.20	89.4
NRCC-Sel-2	4.97	29.90	6.90	97.9
Ullal-1	5.97	29.10	7.20	97.3
Sem ±	0.14	0.17	0.04	0.95
CD at 5%	0.42	0.51	0.12	2.67

**JHARGRAM**

This trial was planted during 2005 with identified cashew varieties.

Maximum girth was observed in T.No.3/33 (81.3 cm) followed by M- 15/4 (80cm) and H- 367 (78.7 cm).

At two years, canopy spread was maximum in T.No. 10/19 (2.43m) followed by M- 44/3 (2.42 m), H- 367 (2.4m) and H- 320 (2.4m). The varieties were on par with respect to canopy spread initially but later on, significant differences were noticed. The rate of increase in canopy spread was maximum during 5-6 years of age.

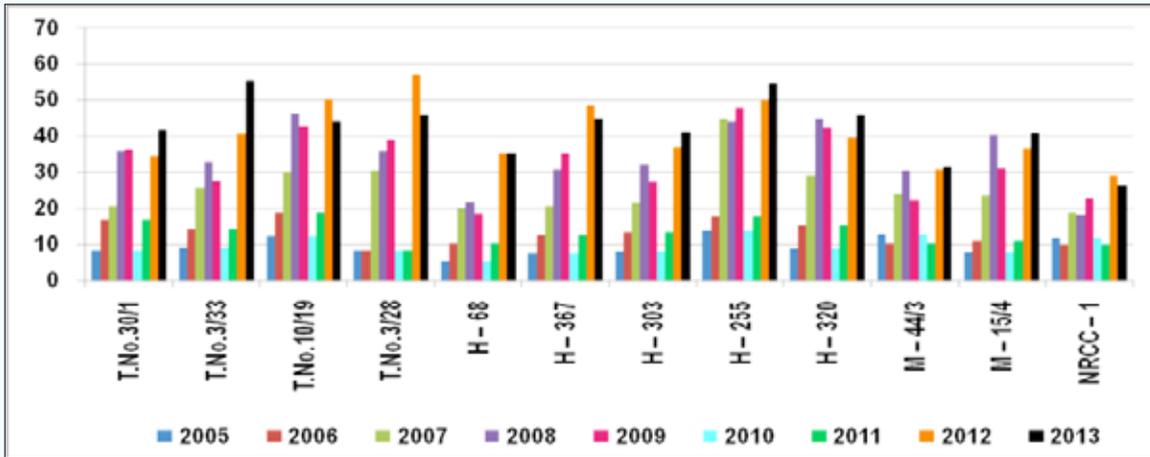


**Trunk girth (cm), of varieties under Multilocation Trial - II during 2005 - 2014 at Jhargram**



Maximum canopy area was recorded in T.No. 3/33 (55.4m<sup>2</sup>) and H-255 (54.7 m<sup>2</sup>) while minimum area was with NRCC Sel-1 (13.9 m<sup>2</sup>). It was noticed that the mean duration of flowering was longest in H-367 (75.6 days) while the short duration varieties were T.No. 3/28 (61.1 days) and H-303 (62.9 days).

Significant variations were recorded with respect to flowering density. Pooled data of 8 years revealed that NRCC Sel- 2 had highest flowering density (16.07 /m<sup>2</sup>) and it was minimum in NRCC Sel-1 (7.43/m<sup>2</sup>).



Canopy area (m<sup>2</sup>), of varieties under MLT - II during 2005 - 2014 at Jhargram

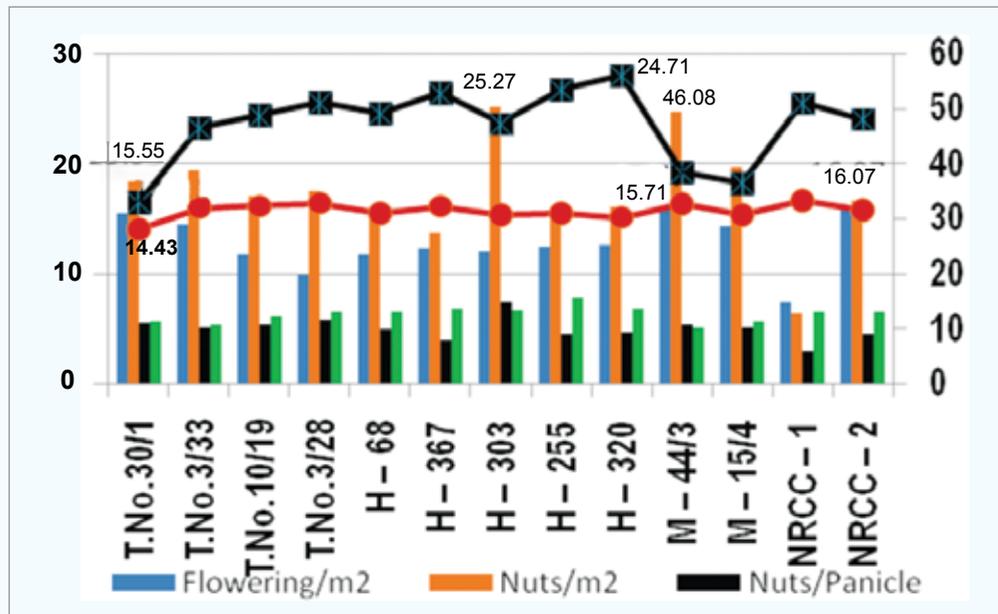
The range of nuts/m<sup>2</sup> was 6.43 to 25.27 and the maximum was in H-303 (25.27) followed by M-44/3 (24.71). It was observed that H-303 had highest number of nuts/panicle (7.41). Boldest nut was recorded with H-255 (7.76g). Heaviest apples were recorded in H-320 (56.08g) followed by H-255 (53.47g). It was found that the juice content in cashew apple was highest in T.No. 3/28 (64.4 %) followed by NRCC Sel-2 (53.6 %).

The highest cumulative yield for 8 harvests was obtained in H-303 (35.3 kg/tree) followed by H-255 and T.No. 3/28 (28.5 kg nut/tree each). All the varieties, had more than 30% shelling except T.No. 30/1 (28.06%) and the highest was with NRCC Sel-1 (33.39%) (Table 1.23).



**Table 1.23 : Yield (kg/tree) of varieties under Multilocation Trial - II during 2005 - 2014 at Jhargram**

Variety	Yield (kg/tree)								Cumulative Yield (kg/tree) 8 hvsts
	2007	2008	2009	2010	2011	2012	2013	2014	
T.No.30/1	0.67	0.99	2.36	3.8	4.9	4.6	6.77	1.0	19.5
T.No.3/33	0.41	0.66	3.48	4.5	3.3	6.6	4.86	1.1	21.2
T.No.10/19	0.51	1.24	2.74	5.4	4.3	7.0	5.41	2.0	25.2
T.No.3/28	0.46	0.55	3.80	5.8	5.4	10.0	5.36	1.8	28.5
H - 68	0.44	0.41	2.17	3.5	2.6	3.9	1.78	1.1	12.5
H - 367	0.34	0.95	0.69	5.5	2.9	6.2	3.26	2.3	18.6
H - 303	0.75	0.71	4.08	7.4	3.7	10.6	9.30	2.5	35.3
H - 255	0.85	0.90	6.34	10.4	6.8	6.1	4.20	2.1	28.5
H - 320	0.52	0.88	3.64	6.2	4.9	6.9	5.47	1.9	22.9
M - 44/3	0.82	0.59	4.88	4.1	2.4	5.9	4.08	1.0	23.6
M - 15/4	0.37	0.41	5.09	7.2	4.1	5.4	4.19	1.6	23.1
NRCC Sel - 1	0.60	0.50	0.91	1.1	0.2	1.2	1.60	0.1	6.21
NRCC Sel - 2	0.45	0.69	4.32	4.9	2.6	5.9	3.59	1.8	21.6
SEm (±)	0.1978	0.25	1.354	0.94	1.00	2.14	0.45	0.20	1.4
C.D. at 5%	0.408	0.52	2.794	1.94	2.10	4.42	0.92	0.41	2.88



**Yield attributing characters of varieties under MLT - II at Jhargram**



The number of nuts per panicle and the nuts per unit area of canopy was maximum in H-303 (7.41 and 25.27, respectively). Bold nuts were observed in H- 255, H- 303, NRCC-Sel-1, H- 320, NRCC- Sel-2 and T.No. 3/28 having more than 7.0 g nut weight.

**Conclusion :**

Based on cumulative yield the best yielding varieties were H-303 (35.3 Kg/tree) followed by H- 255 and T.No. 3/28 both produced 28.5 kg nut/tree which were identified as promising types for the red and laterite zone of west Bengal.

**VENGURLA**

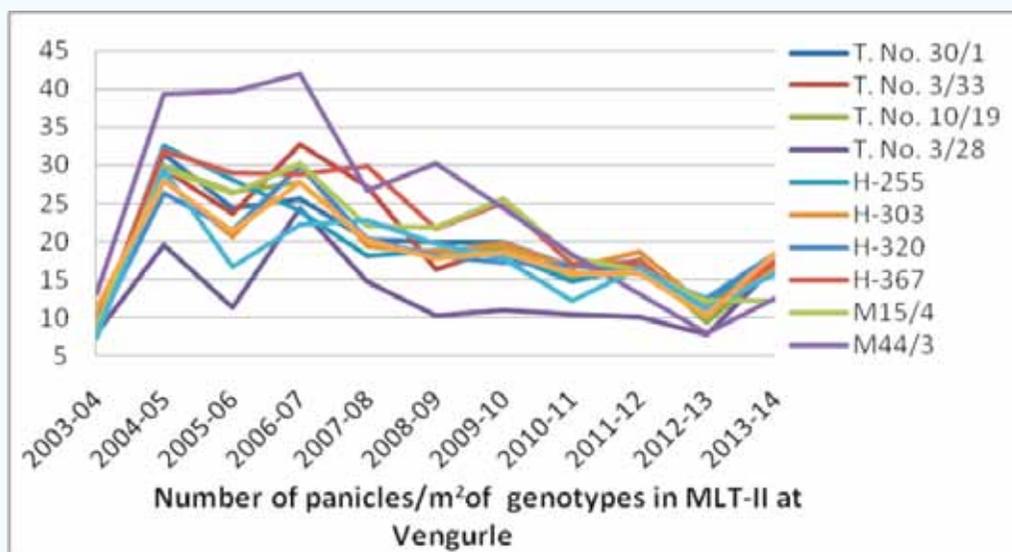
The trial was planted during 2003 with identified varieties. T.No. 30/1 recorded significantly maximum height which was on par with the H-320, T.No. 3/28, NRCC-Sel-1, T.No. 3/33 and H-255. Among the different genotypes, minimum height was observed in M 44/3 and H-367.

The trunk girth and mean canopy significantly varied during initial growth period only up to 8 years. Significant difference among the cashew genotypes in respect of EW canopy spread (m) occurred only during the initial 8 years (2004-05 to 2006-07).

H-255 recorded significantly maximum mean canopy spread of 7.52 m and was at par with T. No. 30/1 (6.65 m), NRCC Sel.1 (6.56 m), T. No. 10/19 (6.19 m), T.No. 3/33 (6.19 m) during the year 2004-05. The production of laterals/m<sup>2</sup> significantly varied in the various cashew genotypes only during the years 2003-04, 2006-07, 2008-09 and 2009-10.

T. No. 3/33 recorded significantly maximum number of laterals/m<sup>2</sup> (18.73/m<sup>2</sup>) while M 44/3 produced significantly maximum number of laterals/m<sup>2</sup> i.e. 51.97/m<sup>2</sup> and 44.8/m<sup>2</sup> during the later years. The pooled data for 11 years revealed that, M15/4 recorded significantly maximum mean number of laterals/m<sup>2</sup> (33.40 /m<sup>2</sup>) which was at par with H-367 (31.32/m<sup>2</sup>).

In 2009-10, M15/4 recorded significantly maximum number of panicle/m<sup>2</sup> (25.6/m<sup>2</sup>) and on par with H-367 (25.0/m<sup>2</sup>), T. No. 30/1 (20.0/m<sup>2</sup>), T. No. 10/19 (19.6/m<sup>2</sup>) and H-303 (19.7/m<sup>2</sup>). The pooled data with respect to number of panicle/m<sup>2</sup> for 11 years revealed that, M15/4 recorded maximum (24.29/m<sup>2</sup>) number of panicle/m<sup>2</sup> which was found significantly superior over rest of test varieties.




**Table 1.24 : Yield parameters of cashew genotypes in MLT-II at Vengurle centre during the year 2003-04 to 2013-14**

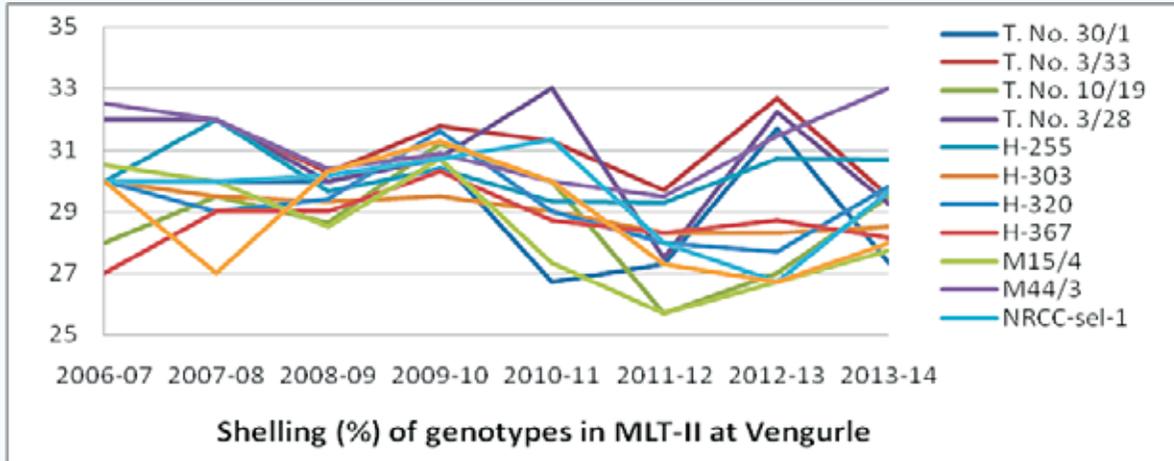
Accession	Pooled mean for Fruit set/m <sup>2</sup> 10 years	Pooled mean for Flowering duration (days) 9 years	Pooled mean for Nut wt (g) 11 years	Pooled mean for Apple wt. (g) 11 years	Pooled mean for Yield (kg/tree) 11 years	Cum. yield (kg/tree) (for 11 Harvests)	Pooled mean for Shelling (%) 8 years
T. No. 30/1	30.02	108.48	6.33	61.78	3.02	33.26	29.21
T. No. 3/33	31.68	107.38	6.90	50.75	1.98	21.02	31.15
T. No. 10/19	29.68	110.38	6.25	52.95	2.26	24.88	28.69
T. No. 3/28	19.78	78.31	5.10	49.64	1.24	13.37	30.84
H-255	30.08	107.89	9.37	68.74	2.97	32.60	30.25
H-303	42.56	109.98	8.88	72.90	3.65	40.26	29.05
H-320	33.02	108.29	8.37	69.31	2.45	26.97	29.32
H-367	30.48	110.92	9.98	91.33	2.68	29.58	28.64
M15/4	24.13	107.04	6.91	59.39	1.40	15.42	28.40
M44/3	25.52	98.57	4.76	42.02	0.93	10.30	31.47
NRCC-Sel-1	31.88	107.05	8.03	61.32	2.34	25.81	29.57
NRCC-Sel-2	31.40	107.68	7.13	58.10	1.70	18.08	28.82
SEm±	1.80	1.02	0.20	1.98	0.25	-	0.42
CD @ 5%	NS	NS	0.47	5.55	NS	-	1.14
CV%	32.82	5.34	15.12	17.95	64.00	-	7.97

The evaluated genotypes were non-significant with respect to fruit set/m<sup>2</sup> during the entire period of investigation. H-303 recorded significantly maximum fruit set/m<sup>2</sup> (30.36/m<sup>2</sup>) and maximum number of nuts/panicle (7.3 nuts/panicle), which was at par with NRCC Sel.-1 (6.8), NRCC Sel.-2 (6.7), H-255 (4.7) and H-320 (4.5). No significant variation observed among the genotypes with respect to flowering duration.

H-367 recorded significantly maximum nut weight of 10.20g, 10.77g and 9.73g during the year 2011-12, 2012-13 and 2013-14 respectively. Pooled

analysis of nut weight for 11 years indicated that H-367 recorded maximum nut weight (9.98 g) which was significantly superior.

Significantly maximum apple weight of 91.33g was recorded by H-367 and was on par with H-303 (72.90g). The maximum cumulative yield of 40.26 kg/tree for 11 harvests and 1.63 t/ha was recorded by H-303 and superior over the rest of genotypes. The maximum pooled mean of shelling (%) was noted in T. No. M44/3 (31.47%) which was found at par with T. No. 3/33 (31.15%) and T. No. 3/28 (30.84%) (Table 1.24).



**Conclusion:**

Among the 12 genotypes tested, H-303 performed the best in respect of production of

laterals/m<sup>2</sup>, panicles/m<sup>2</sup>, fruit set/m<sup>2</sup>, number of nuts/panicle, nut weight, apple weight, nut yield as well as shelling (%).



## 2. Multi Location Trial - III

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

The trial comprises of 10 test varieties and one local check variety.

Sponsoring centre	Promising hybrids	TMB tolerant type
CRS, Bhubaneswar	BH 6, BH 85	--
CRS, Madakkathara	H 1597	K 22-1
RFRS, Vengurla	H 662, H 675	--
RRS, Vridhachalam	--	H 11 & H 14
DCR, Puttur	H 32/4	Goa 11/6
Total	6	4
Replications - Three	Spacing 7.5 x 7.5 m	Plot size - 4 plants per plot

### BAPATLA

Among the 11 genotypes evaluated the mean tree height was the highest in H 32/4 (4.41 m). The trunk

girth was maximum with H-32/4 (93.16 cm). The maximum mean canopy spread was noticed in BPP-8 (8.04 m) while the mean canopy surface area was highest in BPP-8 (71.02 m<sup>2</sup>) (Table 1.25).

**Table 1.25 : Growth parameters of cashew genotypes under MLT-III at Bapatla Centre**

Variety/ Genotype	Mean tree height (m)	Canopy Height (m)	Trunk Girth (cm)	Mean canopy spread (m)	Canopy surface area (m <sup>2</sup> )
Goa 11/6	4.06	3.87	87.0	7.28	60.82
H.662	2.78	2.50	63.66	5.36	31.06
H.32/4	4.41	4.09	93.16	7.22	61.72
K.22/1	3.96	3.61	62.33	4.93	33.86
H.11	3.71	3.20	67.66	6.31	45.32
H.675	3.46	3.22	66.66	5.83	40.86
H.14	3.76	3.53	71.3	6.12	44.82
BPP-8	4.30	3.88	82.66	8.04	71.02
H.1597	4.00	3.77	78.33	6.53	51.90
B.H.6	4.19	3.81	73.66	6.79	54.33
B.H.85	4.10	3.76	72.00	6.85	54.60
SEm ±	0.418	0.294	5.89	0.562	7.83
CD@5%	NS	NS	17.49	1.67	23.28



The duration of flowering was shortest in BPP-8 (75.0 days) followed by H-662 (76.0 days). The flowering intensity per /m<sup>2</sup> was significantly

highest with H-675 (41.20). The highest sex ratio was recorded in H-675 (0.35) and mean no of nuts per /m<sup>2</sup> was highest in H-675 (41.20) (Table 1.26).

**Table 1.26 : Yield parameters of cashew genotypes under MLT-III at Bapatla Centre**

Variety/ Genotype	Duration of Flowering (Days)	Flowering Intensity/m <sup>2</sup>	Sex Ratio	Mean No Nut/m <sup>2</sup>	Mean No. Nuts/Panicle
Goa 11/6	84.0	23.42	0.24	22.9	4.22
H.662	76.0	27.31	0.15	13.9	2.63
H.32/4	83.0	22.05	0.20	39.66	6.58
K.22/1	80.0	19.83	0.15	35.0	4.07
H.11	88.0	28.54	0.07	30.91	3.87
H.675	83.0	41.20	0.35	41.20	4.46
H.14	84.0	26.53	0.31	23.50	4.07
BPP-8	75.0	24.63	0.07	25.3	3.91
H.1597	86.0	31.33	0.11	22.5	4.00
B.H.6	89.0	27.03	0.15	34.41	4.97
B.H.85	81.0	23.16	0.14	24.66	3.30
SEm±		1.33	0.008	4.15	0.528
CD@5%		3.977	0.023	12.31	1.56

H-32/4 recorded maximum apple weight of 71.5g. Mean annual nut yield per tree and cumulative nut yield per tree were highest in

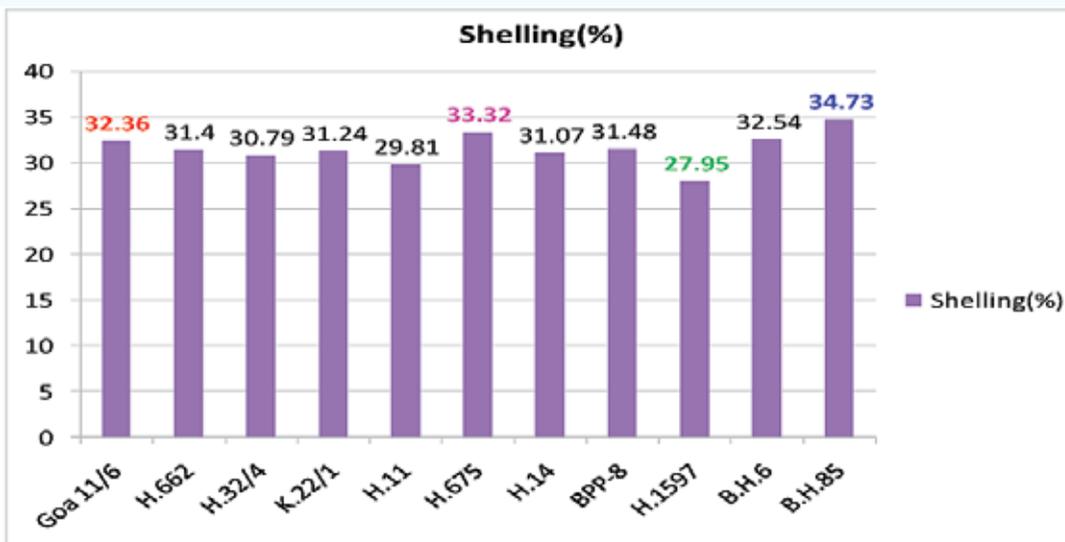
BPP-8 (14.10kg and 46.16kg/tree, respectively) at 7<sup>th</sup> harvest. (Table 1.27).

**Table 1.27 : Yield parameters of cashew genotypes at Bapatla Centre**

Variety/ Genotype	Nut weight (g)	Apple weight (g)	Shelling (%)	Nut yield (kg/tree)	Cum. Nut yield (kg/tree) 7 hvsts
Goa 11/6	5.81	43.3	32.36	12.60	31.59
H.662	6.80	63.0	31.4	5.18	13.88
H.32/4	6.30	71.5	30.79	13.16	36.57
K.22/1	6.53	55.0	31.24	6.65	19.74
H.11	5.18	43.0	29.81	8.65	23.75
H.675	4.11	31.6	33.32	5.41	19.37
H.14	4.95	41.0	31.07	7.06	26.83
BPP-8	7.85	56.6	31.48	14.10	46.16
H.1597	5.97	56.1	27.95	9.55	28.23
B.H.6	6.88	65.76	32.54	9.26	28.66
B.H.85	6.73	68.0	34.73	6.70	22.61
SEm±	0.265	5.84	0.91	1.97	
CD@5%	0.78	17.37	2.72	5.85	



**High yielding variety BPP-8 identified under MLT-III**



**Shelling percentage of different varieties of MLT-III at Bapatla Centre.**

### BHUBANESWAR

Significantly highest tree height (5.41 m) and stem girth (87.17 cm) were recorded in H 32/4. Significantly highest mean canopy area was observed in BPP-8 (104.84m<sup>2</sup>), followed by BH-85 (94.92 m<sup>2</sup>) and H-32/4 (92.88m<sup>2</sup>). K 22-1 (14.76 m<sup>2</sup>) registered significantly lowest plant height (3.13m) and trunk girth (33.67cm).

The accessions BH-85, H-32/4 and Goa-11/6 including the local check BPP-8 showed superiority for majority of nut yield attributing parameters viz., flowering duration (85 to 104), number of

panicles/m<sup>2</sup> (17.63 to 22.05), ratio of male: bisexual flowers (0.21 to 0.36), mean number of nuts/ m<sup>2</sup> (27.91 to 42.59) as well as number of nuts/panicle (5.00 to 6.00).

Significantly better performance of BH 6, BH 85, H 1597 and Goa 11/6 and BPP 8 was observed for mean nut weight (7.17 to 8.60g), shelling percentage (28.17 to 31.33%) and annual yield (6.06 to 7.97kg/ha). The cumulative nut yield (kg/tree) for 8 harvests indicated maximum yield for BH 85 (39.49 kg/tree) followed by BH 6 (34.41 kg /tree) (Table 1.28).



**Table 1.28 : Yield parameters of cashew genotypes in MLT-III at Bhubaneswar Centre**

Accession	Mean nut wt. (g)	Mean apple wt. (g)	Shelling % (kg/tree)	Mean annual nut yield (kg/tree)	Cum. yield (for 8 Harvests)
BH 6	8.13	61.00	31.33	6.06	34.41
BH 85	7.17	50.33	29.33	7.97	39.49
H 1597	8.53	68.00	30.67	7.11	22.27
K 22-1	5.40	36.00	30.33	4.23	11.56
H 662	8.63	65.67	29.33	4.00	12.51
H 675	4.60	37.33	31.00	2.57	10.01
H 11	5.73	34.33	29.27	5.45	24.58
H 14	4.90	24.67	29.93	4.39	19.49
H 32/4	6.53	63.33	28.33	6.27	24.08
Goa 11/6	7.47	59.17	29.20	6.20	28.98
BPP 8 (Local Check)	8.60	64.33	28.17	7.33	27.13
SEm ±	0.53	1.61	0.35	0.54	-
CD at 5%	1.58	4.75	1.05	1.59	-

Based on the past three years yield, the cashew types viz., BH-85, Goa 11/6 and BH6 showed consistency for mean annual nut production (kg/tree) as compared to the other test entries (Table 1.29).

**Table 1.29 : Performance of cashew types in MLT-III at cashew at Bhubaneswar centre**

Accession	Mean annual nut yield(kg/plant)			Cum. yield (kg/tree) (for 8 Harvests)
	2011-12	2012-13	2013-14	
BH 6	7.66	9.0	6.06	34.41
BH 85	7.52	10.3	7.97	39.49
H 1597	1.24	5.7	7.11	22.27
K 22-1	0.73	2.1	4.23	11.56
H 662	0.91	3.2	4.00	12.51
H 675	1.37	2.2	2.57	10.01
H 11	5.90	4.8	5.45	24.58
H 14	2.85	5.6	4.39	19.49
H 32/4	2.23	5.1	6.27	24.08
Goa 11/6	6.08	6.8	6.20	28.98
BPP 8 (Local Check)	1.96	8.1	7.33	27.13
SEm ±	0.66	0.3	0.54	-
CD at 5%	1.96	0.96	1.59	-



## HOGALAGERE

The highest mean tree height was recorded in K-22-1 (5.53m) whereas lowest tree height was observed in H-14 (3.98m). H-32/4 recorded maximum mean stem girth (72.24cm) and mean canopy area (22.55m<sup>2</sup>).

H-1597 had a lowest mean flowering duration of 43.33 days. Highest mean number of panicles per m<sup>2</sup> was recorded in BH-6 (10.64). BH-6 had maximum mean number of nuts per m<sup>2</sup> (22.40)

and the highest nut weight (g) was recorded in H-32/4 (6.21g). Significantly higher mean apple weight was noticed in Goa-11/6 (71.97g). The maximum shelling percentage was recorded in H-1597 (28.84%), followed by Goa-11/6 (28.60%). Significantly higher mean annual nut yield was observed in H-32/4 (7.14 kg/tree) and in H-662 (6.26 kg/tree) followed by Chintamani-1 (6.11 kg/tree). Similarly, maximum cumulative nut yield for 8 harvests was recorded in H-32/4 (48.10 kg/tree) and H-1597 (43.59 kg/tree) (Table 1.30).

**Table 1.30: Yield parameters of cashew genotypes in MLT-III at Chintamani Centre**

Accession	Mean nut wt. (g)	Mean apple wt. (g)	Shelling % (kg/tree)	Mean annual nut yield (kg/tree)	Cum. yield (for 8 Harvests)
BH 6	5.74	68.53	28.35	5.10	37.06
BH 85	5.57	34.05	25.93	4.14	32.90
H 1597	6.04	61.07	28.84	6.08	43.59
K 22-1	5.03	61.65	25.03	5.33	37.73
H 662	4.22	41.85	26.18	6.26	38.86
H 675	3.47	38.62	28.40	3.55	23.10
H 11	4.27	36.75	25.61	4.83	30.37
H 14	3.65	26.82	25.26	1.80	16.26
H 32/4	6.21	39.16	27.39	7.14	48.10
Goa 11/6	5.73	71.97	28.60	4.06	33.10
Chintamani-1	5.31	41.69	28.01	6.11	39.96
SEm ±	0.21	1.69	1.12	0.19	1.43
CD at 5%	0.62	4.99	3.30	0.56	4.21
CV%	21.57	19.34	21.87	20.65	21.51

## MADAKKATHARA

Maximum girth was recorded in H-662 (95.87 cm) followed by Dhana (91.58 cm). Flowering duration was maximum for H 32/4 (157 days) and minimum for BH 85 (122 days). Maximum apple weight was recorded in H-14 (74 g) followed by BH 6 (73.94g). The maximum nut weight was

recorded by Dhana (9.74 g) while the highest nut yield was recorded by H-662 (6.93 kg/tree). H-1593 (31.78kg/tree) and H-662 (30.27kg/tree) gave highest cumulative yield. Based on the previous two years data, Goa 11/6 and H-1593 performed well compared to other genotypes (Table 1.31).


**Table 1.31 : Yield characters of cashew genotypes under MLT III at Madakkathara**

Genotypes	Duration of flowering	Ratio of bisexual: total flowers	No. of Flowering laterals / (m <sup>2</sup> )	Apple wt. (g)	Nut wt. (g)	Yield (kg/tree/Year)	Cum. yield (8 hvsts) (kg/tree)
Dhana	125	0.246	6.03	62.33	9.74	5.30	26.15
H-11	156	0.098	7.18	62.33	9.24	5.85	25.43
H-32/4	157	0.088	7.09	72.11	8.40	5.45	23.85
H-1593	148	0.180	8.48	67.33	9.17	6.00	31.78
BH-6	143	0.081	7.73	73.94	8.10	5.61	22.23
H-662	137	0.070	11.67	47.41	7.58	6.93	30.27
H-675	151	0.069	8.58	60.08	8.18	5.51	23.69
BH-85	122	0.140	4.12	70.66	8.36	4.26	21.50
K-22-1	130	0.201	7.52	63.58	9.52	5.43	22.89
Goa 11/6	123	0.202	8.28	70.33	9.33	4.82	26.77
H-14	150	0.101	6.22	74.00	8.85	4.71	23.99
CD@0.05	7.75	NS		17.73	1.020	1.202	
SEm ±	2.64	0.490		7.06	0.346	0.408	
CV%	3.26	303.69		18.57	6.75	13.00	

### VENGURLA

Maximum mean height was recorded in V-7 (3.3 m) whereas the mean girth was maximum in Goa 11/6 (42.9 cm) and maximum mean canopy

spread was observed in H-675 (5.4 m). Maximum fruit set was recorded in H-1597 (58.4/m<sup>2</sup>). The mean number of nuts per panicle was maximum in H-1597 (9.8 per panicle) and maximum mean nut weight of 8.9g in BH-6 (Table 1.32).

**Table 1.32 : Yield parameters of entries under MLT-III at Vengurla ( replanted in 2008 )**

Variety / Type	Flowering duration (days)	Mean fruit set / m <sup>2</sup>	Mean yield (kg/tree)	Mean yield (t/ ha)	Mean apple weight (g)	Nut wt (g)	Shelling (%)	Cum. Yield kg/tree (2 harvests)
Goa - 11/6	94.3	50.8	2.03	0.42	61.4	7.7	31.8	2.92
H-11	95.0	50.0	2.40	0.49	43.6	5.7	30.7	4.21
B.H.6	99.2	52.8	1.58	0.32	95.5	8.9	31.5	3.22
H-14	94.3	50.9	3.01	0.61	37.7	6.3	32.7	4.55
H-1597	96.3	58.4	2.49	0.51	88.3	7.4	33.2	4.54
K-22/1	99.3	51.0	1.57	0.32	104.2	7.1	31.2	3.11
V-7	97.1	42.1	3.3	0.67	54.3	8.7	32.0	5.12
H-662	95.1	49.3	3.56	0.73	68.4	8.0	31.7	4.93
32/14	96.1	37.4	2.57	0.53	53.3	7.4	31.3	4.51
B.H.-85	95.7	52.7	2.64	0.54	84.4	6.6	32.8	3.37
H-675	96.3	45.2	2.42	0.59	50.0	6.2	33.3	3.55
SEm ±	3.10	4.45	0.53	0.12	6.69	0.39	0.65	
CD at 5%	N.S.	N.S.	N.S.	N.S.	19.74	1.14	N.S	



## VRIDHACHALAM

Significant variations were observed in flowering duration (72 to 86 days), number of panicles/ m<sup>2</sup> (13.2 to 22.2), mean number of 20nuts/ m<sup>2</sup> (20.5 to 38.2) as well as number of nuts/ panicle (3.2 to 6.4). The genotype H14 of Vridhachalam recorded highest number of panicles/ m<sup>2</sup> (22.2),

mean number of nuts/ m<sup>2</sup> (38.2) and number of nuts/ panicle (6.40).

The accessions K22-1, H11, H32/4, Goa 11/6, Goa 11/6 and VRI 3 recorded nut weight more than 7.2 g. The accession H14 of Vridhachalam centre recorded highest nut yield (4.12 kg/tree) and cumulative yield (6.64 kg/tree) (Table 1.33).

**Table 1.33: Yield parameters of cashew genotypes in MLT-III at Vridhachalam Centre**

Accession No.	Mean nut wt. (g)	Mean apple wt. (g)	Shelling % (kg/tree)	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 3 Harvests)
BH 6	7.0	63.2	30.0	2.44	4.56
BH 85	6.8	50.8	29.6	3.80	5.68
H 1597	7.0	52.4	29.2	2.92	5.04
K 22-1	7.2	56.0	28.0	2.08	3.76
H 662	6.8	65.4	30.0	3.02	5.54
H 675	7.0	56.4	30.2	3.94	5.74
H 11	7.2	62.2	29.2	3.56	6.18
H 14	7.0	60.8	29.8	4.12	6.64
H 32/4	7.2	58.4	29.0	3.10	5.18
Goa 11/6	7.4	67.6	29.6	3.08	5.26
VRI-3 (Check)	7.2	54.0	29.0	3.14	5.72
SEm ±	NS	1.2	NS	0.10	
CD at 5%		3.5		0.52	





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

The objective of this experiment is to evaluate the performance of released cashew varieties from various centres for their suitability to different agro-climatic regions.

Treatments :

This MLT-V trial was initiated in 2006 using the following 25 selected varieties.

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

#### BAPATLA

The trial has been freshly laid out at this centre and graft establishment is satisfactory.



Protection of young cashew plants with Palmyra leaves in newly planted MLT-V



## BHUBANESWAR

The mean tree height and mean stem girth ranged from 3.03 m (VRI-3) to 4.43 m (BPP8) and 37.53 cm (Amrutha) to 57.33cm (Jhargram-1). Significantly lower canopy area was recorded in Amrutha (10.87m<sup>2</sup>), Madkathara-2 (11.88m<sup>2</sup>), UN-50 (13.47m<sup>2</sup>), K-22-1 (15.10m<sup>2</sup>), VRI-3 (15.87m<sup>2</sup>), Goa-1 (14.24m<sup>2</sup>) and Ullal-4 (14.24m<sup>2</sup>) which were statistically at par. On the other hand, significantly higher canopy area were recorded with the varieties such as Vengurla-7 (34.78m<sup>2</sup>), Jhargram-1 (30.85m<sup>2</sup>) and Dhana (30.56m<sup>2</sup>). The mean flowering duration varied between 74 days (Ullal-3) to 99 days (Vengurla-4).

Significantly highest panicle per m<sup>2</sup> was recorded in VRI-3 (23.80) and ratio of male to bisexual flowers varied from 0.10 (Jhargram & Ullal) to 0.86 (Kanaka). Significantly highest mean number

of nut per m<sup>2</sup> was observed in BPP-4 (31.75). The number of nuts per panicle varied from 2.00 (Ullal-3) to 6.50 (BPP-6 & Bhubaneswar-1).

The average nut weight varied from 4.70 g (BPP 6) to 8.75 g (Priyanka). The mean apple weight varied from minimum of 24.00 g in VRI-3 to maximum of 76.50g in Priyanka. Shelling percentage ranged from 25.75 (BPP-4) to 30.85 (Ullal-4). The mean annual nut yield (kg/tree) varied from 1.30 (Amrutha) to 6.05 (Vengurla-7) with cumulative nut yield of 3.07 kg/tree (Amrutha) to 11.86 kg/tree (BPP-8) for 4 harvests. The overall yield performance of BPP-8, Vengurla-7, NRCC Sel-2, Ullal-3 and Bhaskara were higher compared to other varieties. The varieties having cumulative nut yield of more than 6kg per plant for 4 harvests were BPP-8, Bhubaneswar-1, Madakkathara-1, Dhana, Kanaka, Vengurla-4, Vengurla-7, VRI-3, NRCC Sel. -2, Ullal-3 and Bhaskara (Table 1.34).

**Table 1.34: Yield parameters of cashew genotypes in MLT-V at Bhubaneswar Centre**

Accessions	Mean nut wt. (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 4 Harvests)
BPP-4	6.20	33.00	25.75	3.33	5.23
BPP-6	4.70	34.00	26.80	2.76	4.03
BPP-8	7.70	69.50	28.90	6.00	11.86
Bhubaneswar-1	6.00	34.50	30.68	3.97	7.12
Chintamani-1	6.80	34.00	30.15	2.60	4.67
Jhargram-1	6.40	59.50	28.40	1.96	3.25
Madakkathara-1	5.70	36.00	28.60	4.10	6.48
Madakkathara-2	7.80	43.00	28.25	1.46	3.03
K-22-1	6.70	47.50	29.50	2.27	4.00
Dhana	7.80	68.00	29.85	4.60	7.28
Kanaka	6.15	51.50	29.90	3.80	7.16
Priyanka	8.75	76.50	27.95	1.51	4.15
Amrutha	8.00	52.50	30.80	1.30	3.07
Vengurla-1	8.30	49.50	29.85	1.71	3.96
Vengurla-4	7.65	41.50	29.69	4.30	7.68
Vengurla-6	7.90	49.00	29.50	2.68	5.20
Vengurla-7	8.50	33.00	30.20	6.05	10.32
VRI-3	6.60	24.00	29.40	4.60	7.80
NRCC Sel-2	7.90	33.00	30.70	5.15	8.81
Ullal-1	8.10	39.50	29.80	2.44	4.22
Ullal-3	7.30	63.00	29.65	4.00	8.04
Ullal-4	7.80	56.00	30.85	2.13	3.73
UN-50	8.20	52.50	29.87	2.18	4.03
Goa-1	6.50	49.50	30.55	2.43	5.25
Bhaskara	6.90	46.00	29.85	5.25	9.85
SEm ±	0.4	3.13	0.53	0.32	-
CD at 5%	1.17	9.13	1.54	0.94	-



## DARISAI

Under Darisai conditions, highest mean tree height (4.06m) was observed in NRCC Sel-2. The highest mean stem girth was observed in NRCC Sel-1 (54.6cm) followed by NRCC Sel-2. The highest

mean canopy spread in E-W & N-S was recorded in NRCC Sel-1 (4.7m & 4.9m respectively) which was significantly superior. The significantly highest mean canopy area was recorded in NRCC Sel-1 (14.4m<sup>2</sup>) (Table 1.35).

**Table 1.35 : Vegetative parameters of cashew genotypes in MLT-V at Darisai Centre**

Accession No.	Mean tree ht. (m)	Mean stem girth (cm)	Mean canopy spread (m)		Mean canopy area (m <sup>2</sup> )
			E-W	N-S	
NRCC Sel-1	3.6*	54.6**	4.7*	4.9**	14.4
NRCC Sel-2	4.06**	49.8*	3.46	3.2*	8.7
BPP-8	3.56*	47.6	3.6	4.1*	11.2
H 303	2.93	38.4	2.9	2.4	7.2
H 320	2.8	36.7	4.6	3.5*	11.4
H 68	3.4*	47.8	2.7	3.2*	5.3
H 367	3.36*	38	3.36	3.6*	8.4
H 255	3.2*	36.5	1.9	2.4	4.5
BPP3/28	1.9	29.7	2.2	1.8	3.7
BPP30/1	2.2	27.6	1.76	2.5	4.75
M15/4	2.4	24.5	1.8	2.06	3.93
SEm ±	0.590	2.092	0.328	0.256	0.455
CD at 5%	1.240	6.214	0.973	0.760	1.351
CV%	23.778	9.242	18.914	14.486	10.377

## HOGALAGERE

The highest tree height was recorded in BPP-8 (4.21m), and stem girth was maximum in Vengurla-6 (51.72 cm). The higher mean canopy area was noticed in UN-50 (10.21). The flowering duration was higher in UN-50 (59.5 days) while lowest flowering duration was noticed in VRI-3 (38.9 days).

The highest nut weight was recorded in Chintamani-1 (6.30g) and mean apple weight was maximum in Dhana (35.5g). The highest shelling percentage was recorded in NRCC Sel-2 (34.47%), followed by UN-50 (32.31%) and Ullal-4 (30.54%). Mean annual nut yield was maximum in Ullal-1 (2.61 kg/tree) and cumulative nut yield for 4 harvests was highest in Ullal-1 (7.51 kg/tree) (Table 1.36).

**Table 1.36 : Yield parameters of cashew genotypes in MLT-V at ARS, Chintamani Centre**

Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (4 hvsts)
BPP-4	4.87	25.4	29.10	1.80	5.18
BPP-6	3.16	16.6	29.38	1.99	5.72
BPP-8	4.89	27.3	25.13	1.52	4.37
Bhubaneswar-1	3.94	23.8	27.55	1.37	3.94
Chintamani-1	6.30	22.5	24.08	2.59	7.45
Jhargram-1	4.02	28.4	28.18	1.11	3.19
Madakkathara-1	3.70	21.4	21.89	0.84	2.43
Madakkathara-2	4.89	27.5	23.99	1.52	4.37
K-22-1	4.66	31.6	28.09	1.99	5.72
Dhana	4.80	35.5	26.99	2.29	6.59
Kanaka	4.33	24.9	27.00	1.33	3.83
Priyanka	4.99	30.7	22.73	1.39	4.00
Amrutha	5.34	31.2	29.40	1.56	4.48
Vengurla-1	4.27	18.1	26.82	1.54	4.43
Vengurla-4	4.44	19.5	25.11	1.97	5.67
Vengurla-6	5.29	22.1	24.55	1.52	4.37
Vengurla-7	5.62	27.3	24.72	1.22	3.51
VRI-3	5.13	20.4	24.56	0.88	2.54
NRCC Sel-2	3.90	17.8	34.47	0.92	2.65
Ullal-1	5.85	27.3	28.36	2.61	7.51
Ullal-3	5.75	21.0	31.06	1.14	3.29
Ullal-4	5.74	31.3	30.54	2.06	5.94
UN-50	5.72	33.3	32.31	2.10	6.05
Goa-1	5.54	32.1	26.37	2.40	6.91
Bhaskara	4.98	26.0	28.09	2.18	6.26
SEm ±	0.35	1.97	2.42	0.13	0.38
CD at 5%	0.99	5.61	6.87	0.36	1.03
CV%	12.31	13.28	20.05	12.94	16.84

### JHARGRAM

Bhaskara and Ullal - 4 had maximum tree height of 3.3 m and maximum girth was noticed in Ullal - 4. Maximum canopy area was recorded in Bhaskara (21.7m<sup>2</sup>) followed by Ullal - 4 (17.5 m<sup>2</sup>) and Ullal - 1 (16.5m<sup>2</sup>).

BPP - 8 had maximum flowering intensity (22.6 flowering laterals /m<sup>2</sup>). UN- 50 had maximum

number of nuts/panicle (10.4) followed by Goa- 1 (8.4 nuts/panicle), the exception of Vengurla- 6 all other varieties had shelling percentage more than 28.0. Maximum yield was obtained in NRCC Sel-2 (2.0 kg/tree) followed by Bhaskara and UN-50 (1.9 kg/tree). Maximum cumulative yield of 3.8kg/tree was obtained in Amrutha. (Table 1.37).


**Table 1.37 : Yield parameters of cashew genotypes in MLT-V at Jhargram Centre (Year of Planting:2010)**

Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (4 hvsts)
BPP-4	6.2	31.5	28.6	0.9	1.5
BPP-6	4.8	39.4	32.4	1.4	2.0
BPP-8	5.4	61.5	31.0	0.6	2.1
Bhubaneswar-1	4.7	24.0	30.6	1.5	3.0
Chintamani-1	5.1	24.8	31.3	1.2	1.9
Jhargram-1	5.0	45.3	40.5	1.0	2.2
Madakkathara-1	4.6	25.4	33.0	0.5	0.8
Madakkathara-2	5.6	30.0	31.5	1.8	2.1
K-22-1	6.1	41.5	33.5	1.5	2.2
Dhana	5.6	42.2	37.0	0.8	1.5
Kanaka	5.5	35.3	28.0	1.0	1.9
Priyanka	6.1	35.3	29.5	0.6	0.8
Amrutha	5.1	30.4	33.9	1.8	3.8
Vengurla-1	8.1	57.1	34.0	0.9	2.0
Vengurla-4	5.6	32.4	32.9	1.8	2.8
Vengurla-6	4.7	42.6	27.3	0.5	1.6
Vengurla-7	7.9	48.6	32.0	1.8	3.2
VRI-3	5.8	36.8	35.1	0.9	2.2
NRCC Sel-2	6.5	50.2	48.6	2.0	2.8
Ullal-1	6.5	62.2	30.4	0.8	2.2
Ullal-3	6.6	60.8	31.8	0.3	1.5
Ullal-4	5.6	53.8	30.5	1.4	2.6
UN-50	4.7	36.5	32.2	1.9	2.9
Goa-1	6.1	47.4	33.9	1.6	2.5
Bhaskara	6.0	46.4	34.6	1.9	2.8
SEm ±	0.09	1.14	0.49	0.07	0.10
CD at 5%	0.18	2.28	0.98	0.14	0.20
CV%	6.3	14.3	6.2	4.32	35.3

### MADAKKATHARA

The variety, UN-50 recorded maximum height (5.72 m) followed by Madakkathara-2 (5.64m). Variety K22-1 recorded highest girth (61.54 cm) followed by Madakkathara-1 (59.38 cm). V-1 and

Jhargram recorded maximum spread (7.00m) followed by UN-50 (6.99 m). Highest yield was recorded by Kanaka (2.85 kg/tree). The highest cumulative yield was recorded by Dhana (5.64 kg/tree) followed by Jhargram (5.52 kg/tree) (Table 1.38).

**Table 1.38 : Yield performance of cashew varieties under MLT-V at Madakkathara Centre**

Variety	Ratio of bisexual: total flowers	No. of Flowering laterals / (m <sup>2</sup> )	Yield (kg/tree Year)	Cumulative yield (kg/tree) (3 hvsts)
Bhaskara	0.16	7.00	1.56	5.32
UN 50	0.19	9.00	1.94	4.84
Ullal-I	0.12	5.00	1.42	3.72
Ullal -3	0.19	7.10	1.94	5.22
Ullal-4	0.14	6.00	1.50	5.16
NRCC sel-2	0.18	6.70	1.80	4.84
V1	0.19	9.00	2.04	4.84
V4	0.16	8.00	1.63	4.17
V6	0.18	9.00	2.16	4.88
Madakkathara-1	0.18	10.00	2.58	4.98
Madakkathara-2	0.15	8.18	2.02	4.53
K-22-1	0.17	11.00	1.96	4.18
Jhargram-1	0.20	9.10	2.24	5.52
Chinthamani-1	0.20	9.00	2.00	4.36
BPP-4	0.16	6.90	1.87	4.19
Priyanka	0.21	9.96	2.16	5.40
Dhana	0.16	10.10	2.63	5.64
Kanaka	0.33	6.36	2.85	5.34
Amrutha	0.22	9.80	2.18	4.98
Vridhachalam-3	0.16	9.16	2.28	4.76

### PILICODE

Higher number of flowering laterals per sq.m was observed in NRCC Sel-2. The variety Dhana had higher sex ratio with more proportion of bisexual flowers followed by Amritha and Ullal 3. BPP 6 produced apples with highest weight (105.0g).

Highest nut size of 12.3g and 12g was observed in Priyanka and Amritha respectively. The cumulative yield (kg/tree) for 2 harvests was obtained in Bhaskara (3.75kg.) followed by Madakathara-1 (3.45kg.) (Table 1.39).

**Table 1.39 : Yield parameters of the varieties in MLT-V at Pilicode Centre**

Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 2 Harvests)
BPP-6	5.80	105.0	0.23	0.33
BPP-8	-	-	0.00	0.00
Bhubaneswar-1	5.20	75.0	0.10	0.30
Madakkathara-1	7.25	44.0	0.45	3.45
Madakkathara-2	7.10	60.0	0.95	2.45
K-22-1	7.90	52.0	0.85	1.30
Dhana	8.00	59.0	0.30	0.70
Kanaka	10.20	59.0	1.64	1.94
Priyanka	12.30	63.0	6.53	7.03
Amrutha	12.00	62.5	1.45	1.85
Vengurla-4	7.40	53.5	0.50	0.60
Vengurla-7	9.60	47.2	0.95	0.95
VRI-3	6.10	50.0	0.45	0.45
NRCC Sel-2	11.20	84.6	1.13	1.68
Ullal-1	7.00	49.6	1.00	1.00
Ullal-3	7.20	50.5	0.98	1.28
UN-50	10.60	62.3	0.85	1.00
Goa-1	6.80	54.3	0.19	0.39
Bhaskara	7.60	54.0	0.20	3.70
Mean	8.29	60.31	0.99	1.60
F Test	**	**	**	**
CD at p=0.05	0.55	1.57	0.19	0.30

### VRIDHACHALAM

The mean tree height ranged from 3.03m (VRI-3) to 3.42m (Bhaskara). Higher canopy area was recorded in Ullal 4 and UN 50. The flowering duration varied with a mean flowering duration of 62 days to 86 days. VRI-3 recorded maximum number of panicle/ m<sup>2</sup> and highest mean number of nuts/ m<sup>2</sup>. The number of nuts/ panicle varied from 4.2 to 6.4.

Maximum nut weight of 7.8 g was recorded by Priyanka. The varieties BPP4, BPP-8, Madkathara-2,

Amrutha, Vengurla-4, Vengurla-7, VRI 3 and Ullal-4 recorded nut weight of 7.2g.

Apple weight varied from minimum of 51.2g in BPP 6 to maximum of 70.0 in Vengurla-4. Shelling ranged from 26.2 % (BPP-4) to 30.2 % (Vengurlal-4). Nut yield/tree recorded significant differences among the varieties. The mean annual nut yield/plant (kg) varied from 2.48 (Bhubaneswar 1) to 3.82 (Vengurla-4) with cumulative nut yield of 3.98 (Bhubaneswar 1) to 5.92 (VRI 3) for 3 harvests (Table 1.40).



**Table 1.40 : Yield parameters of cashew genotypes in MLT-V planted during 2008 at Vridhachalam centre**

Accession No.	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (for 3 hvsts)
BPP-4	7.2	63.3	26.2	3.26	5.18
BPP-6	5.0	51.2	27.4	3.32	5.52
BPP-8	7.2	66.2	28.0	3.40	5.88
Bhubaneswar-1	6.6	56.7	26.8	2.48	3.98
Chintamani-1	6.0	66.6	27.0	2.78	4.54
Jhargram-1	5.8	53.3	28.2	2.72	4.42
Madakkathara-1	6.2	52.7	28.0	3.42	5.72
Madakkathara-2	7.2	60.4	29.2	2.92	5.12
K-22-1	6.6	59.4	30.0	3.20	5.42
Dhana	7.0	59.5	28.6	2.94	5.08
Kanaka	6.6	56.7	27.8	3.32	5.56
Priyanka	7.8	68.1	29.4	3.06	5.56
Amrutha	7.2	61.2	29.8	2.94	5.14
Vengurla-1	6.6	60.7	29.0	3.50	5.58
Vengurla-4	7.2	70.0	30.2	3.82	5.74
Vengurla-6	6.8	58.4	28.4	2.90	4.94
Vengurla-7	7.2	67.6	29.2	3.30	5.86
VRI-3	7.2	59.0	27.4	3.34	5.92
NRCC Sel-2	7.0	60.2	28.6	3.00	4.64
Ullal-1	6.8	53.0	29.2	3.02	5.04
Ullal-3	7.0	51.8	28.2	2.98	4.88
Ullal-4	7.2	59.0	28.0	2.85	5.25
UN-50	7.0	56.2	29.2	3.04	5.20
Goa-1	7.0	61.6	30.0	2.78	5.30
Bhaskara	6.8	62.5	28.6	3.26	5.72
SEm ±	0.07	1.35	0.16	0.07	
CD at 5%	0.22	2.92	0.40	0.22	



## 4. Special Multi Location Trial ( MLT - VI )

The objective of this experiment is to evaluate selected released varieties in new centres started during XI Plan (2009).

### Experimental details:

Two rows each, of the cashew varieties (listed below) comprising of six plants per row.

#### Varieties :

NRCC Sel-2	Bhaskara	BPP-8	Dhana	VRI-3
VRI (CW) H-1	H 303	Vengurla-4 (Common check)		Local Check *

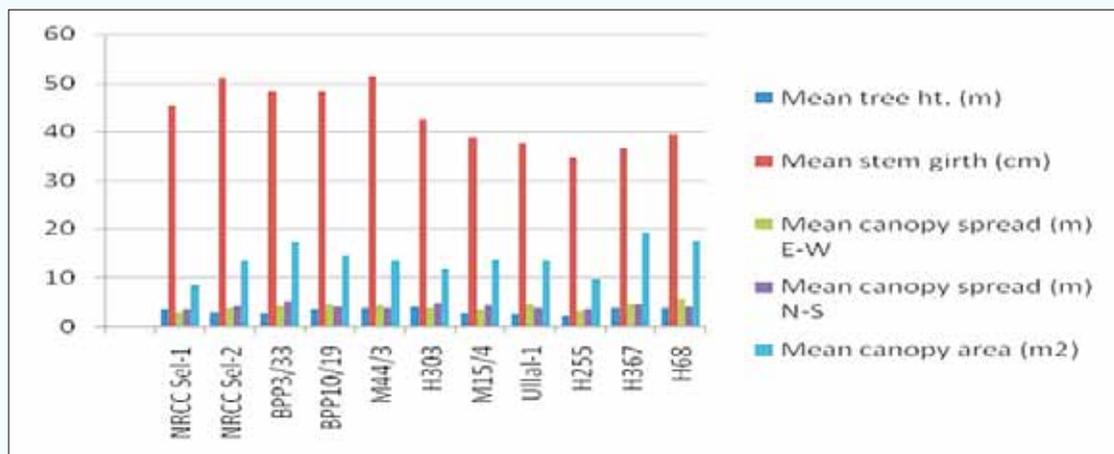
#### \* Local Check for New Centres :

BAU Centre	:	BPP-8
Paria, Arabhavi & Tura	:	V-4
Goa	:	Goa-1 or Goa 2

### DARISAI

Highest mean tree height was observed in H 303 (3.98m) closely followed by H 68 (3.76m) & M44/3 (3.76m). The mean stem girth was maximum in M44/3 (51.3 cm) followed by NRCC Sel-2 (50.86cm). The highest mean canopy spread

E-W was observed in H 68 (5.48m) and the highest mean canopy spread N-S was noted in BPP3/33 (4.86m). The significantly highest mean canopy area was observed in H 367 (19.1m<sup>2</sup>) followed by H 68 (17.6m<sup>2</sup>).



### GOA

During the year, Vengurla-8 recorded significantly higher nut yield of 3.88kg/tree followed by Bhaskara (3.33kg/tree) and Priyanka (2.3kg/

tree), as against the corresponding nut yield of 3.76, 3.48 and 1.95 kg/tree during the previous season. Nut weight and apple weight were stable over the years (Table 1.41).



**Table 1.41 : Initial trends of growth and yield on different cashew varieties**

Variety	Height (m)	Nut yield (kg/tree)			Nut weight (g)			Apple weight (g)		
		11-12	2012-13	13-14	11-12	2012-13	13-14	11-12	2012-13	13-14
Vengurla-8	3.4	0.98	3.76	3.88	8.2	8.28	8.17	78.5	85.5	82.6
Dhana	2.8	0.52	1.86	1.68	7.55	7.72	7.52	68.5	70.6	66.3
Raghava	2.8	0.35	1.96	2.01	7.68	7.90	7.25	60.4	65.5	61.3
Priyanka	3.6	0.85	1.95	2.3	8.12	7.95	8.02	56.6	68.5	65.7
Bhaskara	3.1	1.1	3.48	3.33	7.75	7.45	7.33	55.65	59.4	54.6
Ullal-3	2.9	0.65	2.04	1.89	8.28	8.11	8.10	70.2	72.3	68.3
Tiswadi-3	2.8	0.98	1.91	1.65	9.8	10.1	9.95	98.3	102.3	91.2
NRCC Sel.2	1.5	-	-	-	-	-	-	-	-	-
VRI-3	1.4	-	-	-	-	-	-	-	-	-
Sem ±	0.28		-	0.27	0.211	0.19	0.14	4.10	3.88	3.08
CD (5%)	0.71	N.S	-	0.89	0.687	0.78	0.58	14.6	16.23	13.5



## Gen.4. Hybridization and Selection

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

### BAPATLA

Among different hybrids under evaluation, the maximum flowering duration was recorded in H-14 (131.0 days) and mean no of flowering laterals for

square meter was maximum in H-67 (31.75). The sex ratio was highest in H-94 (0.25) while mean number of nuts per square meter area was highest (48.0) in H-76.

**Table 1.42 : Yield parameters of different cashew hybrids at Bapatla Centre (planted during 1997).**

Hybrid No.	Cross combination	Mean Nut wt (g)	Mean apple wt. (g)	Shelling %	Annual nut yield (kg/tree)	Cum. Nut yield (kg/tree) 12 hvsts
H-9	T 273 x T 72	6.748	50.0	31.28	4.30	89.38
H-14	T 228 x T2/22	4.606	30.0	28.22	15.90	110.04
H-19	T 228 x T2/22	3.521	35.0	30.68	5.70	87.01
H-36	F.No 3 x T 30/1	8.271	50.0	28.84	24.2	145.45
H-38	BPP 6 x T2/22	4.791	25.0	31.49	21.3	103.43
H-49	BPP-8 x T 2/22	6.912	40.0	23.96	13.6	100.18
H-61	T 71 x T 273	4.296	25.0	36.54	16.15	79.95
H-64	T 71 x T 273	4.576	30.0	28.64	3.95	98.33
H-65	T 71 x T 273	3.579	25.0	36.96	6.80	85.97
H-67	T 71 x T 273	4.427	25.0	31.99	14.5	153.75
H-73	T 71 x T 273	5.233	45.0	30.47	6.60	108.91
H-76	T 71 x T 273	5.058	30.0	36.89	22.1	116.93

Mean nut weight was highest in H-36 (8.29 g) and maximum mean apple weight was 50.0g in H-36. The shelling percentage was highest in H-67 (31.99). The maximum annual nut yield of 24.2 kg per tree was recorded in H-36. The cumulative nut yield for 12 harvests was highest in H-67 (153.75 kg per tree) (Table 1.42).

Among the hybrids planted in 1998, the duration of flowering was minimum in H-94 (89.0 days) and mean nut weight, the cumulative nut yield per tree were found to be maximum with H-94 (6.99g and 40.30 kg respectively) (Table 1.43)



**Table 1.43 : Yield parameters of different cashew hybrids at Bapatla Centre (planted during 1998)**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Annual nut yield (kg/tree)	Cum.nut yield (kg/tree) 5 hvts
H85	BPP-8 x T No. 228	5.26	50.0	23.63	6.90	35.06
H94	Priyanka x VRI-2	6.99	20.0	20.86	6.50	40.30
H110	Priyanka x BPP-8	5.95	50.0	18.14	2.50	17.75

Among hybrids planted in 1999, the maximum mean nut weight was recorded in H-165 (7.70g). The apple weight was also maximum with H-165 & H169 (50.0 g). The highest shelling percentage

was obtained in H-169 (33.81) and the mean annual nut yield was highest in H-165 (9.90 kg/tree). The cumulative nut yield per tree for 5 harvests was maximum in H-132 (47.62 kg) (Table 1.44).

**Table 1.44 : Yield parameters of different cashew hybrids at Bapatla Centre (planted during 1999)**

Hybrid No.	Cross combination	Mean nut wt. (g)	Mean apple wt. (g)	Shelling %	Annual nut yield (kg/tree)	Cum. nut yield (kg/tree)
H132	T No 71 x T No 273	5.44	25.0	20.59	7.80	47.62
H136	T No. 71 x T No 273	4.79	45.0	30.79	6.20	45.85
H150	BPP 5 x BPP 9	6.67	35.0	28.60	4.20	24.46
H151	T No 228 x Priyanka	4.96	25.0	28.19	6.40	45.20
H159	T No 30/1 x T No 228	3.68	25.0	30.29	5.10	32.55
H165	BPP 6 x BPP 9	7.70	50.0	31.15	9.90	37.05
H168	Priyanka x T No 30/1	6.47	20.0	30.01	5.10	47.60
H169	BPP 8 x BPP 6	6.66	50.0	33.81	6.10	30.83
H170	BPP 8 x Priyanka	6.70	30.0	27.01	9.60	39.85

Among hybrids of 2000, the mean no of flowering laterals per square meter was maximum in H-179 (29.5). The sex ratio was highest in H-200

(0.260) and highest mean number of nuts/m<sup>2</sup> was recorded in H-190 (58.0).

**Table 1.45 : Yield parameters of different cashew hybrids planted during 2000 at Bapatla Centre**

Hybrid No.	Cross combination	Mean nut wt. (g)	Mean apple wt. (g)	Shelling %	Annual nut yield (kg/tree)	Cum. Nut yield (kg/tree)
H179	BPP-6 x T No. 2/22	6.24	30.0	32.93	4.90	43.92
H180	BPP-6 x T No. 2/22	4.66	37.0	24.51	3.60	44.20
H186	T No. 228 x T No. 273	5.45	35.0	21.82	8.40	44.75
H187	T No. 228 x T No. 273	4.02	35.0	31.08	6.30	40.07
H190	T No. 228 x T No. 273	5.10	45.0	25.04	6.10	35.15
H194	T No. 228 x F No. 5	6.27	80.0	22.83	6.40	30.95
H197	T No. 228 x F No. 5	4.52	30.0	26.81	8.80	46.85
H200	T No. 228 x BPP8	5.75	45.0	26.27	6.60	31.20
H218	Priyanka x T No. 30/1	10.15	40.0	32.63	15.80	50.45



The mean nut weight was maximum in H-218 (10.15 g) and highest mean apple weight was recorded in H-194 (80.0 g). The highest shelling percentage was found in H-179 (32.93). The annual

nut yield per tree was highest in H-218 (15.80kg) while the cumulative nut yield per tree was highest in H-218 (50.45 kg).



**Promising Cashew F1 hybrid H-218 planted during 2000**

Among the different hybrids of 2001, the mean no. of flowering laterals per square meter was found highest in H-233 (29.50) and maximum sex ratio was found in H-239 (0.55). The mean no. of nuts per square meter area (53.0) and mean no. of nuts per panicle (9.50) were highest in H-230. The maximum mean annual nut yield per tree was recorded with H-230 (11.3 kg), while H-239 had a maximum cumulative nut yield (64.32 kg/tree) for 5 harvests (Table 1.46).

**Table 1.46 : Yield parameters of different cashew hybrids at Bapatla Centre (planted during 2001)**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Annual nut yield (kg/tree) 2014	Cum.nut yield (kg/tree) 5 hvts
H230	T No. 228 x Priyanka	6.99	20.0	21.78	11.3	59.32
H232	T No. 228 x Priyanka	3.88	25.0	34.98	7.50	32.60
H233	T No. 228 x Priyanka	5.91	40.0	24.34	9.50	50.47
H238	BPP 5 x T No. 2/22	4.65	25.0	25.78	9.40	41.60
H239	BPP 5 x T No. 2/22	4.10	40.0	34.63	6.60	64.32

Among the hybrids of 2006, the mean nut weight was highest in H-362 (9.98g). The shelling percentage was highest in H-356 (33.5). The mean

annual nut yield per tree was highest in H-319 (10.95 kg) and cumulative nut yield was highest in H-355 (30.95 kg) for 3 harvests (Table 1.47).


**Table 1.47 : Yield parameters of different cashew hybrids at Bapatla Centre (planted during 2006)**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Annual nut yield (kg/tree) 3 <sup>rd</sup> Harvest	Cum.nut yield (kg/tree) 3 hvts
H230	T No. 228 x Priyanka	6.99	20.0	21.78	11.3	59.32
H-298	BPP6 x NRCC SEL2	5.62	30.0	33.48	5.50	10.55
H-302	BPP6 x NRCC SEL2	5.04	45.0	33.47	1.80	5.40
H-319	BPP6 x NRCC Sel 2	6.22	40.0	26.62	10.95	15.45
H-320	BPP6 x NRCC Sel 2	8.25	30.0	28.75	3.00	4.95
H-338	BPP8 x T No. 228	8.55	50.0	27.36	2.50	6.25
H-343	T No. 228 x BPP8	4.61	45.0	32.31	3.60	7.70
H-355	BPP8 x T No. 10/19	6.23	50.0	23.35	3.80	30.95
H-356	BPP8 x T No. 10/19	4.61	30.0	33.50	8.00	19.70
H-358	BPP8 x T No. 10/19	9.18	75.0	27.01	5.05	10.38
H-362	BPP8 x BPP3	9.98	55.0	25.48	4.90	9.83
H-365	BPP8 x BPP3	5.94	65.0	29.95	9.50	27.60
H-369	T No. 228 x BPP-8	6.26	45.0	31.47	1.90	3.58

Among hybrids of 2007, the mean nut weight was highest in H-420 (11.26g) and shelling percentage was highest with H-420 (35.17). The

mean annual nut yield was highest in H-410 (10.1 kg / tree) and cumulative nut yield was highest in H-410 (13.30 kg/tree) (Table 1.48).

**Table 1.48 : Yield parameters of different cashew hybrids at Bapatla Centre (planted during 2007)**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. Nut Yield (kg/tree) 2 hvts
H377	BPP8 x T No. 10/19	5.92	75.0	31.43	4.10	4.60
H381	BPP8 x H 320	5.07	35.0	37.00	6.95	9.75
H382	BPP8 x H 320	9.08	45.0	27.80	6.75	8.85
H387	BPP-8 x H 255	6.87	50.0	34.94	6.55	8.65
H407	Priyanka x BPP-4	6.68	60.0	28.56	5.4	8.50
H410	T No. 228 x BPP-8	4.13	40.0	29.70	10.10	13.30
H420	BPP8 x Priyanka	11.26	100.0	35.17	1.2	1.95

Among the hybrids of 2008, the highest mean nut weight was recorded in H-437 (7.45 g) and the mean apple weight was maximum in H-436 (75.0 g). Maximum shelling percentage of 33.85

was obtained in H-436 (33.85) and maximum mean annual nut yield per tree at first harvest was obtained in H-431 (2.10 kg/tree) (Table 1.49).

**Table 1.49 : Yield parameters of different cashew hybrids at Bapatla Centre (planted during 2008).**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)
H 422	T.No.228xBPP-8	5.60	55.0	33.52	0.60
H 428	TNo.10/19xBPP9	4.98	65.0	31.38	1.40
H 431	H-303xBPP-5	6.04	50.0	20.80	2.10
H 432	T.No.228 x T.No.10/19	5.51	35.0	21.63	0.75
H436	T.No.228 x T.No.10/19	7.11	75.0	33.85	0.80
H 437	T.No.228 x T.No.10/19	7.45	65.0	30.00	0.80

Among the different hybrids of 2009, the highest mean nut weight was recorded in H-474 (10.12 g) and the mean apple weight was highest with H-482 (95.0 g). The maximum shelling percentage was recorded in H-487 (30.93). The mean annual nut yield was highest in H-474 (3.90 kg).

### BHUBANESWAR

Among hybrids planted from 1997 to 2003, maximum flowering duration was recorded in A-1-105 and J-5-13 (94 days each) while minimum was recorded in hybrid F-4-24 (76 days). Ratio of male to bisexual flower varied from 0.34 in hybrid E-5-20 to 0.10 in hybrid D-3-11. The hybrid A-1-105 recorded maximum nuts per panicle (6.5) followed by J-5-13 (6.2) and H-6-6 (6.0).

Among the hybrids planted in the year 1995, A-9 was found to be the most promising hybrid with respect to mean annual nut yield (12.8kg/tree) and cumulative nut yield (89.3kg/tree) for 15 harvests. The mean nut weight and apple weight of 8.4g and 54.4g respectively were recorded for this hybrid.

Among the 1997 planted hybrids A-1-105 recorded mean annual nut yield (kg/plant), cumulative nut yield (kg/plant), mean nut weight (g) and apple weight (g) of 11.0, 70.9, 8.0 and 55.0 respectively for 13 harvests.

B-2-32 showed promising performance with respect to yield and yield attributing parameters among the hybrids planted during 1998. The hybrid recorded cumulative nut yield, mean annual nut yield, nut weight and apple weight of 53.0kg/tree,

11.30kg/tree, 7.2g and 42.5g respectively for 11 harvests.

In the 1999 hybrid block, D-3-11 recorded mean annual nut yield (kg/plant), nut weight (g), apple weight (g) and cumulative nut weight yield (kg/plant) of 11.0, 10.0, 42.0 and 69.3 respectively for 12 harvests. From the hybrids of 2000 planting, F-4-24 recorded maximum mean nut weight (9.0g) and cumulative nut yield (42.3kg/tree) at 11 harvests, while mean annual nut yield (10.3kg/tree) and mean apple weight (38.8g) were recorded to be maximum in hybrid D-4-6.

Among the hybrids of 2001 planting, maximum mean annual nut yield of 7.8kg/tree was recorded in E-5-20, while mean nut weight (7.5g), mean apple weight (50.0g) and cumulative nut yield (32.3kg/tree) were maximum in hybrid J-5-13. Regarding the hybrids of 2002, D-6-19 recorded maximum mean nut weight (9.2g), mean annual nut yield (2.3kg/tree) as well as cumulative nut yield (16.4kg/tree) which was closely followed by B-6-27 (8.2g, 2.0kg and 16.0kg) and C-6-30 (9.0g, 1.8kg and 16.3kg) respectively.

C-2-6 recorded maximum mean annual nut yield (2.0kg/plant) as well as cumulative nut yield (15.6kg/tree) for 7 harvests. E-7-2 was the second best hybrid with respect to mean annual nut yield (1.7kg/tree) and cumulative nut yield (11.8kg/tree). Hybrid E-7-2 also recorded the maximum nut weight (10.0g) while apple weight was maximum in hybrid J-1-13 (63.0g) (Table 1.50).



**Table 1.50 : Yield parameters of different cashew hybrids at Bhubaneswar Centre**

Hybrid No.	Cross combination	Year of planting	Mean nut wt (g)	Mean apple wt. (g)	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree)
<b>15 harvests</b>						
A-9	Bhubaneswar C-2 x VTH 711/4	1995	8.4	54.4	12.8	89.3
<b>13 harvests</b>						
A-1-105	Bhubaneswar-1 x H2/16	1997	8.0	55.0	11.0	70.9
<b>12 harvests</b>						
B-2-32	H 2/16 x M 44/3	1998	7.2	42.5	11.3	
<b>11 harvests</b>						
D-3-11	M 44/3 x H 2/15	1999	10.0	42.0	11.0	69.3
<b>10 harvests</b>						
D-4-6	H 2/16 x M44/3	2000	7.4	40.0	10.3	39.1
F-4-24	M 44/3 x H 2/15		9.0	38.8	10.0	42.3
<b>9 harvests</b>						
E-5-20	BPP 30/1 x H 2/16	2001	7.2	31.0	7.8	32.0
J-5-13	Bhubaneswar -1 x VTH 711/4		7.5	50.0	6.1	32.3
<b>8 harvests</b>						
B-6-27	RP-1 x VTH 711/4	2002	8.2	70.1	2.0	16.0
C-6-30	RP2 x Kankady		9.0	63.3	1.8	16.3
C-6-41	RP2 x Kankady		8.5	72.0	1.7	15.7
D-6-19	M44/3 x VTH 711/4		9.2	81.6	2.3	16.4
H-6-6	M44/3 x Kalyanpur bold nut		7.1	30.6	1.7	14.8
<b>7 harvests</b>						
C-2-6	RP 2 x Kankady	2003	7.8	58.0	2.2	15.6
E-7-2	OC 56 x VTH 711/4		10.0	60.0	1.7	11.8
E-7-6	OC 56 x VTH 711/4		9.2	34.3	1.4	10.7
J-1-13	RP -1 x OC 22		9.0	63.0	1.1	10.0

Regarding the nut yield consistency of cashew hybrids for last three years, the hybrids such as A-9, A-1-105, D-3-11, D-4-6 and F-4-24 recorded better yield over the years as compared to other hybrids.

### GOA

Among the first set of 12 hybrids, H-31/05, H-22/05 and H-21/05 had vigorous growth habit recording the higher tree height and canopy spread.

The highest tree height of 5.36 m was recorded in H-31/05 followed by H-22/05 (4.9m) and H-21/05 (4.6m). Three hybrids, H-11/05, H-31/05 and H-21/05 showed precocious bearing, while, H-27/05 had late flowering habit.

The hybrid H-31/05 recorded the highest yield of 14.56kg per tree followed by the hybrid 21/05 (6.7kg/tree) and hybrid 12/05 (5.85 kg/



tree). Nut size of 8-9g was recorded in H-14/05, H-21/05 and H-22/05. The percent shelling was

more than 28 per cent in all the hybrids except in H-13/05 and H-30/05 (Table 1.51).

**Table 1.51 : Trend of yield and nut characteristics of first set of hybrids at Goa**

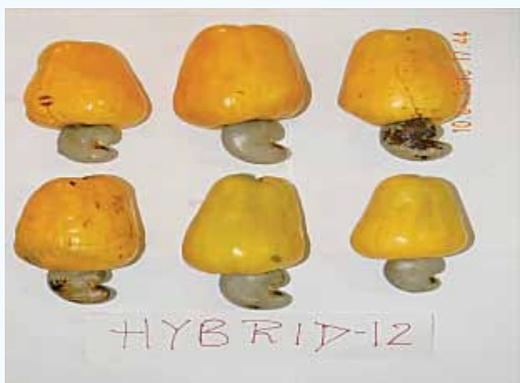
Hybrid	Av. Nut Wt. (g)			Nut yield (kg/tree)			Shelling (%)	
	2010-11	2011-12	2013-14	2010-11	2011-12	2013-14	2011-12	2013-14
H- 5/05	7.2	7.6	7.8	0.09	0.88	1.65	28.63	28.22
H- 14/05	8.1	8.25	8.12	0.1	0.65	1.81	27.45	28.00
H- 11/05	8.0	7.86	7.80	0.55	2.10	4.41	29.05	28.86
H- 12/05	7.8	7.56	7.82	0.15	1.85	5.85	29.65	29.45
H- 13/05	-	7.88	7.91	-	0.32	0.89	28.33	27.92
H- 21/05	8.3	8.26	8.6	1.25	3.12	6.7	29.2	29.15
H- 22/05	8.59	8.88	9.02	0.15	1.95	2.87	29.33	29.21
H- 23/05	7.5	7.66	7.9	0.16	0.78	2.02	28.80	28.86
H- 27/05	-	7.35	7.56	-	0.75	3.35	28.10	28.55
H- 29/05	7.4	7.68	7.60	0.08	0.90	1.55	28.68	28.00
H- 30/05	-	7.55	7.62	-	0.35	1.01	27.80	27.68
H- 31/05	7.0	7.11	7.22	1.0	4.80	14.56	28.14	29.02



**Nut set and nuts of H-21/05**



**Hybrid 22/05**



### HOGALAGERE

The highest mean flowering duration was recorded in H-216 (2/77-Tuni x Vetore-56) (93.79 days) and lowest in H-151 (NRCC-2 x Vetore-56) (57.49 days). The number of flowering laterals/m<sup>2</sup> was highest in H-191 (Ullal-3 x Vetore-56) (5.40). The hybrid H-216 (2/77-Tuni x Vetore-56) recorded highest nuts per square meter (11.83) as well as, number of nuts per panicle (3.88).

H-216 (2/77-Tuni x Vetore-56) recorded highest mean nut weight (8.44 g) and maximum mean cashew apple weight was recorded in H-216 (2/77-Tuni x Vetore-56) (52.3g). The highest shelling percentage was in H-81 (Ullal-3 x Vetore-56) (27.14g). Maximum mean annual nut yield and cumulative nut yield were highest in H-01 (Ullal-3 x Kankady 7/6) (5.8kg/tree & 23.2kg/tree), followed by H-81 (Ullal-3 x Vetore-56) (5.3 kg/tree & 21.2 kg/tree) (Table 1.52).

**Table 1.52: Yield parameters of different cashew hybrids at Chintamani Centre**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree) (8 hvsts.)
H230	T No. 228 x Priyanka	6.99	20.0	21.78	11.3	59.32
H-01	(Ullal-3 x Kankady 7/6)	5.43	42.6	23.34	5.8	23.2
H-81	(Ullal-3 x Vetore-56)	6.25	40.7	27.14	5.3	21.2
H-151	(NRCC-2 x Vetore-56)	5.70	28.5	23.49	0.96	3.84
H-188	(V-5 x Vetore-56)	6.32	32.2	23.64	5.3	21.2
H-191	(Ullal-3 x Vetore-56)	7.40	33.6	22.52	4.96	19.84
H-216	(2/77-Tuni x Vetore-56)	8.44	52.3	25.26	5.24	20.96

### JHARGRAM

Maximum flowering density was recorded in H-121 (15 /m<sup>2</sup>) followed by H- 145 & H-157 (14.5 /m<sup>2</sup>). Number of nuts per square meter was highest in case of H-132 (54/ m<sup>2</sup>) followed by H-126 (51/ m<sup>2</sup>). Maximum number of nuts/panicle was observed in case of H- 126 (51 nuts/panicle).

The hybrids H-72, H-139, H-180, H-160, H-145, H-39 and H-170 produced bold nuts having more than 7g weight. Yield was highest in H-132 (8.2 kg/tree) followed by H-109 (6.9 kg/tree). Highest shelling percentage was recorded in H-179 (35.9%) followed by H-125 (35.3%) and H-180 (35.1%) (Table 1.53)


**Table 1.53 : Yield parameters of different cashew hybrids at Jhargram Centre**

Hybrid No.	Cross combination	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree)
H - 30	Local x2/9 Dicherla	6.0	45.0	33.6	3.8	37.8 (9 hvst)
H - 39	Local x 2/9 Dicherla	7.1	26.0	31.9	3.2	48.5 (9 hvst)
H - 41	Local x 2/9 Dicherla	6.4	47.4	32.8	3.7	32.7(9 hvst)
H- 72	BPP- 8 x BLA- 39-4	8.4	25.0	29.6	1.0	35.7 (8 hvst)
H - 98	BPP- 8 x Vengurla-4	6.6	40.7	34.3	2.1	35.2 (8 hvst)
H - 109	JGM-216 x Yellow Hazari	6.0	22.0	33.7	6.9	22.1 (7 hvst)
H - 126	JGM-216 x Yellow Hazari	5.6	27.9	27.6	6.5	27.4 (7 hvst)
H - 110	JGM-216 x Yellow Hazari	6.0	40.8	30.8	2.7	37.2 (7 hvst)
H - 139	JGM-216 x Yellow Hazari	7.6	96.1	29.9	1.9	26.0 (7 hvst)
H - 145	JGM-216 x BLA	7.2	80.0	28.3	3.0	29.2 (7 hvst)
H - 146	JGM-216 x BLA-39-4	6.8	53.9	32.9	2.6	31.8 (7 hvst)
H - 147	JGM-216 x BLA	6.9	46.2	30.4	2.4	36.0 (7 hvst)
H - 153	JGM-216 x Yellow Hazari	6.0	65.0	32.4	1.0	25.0 (6 hvst)
H - 157	JGM-216 x Yellow Hazari	6.8	47.0	31.0	3.3	39.8 (6 hvst)
H - 158	JGM-216 x Yellow Hazari	6.0	70.0	33.4	1.2	30.1 (6 hvst)
H - 179	JGM-216 x Yellow Hazari	6.0	57.8	35.9	1.4	30.5 (6 hvst)

### MADAKKATHARA

Out of the hybrids planted in 1993, the highest yield was recorded by H 21 (18.20 kg/tree) followed by H 44 (13.00 kg/tree). Highest cumulative yield for 17 years was recorded by H 21 (155.95 kg/tree). Out of hybrids planted in 1994, highest annual yield/tree were given by H 70 (10.00 kg/tree). The highest

cumulative yield/tree for 16 years was obtained in H 73 (87.70 kg/tree) followed by H 70 (79.95 kg/tree).

H 97 and H 95 recorded the highest yield (10.00kg/tree) among the 92 hybrids planted during 1995. The highest cumulative yield /tree for 17 years was recorded by H21 (155.95 kg/tree) (Table 1.54).

**Table 1.54 : Performance of selected F1 hybrids at Madakkathara Centre**

Hy. No.	Cross combinations	Annual yield (kg/tree)	Cum yield (kg/tree) (17 hvsts)	Apple wt. (g)	Nut wt. (g)	Shelling %
1993 planted						
21	BLA -39-4 X P-3-2	18.20	155.95	73.60	7.90	27.40
22	BLA -39-4 X P-3-2	7.00	87.50	104.00	7.60	25.86
35	V-5 X H-1591	6.00	110.00	113.00	9.00	26.38
36	V-5 X H-1591	10.20	115.87	133.00	12.00	25.30
1994 planted						
70	BLA -39-4 x P-3-2	10.00	79.95	69.00	9.00	27.20
73	BLA -39-4 x P-3-2	7.00	87.70	105.00	7.00	24.30
1995 planted						
95	BLA -39-4 x P-3-5	10.00	62.25	123.00	8.70	27.21
97	BLA -39-4 x P-3-7	10.00	71.70	80.00	9.00	25.50



### PILICODE

The hybrids from ANK1 x PLD 57 were tallest and on par with the hybrid from MDK 1 x PLD 57. Higher seed set per sq. m also observed in this cross combination. Hybrids and the parents

were statistically on par with respect to sex ratio. Higher number of flowering laterals per unit area was observed in PLD 57 grafts. PLD 57 (OP) was the shortest with lowest canopy area. The highest yield was obtained in MDK 1 X PLD 57 (5.35 kg/tree) (Table 1.55).

**Table 1.55 : Mean of yield characteristics of different crosses involving PLD-57 at Pilicode**

Hybrid	No. of Panicle /sqm	Number of branches not flowered	Sex ratio (kg/tree)	Seed set/ sqm	Mean annual nut yield
PLD 57 graft	14.38a	7.78e	0.12	1.03d	0.35
PLD 57 (OP)	6.50b	8.50cd	0.14	0.75d	0.30
PLD 57 X ANK-1	3.75c	9.50bc	0.18	2.25c	1.70
ANK-1 X PLD 57	3.75c	9.50bc	0.15	6.00a	1.10
MDK-1 X PLD57	2.69c	10.50a	0.16	3.88b	5.35
MDK-1	2.75c	11.00a	0.14	2.75c	2.65
Mean	5.64	9.46	0.15	2.78	1.91
F test	**	**	NS	**	**
CD 0.05	2.09	1.48	-	0.59	3.29

### VENGURLA

H-1039 (M-44/3 x B.T.22) recorded highest fruit set per sq. m. (34/m<sup>2</sup>) and yield (8.52 kg /tree) (Table 1.56).

**Table 1.56 : Growth and yield performance of promising hybrids at Vengurle Centre**

Hybrid No.	Year of planting	Cross combination	Flow. duration	Fruit set/m <sup>2</sup>	Yield (kg/plant)	Cum yield kg/ tree	Av. Nut wt. (g)	Apple wt (g)	Shelling %
1003	2004	M-26/2 x B.T.65	90	20	5.42	18.43	9.9	35.0	31.5
1039	2001	M-26/2 x B.T.65	92	34	8.52	22.77	8.8	60.0	32.0
1675	2003	V-4 x H-2/16	114	12	4.09	9.58	10.0	50.0	29.5

### VRIDHACHALAM

Evaluation of different hybrids at Vridhachalam revealed that HC 1 resembled VRI 2 in terms of high yield, but had an important advantageous character of easy peeling testa. HC 24 recorded good fruit set, high yield, bold nut (7.6 g) along with easy peeling

testa. HC 10, HC 25, HC 27 and HC 30 were cluster bearing with bold nuts. HC 23 and HC 25 had compact canopy, cluster bearing and bold nuts. HC 17 and HC 23 showed intensive branching pattern occupying less space (Table 1.57).

**Table 1.57 : Yield parameters of promising cashew hybrids at Vridhachalam Centre**

Hybrid No.	Cross combinations	Mean nut wt (g)	Mean apple wt. (g)	Shelling %	Mean annual nut yield (kg/tree)	Cum. yield (kg/tree)	Number of Harvests
HC1	VRI2 x VRI 3	6.04	26.5	27.5	4.75	22.75	6
HC2	VRI 3 x VSK 2	6.54	32.4	26.5	2.60	18.60	6
HC3	VRI 3 x TK 1	6.82	38.5	24.5	1.65	11.65	6
HC4	VRI 3 x SL 1	7.00	37.4	26.0	3.50	21.50	6
HC 5	VRI 3 x VRI 2	7.15	43.2	27.5	2.75	17.75	6
HC6	VRI 3 x KGN 1	6.10	55.4	26.0	1.60	9.60	6
HC8	VRI 3 x PKP 1	6.80	50.4	26.0	2.10	10.60	6
HC9	VRI 3 x PKP 2	6.24	38.5	26.4	3.50	16.50	6
HC10	VRI 3 x KK 1	7.35	30.5	28.5	3.65	18.65	5
HC 17	VRI 3 x AM 1	6.40	32.5	27.0	2.75	16.75	5
HC 22	VRI 3 x TK 1	7.50	55.0	28.5	2.75	12.75	4
HC 23	VRI 3 x AM 1	7.30	30.4	27.6	2.35	10.35	4
HC 24	VRI3 x M 33/3	7.10	32.5	26.0	2.10	11.90	4
HC 25	VRI3 x M 33/3	7.60	50.5	30.0	3.65	14.15	4
HC 27	VRI 3 x SL 1	8.00	52.5	31.5	3.25	16.05	4
HC 30	VRI 3 x PV 1	8.10	53.5	26.8	3.65	14.15	4





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

The objective of the experiment is to identify germplasm having preferred apple characters suitable for value addition.

### BAPATLA

The highest mean nut yield/tree was observed in BLA-39/4 (7.93 kg) followed by T.No.228 (6.96 kg). The maximum apple weight was recorded in Priyanka (125.0 g) while maximum nut weight was recorded with Priyanka (10.55 g). The apple nut ratio was highest in T.No.2/14 (13.19). The maximum juice recovery percentage was found in BLA-39/4 (74.6) (Table 1.52).

The TSS content ranged from 9.6 °Brix to 12.9°Brix with the highest being recorded in Priyanka (12.9). The highest vitamin C was recorded in T.No.8/7 (190.6 mg/100 g) and highest tannin content was registered in BLA-139-1 (3.91). The acidity was highest with BLA – 139-1 (1.19%) and the lowest was recorded with Priyanka (0.47%) (Table 1.58).

**Table 1.58 : Physical parameters of cashew germplasm for cashew apple at Bapatla Centre**

Germplasm	Yield /tree (kg)	Apple wt (g)	Nut wt (g)	Apple nut ratio	Juice recovery (%)
Priyanka	5.63	125.0	10.55	11.84	64.0
T.No. 2/14	3.50	61.5	4.66	13.19	66.8
T.No.17/5	4.60	39.0	3.71	10.51	61.4
T.No. 5/1	5.95	48.0	4.32	11.11	61.6
BLA. 39/4	7.93	33.0	4.42	7.46	74.6
T.No. 3/4	3.76	53.7	5.48	9.79	64.8
T.No. 8/7	3.62	48.0	3.95	12.15	54.2
Hy 95-T4	6.06	48.0	5.24	9.16	67.0
T.No. 228	6.96	43.0	4.74	9.07	71.4
BPP-8	6.59	56.6	7.85	7.21	66.0
SEm±	0.11	2.49	0.41	0.48	2.72
CD at (5%)	0.32	7.31	1.23	1.41	7.99

### BHUBANESWAR

The weight of cashew apple ranged from 33.0g in OC 36 to 58.8g in OC 131. Maximum apple to nut ratio was recorded in OC 147 (7.4) and the lowest was recorded in OC 130 (5.1). The percentage of juice recovery was maximum in screw type juice extractor than mixer grinder. The juice recovery was maximum in OC 84 (71.37) when grinder was used for the purpose. OC124 recorded the highest juice

recovery (84.23%) followed by OC 130 (84.23%) and OC146 (82.53%) in screw type juice extraction. Mean nut yield (kg) per tree was recorded maximum in OC 124 (9.9) followed by OC 147 (9.0) and OC 146 (8.6).

The accession OC 36 recorded maximum values for the parameters viz., total sugar (11.8%), TSS (12.50 brix) and acidity (0.51) among all the tested germplasm. Vitamin C content was recorded



maximum in OC 125 (274.0 mg) followed by OC 124 (271.26 mg) and OC 36 (243.16 mg).

### JAGDALPUR

The apple weight ranged between 45 g to 105 g in CARS-4 and CARS-8 respectively. The

maximum juice recovery was recorded in CARS-8 (75%). The Vit C content varied between 204.6 to 266.6 mg/100 ml juice. The TSS ranged from 9.5 (CARS - 9.50) to 15.8°Brix (CARS-3) Table 1.59).

**Table 1.59 : Physical parameters of cashew germplasm for cashew apple at Jagdalpur Centre**

Germplasm	Age of tree (Years)	Apple wt. (g)	Nut wt. (g)	Apple nut ratio	Colour of apple
CARS-1	31	55	7.00	7.85	Red
CARS-2	31	60	7.20	8.33	Yellow
CARS-3	18	62	8.00	7.75	Red
CARS-4	18	45	6.50	6.92	Yellow
CARS-5	18	72	7.50	9.60	Yellow
CARS-6	18	65	7.00	9.28	Red
CARS-8	18	105	12.50	8.40	Yellow
CARS-9	18	76	9.50	8.00	Red
CARS-10	18	82	10.50	7.80	Yellow
CARS-11	18	86	8.20	10.48	Red

### JHARGRAM

The hybrids H-59, H-120, H-12, H-115 and H-180 had apple weight more than 60g. Maximum juice content was recorded in H-139 (83.8%). The TSS value was highest in H-41 (15.2°Brix) and minimum TSS was in H-110 (1.5 °Brix). Acidity was highest in H-10 (0.4 %) and minimum in H-41 (0.1 %). Total sugar content was maximum in H-117 (14.3%). Apple production was maximum with H-132 (77.9 Kg/tree) followed by JGM-23 (42.4 Kg/tree).

### PILICODE

Highest apple weight was recorded in variety VTH 30 (139.60g). Highest apple to nut ratio was recorded in BPP 6 (18.10). Highest juice recovery was obtained from VTH 30 and the local germplasm KLM (100.00ml each). Acidity was highest in KGN (0.21g/100ml). Tannin content was lowest in OCT (9.97) and was very high in BPP 6 (24.96) (Table 1.60).

**Table 1.60 : Physical characters of apple in different germplasm at Pilicode Centre**

Germplasm details	Apple weight	Apple nut ratio	Juice recovery (ml)	Sugar	Acidity (Citric Acid) g/100ml	Tannin content
PLD57 x ANK	34.52	4.24	50.00	13.60	0.40	13.30
MDK1 x PLD57	45.80	7.90	25.00	12.40	0.32	11.64
Raghav	83.20	12.02	53.60	15.80	0.24	16.30
OCT	68.90	9.99	43.30	14.30	0.26	9.97
PCK A2	73.70	8.53	61.60	12.40	0.27	13.30
VTH 30	139.60	13.70	100.00	11.80	0.24	13.30
V2	71.60	11.37	68.50	12.90	0.40	11.63
KGN	102.90	8.95	63.30	12.50	0.21	13.30
BPP 6	105.00	18.10	50.00	15.70	0.45	24.96
Amritha	100.00	8.33	32.50	14.60	0.45	16.64
KLM	72.10	5.55	100.00	12.50	0.32	11.65
MDK1	44.00	6.03	37.20	13.00	0.59	14.97
PCC 9	--	--	--	16.20	0.28	11.64

### VRIDHACHALAM

VRI 2 recorded the highest juice recovery of 82%. Vitamin C content was more in VRI 3 (312.00 mg/100g) and NF 57 (243.14 mg/100g). The germplasm accessions M 33/2, VRI-2, VRI-3,

VRI (Cw) H1 recorded highest total sugars. TSS was highest in A 5/3 (13.00 °Brix). Tannin content ranged between 0.05 – 0.1 g/ 100g.





## II. CROP MANAGEMENT





## II. CROP MANAGEMENT

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

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

#### Experiment Details :

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

#### BAPATLA

The mean annual nut yield per tree was highest (10.69 kg per tree) in 10 x 5m spaced trees with fertilizer application at 150:50:50 kg/ha [S1M2] which was followed by treatment S1M3 [10.57 kg/tree]. Cumulative nut yield was also highest in the same treatments i.e. S1M2 [51.78kg/tree] and S1M1 [51.36 kg/tree].

The mean plant height and mean canopy height were highest in S3M1 (5.72m & 5.12m and mean trunk girth was maximum in S1M3 (95.80cm) followed by S3M1 (95.23 cm). The mean canopy spread and mean canopy surface area were maximum (7.89m & 79.56m<sup>2</sup> respectively) in S1M1.

The percentage of ground area coverage by canopy was found to be maximum in S3M1 (218.80%).

Minimum duration of flowering was recorded in S3M2 (83.0 days) and mean number of flowering laterals per m<sup>2</sup> was highest in S2M3 (26.38). The mean number of nuts/m<sup>2</sup> was recorded highest in S1M2 (28.01). The mean apple weight was registered to be highest in S1M1 (63.0g) while, mean nut weight was recorded to be highest in S2M1 (7.96g) followed by S2M2 (7.60g). Annual nut yield was maximum in S1M2 (10.69 kg/tree) followed by S1M3 (10.57 kg/tree) at 7<sup>th</sup> harvest. The cumulative nut yield for seven harvests was recorded to be highest in S1M2 (51.78 kg/tree) followed by S1M1 (51.36 kg/tree (Table 2.1).

**Table 2.1 : Effect of tree density and fertilizer levels on yield parameters of cashew at Bapatla Centre**

Treatments	Duration of Flowering (Days)	Sex Ratio	Mean Apple weight (g)	Mean Nut (g)	Mean Nut yield /tree (kg)	Cum. nut yield kg/tree (7 hvsts)
S1M1	90.0	0.120	63.0	7.48	8.17	51.36
S1M2	103.0	0.096	52.5	7.49	10.69	51.78
S1M3	92.00	0.140	59.0	7.27	10.57	35.48



Treatments	Duration of Flowering (Days)	Sex Ratio	Mean Apple weight (g)	Mean Nut (g)	Mean Nut yield /tree (kg)	Cum. nut yield kg/tree (7 hvsts)
S2M1	99.0	0.148	50.93	7.96	6.05	36.10
S2M2	89.0	0.100	54.75	7.60	7.13	40.57
S2M3	89.0	0.119	56.67	7.40	5.85	30.89
S3M1	87.0	0.109	62.72	7.51	5.01	36.56
S3M2	83.0	0.118	44.06	7.26	6.83	32.83
S3M3	86.0	0.121	56.50	7.00	6.70	32.38
SEm±		0.003	6.47	0.307	0.88	
CD@5%		0.008	19.00	NS	2.58	

### BHUBANESWAR

Both tree density and levels of fertilizer had significant influence by vegetative parameters such as plant height, trunk girth, mean canopy diameter and canopy surface area while, ground coverage by canopy (%) was influenced only by fertilizer levels. However, the interaction effects on all the parameters were found to be non-significant.

The tree density, S1 (10mx5m) had significantly highest of plant height (6.64m), trunk

girth (86.68 cm), canopy diameter (9.02 m) as well as canopy surface area (63.99 m<sup>2</sup>). Maximum ground area coverage by canopy was recorded in S3 (135.31 %) at a density of 10 m x 5 m, i.e. 200 plants/ha (Table 2.2 & 2.3).

The tree height (6.34m), canopy diameter (7.35m), canopy surface area (43.82m<sup>2</sup>) as well as ground area coverage by canopy (143.90%) were highest at higher dose of fertilizers, M<sub>3</sub> (N<sub>225</sub>P<sub>75</sub>K<sub>75</sub> kg/ha) (Table 2.2 & 2.3).

**Table 2.2 : Vegetative growth as influenced by tree density and fertilizers at Bhubaneswar**

Treatment	Plant height (m)	Trunk girth (cm)	Mean canopy diameter (m)	Canopy surface area (m <sup>2</sup> )
S1	6.64	86.68	9.02	63.99
S2	5.97	73.32	6.38	32.02
S3	5.82	70.47	5.85	27.06
Mean	6.14	76.82	7.08	41.02
SE m+	0.17	2.12	0.15	1.83
CD@5%	0.57	7.33	0.53	6.33
M1	5.99	74.89	6.85	38.69
M2	6.12	78.37	7.04	40.56
M3	6.34	77.20	7.35	43.82
Mean	6.15	76.82	7.08	41.02
SE m +	0.08	0.85	0.10	1.21
CD@5%	0.24	2.51	0.30	3.59



**Table 2.3 : Effect of tree density and fertilizer application on ground coverage by canopy (%) at Bhubaneswar**

Treatments	Ground area coverage by canopy (%)			Mean
	M1	M2	M3	
S1	125.97	126.92	131.05	127.98
S2	124.82	130.51	144.89	133.41
S3	115.62	134.52	155.77	135.31
Mean	122.14	130.65	143.90	132.23
SE(m)SP	5.98	SE(m) MP	4.16	
CD (5%) SP	NS	CD (5%) MP	12.37	

S1M3 (planting density of 10m x5m with fertilizerat  $N_{225}P_{75}K_{75}$  (kg/ha) treatment recorded maximum plant height (6.68 m), canopy diameter (9.13m) and canopy surface area (65.53 m<sup>2</sup>). Maximum ground area coverage by canopy (155.77%) was recorded in S3M3 (planting density of 5 m x 4 m with fertilizer @  $N_{225}P_{75}K_{75}$  kg/ha).

Significant variations occurred for all the parameters among the tree densities and levels of fertilizers, except for mean annual nut yield (kg/ha). However, non-significant variations were observed for interaction effects of both tree density and levels of fertilizers.

The tree density, S1 (10m x 5m) was significantly superior in respect of number of panicles/m<sup>2</sup> (15.44), average nut weight (8.32g), apple weight (66.49g) as well as nut yield/tree (5.19 kg). Highest mean annual nut yield was recorded in S<sub>3</sub> (1099.58 kg/ha) than S1 and S2, but all were statistically at par. Similarly, the cumulative nut yield over 12 harvests indicated highest nut yield of 51.14 kg/tree in higher tree density of S1 (10m x 5m) than S2 (6m x 4m) and S3. (5m x 4m). Application of M<sub>2</sub> ( $N_{150}P_{50}K_{50}$  kg/ha) in cashew recorded maximum cumulative nut yield of 40.44 kg/tree for 12 harvests. (Table 2.4).

**Table 2.4 : Effect of tree density and fertilizer levels on yield parameters of cashew at Bhubaneswar centre**

Treatment	Mean no. of panicles/ m <sup>2</sup>	Mean nut weight (g) wt. (g)	Mean apple 12 hvsts	Mean annual nut yield		Cum. nut yield (kg/tree)
				(kg/tree)	(kg/ha)	
S1	15.44	8.32	66.49	5.19	1037.03	51.14
S2	12.30	8.20	61.53	2.57	1027.22	33.34
S3	10.06	7.95	59.76	2.20	1099.58	28.97
Mean	12.60	8.16	62.59	3.32	1054.61	37.82
SE (m) +	0.42	0.08	1.39	0.31	61.71	
CD@5%	1.45	0.28	4.80	1.07	NS	
M1	11.33	7.71	60.06	2.66	821.81	35.22
M2	13.47	8.33	62.76	3.75	1198.35	40.44
M3	13.00	8.43	64.97	3.54	1143.68	39.27
Mean	12.60	8.16	62.60	3.31	1054.61	38.31
SE (m)+	0.51	0.08	1.16	0.25	71.22	
CD@5%	1.51	0.23	3.45	0.76	211.61	



**EFFECT OF TREE DENSITY ON NUT YIELD**



**EFFECT OF FERTILIZER ON NUT YIELD**



**Effect of tree density and fertilizer levels on nut yield in cashew**

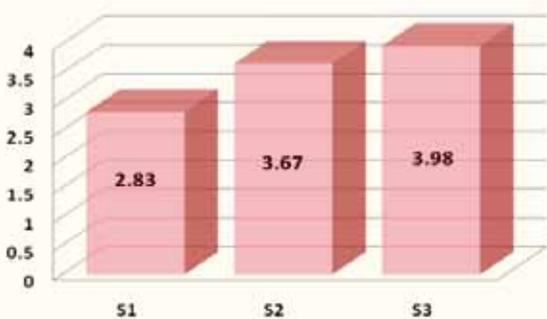
**Table 2.5 : Economics of high density planting based on cumulative yield at Bhubaneswar Centre**

Spacing (Density)	Fertilizer Dose NPK (Kg/ha)	Cum. Cost of cultivation (Rs./ha) Over 12 years (Rs./ha)	Cum. Total return of cashew	Cum. net return (Rs./ha)	Benefit : Cost Ratio
S1: 10m x 5m (200plant/ha)	M1: 75-25-25	171690	440092	268402	2.56
	M2: 150-50-50	185704	598954	413250	3.23
	M3: 225-75-75	199725	537933	338208	2.69
S2: 6m x 4m (400plant/ha)	M1: 75-25-25	175542	617083	441541	3.52
	M2: 150-50-50	189556	749483	559927	3.95
	M3: 225-75-75	203577	723217	519639	3.55
S3: 5m x 4m (500plant/ha)	M1: 75-25-25	177468	699261	521793	3.94
	M2: 150-50-50	191482	818890	627408	4.28
	M3: 225-75-75	205503	761405	555902	3.71

The cumulative total net returns and benefit cost ratio varied significantly due to different tree density as well as, levels of fertilizers. The cumulative cost of cultivation over 12 harvests ranged from Rs. 171690.00 (S1M1) to Rs. 205503.00 (S3M3)

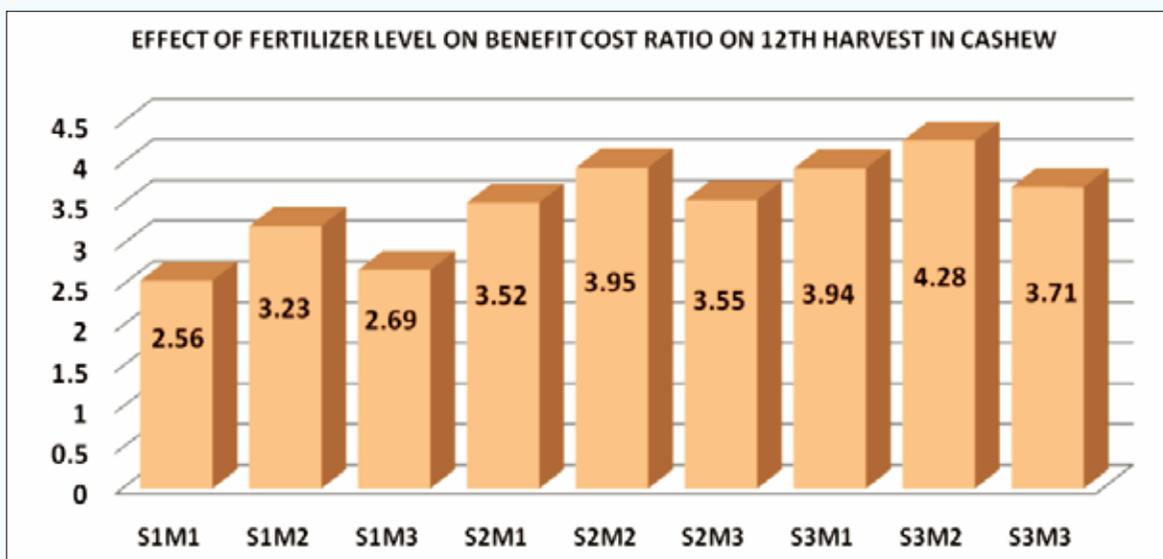
while cumulative net returns varied from Rs.440092.00 (S1M1) to Rs.818890.00 (S3M2). Maximum BCR (4.28) was recorded in the treatment, S3M2 (Table 2.5).

**EFFECT OF TREE DENSITY ON B.C.R.**



**EFFECT OF FERTILIZER LEVEL ON B.C.R.**





**Effect of tree density and fertilizer levels on BCR in Cashew**

Maximum yield was obtained with lower plant density (S1=200 plants/ha) i.e., 1.70, 3.65 and 5.19 kg/tree during 2012, 2013 and 2014 respectively in comparison to the other tree density of S2 (400 plants/ha) or S3 (500 plants/ha). The

nut yield on hectare basis revealed highest nut yield of 647.90 kg and 1099.58 kg during 2012 and 2014 respectively in S3 (500 plants/ha) while it was 730.00 kg in S1 (Table 2.6).

**Table 2.6 : Effect of tree density and fertilizer levels on yield parameters of cashew at Bhubaneswar Centre**

Treatment	Mean annual nut yield					
	2011-12		2012-13		2013-14	
	(kg/tree)	(kg/ha)	(kg/tree)	(kg/ha)	(kg/tree)	(kg/ha)
S1	1.70	339.20	3.65	730.00	5.19	1037.03
S2	1.16	465.00	1.78	712.67	2.57	1027.22
S3	1.30	647.90	1.23	615.42	2.20	1099.58
Mean	1.39	484.03	2.22	686.03	3.32	1054.61
SEm ±	0.41	140.01	0.157	67.75	0.31	61.71
CD@5%	NS	NS	0.543	NS	1.07	NS
M1	1.26	499.20	1.81	538.83	2.66	821.81
M2	1.31	475.80	2.46	754.50	3.75	1198.35
M3	1.59	477.10	2.39	764.75	3.54	1143.68
Mean	1.39	484.03	2.22	686.03	3.31	1054.61
SEm ±	0.34	123.60	0.128	44.61	0.25	71.22
CD@5%	NS	NS	0.382	132.55	0.76	211.61



Application of fertilizer either M3 (N<sub>225</sub> P<sub>75</sub>K<sub>75</sub> kg/ha) or M2 (N<sub>150</sub> P<sub>50</sub>K<sub>50</sub> kg/ha) recorded significantly higher nut yield of 1.31 to 1.59, 2.39 to 2.46 and 3.54 to 3.75 kg/tree during 2012, 2013 and 2014, respectively than the lower fertilizer levels. Similar trend was also observed for nut yield on hectare basis which varied from 475.80 to 477.10 during 2012, 754.50 to 764.75 during 2013 and 1143.68 to 1198.35 kg/ha during 2014, in the treatments M2 and M3 respectively.

Hence, lower tree density, i.e. S<sub>1</sub> (200 plants/ha) recorded significantly higher nut yield (both on tree as well as, hectare basis) while moderate applications of fertilizer levels, i.e. M2 was found to

be the best treatment for optimum yield in cashew, irrespective of planting density.

### DARISAI

The highest mean stem girth was found in S3M1 (49.6cm) and highest mean canopy diameter was noted in S3M2 (4.76m) which was significantly superior to all other treatments. The highest mean canopy surface area was observed in S3M3 (34.38m<sup>2</sup>) closely followed by S3M2 (34.36m<sup>2</sup>). These two treatments were significantly superior to the other treatments. There were no significant differences in ground coverage by canopy (Table 2.7).

**Table 2.7 : Effect of tree density and fertilizer levels on growth parameters of cashew at Darisai**

Treatment	Mean tree height (m)	Mean stem girth (cm)	Mean canopy diameter (m)	Mean canopy surface area (m <sup>2</sup> )	Ground coverage by canopy (%)
S1M1	2.29	46.54*	3.27	18.27	13.8
S1M2	1.98	48.86*	2.88	16.54	19.6
S1M3	1.86	41.34	2.67	16.76	23.7
S2M1	2.36	38.23	2.98	14.3	16.4
S2M2	3.1	47.54*	2.64	14.4	20.6
S2M3	2.88	32.53	1.98	12.1	22.5
S3M1	3.94**	49.6**	2.36	12	26.2
S3M2	3.64*	48.4*	4.76*	34.36*	29.4
S3M3	3.86*	48.6*	2.1	34.38**	24.6
SEm±	0.244	2.242	0.235	1.097	1.02
CD at 5%	0.737	6.778	0.709	3.316	NS
CV%	14.657	8.700	14.259	9.876	8.74

### HOGALAGERE

The highest mean flowering duration (53 days), mean number of panicles per m<sup>2</sup> (10.15), mean nut weight (3.75g), mean apple weight (30.2g), mean annual nut yield per tree (4.81kg/tree) were recorded in S1M3, while highest mean annual nut yield per hectare (1812 kg/ha)

was recorded in S3M2 and cumulative nut yield (40.14 kg/tree) for 8 harvests was recorded in S1M2 (Table 2.8).

The economics of high density planting based on cumulative yield indicated that highest benefit cost ratio was found in S1M1 (5.50) and S1M3 (4.67) (Table 2.9).


**Table 2.8 : Effect of tree density and fertilizer levels on yield parameters of cashew at Chintamani centre**

Treatment	Duration of flowering (days)		Mean no. of panicles / m <sup>2</sup>	Male: Bisexual flowers ratio	Mean nut weight (g)	Mean apple wt. (g)	Mean annual nut yield (kg/tree)(kg/ha)		Cum. nut yield (kg/tree) (for 8 hvts)
	Range	Mean							
S1M1	36 - 55	46.5	9.69	0.16	2.43	20.5	3.99	798	38.35
S1M2	26 - 54	42.9	9.82	0.15	2.70	21.0	4.15	830	40.14
S1M3	39 - 67	53.0	10.15	0.14	3.75	30.2	4.81	962	39.49
S2M1	41 - 54	45.6	9.49	0.17	2.42	25.3	2.77	1108	28.25
S2M2	33 - 48	42.7	9.43	0.17	3.38	24.0	3.42	1368	30.19
S2M3	40 - 74	52.6	9.75	0.18	3.67	29.8	3.03	1212	29.18
S3M1	31 - 48	39.2	9.22	0.19	2.07	16.6	2.19	1314	29.05
S3M2	39 - 52	44.7	9.57	0.18	2.93	28.8	3.02	1812	26.47
S3M3	45 - 57	49.9	9.48	0.18	3.45	24.3	2.85	1710	24.20
SEm±	-	3.67	0.90	0.02	0.19	2.10	0.29	-	2.68
CD @ 5%	-	10.91	2.66	0.047	0.57	6.23	0.86	-	7.95

**Table 2.9 : Economics of high density planting based on cumulative yield at Chintamani Centre**

Spacing (Density)	Fertilizer Dose NPK (kg/ha)	Cum. Cost of cultivation (Rs/ha) (12 years)	Cum. Total return of cashew (Rs./ha)	Cum. net return (Rs./ha)	Benefit : Cost Ratio
S1: 10m x 5m (200 plant/ha)	M1: 75-25-25	17800	115643	97843	5.50
	M2: 150-50-50	25000	133902	108902	4.36
	M3: 225-75-75	32200	182594	150394	4.67
S2: 6m x 4m (400 plant/ha)	M1: 75-25-25	35600	194767	159167	4.47
	M2: 150-50-50	50000	233721	183721	3.67
	M3: 225-75-75	64200	284847	220647	3.44
S3: 5m x 4m (600 plant/ha)	M1: 75-25-25	44500	191724	147224	3.31
	M2: 150-50-50	62500	261718	199218	3.19
	M3: 225-75-75	80500	319540	239040	2.97

### JHARGRAM

Highest ground coverage (118.2%) and mean annual net yield (11.7q/ha) was obtained in 200 pl/ha with 150:50:50 of NPK. While highest number of panicles m<sup>2</sup> (16.9) was obtained with 75:25:25 NPK (kg/ha).

Highest cumulative yield per unit area (99.5 q/ha) was recorded at 8<sup>th</sup> harvest with plant density of 400/ha. Maximum benefit : cost ratio (3.52) was recorded with M1S2 treatment i.e. application of fertilizer @ 75 kg N + 25 kg P<sub>2</sub>O<sub>5</sub> + 25 kg K<sub>2</sub>O per ha per year with tree density of 400 plants/ha (Table 2.10 & 2.11).


**Table 2.10 : Effect of tree density and fertilizer levels on yield parameters of cashew at Jhargram centre**

Treatment	Ground coverage by canopy (%)	Mean no. of panicles/m <sup>2</sup>	Mean nut weight (g)	Mean annual nut yield		Cum. nut yield (q/ha) 8 hvsts
				(kg/tree)	(Q/ha)	
S1M1	108.0	16.9	4.9	5.4	10.8	66.1
S1M2	118.2	15.3	4.7	5.8	11.7	64.9
S1M3	112.5	15.9	4.6	4.4	8.9	64.8
S2M1	29.9	9.8	4.3	0.8	3.4	96.7
S2M2	27.5	12.5	3.9	0.6	2.5	98.1
S2M3	28.4	12.4	3.9	0.5	2.1	99.5
S3M1	27.6	9.6	4.3	0.3	1.6	83.4
S3M2	30.1	8.7	3.9	0.4	2.1	94.2
S3M3	26.7	8.8	4.2	0.5	2.3	92.6
SEm±	5.277	0.70	0.35	0.49	1.02	7.94
CD @ 5%	11.93	1.59	0.79	1.12	2.31	17.94

**Table 2.11 : Economics of high density planting based on cumulative yield at Jhargram Centre**

Spacing (Density)	Fertilizer Dose NPK (kg/ha)	Cum. Cost of cultivation (Rs/ha) Over 11 years	Cum. Total return of cashew (Rs./ha)	Cum. net return (Rs./ha)	Benefit : Cost Ratio
S1: 10m x 5m (200plant/ha)	M1: 75-25-25	82649	351561	268912	3.25
	M2: 150-50-50	97126	366360	269234	2.77
	M3: 225-75-75	116504	357383	240879	2.07
S2: 6m x 4m (400plant/ha)	M1: 75-25-25	94971	429005	334034	3.52
	M2: 150-50-50	125284	412300	287016	2.29
	M3: 225-75-75	140365	430230	289865	2.07
S3: 5m x 4m (500plant/ha)	M1: 75-25-25	135890	374248	238358	1.75
	M2: 150-50-50	150730	428705	277975	1.84
	M3: 225-75-75	164925	430720	265795	1.61

### MADAKKATHARA

The tree height was maximum in plots planted at a tree density of 500 trees/ha. Maximum canopy spread was higher in plants at lowest density i.e. 200 plants per ha. Highest yield (6.76 kg/tree) was obtained in lowest density of 200 trees per hectare. Whereas the per hectare yield was

high under highest density of 500 trees/hectare (2009.58 kg/ha). The different doses of fertilizers did not influence the yield per tree significantly, whereas the per hectare yield was found to be affected significantly. Highest yield (5.47 kg/tree and 1840.83 kg/ha) was obtained from the plots applied with M<sub>3</sub> i.e.225:75:75(N:P:K) per hectare.



Significantly highest yield (26.08 kg/tree) was obtained under the lowest density of 200 trees/ha. Highest yield of 1148 kg/ha was obtained when highest density of 500 trees/ha was adopted. Highest yield of 8948 kg/ha was obtained from M3

plots which received highest doses of fertilizers. The ground area coverage by canopy was highest in S3M3 (137.95%) whereas it was lowest in S1M3 (83.0%) (Table 2.12 and 2.13).

**Table 2.12 : Effect of tree densities and fertilizer doses on the growth and yield of cashew at Madakkathara Centre**

Treatments	Height (m)	Girth (cm)	Canopy spread - NS (m)	Canopy spread - EW (m)	Mean Annual yield (2013-14)		Cumulative (2004-14) (9 years)	
					kg/tree	kg/ha	kg/tree	kg/ha
<b>Plant Densities</b>								
S1 - 200 pl/ha	5.20	89.7	8.09	8.25	6.76	1258.33	26.08	5214
S2 - 400 pl/ha	5.36	90.7	6.47	6.89	4.83	1916.66	23.79	9514
S3 - 500 pl/ha	5.46	90.0	5.58	5.96	4.02	2009.58	22.30	1148
CD (0.05)	NS	NS	NS	NS	0.51	238.56	1.38	472.5
SEm±	0.017	1.45	0.16	0.12	0.17	80.34	0.46	59.12
<b>Fertilizer doses</b>								
M1- 75:25:25	5.32	91.6	6.67	7.01	4.86	1629.58	23.56	8338
M2- 150:50:50	5.36	89.5	6.74	7.03	5.28	1714.16	23.92	8591
M3- 225:75:75	5.33	89.2	6.73	7.06	5.47	1840.83	24.68	8948
CD (0.05)	NS	4.3	0.47	0.36	NS	203.81	NS	492.85
SEm±	0.017	1.45	0.16	0.12	0.21	68.63	0.47	165.97

The annual yield (kg/ha) i.e., 2212.00 and cumulative yield for 9 years (11844.00 kg/ha)

was obtained in 500 trees/ha with 225:75 kg NPK/ha.

**Table 2.13 : Interaction effect between tree densities and fertilizer doses on growth and yield of cashew at Madakkathara Centre**

Treatments	Height (m)	Girth (cm)	Canopy spread - NS (m)	Canopy spread - EW (m)	Mean Annual yield (2013-14)		Cumulative yield (2004-14) (9 years)	
					kg/tree	kg/ha	kg/tree	kg/ha
S1 M1	5.10	93.0	8.00	8.19	6.15	1180	26.79	5357
S1 M2	5.27	87.5	8.14	8.15	7.05	1245	25.74	5147
S1 M3	5.22	88.7	8.14	8.41	7.07	1350	25.70	5139
S2 M1	5.40	91.5	6.70	7.05	4.68	1830	22.92	9168
S2 M2	5.37	90.7	6.45	6.92	4.90	1960	23.78	9512
S2 M3	5.30	90.0	6.27	6.70	4.90	1960	24.66	9862
S3 M1	5.46	90.5	5.32	5.77	3.76	1878	20.98	10488
S3 M2	5.45	90.5	5.65	6.03	3.88	1937	22.23	11113
S3 M3	5.47	89.0	5.77	6.07	4.43	2212	23.69	11844
CD (0.05)	NS	0.18	NS	NS	1.1	353.01	2.43	853.64
SEm±	0.03	2.52	0.27	0.20	0.37	118.88	0.82	287.48



## PILICODE

Closer spacing resulted in significantly higher ground coverage by the canopy. Higher number of flowering panicles per unit area was obtained with wider spacing of 10 x 5m (200 plants/ha) and with closer spacing of 5 x 4m (600 plants/ha). Flowering duration was found to be extended with wider spacing.

The mean apple weight and the mean nut weight were not influenced by different levels of plant density. Highest yield per plant (5.41kg) and yield per ha (2165.16kg) was observed at medium spacing of 400 plants / ha (6m x 4m). (Table 2.14).

**Table 2.14 : Effect of spacing on yield characters of Cashew variety at Pilicode Centre**

Treatment	Mean Apple weight	Mean Nut weight	Mean annual nut yield	
			(kg/tree)	(kg/ha)
S1	46.50	8.47	5.01 <sup>b</sup>	1001.93 <sup>c</sup>
S2	50.09	7.16	5.41 <sup>a</sup>	2165.16 <sup>a</sup>
S3	55.69	8.17	3.76 <sup>c</sup>	1880.87 <sup>b</sup>
Mean	50.76	7.93	4.73	1682.65
F test	NS	NS	**	**
CD @ 5%	-	-	0.28	88.57
CV %	29.91	13.91	27.23	24.22

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

The medium fertilizer dose 150 kg N : 50kg P<sub>2</sub>O<sub>5</sub>: 50kg K<sub>2</sub>O resulted in higher fruit set and seed set per unit area. Lower dose of fertilizer 75kg N : 25kg P<sub>2</sub>O<sub>5</sub>: 25 kg K<sub>2</sub>O resulted in higher mean

nut weight of 9.31g. Annual yield was highest with low fertilizer dose 75kg N : 25kg P<sub>2</sub>O<sub>5</sub>: 25kg K<sub>2</sub>O (2190.02kg/ha) (Table 2.15).

**Table 2.15 : Effect of Fertilizer on yield characters of Cashew variety MDK-1 at Pilicode Centre**

Treatment	Mean Apple weight	Mean Nut weight	Mean annual nut yield	
			(kg/tree)	(kg/ha)
M1	56.23	9.31	5.74 <sup>a</sup>	2190.02 <sup>a</sup>
M2	49.38	8.53	2.98 <sup>b</sup>	893.99 <sup>c</sup>
M3	46.67	6.84	5.46 <sup>a</sup>	1963.95 <sup>b</sup>
Mean	50.76	7.93	4.73	1682.65
F test	NS	NS	**	**
CD @ 5%	-	-	0.47	144.88
CV %	29.91	13.91	27.23	24.22

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



Mean annual nut yield per plant and yield per hectare was the highest in S2M1 (S2: 400 plants/ha (6 m x 4m), 75kg N : 25kg P<sub>2</sub>O<sub>5</sub>: 25kg K<sub>2</sub>O) (11.44 kg/tree & 4576.00kg/ha). (Table 2.16).

**Table 2.16 : Interaction effect of spacing and doses of fertilizer application on yield parameters of cashew variety MDK -1 at Pilicode**

Treatment	Mean Apple weight	Mean Nut weight	Mean annual nut yield		Cum. nut yield (kg/tree) (10 No. of hvts)
			(kg/tree)	(kg/ha)	
S1M1	50.00	8.93	3.00	599.22	44.28
S1M2	45.33	9.43	5.17	1037.17	31.25
S1M3	44.17	7.05	6.85	1369.39	42.57
S2M1	51.60	7.00	11.44	4576.00	38.56
S2M2	56.17	7.67	2.39	954.80	35.18
S2M3	42.50	6.80	2.41	964.67	43.87
S3M1	67.10	9.33	2.79	1394.83	37.98
S3M2	46.65	8.50	1.38	690.00	31.60
S3M3	53.33	6.68	7.12	3557.78	36.65
Mean	50.76	7.93	4.73	1682.65	37.99
F test	NS	NS	**	**	NS
CD @ 5%	-	-	1.13	505.36	-
CV%	29.91	13.91	27.23	24.22	19.32

**VENGURLA**

S1 (10m x 5m) spacing was significantly superior over S2 (6mx4m) and S3 (5m x 4m) in respect of mean height, mean spread and mean canopy area. However, in respect of mean height,

mean spread, mean canopy height and mean canopy area S3 (5m x 4m) spacing was significantly superior than S2 (6m x 4m), whereas the growth characters were not influenced significantly due to fertilizer levels. (Table 2.17).

**Table 2.17 : Effect of spacing and fertilizer on growth and yield of cashew, at Vengurla**

Treatments	Mean Height (m)	Mean Girth (cm)	Mean Spread (m)	Mean Canopy height (m)	Mean Canopy area (m <sup>2</sup> )	Mean Canopy surface area (m <sup>2</sup> )
S1 200 plants/ha (10m x 5m)	7.50	107.43	10.11	6.90	82.67	138.35
S2 400 plants/ha (6m x 4 m)	4.34	97.50	3.64	3.60	10.89	24.04
S3 500 plants/ha (5m x 4m)	6.32	102.21	5.73	5.77	26.68	59.46
SEm±	0.23	3.71	0.27	0.23	5.37	7.04
CD at 5%	0.92	N.S	1.1	0.93	21.08	27.68
M1 75kg N : 25kg P <sub>2</sub> O <sub>5</sub> : 25kg K <sub>2</sub> O/ha	5.84	101.6	6.34	5.18	38.26	70.23
M2 150kg N : 50kg P <sub>2</sub> O <sub>5</sub> : 50kg K <sub>2</sub> O/ha	6.21	104.6	6.70	5.61	42.55	78.22
M3 225kg N : 75 kg P <sub>2</sub> O <sub>5</sub> : 75kg K <sub>2</sub> O/ha	6.11	100.94	6.44	5.47	39.42	73.41
SEm±	0.12	2.58	0.23	0.11	3.59	4.88
CD at 5%	N.S	N.S	N.S	N.S	N.S	N.S



None of the yield parameters were influenced significantly due to the interaction effect between spacing and fertilizer levels. The maximum cumulative yield for 11 harvests was recorded in S1M3 (21.74 kg/tree) (Table 2.18).

**Table 2.18 : Interaction effect of spacing and fertilizer on growth and yield of cashew at Vengurle Centre**

Treatments	Mean Flow. duration (days)	Mean Fruit set/ m <sup>2</sup>	Mean Yield (kg/ tree)	Mean Yield (t/ ha)	Cum. yield kg/tree (11 <sup>th</sup> hvsts)	Mean Nut wt. (g)	Mean Apple wt. (g)	Shelling (%)
S1M1	94.27	7.22	5.39	1.08	18.58	10.20	67.50	31.33
S1M2	92.37	6.24	2.97	0.59	16.72	10.20	68.83	30.50
S1M3	94.10	7.44	4.23	0.84	21.74	10.23	72.57	31.00
S2M1	91.83	7.70	1.77	0.71	7.33	10.36	75.50	31.67
S2M2	94.00	7.38	1.42	0.57	7.25	10.40	76.60	31.17
S2M3	94.93	8.76	1.76	0.70	9.00	9.93	75.33	30.50
S3M1	91.93	7.34	2.23	1.11	12.73	9.86	66.76	27.33
S3M2	97.60	6.26	1.50	0.75	8.87	9.96	71.33	31.50
S3M3	95.83	9.38	2.55	1.28	12.66	10.20	74.16	29.83
SEm±	1.19	0.77	1.16	0.31	-	0.12	1.58	0.62
CD at 5%	N.S	N.S.	N.S.	N.S.	-	N.S.	N.S.	N.S.



## Fertilizer application in high density cashew plantations (Centres wherein trial concluded)

### JHARGRAM

The trial was planted with BPP-8 during 2005. The trunk girth had indirect relation with an increase in fertilizer dose during initial years. Increase in trunk girth was directly related with increase in fertilizer dose subsequently upto 8 yrs with moderate dose of fertilizer. But an excess fertilizer application did not have positive effect on trunk girth.

The plant height as well as trunk girth were higher i.e., more with wider spacing i.e 10m x 5m. Trunk girth was minimum in narrowest spacing i.e. 5m x 4m.

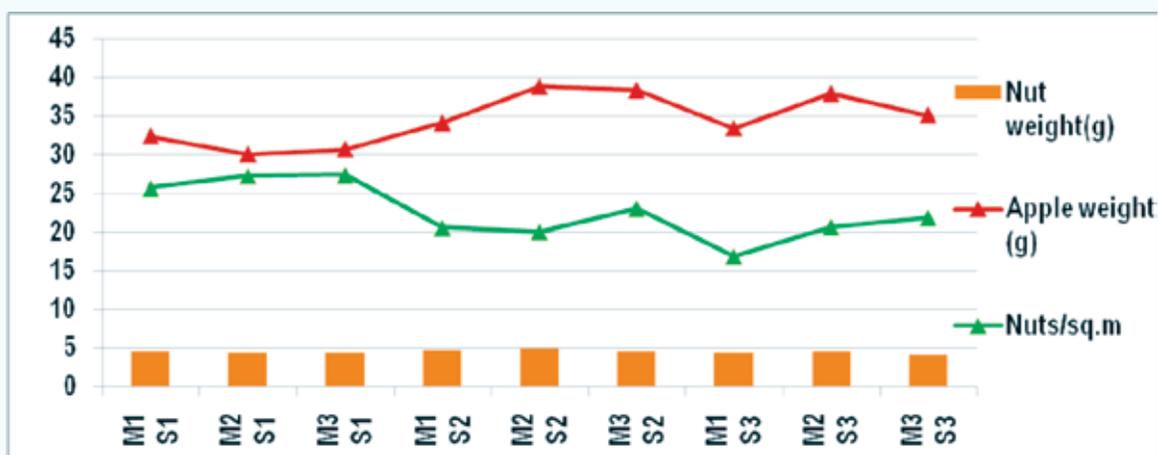
During the initial years canopy spread was more with the plant density of 200 plants/ha with the highest dose of fertilizer. An indirect relation with the increase in fertilizer dose and canopy spread was observed during 3<sup>rd</sup> year. At 5 years it was found that 6m x 4m spaced plants had canopy spread more than the other two spacings. Application of 150kg N + 50kg P<sub>2</sub>O<sub>5</sub> + 50kg K<sub>2</sub>O per ha per year had maximum positive effect on canopy spread. Irrespective of densities, canopy height was maximum with the moderate dose of fertilizer i.e. 150kg N + 50kg P<sub>2</sub>O<sub>5</sub> + 50kg K<sub>2</sub>O per ha per year.

During the 4<sup>th</sup> year in all the three densities, canopy area was maximum with the highest dose of fertilizer i.e. 225kg N + 75kg P<sub>2</sub>O<sub>5</sub> + 75kg K<sub>2</sub>O per ha per year and it increased with wider spacing.

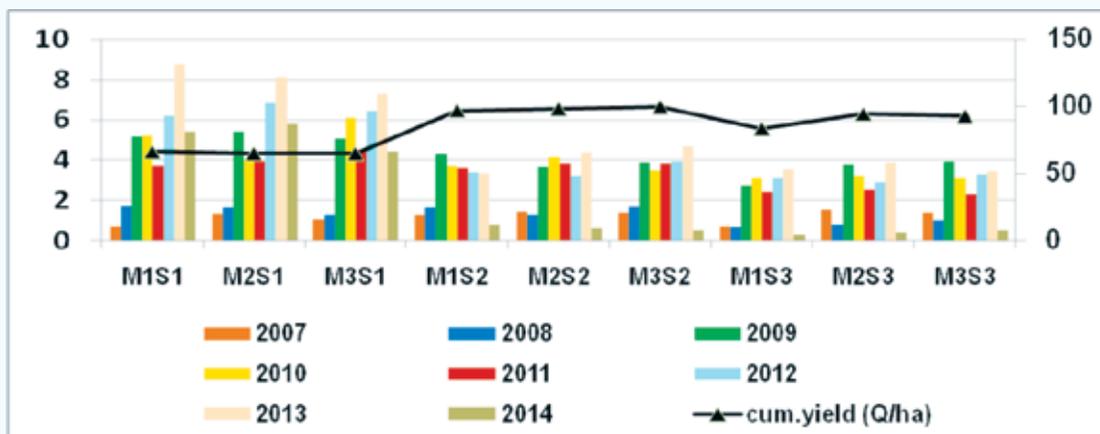
Canopy area was maximum (59.73m<sup>2</sup>) with wider spacing. The duration of flowering was maximum in widest spacing (10m x 5m) 78.5 days followed by 5 x 5m (77.1 days). In all the spacings, fertilizer dose had a negative relation with duration of flowering.

Highest fertilizer dose supported the maximum flowering per square meter (13.50), while flowering intensity was inversely affected by plant density.

Maximum nuts per square meter (35.75) was noticed with widest spacing. Pooled data analysis had depicted that highest dose of fertilizer application had positive effect on nut density per unit of canopy area in all the tree spacings. The results revealed that the nut weight was not influenced by plant density or fertilizer level. Pooled data indicated that apple weight was higher (38.8 g) with a narrow spacing with moderate dose of fertilizer.



Effect of tree density and fertilizer application on nut and apple characters of Jhargram - 1



**Effect of tree density and fertilizer application on yield of Jhargram - 1**

Irrespective of density, a higher dose of fertilizer had positive effect on nut production.

Cumulative yield increased with the application of higher fertilizer dose and closer spacing. Minimum area had been covered by the plants planted with widest density (200 plants/ha).

### Conclusion:

Maximum benefit : cost ratio (3.52) was recorded with application of fertilizer at 75kg N + 25kg P<sub>2</sub>O<sub>5</sub> + 25kg K<sub>2</sub>O per ha per year under a tree density of 400 plants/ha followed by M1S3 (3.25) application of fertilizer at 75kg N + 25kg P<sub>2</sub>O<sub>5</sub> + 25kg K<sub>2</sub>O per ha per year with a tree density of 200 plants/ha indicating 400 pl/ha with 75:25:25 NPK was ideal for red and laterite zone of West Bengal.

### VENGURLA

This trial was planted during 2004-05 with variety Vengurla-7. The maximum plant height (6.07m) was recorded in S1 (10m x 5m) spacing which was at par with S2 (6m x 5m) (6.02m). Both S1 and S2 spacings were at par with each other and significantly superior over S3 (5m x 4m) spacing.

The spacing (10m x 5m) recorded significantly maximum height over S2 and S3 spacing.

Interaction effect of spacing and fertilizer levels on height of plant indicated that plant height was not influenced significantly due to interaction effect of spacing and fertilizer levels. Similarly, the pooled analysis with respect to height for 11 years also showed non-significant results. The individual and interaction effect of spacing and fertilizer levels did not influence plant girth, canopy spread and canopy area during the trials.

The S1 spacing (10m x 5m) recorded significantly maximum number of laterals/m<sup>2</sup> (32.03/m<sup>2</sup>) and was superior over S2 (29.96/m<sup>2</sup>) and S3 (30.63/m<sup>2</sup>) spacing during 2012-13.

S1 (10m x 5m) spacing recorded significantly maximum number of panicle (22.61/m<sup>2</sup>) and was on par with the spacing S2 (6m x 4m) i.e. 18.86/ m<sup>2</sup> and both these spacing were significantly superior over S3 spacing (5m x 4m). The number of panicles/ m<sup>2</sup>, fruit set/m<sup>2</sup> and number of nuts per panicle as well as flowering duration were not significantly influenced due to interaction effect of spacing and fertilizer levels. The nut weight (g) and apple



weight (g) of cashew and shelling percentage were not influenced significantly by both tree density and fertilizer levels individually as well as by the interaction effect. Spacing of 10 x 5m recorded significantly maximum yield of (3.23kg/tree) over rest of spacings. Fertilizer levels had no significant effect on yield of cashew and as well as in pooled studies.

**Conclusion :**

The maximum cumulative yield (23.66kg/tree) for eleven harvests was noticed in S1M3

treatment (200 plants/ha with 225:75:75kg NPK/ha) but the maximum cumulative per hectare yield (6.838 t/ha) for eleven harvests was noticed in S3M1 treatment (500 plants/ha with 75:25:25kg NPK/ha).

S3M1 treatment gave the maximum cumulative total returns of Rs. 3,98,350/- per ha and cumulative net returns of Rs.2,11,460/- with higher C:B ratio (1:2.13) which could be adopted for V-7. However, V-7 being a vigorous growing plant higher density planting requires regular pruning (Table 2.19).

**Table 2.19 : Economics of high density planting based on cumulative yield at Vengurle centre**

Spacing (Density)	Fertilizer Dose NPK (kg/ha)	Cum. Cost of cultivation (Rs./ha) 11 years	Cum. Total return of cashew (Rs./ha)	Cum. net return (Rs./ha)	Benefit : Cost Ratio
S1: 10m x 5m (200 plant/ha)	M1 75 : 25 : 25	145448	239460	94012	1.65
	M2 150 : 50 : 50	161058	217786	56728	1.35
	M3 225 : 75 : 75	170081	289160	119079	1.70
S2: 6m x 4m (400 plant/ha)	M1 75 : 25 : 25	173076	154980	-18096	0.90
	M2 150 : 50 : 50	189496	169740	-19756	0.90
	M3 225 : 75 : 75	197709	204900	7191	1.04
S3: 5m x 4m (500 plant/ha)	M1 75 : 25 : 25	186890	398350	211460	2.13
	M2 150 : 50 : 50	203306	273775	70469	1.35
	M3 225 : 75 : 75	211523	387950	176427	1.83



### Hort.3: Drip irrigation trial

The trial aims at studying the response of cashew to supplementary irrigation during critical stages of growth and development.

#### 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

#### HOGALAGERE

The highest mean tree height (5.95m), mean stem girth (99.6cm), mean and canopy spread (N-S- 4.41m & E-W- 4.47m) and canopy surface area (20.45m<sup>2</sup>) were recorded in treatment T5 (80% CPE). Maximum number of laterals/m<sup>2</sup> (1449) was recorded in T2 (20% CPE) (Table 2.20).

**Table 2.20 : Effect of drip irrigation levels on growth parameters of cashew at ARS, Chintamani Centre**

Treatments	Mean tree height (m)	Mean stem girth (cm)	Mean canopy spread (m)		Mean canopy surface area (m <sup>2</sup> )	No. of laterals / m <sup>2</sup>
			N - S	E - W		
T1 : No irrigation	4.63	86.1	4.17	4.33	8.67	10.65
T2 : Irrigation at 20% CPE	5.19	86.4	4.28	4.40	12.26	14.49
T3 : Irrigation at 40% CPE	4.82	88.1	4.33	4.43	16.23	14.43
T4 : Irrigation at 60% CPE	5.82	89.2	4.37	4.41	18.14	09.78
T5: Irrigation at 80% CPE	5.95	99.6	4.41	4.47	20.45	11.35
SEm ±	0.61	7.71	0.40	0.33	1.06	1.34
CD at 5%	2.00	25.15	1.31	1.07	3.48	4.36
CV%	20.07	14.86	16.17	12.91	12.18	19.08



The maximum mean number of panicles/m<sup>2</sup> (9.12), mean nut weight (6.52g), mean apple weight (29.76g), mean annual nut yield (9.05 kg/

tree), mean cumulative nut yield (77.57 kg/tree) and shelling percentage (27.42%) were recorded in treatment T5 (80% CPE) (Table 2.21).

**Table 2.21 : Effect of drip irrigation levels on yield parameters of cashew at Chintamani Centre**

Treatments	Mean no. of panicles / m <sup>2</sup>	Male: Bisexual flowers ratio	Mean nut wt. (g)	Mean apple wt. (g)	Mean Annual nut yield (kg/tree)	Mean Cum. yield (kg/tree) (8 hvsts)	Shelling (%)
T1 : No irrigation	7.42	0.17	5.36	17.81	4.78	44.77	26.59
T2 : Irrigation at 20% CPE	8.02	0.17	5.98	18.29	5.06	54.04	26.14
T3 : Irrigation at 40% CPE	8.48	0.15	6.07	17.32	7.37	63.94	26.2
T4 : Irrigation at 60% CPE	8.87	0.17	6.34	17.40	8.37	73.55	26.53
T5: Irrigation at 80% CPE	9.12	0.17	6.52	29.76	9.05	77.57	27.42
SEm ±	1.03	0.01	0.64	1.33	0.52	7.78	2.38
CD at 5%	3.37	0.02	2.07	4.34	1.70	25.39	7.77
CV%	21.33	0.16	18.17	11.45	13.05	21.48	15.53

## VENGURLA

Mean fruit set/m<sup>2</sup> (65.00) and mean no. of nuts/ panicle (11.82) were maximum in irrigation at 80% CPE. The cumulative yield for eleven

harvests was maximum in irrigation at 80 percent C.P.E. i.e. 45.92 kg/tree. The other parameters were not influenced significantly (Table 2.22).

**Table 2.22 : Effect of drip irrigation on yield attributing characters at Vengurle Centre**

Treatment	Mean No. of flow. panicle /m <sup>2</sup>	Mean Flow. duration (days)	Mean Fruit set/m <sup>2</sup>	Yield kg/tree	Mean Apple wt. (g)	Mean Nut Weight (g)	Shelling (%)
T1 : No Irrigation	10.75	96.85	45.92	4.77	69.42	9.02	30.75
T2 : Irrigation 20% CPE	11.08	95.82	49.08	3.92	66.77	10.6	31.00
T3 : Irrigation 40% CPE	14.67	95.60	48.42	3.75	72.05	10.1	31.00
T4 : Irrigation 60% CPE	12.38	95.00	43.75	2.85	70.05	10.0	30.50
T5 : Irrigation 80% CPE	12.92	99.60	65.00	8.10	72.87	9.8	31.25
SEm±	1.503	1.96	7.64	0.95	2.98	0.20	0.45
CD at 5%	NS	NS	NS	2.91	NS	0.62	NS



## VRIDHACHALAM

Treatments with irrigation at 80% CPE recorded maximum number of panicles/ m<sup>2</sup> (22.6) and higher male: bisexual flower ratio (0.23). Nut yield vary significantly among the treatments. The

highest nut yield of 8.86 kg/tree with a nut weight of 7.4g and shelling percent of 30.2 was observed in the treatment with irrigation at 80% CPE (Table 2.23).

**Table 2.23 : Effect of drip irrigation levels on yield parameters of cashew at Vridhachalam Centre**

Treatments	Mean no. of panicles/ m <sup>2</sup>	Male: Bisexual flowers ratio	Mean nut wt. (g)	Mean apple wt. (g)	Mean annual nut yield (kg/tree)	Mean cum. yield (kg/tree) (6 hvsts)	Shelling (%)
T1 : No irrigation	14.3	0.14	6.2	50.6	5.84	18.34	28.0
T2 : Irrigation at 20% CPE	16.6	0.17	6.4	58.2	6.54	20.38	28.4
T3 : Irrigation at 40% CPE	18.4	0.18	6.8	61.2	7.30	22.92	29.0
T4 : Irrigation at 60% CPE	19.2	0.20	7.2	57.6	7.34	23.78	29.6
T5: Irrigation at 80% CPE	22.6	0.23	7.4	66.6	8.86	27.1	30.2
SEm ±	0.7	--		2.6	0.2	--	
CD at 5%	2.0	--	NS	5.2	0.6	--	NS



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

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

### Experimental Details :

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

#### BAPATLA

Highest nut yield of 1487.5 kg/ha was recorded with high density plot compared to the normal density plot where the yield obtained was 650.52 kg/ha in BPP-6 planted during 2002. Whereas 8 x 8m spacing was recorded the highest mean trunk girth (64.52 cm), mean canopy spread (5.64m) and mean canopy surface (40.72 m<sup>2</sup>) while maximum ground area coverage by canopy (105.35%) was recorded in 4 x 4m.

Flowering duration was minimum in 8 x 8m spacing (98.0 days), mean number of flowering laterals and mean number of nuts/m<sup>2</sup> was found highest in 8 x 8m spacing (26.30 and 19.82 respectively). The mean nut yield was recorded highest in 8 x 8m spacing (4.17 kg/tree) and cumulative nut yield was also recorded highest in 8 x 8m spacing (14.00 kg/tree) for seven harvests. The B: C ratio for 8 x 8 m spacing increased from 1<sup>st</sup> harvest to 7<sup>th</sup> harvest (-0.51 to 5.25) (Table 2.24).

**Table 2.24 : Yield parameters of cashew in normal and high density planting at Bapatla Centre**

Spacing	Ground area coverage by canopy (%)	Mean no nut/m <sup>2</sup>	Mean Nut yield kg/tree	Nut yield (kg/ha)	Cum. Nut yield kg/tree 7 hvsts	Mean Nut weight (g)
4m x 4m	105.35	15.8	2.38	1487.5	10.51	5.43
8m x 8m	39.92	19.82	4.17	650.52	14.00	6.09

#### JHARGRAM

Maximum plant height, canopy spread, canopy area and flowering /m<sup>2</sup> were recorded in 8m x 8m spacing with BPP-8 which was planted during 2012. It was noticed that when plants were spaced at 8m x 8m, nuts/m<sup>2</sup> and yield/tree (3.85kg) were

higher than the trees spaced at 4m x 4m (2.80kg). The yield per unit area was more in case of trees spaced at 4m x 4m (6.93q/ha). Cost benefit ratio was more (1.69) in 8m x 8m during second harvest (Table 2.25 and 2.26).

**Table 2.25 : Yield parameters of cashew in normal and high density planting at Jhargram Centre**

Spacing	Mean Duration of flowering (days)	Mean no. of panicles/ m <sup>2</sup>	Mean nut weight (g)	Mean apple wt. (g)	Mean annual nut yield		Cum. nut yield (kg/tree) (2 hvts)
					(kg/tree)	(q/ha)	
4m x 4m	66	11.3	6.95	62.2	1.11	6.93	2.80
8m x 8m	68	11.8	7.03	62.5	1.18	1.84	3.85

**Table 2.26 : Yield and B:C ratio in high density trials at Jhargram Centre**

Harvest	Yield (Q/ha.)		Net returns (Rs/ha.)		B:C ratio	
	(4m x 4m)	(8m x 8 m)	(4m x 4 m)	(8m x 8 m)	(4m x 4 m)	(8m x 8 m)
1 <sup>st</sup> harvest	10.55	4.16	25552	14214	0.43	0.75
2 <sup>nd</sup> harvest	6.93	1.84	32143	9247	1.38	1.69



## Hort. 4 Expt. 2 High Density Planting - Observational Trials (Centres wherein Trials concluded)

### BHUBANESWAR

The trial was laid out during the year 1996, with a spacing of 4m x 4m accommodating 625 nos. of plants / ha. The test variety for this trial was BPP-8.

The tree height of 5.31m with stem girth of

64.73cm was recorded in variety BPP 8 wherein the mean canopy diameter as well as surface area was 5.29m and 22.23m<sup>2</sup>, respectively. The ground coverage but canopy was 103.77%. The mean flowering laterals/panicles per m<sup>2</sup> was 4.95 with production of mean nut weight of 7.14g, apple weight of 52.67g was observed (Table 2.27).

**Table 2.27 : Growth and yield attributing parameters of cashew in high density planting at Bhubaneswar Centre #**

Mean tree height (m)	Mean stem girth (cm)	Mean canopy diameter (m)	Mean canopy surface area (m <sup>2</sup> )	Ground coverage by canopy (%)	Mean flowering laterals/panicles m <sup>2</sup>	Mean nut weight (g)	Mean apple wt. (g)
5.31	64.73	5.29	22.23	103.77	4.95	7.14	52.67

# not replicated trial, only observational strip

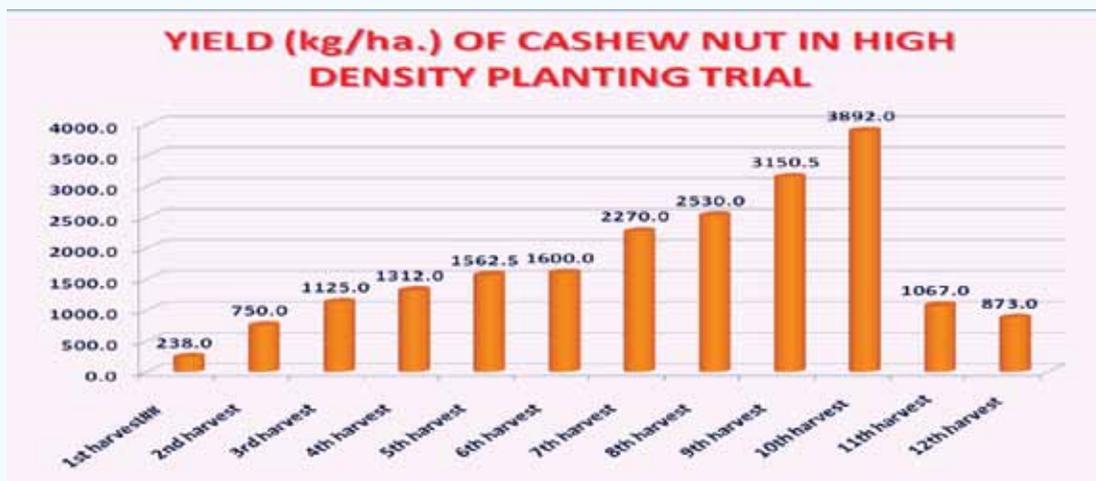
After 10<sup>th</sup> harvest, there was a sharp decline in nut yield due to primarily heavy pruning followed by excessive high day temperature of more than 40°C for a considerable period during flowering and

fruit development stage. Regarding the cumulative nut yield on hectare basis, maximum of 20.37 t/ha was obtained for 12 harvests in high density planting system (Table 2.28a).

**Table 2.28a : Yield parameters of cashew in high density planting at Bhubaneswar Centre**

Year of Harvesting	Year	Yield (kg/tree)	Yield (kg/ha)	Cumulative yield (kg/ha) (18 hvsts)
1 <sup>st</sup>	2000	0.380	238.00	238.00
2 <sup>nd</sup>	2001	1.200	750.00	988.00
3 <sup>rd</sup>	2002	1.800	1125.00	2113.00
4 <sup>th</sup>	2003	2.100	1312.00	3425.00
5 <sup>th</sup>	2004	2.500	1562.50	4987.50
6 <sup>th</sup>	2005	2.560	1600.00	6587.50
7 <sup>th</sup>	2006	3.630	2270.00	8857.50
8 <sup>th</sup>	2007	4.050	2530.00	11387.50
	2008 ##	0.000	0.00	11387.50
9 <sup>th</sup>	2009	5.040	3150.50	14538.00
10 <sup>th</sup>	2010	6.230	3892.00	18430.00
11 <sup>th</sup>	2011	1.707	1067.00	19497.00
12 <sup>th</sup>	2012	1.397	873.00	20370.00

## During 2008, the crop failed due to heavy hail storm



**Benefit Cost Ratio of cashew nut in High Density Planting at Bhubaneswar**

The BC ratio varied from as low as 0.07 during 1<sup>st</sup> harvest to maximum of 5.85 during 10<sup>th</sup> harvest. Net returns reduced drastically after the 10<sup>th</sup> harvest onward (Table 2.28b).

**Table 2.28b : Yield and B:C ratio in high density trials at Bhubaneswar Centre #**

Year of Harvesting	Year	Yield (kg/ha)	Net returns (Rs/ha.)	B:C ratio
1 <sup>st</sup>	2000	238.00	-105013.00	0.07
2 <sup>nd</sup>	2001	750.00	6575.00	1.33
3 <sup>rd</sup>	2002	1125.00	19955.00	2.03
4 <sup>th</sup>	2003	1312.00	26430.00	2.36
5 <sup>th</sup>	2004	1562.50	31710.00	2.38
6 <sup>th</sup>	2005	1600.00	32722.50	2.41
7 <sup>th</sup>	2006	2270.00	56172.50	3.41
8 <sup>th</sup>	2007	2530.00	65272.50	3.80
##	2008	0.00	-23277.50	0.00
9 <sup>th</sup>	2009	3150.50	86990.00	4.74
10 <sup>th</sup>	2010	3892.00	112942.50	5.85
11 <sup>th</sup>	2011	1067.00	14067.50	1.60
12 <sup>th</sup>	2012	873.00	7277.50	1.31

# Not replicated trial, only observational strips

## Date of planting: 1996, 1999 failed due to Super Cyclone, 2008 failed due to heavy hail storm



**Benefit Cost Ratio of cashew nut in High Density Planting at Bhubaneswar**

**Conclusion:**

High density planting could be retained upto 10 years beyond which the yield was found to become uneconomical.

**HOGALAGERE**

This experiment was laid out during 1997 with Chintamani-1 grafts at a spacing of 4m x 4m (625 plants/ha). The growth and yield parameters of high density planting (HDP) system were compared with normal spacing of 8m x 8m (156 plants/ha).

The plant height ranged from 0.98 m to 4.79 m (mean of 3.13 m) in high density planting system and from 5.00 to 6.11 m (mean of 5.46 m) in normal spacing system. The stem girth in high density planting ranged from 8.0 to 61.0cm (mean of 36.50 cm) and in normal spacing it ranges from 77.0 to 95.6 cm (mean of 86.51cm). The canopy spread in high density planting ranged from 1.14 m to 5.57 m (mean of 3.46 m) and in normal spacing it was ranged from 8.10 m to 8.99 m (mean of 8.46 m). The annual yield ranged from 0.43kg/tree to

2.18kg/tree in high density planting. There was a gradual increase in nut yield which was maximum at eighth year, which started declining thereafter. The performance of cashew in normal spacing with respect to yield indicated that it ranged from 6.53kg/tree to 9.11kg/tree.

The mean annual yield per hectare ranged from 1.17 quintals/ha to 13.60 quintals/ha in high density planting and in normal spacing it ranged from 9.57 quintals/ha to 14.23 quintals/ha. The cumulative yield of cashew in high density planting ranged from 0.43kg/tree to 12.91kg/tree whereas, in normal spacing it ranged from 13.88kg/tree to 51.23kg/tree. The cumulative yield per hectare ranged from 1.17 quintals/ha to 71.79 quintals/ha in high density planting and in normal spacing it ranged from 21.51 quintals/ha to 79.92 quintals/ha. (Table 2.29).

**Conclusion:**

It was concluded that high density could be adopted for 8 years and based on the canopy overlapping, tree thinning can be decided for respective agro-climatic region.


**Table 2.29 : Yield parameters of cashew in high density planting and normal density planting system at Chintamani**

Year	Shelling %		Annual nut		Annual nut yield		Cumulative nut		Cumulative yield	
	4m x 4m	8m x 8m	4m x 4m	8m x 8m	4m x 4m	8m x 8m	4m x 4m	8m x 8m	4m x 4m	8m x 8m
2000-2001	28.4	28.7	0.43	-	1.17	-	0.43	-	1.17	-
2001-2002	28.9	29.4	0.56	-	1.84	-	0.99	-	3.01	-
2002-2003	28.7	29.5	0.61	-	1.93	-	1.6	-	4.94	-
2003-2004	29.1	30.1	0.84	-	5.42	-	2.44	-	10.36	-
2004-2005	29.3	29.9	0.95	-	7.65	-	3.39	-	18.01	-
2005-2006	29.5	31.0	1.33	-	8.28	-	4.72	-	26.29	-
2006-2007	29.4	30.8	2.03	6.53	12.69	10.12	6.75	13.88	38.98	21.51
2007-2008	29.0	30.7	2.18	6.85	13.60	10.62	8.93	20.73	52.58	32.13
2008-2009	28.6	30.9	1.6	6.14	10.00	9.57	10.53	26.86	62.58	41.90
2009-2010	28.5	30.8	0.55	7.02	3.44	10.94	11.08	33.88	66.02	52.85
2010-2011	28.2	30.6	0.35	8.98	2.19	14.00	11.43	40.9	68.21	63.80
2011-2012	28.1	30.7	0.28	8.92	1.75	13.92	11.71	49.82	69.96	77.72
2012-2013	28.0	31.05	1.20	9.11	1.83	14.23	12.91	51.23	71.79	79.92

## VENGURLA

The trial was initiated during 2005 with Vengurla-7 wherein only 4 x 4m was evaluated. The mean tree height of 5.95m, stem girth of 78.88cm and mean canopy spread of 4.85m was recorded. The number of panicles per square meter was 14.18 and fruit per square meter was 18.82. Flowering duration ranged from 104.79 to 109.43 days with the mean of 107.25 days.

The nut weight of Vengurla-7 ranged between 9.33 g to 9.75 g with mean weight of 9.52 g while, apple weight ranged between 65.06 g to 70.45 g with mean weight of 68.39 g.

The yield level (kg/tree) was very low as Vengurla-7 being a fast and vigorous growing variety covered the entire ground area at the age of 3<sup>rd</sup> year of plantation leading to severe shading. The mean yield of cashew under high density plantation was 1.53 kg/tree. The mean cumulative yield for 8 harvests was 12.29 kg/tree. The shelling percentage of Vengurla-7 ranged between 29.66% to 31.0% with an mean shelling per cent of 30.3%.

During the year 2013-14 (at 9<sup>th</sup> harvest) the mean yield obtained from high density plot was 1.09 t/ha and net returns was Rs.1,09,688/- per ha with B:C ratio of 2.31:1 (Table 2.30).

**Table 2.30 : Yield and B: C ratio in high density trials at Vengurle Centre**

Harvest	Selling price (Rs.)	Yield (kg/ha) (4m x 4m)	Net returns (Rs./ha) (4m x 4m)	B:C ratio (4m x 4m)
1 <sup>st</sup> harvest	55/-	62.50	3,438/-	0.13:1
2 <sup>nd</sup> harvest	55/-	7.50	413/-	0.01:1
3 <sup>rd</sup> harvest	55/-	93.75	5,156/-	0.19:1
4 <sup>th</sup> harvest	55/-	1150.00	63,250/-	2.31:1
5 <sup>th</sup> harvest	55/-	1506.25	82,844/-	2.69:1
	-	Trees were pruned during Nov. 2008 as per the decision taken in the Biennial Workshop Nov. 2007		
	-	No yield obtained during 2009-10		
6 <sup>th</sup> harvest	60/-	243.75	14,625/-	0.39:1
7 <sup>th</sup> harvest	85/-	1081.25	91,906/-	2.33:1
8 <sup>th</sup> harvest	85/-	1587.50	1,34,937/-	3.1:1
9 <sup>th</sup> harvest	100/-	1096.88	1,09,688/-	2.31:1

(Yield started from year 2003-04)

### Conclusion :

As no comparison plot with normal density was established based on B:C ratio it was observed that after 8<sup>th</sup> harvest the B:C ratio declined. Further, overlapping of canopy at 5<sup>th</sup> year of planting indicated that V-7 is not amenable to high density planting.



## Hort.6: Intercropping in Cashew

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.

### Experimental Details :

Main plot	:	4
Sub plots	:	3
F0	=	No additional fertilizer to the intercrop
F1	=	Additional fertilizer to the intercrop as per the state recommendation
F2	=	50% of additional fertilizer applied to the intercrop
No. of replications	:	3
Design	:	Split plot

### BAPATLA

Marigold when intercropped with cashew (BPP-6 planted in 1997) recorded maximum yield of 64.86 q/ha with a higher cost benefit ratio 2.09 followed by T2 (Cashew + Cluster bean) of 4745 kg/ha; Cashew + hibiscus recorded the lowest yield (53.90q/ha). Growing marigold as inter crop in cashew orchard gave higher net profit of Rs. 94,410/- with C.B ratio of 2.09 followed by cluster bean Rs. 55470.00 and C B ratio of 1.58 (Table 2.31).

**Table 2.31 : Yield and economics of cashew and intercrops in intercropping trials at Bapatla Centre**

Treatment details	Yield of intercrop		Yield of cashew		Returns (Rs./ha)				C.B Ratio
	kg/plot	Q/ha	kg/tree	Q/ha	Cashew	Inter crop	Total	Net	
T1 Cashew + Marigold	41.51	64.86	4.6	7.02	42120	97290	139410	94410	2.09
T2 Cashew + Cluster bean	30.37	47.45	4.6	7.17	43020	47450	90470	55470	1.58
T3 Cashew + Gogu	78.50	122.6	5.0	7.80	46800	18397	65179	40179	1.60
T4 Cashew + Amaranthus	34.50	53.90	4.9	7.64	45860	13475	59339	34339	1.37
T5 Cashew alone	---	---	4.5	7.02	42120	---	42120	27120	1.80
CD@5%	2.69		NS						
SEm ±	0.86		0.28						

### Sale Price (Rs./Kg)

Raw Cashew Nuts	:	60.00		
Cluster bean	:	10.00	Amaranthus	: 2.50
Marigold	:	15.00	Gogu	: 1.50



**Inter cropping in cashew with marigold**

### JHARGRAM

Maximum benefit cost ratio was obtained (1.33) when grown as intercrops in cashew with bottle gourd (2.20) followed by cowpea (Table 2.32).

**Table 2.32 : Yield and economics of cashew and intercrops in intercropping trial at Jhargram Centre**

Treatment details	Yield of intercrop Q/ha	Yield of cashew Q/ha	Cost of Cultivation (Rs./ha)				Returns (Rs./ha)			C:B Ratio
			Cashew	Inter-crop	Cashew + Intercrop	Cashew	Inter-crop	Total	Net	
Cashew + Cowpea	50.4	2.45		25765	40820	19600	75,600	95,200	54380	1.33
Cashew + Bottle gourd	97.8	2.04	15055	20500	35555	16320	97,800	1,14,120	78565	2.20

Price of intercrop : Cowpea: Rs. 15/kg, Bottle Gourd: Rs.10/kg, Price of Cashew: Rs 80/kg

### DARISAI

The main crop is yet to yield. However, the maximum return in terms of Rs/ha was found in

T1 (Rs.2,77,600) with B:C ratio of 2.83 followed by T3 (Rs.92,600) with B:C ratio of 1.37 (Table 2.33).


**Table 2.33: Yield and economics of cashew and intercrops in intercropping trial at Darisai Centre**

Treatment details	Yield of intercrop	Yield of cashew	Returns (Rs./ha)				B:C Ratio
	Q/ha	Q/ha	Cashew	Inter-crop	Total Profit	Net	
T1- Cashew+ Tomato var. Swarn Samriddhi	250	0	0	375000	375000	277600	2.83
T2- Cashew+ Cabbage var. Golden Acre	200	0	0	200000	200000	84100	0.72
T3 - Cashew+ French Bean var. Arka Komal	80	0	0	160000	160000	92600	1.37
T4 - Cashew alone	0	0	0	0	32400	0	0

Price of Intercrop – Tomato = Rs.15/kg, Cabbage = Rs.10/kg, French bean = Rs.20/kg

### KANABARGI

Among the different intercrops *Coleus* (*Plectranthus forskohlii*), cowpea, ginger, ground nut, sweet potato and turmeric, mean yield of four years was maximum in sweet potato (25.36 q/ha) followed by ginger (80.79 q/ha) whereas lowest biomass was recorded in cowpea. Highest net profit from intercrop was maximum in *coleus* (Rs.61,370/ha) followed by turmeric (Rs.56,950/

ha). Minimum net profit was recorded in cowpea (Rs.17,730/ha).

Highest yield of cashew nut was recorded in cashew intercropped with cowpea (19.38 q/ha) followed by cashew intercropped with ground nut (19.08 q/ha). Benefit to cost ratio was highest in cashew alone (5.11) followed by cashew + cowpea (4.06) whereas minimum BC ratio of 1.25 was recorded in cashew + ginger (Table 2.34).

**Table 2.34 : Yield of cashew and economics of cashew based intercropping systems at Kanabargi Centre**

Intercropping system	Cashew nut yield (Mean)		Gross Expenditure- (Main crop + Intercrop) (Rs/ha)	Net Profit (Main crop + Intercrop) (Rs/ha)	Benefit Cost Ratio (BCR)
	kg/tree	q/ha (Estimated)			
Cashew + <i>Coleus</i>	5.95	18.33	96,400	1,48,755	1.77
Cashew + Cowpea	6.22	19.38	33,000	1,02,195	4.06
Cashew + Ginger	6.04	18.57	1,20,600	1,25,540	1.25
Cashew + Groundnut	6.36	19.08	41,100	1,22,095	3.61
Cashew + Sweet potato	5.82	17.49	66,800	1,20,247	2.15
Cashew + Turmeric	6.24	18.56	1,18,300	1,44,035	1.41
Cashew alone	5.44	17.02	19,500	71,175	5.11
S.Em±	0.10	0.247	--	--	--
C.D. at 5%	0.186	1.43	--	--	--



## PARIA

The highest yield (4.59 q/ha) of cashew was observed under treatment T5 (cashew + cowpea). The highest return (77700 Rs/ha) from intercrop was recorded in T2 (cashew + okra) which was followed by T1 (cashew + pigeon pea) (35250 Rs/

ha). The highest net profit of Rs. 53,860 ha<sup>-1</sup> was obtained in treatment T2 (cashew + okra) but the highest benefit cost ratio of 2.04 was observed under the treatment T5 (cashew + cowpea) which was followed by treatment T2 (cashew + okra) (Table 2.35).

**Table 2.35 : Yield and economics of cashew and intercrops in intercropping trial at Paria Centre**

Treatment details	Yield of intercrop Q/ha	Yield of cashew Q/ha	Returns (Rs./ha)				C:B Ratio
			Cashew	Inter-crop	Total	Net	
T <sub>1</sub> : Cashew + Pigeon pea (Vaishali)	14.10	1.39	8618	35250	43868	25068	1.33 <sup>4</sup>
T <sub>2</sub> : Cashew + Okra (GO-2)	25.90	0.80	4960	77700	82660	53860	1.87 <sup>2</sup>
T <sub>3</sub> : Cashew + Indian bean (GW-2)	09.75	0.84	5208	24375	29583	13583	0.85 <sup>5</sup>
T <sub>4</sub> : Cashew + Indian bean (NPS-1)	11.80	1.46	9052	29500	38552	22552	1.41 <sup>3</sup>
T <sub>5</sub> : Cashew + Cow pea (GC-4)	05.90	4.59	28458	17700	46158	30958	2.04 <sup>1</sup>
T <sub>6</sub> : Cashew alone	00.00	1.69	10478	0	10478	2478	0.31 <sup>6</sup>
Sem ±		1.848					
CD at 5%		0.613					

## VENGURLA

Out of five different tuber crops, elephant foot yam recorded significantly higher yield (33.5 kg/plot and 4.42 t/ha) which was followed by

greater yam (23.25 kg/plot & 3.06 t/ha) and tapioca (11.12 kg/plot & 1.46 t/ha). Maximum income was obtained from elephant foot yam (Rs.1,76,180/- per/ ha.) (Table 2.36).

**Table 2.36 : Yield observations of intercrops in cashew at Vengurle Centre**

Treatment	Intercrops	Spacing (cm)	Plot size sq.m	Yield kg/plot	Yield t/ha	Local Market Rate Rs/kg	Income Rs/ha
T1	Lesser Yam (Kangar)	60 x 60	24	4.0	0.53	60/-	31,680/-
T2	Greater Yam (Ghorkand)	60 x 75	24	23.25	3.06	30/-	92,070/-
T3	Aerial Yam (Karanda)	100 x 60	24	9.88	1.30	40/-	52,170/-
T4	Elephant foot Yam(Suran)	75 x 75	24	33.5	4.42	40/-	1,76,180/-
T5	Tapioca	100 x 60	24	11.12	1.46	4/-	5,876/-
SEm±				2.61			
CD at 5%			8.03				
Yield of Cashew (V-1) - kg/tree		8m x 8m		5.43	0.85	100/-	84,700/-



## VRIDHACHALAM

The main crop is yet to start yielding. However, the net return was higher in Cashew + cluster bean (Rs.89000/ha), while the cost benefit ratio is higher

(5.04) in cashew + amaranthus due to less duration as well as lower cost of cultivation.

**Table 2.37 : Yield and economics of cashew and intercrops in intercropping trial at Vridhachalam Centre**

Treatment details	Yield of intercrop Q/ha	Yield of cashew Q/ha	Returns (Rs./ha)			C:B	Ratio
			Cashew	Inter-crop	Total	Net	
Cashew+ cluster bean	35.50	7.25	0	42600	42600	16600	1.64
Cashew+bhendi	37.50	7.25	0	37500	37500	13000	1.53
Cashew + ridge gourd	30.50	7.25	0	30500	30500	3500	1.13
Cashew+ amaranthus	30.25	7.25	0	30250	30250	13250	1.78

### Market Sale Price:

Cluster bean Rs. 12/kg  
Amaranthus: Rs. 10/kg

Bhendi: Rs. 10/kg  
Cashewnuts: Rs. 75/kg

Ridge gourd: Rs. 10/kg



## Hort.7: Organic Management of Cashew

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 system over conventional farming.

### 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

Application of recommended dose of fertilizer (T8), significantly produced maximum plant height (4.88 m), canopy diameter (7.69 m), canopy surface area (46.57 m<sup>2</sup>) and ground coverage by canopy (95.04 %) than rest of the treatments. The treatment, T4 (100 % N as Vermicompost + Bio-fertilizers @200 g) recorded minimum values for all the growth parameters under study.

Application of recommended dose of fertilizers (T8) recorded significantly highest number of panicles/m<sup>2</sup> (20.06), average nut yield (8.27g), average apple weight (58.03g) as well as annual nut yield of 906.61 kg/ha than rest of the treatments. The cumulative nut yield (kg/tree) at 5<sup>th</sup> harvest indicated highest nut yield in T8 (12.00 kg/tree) followed by T7 (9.64 kg/tree) and T2 (8.69 kg/tree) (Table 2.38).

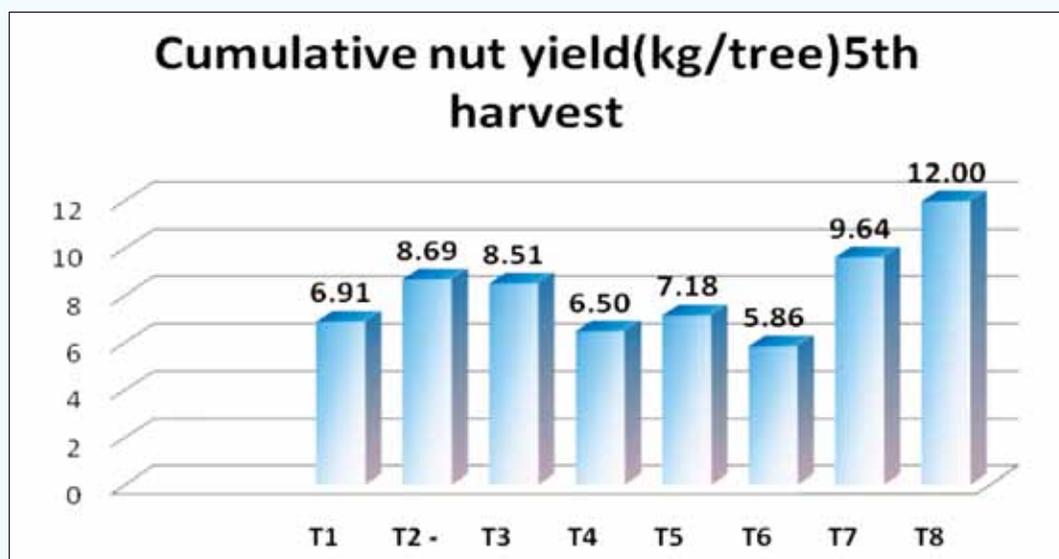
**Table 2.38: Nut yield and yield attributing parameters of cashew under organic management at Bhubaneswar Centre**

Treatment	Mean no. of panicles/m <sup>2</sup>	Mean nut weight (g)	Mean apple wt. (g) (kg/ha)	Mean annual nut yield (5th No. of hvts)	Cum. nut yield (kg/tree)
T1 - 100 % N as FYM	17.79	7.24	47.20	534.65	6.91
T2 - 100 % N as FYM + Bio-fertilizers (Azotobacter + Azospirillum + PSB) 200 g	18.80	7.81	45.23	687.48	8.69
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	17.04	7.46	52.50	572.56	8.51



Table 2.38 continued....

Treatment	Mean no. of panicles/ m <sup>2</sup>	Mean nut weight (g)	Mean apple wt. (g) (kg/ha)	Mean annual nut yield (5 <sup>th</sup> No. of hvts)	Cum. nut yield (kg/tree)
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	18.29	7.30	48.93	573.75	6.50
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	18.08	7.72	50.37	523.26	7.18
T6 - In situ green manuring / green leaf manuring to meet 100 % N	17.54	6.45	50.60	87.05	5.86
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	18.66	7.89	54.53	705.84	9.64
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	20.06	8.27	58.03	906.61	12.00
Mean	18.28	7.52	50.92	623.90	8.16
SE (m) ±	0.67	0.37	3.11	102.47	
CD at 5%	1.43	0.80	6.67	219.79	
CV%	4.47	6.10	7.48	20.11	



Influence of organic inputs on cumulative cashew nut yield (kg/ha)

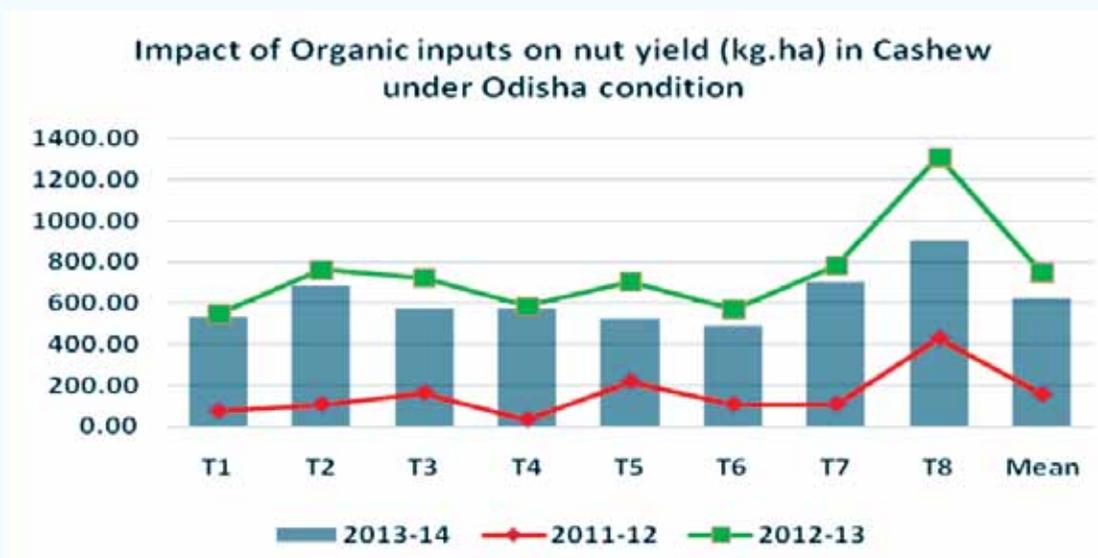


Both T7 and T2 were superior among the different organic sources towards increasing cashew production. The application of recommended dose of fertilizers along with FYM@10kg/plant

(T8), recorded maximum nut yield of 426.7kg/ha, 884.35kg/ha and 906.61kg ha during 2012, 2013 & 2014 respectively. (Table 2.39).

**Table 2.39 : Nut yield and yield attributing parameters of cashew under organic management at Bhubaneswar centre**

Treatment	Mean annual nut yield (kg/ha)		
	2011-12	2012-13	2013-14
T1 - 100 % N as FYM	73.30	469.39	534.65
T2 - 100 % N as FYM + Bio-fertilizers ( <i>Azotobacter</i> + <i>Azospirillum</i> + PSB) 200 g	106.70	653.06	687.48
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	163.30	557.82	572.56
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	33.70	551.02	573.75
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	216.70	486.39	523.26
T6 - In situ green manuring / green leaf manuring to meet 100 % N	106.70	462.59	487.05
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	108.70	673.47	705.84
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	426.70	884.35	906.61
Mean	154.48	592.26	623.90
SEm ±	75.11	63.48	102.47
CD at 5%	NS	192.57	219.79





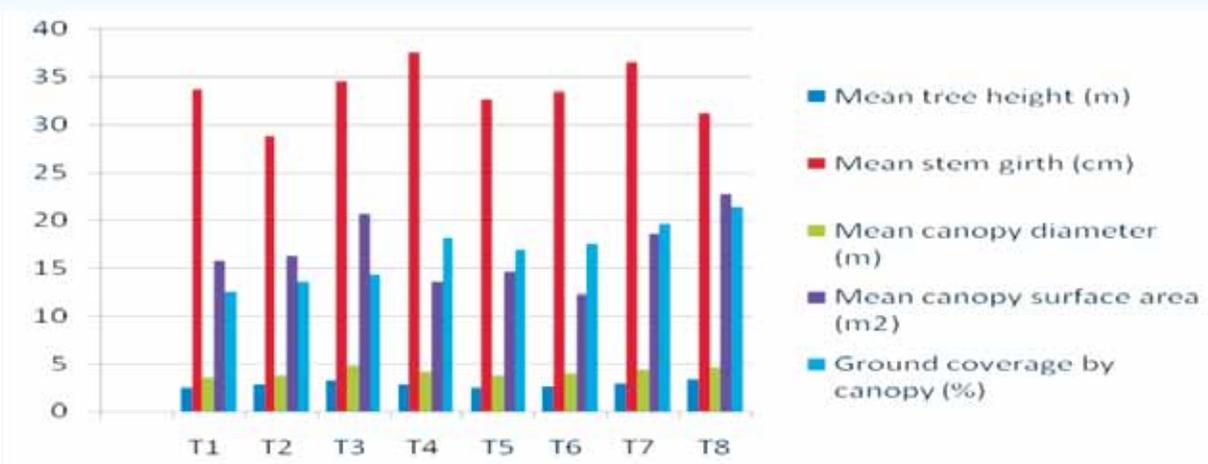
### DARISAI

No significant difference was found in vegetative parameters i.e. mean tree height, mean stem girth and ground coverage by canopy. Significant differences were recorded for mean

canopy diameter and mean canopy surface area. The highest mean canopy diameter was found in T3 (4.76m) and the highest mean canopy surface area was noticed in T8 (22.72m<sup>2</sup>) (Table 2.40)

**Table 2.40 : Growth parameters of cashew under organic management at Darisai Centre**

Treatment	Mean tree height (m)	Mean stem girth (cm)	Mean canopy diameter (m)	Mean canopy surface area (m <sup>2</sup> )	Ground coverage by canopy (%)
T1 - 100 % N as FYM	2.47	33.6	3.56	15.76	12.5
T2 - 100 % N as FYM + Bio-fertilizers (Azotobacter + Azospirillum + PSB) 200 g	2.73	28.7	3.74	16.26	13.6
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	3.25	34.5	4.76	20.61	14.3
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	2.8	37.6	4.1	13.6	18.2
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry(20.0% weight of organic residue as cow dung)	2.45	32.6	3.76	14.56	16.9
T6 - In situ green manuring / green leaf manuring to meet 100 % N	2.56	33.4	3.98	12.31	17.5
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	2.85	36.5	4.3	18.6	19.6
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	3.3	31.2	4.6	22.72	21.4
SEm ±	0.200	3.410	0.244	1.875	1.456
CD at 5%	N.S.	N.S.	0.747	5.743	N.S.
CV%	12.338	17.623	10.299	19.327	10.817



**Influence of organic inputs on vegetative parameters**



## JHARGRAM

The treatments were on par with respect to their influence on plant height, canopy spread and canopy area. The treatments, T6, T3 and T1 had more panicles per square meter and were on par with each other.

No significant variations among the

treatments were noticed with respect to yield /tree and nut weight. But significant variations occurred for nuts /m<sup>2</sup> and cumulative nut yield /tree. Cumulative nut yield /tree was highest (16.58 kg/tree) in T1 where FYM was applied as 100% N and the other treatments had on par cumulative yield / tree (Table 2.41).

**Table 2.41 : Effect of organic management on yield parameters of cashew at Jhargram Centre**

Treatment	Mean panicles/m <sup>2</sup>	Mean nut weight (g) (kg/ha)	Mean apple wt. (g) (5 hvsts)	Mean annual nut yield	Cum. nut yield (kg/tree)
T1 - 100 % N as FYM	13.75	7.69	76.9	7.66	16.58
T2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	11.88	7.25	72.5	7.46	14.50
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	13.79	7.42	74.2	7.24	12.92
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	12.42	7.36	73.6	5.08	10.18
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	12.50	7.55	75.5	5.52	10.32
T6 - In situ green manuring / green leaf manuring to meet 100 % N	14.50	7.37	73.7	6.73	11.96
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	11.83	7.29	72.9	6.61	11.79
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	11.33	7.59	75.9	5.58	10.58
Sem ±	0.34	0.05	0.54	0.59	0.85
CD at 5%	0.73	N.S.	N.S.	N.S.	1.82
CV%	12.2	3.5	3.5	5.9	4.7

## KANABARGI

The crop is in initiated stages of growth. No significant differences were observed among the treatments for plant height stem girth number of branches and canopy spread.

## MADAKKATHARA

Maximum height was recorded (3.46 m) in plants which received green leaf manuring (T6). This was on par with T1, T2, T4, & T7. The lowest

height was recorded in T5. The girth and canopy spread of the plants did not vary significantly among different treatments.

The yield per tree varied significantly in response to different organic manure treatments. The highest yield of 3.90 kg/tree was obtained in T6 (green leaf manured plots) which was on par with T4 plots which received 100% N as vermicompost + bio-fertilisers. The yield was lowest in plots which received 100% N as FYM (Table 2.42).



**Table 2.42 : Effect of organic management on yield parameters of cashew at Madakkathara Centre**

Treatments	Height (m)	Girth (cm)	Canopy spread-NS (m)	Canopy spread-EW (m)	Yield (kg/tree)
T1 - 100 % N as FYM	3.23	60.0	5.53	5.00	2.89
T2 - 100% N as FYM + BF	2.96	46.0	5.46	5.13	3.15
T3 - 50% N as FYM + BF	2.60	48.3	5.20	5.33	3.59
T4 - 100% N as VC + BF	2.80	54.3	5.00	5.90	3.89
T5 - Recycling organic residues	2.33	65.0	5.33	5.36	2.75
T6 - Green leaf/ green manuring	3.46	56.0	5.20	5.53	3.90
T7 - 25% N as FYM + recycling organic residues + green leaf / green manuring + BF	3.23	54.3	5.10	5.60	3.34
T8 - RDF + 10 kg FYM (Control)	3.00	48.3	4.53	5.13	3.58
CD (0.05%)	0.72	NS	NS	NS	0.72

### VENGURLA

There was no significant difference among the various treatments in respect of vegetative parameters. However, T8 (RDF+10kg FYM – control) recorded more mean height (4.10 m), mean canopy height (4.37 m), mean canopy spread (3.40 m). Whereas T6 (In situ green manuring / green leaf manuring to meet 100% N recorded maximum mean canopy area (17.10 m<sup>2</sup>) and

mean canopy surface area (30.23 m<sup>2</sup>). In case of mean fruit set/m<sup>2</sup>, T7 recorded maximum fruit set (40.42/ m<sup>2</sup>) and T8 - RDF + 10 kg FYM (Control) recorded maximum number of nuts per panicle i.e. (6.00). The highest cumulative yield for 3 harvests was 12.39 kg/tree recorded in T8 i.e. recommended dose of fertilizer + 10kg FYM followed by T2 i.e., 100% N as FYM + Biofertilizer consortia (11.21 kg/ tree) (Table 2.43).

**Table 2.43 : Effect of organic management on yield parameters of cashew at Vengurle Centre**

Treatments	Mean fruit set/m <sup>2</sup>	No. of nuts/ panicle	Cum. yield 3 harvests (kg/tree)
T1 - 100% N as FYM	20.28	5.69	8.22
T2 - 100% N as FYM + Biofertilizers (Azatobacter + Azospirillum + PSB)	33.83	5.67	11.21
T3 - 50% N as FYM + Biofertilizers	31.92	5.15	8.39
T4 - 100% N as Vermicompost + Biofertilizers	31.42	5.67	7.05
T5 - Recycling of organic residues with addition of 20% cow dung slurry	37.88	5.88	5.27
T6 - In situ green manuring/green leaf manuring to meet 100% N	34.33	5.77	9.28
T7 - 25% N as FYM + Recycling of organic residues + In situ green manuring/green leaf manuring + Biofertilizers	40.42	4.58	8.07
T8 - RDF + 10 kg FYM (Control)	31.08	6.00	12.39
SEm±	6.67	1.15	
CD at 5%	N.S.	N.S.	



## VRIDHACHALAM

Inorganic fertilizer application (T8) with 10 kg FYM recorded the highest values for mean canopy diameter, mean surface area, mean flowering laterals per m<sup>2</sup>, nut yield and cumulative yield.

The treatment T7 i.e., 25% N as FYM + recycling of organic residue led to second highest nut yield of 1050 kg/ha and 20.0 kg/tree of cumulative nut yield for 5 harvests. (Table 2.44).

**Table 2.44 : Effect of organic management on yield parameters of cashew at Vridhachalam Centre**

Treatment	Mean canopy diameter (m)	Ground coverage by canopy (%)	Mean flowering laterals/panicles per m <sup>2</sup>	Mean nut weight (g)	Mean apple wt. (g)	Mean annual nut yield (kg/ha)	Cum. nut yield (Kg/tree) (5 hvts)
T1 - 100 % N as FYM	5.5	48.5	20.0	6.9	55.5	960	16.8
T2 - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	5.9	55.8	18.0	6.8	53.0	900	17.1
T3 - 50 % N as FYM + Bio-fertilizers (200 g)	5.8	53.9	16.5	6.8	52.5	820	16.3
T4 - 100 % N as Vermicompost + Bio-fertilizers (200 g)	5.8	53.9	16.5	6.8	52.5	920	19.1
T5 - Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	6.0	57.7	16.0	6.9	55.0	880	18.2
T6 - In situ green manuring / green leaf manuring to meet 100 % N	5.9	55.8	19.0	6.8	52.0	880	16.9
T7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	5.8	59.6	19.0	6.8	54.5	1050	20.0
T8 - Recommended doses of fertilizer + 10 kg FYM (Control)	6.3	63.6	23.0	6.9	56.5	1220	21.6
CD @ 5%	0.334	3.851	1.062	0.415	3.504	0.314	0.824
SEm±	0.185	1.814	0.521	0.192	1.421	0.145	0.373
CV %	3.54	3.52	3.44	3.45	3.51	3.42	3.41



## Hort.8 : Spacing cum fertilizer trial

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

### PARIA

All the vegetative parameters were non significant for individual as well as interaction effect of spacings and fertilizer levels. The trial is in the first year of establishment.

### KANABARGI

Trunk girth increased with the fertilizer dose at 78 :20 :20 g NPK/plant/year and fertilizer dose at 117 : 29 : 29g NPK/plant/year recording 6.12 &

6.00 cm respectively. Canopy diameter increased with fertilizer dose at 78 :20 :20 g NPK/plant/year and fertilizer dose at 117 : 29 : 29g NPK/plant/year recording 1.44 & 1.38 m respectively. Canopy surface area was maximum (26.22 m<sup>2</sup>) with fertilizer dose at 78 :20 :20 g NPK/plant/year. Highest plant height was obtained in S2F2 (2.29 m) followed by other treatment combinations which were on par (Table 2.45).

**Table 2.45 : Interaction effect of different spacing and fertilizer levels on growth of cashew at Kanabargi Centre**

Treatments	Plant height (m)	Trunk girth (cm)	Canopy diameter (m)	Canopy height (m)	Canopy surface area (m <sup>2</sup> )
S1F1	1.97	5.70	1.353	1.12	15.44
S1F2	2.12	5.93	1.347	1.44	18.90
S1F3	2.04	6.06	1.327	1.30	16.57
S2F1	1.81	5.54	1.387	1.13	15.95
S2F2	2.29	6.19	1.477	1.64	22.39
S2F3	2.07	6.32	1.410	1.40	18.74
S3F1	2.13	5.74	1.327	1.41	17.29
S3F2	2.07	6.23	1.507	1.44	20.76
S3F3	1.83	5.61	1.430	1.18	11.27
S.E.m±	0.070	0.076	0.027	0.071	0.942
C.D. (p=0.05)	0.369	0.400	0.146	0.371	4.890



## Hort.9: Varietal Screening of cashew apple for preparation of RTS and Jam

The objective of this trial is to identify suitable varieties of cashew for preparation of RTS and Jam.

### BAPATLA

The organoleptic evaluation of RTS for different varieties of cashew showed highest scores for BPP-8 with respect to colour, flavour, appearance,

sweetness and overall acceptability. However BPP-9 had highest score for taste for cashew apple RTS. Regarding shelf life, BPP, 2, 3, 8 & 11 had a shelf life of 90 days (Table 2.46).

**Table 2.46 : Evaluation of organoleptic score of RTS for cashew apple at Bapatla Centre**

Variety	Taste	Colour	Flavour	Appearance	Sweetness	Overall acceptability	Shelf life (Days)
BPP-1	3.62	3.31	3.23	3.23	3.38	3.54	-
BPP-2	3.54	4.38	3.77	4.38	3.77	3.62	90 days
BPP-3	3.38	4.08	3.77	4.08	3.46	3.23	90 days
BPP-4	3.31	4.23	3.31	4.31	3.38	3.08	-
BPP-5	3.08	4.23	3.08	4.23	3.31	3.31	-
BPP-6	3.08	4.15	3.38	4.46	3.54	3.15	-
BPP-8	3.69	4.54	3.92	4.62	4.23	3.85	90 days
BPP-9	4.08	3.38	3.31	3.15	3.46	3.15	-
BPP-10	3.08	2.92	2.85	3.08	3.38	3.23	-
BPP-11	3.54	3.38	3.15	3.69	3.69	3.54	90 days
SEm+	0.356	0.299	0.315	0.288	0.375	0.271	-
CD (5%)	NS	0.830	NS	0.800	NS	NS	CD ( 5%)

(1=Poor, 2= Fair, 3=Good, 4= very good 5= Excellent)



**Cashew apple RTS**



Higher scores were recorded for BPP-8 with respect to colour, flavour, appearance, sweetness and overall acceptability. BPP-1 had the highest score for taste (4.31) while BPP-8 had the least

score of 2.08 for cashew apple jam. Regarding shelf life, BPP-6 had a shelf life of 90 days and BPP-10 had shelf life of 120 days (Table 2.47).

**Table 2.47 : Evaluation of organoleptic score of jam for cashew apple at Bapatla Centre**

Variety	Taste	Colour	Flavour	Appearance	Sweetness	Overall Acceptability	Shelf Life (Days)
BPP-1	4.31	4.08	3.69	4.08	3.92	3.77	-
BPP-2	4.23	3.85	3.92	3.85	3.69	3.69	-
BPP-3	3.69	4.08	3.85	4.15	3.77	3.77	-
BPP-4	3.77	3.54	3.77	4.08	3.85	3.77	-
BPP-5	3.77	3.92	3.85	4.08	4.08	3.85	-
BPP-6	3.69	3.77	3.77	4.31	3.77	3.69	Upto 90 days
BPP-8	2.08	4.23	4.15	4.38	2.46	4.15	-
BPP-9	2.85	2.92	3.46	3.23	4.31	2.92	-
BPP-10	3.15	3.38	2.77	3.46	2.54	2.62	Upto 120 days
BPP-11	3.62	2.69	3.08	2.92	3.08	3.08	-
SEm+	0.233	0.269	0.245	0.24	0.272	0.233	-
CD (5%)	0.653	0.755	0.688	0.69	0.761	0.654	-

(1=Poor    2= Fair    3=Good    4=Very Good    5= Excellent)



**Cashew apple jam**

**BHUBANESWAR**

The cashew variety H-1608 recorded significantly highest TSS (12.33<sup>0</sup> brix) followed by

Vengurla 4 (12.3<sup>0</sup>brix), Balabhadra (12.23<sup>0</sup> brix) and Jagannatha (12.2<sup>0</sup>brix), which were statistically at par. Highest pH was recorded in Vengurla 4 (4.90)



followed by H-303 (4.83) which were statistically at par. Significantly lowest pH was obtained in

variety, Balabhadra (4.34) during the evaluation (Table 2.48).

**Table 2.48 : Organoleptic evaluation of RTS at Bhubaneswar Centre**

Variety	TSS	Taste	Colour	Flavour	Total acceptability	pH
BPP 8	10.83	3.33	4.27	3.60	3.73	4.65
NRCC Sel-2	11.10	1.53	2.07	2.47	2.40	4.61
BH 6 (Jagannath)	12.20	4.40	4.27	3.27	4.53	4.70
BH 85 (Balabhadra)	12.23	3.07	4.27	3.47	3.33	4.34
H 303	10.93	4.63	4.40	3.33	4.13	4.83
H 320	10.96	3.13	4.40	3.40	3.27	4.72
Bhubaneswar 1	12.16	4.40	4.47	3.33	4.27	4.59
H 11	10.30	2.93	3.20	3.27	3.60	4.76
H 1608	12.33	4.13	4.00	3.40	4.20	4.36
Vengurla 4	12.30	3.13	4.47	3.47	3.47	4.90
Grand mean	11.53	3.47	3.98	3.30	3.69	4.65
SEm ±	0.05	0.14	0.08	0.11	0.14	0.03
CD (5%)	0.14	0.41	0.25	0.32	0.42	0.08

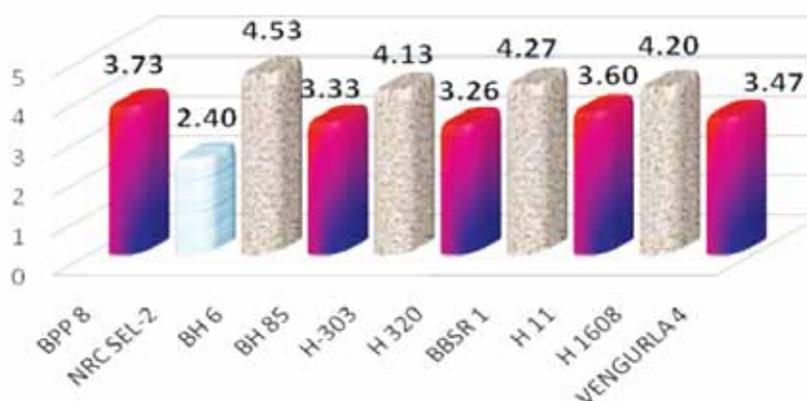
The organoleptic test indicated majority of the tested varieties being graded as “Good” and “Very Good” with a score value of 2.93 to 4.63 with respect to colour, taste, flavor as well as overall acceptability. NRCC Sel-2 recorded “Fair” values for all the organoleptic parameters. The highest score for total acceptability (4.53) was recorded by BH-6 (Jagannath).

The overall scoring of cashew apple RTS revealed wide variations for scoring of taste (1.53

in NRCC Sel-2 to 4.63 in Balabhadra), colour (2.07 in NRCC Sel-2 to 4.47 in Bhubaneswar-1) as well as flavour (2.47 in NRCC Sel-2 to 3.47 in Balabhadra and Vengurla-4).

The overall acceptability of cashew apple RTS, ranged from 2.40 in NRCC Sel-2 to 4.53 in Jagannath. The cashew apple RTS prepared from cashew varieties such as BH 6 (Jagannath), Bhubaneswar-1, H-303 and H-1608 recorded significantly highest overall acceptability (4.13 to 4.53) compared to rest of the tested varieties.

**Total acceptability of cashew apple RTS**



**GOA**

Apple weight was observed to be highest in H-22/05 (100.4g) having juice content of 69.7% and total soluble sugars of 12.4°B, while the corresponding values were 90.55g, 70.3% and 11.8°B in H-21/05 and 69.4g, 69.4% and 11.0°B in H-11/05 (Table 2.49).

**Table 2.49 : Apple characteristics of cashew hybrids at Goa Centre**

Hybrid	Apple			
	Mean Wt.(g)	Juice %	TSS (°B)	Colour
H- 5/05	60.55	68.5	11.2	Yellow
H- 14/05	65.40	65.3	10.6	Orange
H- 11/05	80.50	69.4	11.0	Red
H- 12/05	85.5	65.6	10.8	Yellow
H- 13/05	79.55	70.0	11.2	Yellow
H- 21/05	90.55	70.3	11.8	Yellow
H- 22/05	100.4	69.7	12.4	Yellow
H- 23/05	75.25	63.9	11.2	Red
H- 27/05	70.65	65.5	10.8	Orange
H- 29/05	68.33	66.6	10.6	Yellow
H- 30/05	65.68	60.2	11.2	Yellow
H- 31/05	55.65	60.8	12.0	Yellow

**JAGDALPUR**

Among the 10 cashew genotypes, CARS-8 had the maximum score with respect to taste (4.1) and total acceptability (4.0). However the maximum score for colour was 3.9 in CARS-6 (Table 2.50).

**Table 2.50 : Organoleptic evaluation of jam prepared from different genotypes of cashew at Jagdalpur Centre**

Genotypes	Taste	Colour	Flavour	Total acceptability
CARS-1	3.2	3.1	2.9	3.1
CARS-2	3.5	3.1	2.6	3.3
CARS-3	3.5	3.7	3.2	3.5
CARS-4	3.1	3.4	2.8	3.1
CARS-5	3.3	3.7	2.8	3.2
CARS-6	3.9	3.9	3.2	3.7
CARS-8	4.1	3.8	3.6	4.0
CARS-9	3.4	3.3	2.8	3.4
CARS-10	4.0	3.4	3.3	3.6
CARS-11	3.6	3.4	3.1	3.6



### KANABARGI

The varieties, Vengurla-2, 3, 4 and 7 recorded higher scores for colour and appearance, flavor, taste and overall acceptability for RTS. Vengurla-7 and Ullal-4 recorded higher scores for colour and appearance, flavor, taste, texture and overall acceptability for jam. Jam prepared from Vengurla-6 and RTS from Ullal-2 had lowest scores for all parameters.

### PILICODE

Priyanka had high overall acceptability for

cashew apple RTS (3.84) which was followed by Dhana, Raghav, Amritha and AR 2. Priyanka had the highest score for appearance (3.86). Dhana and Priyanka had the highest score for flavour and colour while, Priyanka had the highest score for texture and sweetness.

Dhana and Priyanka had the highest overall acceptability for jam (3.68 and 3.48 respectively). Dhana had the highest score for colour, whereas Priyanka had the highest score for flavour. Highest score for taste was obtained with Raghav (3.64) (Table 2.51 and 2.52).

**Table 2.51 : Organoleptic scoring of cashew apple RTS at Pilicode Centre**

Variety/ Germplasm	Appearance	Colour	Flavour	Taste	Texture	Sweetness	Overall acceptability
Amritha	3.04	3.12	3.36	3.48	3.24	3.48	3.28
Bhaskara	2.56	2.32	2.68	2.52	2.68	2.84	2.64
Raghav	3.40	3.48	3.12	3.12	3.36	3.40	3.44
MLR-3	2.68	2.68	2.68	2.84	2.76	3.12	2.72
AR-2	3.40	3.60	3.00	3.56	3.20	3.52	3.36
MDK-1	2.92	2.96	2.92	3.08	2.80	3.16	2.96
KM	2.76	2.68	2.68	2.80	2.76	3.12	2.84
PCC-9	2.60	2.64	2.80	2.92	2.88	3.32	2.88
Dhana	3.36	3.76	3.40	3.72	3.28	3.44	3.52
Priyanka	3.56	3.76	3.40	3.92	3.48	3.84	3.84

**Table 2.52 : Organoleptic scoring of cashew apple jam at Pilicode Centre**

Variety/ Germplasm	Appearance	Colour	Flavour	Taste	Texture	Sweetness/ Saltiness	Overall acceptability
Amritha	2.60	2.68	2.48	2.60	2.56	3.00	2.72
Bhaskara	2.40	2.48	2.72	3.04	2.76	3.60	2.88
Raghav	3.64	3.48	3.20	3.48	3.08	3.64	3.64
MLR-3	3.28	3.16	2.80	3.08	2.80	3.32	3.04
AR-2	2.52	2.36	2.32	2.12	2.48	2.64	2.60
MDK-1	2.88	2.96	2.84	2.92	2.96	3.00	2.96
KM	2.68	2.64	2.88	2.68	2.84	3.00	2.84
PCC-9	3.20	3.08	2.96	2.92	3.20	3.12	3.16
Dhana	3.56	3.52	3.16	3.68	3.44	3.64	3.68
Priyanka	3.56	3.32	3.24	3.24	3.24	3.56	3.48



## III. CROP PROTECTION





### III. CROP PROTECTION

#### Ent. 1: Chemical Control of pest complex in cashew

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

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.

##### Experimental details:

- T1 - Neem oil soap (4%) followed by L- Cyhalothrin (0.6ml/l) followed by Neem oil soap
- T2 - Imidacloprid (0.6ml/l)
- T3 - Acetamaprid 20SP(0.5 g/l)
- T4 - L-cyhalothrin 0.003%
- T5 - Monocrotophos 0.05% at flushing, Chlorpyriphos 0.05% at flowering and carbaryl 0.1% at fruit & nut development stage.
- T6 - Untreated Control

##### BAPATLA

Incidence of TMB was not observed at the Centre. Occurrence of lead and blossom webber (LBW) and shoot tip caterpillar (STC) was observed at a low level. The treatment T4 (L-Cyhalothrin 0.003%) was found to be effective in controlling the LBW which was on par with T1 (Neem oil soap (4%) at flushing, L-cyhalothrin (0.6ml/l) at flowering and Neem oil soap (4%) at fruit and nut development stage) & T5 (Monocrotophos 0.05% at flushing, chlorpyriphos 0.05% at flowering and carbaryl 0.1% at fruit & nut development stage). T4 (L-cyhalothrin 0.003%) was found to be more effective in managing STC compared to rest of the treatments followed by T5-recommended schedule spray for the region. Moreover, none of the chemicals evaluated were found to be safe to the natural enemies i.e. spiders and ants.

##### BHUBANESWAR

Minimum damage of TMB was observed

in both T-4 and T-5 (0.10-0.11) which were at par, while damage score was nil in untreated control. Incidence of cashew leaf miner varied from 14.54 to 15.18 per cent damaged leaf before the insecticide application, and was minimum in T-5 (1.35 % damage leaf) closely followed by T- 4 (3.07% damage leaf). The incidence of shoot tip caterpillar was lowest in T4 and T5 (1.03 – 1.09%) while untreated control recorded 16.80 % damage shoot.

Thrips damage was low in both T4 and T5 (0.2-0.32 damage in 0-4 scale). Cashewnut yield was highest in T4 (5.07kg/tree) closely followed by T5 (4.82kg/tree) and were at par.

The results of chemical control of pest complex in cashew over last two years revealed that T-5 i.e. L-cyhalothrin-Profenophos- L-cyhalothrin and T-4 i.e. L-cyhalothrin in all 3 sprays were the most effective against TMB and other pest complex in cashew (Table 3.1).



**Table 3.1 : Efficacy of insecticides against pest complex in cashew at Bhubaneswar Centre**

Treatments	Leaf miner (% DL) 30 days after 2 <sup>nd</sup> spray	STC (5 damaged shoot) 30 days after 3 <sup>rd</sup> spray	Damage by IT (0-4 scale)	TMB damage (0-4 scale)	Yield (Kg/tree)
T-1 Neem oil soap (4%)- L-Cyhalothrin-(0.003%)after 15 D- neem oil soap (4%)	9.14 (3.10)	4.92 (2.31)	1.09 (1.25)	0.28 (0.88)	4.12
T-2 Imidacloprid 17.8 SL (0.6 ml/l) all 3 sprays	6.05 (2.55)	2.93 (1.86)	0.76 (1.11)	0.21 (0.84)	4.35
T-3 Acetamiprid 20 SP (0.5G/l) all 3 sprays	4.75 (2.29)	2.02 (1.58)	0.93 (1.92)	0.22 (0.85)	4.15
T-4 L-cyhalothrin (0.003%) all 3 sprays	3.07 (1.87)	1.03 (1.23)	0.32 (0.90)	0.10 (0.77)	5.07
T-5 L-cyhalothrin (0.003%)- Prophenophos L-Cyhalothrin	1.35 (1.36)	1.09 (1.25)	0.20 (0.83)	0.11 (0.78)	4.82
T-6 Untreated control	18.22 (4.31)	16.80 (4.14)	1.52 (1.41)	0.30 (0.89)	3.17
CD (0.05)	0.301	0.341	0.14	0.044	0.844
CV %	7.74	10.93	8.27	3.47	12.72

STC = Shoot tip caterpillar

IT = Inflorescence thrips

DL = Damaged leaves

### HOGALAGERE

The damage by TMB on shoots and panicles was significantly reduced in L-cyhalothrin 0.003% in all the sprays followed by Imidacloprid (0.6ml/l) all the three sprays (0.22 and 0.38; 1.00 and 1.11 respectively).

The maximum nut yield was obtained in treatment L-cyhalothrin 0.003% (2.10 kg/tree) followed by Imidacloprid (0.6ml/l) all the three sprays (1.86 kg/tree) and Acetamiprid 20 SP (0.5g/l) all the three sprays (1.68 kg/tree) (Table 3.2).

**Table 3.2 : Efficacy of different insecticides against tea mosquito bug incidence in cashew at Hogalagera Centre**

Treatments	Tea mosquito bug damage on 52 leader shoots/panicles (1-4 scale)		Nut yield (kg/tree)
	On shoots 15 DAS	On panicles 15 DAS	
T1 First spray with neem oil soap (4%) followed by L-Cyhalothrin (0.003%) as second spray within 15 days followed by neem oil soap (4%) as third spray	1.56	3.81	1.58
T2 Imidacloprid 17.8 SL (0.6ml/l) all the three sprays	1.00	1.11	1.86
T3 Acetamiprid 20 SP (0.5g/l) all the three sprays	1.20	1.94	1.68
T4 L - Cyhalothrin (0.003% @ 0.6ml/l) all three sprays	0.22	0.38	2.10



Table 3.2 continued....

Treatments		Tea mosquito bug damage on 52 leader shoots/panicles (1-4 scale)		Nut yield (kg/tree)
		On shoots 15 DAS	On panicles 15 DAS	
T5	Rec. spray schedule for the region (Dimethoate @1.7ml/l)	1.18	1.62	1.61
T6	Untreated control	3.55	3.64	1.23
	Sem ±	0.17	0.23	0.19
	CD at 5%	0.51	0.68	0.58
	CV%	23.10	21.75	22.94

### JAGDALPUR

At 30 days after first spray on panicle T4 – L-cyhalothrin (0.003%) gave better reduction of TMB damage recording 0.08 and 0.01 score on shoot and panicle, respectively and was at par with T5 - profenophos (0.05%) (Table 3.3).

Leaf folder damage was significantly minimum in T4 (7.09%) after first spray. Minimum damage of 7.89 per cent was recorded in T4 with respect to leaf miner damage.

**Table 3.3 : Efficacy of different insecticides against major pest of cashew at Jagdalpur**

Treatment	TMB Mean Damage Score	
	Shoot	Panicle
	30 days after II <sup>nd</sup> spray	30 days after II <sup>nd</sup> spray
T-1: Neem oil soap (4%) followed by L-Cyhalothrin (0.6ml/l) followed by Neem oil soap	0.28 (1.12) <sup>a</sup>	0.07 (1.03) <sup>b</sup>
T-2 : Imidacloprid 17.8 SL ( 0.6ml/l)	0.16 (1.07) <sup>a</sup>	0.08 (1.03) <sup>b</sup>
T-3 : Acetamiprid 20 SP (0.5g/l)	0.20 (1.09) <sup>a</sup>	0.07 (1.03) <sup>b</sup>
T-4: L-Cyhalothrin 0.003%	0.08 (1.04) <sup>a</sup>	0.01 (1.00) <sup>a</sup>
T-5 : Profenophos 0.05%	0.09 (1.04) <sup>a</sup>	0.06 (1.02) <sup>ab</sup>
T-6 : Unsprayed check	0.56 (1.24) <sup>b</sup>	1.06 (1.43) <sup>c</sup>
CD at 5%	0.11	0.02
SEm ±	0.03	0.007

\*Figure in parentheses are Square root transformed values



**Table 3.4 : Efficacy of different insecticides against pest complex in cashew at Jagdalpur**

Treatments	Percent incidence of minor pest of Cashew	
	% Leaf folder damage	% Leaf miner damage
	30 days after II <sup>nd</sup> spray	30 days after II <sup>nd</sup> spray
T-1: Neem oil soap (4%) followed by L-Cyhalothrin (0.6ml/l) followed by Neem oil soap	38.89 (35.74) <sup>b</sup>	14.05 (21.99) <sup>c</sup>
T-2 : Imidacloprid 17.8 SL (0.6ml/l)	38.9 (32.64) <sup>a</sup>	12.74 (20.84) <sup>bc</sup>
T-3 : Acetamaprid 20 SP (0.5g/l)	34.4 (34.84) <sup>ab</sup>	15.89 (23.40) <sup>c</sup>
T-4:L-Cyhalohethrin 0.003%	30.75 (33.68) <sup>ab</sup>	5.29 (13.25) <sup>a</sup>
T-5 : Profenophos 0.05%	36.4 (34.77) <sup>ab</sup>	8.973 (17.40) <sup>b</sup>
T-6 : Unsprayed check	44.35 (41.30) <sup>c</sup>	27.10 (31.25) <sup>d</sup>
CD at 5%	2.27	3.49
SEm ±	0.74	1.14

\*Figure in parentheses are angular transformed values

### JHARGRAM

Among the treatments, T4 (L-cyhalothrin 0.003%) was the best treatment with minimum damage (3.87%) by shoot tip caterpillar followed by Acetamiprid 20SP (0.5 g/l) (3.96). Least damage

by the leaf and blossom webber was observed in T3 (Acetamiprid 20SP (0.5 g/l) (1.64%) followed by T4 (L-cyhalothrin 0.003%) (1.66%) which were on par (Table 3.5).

**Table 3.5 : Efficacy of different insecticides against pest complex in cashew at Jhargram Centre**

Treatments		Shoot tip caterpillar damaged shoots (%) (30 days after 3 <sup>rd</sup> spray)	Leaf and blossom webber (%) (30 days after 3 <sup>rd</sup> spray)
T1	Neem oil soap(4%) followed by L-cyhalothrin (0.6ml/l) followed by Neem oil soap	4.13 (11.71) <sup>a</sup>	1.96 (7.97) <sup>c</sup>
T2	Imidacloprid (0.6ml/l)	4.68 (12.52) <sup>b</sup>	1.82 (7.74) <sup>b</sup>
T3	Acetamiprid 20SP(0.5 g/l)	3.96 (11.43) <sup>a</sup>	1.64 (7.27) <sup>a</sup>
T4	L-cyhalothrin 0.003%	3.87 (11.37) <sup>a</sup>	1.66 (7.29) <sup>a</sup>



Table 3.5 continued.....

	Treatment	Shoot tip caterpillar damaged shoots (%) (30 days after 3 <sup>rd</sup> spray)	Leaf and blossom webber (%) (30 days after 3 <sup>rd</sup> spray)
T5	Monocrotophos 0.05% at flushing, Chlorpyrifos 0.05% at lowering and carbaryl 0.1% at fruit & nut development stage.	4.52 (12.25) <sup>b</sup>	1.69 (7.32) <sup>a</sup>
T6	Untreated control	13.42 (21.47) <sup>c</sup>	13.63 (21.63) <sup>d</sup>
	SEm ±	0.241	0.091
	CD at 5%	0.53	0.20

### KANABARGI

Treatment with L-cyhalothrin 0.003% recorded the least damage score of TMB (0.13) followed by Acetamaprid (0.26). Acetamaprid at (0.5g/L) was found superior in controlling thrips

population as compared to L-cyhalothrin and rest of the treatments. L-cyhalothrin recorded highest yield of 5.43 kg/tree followed by acetamaprid (4.52 kg/ha) (Table 3.6).

**Table 3.6 : Evaluation of insecticides for the control of TMB on cashew at Kanabargi Centre**

	Treatments	TMB damage Score	Yield (kg/tree)
T1	First spray with Neem oil soap (4%) followed by L-cyhalothrin (0.003%) as second spray within 15 days followed by Neem oil soap (4%) as third spray	0.34	4.32
T2	Imidacloprid 17.8 SL (0.6 ml/l) all the three sprays	0.29	3.74
T3	Acetamaprid 20 SP (0.5 g/l) all the three sprays	0.26	4.52
T4	L-cyhalothrin (0.003%) all the three sprays	0.13	5.43
T5	Dimethoate 30EC @ 1.70 ml/l all the three sprays	0.27	4.18
T6	Untreated control	1.37	1.68
	SEm±	0.03	0.28
	CD at 5%	0.11	0.84

### MADAKKATHARA

The least damage score on shoot (0.087) was recorded in L-cyhalothrin followed by neem oil in alternation with L-cyhalothrin and imidachloprid, which were on par among each other. POP recommendation and acetamaprid treatments were on par with control (0.360). The least damage score on panicles (0.290) was recorded in T1 - L-cyhalothrin which was on par with remaining

insecticide treatments. On 30th day after second spray, apple and nut borer infestation was nil in L-cyhalothrin treatment.

The highest yield (3.28 kg/ tree) was recorded in T1 which was significantly superior to all other treatments. The remaining treatments were on par with control (1.91 kg) (Table 3.7).



**Table 3.7 : Effect of different insecticides against Tea Mosquito Bug in cashew at Madakkathara Centre**

Treatments	TMB damage score (0-4 scale)		Apple and nut borer % damaged apples	Nut yield (kg/tree)
	On Shoot	On Panicle		
T-1 Neem oil L-cyhalothrin-Neem oil	0.186 <sup>a</sup> (0.828)	0.397 <sup>a</sup> (0.947)	2.245 <sup>a</sup> (1.452)	3.28 <sup>a</sup>
T-2 Imidachloprid	0.207 <sup>a</sup> (0.838)	0.508 <sup>a</sup> (0.999)	3.662 <sup>a</sup> (1.555)	2.06 <sup>ab</sup>
T-3 Acetamaprid	0.357 <sup>b</sup> (0.922)	0.441 <sup>a</sup> (0.966)	2.269 <sup>a</sup> (1.383)	2.19 <sup>ab</sup>
T-4 L-cyhalothrin	0.087 <sup>a</sup> (0.766)	0.290 <sup>a</sup> (0.887)	0.849 <sup>a</sup> (1.073)	2.32 <sup>ab</sup>
T-5 POP	0.278 <sup>b</sup> (0.882)	0.303 <sup>a</sup> (0.895)	1.431 <sup>a</sup> (1.159)	2.49 <sup>ab</sup>
T-6 Control	0.360 <sup>b</sup> (0.926)	1.658 <sup>b</sup> (1.431)	8.204 <sup>b</sup> (2.751)	1.91 <sup>b</sup>
CV %	6.94	8.97	41.37	27.96

Figures in parenthesis are square root transformed values, means followed by common alphabets are not significantly different among themselves

### PARIA

The least damage score caused by TMB (0.95 & 1.01) respectively for shoots and panicles was recorded in the treatment of Acetamiprid.

The least damage score caused by thrips (0.77) was recorded in the treatment with Acetamiprid. The lowest infestation (17.77% & 12.39%, respectively for LM and ANB) was recorded in L-cyhalothrin; however, it was statistically at par with Acetamiprid and Triazophos. Similarly, the lowest infestation (15.36% & 12.62%, respectively for LBW and STC) were recorded

in the treatment with Acetamiprid, however, it was statistically at par with L-cyhalothrin and Triazophos.

The highest nut yield of cashew (974 kg/ha) was recorded in the treatment L-cyhalothrin; however it was on par with Triazophos and Profenophos. The two treatments namely L-cyhalothrin and Acetamiprid exhibited consistently low damage due to cashew pest as well as higher nut yield. (Table 3.8).



**Table 3.8 : Efficacy of different insecticides against tea mosquito bug incidence in cashew at Paria Centre**

Treatments		TMB damage Score		
		On shoots (%)	On panicles (%)	Nut yield kg/ha
T1	Acetamiprid 20 SP @ 0.004%	0.95 (0.25)	1.01 (0.54)	969.00
T2	Imidacloprid 17.8 % SL @ 0.005%	1.08 (0.95)	1.14 (0.80)	906.00
T4	Triazophos 40 EC @ 0.04 %	1.20 (1.22)	1.17 (0.87)	583.00
T5	L-cyhalothrin 5 EC @ 0.003 %	1.08 (0.66)	1.06 (0.63)	974.00
T7	Profenophos 50 EC @ 0.05%	1.19 (1.18)	1.18 (0.90)	802.00
T8	Untreated control	1.88 (3.03)	1.82 (2.84)	370.00
	SEm ±	0.04	0.04	
	CD at 5%	0.10	0.11	
	CV%	9.33	6.36	

Note: Figures in the parenthesis are original values of square root transformation

### VENGURLA

Among the insecticidal treatments, treatment (T4) L-cyhalothrin (0.003%) was significantly superior over rest of the treatments

after third spray (0.08) with respect to thrips damage score. Imidachloprid (T2) was significantly superior over rest of the treatments after third spray (0.07) followed by the treatment (T4) (0.09) (Table 3.9).

**Table 3.9 : Incidence of tea-mosquito bug in various treatments at Vengurle Centre**

Treatment details		Mean TMB damage score	Thrips damage score
T1	First spray with Neem oil soap (4%) followed by L-cyhalothrin (0.003%) as second spray within 15 days followed by neem oil soap (4%) as third spray	0.16	0.10
T2	Imidachloprid 17.8 SL (0.6ml/l) all the three sprays	0.19	0.07
T3	Acetamaprid 20 SP (0.5 g/i) all the three sprays	0.13	0.10
T4	L-cyhalothrin (0.003%-0.6ml/l) all the three sprays	0.08	0.09
T5	Recommended spray schedule for the region	0.12	0.11
T6	Control	0.29	0.19
	SEm ±	0.36	0.14
	C.D. at 5%	0.11	0.04



## VRIDHACHALAM

The overall efficacy of the insecticidal treatments ranked in the order: T-5 (standard spray) > T-1 (First spray with Neem oil soap (4%) followed by L-cyhalothrin (0.003%) as second spray

within 15 days followed by neem oil soap (4%) as third spray) followed by T3 (Acetamaprid 0.5g/lit), T2 (Imidachloprid 0.6ml/lit) > T-4 (L-cyhalothrin 0.003%). However, all the insecticides were statistically on par (Table 3.10).

**Table 3.10 : Effect of insecticides on the incidence of TMB at Vridhachalam Centre**

Treatment		TMB damage score (0-4)	Nut yield (kg/tree)
T1	First spray with Neem oil soap (4%) followed by L-cyhalothrin (0.003%) as second spray within 15 days followed by neem oil soap (4%) as third spray	0.30 <sup>a</sup>	5.60
T2	Imidachloprid 17.8 SL (0.6ml/lit) all the three sprays	0.33 <sup>a</sup>	5.90
T3	Acetamaprid 20 SP (0.5g/lit) all the three sprays	0.36 <sup>a</sup>	5.50
T4	L-cyhalothrin 0.003% all the three sprays	0.30 <sup>a</sup>	5.00
T5	Recommended spray for the region	0.30 <sup>a</sup>	5.80
T6	Untreated check	1.26 <sup>b</sup>	3.60
	CD at 5%	0.33	-

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

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.

#### Treatments :

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

#### BAPATLA

Chlorpyrifos (0.2%) offered protection to the tune of 91.66% trees without re-infestation or persistent attack followed by monocrotophos (0.2%) with 75 % trees without re-infestation or persistent attack. Neem oil offered 58.33 percent protection without re-infestation or persistent

attack and was superior to control which recorded 33.33 % trees without re-infestation or persistent attack. Preferential zone of attack is collar+root in 29.16 percent of trees followed by collar+ root+stem in 20.83 percent of trees followed by stem and collar 16.66 percent (Table 3.11 and 3.12).

**Table 3.11 : Efficacy of insecticides as Post extraction prophylaxies (PEP) against cashew stem and root borer at Bapatla Centre**

Treatment	% trees without reinfestation / persistent attack
Chlorpyrifos 0.2%	91.66
Monocrotophos 0.2%	75.00
Untreated check (only removal of CSRB grubs)	33.33
Treated check (with most effective treatment under prophylactic trials)	58.33



**Table 3.12 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at Bapatla**

Physical parameters		Total trees treated	No. of trees infested after PEP	% out of total trees	No. of trees not reinfested after PEP	% out of total trees
Stem girth	< 60 cm	10	0	0.0	10	100.0
	60-80cm	13	3	23.07	10	76.92
	80-100 cm	03	3	100.0	0	0.00
	>100 cm	22	11	50.00	11	50.00
	Total	48	17	35.41	31	64.58
Age of the tree	< 10 years	0	0	0.00	0	0.00
	10-15 years	27	7	25.92	20	74.07
	>15years	21	10	47.61	11	52.38
	Total	48	17	35.41	31	64.58
Zone of attack	C + R	14	8	57.14	6	42.85
	C + S	06	2	33.33	4	66.66
	R	02	0	0.00	2	100.0
	S	08	3	37.5	5	62.5
	C	08	1	12.5	7	87.5
	C + S + R	10	3	30.0	7	70.0
	Total	48	17	35.41	31	64.58
Yellowing of canopy	Canopy yellowing	03	3	100.0	0	0.00
	Canopy not yellowing	45	14	31.11	31	68.88
Total		48	17	35.41	31	64.58
% of bark circumference damaged	<25	31	9	29.03	22	70.96
	26-50	13	6	46.15	07	53.84
	51-75	4	2	50.00	02	50.00
	>75	0	0	0.00	00	0.00
	Total	48	17	35.41	31	64.58

## BHUBANESWAR

Maximum recovery (82%) of treated trees was observed in chlorpyrifos (0.2%) followed by carbaryl (1.0%) i.e. 67.0% and Neem oil (5%) i.e. 33.0%. In case of control i.e. only extraction of CSRB grub, 33 per cent of the trees recovered from infestation. In case of stem girth less than 60cm, reinfestation of treated trees was nil. With the

increase in stem girth i.e. above 60 cm reinfestation of CSRB was found to be higher (>24 %). Plants aged less than 5 years showed no reinfestation of CSRB and plants in the age group 10-15 years and > 15 years showed 47 and 75 per cent reinfestation respectively. Collar + Root zone was more prone to attack of CSRB (67% infestation). Cent percent recovery of trees



with <60cm girth, < 5 years age and having only root infestation could recover. None of the trees having canopy yellowing could recover. (Table 3.13 and 3.14)

**Table 3.13 : Efficacy of post extraction prophylaxis treatment (PEP) at Bhubaneswar Centre**

Treatment	No. of trees treated	No. of trees without reinfestation	Recovery (%)
T1 Chlorpyriphos (0.2%)	17	14	82
T2 Carbaryl (1.0%)	15	10	67
T3 Untreated check (removal of grubs only)	12	4	33
T4 Neem oil (5%)	12	7	58
Total	56	35	63

**Table 3.14 : Physical parameter of CSRB treated tree at Bhubaneswar Centre**

Parameters		No. of treated trees	No. of reinfested	% of trees reinfested	No. of trees not reinfested	% of trees not reinfested
Stem girth (cm)	< 60 cm	6	0	0	6	100
	60-80 cm	20	5	25	15	75
	80-100 cm	19	10	53	9	47
	>100 cm	11	6	55	5	45
	Total	56	21	38	35	62
Age of tree (yrs)	<5	6	0	0	6	100
	5-10	25	7	28	18	72
	10-15	17	8	47	9	53
	>15	8	6	75	2	25
	Total	56	21	38	35	62
Zone of attack	C+R	9	6	67	3	33
	C+S	12	4	33	8	67
	R	6	0	0	6	100
	S	13	4	31	9	69
	C+S+R	16	7	44	9	56
	Total	56	21	38	35	62
Yellowing of canopy	Yellowed	5	5	100	0	0
	Not yellowed	51	10	20	31	
	Total	56		91		
%bark circumference damage	<25	10	0	0	10	100
	26-50	14	2	14	12	86
	51-75	17	13	76	4	24
	>75	15	6	40	9	60
	Total	56	21	38	35	62



### HOGALAGERE

Chlorpyriphos (0.2%) was found to be superior in reducing the CSRB incidence to the extent of 75.00% of tree without reinfestation, followed by

swabbing neem oil (5%) (66.67%). The untreated check treatment (only removal of CSRB grubs) recorded 28.57% of trees without reinfestation by CSRB (Table 3.15).

**Table 3.15 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Chintamani**

Treatment	Total number of trees treated	No. of trees without reinfestation / persistant attack	% trees without reinfestation / persistant attack
Chlorpyriphos @ 0.2%	12	9	75.00
Dimethoate @ 0.05%	18	6	33.33
Treated check with most effective treatment under prophylactic trails (Swabbing Neem oil 5% during Oct.-Nov., Jan.-Feb. and April - May)	15	10	66.67
Untreated check (only removal of CSRB grubs)	21	6	28.57
Total	82	52	-

The trees having stem girth of 60-100 cm (53.66%), trees with less than 15 years age (95.12%) had more reinfestation of CSRB. The preferred zone of attack of CSRB

was collar and stem region (72.22%). The trees with less than 25% of bark circumference damaged could recover with PEP treatments (65.12%) (Table 3.16).

**Table 3.16 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at Chintamani Centre**

Physical parameters		No. of trees infested after PEP	% out of total trees	No. of trees not reinfested after PEP	% out of total trees
Stem girth	< 60 cm	11	26.83	07	21.21
	60-100 cm	22	53.66	19	57.58
	> 100 cm	08	19.51	07	21.21
	Total	41		33	
Age of the tree	<10 years	0	0.00	0	0.00
	10-15 years	2	4.88	0	0.00
	>15 years	39	95.12	35	100.00
	Total	41		35	
Zone of attack	C + R	06	16.67	04	13.79
	C + S	26	72.22	22	75.86
	C + S + R	04	11.11	03	10.34
	Total	16		29	



Table 3.16 continued...

Physical parameters		No. of trees infested after PEP	% out of total trees	No. of trees not reinfested after PEP	% out of total trees
Yellowing of canopy	Canopy yellowing	04	11.11	03	10.00
	Canopy not yellowing	32	88.89	27	90.00
	Total	36		30	
% of bark circumference damaged	< 25	28	65.12	27	71.05
	26-50	7	16.28	06	15.79
	51-75	2	4.65	0	0.00
	>75	6	13.95	05	13.16
	Total	43		38	

**JAGDALPUR**

Chlorpyriphos (0.2%) led to maximum recovery of 83.34 per cent trees without re-infestation. The cashew trees having 60-100 cm of stem girth were more prone to attack of CSRB. Cashew trees aged more than 15 years (35.42) were more susceptible to attack by this pest.

Preferential zone of attack by cashew stem and root borers in the tree was collar zone followed by stem zone with 28.30 and 22.23 per cent re-infested trees, respectively. Trees with 25-50 per cent bark circumference damage had maximum re-infestation with 37.14 per cent followed by less than 25 per cent bark circumference damage (25.81% re infestation) (Table 3.17 and 3.18).

**Table 3.17 : Efficacy of certain insecticides as curative control against CSRB at Jagdalpur**

Treatment	% of trees without re-infestation / persistent attack
T1 : Carbaryl (1.0%)	--
T2 : Chlorpyriphos (0.2%)	83.34
T3 : Monocrotophos (0.2%)	72.23
T4 : Chlorpyriphos (0.1%)	61.11
T5 : Untreated check (only removal of CSRB grubs followed)	33.33

**Table 3.18 : Physical parameters of trees observed under curative control against CSRB at Jagdalpur Centre**

Physical parameters		Total No. of trees treated	No. of trees re-infested	% of trees re-infested	No. of trees not re-infested	% of trees not re-infested
Stem girth	<60 cm	9	2	22.22	7	77.78
	60-100 cm	19	5	26.32	14	73.68
	>100 cm	62	15	24.19	47	75.81
<b>Total</b>		90	22		68	



Table 3.18 continued...

Physical parameters		Total No. of trees treated	No. of trees re-infested	% of trees re-infested	No. of trees not re-infested	% of trees not re-infested
Age of tree	<10 years	13	0	0.00	13	100.00
	10-15 years	29	5	17.24	24	82.76
	>15 years	48	17	35.42	31	64.58
<b>Total</b>		90	22	68		
Zone of attack	C	53	15	28.30	38	71.70
	C+R	16	3	18.75	13	81.25
	C+S	12	2	16.67	10	83.33
	R	0	0	0.00	0	0.00
	S	9	2	22.22	7	77.78
	S+R	0	0	0.00	0	0.00
	C+S+R	0	0	0.00	0	0.00
<b>Total</b>		90	22		68	
Canopy yellowing	a) Canopy Yellowed	16	0	0	16	100
	b) Canopy not yellowed	74	22	29.73	52	70.27
<b>Total</b>		90	22		68	
% of bark circumference damaged	<25	31	8	25.81	23	74.19
	25-50	35	13	37.14	22	62.86
	50-75	10	1	10.00	9	90.00
	>75	14	0	0.00	14	100.00
<b>Total</b>		90	22		68	

**Zone of attack:**

- a) C+R = Collar + Root,                      b) C+S = Collar + Stem  
 c) C+R+S = Collar + Root + Stem      d) S = Only Stem

**JHARGRAM**

Minimum percentage of reinfestation was observed with Chlorpyriphos 0.2% (90%) followed by carbaryl 1% (80%). However, the treated check

with 5% neem oil and untreated check recorded more reinfestation of CSRB (75% and 50% respectively). (Table 3.19).

**Table 3.19 : Efficacy of insecticides as post extraction prophylaxis (PEP) against cashew stem and root borer (CSRB) at Jhargram Centre**

Treatment	Total number of trees treated	No. of trees without reinfestation / persistant attack	% trees without reinfestation / persistant attack
Carbaryl 1.0%	10	8	80
Chlorpyriphos 0.2%	10	9	90



Table 3.19 continued...

Treatment	Total number of trees treated	No. of trees without reinfestation / persistent attack	% trees without reinfestation / persistent attack
Monocrotophos 0.2%	Not available in market	-	-
Lindane 0.2%	do	-	-
Untreated check (only removal of CSRB grubs)	8	4	50
Treated check with most effective treatment under prophylactic trials (3-regime neem oil)	8	6	75

Maximum reinfestation (22.22%) was observed in trees having stem girth of 60-100 cm, and in trees aged more than 10 years (27.78%). The preferred zone of initial infestation was collar

+ stem, while root zone affected plants were much prone to re-infestation. The trees having 50-75% bark circumference damage had more re-infestation by the pest (16.67%) (Table 3.20).

**Table 3.20 : Physical parameters of treated cashew trees under post extraction prophylaxis (PEP) trial at Jhargram Centre**

Physical parameters		No. of trees infested after PEP	% out of total trees	No. of trees not reinfested after PEP	% out of total trees
Stem girth	< 60 cm	0	0.00	3	8.33
	60-100 cm	8	22.22	23	63.89
	> 100 cm	2	5.56	0	0.00
Total		10	27.78	26	72.22
Age of the tree	<10 years	0	0.00	0	0.00
	10-15 years	10	27.78	26	72.22
	>15 years	0	0.00	0	0.00
Total		10	27.78	26	72.22
Zone of attack	C + R	6	16.67	2	5.56
	C + S	2	5.56	24	66.67
	C + S + R	2	5.56	0	0.00
Total		10	27.79	26	72.23
Yellowing of canopy	Canopy yellowing	2	5.56	0	0.00
	Canopy not yellowing	8	22.22	26	72.22
Total		10	27.78	26	72.22
% of bark circumference damaged	< 25	0	0.00	22	61.11
	26-50	3	8.33	4	11.11
	51-75	6	16.67	0	0.00
	>75	1	2.78	0	0.00
Total		10	27.78	26	72.22



## MADAKKATHARA

Chlorpyriphos (0.2%) recorded the highest recovery of treated trees (80%) followed by monocrotophos (0.2%) and carbaryl (1%) with 60% per cent recovery. Swabbing with 5 per cent neem oil soap recorded 50 per cent recovery. During the

last two years also, drenching with chlorpyriphos (0.02%) recorded the highest recovery (100% and 90%). Only grub extraction without insecticidal treatment led to the recovery of 13.3 per cent (Table 3.21).

**Table 3.21: Efficacy of different insecticides for curative control against CSRB (post prophylaxis treatments) at Madakkathara Centre.**

Treatments		Percentage trees without re-infestation/persistent attack
T-1	Carbaryl (1%)	60.0
T-2	Chlorpyriphos (0.2%)	80.0
T-3	Monocrotophos (0.2%)	60.0
T-4	Check (grub-extraction only)	13.3
T-5	Most effective prophylactic treatment (swabbing neem oil soap 5%)	50.0

Out of total trees re-infested, 61 per cent of the trees had stem girth of more than 100 cm. In trees with stem girth less than 60 cm the re-infestation was not observed. The infestation was significantly related with age of trees. Cent per cent of trees re-infested were within the age group of more than 10 years. Out of 26 trees re-infested, 59 per cent had infestation at collar and stem region.

## VENGURLA

Chlorpyriphos (0.2%) (T2) recorded 93.33 per cent trees without reinfestation followed by chlorpyriphos (0.1%) T4 (73.34 per cent) trees without reinfestation. Reinfestation was more in control (T6) (53.33 %) (Table 3.22).

**Table 3.22: Effect of curative treatments against Cashew Stem and Root Borer (CSRB) at Vengurle Centre**

Sr. No.	Treatment	% tree without reinfested
T1	Carbaryl (1%)	Not available in market
T2	Chlorpyriphos (0.2%)	93.34
T3	Monocrotophos (0.2%)	-
T4	Chlorpyriphos (0.1%)	73.34
T5	Effective treatment in prophylactic trail (Swabbing Neem oil 5% during Oct.- Nov., Jan. - Feb. and April - May)	60.00
T6	Untreated check	53.33



## VRIDHACHALAM

Maximum recovery of 46.15 per cent was noted in chlorpyriphos (0.2%) treated trees, which was on par with monocrotophos 50EC (0.2%) treated trees with 43.16 per cent recovery. Treatments with profenofos 50 EC (1.0%), and neem oil (5.0%) lead to 40.00, and 35.0 per cent

recovery respectively as against 5.5 per cent recovery in untreated control. The overall results indicate that chlorpyriphos and monocrotophos were at par in reducing the CSRB infestation, with an average treatment cost of Rs.65/- and Rs.60/- respectively, per tree (Table 3.23).

**Table 3.23 : 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
T1	Profenofos (0.1%)	25	40.00 <sub>b</sub>	3	65.0
T2	Chlorpyriphos (0.2%)	26	46.15 <sub>a</sub>	3	60.0
T3	Monocrotophos (0.2%)	24	45.84 <sub>a</sub>	3	60.0
T4	Lindane (0.2%)	20	30.00 <sub>d</sub>	3	56.0
T5	Untreated check (removal of grubs)	18	05.55 <sub>e</sub>	3	30.0
T6	Treated check (Neem oil 5%)	20	35.00 <sub>c</sub>	3	60.0
	Total	133	-	-	-



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

The objective of the experiment is to investigate the population dynamics of pests of regional importance and to correlate it to prevalent weather parameters.

#### BAPATLA

Leaf and blossom webber was strongly influenced by minimum temperature (0.78101) while leaf miner was negatively influenced by minimum temperature (-3.02699), similarly leaf folder (-0.84072) and shoot tip caterpillar (-0.63574) also had a negative correlation. Apple and nut borer was negatively influenced by maximum temperature (-0.43504). (Table 3.24).

**Table 3.24 : Influence of abiotic factors on the activity of pest complex of cashew at Bapatla Centre**

Name of the pest	Variables				
	Maximum Temp	Minimum Temp	RH (m)	RH (e)	Rain fall
Leaf and blossom webber	-0.30080	0.78101	0.03863	0.04663	-0.00535
Leaf miner	-0.93245	-3.02699	-0.31885	0.21201	-0.32628
Leaf folder	0.17379	-0.84072	0.24491	0.01290	-0.15105
Shoot tip caterpillar	-0.52176	-0.63574	0.01907	0.05376	-0.13491
Apple & nut borer	-0.43504	0.21094	-0.02095	0.07384	-0.06075

#### BHUBANESWAR

Evening RH showed significant positive correlation with TMB while, positive correlation existed with minimum temperature and bright sunshine. In case of shoot tip caterpillar and leaf miner a negative correlation was observed between pest incidence and majority of the environmental parameters. Significant negative correlation was observed with temperature maximum and sunshine with shoot tip caterpillar. In case of leaf folder significant negative correlation was observed with minimum temperature and rainfall. Significant positive correlation of maximum temperature was observed with apple and nut borer and leaf folder. Both maximum temperature and minimum temperature showed a positive correlation for yellow thrips and minimum temperature had a significant positive correlation with of black thrips incidence (Table 3.25).

**Table 3.25 : Correlation of weather parameters with the pests of regional importance at Bhubaneswar Centre**

	STC	LM	ANB	LF	YT	BT	L& BW	TMB
Temp(max)	-0.8866**	-0.6501	0.7915*	0.7072*	0.5902	0.4892	-0.6964	0.2098
Temp(min)	-0.6034	-0.7139*	0.5802	0.6661*	0.6562	0.6826*	-0.8377	0.5591
RH (Morn)	0.0127	-0.2337	-0.2275	-0.1361	-0.4161	-0.3702	0.5133	-0.1392
RH (Even)	-0.1115	-0.5616	-0.5866	0.3964	-0.3712	-0.0336	-0.1710	0.8854*
Rainfall	-0.405	-0.7640*	0.3750	0.5497	-0.3147	-0.0180	-0.7357	0.5966
BSH	-0.8000*	-0.6135	-0.0029	0.7721**	-0.2320	0.3702	-0.3956	0.6016

TMB-Tea Mosquito Bug, LM- Leaf miner, STC- Shoot tip caterpillar, YT- Yellow thrips, BT- Black thrips,

ANB- Apple and nut borer, L&BW- Leaf and blossom webber.



### HOGALAGERE

The tea mosquito bug had a positive correlation with maximum temperature ( $r=0.187$ ) and bright sunshine hours ( $r=0.293$ ). CSRB had a positive correlation with maximum ( $r=0.386$ ) and minimum temperature ( $r=0.080$ ) and bright sunshine hours ( $r=0.220$ ). Apple and nut borer had a significantly positive correlation with maximum

and minimum temperature, morning relative humidity and bright sunshine hours. Leaf miner had positive correlation with morning and evening relative humidity and bright sunshine hours. Sucking pests like thrips and aphids had a positive correlation with maximum temperature (0.236 and 0.242 respectively) and morning relative humidity (0.250 and 0.303 respectively). (Table 3.26).

**Table 3.26 : Influence of abiotic factors on the activity of pest complex of cashew at ARS, Chintamani centre**

Weather Parameters	TMB	CSRB	MB	ANB	LM	Thrips	Aphids
X1 - Maximum Temp (°C)	0.187	-0.386	0.064	0.176	-0.305	0.236	0.242
X2 - Minimum Temp (°C)	- 0.081	0.080	0.013	-0.199	0.559	-0.170	0.093
X3 - RH (m) (%)	0.117	0.042	-0.105	-0.161	0.593	0.250	0.303
X4 - RH (e) (%)	0.117	0.197	-0.026	-0.528	0.609	0.787	-0.125
X5 - Rain fall (mm)	-0.155	-0.156	0.269	-0.151	-0.305	0.236	0.242
X6 - No. of rainy days	0.058	-0.220	0.269	-0.528	0.609	-0.170	0.093
X7 - Bright sunshine hours	0.293	-0.220	0.004	-0.151	0.609	0.250	0.093

TMB-Tea mosquito bug;

CSRB-Cashew Stem & Root borer;

\* Significant at 0.05% level

MB-Mealy bug; ANB-Apple and nut borer;

LM-Leaf miner

### JAGDALPUR

The maximum temperature significantly positively influenced ( $r=0.370$ ) and relative humidity (evening) significantly negatively influenced ( $r=-0.381$ ) the activity of TMB on panicle. Minimum temperature significantly positively influenced ( $r=0.369$ ) the activity of the leaf caterpillar. Minimum temperature significantly

positively influenced ( $r=0.371$ ) the activity of leaf folder. Minimum temperature, vapour pressure I & II significantly positively influenced ( $r=0.357, 0.367$  and  $0.353$ , respectively) the activity of leaf miner. Whereas, maximum temperature significantly negatively influenced ( $r=-0.324$ ) the incidence of leaf miner (Table 3.27).

**Table 3.27 : Correlation of weather parameters with the pests of regional importance at Jagdalpur Centre**

Weather Parameters	Correlation coefficient values (r) of pests of regional importance						
	Temp °C	Temp °C	mms	Relative Humidity II	Wind Vel. Kmph	Evap. mms	Bright Sunshine hours
Shoot TMB	0.113	-0.040	-0.065	-0.036	-0.045	0.045	0.032
Panicle TMB	0.370*	-0.047	-0.065	-0.381*	-0.006	0.066	0.036
% LC	0.069	0.369*	-0.102	0.127	-0.068	-0.124	-0.024
% LF	0.004	0.371*	0.027	0.279	0.004	-0.094	-0.072
% LM	-0.324*	0.357*	0.300	0.111	0.236	0.097	0.176
% CSRB	-0.085	0.201	0.084	0.032	0.067	0.210	0.015

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



### MADAKKATHARA

Minimum temperature, wind velocity and evaporation had a significant positive correlation with the activity of tea mosquito bug, whereas significant negative correlation was established with relative humidity. None of the abiotic factors significantly influenced the activity of leaf miner. Thrips activity was positively correlated with

maximum temperature, bright sunshine hours and evaporation and significant negative correlation was established with relative humidity and rainy days. Apple and nut borer incidence had significant positive correlation with sunshine hours, wind velocity, evaporation and had a negative correlation with relative humidity (Table 3.28).

**Table 3.28 : Influence of abiotic factors on the activity of pest complex of cashew at Madakkathara Centre**

Insectpests	Temperature		Relative humidity		BSS	RF
	Max	Min	am	pm		
TMB	0.108	0.436*	-0.616**	-0.477*	0.432	-0.356
Leaf Miner	-0.173	0.034	-0.087	-0.045	0.307	-0.203
Thrips	0.694**	-0.118	-0.582**	-0.695**	0.595**	-0.381
Apple and Nut borer	0.178	-0.167	-0.621**	-0.495*	0.445**	-0.267

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

### PARIA

Activity of TMB was negatively correlated with minimum temperature, maximum temperature, morning relative humidity and evaporation rate (r = -0.604). The thrips damage was not correlated with any of the weather parameters. The leaf and blossom webber was significantly negatively correlated with minimum temperature (r = -0.680). Similarly the leaf miner was significantly negatively correlated with evaporation rate and sun shine

hours (r = -0.573). The apple and nut borer was significantly positively correlated with evaporation rate (0.435) while it was significantly negatively correlated with minimum temperature (-0.474) and maximum temperature (r = -0.557).

The regression analysis revealed that activity of TMB varied 61.12 % due to abiotic factors. The damage per cent caused by LBW also varied upto 68.49 % whereas, the infestation caused by ANB varied upto 70.61 % due to various abiotic factors (Table 3.29).

**Table 3.29 : Correlation and regression analysis of major insects of cashew with abiotic factors at Paria Centre**

Abiotic factors	Correlation coefficient (r)					Regression coefficient			
	TMB	Thrips	LBW	LM	ANB	TMB	LBW	LM	ANB
Max. Temp	-0.464*	-0.004	-0.567*	-0.296	-0.557*	0.014	0.121	-	-0.602
Min.-Temp	-0.603*	-0.111	-0.680*	-0.191	-0.474*	-0.073	-0.389	-	-0.592
RH% (M)	0.467*	0.192	0.295	0.286	0.418*	0.028	-	-	0.277
RH% (E)	0.277	-0.063	0.219	0.342	0.098	-	-	-	-
SSH	-0.440*	-0.159	-0.555*	-0.573*	0.002	0.006	-0.880	-0.663	-



Table 3.29 continued...

Abiotic factors	Correlation coefficient (r)					Regression coefficient			
	TMB	Thrips	LBW	LM	ANB	TMB	LBW	LM	ANB
RF (mm)	-0.068	-0.023	0.134	0.325	-0.240	-	-	-	-
Rainydays	-0.079	-0.036	0.124	0.310	-0.285	-	-	-	-
Evaporation rate	-0.604*	-0.350	-0.535*	-0.428*	0.435*	-0.192	-0.080	-0.099	2.668
R <sup>2</sup>	-	-	-	-	-	0.611	0.685	0.334	0.706
% Variation	-	-	-	-	-	61.12	68.49	33.44	70.61
R	-	-	-	-	-	0.782	0.828	0.578	0.840

TMB = Tea mosquito bug      LBW = Leaf & blossom webber      LM = Leaf miner  
 ANB = Apple and nut borer

**VENGURLA**

TMB infestation showed positive correlation with maximum temperature and negative significant correlation with minimum temperature, morning humidity and negative correlation with rainfall and rainy days.

The apple and nut borer (ANB) showed positive correlation with maximum temperature

and negative significant correlation with minimum temperature evening humidity rainfall and no. of rainy days. The incidence of thrips showed positive correlation with maximum temperature and morning humidity negative significant correlation with minimum temperature evening humidity and no. of rainy days and negative correlation with rainfall and morning humidity (Table 3.30).

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

Weather parameters	TMB	ANB	Thrips
Maximum temp.	0.373	0.278	0.405
Minimum temp.	-0.769**	-0.825**	-0.825**
RH% (M)	-0.339	-0.312	-0.312
RH% (E)	-0.705**	-0.755**	-0.755**
Rain fall (mm)	-0.423	-0.451	-0.451
Rainy days	-0.533	-0.428	-0.568*
* - Significant at 5% level of significance.		r = 0.553 at 5% level of significance	
**- Significant at 1% level of significance.		r = 0.684 at 1% level of significance	



## 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 had 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) (Y1)	0.50*	0.23	0.26	*0.23	-0.28	0.39	*0.33
Leaf and blossom webber (Y2)	0.58*	0.38	-0.30*	-0.26	-0.23	-0.24	0.43
Apple and nut borer (Y3)	0.50	0.39	0.33	-0.26	-0.20	-0.32	0.28
Leaf miner (Y4)	0.23	0.28	0.32	0.38	0.49	0.36*	-0.32
Leaf roller (Y5)	-0.49*	-0.33	-0.36*	-0.24	-0.30	-0.33	0.36
Shoot tip caterpillar (Y6)	-0.26	0.26	0.38	0.34	0.46	0.42	-0.48
Aphids (Y7)	-0.28	0.28*	0.36*	0.46*	0.43	0.45*	-0.43
Cashew Stem and Root Borer (Y8)	0.54*	0.45	-0.23	-0.37	-0.40	-0.38	0.46

\* = Significant at 0.05 level



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

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

### BAPATLA

Among the 40 accessions screened to identify the tolerant lines against the pests of cashew and T.No. 129 recorded nil incidence of leaf and blossom webber. The accession T. No.6/14 has recorded with the lowest incidence of leaf miner (1.17%).

With regard to the incidence of leaf folder, T No.129 has recorded with nil incidence and the accession T.No.2/5 recorded with the lowest incidence Shoot tip caterpillar (1.21%). T.No.275 has recorded with the nil incidence of apple and nut borers.

### BHUBANESWAR

All the accessions showed incidence of leaf miner during early stage of new flush and extent of damage ranged between 15 and 20 per cent leaf. The incidence of shoot tip borer and leaf and blossom webber ranged from to be 0.5- 5.0% in various germplasm accessions. Thrips incidence was recorded 0.5 – 5 /- panicle among the germplasms (Table 3.32).

**Table 3.32 : Reaction of germplasm accessions against insect pests in Bhubaneswar Centre**

Pest	Accessions	Min. damage	Accessions	Max. damage
LM	-	-	100 Nos (all)	15-20%
STC	OC 31,OC37, OC130, OC133, OC 140, OC 160	0.5-1.5%	OC 104,OC129, OC132, OC136, OC149	2-5%
IT	OC6, OC21 OC92, OC109, OC117, OC122, OC137	0.5-1.0% panicle	OC22 ,OC107, OC110, OC124,OC158	2-5/panicle
LBW	OC15, OC21, OC55 OC77 126, OC130, OC135, OC158	0.5-2.0%	OC 47,OC100, OC117, OC149	2-5%

### HOGALAGERE

The reactions of germplasm / entries (MLT-1992 and MLT-2002) maintained at the ARS, Chintamani centre against TMB indicated that none of the germplasm accessions/entries showed resistance/tolerance to TMB infestation.

### JAGDALPUR

None of the germplasm were free from the incidence of leaf caterpillar and leaf folder damage.

However, V-4 and Ullal-1 displayed tolerance against leaf miner incidence.

### MADAKKATHARA

TMB damage score in accession Kainoor was 0.064 and Kunjithai recorded damage score of 0.131 which were the lowest. The leaf miner infestation did not occur in varieties Pathannur, ARL-1 and ARL-2. Shoot webber incidence was observed only in two accessions KTR-1 and Ummannur.



Incidence of inflorescence thrips was absent in Pathannur, ARL-1, ARL-2, KTR-2 and ODR accession. Among 14 accessions screened, apple and nut borer incidence was recorded only in KTR-1 (4.16%). Moreover, the leaf miner infestation was absent in Jhargram - 1, V-4, V-6 and Ullal-1.

### **VENGURLA**

NRCC Sel.-1 recorded lowest TMB infestation, whereas, it was maximum in Vengurle-8. The lowest incidence of thrips was observed on NRCC Sel.-2 whereas, it was maximum on variety Vengurle-2.

### **VRIDHACHALAM**

The TMB damage score was low in ME 20/1 (1.0). In other cashew entries, the mean damage score ranged between 1.8 and 3.3. None of the cashew entries have shown immune or resistant reactions to TMB infestation under field condition. In the case of F1 hybrids, all the cross combinations were observed to be susceptible to TMB infestation.



# ORGANISATION





## INTRODUCTION

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

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

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

The headquarters of the independent cashew project was shifted to National Research Centre

for Cashew, Puttur in 1986. Presently, there are ten coordinating Centres and one sub Centre, four in the East Coast viz., Bapatla. Bhubaneswar, Jhargram, Vridhachalam, four in the West Coast viz., Pilicode Madakkathara, Vengurla, Paria and three centres, one each in the plains region at 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.

### Executive Summary :

- At Goa centre maximum apple weight of 106.0g was observed in Bardez 9 in germplasm evaluation.
- The maximum nut weight (10.13g) was recorded in H-255 under MLT-II at Jagdalpur.
- At Hogalagere in Varietal Evaluation Trials (MLT-III) maximum cumulative nut yield for 8 harvests was recorded in H-32/4 (48.10 kg/tree) and H-1597 (43.59 kg/tree).
- At Jhargram, the hybrids recording highest



- shelling percentage were H-179 (35.9%) followed by H-125 (35.3%) and H-180 (35.1%).
- In intercropping trials at Kanabargi, highest net profit from intercrop was maximum in coleus (Rs. 61,370/ha) followed by turmeric (Rs. 56,950/ha). The highest overall acceptability of cashew apple RTS was 4.53 in variety Jagannath at Bhubaneswar.
  - At Bapatla, L-cyhalothrin 0.003% was found to be most effective in managing leaf and blossom webber as well as shoot tip caterpillar. For management of cashew stem and root borer by adopting post extraction prophylaxis (PEP) treatment with chlorpyrifos (0.2%) led to maximum protection without reinfestation by CSRB in majority of the centres.



## REPORT OF THE ANNUAL GROUP MEETING OF SCIENTISTS OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW-2014

The Annual Group Meeting of Scientists of All India Coordinated Research Project on Cashew-2014 was held during 18 – 20<sup>th</sup> December 2014 at Agricultural College, Bapatla, Andhra Pradesh. At the outset, Dr. J. Dilip Babu, Director of Research welcomed the delegates and mentioned that cashew research had been initiated by the former APAU at Cashew Research Station, Bapatla way-back in 1970's. He said that there is substantial potential for crop in both coastal sands as well as interior red sandy loams of Andhra Pradesh. He also mentioned that efforts taken by several NGOs have contributed to area expansion of cashew in the State. The full potential of the crop was not achieved due to lack of awareness about application of fertilizer and unavailability of genuine varieties suitable for the specific locations.

The Annual Group Meeting was inaugurated by Dr. B.M.C. Reddy, Hon'ble Vice Chancellor, Dr. YSR Horticultural University by lighting the traditional lamp. On this occasion, Mr. Vidyasagar Rao, President, CMWA, Vetapalem and Mr. S.S.B. Raju, M.D., Sagi Seeds Pvt. Ltd., Hyderabad were also present as Guest of Honours.

Later, Dr. B.M.C.Reddy in his Presidential Address mentioned that cashew has been confined to the status of forest produce for a long time. As breeding involves long duration, hence intensification of hybridization programme may be confined to few centres. He also suggested that higher number of FLDs need to be taken upon various technologies. Due to the occurrence of Hud Hud cyclone, large cashew tracts have been damaged necessitating abundant requirement

of quality grafts which needs to be catered by the AICRP-Cashew Centres.

Later, the Project Coordinator (Cashew), Prof. P.L. Saroj presented the salient results obtained in field trials of different centres of AICRP-Cashew. He highlighted the efforts in germplasm collection wherein bold nut types and those having higher number of panicles per unit area have been collected. He also mentioned that for improving productivity of cashew orchard, integration of crops like rhizomatous crops, vegetables and medicinal and aromatic plants had given promising response. He opined that the efforts of the AICRP Cashew centres in producing elite planting material upto 5.0 lakhs and also transfer of technology has led to a wider awareness about scientific cashew technology among farmers. Frontline demonstration plots laid out by different centres of AICRP on Cashew have aided in dissemination of the recent production techniques with strong backup of technical guidance. Subsequently, Dr. T.N. Raviprasad, Scientist-in-charge, PC Cell presented the Action Taken Report of the previous year which was discussed in detail.

The research progress and results obtained in various experiments at different AICRP-Cashew centers viz., Bapatla, Bhubaneswar, Chintamani, Darisai, Jagdalpur, Jhargram, Madakkathara, Paria, Pilicode, Vengurle and Vridhachalam as well as, the co-operating centres viz., Arabhavi and Tura were presented by the scientists of the respective disciplines from each Centre. The presentations were made in three main theme areas viz., Crop Improvement chaired by Dr. P.C. Lenka, Former



Professor, OUAT, Bhubaneswar, Crop Management chaired by Dr. K.R.M. Swamy, Former Head of Dept., Vegetable crops, IIHR and Crop Protection chaired by Dr. V. Ambethgar, Professor of Entomology, TNAU, Tiruchirapalli and co-chaired by Dr. P. S. Bhat, Principal Scientist, DCR, Puttur.

A separate technical session was organized regarding Interaction of development departments and research centres which was chaired by Dr. N.K. Krishna Kumar, DDG, ICAR, New Delhi wherein the local progressive cashew farmers mentioned about their experiences in organic cultivation of cashew and pest management approaches for effective management of cashew stem and root borers and tea mosquito bug. Some of the cultivation related issues such as poor plant survival and heavy CSRB attack in the sandy soils, lack of effective knowledge transfer generated in field of cashew cultivation not reaching the farmers at the grass root level and non access to market information of cashew were mentioned by the farmers. DDG informed that a detailed analysis of present cashew scenario from production, processing to marketing needs to be conducted. Role model organic farm needs to be developed.



DDG (Hort.Sci.), ICAR addressing the delegates during the Plenary Session



A progressive farmer sharing his experiences about cashew cultivation in coastal A.P.



Inaugural Session of Annual Group Meeting of AICRP-Cashew 2014 at Agricultural College, ANGRAU, Bapatla.



Asst. Dir. (Hort.) informing about the various schemes for cashew in A.P.



## 2. TRANSFER OF TECHNOLOGY :

A total of 294300 grafts were produced during 2014-15 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	20000
Bhubaneswar	17000
Darisai	00
Goa	2000
Hogalagere	50000
Jagdarpur	80000
Jhargram	2500
Kanabargi	00
Madakkathara	19000
Paria	00
Pilicode	2700
Tura	00
Vengurla	65000
Vridhachalam	36100
<b>TOTAL</b>	<b>294300</b>

### BAPATLA

The scientists of this centre organized the front line technology demonstration on cashew at farmers fields in Prakasam, Krishna, West Godavari and East Godavari Districts with the financial assistance from the Directorate of Cashew and Cocoa Development, Kochi.

Dooradarshan programmes on cashew pest and disease management, irrigation and flower and fruit set management were recorded and broadcast by DD-Saptagiri Channel.

The scientists of this centre organized district

level seminar at Alluri Seetharamaraju museum, Koyyur, Visakapatnam on Production technology on Cashew for the benefit of tribal farmers.

Dr. K. M. Yuvaraj, Senior scientist (Hort.) & Head, and K. Uma Maheswararao Scientist (Hort.) both of them organised a three days farmers training programme on “Advanced Cashew Production Technology” at PCMA hall, Palasa, Srikakulam dist.

Scientists of this centre published book on “Jeedimamidi sagulo melynaya yajamanya paddatalu” elaborating the production technology, rejuvenation of old orchards, soil and water conservation techniques, plant protection measures in cashew and processing, value addition of cashew apple in telugu.

### BHUBANESWAR

Scientists of this centre participated in District level seminars at Dhenkanal and at Jajapur organized by OSCDC, Govt. of Odisha. Doordarshan Programme on the topic “Insect pest management in cashew” in Odiya language was recorded and broadcasted on DD-Odiya Channel.

Consultancy on cashew cultivation to the cashew grower and private entrepreneur on cultivation of cashew and nursery verification was taken up by scientists of this Centre.

### DARISAI

Scientist of this centre conducted a training programme at Birsa Agricultural University, Ranchi on various aspects of cashew cultivation. Cashew growers of East singhbhum participated in the event.

### HOGALAGERE

Scientists of this centre attended Krishi mela at GKVK, Bangalore and National level training on Cashew Production Technologies at ICAR Research Complex for Goa, Goa.



A district level cashew seminar was organized for the benefit of cashew farmers at College of Horticulture. They also participated in crop seminars, diagnostic field visit and training programmes organized by various Institutions.

### JAGDALPUR

The scientists of this centre conducted 2 trainings of 7 days duration on cashew processing under the project 'Enhancement of tribals income through small scale cashew nut & cashew apple processing in Bastar region of Chhattisgarh'.

A training programme on 'Cashew Production, Plant Protection and Processing technologies' was conducted for benefit of new cashew farmers in Bastar region and cashew field workshop was also organized to create awareness about cashew production. They also participated in trainings on cashew apple processing and field workshop as subject matter experts.

### JHARGRAM

The scientist of the Centre functioned as resource person in the farmers training programme on cashew cultivation technology organized by BCKV, Jhargram under TSP and ATMA schemes. Scientist of this centre participated in SLCARP International Symposium, Colombo, Sri Lanka and presented a research article.

### MADAKKATHARA

Scientists of this centre confirmed that sand can be replaced by coir pith in potting media for graft production and pepper (Panniyur-5) was a good intercrop in cashew plantations. Two cashew apple products viz., Halwa and cookies were launched on commercial scale.

Under tribal sub plan (TSP) programme, softwood grafting and value addition of cashew was implemented at Thamaravallachal, Thrissur district. Tribal people from other parts of the

district viz., Nadathara and Puthur also participated in the meeting.

### PILICODE

The scientists of this centre have maintained 2 cashew demonstration plots which are of ninth year.

Five trainings and seminars have been conducted on cashew apple processing. A radio talk on "Climate change and population crops" was broadcast from AIR, Kannur.

### VENGURLA

The scientists of this Centre conducted 3 state level seminars on cashew and three days training programme on cashew production and processing technology as well as on cashew apple utilization for unemployed women, demonstrations on cashew stem and root borer management and cashew apple utilization in Regional Fruit Research Station, Vengurle thereby creating awareness on these aspects for approximately 902 cashew farmers.

### VRIDHACHALAM

A total of 13 nos. of demonstration plot on High Density Planting was laid out in Ariyalur District under DCCD funding. Scientists of this Centre also conducted three trainings on cashew production technology and high yielding varieties in cashew. Practical training on cashew production technology and cashew pruning demonstrations were also organized for benefit of students and farmers at Panruti taluk.

Scientists of this centre also took up field visit to monitor implementation of Shade net nursery under NHM in Cuddalore District. The personnel of this centre participated in the 6th Indian Horticulture Congress and organized an exhibition on cashew production technologies. One day training on Cashew Nursery Technology and Training on Cashew Apple Utilization was organized for benefit of entrepreneurs and farm women.



### 3. STAFF POSITION

#### HEADQUARTERS

##### **ICAR- Directorate of Cashew Research, Darbe PO, Puttur-574 202, DK, Karnataka**

Phone No.: 08251-231530, 233490 (R) and 230992 (R)

EPABX : 08251-230902, 236490 FAX No.: 08251-234350

E-mail : cashewresputr@gmail.com, dircajures@yahoo.co.in, dircajures@gmail.com,  
dircajures@rediffmail.com

Website : <http://www.cashew.res.in>

Project Coordinator : Dr. P.L. Saroj  
Scientist-in-charge : Dr. T.N. Raviprasad  
Secretarial Assistance : Smt. Reshma K.

#### PROJECT CENTRES

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

Phone No.: 08643 – 225304 Fax No. : 08643 – 225304

E-mail : cashewresbapt@gmail.com, headcrs\_bapatla@drysru.edu.in

Horticulturist : Dr. K.M. Yuvaraj (From 10.12.2014)  
Asstt. Horticulturist : Mr. K. Uma Maheswara Rao  
Asstt. Entomologist : Vacant  
Sr. Technical Assistant : Sri. M. Sambasiva Rao  
Jr. Technical Assistant : Mr. Samuel  
Grafter : Mr. V. Kantha Rao

##### **Cashew Research Station, (Odisha University of Agriculture and Technology), Bhubaneswar 751 003, Odisha.**

Phone No. : 0674-2397383 FAX No. : 0674-2397780

E-mail : cashewresbhub@gmail.com, aicrpcashew\_bbsr@yahoo.co.in

Horticulturist : Dr. Pradyumna Tripathy  
Jr. Horticulturist : Mrs. Kabita Sethi  
Jr. Entomologist : Dr. S.K. Mukherjee  
Sr. Technical Assistant : Sri. A. Mansingh  
Jr. Technical Assistant : Sri. C.R. Das  
Grafter : Sri. D. Almango

##### **Zonal Research Station, (Birsa Agricultural University), Darisai - 832 304, East Singhbhum Dist., Jharkhand**

Phone No. : 0651-2450060

FAX No. : 0651-2450060

E-mail : cashewresdari@gmail.com, drprshntkumar@yahoo.com

Horticulturist : Dr. Pawan Kumar Jha

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

Phone No. : 0832 – 2284678 / 2284679 (0)

E-mail : director@icargoa.res.in

Horticulturist : Dr. A.R. Desai



**Horticulture Research Station, (University of Horticultural Sciences), Hogalagere-563 138, Srinivaspura Taluk, Kolar District, Karnataka.**

Phone No. : 08157 - 245022

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

Horticulturist	:	Vacant
Jr. Horticulturist	:	Dr. V.A. Ramachandra (From 23.02.2014)
Jr. Entomologist	:	Dr. N. Aswathanarayana Reddy
Sr. Technical Assistant	:	Mr. B. Subramanyam
Sr. Technical Assistant	:	Mr. Somappa Shivappa Jaggal
Grafter	:	On contractual basis

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

Phone No. : 07782-229360, 229150

Fax No. : 07782-229360

E-mail : cashewresjagd@gmail.com, zars\_igau@rediffmail.com

Jr. Horticulturist	:	Mr. M.S. Paikra
Jr. Entomologist	:	Dr. A.K. Gupta
Jr. Technical Assistant	:	On contractual basis
Grafter	:	Mr. Jagdev

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

Phone No. : 03221-205500

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

Horticulturist	:	Dr. S.B. Chattopadhyay (From 1.4.2014)
Jr. Horticulturist	:	Dr. Mini Poduval
Jr. Entomologist	:	Dr. S. Chakraborti (From 1.4.2014)
Sr. Technical Assistant	:	Vacant
Jr. Technical Assistant	:	Vacant
Grafter	:	Vacant

**Horticulture Research Station, University of Horticulture Sciences, Kanabargi-590 016, Gokak Taluk, Belgaum Dist., Karnataka**

Phone No. : 08332 - 284 502 (0) Fax No. : 08332 - 284684

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

Horticulturist	:	Dr. R.T. Patil
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**Cashew Research Station, (Kerala Agricultural University), Madakkathara 680 651, Thrissur District, Kerala**

Phone No. : 0487-2370339 Fax No. : 0487-2370019

E-mail : cashewresmadk@gmail.com, crsmadakkathara@kau.in

Horticulturist	:	Dr. P.B. Pushpalatha
Jr. Breeder	:	Mr. Gregory Zachariah
Jr. Entomologist	:	Dr. M.S. Smitha
Sr. Technical Assistant	:	Dr. A. Sobhana
Jr. Technical Assistant	:	Mr. M.K. Manoj
Grafter	:	Vacant

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

Phone No. : 0260 2337227 FAX No. : 0260 2337227

E-mail : cashewrespari@gmail.com, aesnau@yahoo.co.in

Horticulturist : Dr. J.P. Makati

Jr. Entomologist : Mr. R.B. Patel

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

Phone No. : 0467-2260450 FAX No. : 0467-2260554

E-mail : cashewpili@gmail.com, adrrarspil@rediffmail.com

Jr. Horticulturist : Dr. Meera Manjusha A.V.

Jr. Technical Assistant : Ms. P.V. Divya (upto 24-7-2014)

Ms. Bhavya K.T. (From 26-11-2014)

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

Phone No. : 02366-262234 FAX No.: 02366-262234

E-mail : cashewresveng@gmail.com, adrrfrsvengurle@yahoo.com

Horticulturist : Mr. R.C. Gajbhiye (From 16.4.2010)

Jr. Breeder : Mr. R.T. Bhingarde

Jr. Entomologist : Mrs. V.K. Zote (From 7.4.2010)

Sr. Technical Assistant : Mr. S.P. Salvi (From 2.8.2011)

Jr. Technical Assistant : Mr. A.L. Patekar (From 4.12.2013)

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

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

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

Horticulturist : Dr. S. Jeeva

Jr. Horticulturist : Dr. D. Keisar Lourdusamy

Jr. Entomologist : Dr. R. Thangapandian (6-1-2014)

Sr. Technical Assistant : Mr. M.K. Sendilnayagam

Jr. Technical Assistant : Mr. C. Jayachandran

Grafter : Mr. C. Gopalakrishnan

**ICAR Research Complex for NEH Region, Tura – 794 001, West Garo Hills, Meghalaya**

Phone No. : 03651 - 222535

E-mail : director@icarneh.ernet.in, kvkwestgarohills@rediffmail.com, shyam\_westgaro@rediffmail.com

Horticulturist : Dr. A.S. Singh



#### 4. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2014-15

##### Allocation

(Rs. in lakhs)

Centre	Details of sanctioned provision					ICAR share
	Pay and Allowances	TA	Recurring contingency	Non-Recurring contingency	Grand Total	
Bapatla	0.00	0.20	0.50	--	0.70	0.53
Bhubaneswar	38.57	1.50	4.33	--	44.40	33.30
Hogalagere	4.33	0.50	0.50	--	5.33	4.00
Darisai	6.00	0.30	1.50	--	7.80	5.85
Jagdapur	4.18	0.50	2.00	--	6.68	5.00
Jhargram	17.50	0.75	2.00	--	20.25	15.19
Madakkathara	39.00	1.50	3.50	--	44.00	33.00
Paria	11.10	0.75	1.50	--	13.35	10.00
Pilicode	6.00	0.50	0.50	--	7.00	5.25
Vengurla	25.00	1.00	3.00	--	29.00	21.75
Vridhachalam	35.00	1.50	3.00	--	39.50	29.63
KRCCH, Arabhavi	0.00	0.50	2.17	--	2.67	2.00
ICAR Res. Compl. For Goa, Goa	0.00	0.50	2.50	--	3.00	3.00
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.50	1.00	--	1.50	1.50
<b>Total</b>	<b>186.68</b>	<b>10.50</b>	<b>28.00</b>	<b>--</b>	<b>225.18</b>	<b>170.00</b>
Provision for TA for PC Cell						2.00
Provision for NEH						1.00
Provision for TSP						32.00
<b>GRAND TOTAL</b>						<b>205.00</b>



**Actual Expenditure**

(₹ in lakhs)

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	0.00	0.63	5.00	0.00	5.63	4.22
Bhubaneswar	42.29	0.99	4.34	0.00	47.62	35.72
Hogalagere	7.72	0.49	2.94	0.00	11.15	8.36
Darisai	12.00	0.30	1.50	0.00	13.80	10.35
Jagdapur	12.21	0.49	2.00	0.00	14.70	11.03
Jhargram	26.41	0.75	6.15	0.00	33.31	24.98
Madakkathara	67.97	0.70	3.00	0.00	71.67	53.75
Paria	15.89	0.35	2.66	0.00	18.90	14.17
Pilicode	8.19	0.40	0.49	0.00	9.08	6.81
Vengurla	30.28	0.15	4.63	0.00	35.06	26.30
Vridhachalam	50.86	1.40	5.38	0.00	57.64	43.23
	<b>273.82</b>	<b>6.65</b>	<b>38.09</b>	<b>0.00</b>	<b>318.56</b>	<b>238.92</b>
KRCCH, Arabhavi	0.00	0.27	1.74	0.00	2.01	1.51
ICAR Res. Compl.						
For Goa, Goa	0.00	0.48	2.46	0.00	2.94	2.94
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total</b>	<b>0.00</b>	<b>0.75</b>	<b>4.20</b>	<b>0.00</b>	<b>4.95</b>	<b>4.45</b>
Provision for TA for PC Cell						2.00
Provision for NEH						1.00
Provision for TSP						32.00
<b>GRAND TOTAL</b>						<b>254.21</b>



## 5. METEOROLOGICAL DATA OF DIFFERENT CENTRES OF AICRP - CASHEW

### BAPATLA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days
			(Max)	(Min)		
Apr.13	34.7	26.3	76	73	6.90	1.0
May 13	38.3	28.5	72	66	36.7	3.0
Jun.13	37.2	26.1	71	57	125.3	7.0
Jul. 13	33.3	25.1	78	67	193.9	13.0
Aug.13	33.6	25.1	80	65	196.1	11.0
Sep.13	34.3	25.0	79	75	78.5	2.0
Oct. 13	31.7	24.5	89	85	497.9	12.0
Nov.13	30.7	21.3	89	79	62.2	5.0
Dec.13	30.0	17.7	88	63	0.00	0.0
Jan.14	29.8	18.2	92	68	0.00	0.0
Feb.14	30.3	18.7	85	65	3.3	1.0
Mar.14	33.3	20.5	80	65	0.00	0.00

### BHUBANESWAR

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	No. of rainy days	BSH
			(Max)	(Min)			
Apr.13	38.2	24.3	84.8	49.9	85.9	5	6.4
May 13	39.3	27.2	88.2	49.3	12.2	2	7.9
Jun.13	37.6	26.0	85.1	57.4	117.2	11	3.0
Jul. 13	32.2	25.1	94.4	81.6	405.5	22	3.2
Aug.13	32.0	25.2	93.7	81.8	255.3	20	3.6
Sep.13	32.4	25.3	93.7	78.7	110.6	17	3.9
Oct. 13	32.1	22.6	91.4	68.6	61.6	7	6.4
Nov.13	29.7	19.1	93.2	62.2	134.9	6	6.1
Dec.13	29.9	15.3	93.0	44.0	0.0	0	7.6
Jan.14	29.7	15.1	91.5	43.1	0.0	0	6.1
Feb.14	32.3	16.7	89.9	37.6	28.0	2	7.1
Mar.14	37.72	21.55	89.41	30.54	0.0	0	4.6



### JAGDALPUR

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)		Rainfall (mm)	BSH
			(Max)	(Min)		
Apr.13	36.7	20.9	87.0	28.1	98.8	7.1
May 13	39.1	26.0	81.0	20.7	35.3	9.4
Jun.13	30.7	24.0	88.2	68.5	476.7	3.4
Jul. 13	27.7	22.4	91.1	64.9	189.2	1.1
Aug.13	27.7	22.4	91.8	64.9	204.7	1.1
Sep.13	29.2	21.1	87.4	49.2	133.8	4.8
Oct. 13	27.9	19.5	88.5	55.4	180.5	4.6
Nov.13	26.8	14.1	87.1	47.1	3.8	6.1
Dec.13	26.4	8.3	88.3	45.0	0.0	6.7
Jan.14	28.5	11.3	91.8	40.4	0.0	6.5
Feb.14	32.2	15.0	96.8	45.0	0.0	10.3
Mar.14	30.6	19.0	98.0	37.0	0.0	9.3

### JHARGRAM

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	RH (%)	Rainfall (mm)	No. of rainy days
			Average		
Apr.13	38.3	22.8	45	5.8	3
May 13	39.4	26.7	53	19.8	9
Jun.13	33.9	26.1	71	22.7	14
Jul. 13	32.2	26.1	82	34.6	20
Aug.13	32.2	25.6	83	30.4	20
Sep.13	32.8	25.0	85	28.1	15
Oct. 13	30.6	22.8	76	28.7	12
Nov.13	29.4	16.1	68	0.0	1
Dec.13	27.2	11.7	65	0.0	0
Jan.14	26.1	11.7	60	0.2	0
Feb.14	28.9	14.4	53	7.3	2
Mar.14	33.3	18.9	45	2.5	0



## MADAKKATHARA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%) (Avg.)	Rainfall (mm)	No. of rainy days	BSH
Apr.13	34.8	25.32	72	0	0	5.98
May 13	33.15	24.75	77.75	55.73	1.75	28.13
Jun.13	28.53	22.75	90.13	227	6.5	6.33
Jul. 13	28.38	22.68	90.2	218.12	6.8	5.12
Aug.13	30.2	23.08	82.88	37.0	3	34.03
Sep.13	29.83	22.35	85	84.83	4	26.13
Oct. 13	30.96	22.92	81.6	75.08	3.4	37.56
Nov.13	32.55	23.8	73.75	20.2	1.0	42.78
Dec.13	31.85	22.2	61.25	0.125	0	58.95
Jan.14	32.96	22.96	51	0	0	63.52
Feb.14	34.75	23.13	58.5	0	0	58.63
Mar.14	36.98	24.2	54.25	0	0	59.98

## PARIA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%)	Rainfall (mm)	No. of rainy days
Apr.13	35.27	19.32	62.32	13.1	1
May 13	35.43	24.07	64.53	0.0	0
Jun.13	31.80	24.45	85.40	768.5	22
Jul. 13	29.50	24.17	91.32	1196.7	31
Aug.13	29.91	23.76	85.68	385.3	24
Sep.13	31.31	23.15	84.37	400.1	13
Oct. 13	33.74	21.41	73.65	52.1	3
Nov.13	35.06	16.66	60.85	3.2	1
Dec.13	33.69	11.86	60.16	0.0	0
Jan.14	30.73	11.93	66.95	0.5	0
Feb.14	31.56	11.77	63.57	0.0	0
Mar.14	34.67	15.13	59.32	0.0	0



### PILICODE

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%) (Avg.)	Rainfall (mm)	No. of rainy days
Apr.13	33.8	24.2	74	8.0	3
May 13	33.5	25.4	75	2.6	4
Jun.13	29.9	22.5	89	44.7	28
Jul. 13	29.3	23.0	91	39.4	31
Aug.13	29.4	23.0	87	12.3	24
Sep.13	30.0	23.0	86	6.17	19
Oct. 13	31.5	23.5	84	1.8	16
Nov.13	32.5	22.7	77	0.17	2
Dec.13	32.4	19.1	74	0.5	1
Jan.14	32.6	20.3	76	0	0
Feb.14	32.9	21.4	77	0	0
Mar.14	33.2	22.2	74	0	0

### TURA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	RH (%)		Rainfall (mm)	No. of rainy days
			Max.	Min.		
Jan. 13	27	7	96	65	0	0
Feb. 13	31	10	94	57	13.4	2
Mar. 13	34	16	80	47	24.8	4
Apr. 13	34	16	83	54	213.80	11
May 13	33	17	85	59	505.2	21
Jun.13	35	18	93	48	471.60	19
Jul. 13	33	18	88	59	257.20	17
Aug.13	33	18	80	58	304.5	18
Sep.13	34	18	89	59	394.6	21
Oct. 13	33	17	88	58	234.2	9
Nov.13	28	16	80	50	3	1
Dec.13	25	15	82	50	0	0



## VENGURLA

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	RH (%)		Rainfall (mm)	No. of rainy days
			(Max)	(Min)		
Apr.13	33.05	23.01	81.93	62.10	0	0
May 13	33.60	24.8	82.29	67.41	100	5
Jun.13	30.38	24.78	87.57	81.96	988	27
Jul. 13	28.31	24.43	89.71	84.31	1455	35
Aug.13	30.23	24.72	88.17	77.60	303.2	23
Sep.13	30.24	24.03	91.26	79.49	367.4	22
Oct. 13	32.35	24.22	88.86	70.99	131.6	9
Nov.13	34.91	20.63	87.78	55.85	-	-
Dec.13	33.59	16.88	86.39	46.81	6.4	1
Jan.14	33.046	18.95	86.56	52.93	0	0
Feb.14	33.12	18.26	84.03	50.56	0	0
Mar.14	33.62	21.66	84.71	55.42		

## VRIDHACHALAM

Month & Year	Max. Temp. (°C)	Min. Temp. (°C)	Mean RH (%) (Avg.)	Rainfall (mm)	No. of rainy days
Apr.13	39.0	24.5	69.4	13.4	1
May 13	42.2	29.9	60.2	-	-
Jun.13	42.4	25.6	63.0	37.2	5
Jul. 13	36.0	25.3	73.0	73.8	5
Aug.13	35.1	25.4	78.4	385.4	10
Sep.13	34.5	24.6	79.8	265.8	10
Oct. 13	35.4	24.1	77.6	113.4	3
Nov.13	31.5	21.7	83.0	231.2	8
Dec.13	30.1	23.8	86.7	68.7	7
Jan.14	29.9	19.4	83.5	13.0	1
Feb.14	31.6	19.9	79.8	2.0	1
Mar.14	32.6	21.3	79.6	12.4	



## 6. RESEARCH PUBLICATIONS

### BHUBANESWAR

Tripathy, P., Sethi, K., Mukherjee, S. K. and Pattnaik, A. K. 2014. Evaluation of different sources of organics on growth and yield of cashew (*Anacardium occidentale* L.). *Indian Agriculturist*, 58(2):117-122.

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