

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

वार्षिक प्रतिवेदन  
ANNUAL REPORT  
2009-10

परियोजना समन्वयकर्ता  
डा. एम. गोपालकृष्ण भट  
PROJECT COORDINATOR  
Dr. M. Gopalakrishna Bhat



काजू अनुसंधान निदेशनालय  
(भारतीय कृषि अनुसंधान परिषद्)  
पुत्तूर - 574 202, दक्षिण कन्नड, कर्नाटक

**DIRECTORATE OF CASHEW RESEARCH**  
(*Indian Council of Agricultural Research*)  
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## प्राक्कथन

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की बाइसवी वार्षिक प्रतिवेदन प्रस्तुत है। इस प्रतिवेदन में अप्रैल 2008 से मार्च 2009 तक की अनुसंधान उपलब्धियाँ तथा अन्य जानकारी सम्मिलित की गई है।

इस परियोजना में आठ केंद्र तथा एक उपाकेंद्र है, जैसे भारत की पूर्व तट में चार; बापट्ला (आंध्र प्रदेश), भुवनेश्वर (उड़ीसा), झारग्राम (प. बंगाल) और वृद्धाचलम् (तमिल नाडु); पश्चिम तट पर दो केंद्र और एक उपकेंद्र जैसे माडक्कतरा केंद्र (केरल) और पिलिकोड उपकेंद्र (केरल) तथा वेंगुर्ले केंद्र (महाराष्ट्र); मैदानी भाग में दो केंद्र, एक चिंतामणि (कर्नाटक) और दूसरी जगदलपुर (छत्तीसगड) में स्थित है और, इस परियोजना का अनुसंधान कार्यसूची को कार्यान्वयन करते हैं।

प्रतिवेदन में चालू बारह अनुसंधान परियोजनाओं कि उपलब्धियों की क्षेत्रीय स्तर पर विषयानुसार, जैसे फसल सुधार (3), फसल प्रबंध (5), और फसल संरक्षण (4) के विविध विषयों को संबंधित बारह अनुसंधान परियोजनाओं की उपलब्धियों को संकलित करके प्रस्तुत की गई है।

इस प्रतिवेदन में दो अध्याय हैं, जैसे,

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

(एम गोपालकृष्ण भट्ट)  
निदेशक एवं परियोजना समन्वयकर्ता

पुत्तुर - 574 202  
दिनांक : 5.12.2009

## **ABOUT THIS REPORT**

This is the **twenty sixth** Annual Report of the All India Coordinated Research Project on Cashew. This report covers the research results and other information pertaining to the period from April 2008 to March 2009.

There are eight project centres and one sub centre, four in the East Coast of India, namely, Bapatla (Andhra Pradesh); Bhubaneshwar (Orissa); Jhargram (West Bengal) and Vridhachalam (Tamil Nadu), two centres and one sub centre in the West Coast, namely, Madakkathara (Kerala) and Pilicode (Kerala) (Sub centre); Vengurla (Maharashtra) and one each in Plains Region, namely, Chintamani (Karnataka) and Jagdalpur (Chhattisgarh) which are implementing the research programmes.

During XI Plan, 2 new centres were added one in Gujarat and another in Jharkhand thereby increasing the total to 11 centres. Further, 3 cooperating centres are also functioning under AICRP-Cashew (one each in Karnataka, Goa and Meghalaya).

There are twelve research projects pertaining to different disciplines such as Crop Improvement (3) Crop Management (5) and Crop Protection (4). The results reported by each centre are compiled region-wise and discipline wise and presented in this report.

This report consists of two chapters, they are:

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

**(M. GOPALAKRISHNA BHAT)**  
DIRECTOR & PROJECT COORDINATOR

Puttur 574 202  
Dated : **05-12-2009**

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## **CHAPTER 1 : TECHNICAL**

## परियोजना समन्वयकर्ता की रिपोर्ट

अखिल भारतीय समन्वित मसाला व काजू अनुसंधान पारयोजना 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 विभजित किया गया। अखिल भारतीय समन्वित काजू अनुसंधान पारयोजना का मुख्यालय नव निर्मित राष्ट्रीय काजू अनुसंधान केंद्र पुतूर 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) माडक्कतरा (केरल कृषि विश्वविद्यालय, आनक्कायम् से स्थानांतरित), वेंगुर्ले (डॉ. बाला साहेब कोंकण कृषि विद्यापीठ) और वृद्धाचलम (तमिलनाडु कृषि विश्वविद्यालय) में प्रारंभ किया गया। पाँचवीं पंचवार्षिक योजना में एक केंद्र भुवनेश्वर (औ.यू.ए.टी.) और छठवीं पंचवार्षिक योजना में दो केन्द्र, एक झारग्राम (बी.सी.के.वि) और दूसरा चिंतामणि (यू.ए.एस) को सम्मिलित किया गया। आठवीं योजना में एक केंद्र - जगदलपुर (आई.जी.ए.यू) और एक उपकेंद्र पिलिकोड (के.ए.यू.) प्रारंभ किया गया। अखिल भारतीय समन्वित काजू अनुसंधान परियोजना के यह केंद्र 8 काजू उगानेवाला राज्यों में स्थित है और यह विभिन्न राज्य कृषि विश्वविद्यालयों के प्रशासनिक नियंत्रण में है।

परियोजना का 2008-09 में बजट आबंटन रु. 142.66 लाख (रु. 107.00 लाख भा.कृ.अ.प. का अंश) था और व्यय रु. 140.10 लाख (रु. 105.08 लाख भा.कृ.अ.प. का अंश) था।

निम्न लिखित विधियों से काजू की उत्पाद और उत्पादन क्षमता बढ़ाना इस पारयोजना 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 प्रारंभिक विविध परियोजनाओं से प्रतिवेदन अवधि में प्राप्त मुख्य परिणामों, विविध विभागों में प्रस्तुत है।





## PROJECT CO-ORDINATOR'S REPORT

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

The AICRP on Cashew has presently eight centres and one sub-centre; of which four were started at the inception of AICS & CIP in the year 1971 [Bapatla (ANGRAU the then APAU); Madakkathara (KAU, shifted from Anakkayam); Vengurla (BSKKV the then KKV) and Vridhachalam (TNAU)]. During the V Plan, one centre at Bhubaneswar (OUAT) and in the VI Plan, two centres, one at Jhargram (BCKVV) and another at Chintamani (UAS) were added. During VIII Plan, one centre at Jagdalpur (IGAU) and a sub centre at Pilicode (KAU) were also started. These centres of AICRP on Cashew are located in eight 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 2009-10 was **Rs.142.66** lakhs (Rs.107.00 lakhs - ICAR Share) and the expenditure was **Rs.140.10** lakhs (Rs.105.08 lakhs - ICAR Share)

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

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

The salient findings during the period under report, under different projects initiated to fulfill these objectives have been presented hereunder under the following sections.

### CROP IMPROVEMENT

#### **Germplasm collection, conservation, evaluation, characterization and cataloguing**

The total number of accessions conserved so far in the Regional Cashew Field Gene Banks (RCFGBs) is 1232. At Bhubaneswar, out of 95 accessions, 56 nos. of accessions had bold nut with nut weight ranging from 7.0 g to 14.0 g (OC 85). Among the promising germplasm collections, 44/1-ARSC (Vengurla -5) recorded highest cumulative nut yield (21 harvests) of 370.13kg/tree at Chintamani. The shelling percentage in BCKV-14 was 35%

at Jhargram. The number of flowering panicles/m<sup>2</sup> was highest in RFRS-184 (22.50) at Vengurla.

### **Varietal Evaluation Trials: Multi Location Trial – II**

The duration of flowering in T.No. 40/1 was the lowest (95days) at Bapatla. H-303, H-68 and NRCC Sel-2 had bold nut weighing more than 8.0 g and shelling percentage ranging from 29.0 to 32.0 at Bhubaneswar. Over a period of 15 harvests, H-320 recorded highest cumulative yield (131.85 kg/tree) at Chintamani. Nut weight was highest for H-68 (9.37 g) and apple weight was highest for H -255 (65.07g) at Jagdalpur. At Jhargram, maximum number of nuts (26.92/m<sup>2</sup>) was observed in case of H-255 followed by H-303 (26.3). The highest cumulative yield was recorded by H 303 (58.90 kg) followed by H 320 (51.37 kg) at Madakkathara.

### **Multi Location Trial – III**

The duration of flowering was shortest in K-22-1 [85days] at Bapatla. Cumulative nut yield per tree for 2 years and nut weight was maximum in BPP-8 [6.5 kg/tree and 8.2 g respectively] at Bapatla. Highest no. of flowering laterals / sq. m. (18.0) was recorded in BH 85 at Bhubaneswar. At Chintamani, significantly highest plant height was recorded by Bhaskara (4.51 m) and lowest plant height was recorded by H-14 (3.14 m). At Madakkathara, maximum canopy spread was recorded in H - 14 (6.98 m) followed by H-11 (6.12 m).

### **Performance of Released Varieties**

#### **(Multi Location Trial – V)**

At Jhargram, the plant height was maximum in case of Vengurla – 4 (4.8 m) followed by Kanaka (4.2 m). Nuts/panicle was highest in case of Jhargram-1 (16.3) followed by Bhubaneswar-1 (14.8 nuts/panicle) at Jhargram. Vengurla-6 had the highest shelling (37.4 %) followed by Vengurla-1 (37.1 %) at Jhargram. The variety Amrutha recorded maximum spread (4.27 m) followed by Vridhachalam-3 (3.96 m) at Madakkathara.

### **Hybridization and Selection**

At Bhubaneswar, for 10 harvests highest cumulative nut yield (kg/plant) was recorded in A6 (62.4), followed by A9 (37.7) and E1 (30.4). The hybrid F4-24 at Bhubaneswar recorded a highest cumulative nut yield (16.7 kg/plant) for 5 harvests and annual nut yield (7.0 kg/plant). The maximum nut weight of 10.29g with a shelling percentage of 30.1g was recorded in H-216 at Chintamani. The highest cumulative yield/tree was recorded in the hybrids H-74 (77.25 kg/tree) followed by H-73 (74.90 kg/tree) for 13 harvests at Madakkathara. The hybrids from the cross MDK1 X PLD-57 was found to be

taller than both the parents at Pilicode. At Vengurla H 777 (M-44/3 x BT 22) recorded maximum annual nut yield of 3.85kg/plot. Out of 10 F<sub>1</sub> hybrid trees, three trees exhibited dwarfness/compactness which were < 5m tall and had intensive branching pattern at Vridhachalam.

## **CROP MANAGEMENT**

### **Agr.1: NPK Fertilizer Experiment**

At Bapatla, significantly highest cumulative nut yield was recorded in the treatment with 1000:125:125g NPK/tree (N<sub>2</sub>P<sub>1</sub>K<sub>1</sub>) (78.39kg/tree). No significant variation in cumulative nut yield was observed due to direct/interactions effect of N, P or K at Madakkathara. Spacing of 10m x 5m was at par with 6m x 4m with respect to plant height and canopy height at Vengurla.

### **Agr.2: Fertilizer application in high density cashew plantations**

Maximum percentage of ground area coverage was under 5x4m spacing (78.95) followed by 6x4m spacing (54.34) at Bapatla. Maximum apple weight (58.0g) and maximum nut weight (8.37g) was recorded in 75:25:25kg NPK/ha at Bhubaneswar. The highest yield (20.2q/ha) was obtained in 600pl/ha and fertilizer dose of 150:50:50kg NPK/ha at Chintamani. At Jhargram, maximum number of nuts (34.3/m<sup>2</sup>) was found with 10m x 5m spacing which also resulted in maximum nut yield (6.10 kg/tree). At Pilicode, the number of flowering panicles was maximum (15.99/m<sup>2</sup>) at 75:25:25 NPK kg/ha.

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

Annual yield per hectare was 3438kg in high density planting and 1195kg in normal density planting in Madakkathara. Further, the cumulative yield kg/ha for nine harvests was 23,481kg/ha in high density planting and 6562kg/ha in Normal Density Planting in Madakkathara.

### **Agr.3: Drip irrigation trial**

A nut weight of 7.4 g. and shelling per cent of 32.1 and cumulative yield of 39.80kg for 4 harvests was recorded in 80% CPE at Chintamani. The cumulative yield for seven harvests was maximum at 40 percent CPE (21.41 Kg/tree) at Vengurla.

### **Agr.6: Intercropping in Cashew**

The inter cropping of marigold with cashew recorded the highest net profit of Rs.65,967/- per hectare at Bapatla. The highest total returns (Rs. 66,616/-) value was recorded by amorphophallus, followed by coleus (Rs. 65,382/-) at

Madakkathara. At Vridhachalam, *Aloe vera* and *Ocimum* yielded better with high BCR of 3.0 and 2.3 respectively when compared to other crops.

## **CROP PROTECTION**

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

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

Thrips damage score on apple and nut was found to be lowest (0.8) in all the treated trees at Bapatla. At Bhubaneswar, L- cyhalothrin resulted in minimum incidence of shoot tip caterpillar (STC) (0.62 %), as compared to recommended spray (0.9%). The maximum increase in nut yield was in L- cyhalothrin spray (39.2%) followed by recommended spray schedule (27.0%) at Bhubaneswar. The incidence of thrips, aphids, mealy bugs and nut borer at Chintamani were on par in triazophos (0.10%), chloropyriphos (0.05%) and recommended spray schedule. The yield was highest (186.10 kg/ha) in Triazophos 0.1% at Jagdalpur which was at par with L-cyhalothrin (0.003%) (155.49 kg/ha). The treatment with L-cyhalothrin (0.003%) significantly reduced damage score of inflorescence thrips on apple and nut (3.26 and 2.72, respectively) at Vengurla.

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

#### **Expt. 2. Curative control trial**

Under post extraction prophylaxis with chlorphyriphos (0.2%) led to 90.9% of trees without re-infestation or persistent attack at Bapatla. Monocrotophos and chlorpyriphos treatments resulted in 67.8 and 76% non reinfestation with minimum cost of treatment (Rs. 24.50 and 28.00/treatment/year, respectively) at Bhubaneswar. Reinfestation by CSR B was totally absent in the trees treated with the chlorpyriphos (0.2%), at Chintamani and even in the treated check, where grub extraction was adopted, 77.78% trees could recover. At Vengurla, Chlorpyriphos (0.2%) recorded 93.33 per cent of treated trees without reinfestation.

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

Rainfall showed negative significant influence ( $r = -0.3751$ ) on the incidence of leaf miner and on inflorescence thrips ( $r = -0.321$ ) at Bapatla. The Relative humidity had positive significant correlation on the incidence of shoot tip caterpillar (*Hypatiama haligramma*) at Bhubaneswar. Bright sunshine hours positively influenced ( $r = 0.269$ ) the activity of leaf folder at Jagdalpur. Apple

and nut borer incidence showed negative correlation with relative humidity (-0.537), and number of rainy days (-0.472) at Vengurla.

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

Lowest damage by shoot tip caterpillar (STC) of 1.6 per cent was recorded in germplasm T.No.274 at Bapatla. Among 108 germplasm, evaluated at Chintamani ME-4/4 and 1/64-Madhuranthakam were found to escape from the TMB infestation due to early flushing and flowering. Mean percentage infestation of leaf miner was minimum (0.25) in Goa-1 at Madakkathara. The maximum per cent damaged shoots were recorded in 30/1 (6.67%) followed by Vengurla-4 (6.05%) at Vengurla. None of the cashew accessions showed resistance to TMB infestation at Vridhachalam.

**TRANSFER OF TECHNOLOGY**

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**CENTRES OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW**

**MAP**

## **LOCATION OF CENTRES TO BE INDICATED ON MAP IN THE PRESS ITSELF**

### **HEADQUARTERS OF AICRP ON CASHEW**

#### **▲ Directorate of Cashew Research, Puttur 574 202**

##### *AICRP on cashew Centres:*

1. Cashew Research Station, (APHU), Bapatla, 522 101, Guntur District, Andhra Pradesh
2. Cashew Research Station, (OUAT), Bhubaneswar 751 003, Orissa
3. Agricultural Research Station, (UAS), Chintamani 563 125, Kolar District, Karnataka.
4. SG College of Agricultural and Research Station, (IGAU), Jagdalpur 494 005, Chattisgarh
5. Regional Research Station, (BCKV), Jhargram - 721 507, Midnapore West District, West Bengal
6. Cashew Research Station, (KAU), Madakkathara 680 651, Kerala
7. Regional Agricultural Research Station, (KAU), Pilicode 671 353, Kasaragod District, Kerala.
8. Regional Fruit Research Station, (Dr. BSKKV), Vengurla 416 516, Maharashtra.
9. Regional Research Station, (TNAU), Vridhachalam 606 001, Cuddalore District, Tamil Nadu.
10. Birsa Agricultural University Centre, Jharkhand.
11. Agricultural Experimental Station (Navsari Agricultural University), Paria, Pardi Taluk, Valsad District, Gujarat.

##### **Cooperating Centres**

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

## GENERAL CHARACTERISTICS OF CENTRES OF AICRP ON CASHEW

The eight coordinating centres and one sub centre are spread 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 and Vengurla. This zone receives rainfall ranging from 2800 mm to 3800 mm annually and is distributed over a period of 7-9 months from April/June to December. The soil is typically sandy, sandy loam, sandy clay loam and laterite (oxisol). Madakkathara receives an average rainfall of 3550 mm and the temperature ranges from 22 to 36.2° C, the soil is laterite (oxisol), medium in N, low in P and medium in K contents. The climate is per humid and AWC is 150 mm. At Vengurla average rainfall is 2916 mm and the temperature ranges from 17.4 to 32.9° C. Centre is situated at an elevation of 90m above MSL; the soil is sandy loam to sandy clay loam with high organic matter, N, K and low in P. The climate is humid and, AWC is 150 mm.

Maidan tract characterized by even land has Chintamani, Jagdalpur, Paria centres and Cooperating 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. 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. Paria centre is characterized by heavy black soils and receives an average annual rainfall of



2100mm. 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 1200mm. The cooperating centre at Goa is characterized by lateritic soils with shallow to medium depth. The centre is situated at altitude of 25-40m above the MSL. This centre receives rainfall ranging from 2800 mm to 3800 mm spread out during June to December.

## **EXPERIMENTAL RESULTS**

# **I. CROP IMPROVEMENT**

# I. CROP IMPROVEMENT

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

### *Centres: East Coast*

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

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### *West Coast*

Madakkathara, Pilicode and Vengurla

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### *Plains / others*

Chintamani and Jagdalpur

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

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### **SUMMARY:**

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#### **Germplasm Collection:**

During the current year, 7 germplasm collections have been done by different centres of AICRP on Cashew and have been planted in the respective Regional Cashew Field Gene Banks (RCFGBs). The total number of accessions conserved so far is 1232. (Table. 1.1 )

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

Centre	No. of accessions		
	Earlier existing	Collected during 2009-10	Existing
<b>East Coast</b>			
Bapatla	132	-	132
Bhubaneshwar	98	2	100
Jhargram	119	1	120
Vridhachalam	208	-	208
<b>West Coast</b>			
Madakkathara	130	2	132
Pilicode	43	--	43
Vengurla	302	--	302
<b>Plains tract/others</b>			
Chintamani	128	--	128
Jagdalpur	65	2	67
<b>Total</b>	<b>1225</b>	<b>7</b>	<b>1232</b>

## Germplasm Evaluation :

The growth and yield parameters of cashew germplasm available at different AICRP-Cashew Centres have been evaluated during 2009-10 and the relevant results are reported here

### BAPATLA

Among the accessions, Hy-94-3 recorded highest plant height (7.50m) followed by Hy95-4, 1/1, 3/4 respectively (7.40cm). Maximum mean spread of canopy recorded in the T.No275(11.9m) followed by Hy-95-4 (10.80m), mean nut yield per tree was maximum in BLA 39-4 (7.8kg/tree) followed by Priyanka(7.00kg/tree).The cumulative nut yield since 2001 recorded highest in he entry BLA 39/4 as 55.68 kg per tree followed by accession- 5/1 [50.62 kg per tree] (Table. 1.2 )..

**Table 1.2 : Performance of cashew accessions at Bapatla**

Accession No	Plant Height [m]	Spread		Annual Nut Yield [kg/tree]	Cum. Nut yield 9 hvsts [kg/tree]	Mean Nut weight [g]	Shelling percentage
		E-W	N-S				
T.NO-129	4.9	6.4	8.7	3.800	46.77	5.39	30.45
T.NO -268	6.4	9.8	8.0	2.150	47.21	5.80	32.08
4/3	7.34	6.3	6.0	1.240	30.15	4.88	33.99
4/5	7.22	7.22	8.1	1.830	32.97	3.51	32.66
5/1	6.9	10.5	8.9	1.930	50.62	5.29	27.41
15/4	5.5	8.5	7.0	2.750	35.70	8.99	33.42
17/5	6.2	7.95	9.3	2.100	32.48	4.51	32.64
18/3	5.1	5.9	7.1	1.400	20.18	5.15	33.67
Hy94-3	7.5	9.2	7.8	0.800	22.49	5.16	27.33
Hy94-4	5.8	9.7	7.5	4.00	21.52	9.16	27.07
BLA39-4	5.5	11	7.9	7.800	55.68	4.81	30.29
BLA139-1	4.23	5.7	6.9	0.633	20.44	5.66	34.09
CHG-1	5.5	9.6	7.4	1.860	27.99	4.10	31.43

Further highest nut weight of 10.55 g was recorded with Priyanka followed by Hy94-4 with 9.16 g.

## BHUBANESWAR

In the Regional Cashew Field Gene Bank, 2 no. of elite cashew type have been collected, vegetatively multiplied and planted in the Regional Field Gene Bank (table-1) during 2009. A total of 100 accessions are available for future evaluation (Table.1.3 ).

**Table 1.3 : Germplasm accessions surveyed and conserved at Bhubaneswar.**

Year	Collection number	Place and collection	Remarks
2009	1) KGN-1	1) CRS, Kerala	1) Nut weight is 8.4 g with 2 nuts per panicle. Apple is yellow and nut yield is 1.3 kg/plant in a six year old plant
	2) RP-6	2)Ranasingpur,Khurda	2) Bold nut type having nut weight 11.0 g with 3 nuts per panicle. Apple is red and nut yield is 3.5 kg/plant

Out of 95 accessions, 56 nos. of accessions had bold nut with nut weight ranging from 7.0 g to 14.0 g (OC 85). Seventy-one accessions had shelling percentage ranging from 28.0 to 35.0 % (OC 78, OC 83, OC 100 OC 111, OC 147, OC 148 and OC 154) At 4<sup>th</sup> harvest the cumulative nut yield (kg/plant) ranged from 5.1 to 5.5 (OC 78 and OC 92) in 4 accessions. The promising yielders (kg/plant) were OC 92 (2.7), OC 129 (2.0) and OC 148 (1.1) planted during the year 2002, 2003 and 2004 respectively (Table. 1.4 ).

**Table 1.4: Performances of promising germplasm accessions at Bhubaneswar**

Plantin g Year	Accession No.	No. of nuts/panicle	Nut weight (g)	Nut yield (kg/ plant)	Shelling (%)
<b>2002</b>					
	OC60	2	7.8	1.5	-
	OC65	3	6.2	0.9	29
	OC66	2	6.0	0.8	28
	OC69	2	11.3	1.1	27
	OC78	4	6.0	1.9	35
	OC83	3	7.7	0.8	35
<b>2002</b>					
	OC92	5	5.0	2.7	30
	OC101	4	8.0	1.0	30
	OC102	2	7.0	1.3	33
	OC109	4	7.5	0.7	28
<b>2003</b>					
	OC120	4	5.4	1.0	31
	OC121	5	7.1	1.2	32

### CHINTAMANI

Out of 128 germplasm collections maintained at ARS, Chintamani, 108 accessions are yielding and remaining is yet to yield.

Among the promising accessions, during the year 2009-10 the accession 41/3 ARSC (5/37- Manjeri) recorded highest nut yield of 21.85 kg/tree followed by 44/1- ARSC (Vengurla-5) which recorded nut yield of 21.60 kg/tree. The accession 27/1- ARSC (Vetore-56) recorded highest nut weight of 8.7g with 29.5 shelling per cent followed by accession 41/3 - ARSC (5/37 - Manjeri) recorded 8.1 g nut weight and 30.4 per cent shelling.

Among the promising accessions of the germplasm collections 44/1-ARSC (Vengurla -5) recorded highest cumulative nut yield of 370.13kg/tree followed by 41/3-ARSC (5/37 Manjeri) and 2/6-ARSC (3/108-Gubbi) recorded 329.59 kg/tree and 281.37 kg/tree respectively (Table. 1.5 ).

**Table 1.5 : Yield performance of promising germplasm accessions at Chintamani**

<b>Accession</b>	<b>Year of planting</b>	<b>Nut Yield ( kg/tree)</b>	<b>Cum. nut yield (kg/tree)</b>	<b>Nut weight (g)</b>	<b>Shelling (%)</b>
3/108 Gubbi (2/6 ARSC)	1982	12.75	281.37 (24hvts)	6.7	30.1
Vetore-56 (27/1 ARSC)	1983	11.20	150.79 (23hvts)	8.7	29.5
M-6/1 (36/8 ARSC)	1983	11.85	213.80 (23hvts)	6.5	30.2
5/37 Manjeri (41/3 ARSC)	1985	21.85	329.59 (21hvts)	8.1	30.4
Vengurla - 5 (44/1 ARSC)	1985	21.60	370.13 (21hvts)	5.6	31.2
K-3-C (56/1 ARSC)	1993	11.5	122.60 (12hvts)	6.5	31.3

Description of 102 accessions of germplasm collections were made as per the descriptions developed by DCR, Puttur.

### **JAGDALPUR**

The nut yield/tree was highest for NRC- 138 (8.46 Kg), followed by NRC– 137 (7.70 Kg). The cumulative Nut yield was highest in NRC- 137 (47.35 Kg) with 11 harvests. Mean nut weight was found to be highest for NRC-190 (9.23 g) followed by NRC-140 and 138 with 8.10 g. Shelling per cent was found to be highest in NRC- 137 (30.62%) (Table 1.6 ).



**Table 1.6 : Growth and yield parameters of germplasm evaluated at Jagdalpur**

Accession	Yield during 2009-10 (Kg)	Cum. yield Kg/Plant (11 harvests)	Mean weight/nut (g)	Mean weight/apple (g)	Shelling (%)
NRC- 130	3.89	19.18	6.50	57.50	29.50
NRC- 131	4.72	22.08	7.83	43.50	<b>30.60</b>
NRC- 136	4.39	20.20	5.53	38.50	29.75
NRC- 137	7.70	47.35	5.50	45.27	30.62
NRC- 138	8.46	36.68	7.85	42.75	30.50
NRC- 140	4.78	26.30	8.10	46.17	28.45
NRC- 190	3.87	15.79	9.23	24.00	30.10
NRC- 191	3.56	31.61	5.46	37.50	30.28
NRC- 192	5.52	19.09	6.83	54.23	28.39
NRC- 193	7.42	33.25	5.32	36.83	30.55

## **JHARGRAM**

One germplasm accession (BCKV-14) was collected from the seedling cashew plantation of Regional Research Station, B.C.K.V., Jhargram, Paschim Medinipur, West Bengal. The tree had an average of 10 nuts per panicle and yielded 35 kg/tree. The canopy was upright and compact with intensive branching. The shelling percentage was also very high i.e. 35%.

At present the center is maintaining a total of 120 germplasm collections. The accessions JGM – 251, JGM – 231, and JGM – 226 was found to bear nuts with more than 7g weight. The yield was maximum in case of JGM – 251 4.36 Kg/tree followed by JGM – 231 (3.18 Kg/tree) and JGM – 223 (2.43 Kg/tree). The cumulative yield was highest with JGM – 231 (7.13 Kg/tree) followed by JGM – 251 (6.61 Kg/tree) and JGM – 223 (4.89 Kg/tree) (Table.1.7 ).

**Table 1.7 : Performance of promising secondary germplasm accessions at Jhargram**

Accession No.	Year of planting	Mean nut wt (g)	Mean Apple wt (g)	Shelling %	Yield (kg/tree) (Reporting Year)	Yield/m <sup>2</sup> (g)	Cumulative yield (kg/tree) 2 <sup>nd</sup> .rvest
JGM – 223	2005	6.28	52.0	31.12	2.43	0.097	4.89
JGM – 226	2005	7.12	35.0	31.61	1.19	0.062	2.16
JGM – 231	2005	7.07	45.0	35.36	3.18	0.156	7.13
JGM – 251	2005	7.32	68.8	30.60	4.36	0.222	6.61
JGM – 247	2005	6.04	55.0	33.61	0.99	0.072	1.23
JGM – 241	2005	6.64	50.0	35.84	0.34	0.027	0.40
JGM – 240	2005	5.37	35.0	36.13	1.12	0.046	1.32

The germplasms were at par with respect to plant height, trunk girth, canopy spread, trunk height and canopy area. JGM – 148 and JGM- 147 had early flowering habit and longer flowering duration. JGM – 152 produced highest number of flowering laterals per square meter (13.0). JGM- 148 had maximum nuts/square meter (37.2) followed by JGM – 149 (18.7 nuts /square meter). JGM – 148 was found to bear highest numbers of nuts/panicle (19). The nut weight was recorded highest in case of JGM – 152 (9.1 g) followed by JGM – 151 (7.7 g) and JGM- 150 (6.8 g). JGM – 148 had a nut weight of 5.8 g only but the yield was (10.1 kg/tree). JGM – 148 had a high shelling percentage. The cumulative yield was maximum with JGM – 148 (18.5 Kg/tree) at the 3<sup>rd</sup> harvest (Table. 1.8 & 1.9).

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

Sl. No.	Name of Selection	Accession No.	Plant height (m)	Trunk girth (cm)	Trunk Height (m)	Canopy Spread (m)	Canopy Area (m <sup>2</sup> )
1.	N – 1	JGM – 147	4.07	50.7	0.80	5.74	39.7
2.	N – 2	JGM – 148	4.62	50.3	0.74	5.70	43.4
3.	N – 3	JGM – 149	4.17	53.0	0.82	5.14	34.3
4.	R – 1	JGM – 150	4.65	51.7	0.90	4.47	30.9
5.	G – 34 ( 7 )	JGM – 151	4.04	46.3	0.92	5.01	32.2
6.	G – 34 ( 1 )	JGM – 152	3.72	48.3	0.90	4.87	28.6
S Em ±			0.20	2.89	0.09	0.37	4.17
C.D.at 5%			0.45	6.44	0.22	0.82	9.30
CV%			8.54	10.0	20.1	12.3	20.8

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

Name of Selection	Accession No.	Flowering /m <sup>2</sup>	Nuts/ m <sup>2</sup>	Nuts/ Panicle	Nut weight (g)	Yield (Kg/tree )	Shelling %	Cumulative Yield Kg/tree (2 <sup>nd</sup> . harvest)
N – 1	JGM – 147	8.9	17.8	7.3	5.5	3.9	32.0	8.5
N – 2	JGM – 148	6.0	37.2	19.8	5.8	10.1	32.0	18.5
N – 3	JGM – 149	10.9	18.7	5.8	5.1	3.4	32.1	6.5
R – 1	JGM – 150	5.6	7.9	4.4	6.8	1.7	30.8	3.3
G – 34 ( 7 )	JGM – 151	8.3	18.9	4.7	7.7	4.6	27.3	9.0
G – 34 ( 1 )	JGM – 152	13.0	7.4	2.3	9.1	2.0	12.3	5.5
S Em ±		1.70	6.76	2.68	0.06	2.24	2.2	0.43
C.D.at 5%		3.79	15.07	5.96	0.13	4.99	4.9	0.95
CV%		33.6	65.2	62.5	1.5	9.3	45.2	2.7

## MADAKKATHARA

Highest yield was recorded by Pathanoor (3.80 kg/tree) followed by Kunjithai (3.40 kg/tree). The maximum cumulative yield was recorded by Pathanoor ( 11.85 kg) followed by Kunjithai (10.90 kg) for 3 harvests. Accession Kainur recorded maximum height (6.75 m) and maximum canopy spread (7.65 m) followed by Mannur with height of 6.12 m and canopy spread of 7.27 m (Table.1.10 ).

**Table 1.10 : Growth and yield characters of accessions of the germplasm collection planted during 2002-2003 at Madakkathara**

Variety	Height (m)	Girth (cm)	Mean canopy spread (m)	Annual yield (kg/tree)	Cum. Yield kg/tree (5 Hvsts)
KTR-1	4.12	57.50	4.89	2.60	8.15
KTR-3	4.81	63.00	6.40	2.00	6.35
Kiralur	5.66	69.34	6.28	1.90	5.85
Mannur	6.12	81.50	7.27	1.80	5.91
Kainur	6.75	79.00	7.65	3.00	9.32
Ummanoor	5.45	68.00	6.79	2.70	8.85
Kottukkal	4.33	55.00	5.20	1.40	4.45
Peechi	4.58	54.00	6.05	1.75	5.40
Kunjithai	5.00	50.00	5.37	3.40	10.90
Pathanoor	5.12	59.00	4.60	3.80	11.85
ARL-1	5.25	66.66	5.20	1.10	3.20
KTR-2	4.87	49.50	4.88	1.85	5.15
ARL-2	4.87	60.50	4.48	2.80	8.05
ODR	4.50	47.25	4.20	2.70	7.60

## PILICODE

The accession PLD-4 was found to be superior in yield (7.26 Kg/plant) and cumulative nut yield (11.64 Kg/plant) followed by PLD-12 which gave an yield of 6.42 Kg/plant and cumulative yield of 19.35 Kg/plant. The density of panicles per unit area was highest in PLD-57. PLD-15 had highest vegetative parameters. The dwarf variety, PLD-57 was utilized for hybridisation programmes with varieties MDK-1 and ANK-1 (Table. 1.11 ).

**Table 1.11 : Biometric observations of cashew germplasm at Pilicode**

Accession No./Variety	Plant height (m)	Collar Girth (cm)	Canopy Spread(m)		Canopy area (m <sup>2</sup> )	No.of Panicle/ Sq m	Yield of nuts/ plant (Kg)	Cum. nut yield per plant ( Kg)
			E-W	N-S				
PLD-1	7.500 <sup>b</sup>	0.760 <sup>de</sup>	6.250	6.000 <sup>d</sup>	41.000 <sup>def</sup>	2.20 <sup>e</sup>	6.22 <sup>b</sup>	18.73 <sup>b</sup>
PLD-3	9.000 <sup>a</sup>	0.985 <sup>a</sup>	7.500	5.750 <sup>d</sup>	56.150 <sup>b</sup>	3.2 <sup>d</sup>	5.23 <sup>c</sup>	12.03 <sup>c</sup>
PLD-4	7.075 <sup>bc</sup>	0.730 <sup>efg</sup>	5.750	5.425 <sup>d</sup>	36.137 <sup>efg</sup>	5.25 <sup>b</sup>	7.26 <sup>a</sup>	22.64 <sup>a</sup>
PLD 15	5.750 <sup>d</sup>	0.630 <sup>fg</sup>	5.500	5.500 <sup>d</sup>	30.630 <sup>g</sup>	6.2 <sup>a</sup>	2.95 <sup>ef</sup>	6.70 <sup>d</sup>
PLD-16	7.000 <sup>bc</sup>	0.610 <sup>g</sup>	5.625	5.600 <sup>d</sup>	33.356 <sup>fg</sup>	2.4 <sup>e</sup>	4.26 <sup>d</sup>	11.78 <sup>c</sup>
PLD-12	7.250 <sup>bc</sup>	0.940 <sup>ab</sup>	8.150	9.500 <sup>a</sup>	60.022 <sup>b</sup>	2.07 <sup>e</sup>	6.42 <sup>b</sup>	19.35 <sup>b</sup>
PLD-18	7.725 <sup>b</sup>	0.800 <sup>cde</sup>	7.700	7.000 <sup>c</sup>	52.941 <sup>bc</sup>	4.02 <sup>c</sup>	2.92 <sup>ef</sup>	5.21 <sup>e</sup>
PLD-17	8.650 <sup>a</sup>	0.990 <sup>a</sup>	9.850	8.000 <sup>b</sup>	71.498 <sup>a</sup>	2.20 <sup>e</sup>	2.50 <sup>f</sup>	3.84 <sup>f</sup>
PLD-19	6.500 <sup>cd</sup>	0.870 <sup>bcde</sup>	7.500	7.000 <sup>c</sup>	43.790 <sup>cde</sup>	2.62 <sup>e</sup>	2.95 <sup>ef</sup>	4.72 <sup>e</sup>
PLD-20	7.120 <sup>bc</sup>	0.845 <sup>bcde</sup>	7.250	6.000 <sup>d</sup>	45.217 <sup>cde</sup>	2.03 <sup>e</sup>	3.2 <sup>e</sup>	4.67 <sup>e</sup>
PLD 57	2.600 <sup>e</sup>	0.321 <sup>h</sup>	2.500	2.700 <sup>e</sup>	5.388 <sup>h</sup>	6.32 <sup>a</sup>	0.47 <sup>g</sup>	1.02 <sup>g</sup>
<b>CD 0.05</b>	<b>0.852</b>	<b>0.126</b>	<b>NS</b>	<b>0.848</b>	<b>10.064</b>	<b>0.76</b>	<b>0.65</b>	<b>0.67</b>

## VENGURLA

Among the 14 types RFRS 184 recorded lowest mean height (3.68m) and mean girth (22.3cm) whereas, mean laterals /sq.m and flowering panicles per sq.m. were highest in RFRS 171 type i.e. 32.5 and 22.5 per sq.m. respectively. This was closely followed by RFRS 177 i.e. 31.0 and 22.5 sq.m. respectively. As far as yield is concern RFRS 172 recorded the highest mean annual yield of 1.76 Kg /plant (Table. 1.12).

**Table 1.12 : Growth and yield observations for the year 2009-10 of the germplasm collected at Vengurla**

Name of the type	Mean Plant Height (m)	Mean Plant Girth (cm)	Mean Spread (m)		Mean Panicles /Sq. m	Fruit set / m <sup>2</sup>	Mean Yield (Kg)	Mean Nut weight (g)
			E.W.	N.S.				
RFRS 171	4.95	61.00	5.70	6.05	22.5	34.0	0.660	9.9
RFRS 172	5.60	62.67	6.87	5.73	18.7	54.0	1.760	8.1
RFRS 173	5.50	58.33	5.57	5.70	18.7	27.3	0.770	6.7
RFRS 174	5.93	67.00	5.50	5.67	19.3	12.3	0.430	6.7
RFRS 175	6.47	50.33	5.37	4.63	18.3	6.0	0.165	7.2
RFRS 176	4.73	54.67	5.60	4.87	13.3	11.0	0.481	6.0
RFRS 177	4.85	56.50	5.50	5.65	22.5	14.0	0.336	6.8
RFRS 178	6.50	65.50	5.95	6.15	17.5	9.0	0.167	8.0
RFRS 179	5.73	43.67	4.67	4.17	16.3	9.8	0.115	8.1
RFRS 180	7.37	59.33	5.73	5.53	21.7	9.5	0.140	6.7
RFRS 181	6.03	47.00	4.30	4.20	17.7	12.0	0.065	6.5
RFRS 182	5.38	46.33	5.17	5.07	19.5	30.5	0.847	5.7
RFRS 183	5.80	22.71	9.20	8.80	22.0	28.0	0.260	4.6
RFRS 184	3.68	22.33	2.90	2.97	9.7	7.5	0.290	5.2

### VRIDHACHALAM

Eight germplasm accessions planted during 1999 were evaluated for their performance. Cashew accession from Tirukattupalli, TK 1 recorded the highest cumulative nut yield of 29.382 kg/ tree in Eight harvests. The accession KK 1 from Kanyakumari District recorded the highest nut weight of 7.8g and the highest shelling percentage of 28.5 (Table. 1.13)

**Table 1.13 : Performance of cashew germplasm accessions at Vridhachalam**

Acc.No	Nut yield / plant(Kg)	Cumulative nut yield / plant(Kg) (8 <sup>th</sup> harvest)	Mean weight/ nut (g)	Mean weight/ apple (g)	Shelling %
VSK 1	7.62	26.18	6.6	62	27.6
VSK 2	7.11	26.80	7.2	50	27.8
SL 1	8.95	27.66	7.0	58	27.4
TK 1	8.65	<b>29.38</b>	6.2	65	27.7
NK 1	6.58	25.21	6.4	45	28.1
KK 1	6.45	23.36	<b>7.8</b>	50	<b>28.5</b>
PV 1	6.82	23.97	6.4	52	27.7
AM	6.24	23.26	6.2	40	26.4

## Gen.3. Varietal Evaluation Trials

### 1. Multi Location Trial – II

#### **Centres : East Coast :**

Bapatla, Bhubaneswar, Jhargram and Vridhachalam

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#### **West Coast :**

Madakkathara and Vengurla

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#### **Plains / others :**

Chintamani and Jagdalpur

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

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#### **SUMMARY :**

##### **Experimental Details:**

Design	:	RBD
Replications	:	Three
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
Puttur	:	VTH 107/3, VTH 40/1
Year of Planting	:	1992 (1993 at Bapatla, 2002 at Jhargram, 1994 at Vridhachalam)

##### **BAPATLA**

In the MLT-II trial, the entry T.No 3/33 (6.00m) followed by H-68(5.79m) recorded highest plant height and where as T.No 3/33 (118.33cm) followed by H-68 (114.15cm) recorded maximum stem girth (**Table 1.14** ).

**Table 1.14 : Performance of cashew varieties/genotypes in MLT II (MLT 92) at Bapatla**

Variety/ Genotype	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	
			E-W	N-S
Hy-3/28	5.20	97.15	9.07	9.26
T.No.3/33	6.00	118.33	11.83	12.07
T.No.10/19	5.42	98.00	9.25	10.22
T.No.30/1	4.90	74.00	8.22	8.20
H-68	5.79	114.15	11.79	10.29
H-367	4.93	99.13	9.69	8.98
H-303	4.72	102.90	9.91	10.13
H-255	4.90	96.25	7.67	7.75
H-320	5.63	111.20	12.74	11.35
M-44/3	4.35	85.36	7.28	7.23
M-15/4	4.23	83.33	6.6	6.87
T.No.107/3	4.60	104.52	7.85	7.33
T.No. 40/1	4.93	89.25	9.67	8.40

With regard to duration of flowering, the entry T.No 40/1 (95days) followed by M-44/3 (102 days) recorded lowest number of days. The M-107/3 (30) followed by T.No 40/1(24) recorded maximum number of flowering laterals per square meter. Mean number of nuts per panicle was highest in M-44/3 (7.11) followed by T.No. 3/33 (5.55) (Table 1.15 ).

**Table 1.15: Performance of cashew varieties/genotypes in MLT II (MLT 92) at Bapatla**

Variety/ Genotype	Duration of Flowering	Number of flowering laterals m <sup>-2</sup>	Number of nuts/ Panicle
Hy-3/28	105	13	4.20
T.No.3/33	109	19	5.55
T.No.10/19	107	18	5.35
T.No.30/1	103	13	5.15
H-68	112	15	2.05
H-367	132	19	3.90
H-303	121	18	3.33
H-255	109	17	3.25
H-320	122	16	5.25
M-44/3	102	20	7.11
M-15/4	157	20	4.85
T.No.107/3	135	30	4.25
T.No. 40/1	95	24	4.00



The maximum mean annual nut yield per tree was recorded in the T.No.10/19 (16.04kg) followed by M-44/3 (7.78kg). And the cumulative nut yield per tree was recorded highest in T.No.10/19 (94.73kg) followed by M-44/3 (73.65kg) in fifteen annual harvests and the highest nut weight recorded in the H-255 (8.09g) followed by H-320 (7.26g) during the period. Highest shelling percentage was recorded in T.No.10/19 (33.24%) followed by T.No.107/3 (31.15%). Apple weight was highest in H-320 [115g] followed by T.No.10/19 and H-255 [100g each] respectively (Table 1.16 ).

**Table 1.16: Performance of cashew varieties/genotypes in MLT II (MLT 92) at Bapatla**

Variety/ Genotype	Nut yield / tree (Harvest No.15) (kg)	Cum. nut yield/ Kg / tree (15 hvsts)	Nut weight [g]	Apple weight (g)	Shelling (%)
Hy-3/28	4.64	54.00	5.14	70	26.29
T.No.3/33	3.00	53.98	7.02	63	29.08
T.No.10/19	16.04	94.73	4.14	100	33.24
T.No.30/1	4.58	71.07	4.52	40	28.40
H-68	1.57	49.90	7.17	63	28.77
H-367	3.33	46.57	6.77	94	27.22
H-303	0.75	42.28	5.39	52	25.67
H-255	0.88	36.69	8.09	100	28.41
H-320	1.03	43.63	7.26	115	28.20
M-44/3	7.78	73.65	4.83	45	29.58
M-15/4	2.55	63.55	5.33	75	31.05
T.No.107/3	6.54	43.82	5.69	51	31.15
T.No. 40/1	5.28	51.40	5.74	38	25.94

### **BHUBANESWAR**

Maximum plant height was observed in H255 (6.5 m) followed by BPP 3/33 (6.2 m) and BPP 10/19 (6.1 m). Similarly H 255 recorded the maximum canopy spread (10.9 m in E-W), maximum number of total laterals / sq. m. (26) as well as flowering laterals / sq. m. (22) (Table 1.17 ).

**Table 1.17 : Vegetative & flowering characters of cashew types in MLT-II at Bhubaneswar**

Cashew types	Height of plant (m)	Girth of trunk (cm)	Canopy spread (m)		No. of flowering laterals/m <sup>2</sup>
			E-W	N-S	
NRCC Sel-1	5.0	68	9.5	8.3	18
NRCC Sel-2	5.5	99	10.0	9.1	19
M 44/3	4.0	53	5.6	6.0	19
M 15/4	4.8	93	8.3	8.5	16
BPP 3/33	6.2	113	9.4	8.4	22
BPP 10/19	6.1	101	9.7	10.9	14
BPP 30/1	5.4	99	9.7	9.0	16
BPP 3/28	5.9	104	10.6	9.7	16
H 303	5.1	94	8.3	8.9	17
H 320	5.3	95	10.0	9.0	20
H 255	6.5	129	10.9	10.6	22
H 367	4.7	93	9.0	8.7	20
H 68	4.8	93	10.0	9.3	18

Out of the 13 cashew types highest nut yield (kg/plant) was recorded in NRCC Selection-2 (9.4) followed by H 303 (8.7) and H 68 (7.3) with highest cumulative yield (kg/plant) at 13<sup>th</sup> harvest in H 303 (89.0) followed by NRC Selection-2 (80.9) and H 68 (77.5). These three types were also observed to be bold nut types having nut weight more than 8.0 g and shelling percentage ranging from 29.0 to 32.0 (Table 1.18).

**Table 1.18 : Yield and yield attributing characters of cashew types in MLT- II. at Bhubaneswar**

Cashew types	Yield	Cum. at 13 <sup>th</sup> harvest	Nut weight (g)	Apple weight (g)	Shelling %
NRCC Sel-1	4.1	34.9	8.4	63	31
NRCC Sel-2	9.4	80.9	9.1	70	32
M 44/3	3.2	32.6	5.2	28	29
M 15/4	2.8	30.8	7.7	68	28
BPP 3/33	3.5	52.5	7.3	58	33
BPP 10/19	3.0	38.5	6.6	57	29
BPP 30/1	3.5	64.0	6.7	43	26
BPP 3/28	3.3	49.1	8.5	59	29
H 303	8.7	89.0	8.4	52	29
H 320	3.2	76.1	8.7	73	29
H 255	1.1	37.6	10.1	76	33
H 367	3.6	60.6	10.2	110	27
H 68	7.3	77.5	8.7	68	30
SEM±	0.481				
CD (5 %)	1.403				

## CHINTAMANI

Significant variation in tree height was observed among the entries. The highest tree height was recorded in the entries NRCC-1 (6.16 m) and H-255 (6.16 m) followed by M -15/4 (5.98 m) and H – 320 (5.90 m). The lowest plant height was observed in M-44/3 (5.02 m). The trunk girth varied significantly among the entries during the year of reporting. The stem girth varied from 77.02 to 108.39 cm. Among the entries, the highest girth was recorded by NRCC-1 (108.39 cm) followed by Ullal-1 (104.06 cm) and the minimum girth was observed in NRCC-2 (77.02 cm). The canopy spread in E-W direction was non-significant, where as, in N-S direction it was significant. However, the highest E-W spread was noticed in NRCC-1 (10.21m) and N-S spread was noticed in H-255 (10.21 m). The lowest canopy spread in E-W and N-S directions was noticed in M-44/3 (8.49m & 8.22 m, respectively).

The highest number of flowering laterals/m<sup>2</sup> were observed in M-44/3 (17.04) followed by H-320 (15.44). The least flowering laterals were recorded by H-

367 (12.13). The H-320 recorded highest nut weight of 8.7g followed by H-68 and H-367 with nut weight of 8.6g each and lowest nut weight was obtained in TN-10/19 (5.1g) followed by M-44/3 (5.9g). The shelling percentage was highest in TN-10/19 (32.1%) followed by M-44/3 (31.9%) and H-320 (31%) and the least shelling percentage was observed in H-303 (27.7%). The nut yield per tree varied significantly.

Highest nut yield of 12.76 kg/tree was noticed in H-320 followed by NRCC -2 (10.82 kg/tree) and lowest was in H-68 (5.24 kg/tree) followed by TN-10/19 (5.26 kg/tree). Over a period of 15 harvests, H-320 recorded highest cumulative yield (131.85 kg/tree) followed by the entries NRCC-2 (116.94 kg/tree) and M-15/4 (100.46 kg/tree) (Table 1.19 & 1.20 ).

**Table 1.19 : Vegetative and yield attributing characters of cashew in MLT-II at Chintamani**

Cashew entries	Tree Height (m)	Trunk Girth (cm)	Canopy spread(m)		No. of flowering laterals/m <sup>2</sup>
			E-W	N-S	
H – 68	5.66	99.10	9.69	9.65	13.14
H – 367	5.24	90.98	9.12	8.91	12.13
H – 303	5.12	99.68	9.68	9.72	15.08
H – 255	6.16	102.10	9.73	10.21	13.44
H – 320	5.90	92.18	9.74	10.04	15.44
M -44/3	5.02	79.48	8.49	8.22	17.04
M -15/4	5.98	96.95	9.75	9.53	15.22
NRCC -1	6.16	108.39	10.21	10.19	13.31
NRCC -2	5.74	77.02	8.71	8.80	12.96
TN- 30/1	5.12	89.16	8.79	8.89	12.69
TN -3/33	5.76	97.15	9.68	9.35	14.27
TN -10/19	5.62	94.76	9.15	9.68	12.20
TN -3/28	5.52	97.00	9.65	9.99	13.85
Ullal – 1	5.72	104.06	9.52	9.41	14.01
S.Em ±	0.11	0.98	0.37	0.25	-
C.D @ 5%	0.33	2.85	NS	0.72	-

**Table 1.20: Yield and yield attributing characters of cashew entries in MLT-II at Chintamani.**

<b>Cashew entries</b>	<b>Nut Yield (Kg/Tree)</b>	<b>Cumulative yield (kg/tree) 15 hvts.</b>	<b>Nut weight (g)</b>	<b>Shelling (%)</b>	<b>Apple weight (g)</b>
H -68	5.24	46.84	8.6	30.9	85.00
H-367	6.86	77.46	8.6	30.7	95.00
H- 303	7.20	92.08	8.0	27.7	55.00
H- 255	6.36	80.22	8.2	29.5	50.00
H- 320	12.76	131.85	8.7	31.0	90.00
M- 44/3	10.62	99.96	5.9	31.9	40.00
M -15/4	10.40	100.46	7.5	29.5	55.00
NRCC -1	6.30	81.80	7.6	30.2	40.00
NRCC -2	10.82	116.94	7.8	30.2	55.00
TN -30/1	8.20	86.92	6.2	28.2	60.00
TN -3/33	5.65	69.17	8.4	30.1	75.00
TN -10/19	5.26	67.08	5.1	32.1	30.00
TN -3/28	8.40	86.85	7.1	30.6	70.00
Ullal – 1	9.36	82.80	7.0	30.8	35.00
S.Em ±	0.44	-	-	-	-
C.D @5%	1.27	-	-	-	-

## **JAGDALPUR**

Hybrid – 10/19 was found superior over all the varieties for plant height (3.42 m) and trunk girth (50.17 cm). VRI-1 had largest canopy coverage (E-W/N-S = 4.09/4.34m). The annual nut yield (4.63 Kg/tree) and cumulative nut yield for 7 harvests (15.18 Kg/tree) was highest for NRCC Sel-2 (15.19 kg). Nut weight was highest for H-68 (9.37 g) and apple weight was highest for H - 255 (65.07 g). Shelling per cent was recorded to be maximum in V-4 (31.2%) (Table 1.21 & 1.22).

**Table 1.21: Performance of different varieties at Jagdalpur under MLT-II**

Varieties/ Genotype	Plant height (cm)	Girth (cm)	Canopy Spread (cm)	
			E--W	N--S
3/28	287.39	46.61	376.58	379.94
3/33	249.92	36.39	330.42	334.83
30/1	211.17	28.28	250.08	248.44
10/19	342.92	50.17	404.50	410.58
VRI-1	277.17	47.08	409.25	434.83
VRI-2	306.86	44.92	376.17	381.69
H-68	331.78	44.94	395.75	436.47
H-255	297.19	38.39	304.61	326.03
H-367	156.67	23.28	174.50	190.78
H-320	265.39	43.53	341.56	409.75
H-303	245.42	40.97	356.17	367.14
NRCC Sel-1	284.25	41.17	352.67	374.83
NRCC Sel-2	227.08	28.33	299.08	298.75
V-4	322.42	43.42	403.42	413.17
SE(m)	150.83	19.16	46.39	49.62
CD 5%	53.95	9.11	94.73	101.33

**Table 1.22: Performance of different varieties at Jagdalpur under MLT- II**

Varieties/ Genotype	Nut yield (Kg/tree) Harvests no. 06	Cumulative Nut yield (No of harvests 07)	Nut weight (g)	Apple weight (g)	Shelling %
3/28	2.38	12.06	8.27	39.44	29.6
3/33	2.73	8.87	6.87	25.27	28.7
30/1	2.63	8.72	6.50	45.00	27.2
HY - 255	2.73	8.20	8.47	65.07	28.3
HY - 303	2.41	8.91	5.13	39.90	29.4
HY - 320	3.33	9.44	5.17	18.97	28.5
HY - 367	4.29	10.49	6.90	31.67	28.7
HY - 68	3.33	7.95	9.73	62.50	28.4
P 10/19	2.95	6.57	4.77	48.17	29.4
NRCC SEL - 1	2.27	9.16	5.23	33.37	28.6
NRCC SEL - 2	4.63	15.19	7.27	27.67	27.6
V - 4	4.33	10.07	6.80	45.00	31.2
VRI - 1	3.10	7.99	6.63	21.07	30.9
VRI - 2	4.42	12.76	6.77	27.50	29.7
SE(m)	<b>1.79</b>		<b>2.96</b>	<b>26</b>	
CD 5%	<b>0.74</b>		<b>3.17</b>	<b>7.26</b>	<b>0.054</b>

## JHARGRAM

All the varieties had a plant height ranging between 3.4 m to 4.9 m. The tallest plants were observed with the variety H –255 (4.9 m). Trunk girth was maximum in case of H –255 (65.7cm) followed by H –320 (64cm) and M- 15/4 (59.3 cm). Trunk height was maximum with H - 255 (1.3 m). The canopy spread was maximum in case of T.No. 10/19 (6.4 m) followed by H - 320. (6.3 m) and M- 15/4 (5.9 m).

Canopy area was highest with T.No. 10/19 (46.5 m<sup>2</sup>) followed by H-320 (45.0 m<sup>2</sup>), H-255 (44.2 m<sup>2</sup>) and M- 15/4 (40.5 m<sup>2</sup>). Precocious flowering was observed with H-367, H-255 and M-15/4. Late flowering varieties were NRCC Sel-2, M-44/3 & H-303 (10.02.09). Longest duration of flowering was noticed in case of H-367 (84 days) followed by H-255 (76 days) (Table 1. 23 ).

**Table 1.23: Growth parameters of different varieties under MLT – II at Jhargram**

Variety	Plant Height (m)	Trunk Girth (cm)	Canopy Spread (m)	Canopy area ( m <sup>2</sup> )	Duration ( Days)	Flowering/m <sup>2</sup>
T.No.30/1	4.2	54.3	5.3	35.8	62	16.8
T.No.3/33	4.4	51.7	5.0	32.9	68	15.8
T.No.10/19	4.4	58.7	6.4	46.5	68	12.9
T.No.3/28	4.1	56.3	5.5	35.9	59	6.8
H – 68	3.4	41.3	4.2	21.9	70	9.9
H – 367	3.9	43.0	5.1	30.8	84	14.3
H – 303	4.4	44.7	4.9	32.1	61	10.8
H – 255	4.9	65.7	5.7	44.2	76	15.3
H – 320	4.2	64.0	6.3	45.0	68	12.3
M – 44/3	3.8	44.7	5.2	30.6	64	15.3
M – 15/4	4.4	59.3	5.9	40.5	71	13.2
NRCC Sel- 1	3.8	40.3	3.6	18.3	69	4.0
NRCC Sel- 2	3.7	54.0	5.2	33.0	67	11.8
S. Em ( ± )	0.27	3.10	0.40	4.41	--	1.83
C.D. at 5%	0.56	6.4	0.82	9.10	--	3.76
CV	11.3	10.3	13.1	22.2	--	26.0

T.No. 30/1 had the highest numbers of flowering laterals per square meter (16.8) followed by T.No. 3/33 (15.8). Maximum number of nuts (26.92 /m<sup>2</sup>) was observed in case of H-255 followed by H- 303 (26.3), M-15/4 (25.4), T No. 3/33 (24.8) and M-44/3 (24.2). H-303 had maximum number of nuts per panicle (10.2). Nut weight was maximum with NRCC Sel-1 (8.2 g) followed by H-68 (8g) and H-255 (7.8 g). Most of the varieties had nut weight above 6g. H-255 was the highest yielder (10.4 Kg/tree) followed by H-303 (7.4 Kg/tree) and M-15/4 (7.2 Kg/tree). Cumulative yield of the varieties showed that after 4<sup>th</sup> harvest H-255 had maximum production over the years and the cumulative yield over 4 years reached an amount of 16.2 Kg/tree. All the varieties had good shelling percentage exceeding 28% (Table 1.24 ).

**Table 1.24 : Yield parameters of different varieties under MLT – II at Jhargram**

Sl. No	Variety	Nuts/ m <sup>2</sup>	Nut weight (g)	Apple Weight (g)	Yield (Kg/ tree)	Cumulative Yield (Kg/tree) 3 <sup>rd</sup> harvest	Shelling %
1	<b>T.No.30/1</b>	16.3	6.7	28.0	3.8	7.1	25.9
2	<b>T.No.3/33</b>	24.8	5.6	35.1	4.5	8.7	30.2
3	<b>T.No.10/19</b>	17.1	6.7	55.8	5.4	9.5	33.3
4	<b>T.No.3/28</b>	20.9	7.7	39.8	5.8	11.3	31.4
5	<b>H – 68</b>	19.8	8.0	55.0	3.5	5.7	31.8
6	<b>H – 367</b>	23.5	7.3	76.7	5.5	6.8	29.8
7	<b>H – 303</b>	26.3	6.6	60.3	7.4	12.9	29.7
8	<b>H – 255</b>	26.9	7.8	63.3	10.4	16.2	29.4
9	<b>H – 320</b>	19.4	7.4	61.0	6.2	8.6	27.9
10	<b>M – 44/3</b>	24.2	5.3	38.0	4.1	12.5	32.2
11	<b>M – 15/4</b>	25.4	5.9	53.7	7.2	11.8	30.1
12	<b>NRCC Sel-1</b>	10.7	8.2	68.3	1.1	3.5	29.1
13	<b>NRCC Sell-2</b>	23.5	6.4	56.4	4.9	10.2	30.2
	S. Em ( ± )	2.81	0.36	3.22	0.94	1.54	1.32
	C.D. at 5%	5.79	1.24	7.69	1.94	3.17	2.72
	CV %	22.7	9.1	12.2	30.2	27.7	7.6



## MADAKKATHARA

There was no significant difference among genotypes with respect to tree height and stem girth. Maximum height was recorded by T 107/3 (7.63 m) followed by HY- 320 (7.41 m). Variety T 107/3 recorded highest canopy spread (10.14 m) followed by T3/33 (9.82 m) which were however on par with each other and with other genotypes. The highest nut weight was recorded by variety H 1608 (10.06 g) followed by H 255 (9.94g). The significantly highest yield was recorded by H 303 (10.20 kg per tree per year) followed by H 320 (8.90 kg). The highest cumulative yield was recorded by H 303 (58.90 kg) followed by H 320 (51.37 kg) (Table 1.24 & 1.25).

**Table 1.24 : Vegetative characters of different varieties under MLT II at Madakkathara**

Source	Variety	Height (m)	Girth (cm)	Mean canopy spread (m)
Bapatla	T 30/1	6.51	104.78	8.65
	T 3/33	7.36	103.94	9.78
	T 10/19	6.75	96.67	8.31
	T 3/28	7.16	106.25	8.67
Vengurla	Hy 68	7.15	105.91	9.10
	Hy 367	6.00	82.91	8.57
	Hy 303	7.06	112.91	8.52
	Hy 255	7.16	118.33	9.44
	Hy 320	7.41	99.58	8.66
Vridhachalam	M 44/3	6.06	92.08	7.72
	M 15/4	6.35	104.66	8.96
NRCC, Puttur	T 107/3	7.63	130.83	10.16
	T 40/1	6.74	95.89	9.19
	Check (Dhana)	6.63	111.00	8.44
	<b>CD (0.05)</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

**Table 1.25 : Flowering characters of cashew types in MLT II at Madakkathara**

Variety	Duration of flowering	Flowering intensity/ m <sup>2</sup>	Nut Yield during 09-10 (kg/tree)	Cum. nut Yield (kg/tree)	Nut wt (g)	Shelling %
T30/1	140	4.91	3.00	24.15	8.00	24.50
T 3/33	148	6.16	3.50	22.49	6.58	22.90
T 10/19	155	6.00	2.90	16.25	6.95	23.67
T 3/28	133	6.52	4.20	32.96	7.58	24.50
Hy 68	153	6.45	3.15	23.64	8.76	26.30
Hy 367	137	4.42	4.10	26.22	8.46	24.10
Hy 303	155	6.83	10.20	58.90	8.48	21.30
Hy 255	117	5.50	3.10	22.88	9.94	22.40
Hy 320	153	5.00	8.90	51.37	9.68	22.87
M 44/3	151	5.00	4.70	31.24	8.89	23.40
M 15/4	143	3.84	4.10	39.08	7.57	24.20
T 107/3	151	4.33	2.80	23.70	9.35	24.30
T 40/1	153	3.92	3.85	29.05	9.15	24.70
Dhana (Local check)	126	4.50	7.25	45.27	10.06	23.16
CD (0.05)		NS	0.240		NS	

### VENGURLA

The varieties did not differ significantly for vegetative characters except mean lateral/m<sup>2</sup> and mean flowering panicles/m<sup>2</sup>. The maximum height and spread were reported in the variety 30/1 ( 6.7 m, and 9.4 m respectively) whereas, maximum girth was observed in T.No.107/3 (98.0 cm).

The yield of the varieties did not differ significantly. The nut weight and apple weight was maximum in Hy.No. 367 (10.2g and 96.7g respectively). The highest mean yield/tree (1.28 Kg/tree) was observed in Hy-303 and maximum cumulative yield for last seven harvests (19.61 Kg/tree) was found in the Variety Hy-303 followed by Hy-255 i.e. 16.70 Kg/tree (Table 1.26 ).

**Table 1.26 : Growth and yield observations under MLT-II at Vengurla**

Variety /type	Mean Height (m)	Mean Girth (cm)	Mean Spread (m)	Mean Flowering panicles /m <sup>2</sup>	Mean Flowering duration (Days)	Mean Fruit set /m <sup>2</sup>	Mean Yield (kg/ tree)	Cum. Yield kg/ tree (7 <sup>th</sup> harvest)	Mean Nut weight (g)	Mean Apple weight (g)	Mean Shelling (%)
Hy .No. 255	5.7	91.2	9.0	18.5	111.3	12.5	0.70	16.70	9.9	68.3	30.4
Hy. No. 303	4.5	73.0	7.4	19.7	116.1	36.7	1.28	19.61	9.9	76.7	29.5
Hy. No. 320	5.9	89.4	7.5	17.2	106.1	19.7	0.46	11.04	8.1	63.3	31.6
Hy.No.367	3.7	68.6	7.1	25.0	118.9	26.0	0.80	11.89	10.2	96.7	30.3
NRCC Sel.1	5.4	98.0	8.9	17.8	102.6	22.4	0.65	12.51	7.0	56.7	30.7
NRCC Sel.2	5.1	75.8	7.4	18.7	106.2	25.3	0.70	8.71	7.9	58.3	31.3
M-44/3	4.0	65.4	5.4	24.3	115.2	23.6	0.14	6.63	5.1	46.7	30.9
M-15/4	4.8	67.6	7.0	25.6	109.8	22.7	0.50	7.36	8.0	60.0	30.7
10/19	6.4	95.1	8.9	19.6	119.4	27.5	0.37	9.58	6.4	46.7	31.2
3/28	4.2	60.4	5.5	11.1	64.6	9.03	0.16	6.61	4.5	43.3	20.5
3/33	5.6	85.4	8.7	19.3	105.7	30.0	0.49	10.90	7.1	48.3	31.8
30/1	6.7	96.4	9.4	20.0	105.9	24.6	0.33	16.05	6.3	56.7	30.7
SEm ±	0.7	11.4	0.9	2.1	11.37	5.6	0.31	-	0.7	8.6	3.06
CD at 5%	N.S.	N.S.	N.S.	6.2	N.S.	N.S.	N.S.	-	2.2	25.2	N.S.

## VRIDHACHALAM

The maximum plant height was recorded by T 10/19 (5.22 m) and maximum stem girth was observed in M107/3 (68.42cm). A consistent higher annual nut yield was observed in M 44/3 and M 15/4 types of Vridhachalam. H 320 recorded the highest nut weight of 7.6 g. Highest shelling percentage of 28.4 was recorded in M 107/3 of NRCC, Puttur and H 367 of Vengurla (Table 1.27).

**Table 1.27 : Vegetative characters of cashew types in MLT II Vridhachalam**

Variety/Genotype	Plant Height (m)	Trunk Girth (cm)	Duration of flowering	Yield (Kg/tree)	Cum. Yield (Kg/tree) (12 harvests)	Nut weight (g)
<b>BAPATLA</b>						
T. 30/1	4.72	54.44	65	8.25	34.12	7.0
T. 3/33	3.96	50.46	64	7.65	32.67	7.2
T.10/19	5.22	62.24	62	7.02	32.44	7.0
T. 3/28	4.36	58.16	64	6.54	34.8	6.8
<b>VENGURLA</b>						
H 68	4.22	54.46	65	34.71	6.6	27.6
H 367	4.16	59.22	60	34.68	6.8	28.4
H 303	5.10	64.64	64	37.08	6.8	28.0
H 255	4.62	58.62	65	32.62	7.4	28.2
H 320	4.46	49.84	61	38.41	7.6	28.2
<b>VRIDDHACHALAM</b>						
M 44/3	4.68	52.46	65	41.46	5.8	28.0
M 15/4	4.88	66.24	64	39.82	6.6	28.2
<b>NRCC, PUTTUR</b>						
107/3	5.14	68.42	65	32.96	6.8	28.4
40/1	4.44	58.16	62	37.63	7.2	28.2
SEd	0.27	0.06				
CD 5%	0.79	0.13			0.46	NS

## 2. Multi Location Trial – III

### **Centres: East Coast**

Bapatla, Bhubaneswar and Vridhachalam

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### **West Coast**

Madakkathara and Vengurla

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### **Plains / others**

Chintamani

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

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### **SUMMARY :**

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### **Experimental Details :**

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

<b>Sponsoring centre</b>	<b>Promising hybrids</b>	<b>TMB tolerant type</b>
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
NRCC, 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, plant heights varied from 2.5 meters to the highest of 3.2 meters in genotypes Goa-11/6, H-32/4 and BPP-8. maximum stem girth and canopy spread was recorded with BPP-8 variety i.e. 58.4 cm, 6.4m [E-W] and 6.5m [N-S] respectively (Table 1.28 ).

**Table 1.28 : Performance of cashew varieties/genotypes in MLT III at Bapatla**

Variety/ Genotype	Plant height (m)	Trunk Girth (cm)	Canopy spread (m)	
			E-W	N-S
Goa 11/6	3.2	52.9	6.2	5.6
H 662	2.8	38.5	4.3	4.4
H 675	2.5	40.5	3.8	3.9
H 32/4	3.2	54.5	5.2	5.5
K 22-1	2.6	54.3	4.6	4.6
H 11	2.7	45.9	4.9	5.0
H 14	2.9	41.1	4.5	4.7
H 1597	3.1	54.2	4.6	4.7
BH 6	2.7	45.3	4.4	4.5
BH 85	2.7	44.9	4.6	4.8
BPP 8	3.2	58.4	6.4	6.5

Duration of flowering was found shortest in K-22-1 [85days] followed by H-675 [86 days]. Number of panicles produced per square meter and the number of fruits per panicle were found highest in BH - 85 [20 and 9.3 numbers] followed by H – 675 (Table 1.29 ).

**Table1.29 : Performance of cashew varieties/genotypes in MLT III at Bapatla**

Variety/ Genotype	Flowering Intensity / Sq mt	No of Fruits / panicle
Goa- 11/6	13.0	2.0
H -662	11.0	2.0
H -675	17.3	4.0
H 32/4	15.0	2.3
K -22-1	12.5	3.1
H -11	16.4	3.4
H -14	14.0	3.3
H -1597	9.35	1.4
BH -6	15.6	3.5
BH -85	20.0	9.3
BPP -8	6.10	2.1

Cumulative nut yield per tree and weight of nut was also found maximum with variety BPP-8 [6.5 kg/tree and 8.2 g respectively]. However, highest shelling percentage of 30% has been recorded with BH-85 variety which was closely followed by BH-6 with 29.8% (Table 1.30 )

**Table 1.30: Performance of cashew varieties/genotypes in MLT III at Bapatla**

Variety/ Genotype	Flower ing Intensi ty / Sq mt	No of Fruits / panicle	Nut yield / tree (Hvst No.3) (kg)	Cum. nut yield / tree (2 hvsts kg/tree )	Nut weight [g]	Apple weight (g)	Shellin g (%)
Goa-11/6	13.0	2.0	1.500	2.160	5.4	30	29.4
H -662	11.0	2.0	0.425	2.185	6.4	66	28.8
H -675	17.3	4.0	0.505	1.725	3.9	30	28.0
H -32/4	15.0	2.3	1.700	3.840	6.0	50	29.3
K -22-1	12.5	3.1	1.500	3.320	5.2	55	28.8
H -11	16.4	3.4	0.753	2.413	5.0	30	29.6
H -14	14.0	3.3	1.683	3.203	4.8	25	28.1
H -1597	9.35	1.4	0.500	3.160	5.5	75	27.0
BH- 6	15.6	3.5	0.767	0.767	6.4	75	29.8
BH -85	20.0	9.3	1.250	1.250	6.8	62	30.6
BPP- 8	6.10	2.1	1.900	6.520	8.2	68	28.7

## BHUBANESWAR

It was observed that maximum plant height of 4 m was recorded both in BH 6 and BH 85. Maximum canopy spread (E-W) of 5.8 m was recorded both in BH 85 and H 2/16. Similarly maximum spread in N-S direction was recorded in BH 6 (5.3) followed by H 2/16 (5.2 m) and in BH 85 (5.0 m). Highest no. of flowering laterals / sq. m. (18.0) was recorded in BH 85 (Table 1.31 ).

**Table 1.31 : Vegetative and flowering characters in MLT-III at Bhubaneswar.**

Cashew types	Height of plant (m)	Girth of trunk (cm)	Canopy spread (m)		No. of flowering laterals/m <sup>2</sup>
			E-W	N-S	
BH 6	4.0	46.0	5.1	5.3	13
BH 85	4.0	45.7	5.8	5.0	18
H 1597	3.9	49.3	4.9	4.9	11
K 22-1	3.2	37.7	4.0	4.0	17
H 662	1.6	16.0	1.6	1.7	7
H 675	3.4	38.3	3.5	4.0	17
H 11	3.7	44.0	5.2	4.9	15
H 14	2.9	36.7	3.6	4.2	17
H 32/4	3.9	51.7	4.9	4.9	8
Goa 11/6	3.6	46.7	4.8	4.5	14
H 2/16 (Local Check)	3.9	49.3	5.8	5.2	12
CD (0.05)	0.87	10.64	1.33	0.99	

Out of 11 cashew types along with the local check H 2/16, it was observed that the highest nut yield (kg/plant) was obtained in BH 85 (3.1) followed by BH 6 (2.6) and H 32/4 (2.6). The highest cumulative nut yield (kg/plant) was also observed in BH 6 (5.8) followed by BH 85 (5.6) and H 32/4 (5.2) at 3<sup>rd</sup> harvest. These 3 types had shelling percentage ranging from 30 to 34 % and were bold nut types with nut weight ranging from 7.9 g to 8.9 g (Table 1.32 ).



**Table 1.32: Yield and yield attributing characters of cashew types in MLT-III at Bhubaneswar.**

Cashew types	Yield	Cum. Nut yield (3hvsts)	No. of nuts / panicle	Nut weight (g)	Apple weight (g)	Shelling %
BH 6	2.6	5.8	4	8.9	09	34
BH 85	3.1	5.6	4	7.9	65	30
H 1597	1.2	3.6	2	8.5	72	31
K 22-1	0.5	2.9	2	6.4	58	29
H 662	0.4	2.9	3	5.5	47	31
H 675	0.7	2.1	3	4.3	28	31
H 11	1.4	4.3	3	6.2	29	30
H 14	1.2	2.3	3	5.5	55	31
H 32/4	2.6	5.2	4	8.1	34	30
Goa 11/6	2.1	3.9	4	7.5	67	33
H 2/16 (Local check)	0.9	3.8	3	8.4	48	29
SEM±	0.493					
CD (5%)	1.456					

### CHINTAMANI

The growth parameters and nut yield recorded significant variation among the entries. Significantly highest plant height was recorded by Bhaskara (4.51 m) followed by H-32/4 (4.43 m) and lowest plant height was recorded by H-14 (3.14 m) followed by H-675 (3.46 m). Significant variation in the trunk girth was observed among the entries. The highest trunk girth was recorded in H-32/4 (67.83 cm) followed by BH-6 (64.33 cm). The lowest trunk girth was observed by H-14 (44.19 cm). Canopy spread of plant significantly varied among entries. The highest E-W & N-S spread was recorded by H-32/4 (7.99 and 7.53 m. respectively). The lowest E-W and N-S spread was recorded by H-14(4.99 and 5.21 m. respectively).

The highest nut weight was recorded by H-1593 (8.8 g) followed by BH-6 (8.0 g) and lowest was recorded by H-675 (4.0 g.). The shelling percentage of entries ranged from 29.4 to 34.2 per cent. Significantly highest nut yield was recorded by H - 32/4 (5.95 kg/tree) followed by Bhaskara (5.88 kg/tree) and lowest nut yield was recorded by H - 14 (2.27

kg/tree). The cumulative yield of two years recorded highest by H-1593 (14.27 kg/plant) followed by Bhaskara (13.49 kg /plant) and lowest was in H-14 (7.04 kg/plant) (Table 1.33 ).

**Table 1.33 : Growth and yield performance of cashew entries – MLT - III at Chintamani**

Entries	Plant ht. (m)	Trunk girth (cm)	Canopy spread (m)		Nut yield (kg/tree)	Cu. yield (kg/tree) of 4 harvests	Nut Wt. (g)	Apple wt. (g)	Shelling (%)
			E-W	N-S					
BH – 6	3.82	64.33	7.03	6.68	3.92	10.79	8.0	49.1	33.2
BH – 85	4.06	59.25	6.15	6.37	4.15	10.79	7.2	51.2	32.9
H - 1593	3.88	62.08	6.78	6.91	5.78	14.27	8.8	67.8	30.2
H – 662	3.88	53.85	6.55	6.42	4.45	9.27	5.1	28.8	34.2
H – 675	3.46	51.83	6.26	5.75	3.67	8.25	4.0	32.4	34.2
H – 32/4	4.43	67.83	7.99	7.53	5.95	12.39	7.3	51.5	29.4
K - 22/1	4.14	58.17	6.49	6.13	3.41	9.45	5.7	43.0	31.0
H –11	4.08	62.20	7.20	6.74	3.22	9.25	6.2	30.1	32.3
H – 14	3.14	44.19	4.99	5.21	2.27	7.04	4.7	27.7	31.6
Bhaskara	4.51	63.19	6.83	7.02	5.88	13.49	7.9	53.2	30.5
Chintamani–1	3.92	58.64	6.78	6.41	4.92	11.49	7.2	34.0	30.5
S.Em ±	0.18	3.39	0.37	0.33	0.18	-	-	-	-
C.D at 5%	0.54	9.99	1.08	0.98	0.53	-	-	-	-

## MADAKKATHARA

Maximum height was recorded in H 662 (5.14 m) followed by BH 85 (5.04 m). Maximum girth in H-11 (68.75 cm) was followed by H - 662 (67.50 cm) while maximum canopy spread were shown by the genotype H - 14 (6.98 m) followed by H-11 (6.12 m).

H 1593 recorded maximum nut yield/ tree (4.60 kg) followed by variety Goa 11/6 (4.20 kg). The highest cumulative yield was recorded by genotypes H 1593 (12.07 kg) followed by Goa 11/6 (11.97 kg) (Table 1.34 and 1.35 ).

Table 1.34 : Morphological and yield characters of cashew genotypes under MLT III at Madakkathara

Variety	Height (m)	Girth (cm)	Canopy spread – EW (m)	Canopy spread – NS (m)	Flowering intensity (m <sup>2</sup> )
Dhana	4.75	64.41	5.85	6.01	6.34
H-11	4.68	68.75	5.97	6.28	7.00
H-32/4	4.66	63.75	5.56	5.38	5.67
H-1593	3.85	60.41	5.79	5.30	7.34
BH-6	3.87	60.84	5.60	5.84	5.67
H-662	5.14	67.50	6.02	5.85	6.67
H-675	4.63	65.97	5.45	5.25	5.67
BH-85	5.04	65.00	5.16	4.71	5.00
H-22-1	4.24	67.41	5.53	5.43	9.34
Goa 11/6	4.54	65.00	6.14	4.11	7.34
H-14	4.78	65.28	7.15	6.82	7.67

Table 1.35: Yield characters of cashew genotypes under MLT III at Madakkathara

Variety	Nut wt. (g)	Yield (kg/tree/year)	Cumulative yield (kg/tree)
Dhana	9.26	3.50	9.83
H-11	8.40	3.00	8.00
H-32/4	8.00	3.20	8.70
H-1593	9.50	4.60	12.07
BH-6	8.76	2.45	6.50
H-662	9.00	3.60	9.56
H-675	7.56	3.00	7.17
BH-85	9.09	3.55	8.73
H-22-1	6.90	2.90	7.68
Goa 11/6	9.23	4.20	11.97
H-14	6.90	3.70	9.77

## **VENGURLA**

Re-laying of the Expt. MLT – III with the grafts of the 11 varieties was done during December, 2008. The grafts are in initial stage of growth..

## **VRIDHACHALAM**

The trial has been relaid and the grafts of the identified varieties were planted during December 2008. The crop is in initial stages of growth.

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

#### **Centres : East Coast :**

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

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#### **West Coast :**

Madakkathara, Pilicode and Vengurla

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#### **Plains / others :**

Chintamani and Jagdalpur

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

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#### **Treatments :**

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

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

#### **BHUBANESWAR**

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

## CHINTAMANI

The growth parameters of varieties planted during June 2007 with a spacing of 8X8 m. recorded plant height ranging from 1.83 to 2.80 m and stem girth varied from 15.00 to 34.00 cm (Table 1.36 ).

**Table 1.36 : Growth Performance of released varieties under MLT-V at Chintamani.**

Varieties	Pl. ht (m)	Stem girth (cm)	Canopy spread (m)	
			E-W	N-S
BPP-4	2.10	26.50	3.00	2.60
BPP-6	2.10	27.00	2.60	3.30
BPP-8	2.15	25.60	2.40	2.35
Chintamani -1	2.30	27.70	2.33	2.27
Chintamani -2	2.10	28.00	1.70	1.70
Madakkathara-2	2.05	26.10	2.15	2.10
K-22-1	2.13	24.00	2.23	2.43
Dhana	2.60	29.00	3.50	4.50
Amrutha	2.45	27.00	2.45	3.00
Vengurla -1	2.25	31.50	3.10	2.80
Vengurla -4	2.03	26.67	2.47	2.47
NRCC-2	2.05	27.50	2.75	3.40
Ullal-1	2.23	26.00	3.13	3.73
Ullal-3	2.45	19.00	2.10	2.30
Ullal-4	2.60	30.00	3.35	4.00
UN-50	2.80	28.67	3.03	3.17
Bhaskara	1.90	15.00	1.70	1.10
H-2/16	2.50	34.00	3.10	2.90
NDR-2-1	1.83	17.67	1.40	1.37

## JHARGRAM

The plant height was maximum in case of Vengurla – 4 (4.8 m) followed by Kanaka (4.2 m). Maximum trunk girth was reported with Jhargram –1 (59 cm) followed by Dhana (57.5 cm) and BPP –4 (55 cm). The trunk height was found highest in case of NRCC Sel-1 (1.4 m) and Vengurla- 4 (1.3 m). The surface canopy area was maximum with the variety Dhana (38.9 m<sup>2</sup>) followed by Vengurla –4 (38.3 m<sup>2</sup>) and Jhargram-1 (36.8 m<sup>2</sup>) (Table 1.37 ).

**Table 1.37: Growth performance of cashew released varieties under MLT-V at Jhargram**

Varieties	Plant Height (cm)	Trunk Girth (cm)	Canopy spread (m)	Canopy area (m <sup>2</sup> )
BPP – 4	3.8	55.0	5.4	33.8
Ullal – 3	3.2	36.0	5.0	26.1
Vengurla – 6	2.4	40.0	3.1	11.7
Vengurla – 4	4.8	48.0	5.5	38.3
Vengurla –1	3.5	44.2	4.8	26.4
Jhargram – 1	3.7	59.0	5.6	36.8
Dhana	3.9	57.5	5.9	38.9
Kanaka	4.2	51.4	5.2	34.4
Madakkathara - 1	3.7	38.3	3.9	20.3
Bhubaneswar - 1	3.1	52.2	4.3	21.5
UN – 50	3.9	45.5	4.5	27.8
NRCC Sel-2	3.2	49.6	4.2	20.8
NRCC Sel-1	2.9	49.9	4.0	15.9
BPP - 8	3.9	49.4	5.1	29.3

Precocious bearers were BPP-8, Bhubaneswar-1, Vengurla-1, UN - 50 and Vengurla-4. The longest duration of flowering was reported in the variety Jhargram-1 (81 days), while the shortest duration with late flowering was observed in case of BPP-4 & Ullal-3. Highest number of

flowering per square meter was noticed with NRCC Sel-2 (18.0) followed by Dhana (14.5) and minimum numbers were reported from the variety UN-50 (4). Maximum nut per square meter was reported with Bhubaneswar – 1(38.8) followed by BPP –8 (38.0), Jhargram-1 (34.5) and BPP-4 (29.0). Nuts/panicle was also highest in case of the varieties Jhargram-1 (16.3) and Bhubaneswar-1 (14.8 nuts/panicle). NRCC Sel-1, BPP-8, Dhana and Ullal-3 had nut weight exceeding 7.0g. Yield was also found to be highest in BPP-8 (8.4 Kg/tree). Vengurla-6 had the highest shelling (37.4 %) followed by and Vengurla-1 (37.1 %) (Table 1.38 ).

**Table 1.38: Yield performance of cashew released varieties under MLT-V at Jhargram**

Varieties	Duration Of flowering	Flowering g /m <sup>2</sup>	Nuts / M <sup>2</sup>	Nuts/ Panicle	Nut weight (g)	Apple Weight (g)	Yield (Kg/tree) (2 <sup>nd</sup> . harvest)	Shellin g %
BPP – 4	54	6.5	29.0	14.0	4.8	43.5	4.8	33.1
Ullal – 3	57	11.8	17.3	8.5	7.1	46.0	3.2	32.2
Vengurla – 6	72	6.8	10.0	4.3	4.3	51.3	0.5	37.4
Vengurla – 4	65	9.8	6.3	3.0	6.5	45.0	1.6	35.4
Vengurla –1	70	6.3	25.8	13.3	4.9	53.3	4.8	37.1
Jhargram – 1	81	9.0	34.5	16.3	5.1	36.0	4.6	27.1
Dhana	78	14.5	11.3	3.0	8.6	50.0	3.5	30.1
Kanaka	63	13.8	16.5	3.3	5.9	62.5	3.8	28.5
Madakkathara - 1	58	9.5	26.8	10.3	5.8	48.0	5.4	30.6
Bhubaneswar - 1	67	7.8	38.8	14.8	4.3	30.0	3.4	28.4
UN – 50	71	4.0	6.03	10.0	3.8	42.0	0.6	22.0
NRCC Sel-2	71	18.0	19.3	4.3	6.7	56.0	2.2	33.0
NRCC Sel-1	67	9.0	9.5	1.8	7.9	69.0	0.9	25.2
BPP - 8	65	12.0	38.0	5.5	7.5	48.0	8.4	32.1



## MADAKKATHARA

Variety Ullal-IV recorded maximum height (3.09 m) followed by Madakkathara-II (2.95 m). Variety Madakkathara-1 recorded highest girth (27.60 cm). With respect to canopy spread (EW) the variety Amrutha recorded maximum spread (4.22 m) followed by Vridhachalam-3 (3.90 m). With respect to canopy spread (NS) the variety Amrutha recorded maximum spread (4.27 m) followed by Vridhachalam-3 (3.96 m) (Table 1.39).

**Table 1.39 : Morphological characters of cashew varieties under MLT-V at Madakkathara**

Variety	Height (m)	Girth (cm)	Canopy spread -EW (m)	Canopy spread -NS (m)
Goa -1	2.37	25.00	2.72	2.62
UN 50	2.69	26.60	2.66	2.72
Ullal-IV	3.09	26.00	3.32	3.18
Ullal III	2.45	21.60	3.38	3.26
Ullal-I	2.45	22.70	3.20	3.12
NRCC sel-2	2.05	22.00	2.84	2.86
V6	2.66	26.50	2.65	2.67
V4	2.62	23.25	2.15	3.25
V1	2.37	21.75	2.82	2.65
Jhargram	2.87	27.25	3.52	3.55
Chinthamani	2.68	21.25	3.20	3.07
BPP-4	2.56	26.50	2.95	2.92
Akshaya	2.41	25.00	3.20	3.30
Anagha	2.16	19.33	2.93	2.70
Damodar	2.15	22.20	2.28	2.54
Raghav	2.30	19.60	3.10	2.80
Dharasree	2.43	22.75	2.37	2.80
Sulabha	2.50	26.33	3.50	3.76
Anakkayam-1	2.31	21.75	3.00	3.20
Priyanka	2.68	25.75	3.55	3.40
Dhana	2.25	24.60	3.10	3.30
amrutha	2.87	26.25	4.22	4.27
Vridhachalam-3	2.32	26.00	3.90	3.96
K-22-1	2.29	26.20	3.44	3.68
Madakkathara-II	2.60	24.80	2.62	2.68
Kanaka	2.58	24.80	2.70	2.88
Madakkathara-1	2.95	27.60	2.98	3.32
Poornima	2.49	27.40	3.85	2.72

## PILICODE

The plant height, collar girth and north-south spread of plants differed significantly between varieties. Tallest plants were observed in variety NRCC Sel 2, Ullal 1, MDK 2, Bhaskara, Kanaka, V4, Priyanka, Dhana and K-22-1. Canopy spread, collar girth and canopy area were also highest in these varieties (Table 1.40 ).

**Table 1.40 : Biometric observations of Cashew varieties MLT V at Pilicode**

Accession No./ Variety	Plant Height (m)	Collar Girth (cm)	Canopy Spread (m)		Canopy area
			E-W	N-S	
NRCC Sel 2	2.206	17.240a	2.519	2.745	4.943
MDK 1	1.713	13.625	1.346	1.783	2.609
Goa 1	1.704	11.583	1.578	1.623	2.298
Ullal 1	2.747	18.388	1.804	2.021	4.098
MDK 2	2.603	19.210	1.887	2.192	4.651
Bhaskara	2.768	18.775	2.367	2.637	6.034
BPP 6	1.478	10.458	1.346	1.504	1.665
Kanaka	2.257	19.900	2.035	2.382	4.614
V4	2.400	16.750	2.800	3.160	5.418
Priyanka	2.192	14.583	1.867	1.695	2.901
Dhana	2.800	11.050	1.408	2.300	3.858
VRI 3	1.731	12.919	1.833	1.645	2.662
Amritha	1.653	12.900	1.357	1.795	2.639
Ullal 3	1.857	11.634	1.288	1.558	2.219
K-22-1	2.375	16.500	1.720	1.650	3.436
V7	1.400	9.200	0.865	0.850	0.924
Bhuvaneshwar 1	1.400	10.000	1.475	1.450	1.481
UN 50	1.968	17.345	2.104	2.175	3.331
BPP 8	1.285	9.325	0.952	0.700	0.725
<b>Mean</b>	<b>2.028</b>	<b>14.283</b>	<b>1.713</b>	<b>1.888</b>	<b>3.185</b>
<b>F Test</b>	<b>**</b>	<b>**</b>	<b>NS</b>	<b>**</b>	<b>**</b>
<b>CD @ 5%</b>	<b>0.655</b>	<b>4.560</b>	<b>-</b>	<b>0.896</b>	<b>1.998</b>

## VRIDHACHALAM

The planting of this trial with released varieties was undertaken during January 2008. There was no significant difference among the different varieties during early stage of growth (Table 1.41 ).

**Table 1.41: Performance of released varieties of Cashew at Vridhachalam**

Varieties	Plant Height (cm)	Stem Girth (cm)
BPP-4	39.22	8.42
BPP-6	31.28	8.10
BPP-8 ( H 2/16)	25.84	7.86
Bhubaneshwar-1	34.46	8.12
Chintamani-1	32.20	8.10
Madakkathara-2	28.72	7.92
K-22-1	45.64	9.14
Dhana	42.24	8.88
Kanaka	31.42	7.96
Priyanka	29.86	7.44
Amrutha	34.66	8.22
Vengurla-4	38.24	8.46
Vengurla-6	41.02	8.96
Vengurla-7	40.88	8.86
VRI-3	40.80	8.42
NRCC Sel-2	38.98	8.10
Ullal-1	36.64	7.98
Ullal-3	38.42	8.02
Ullal-4	34.44	7.88
Bhaskara	40.88	8.24
C.D.%	N.S.	N.S.

## Gen.4. Hybridization and Selection

### **Centres : East Coast :**

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

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### **West Coast :**

Madakkathara and Vengurla

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### **Plains / others :**

Chintamani and Jagdalpur

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

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## **SUMMARY:**

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### **BAPATLA**

Among the different hybrids of 1997 under evaluation the F1 seedlings planted during the year 1997, 21 trees succumbed either due to drought or due to CSRB attack during 2009-10 (Table 1.42 )

**Table 1.42: Performance of cashew hybrids at Bapatla (1997 planted )**

Hybrid No	Cross combination	Yield/ tree(kg) (8 <sup>th</sup> harvest)	Cum. nut yield 8 hvsts) (kg/tree)	Nut weight (g)
H-10	T 273 x T 71	6.000	26.03	6.00
H-14	T 228 x T2/22	9.000	23.3	6.50
H-36	F.No.3 x T30/1	14.500	39.3	8.50
H-49	BPP-8 x T 2/22	3.000	4.9	6.3
H-67	T 71 x T 273	12.000	27.25	5.85
H-69	T 71 x T 273	6.200	24.15	8.0
H-76	T 71 x T 273	9.190	23.44	5.75

## **BHUBANESWAR**

The performances of the promising hybrids planted in different years as reflected in table-10 revealed that, the hybrids planted in 1995, at 10<sup>th</sup> harvest recorded highest cumulative nut yield (kg/plant) in A6 (62.4) followed by A9 (37.7) and E1 (30.4). All are bold nut types nut weight ranging from 7.2g to 10.0g, no. of nuts/panicle 2-4, shelling percentage (%) 29 to of 34. The nut yield (kg/plant) during 2009 recorded in A6 (9.8) followed by A9 (8.5) and E1 (7.0).

Among the promising hybrids planted in the year 1997 at the 8th harvest highest cumulative nut yield (kg/plant) was recorded in A1-85 (58.7) followed by A1-16 (39.3) and A1-105 (39.0) and shelling percentage (%) of 32, 28 and 29 respectively. A1-16 recorded highest nut yield (kg/plant) of 10.0 during 2009.

B2-32 A2-13 was recorded one of the most promising hybrids planted during 1998 having, 9.6g nut weight, 30 % shelling percentage with nut yield (kg/plant) as well as highest cumulative nut yield (20.4 kg/plant) at 7th harvest 20.4.

Amongst the hybrids planted in 1999 highest nut yield (8.6 kg/plant) during 2009, cumulative nut yield (25.5 kg/plant) at 6th harvest and nut weight (10.0 g) were observed in D3-11 followed by D3-18 which had nut yield of 6.2 kg/plant. Cumulative nut yield of 18.1 kg/plant and nut weight of 9.5 g. The shelling percentage observed in both the hybrids was 29.32 respectively.

The hybrid F4-24 planted during 2000 recorded a highest cumulative nut yield (16.7 kg/plant) at 5th harvest and nut yield (7.0 kg/plant) during 2009. The nut weight (8.2 g) and shelling percentage (28.0 %) was recorded in this hybrid.

Out of the hybrids planted during 2001, promising results for cumulative nut yield (kg/plant) at 4th harvest and shelling percentage (%) were recorded in J5-13 (10.7, 32 respectively) and L5-27 (10.1, 30 respectively).

Among the 2002-year planted hybrid plants; A6-71, B6-35, C 6-30, C6-41, C6-43 and S6-5 hybrids were recorded to be bold nut types (nut weight of 8.0 to 10.0g) and had high shelling percentage (31 to 37%) (Table 1.43 ).

**Table 1.43 : Yield and yield attributing traits of cashew hybrids during 2009 at Bhubaneswar.**

Year of planting	Hybrid no.	Cross Combinations	No. of fruits / panicle	Nut weight (g)	Shelling %	Nut Yield (kg / plant)	Cum. nut yield (kg / plant)
1995							
	A6	Bhubaneswar C-2 x VTH 711/4	4	10.0	29	9.8	62.4
	A9	Bhubaneswar C-2 x VTH 711/4	3	8.0	34	8.5	37.7
	E1	Bhubaneswar C2 x Kankady	2	7.2	31	7.0	30.4
1997							
	A1-16	Bhubaneswar-1 x H2/16	4	7.0	28	10.0	39.3
	A1-85	Bhubaneswar-1 x H2/16	4	7.8	32	9.0	58.7
	A1-105	Bhubaneswar-1 x H2/16	4	8.2	29	3.0	39.0
1998							
	A2-13	M 44/3 x H 2/16	4	9.6	30	8.0	20.4
	A2-22	M 44/3 x H 2/16	3	9.1	31	3.0	18.5
	B2-32	H 2/16 x M 44/3	2	8.4	30	3.0	17.2
1999							
	D3-11	M 44/3 x H 2/15	4	10.0	29	8.6	25.5
	D3-18	M 44/3 x H 2/15	3	9.5	32	6.2	18.1
	F3-13	H 2/16 x M 44/3	3	11.0	29	5.5	14.7
2000							
	F4-18	M 44/3 x H 2/15	3	8.2	32	5.5	12.5
	F4-24	M 44/3 x H 2/15	5	8.2	28	7.0	16.7
2001							<b>4<sup>th</sup> harvest</b>
	J5-13	Bhubaneswar-1 x VTH 711/4	3	7.6	32	3.2	10.7
	L5-27	M 44/3 x VTH 711/4	4	7.4	30	3.8	10.1
2002							<b>3<sup>rd</sup> harvest</b>
	A6-71	RP1 x Kalyanpur Bold nut	3	8.0	34	2.5	6.8
	B6-35	RP1 x VTH711/4	2	9.2	37	1.5	5.4
	C6-30	RP2 x Kankady	3	9.0	33	2.5	6.3
	C6-41	RP2 x Kankady	3	10.0	33	2.5	6.2
	C6-43	RP2 x Kankady	3	9.5	31	2.5	6.2
	S6-5	Lokipur x Kankady	2	10.0	31	2.5	6.0

## CHINTAMANI

During 2009-10, five selected female and two selected male parents were used for crossing. In these cross combinations 107 nuts were obtained and out of these 72 F<sub>1</sub> seedlings have been raised and these will be planted in the main field for evaluation. The female parents used for crossing were K-5B, Vengurla-4, 6/21-Moodabidri, CKD-1 and 5/37-Manjeri. The male parents used were 4/9-Dicherla and 8/7-Sompet.

The hybrids planted during 2001-02 viz. H-01 (Ullal-3 x Kankady), H-81 (Ullal-3 x Vetore-56), H-151(NRCC-2 x Vetore-56), H-188 (V-5 x Vetore-56), H-191 (Ullal-3 x Vetore-56) and H-216 (2/77- Tuni x Vetore-56) recorded an yield of 3.80, 3.92, 0.45, 3.75, 4.00 and 4.24 kg/tree respectively during the fourth year of harvest and the highest cumulative yield for four harvests was recorded in H-216 (8.23 kg/plant). The average nut weight was 7.50, 9.40, 9.40, 9.58, 9.54 and 10.29 g respectively for the above hybrids which recorded shelling percent of 32.6, 31.5, 31.2, 31.0, 30.2 and 30.1 respectively ([Table 1.44](#) ).

**Table 1.44: Performance of selected F<sub>1</sub> Hybrids planted at Chintamani.**

Hybrid No. & Cross combination	Year of planting	Plant ht. (m)	Stem girth (cm)	Canopy spread (m)		Yield (kg/tree)	Cum. Yield (Kg/tree) of 4 hvts	Nut wt. (g)	Shelling (%)	Apple Wt. (g)
				E-W	N-S					
H-01 (Ullal-3 x Kankady 7/6)	2001	5.3	50	6.4	6.2	3.80	3.80 (1 hvt.)	7.50	32.6	48.8
H-81 (Ullal-3 x Vetore-56)	2002	6.2	49	8.9	7.0	3.92	3.92 (1 hvt.)	9.40	31.5	37.6
H-151 (NRCC-2 x Vetore-56)	2002	2.8	26	2.2	2.1	0.45	1.74	9.40	31.2	40.2
H-188 (V-5 x Vetore-56)	2002	4.5	56	6.0	5.3	3.75	7.93	9.58	31.0	38.4
H-191 (Ullal-3 x Vetore-56)	2002	4.0	53	6.3	5.6	4.00	7.78	9.54	30.2	55.9
H-216 (2/77-Tuni x Vetore-56)	2002	5.0	70	7.2	5.9	4.24	8.23	10.29	30.1	43.8

## **JHARGRAM**

The plant height ranged between 3.4 – 4.6. H-41 had maximum trunk girth (72 cm) and canopy spread was maximum with H-35(7.0m) followed by H-41 (6.7m). The canopy area was maximum with H-41 (55.5 m<sup>2</sup>) followed by H – 35 (54.8 m<sup>2</sup>) (Table 1.45).



**Table 1.45: Growth performance of promising cashew hybrids at Jhargram**

Year of planting / Cross Combination	Hybrid No.	Year of planting	Plant height (m)	Canopy spread (m)	Duration of flowering
BLA – 39-4 x WBDC – V	H –1	2002	3.9	4.6	65
KC-1 X BLA – 39-4	H –6	2002	4.1	5.0	62
KC-1 X BLA – 39-4	H –12	2002	3.9	4.4	72
KC-1 X BLA – 39-4	H – 20	2002	4.6	5.2	68
KC-1 X BLA – 39-4	H- 25	2002	3.5	3.7	60
Local X 2/9 Dicherla	H –28	2002	4.0	6.5	60
Local X 2/9 Dicherla	H –33	2002	4.5	5.5	63
Local X 2/9 Dicherla	H –35	2002	4.6	7.0	68
Local X 2/9 Dicherla	H - 36	2003	4.4	6.0	70
Local X 2/9 Dicherla	H - 41	2002	4.5	6.7	59
BLA 39-4 x DC – 8	H –59	2002	4.5	5.9	63
WBDC – V x Red Hazari	H –69	2002	4.4	6.3	56
BLA – 39 – 4 X BPP- 8	H - 75	2003	3.6	4.9	66
BPP – 8 X BLA – 39-4	H - 72	2003	4.2	5.4	58
BLA – 39-4X Red Hazari	H- 80	2003	4.2	3.6	57
H – 2/15 X Red Hazari	H - 117	2004	3.6	4.3	61
JGM- 34/3 X Yellow Hazari	H- 165	2005	3.4	2.5	66

The precocious hybrids were H – 12, H- 33, H- 59, H- 117, and H- 165. The hybrids H-12 & H-35 had longer flowering duration while H-69 & H- 80 had short duration of flowering.

Maximum number of nuts /panicle was noticed with H – 1, H- 25, H- 35 and H- 36 which had more than 10 nuts/panicle. H- 35 had the maximum number of nuts /square meter (63.5) followed by H- 1 (58.5) and H- 25 (56.3). The annual nut yield was maximum in H-35 (18.8 kg/tree) followed by H- 41 (13.9 Kg/tree) and H- 33 (12.2 kg/tree) (Table 1.46 ).

**Table 1.46 : Yield performance of promising cashew hybrids at Jhargram**

Hybrid No.	Year of planting	Nut weight (g)	Nuts /panicle	Nuts/m <sup>2</sup>	Yield Kg/tree	Shelling %
H -1	2002	5.5	15.0	58.5	10.2	31.9
H -6	2002	6.3	4.0	21.5	4.9	30.9
H -12	2002	5.7	6.0	27.0	3.9	31.5
H - 20	2002	5.6	8.0	42.0	8.9	29.2
H- 25	2002	5.4	10.8	56.3	5.9	30.9
H -28	2002	5.3	8.3	37.5	9.7	31.6
H -33	2002	6.7	8.8	42.0	12.2	34.8
H -35	2002	5.4	7.8	46.0	18.8	30.9
H - 36	2003	5.2	10.0	63.5	11.5	35.5
H - 41	2002	6.0	10.0	52.0	13.9	34.0
H -59	2002	6.1	3.5	28.0	7.3	32.3
H -69	2002	6.2	5.0	27.5	8.7	30.2
H - 72	2003	6.4	5.3	19.0	4.4	30.0
H - 75	2003	8.4	1.5	7.8	2.0	27.1
H- 80	2003	6.7	5.8	24.3	3.7	28.5
H - 117	2004	7.1	6.5	44.5	8.0	28.2
H- 165	2005	5.8	6.5	19.0	1.2	30.4

## **MADAKKATHARA**

### **1993 hybrids**

Out of the 56 hybrids planted in 1993, the highest yield was recorded by H 36 (10.00 kg/tree) followed by H 44 (6.45 kg/tree). Highest cumulative yield was recorded by H 21 (143.92 kg) and H 24 (136.14 kg) (Table 1.47).

**Table 1.47 : Performance of selected F1 hybrids planted during 1993 at Madakkathara (2009-10)**

Hy. No.	Cross combinations	Annual yield (kg/tree)	Cum yield (kg/tree)	Apple wt. (g)	Nut wt. (g)	Shelling %
	<b>1993</b>					
21	BLA -39-4 X P-3-2	4.00	143.92 (12)	35	10.00	27.40
24	BLA -39-4 X P-3-2	2.00	136.14 (12)	38	7.50	24.75
35	V-5 X H-1591	2.00	106.60 (12)	47	10.00	26.38
36	V-5 X H-1591	10.00	101.28 (13)	40	9.18	25.30

Note : Values in parenthesis are number of harvests

### 1994 hybrids

Out of 26 hybrids planted in 1994, highest annual yield/ tree were given by H 74 (3.15 kg/tree). The highest cumulative yield/tree were given by H 74 (77.25 kg/tree) followed by H 73 (74.90 kg/tree) (Table 1.48 )

**Table1.48 : Performance of selected F1 hybrids planted during 1994 at Madakkathara**

Hy. No.	Cross combinations	Annual yield (kg/tree)	Cum yield (kg/tree)	Apple wt. (g)	Nut wt. (g)	Shelling %
69	BLA -39-4 X P-3-2	1.00	56.20 (11)	38	9.90	29.70
70	BLA -39-4 X P-3-2	1.50	58.70 (11)	60	9.60	27.20
71	BLA -39-4 X P-3-2	0.00	63.25 (12)	63	10.00	21.99
72	BLA -39-4 X P-3-2	0.00	59.25 (11)	66	7.35	26.50
73	BLA -39-4 X P-3-2	2.00	74.90 (11)	32	7.98	24.30
74	BLA -39-4 X P-3-2	3.15	77.25 (12)	50	8.00	29.68

Note : Values in parenthesis are number of harvests

### 1995 hybrids

Out of the 92 hybrids planted during 1995, H 87 recorded the highest yield (7.00 kg/ha). The highest cumulative yield/tree was recorded by H 87 (69.26 kg/tree) followed by H 97 (53.73 kg/tree).

The hybrids H-111 to H-176 were planted at a closer spacing of 4 m x 4 m and hence thinning of weak trees was done to give space for vigorous ones. Even then most of the trees gave negligible yield (Table 1.49)

**Table 1. 49 : Performance of selected F1 hybrids planted during 1995 at Madakkathara**

Hy. No.	Cross combinations	Annual yield (kg/tree)	Cum yield (kg/tree)	Apple wt. (g)	Nut wt. (g)	Shelling %
95	BLA -39-4 X P-3-5	0.50	40.75 (12)	85	9.00	27.21
97	BLA -39-4 X P-3-7	2.00	53.73 (11)	73	9.90	25.50
98	BLA -39-4 X P-3-8	0.00	50.27 (11)	60	10.00	25.40

Note : Values in parenthesis are number of harvests

### 2001 hybrids

The highest annual yield was recorded by hybrid No. 1 (3.70 kg/tree) followed by hybrid 13 (2.70 kg/tree).

### 2002 hybrids

The highest annual yield was recorded by Hybrid No. 30 (2.50 kg/tree) followed by Hybrid No. 10 (2.10 kg/tree).

## Hybridisation during 2008-09

A total of 240 pollinations were done during 2009-10 with 6.66 percentage of nut set (Table 1.50 ).

**Table 1.50 : Details of crossing programme during 2009-2010 at Madakkathara**

Cross Combinations	No. of pollinations	No. of nuts set	No. of nuts harvested	% of nut harvested
Poornima x Dhana	80	30	6	7.50
Priyanka x Poornima	85	26	6	7.05
Dhana x Sulabha	75	25	4	5.33
Total	240	81	16	6.66

## PILICODE

Among the characteristics recorded the plant height, trunk girth, tree spread, number of panicles/sqm and number non-flowering laterals found to vary significantly among the hybrids as well as parents and PLD 57 graft. The hybrids from the cross MDK1 X PLD-57 was found to be taller than both the parents (Table 1.51 ).

**Table 1.51: Mean of growth characteristics of different crosses involving PLD-57**

Hybrid	Height (m)	Girth (cm)	Tree spread(m)		No. of Panicle /sqm	Number of branches not flowered	Male : Bisexual flowers ratio
			N-S	E-W			
PLD 57 graft	2.571 <sup>e</sup>	38.114 <sup>c</sup>	3.545 <sup>d</sup>	3.414 <sup>d</sup>	20.03 <sup>a</sup>	17.25 <sup>d</sup>	2.53 <sup>b</sup>
PLD 57 (OP)	1.006 <sup>f</sup>	22.800 <sup>d</sup>	2.433 <sup>e</sup>	2.500 <sup>e</sup>	6.81 <sup>e</sup>	22.94 <sup>f</sup>	2.32 <sup>bcd</sup>
PLD 57 X ANK-1	4.250 <sup>b</sup>	55.000 <sup>b</sup>	4.100 <sup>c</sup>	5.650 <sup>a</sup>	16.50 <sup>b</sup>	14.75 <sup>c</sup>	2.23 <sup>cd</sup>
ANK-1 X PLD 57	4.100 <sup>c</sup>	54.200 <sup>b</sup>	4.500 <sup>b</sup>	4.150 <sup>c</sup>	3.50 <sup>f</sup>	6.25 <sup>a</sup>	3.00 <sup>a</sup>
MDK-1 X PLD57	4.425 <sup>a</sup>	58.450 <sup>a</sup>	4.675 <sup>b</sup>	5.425 <sup>a</sup>	9.85 <sup>c</sup>	14.68 <sup>c</sup>	2.13 <sup>d</sup>
MDK-1	4.000 <sup>d</sup>	37.000 <sup>c</sup>	5.500 <sup>a</sup>	4.600 <sup>b</sup>	8.00 <sup>d</sup>	12.25 <sup>b</sup>	1.62 <sup>e</sup>
<b>Mean</b>	<b>3.392</b>	<b>44.261</b>	<b>4.126</b>	<b>4.290</b>	<b>10.77</b>	<b>14.69</b>	<b>2.30</b>
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>CD 0.05</b>	<b>0.146</b>	<b>1.461</b>	<b>0.264</b>	<b>0.319</b>	<b>0.412</b>	<b>0.848</b>	<b>0.221</b>

## VENGURLA

. On the basis of standard criteria viz.; compact canopy, cluster bearing habit, nut weight (more than 8 g), shelling percentage (more than 28%) and high yield, 16 F<sub>1</sub> hybrid seedlings during the year 2009-10 screened initially as promising hybrids. Hybrid No. 777 (M-44/3 x B.T.22) recorded highest yield i.e. 3.85 kg/plant followed by the hybrid No. 1306 (Hy.2/16 x V-4) i.e. 3.41 kg/plant and hybrid No. 1187(M-26/2 x B.T.1) 3.34 kg/plant (Table 1.52 ).

**Table 1.52 : Growth and Yield Performance of New promising hybrids at Vengurle**

Hybrid No.	Year of planting	Cross combination	Plant Height (m)	Mean Spread (m)	Flowering panicles/ m <sup>2</sup>	Fruit set %	Av. Nut wt. (g)	Yield (kg/tree)
777	2001	M-44/3 X B.T.22	6.70	6.35	21.0	34.0	9.3	3.850
778	2001	M-44/3 X B.T.22	7.20	7.85	23.0	40.0	8.8	1.280
788	2001	M-44/3 X B.T.22	6.10	4.70	19.0	28.0	9.7	0.280
1167	2001	M-26/2 X B.T.1	6.05	4.30	13.0	20.0	10.03	0.735
1187	2001	M-26/2 X B.T.1	6.10	5.75	14.0	28.0	9.8	3.345
1298	2001	Hy.2/16 X V-4	5.70	6.35	16.0	29.0	9.6	2.490
1306	2001	Hy.2/16 X V-4	5.40	7.27	26.0	40.0	10.8	3.410
3043	2004	Jawahar-1 X Kolgaon	5.10	4.40	6.0	20.0	15.0	0.085
3062	2004	C.Y.T.176X B.T.65	4.60	4.70	22.0	38.0	10.3	0.310
3085	2004	Hy.320 X B.T.1	6.20	4.60	25.0	23.0	15.6	0.470
3096	2004	Hy.320 X B.T.65	4.50	4.20	23.0	16.0	12.2	0.590
3139	2004	A. Microcarpum X V-7	3.70	4.60	6.0	8.0	10.8	0.180
735	1999	V-2 X B.T. 65	8.10	7.25	16.0	8.0	12.0	0.350
969	2001	V-4 X Hy.2/16	7.90	6.40	22.0	6.0	12.0	0.180
970	2001	V-4 X Hy.2/16	7.20	5.05	21.0	10.0	9.1	0.550
1010	2001	M-26/2 X B.T.65	7.20	6.65	21.0	8.0	9.3	0.220

In all, 382 hermaphrodite flowers were crossed and from these the percent fruit set was 52.20 per cent.. and the fruit retention was 52.60 per cent.

## VRIDHACHALAM

Totally, 10 trees of the F1 hybrid of the cross combination M 33/3 X ME 3/2 are planted during 1995. Out of which three trees have exhibited dwarfness/compactness and named as C, C1 and C2 which were compact, 5 m tall, and had intensive branching pattern. Canopy spread was also very less i.e., 3.4 m E-W and 2.8 m N-S. However, the fruit set was very poor (Table 1.53 ).

**Table 1.53 : Performance of the compact/dwarf cashew F1 hybrids under evaluation (Mean of 3 years) at Vridhachalam**

Characteristics	Hybrid C	Hybrid C1	Hybrid C2
Age of the tree	15 years	15 years	15 years
Plant height	5.0	7.20	7.00
Branching pattern	Intensive	Intensive	Intensive
Canopy height	3.80	4.40	4.5
Canopy spread (E-W)	3.4	4.8	4.2
(N-S)	2.8	4.1	3.8
Trunk Height	1.0	1.45	1.40
Trunk Girth	32	60	58.5
No. of flower clusters/m <sup>2</sup>	15	27	25
No. of bisexual flowers/cluster	2	4	5
No.of male flowers /cluster	8	9	8
No. of nuts /m <sup>2</sup>	10	20	22

x

Hy.2/16

combinati



## **II. CROP MANAGEMENT**

## II. CROP MANAGEMENT

### Agr.1: NPK Fertilizer Experiment

#### **Centres : East Coast :**

Bapatla, Jhargram and Vridhachalam

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#### **West Coast :**

Madakkathara

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#### **Plains / others :**

Chintamani

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

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### SUMMARY:

#### **Experimental Details :**

Design : Three factorial confounded design with 27 treatment combinations

Replications : Two

Treatments : N = 0, 500 and 1000 g/plant  
P = 0, 125 and 250 g/plant  
K = 0, 125 and 250 g/plant

No. of plants per plot : Six

#### **BAPATLA**

During the year 2009-10 the N<sub>2</sub> level gave significantly higher yield of 1.87 kg per tree over N<sub>0</sub> level (1.18 kg per tree). P and K levels were found non significant. Cumulative nut yield differed significantly for nitrogen, phosphorus and potash and NP, PK, NK and NPK interactions. Highest cumulative nut yield of 58.77 kg/tree was registered with N<sub>2</sub> level and lowest was with N<sub>0</sub> level (38.41 kg/tree). (Table 2.1 and 2.2).

**Table 2.1: Annual Nut Yield (kg/tree) in response to N, P and K interaction at Bapatla**

	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	Mean	K <sub>0</sub>	K <sub>1</sub>	K <sub>2</sub>
N <sub>0</sub>	1.32	1.12	1.11	1.18 b	0.94	0.97	1.65
N <sub>1</sub>	1.92	1.66	1.63	1.73 a	2.24	1.30	1.67
N <sub>2</sub>	1.77	1.94	1.89	1.87 a	1.75	2.03	1.83
Mean	1.67	1.57	1.55		1.64	1.43	1.71
K <sub>0</sub>	1.76	1.60	1.58				
K <sub>1</sub>	1.17	1.59	1.53				
K <sub>2</sub>	2.08	1.53	1.53				

  

F-Test	N	P	K	NP	NK	PK
Significance	*	NS	NS	NS	NS	NS
CD 5%	0.509					

**Table 2.2 : Cumulative nut yield (kg/tree) in response to N, P and K interaction at Bapatla**

	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	Mean	K <sub>0</sub>	K <sub>1</sub>	K <sub>2</sub>
N <sub>0</sub>	38.73 g	36.30 h	40.19 f	38.41 c	37.88 f	37.70 f	39.63 e
N <sub>1</sub>	57.17 c	51.85 d	57.90 c	55.64 b	53.30 c	57.15 b	56.17 b
N <sub>2</sub>	49.38 e	61.34 b	65.60 a	58.77 a	51.85 d	67.43 a	57.04 b
Mean	48.43 c	49.83 b	54.57 a		47.77 c	54.10 a	50.95 b
K <sub>0</sub>	46.91 e	45.30 f	51.12 b				
K <sub>1</sub>	49.87c	56.20 a	56.22 a				
K <sub>2</sub>	48.50 d	47.99 de	56.35 a				

  

F-Test	N	P	K	NP	NK	PK
Significance	*	*	*	*	*	*
CD 5%	0.752			1.303		

For the first order interaction the cumulative nut yield per tree was highest in the treatment N<sub>2</sub>K<sub>1</sub> (67.43 kg per tree) followed by N<sub>2</sub>P<sub>2</sub> (65.60 kg per tree) and lowest in N<sub>0</sub>P<sub>1</sub> (36.30 kg/tree).

No significant differences were observed for vegetative parameters and nut yield in response to N, P and K interaction. Significantly highest cumulative nut yield was recorded in the treatment N<sub>2</sub>P<sub>1</sub>K<sub>1</sub> (78.39 kg/tree) followed by N<sub>2</sub>P<sub>2</sub>K<sub>1</sub> (73.41 kg/tree).

**BHUBANESWAR**

No significant variation occurred in vegetative characters like plant height, trunk girth and plant spread in both the directions due to different doses of fertilizer during 2009 – 10. However, M<sub>2</sub> i.e. manure dose of N<sub>150</sub>P<sub>50</sub>K<sub>50</sub> kg / ha recorded maximum plant height (4.99 m), trunk girth (69.19 cm), and plant spread (6.36 m) in N-S direction. But M<sub>3</sub> i.e. N<sub>225</sub>P<sub>75</sub>K<sub>75</sub> kg / ha recorded maximum plant spread (5.09 m) in E-W direction. The spread of plant was more in N-S direction as compared to E-W. (Table 2.3 )

**Table 2.3 : Effect of fertilizer and spacing on vegetative character (2008-09) at Bhubaneswar**

**a). Effect of spacing (Main plot)**

Treatment	Plant Height (m)	Girth (cm)	Spread (m)	
			E-W	N-S
S <sub>1</sub>	5.78	73.81	7.40	9.90
S <sub>2</sub>	4.79	65.99	4.26	5.20
S <sub>3</sub>	4.26	63.83	3.33	3.57
F 'test'	S	S	S	S
SE (m) ±	0.32	1.28	0.33	0.48
CD 5%	1.12	4.44	1.14	1.67

**b) Effect of doses of fertilizer (sub plot)**

Treatment	Plant Height (m)	Girth (cm)	Spread (m)	
			E-W	N-S
M <sub>1</sub>	4.97	67.87	4.98	6.20
M <sub>2</sub>	4.99	69.19	4.91	6.36
M <sub>3</sub>	4.87	66.57	5.09	6.11
F 'test'	NS	NS	NS	NS
SE (m) ±	0.06	0.88	0.10	0.07
CD5%				

No significant variation was observed in plant height, trunk girth and spread of the plant in E-W direction due to interaction effect of spacing and doses of fertilizer. But significant variation in plant spread in N-S direction was observed in S<sub>1</sub>M<sub>2</sub> (10.33 m) due to interaction effect of spacing and doses of fertilizer. Maximum plant height was recorded in S<sub>1</sub>M<sub>1</sub> (5.95 m) and minimum in S<sub>3</sub>M<sub>1</sub> (4.15 m). Maximum trunk girth

was recorded in S<sub>1</sub>M<sub>2</sub> (76.05 cm) and minimum in S<sub>3</sub>M<sub>1</sub> (62.15 cm). Maximum plant spread in E-W direction was recorded in S<sub>1</sub>M<sub>1</sub> (7.65 m) and minimum in S<sub>3</sub>M<sub>1</sub> (3.13 m). (Table 2.4 )

**Table 2.4 : Effect of fertilizer and spacing on vegetative character at Bhubaneswar**

Treatment	Plant Height (m)	Girth (cm)	Spread (m)	
			E-W	N-S
S <sub>1</sub> M <sub>1</sub>	5.95	73.10	7.65	9.90
S <sub>1</sub> M <sub>2</sub>	5.80	76.05	7.10	10.33
S <sub>1</sub> M <sub>3</sub>	5.58	72.28	7.45	9.48
S <sub>2</sub> M <sub>1</sub>	4.80	68.35	4.18	5.22
S <sub>2</sub> M <sub>2</sub>	4.78	66.03	4.23	5.13
S <sub>2</sub> M <sub>3</sub>	4.80	63.60	4.38	5.23
S <sub>3</sub> M <sub>1</sub>	4.15	62.15	3.13	3.45
S <sub>3</sub> M <sub>2</sub>	4.40	65.50	3.40	3.63
S <sub>3</sub> M <sub>3</sub>	4.23	63.83	3.45	3.63
F 'test'	NS	NS	NS	S
SE (m)±	0.10	1.52	0.18	0.13
CD5%	-	-	-	0.38

The number of flowering panicles was significantly more in S<sub>1</sub> (21.6) compared to S<sub>2</sub> (19.8) and S<sub>3</sub> (14.5). The number of nuts per panicle was maximum in S<sub>3</sub> (7.9) and minimum in S<sub>1</sub> (7.3). The apple weight was maximum in S<sub>1</sub> compared to S<sub>2</sub> and S<sub>3</sub>. The yield per plant due to spacing was found significant. Significantly highest yield was recorded in S<sub>1</sub> (10.28 kg). The cumulative nut yield per plant for 8 years was found to be maximum in S<sub>1</sub> (29.43 kg) followed by S<sub>2</sub> (22.59 kg) and minimum in S<sub>3</sub> (19.61 kg). Highest yield was recorded in S<sub>3</sub> (9800.4 kg/ha) followed by S<sub>2</sub> (9041.3 kg/ha) and minimum in S<sub>1</sub> (5894.0 kg/ha). The percentage of increase in yield per ha in S<sub>1</sub> was 66 % over S<sub>1</sub> in S<sub>2</sub> was 53 % more as compared to S<sub>1</sub>. (Table 2.5 )

**Table 2.5: Effect of doses of fertilizer and spacing on flowering and yield attributes. at Bhubaneswar**

**a) Effect of spacing (Main plot)**

Treatments	No. of Flowering Panicles / m <sup>2</sup>	No. of nuts / panicle	Apple weight (g)	Nut weight (g)	Yield (kg / plant)	Cum. Yield (kg) 8 <sup>th</sup> harvest	Yield (Kg/ha)	Cum. yield (kg/ha)
S <sub>1</sub>	21.57	7.3	60.0	8.3	10.28	29.43	2055.0	5894.0
S <sub>2</sub>	19.78	7.6	54.0	8.0	3.93	22.59	1573.3	9041.3
S <sub>3</sub>	14.47	7.9	46.3	7.4	2.92	19.61	1460.4	9800.4
F 'test'	S				S		NS	
SE (m) ±	0.30				0.87		230.67	
CD 5%	1.03				3.02		-	

**b) Effect of doses of fertilizer (Subplot)**

Treatments	No. of Flowering Panicles / m <sup>2</sup>	No. of nuts / panicle	Apple weight (g)	Nut weight (g)	Yield (kg/ plant)	Cum. Yield (kg) 8 <sup>th</sup> harvest	Yield (Q/ha)	Cum. yield (Q)
M <sub>1</sub>	18.00	6.8	56.7	8.0	3.75	21.94	1099.6	7662.6
M <sub>2</sub>	19.22	7.3	51.7	7.9	6.94	26.01	1985.0	8855.0
M <sub>3</sub>	18.60	8.7	52.0	7.8	6.44	23.88	2004.2	8206.2
F 'test'	NS				S		S	
SE (m) ±	0.38				0.38		135.5	
CD 5%	-				1.14		402.7	

Doses of fertilizer significantly increased the number of flowering panicles / m<sup>2</sup>. M<sub>3</sub> was found significantly superior to M<sub>1</sub>. The number of nuts per panicle was maximum in higher doses of fertilizer M<sub>3</sub> (8.5) followed by M<sub>2</sub> (7.13) and minimum in M<sub>1</sub> (6.5). The apple weight was maximum in M<sub>1</sub> (58.0 g) and minimum in M<sub>3</sub> (44.67 g). The nut weight was highest in M<sub>1</sub> (8.37 g) followed by M<sub>2</sub> (7.93 g) and M<sub>3</sub> (7.27 g). Significantly highest yield was obtained in M<sub>2</sub> (6.94 kg/plant), which is at par with M<sub>3</sub> (6.44 kg/plant).

Cumulative yield at 8<sup>th</sup> harvest was highest in M<sub>3</sub> (8855.0 kg/ha) and minimum in M<sub>1</sub> (7662.6 kg). (Table 2.6 )

**Table 2.6 : Effect of doses of fertilizer and spacing on flowering and yield attributes (2008-09) at Bhubaneswar**

Treatment	No. of Flowering panicles/m <sup>2</sup>	Apple weight (g)	Nut weight (g)	Yield (Kg/plant)	Cum. Yield (kg/plant) 6 harvests	Yield (kg/ha)	Cum. Yield (kg/ha)
S <sub>1</sub> M <sub>1</sub>	20.20	65	8.2	6.80	25.83	1360.0	5404.0
S <sub>1</sub> M <sub>2</sub>	22.55	58	8.2	13.48	33.72	2695.0	7012.0
S <sub>1</sub> M <sub>3</sub>	21.95	47	7.5	10.55	28.76	2110.0	6105.0
S <sub>2</sub> M <sub>1</sub>	18.95	55	8.4	2.80	21.68	1120.0	9208.0
S <sub>2</sub> M <sub>2</sub>	19.45	52	8	4.15	23.56	1660.0	9968.0
S <sub>2</sub> M <sub>3</sub>	20.95	48	7.2	4.85	22.57	1940.0	9745.0
S <sub>3</sub> M <sub>1</sub>	14.85	60	8.2	1.64	18.32	818.8	9829.8
S <sub>3</sub> M <sub>2</sub>	15.65	52	7.8	3.20	20.80	1600.0	11073.0
S <sub>3</sub> M <sub>3</sub>	12.90	44	7.4	3.93	19.70	1962.5	10649.5
F 'test'	S			S		NS	
SE (m) ±	0.65			0.67		234.7	
CD 5%	1.96			1.98		-	

Significant variation was observed among the treatments with respect to flowering and yield attributes due interaction effect of plant density and different levels of fertilizer. The yield per plant was maximum in S<sub>1</sub>M<sub>2</sub> (13.48 kg) and minimum in S<sub>3</sub>M<sub>1</sub> (1.64 kg). As regard the cumulative yield per hectare, S<sub>3</sub>M<sub>2</sub> treatment contributed maximum yield (11073.0 kg/ha) and S<sub>1</sub>M<sub>1</sub> contributed minimum yield (5404.0 kg/ha)

The leaf Nitrogen % increased due to higher doses of fertilizer application. M<sub>3</sub> recorded maximum leaf Nitrogen 2.28% followed by M<sub>2</sub> (2.12%) and minimum in M<sub>1</sub> (1.88%). (Table 2.7 )

**Table 2.7 : Leaf Nitrogen content (%) due to the effect of spacing and levels of fertilizer at Bhubaneswar.**

	<b>M<sub>1</sub></b>	<b>M<sub>2</sub></b>	<b>M<sub>3</sub></b>	<b>Average</b>
<b>S<sub>1</sub></b>	2.01	2.19	2.32	2.17
<b>S<sub>2</sub></b>	1.92	2.16	2.19	2.09
<b>S<sub>3</sub></b>	1.72	2.02	2.34	2.03
<b>Average</b>	1.88	2.12	2.28	

The leaf P<sub>2</sub>O<sub>5</sub> content increased with decrease in spacing. S<sub>1</sub> recorded 0.041%, where as S<sub>2</sub> and S<sub>3</sub> recorded 0.043 % and 0.044% P<sub>2</sub>O<sub>5</sub> content respectively. The P<sub>2</sub>O<sub>5</sub> content increased with increased doses of P<sub>2</sub>O<sub>5</sub> and was maximum in M<sub>3</sub> (0.045 %). (Table 2.8 )

**Table 2.8 : Leaf phosphorous content (%) due to the effect of spacing and levels of fertilizer at Bhubaneswar.**

	<b>M<sub>1</sub></b>	<b>M<sub>2</sub></b>	<b>M<sub>3</sub></b>	<b>Average</b>
<b>S<sub>1</sub></b>	0.041	0.041	0.042	0.041
<b>S<sub>2</sub></b>	0.042	0.041	0.045	0.043
<b>S<sub>3</sub></b>	0.041	0.045	0.047	0.044
<b>Average</b>	0.041	0.042	0.045	

Maximum K<sub>2</sub>O content was recorded in M<sub>2</sub> (0.47%) followed by M<sub>3</sub> (0.41%). S<sub>2</sub>M<sub>2</sub> and S<sub>3</sub>M<sub>2</sub> recorded highest K<sub>2</sub>O % (0.48%) followed by S<sub>1</sub>M<sub>2</sub> and S<sub>3</sub>M<sub>3</sub> (0.46%). (Table 2.9 )

**Table 2.9 : Leaf Potassium content (%) due to the effect of spacing and levels of fertilizer at Bhubaneswar.**

	<b>M<sub>1</sub></b>	<b>M<sub>2</sub></b>	<b>M<sub>3</sub></b>	<b>Average</b>
<b>S<sub>1</sub></b>	0.23	0.46	0.36	0.35
<b>S<sub>2</sub></b>	0.29	0.48	0.40	0.39
<b>S<sub>3</sub></b>	0.33	0.48	0.46	0.42
<b>Average</b>	0.28	0.47	0.41	

## CHINTAMANI

The NPK treatments were evaluated on the limb pruned trees during fourth year, highest plant height (4.65 m) highest trunk girth (116.88 cm) and highest nut yield of 4.76 kg/tree was recorded in 500:250:250 g. NPK/tree/year (Table 2.10 ).



**Table 2.10 : Performance of Cashew in response to NPK fertilizer treatments.**

Treatments	Plant ht (m)	Trunk girth(cm)	Canopy spread (m)		Yield (kg/tree)
			E-W	N-S	
N <sub>0</sub> P <sub>0</sub> K <sub>0</sub>	3.65	92.75	6.28	6.11	2.76
N <sub>0</sub> P <sub>0</sub> K <sub>1</sub>	3.90	96.50	6.20	5.96	2.98
N <sub>0</sub> P <sub>0</sub> K <sub>2</sub>	4.22	99.75	6.76	6.74	3.10
N <sub>0</sub> P <sub>1</sub> K <sub>0</sub>	3.99	107.38	6.38	6.94	3.16
N <sub>0</sub> P <sub>1</sub> K <sub>1</sub>	4.08	102.38	6.68	6.75	3.25
N <sub>0</sub> P <sub>1</sub> K <sub>2</sub>	4.12	96.79	6.42	6.61	3.38
N <sub>0</sub> P <sub>2</sub> K <sub>0</sub>	4.18	114.42	7.12	6.90	3.15
N <sub>0</sub> P <sub>2</sub> K <sub>1</sub>	4.44	101.50	6.64	6.78	3.26
N <sub>0</sub> P <sub>2</sub> K <sub>2</sub>	4.25	110.62	6.90	6.95	3.35
N <sub>1</sub> P <sub>0</sub> K <sub>0</sub>	3.64	97.75	5.70	5.66	3.18
N <sub>1</sub> P <sub>0</sub> K <sub>1</sub>	3.85	92.12	6.02	5.89	3.40
N <sub>1</sub> P <sub>0</sub> K <sub>2</sub>	3.88	88.16	6.46	6.94	3.52
N <sub>1</sub> P <sub>1</sub> K <sub>0</sub>	4.29	99.38	7.16	6.93	3.78
N <sub>1</sub> P <sub>1</sub> K <sub>1</sub>	4.11	98.12	6.52	6.79	4.12
N <sub>1</sub> P <sub>1</sub> K <sub>2</sub>	4.28	94.88	6.34	6.42	4.25
N <sub>1</sub> P <sub>2</sub> K <sub>0</sub>	4.32	97.50	6.90	6.78	4.36
N <sub>1</sub> P <sub>2</sub> K <sub>1</sub>	4.24	103.50	6.75	6.95	4.48
N <sub>1</sub> P <sub>2</sub> K <sub>2</sub>	4.65	116.88	6.82	7.16	4.76
N <sub>2</sub> P <sub>0</sub> K <sub>0</sub>	4.56	92.00	5.63	5.28	4.52
N <sub>2</sub> P <sub>0</sub> K <sub>1</sub>	4.06	102.50	6.30	6.24	4.64
N <sub>2</sub> P <sub>0</sub> K <sub>2</sub>	3.80	91.75	5.76	5.45	4.72
N <sub>2</sub> P <sub>1</sub> K <sub>0</sub>	4.06	99.00	6.48	6.72	4.85
N <sub>2</sub> P <sub>1</sub> K <sub>1</sub>	4.12	90.88	6.48	6.25	4.90
N <sub>2</sub> P <sub>1</sub> K <sub>2</sub>	4.18	96.00	6.68	6.82	4.96
N <sub>2</sub> P <sub>2</sub> K <sub>0</sub>	4.30	105.75	7.09	6.92	5.10
N <sub>2</sub> P <sub>2</sub> K <sub>1</sub>	4.05	96.25	6.79	6.46	5.24
N <sub>2</sub> P <sub>2</sub> K <sub>2</sub>	4.26	97.29	6.96	6.68	5.45

## JHARGRAM

There were no significant differences with respect to growth characters among the treatments with respect to different doses of fertilizer (Table 2.11 ).

**Table 2.11 : Growth characters of cashew variety BPP –8 under different fertilizer treatments under on -farm trial at Jhargram**

Treatment	Plant height (m)	Trunk girth (cm)	Canopy spread (m)
N <sub>500</sub> P <sub>125</sub> K <sub>125</sub>	2.50	18.0	2.01
N <sub>1000</sub> P <sub>250</sub> K <sub>250</sub>	2.50	17.9	1.91
N <sub>1500</sub> P <sub>250</sub> K <sub>375</sub>	2.30	18.2	1.95
S.Em ±	NS	NS	NS
C.D. at 5%			
C.V%	5.90	6.68	9.88

## MADAKKATHARA

Statistical analysis of the data indicated that none of the growth or yield characters viz., height of trees, girth of trees and canopy spread of trees (both East West and North South) were significantly influenced by the application of graded levels of N, P or K or their 2-way or 3-way interactions. No significant variation in nut yield was observed among the levels of N, P or K or their 2-way or 3-way interactions.

No significant variation in cumulative nut yield was observed due to the direct effect of N, P or K or their 2- way or 3- way interactions, as revealed by statistical analysis (Table 2.12 ).

**Table 2.12: Effect of 3-way interactions of graded levels of N, P and K on growth and yield characters and yield at Madakkathara**

Treatment	Tree height (m)	Trunk girth (m)	Canopy spread-EW (m)	Canopy spread - NS (m)	Yield (kg/tree/annum)	Cumulative yield (kg/tree)
N <sub>0</sub> P <sub>0</sub> K <sub>0</sub>	5.73	0.93	6.89	7.08	1.719	32.180
N <sub>0</sub> P <sub>0</sub> K <sub>1</sub>	6.15	1.00	6.64	6.88	0.483	26.958
N <sub>0</sub> P <sub>0</sub> K <sub>2</sub>	5.63	0.88	6.58	6.62	0.883	22.878
N <sub>0</sub> P <sub>1</sub> K <sub>0</sub>	3.42	0.57	4.03	3.38	1.413	24.423
N <sub>0</sub> P <sub>1</sub> K <sub>1</sub>	4.55	0.62	4.93	5.62	1.025	25.060
N <sub>0</sub> P <sub>1</sub> K <sub>2</sub>	6.52	0.97	8.01	7.48	1.175	30.190
N <sub>0</sub> P <sub>2</sub> K <sub>0</sub>	4.65	0.73	5.18	5.53	1.567	34.767
N <sub>0</sub> P <sub>2</sub> K <sub>1</sub>	6.82	1.25	9.12	8.81	1.671	45.222
N <sub>0</sub> P <sub>2</sub> K <sub>2</sub>	3.33	0.52	3.88	3.53	0.592	24.400
N <sub>1</sub> P <sub>0</sub> K <sub>0</sub>	6.80	1.14	8.60	8.65	1.567	31.460
N <sub>1</sub> P <sub>0</sub> K <sub>1</sub>	3.55	0.55	3.82	3.45	0.917	24.960
N <sub>1</sub> P <sub>0</sub> K <sub>2</sub>	3.85	0.53	3.83	3.85	0.612	28.003
N <sub>1</sub> P <sub>1</sub> K <sub>0</sub>	5.37	0.89	6.85	6.53	1.337	32.055
N <sub>1</sub> P <sub>1</sub> K <sub>1</sub>	5.63	0.83	6.33	6.81	0.480	24.718
N <sub>1</sub> P <sub>1</sub> K <sub>2</sub>	4.60	0.62	4.37	4.28	2.210	37.857
N <sub>1</sub> P <sub>2</sub> K <sub>0</sub>	6.65	1.00	8.21	8.09	1.342	30.676
N <sub>1</sub> P <sub>2</sub> K <sub>1</sub>	5.93	1.00	7.03	7.04	1.130	35.773
N <sub>1</sub> P <sub>2</sub> K <sub>2</sub>	7.18	1.20	7.93	9.08	1.343	43.643
N <sub>2</sub> P <sub>0</sub> K <sub>0</sub>	4.92	0.83	5.47	5.64	1.111	37.973
N <sub>2</sub> P <sub>0</sub> K <sub>1</sub>	6.02	0.98	6.58	7.25	2.070	39.533
N <sub>2</sub> P <sub>0</sub> K <sub>2</sub>	6.18	0.97	6.76	6.72	1.380	40.322
N <sub>2</sub> P <sub>1</sub> K <sub>0</sub>	4.57	0.76	5.13	5.42	0.950	33.029
N <sub>2</sub> P <sub>1</sub> K <sub>1</sub>	6.78	1.12	7.47	7.75	1.213	38.880
N <sub>2</sub> P <sub>1</sub> K <sub>2</sub>	5.98	0.96	6.80	8.03	1.467	34.604
N <sub>2</sub> P <sub>2</sub> K <sub>0</sub>	3.33	0.51	3.47	3.97	0.455	24.010
N <sub>2</sub> P <sub>2</sub> K <sub>1</sub>	3.33	0.58	4.31	4.03	1.092	31.936
N <sub>2</sub> P <sub>2</sub> K <sub>2</sub>	5.68	0.95	7.31	7.03	1.781	39.436
SEm	<b>1.75</b>	<b>0.30</b>	<b>2.01</b>	<b>2.22</b>	<b>0.743</b>	<b>5.699</b>
CD (0.05)	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

The data on nut yield indicated that application of increasing doses of fertilizer tended to increase the nut yield. The maximum yield (12.52 kg/tree) was recorded by the KAU dose of 750:325:750 g NPK/tree during the current year. The fully organic dose recorded the lowest yield of 9.28 kg/tree (Table 2.13 ).

**Table 2.13 : Nut yield (g/tree/annum) of cashew under on- farm fertilizer trial at Madakkathara**

Fertilizer schedule (g NPK/tree)	2005- 06	2006- 07	2007- 08	2008- 09	2009- 10
T <sub>1</sub> - 500:125:125 (DCR)	2.50	2.77	5.03	6.47	9.55
T <sub>2</sub> - 750:187.5: 187.5 (150% DCR)	2.73	3.06	3.61	8.18	11.35
T <sub>3</sub> - 1000: 250: 250 (200% DCR)	2.80	3.10	3.81	5.89	10.75
T <sub>4</sub> - 750: 325: 750 (KAU)	3.95	4.17	4.55	6.85	12.52
T <sub>5</sub> - Fully organic (Farmers' practice)	2.45	2.94	3.42	5.61	9.28

During the reporting year, nut yield increased progressively with incremental doses of fertilizer, upto 150% DCR dose. However yield showed a declining trend with 200% DCR dose. The maximum yield was recorded by the KAU dose (750 : 375 : 750). The fully organic dose failed to catch up with fertilizer treatments during the reporting year also. The tree densities, fertilizer doses and their interactions did not significantly influence any of the growth parameters.

Data on cumulative nut yield for five years showed no definite trend in per tree yield with varying in tree densities though the maximum yield of 8.082 kg/tree was recorded by the medium tree density of 400 trees/ha. The cumulative yield per hectare yield showed an increase with an increase in tree density. The treatment having 500 trees/ha has recorded an increase of 2430 kg/ha (151 %) over the treatment having 200 trees/ha in the cumulative yield.

There was an increasing trend in the annual nut yield for 2009-10 (both per tree and per hectare) with the increasing fertilizer levels and the maximum yield (2.65 kg/tree) was recorded by the treatment receiving the highest fertilizer level of 225: 75: 75 kg NPK/ha. In respect of per hectare yield, an increasing trend was observed with increasing fertilizer levels, with the maximum yield (956 kg/ha) recorded by 225 : 75 : 75 kg NPK/ha (Tables 2.14 and 2.15 ).

**Table 2.15 : Effect of tree densities and fertilizer doses on the growth and yield of cashew at Madakkathara**

Treatments	Height (m)	Girth (cm)	Canopy spread –NS (m)	Canopy spread – EW (m)	Annual yield (2009-10)		Cumulative yield (2004-10) (5 years)	
					kg/tree	kg/ha	kg/tree	kg/ha
Densities								
S <sub>1</sub> - 200	4.73	77.1	5.50	5.59	2.796	559	8.039	1608
S <sub>2</sub> -400	4.57	71.5	5.09	4.93	2.574	1030	8.082	3233
S <sub>3</sub> -500	4.91	70.8	4.84	5.02	2.465	1233	8.075	4038
CD (0.05)	NS	NS	NS	NS	NS	173	NS	380
SEm	0.10	2.55	0.20	0.34	0.150	50	0.214	110
Fertilizer doses								
M <sub>1</sub> - 75:25:25	4.84	72.2	5.11	5.21	2.572	922	7.999	2863
M <sub>2</sub> - 150:50:50	4.80	74.7	5.16	5.09	2.606	943	8.135	2983
M <sub>3</sub> - 225:75:75	4.57	72.4	5.16	5.25	2.657	956	8.062	3032
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
SEm	0.12	2.14	0.18	0.13	0.130	51	0.271	93

**Table 2.16 : Interaction effect between tree densities and fertilizer doses on growth and yield of cashew at Madakkathara**

Treatments	Height (m)	Girth (cm)	Canopy spread –NS (m)	Canopy spread – EW (m)	Annual yield (2009-10)		Cumulative yield (2004-10)	
					Kg/tree	Kg/ha	Kg/tree	Kg/ha
S <sub>1</sub> M <sub>1</sub>	4.83	76.8	5.45	5.50	2.757	552	8.774	1755
S <sub>1</sub> M <sub>2</sub>	4.62	76.9	5.33	5.34	2.712	543	8.096	1619
S <sub>1</sub> M <sub>3</sub>	4.74	77.6	5.73	5.94	2.918	584	7.248	1450
S <sub>2</sub> M <sub>1</sub>	4.61	71.7	5.05	5.08	2.633	1053	7.779	3112
S <sub>2</sub> M <sub>2</sub>	4.77	73.4	5.18	4.72	2.665	1066	8.244	3298
S <sub>2</sub> M <sub>3</sub>	4.34	69.3	5.04	5.00	2.425	970	8.222	3289
S <sub>3</sub> M <sub>1</sub>	5.09	68.3	4.84	5.05	2.325	1163	7.444	3722
S <sub>3</sub> M <sub>2</sub>	5.02	73.7	4.99	5.20	2.440	1220	8.064	4033
S <sub>3</sub> M <sub>3</sub>	4.62	70.3	4.70	4.82	2.630	1315	8.716	4358
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
SEm	0.20	3.70	0.32	0.22	0.23	88	0.470	161

### VENGURLA

Spacing of 10m X5 m was at par with 6m X 4m and they were significantly superior in respect of mean plant height (6.06 and 6.01m respectively) and mean canopy height (4.8 and 4.7 m respectively) in comparison to 5mX4m spacing. However, in respect of mean spread, mean canopy area and mean canopy surface area, 10m X5 m spacing was significantly superior than 6m X 4m and 5mX4m spacings.

Fertilizer dose of 150 kg N : 50 kg P<sub>2</sub>O<sub>5</sub> : 50 kg K<sub>2</sub>O/ha recorded significantly higher plant height (5.64 m) than 75 kg N : 25 kg P<sub>2</sub>O<sub>5</sub> : 25 kg K<sub>2</sub>O/ha and 225 kg N : 75 kg P<sub>2</sub>O<sub>5</sub> : 75 kg K<sub>2</sub>O/ha. However, the remaining growth characters were not influenced significantly due to fertilizer levels. None of the growth, yield attributes

and yield were influenced significantly due to the interaction effect between spacing and 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> )
S <sub>1</sub>	6.06	92.8	8.73	4.8	59.7	91.1
S <sub>2</sub>	6.01	75.9	6.49	4.7	35.0	63.0
S <sub>3</sub>	4.11	87.7	4.04	3.0	13.5	24.6
SE m±	0.22	5.2	0.26	0.2	3.5	5.1
CD at 5%	0.86	N.S.	1.03	0.81	14.1	20.8
M <sub>1</sub>	5.25	83.3	6.30	4.2	33.6	55.8
M <sub>2</sub>	5.64	89.4	6.58	4.4	37.7	62.7
M <sub>3</sub>	5.30	83.6	6.40	4.1	36.9	60.8
SEm±	0.10	1.9	0.20	0.1	2.5	3.5
CD at 5%	0.32	N.S.	N.S.	N.S.	N.S.	N.S.

## **Agr.2: Fertilizer application in high density cashew plantations**

### ***Centres : East Coast :***

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

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### ***West Coast :***

Madakkathara, Pilicode and Vengurla

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### ***Plains / others :***

Chintamani, Jagdalpur

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

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### **SUMMARY:**

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#### **Experiment Details :**

Design	:	Split plot
Main plot : Plant density	:	S <sub>1</sub> 200 plants/ha (10m x 5m) S <sub>2</sub> 400 plants/ha (6m x 4m) S <sub>3</sub> 600 plants/ha (5m 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>2</sub> 150 kg N, 50 kg P <sub>2</sub> O <sub>5</sub> , 50 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
Total area	:	2.5 ha
Fertilizers application level :	:	1 <sup>st</sup> year : 1/5 <sup>th</sup> 2 <sup>nd</sup> year : 2/5 <sup>th</sup> 3 <sup>rd</sup> year : 3/5 <sup>th</sup> 4 <sup>th</sup> year : 4/5 <sup>th</sup> 5 <sup>th</sup> year : Full dose

#### **BAPATLA**

Among the various plant densities evaluated., plant height, trunk girth, mean canopy diameter and canopy height did not vary significantly. However, significant differences were recorded for canopy surface area, nut weight and cumulative nut yield. Highest cumulative nut yield of 11.36 kg/tree was recorded by trees spaced at



10x5m followed by 6x4m spaced trees (9.14 kg/tree). Highest nut yield/tree (2.74 kg) and cumulative nut yield/tree (12.30 kg) were noticed with M2 fertilizer dose .

Plant densities and fertilizers interaction effect did not show significant variation for vegetative and yield parameters except nut weight. Maximum nut weight was recorded in S<sub>1</sub>M<sub>2</sub> (7.89 g) followed by S<sub>3</sub>M<sub>2</sub> interaction (7.32 g) . Significantly maximum percentage of ground area coverage was under 5x4m spacing (78.95) followed by 6x4m spacing (54.34).

Effect of tree density and fertilizer application on annual nut yield (Kg/ha) was found non significant. Per hectare cumulative nut yield was observed significantly highest at 5x4m spacing (4476.67 kg/ha) and 150:50:50 kg/ha fertilizer dose (4327.00 kg/ha) (Tables 2.18, 2.19 and 2.20 ).



**Table 2.18: Effect of NPK fertilizers and their interactions on yield parameters of cashew at Bapatla**

Treatment	Mean nut weight (g)	Mean apple weight (g)	Nut yield (Kg/tree)	Cum. yield (kg/tree) (11 hvsts)
<b>N<sub>0</sub>P<sub>0</sub>K<sub>0</sub></b>	5.77	41.50 d	1.02	41.10 n
<b>N<sub>0</sub>P<sub>0</sub>K<sub>1</sub></b>	6.62	36.25 gh	1.15	41.07 n
<b>N<sub>0</sub>P<sub>0</sub>K<sub>2</sub></b>	5.62	38.75 ef	1.80	34.01 p
<b>N<sub>0</sub>P<sub>1</sub>K<sub>0</sub></b>	5.41	32.50 h	0.90	31.92 q
<b>N<sub>0</sub>P<sub>1</sub>K<sub>1</sub></b>	6.15	52.50 ab	0.95	37.35 o
<b>N<sub>0</sub>P<sub>1</sub>K<sub>2</sub></b>	5.59	37.50 fg	1.50	39.62 n
<b>N<sub>0</sub>P<sub>2</sub>K<sub>0</sub></b>	6.13	52.50 ab	0.90	40.62 n
<b>N<sub>0</sub>P<sub>2</sub>K<sub>1</sub></b>	5.95	52.50 ab	0.80	34.69 p
<b>N<sub>0</sub>P<sub>2</sub>K<sub>2</sub></b>	5.77	51.25 ab	1.64	45.27 m
<b>N<sub>1</sub>P<sub>0</sub>K<sub>0</sub></b>	5.56	50.00 bc	2.70	60.65 cd
<b>N<sub>1</sub>P<sub>0</sub>K<sub>1</sub></b>	5.34	62.50 ab	1.14	58.04 ef
<b>N<sub>1</sub>P<sub>0</sub>K<sub>2</sub></b>	5.83	63.75 a	1.93	52.83 hi
<b>N<sub>1</sub>P<sub>1</sub>K<sub>0</sub></b>	5.05	61.25 ab	1.68	47.94 l
<b>N<sub>1</sub>P<sub>1</sub>K<sub>1</sub></b>	5.05	45.00 cd	1.40	52.86 h
<b>N<sub>1</sub>P<sub>1</sub>K<sub>2</sub></b>	5.53	45.00 cd	1.90	54.75 gh
<b>N<sub>1</sub>P<sub>2</sub>K<sub>0</sub></b>	5.42	42.50 cd	2.35	52.22 ij
<b>N<sub>1</sub>P<sub>2</sub>K<sub>1</sub></b>	5.42	37.50 fg	1.35	60.56 d
<b>N<sub>1</sub>P<sub>2</sub>K<sub>2</sub></b>	5.86	50.00 bc	1.19	60.92 cd
<b>N<sub>2</sub>P<sub>0</sub>K<sub>0</sub></b>	5.96	55.00 ab	1.57	38.97 no
<b>N<sub>2</sub>P<sub>0</sub>K<sub>1</sub></b>	5.61	50.00 bc	1.23	50.50 jk
<b>N<sub>2</sub>P<sub>0</sub>K<sub>2</sub></b>	5.47	52.50 ab	2.53	58.67 de
<b>N<sub>2</sub>P<sub>1</sub>K<sub>0</sub></b>	5.48	47.50 cd	2.22	56.04 fg
<b>N<sub>2</sub>P<sub>1</sub>K<sub>1</sub></b>	6.20	40.00 de	2.42	<b>78.39 a</b>
<b>N<sub>2</sub>P<sub>1</sub>K<sub>2</sub></b>	5.48	52.50 ab	1.20	49.59 kl
<b>N<sub>2</sub>P<sub>2</sub>K<sub>0</sub></b>	6.27	38.75 ef	1.48	60.53 d
<b>N<sub>2</sub>P<sub>2</sub>K<sub>1</sub></b>	5.35	47.50 cd	2.45	<b>73.41 b</b>
<b>N<sub>2</sub>P<sub>2</sub>K<sub>2</sub></b>	6.48	52.50 ab	1.75	62.87 c
<b>CD at 5%</b>	NS	13.16	NS	2.26

**Table 2.19 : Effect of tree density and fertilizer levels on growth and yield of cashew at Bapatla**

Treatment	Canopy surface area(m <sup>2</sup> )	Mean nut weight (g)	Mean apple weight (g)	Nut yield (Kg/tree)	Cum. nut yield (Kg/tree) (3 no. of harvests)
<b>S1</b>	<b>33.34 a</b>	6.59 b	53.89	2.57	<b>11.36 a</b>
<b>S2</b>	26.45 b	6.15 b	58.33	2.17	9.14 b
<b>S3</b>	32.42 a	<b>7.15 a</b>	55.56	2.66	8.95 b
<b>CD at 5 %</b>	3.765	0.525	NS	NS	0.800
<b>M1</b>	<b>34.71 a</b>	5.95 b	56.67	2.24	9.74 b
<b>M2</b>	31.53 ab	<b>7.27 a</b>	57.22	2.74	12.30 a
M3	25.97 b	6.68 ab	53.89	2.42	7.42 c
<b>CD at 5 %</b>	6.170	0.433	NS	NS	2.058

**Table 2.20 : Effect of tree density and fertilizer application on cumulative nut yield (Kg/ha) at Bapatla**

Treatments	Cumulative nut yield (Kg/ha)			Mean
	M1	M2	M3	
<b>MP/SP</b>				
<b>S1</b>	2278.00	2876.00	1664.00	2272.67 c
<b>S2</b>	3496.00	4600.00	2868.00	3654.67 b
<b>S3</b>	4545.00	5505.00	3380.00	4476.67 a
<b>Mean</b>	3439.67 b	4327.00 a	2637.33 c	
<b>CD at 5 %</b>				
Main plot				468.22
Sub plot				761.46
Sub x Main				NS
Main x Sub				NS

## CHINTAMANI

The plant height did not vary significantly, but trunk girth and canopy spread varied significantly among the different plant densities. The nut yield per plant varied significantly among the plant densities. The highest nut yield per plant was recorded by S<sub>1</sub> (5.32 kg/plant) and lowest in S<sub>3</sub> (3.90 kg/plant). The highest nut yield per ha. was recorded by S<sub>3</sub> (19.20 q/ha) and lowest was recorded by S<sub>1</sub> (10.65 q/ha). The plant height, stem girth, canopy spread and yield (q/ha.) recorded did not vary significantly among the different levels of fertilizers. However, yield (kg/plant) varied significantly among fertilizer levels. The highest yield kg/plant was noticed in M<sub>1</sub> and M<sub>2</sub> (4.62 and 4.62 kg) and highest yield (q/ha) was observed in M<sub>2</sub> (16.33q/ha) (Table 2.21).

**Table 2.21 : Effect of Plant density and fertilizer levels on growth and yield of Cashew at Chintamani.**

Treatments	Canopy spread (m)		Yield (kg/plant)	Cu. Yield (Kg/tree) of 5 havsts	Yield (Q/ha.)
	E-W	N-S			
Densities	-	-	-	-	-
S <sub>1</sub> - 200	6.08	7.00	5.32	20.41	10.65
S <sub>2</sub> – 400	5.31	5.85	4.41	15.70	17.65
S <sub>3</sub> – 500	4.78	4.98	3.90	14.37	19.20
S .Em ±	0.27	0.22	0.11	-	0.63
C.D at 5%	0.92	0.77	0.37	-	2.17
Fertilizer levels	-	-	-	-	-
M <sub>1</sub> - 75 : 25 : 25	5.47	5.96	4.62	16.43	15.77
M <sub>2</sub> - 150 : 50 : 50	5.52	5.95	4.62	17.03	16.33
M <sub>3</sub> - 225 : 75 : 75	5.18	5.92	4.40	17.05	15.40
S. Em ±	0.17	0.25	0.06	-	0.23
C.D at 5%	NS	NS	0.19	-	NS

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

interactions. The highest yield was obtained in S<sub>1</sub> M<sub>1</sub> (5.91 kg/plant) followed by S<sub>1</sub>M<sub>2</sub> (5.27kg/plant) and lowest was in S<sub>3</sub> M<sub>1</sub> (3.68 kg). The highest (q/ha) was obtained in S<sub>3</sub> M<sub>2</sub> (20.20q.) and lowest was in S<sub>1</sub> M<sub>3</sub> (9.56q.) (Table 2.22 ).

**Table 2.22 : Interaction effect between plant density and fertilizer levels on growth and yield of Cashew at Chintamani.**

Interactions	Canopy spread (m)		Yield (kg/plant)	Cu. yield (kg/plant) of 5 harvests	Yield (q/ ha.)
	E-W	N-S			
S <sub>1</sub> M <sub>1</sub>	6.25	7.28	5.91	19.73	11.82
S <sub>1</sub> M <sub>2</sub>	6.42	6.88	5.27	20.18	10.57
S <sub>1</sub> M <sub>3</sub>	5.57	6.83	4.78	19.41	9.56
S <sub>2</sub> M <sub>1</sub>	5.35	5.50	4.27	14.87	17.08
S <sub>2</sub> M <sub>2</sub>	5.46	6.39	4.55	15.67	18.21
S <sub>2</sub> M <sub>3</sub>	5.12	5.66	4.42	15.73	17.67
S <sub>3</sub> M <sub>1</sub>	4.80	5.09	3.68	13.35	18.41
S <sub>3</sub> M <sub>2</sub>	4.68	4.59	4.04	14.22	20.20
S <sub>3</sub> M <sub>3</sub>	4.85	5.27	3.99	14.84	18.98
S.Em ±	0.30	0.44	0.10	-	0.40
C.D at 5%	NS	NS	0.28	-	1.19

## JHARGRAM

The fertilizer and spacing treatments were at par with respect to plant height and trunk girth. It was noticed that 10m x 5m spaced plants spread more than the other two spacings. 150 Kg N + 50 Kg P<sub>2</sub>O<sub>5</sub> + 50 Kg K<sub>2</sub>O fertilizer application per hectare had maximum positive effect on canopy spread under the density of 200 plants/ha. In case of precocity in flowering, lower dose of fertilizer application had shown positive effect under all the spacings.. In case of 5m x 4m spacing, the flowering per square meter was highest with the fertilizer dose of 75 Kg N + 25 Kg P<sub>2</sub>O<sub>5</sub> + 25 Kg K<sub>2</sub>O per hectare.

Maximum number of nuts was found with 10m x 5m spacing (34.3/m<sup>2</sup>) with higher doses of fertilizers. Nut weight was highest with lower dose of fertilizer in both the densities i.e. 200 and 400 plants/ha. The individual tree yield at 10m x 5 spacing was maximum ( 6.1 kg/tree) followed by 6m x 4m which gave the next highest yield (4.1 kg/tree) (Table 2.23 ).

**Table 2.23 : Growth parameters of cashew under high density planting at Jhargram**

Parameters	Fertilizer	Spacing			CV %	S.Em. ±	C.D.at 5%
	Treatments	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>			
Plant Height (m)	M <sub>1</sub>	4.4	4.4	4.6	5.29	0.137	0.299
	M <sub>2</sub>	4.4	4.6	4.5			
	M <sub>3</sub>	4.5	4.5	4.4			
Trunk Girth (Cm)	M <sub>1</sub>	55.7	55.7	57.1	5.98	1.93	4.21
	M <sub>2</sub>	55.7	57.8	57.6			
	M <sub>3</sub>	53.8	56.6	53.9			
Canopy Spread (m)	M <sub>1</sub>	5.3	4.9	4.1	6.71	0.187	0.407
	M <sub>2</sub>	5.5	4.9	4.0			
	M <sub>3</sub>	5.4	4.9	4.2			
Canopy Area (m <sup>2</sup> )	M <sub>1</sub>	35.4	32.1	24.8	11.25	2.035	4.434
	M <sub>2</sub>	38.0	33.1	23.5			
	M <sub>3</sub>	37.9	32.2	24.9			
Duration of flowering	M <sub>1</sub>	60	70	59			
	M <sub>2</sub>	61	64	59			
	M <sub>3</sub>	64	64	54			
Flowering /m <sup>2</sup>	M <sub>1</sub>	8.54	7.50	10.28	13.36	0.666	1.45
	M <sub>2</sub>	8.68	8.60	7.53			
	M <sub>3</sub>	9.77	7.57	9.17			
Nuts/m <sup>2</sup>	M <sub>1</sub>	27.7	21.1	23.6	26.95	3.83	8.35
	M <sub>2</sub>	22.0	23.9	23.9			
	M <sub>3</sub>	34.3	20.1	24.9			
Nut Weight (g)	M <sub>1</sub>	5.06	5.52	5.50	11.18	0.333	0.73
	M <sub>2</sub>	4.80	5.46	5.56			
	M <sub>3</sub>	4.57	5.04	4.96			
Apple Weight (g)	M <sub>1</sub>	37.5	36.8	36.3	13.78	2.93	6.38
	M <sub>2</sub>	33.3	37.9	43.6			
	M <sub>3</sub>	29.1	39.1	37.7			
Yield (kg/tree)	M <sub>1</sub>	5.2	3.7	3.1	33.68	.776	1.69
	M <sub>2</sub>	4.0	4.1	3.2			
	M <sub>3</sub>	6.1	3.5	3.1			
Biomass Removed (kg/tree)	M <sub>1</sub>	35.3	46.7	42.0	3.64	0.905	1.97
	M <sub>2</sub>	35.5	48.9	47.0			
	M <sub>3</sub>	43.7	52.3	35.3			
Yield/sq. m	M <sub>1</sub>	0.14	0.12	0.13	27.83	0.021	0.046
	M <sub>2</sub>	0.11	0.13	0.13			
	M <sub>3</sub>	0.16	0.11	0.13			

The ground area coverage was maximum with the plants under 6m x 4m spacing with lower doses of fertilizer application followed by 5m x 4m spacing (Table-13).



Yield per hectare was maximum (1647.0 kg/ha) under 5m x 4m spacing with moderate dose of fertilizer. There was an increase in the yield /ha with an increase in fertilizer dose under the plant density of 500 as well as 200 plants /ha. But with a plant density of 400 plants /ha maximum yield /ha was noticed with a support from moderate fertilizer dose i.e. 150 Kg N + 50 Kg P<sub>2</sub>O<sub>5</sub> + 50 Kg K<sub>2</sub>O per hectare (Table 2.24).

**Table 2.24: Effect of tree density and fertilizer application on ground coverage by canopy (%) at Jhargram**

Treatments MP/SP	Ground coverage by canopy (%)			Mean
	M1	M2	M3	
S1	45.3	48.9	47.1	47.1
S2	81.2	79.2	64.6	75.0
S3	66.9	64.6	68.3	66.6
Mean	64.5	64.2	60.0	
MP/SP- S.Em ±	4.30			
C.D. at 5%	9.37			
CV %	11.56			

The cumulative yield/ha was highest (16.7 q/ha) at 5 x 4 m than the other spacing. At the fertilizer dose of 150 Kg N + 50 Kg P<sub>2</sub>O<sub>5</sub> + 50 Kg K<sub>2</sub>O per hectare cumulative yield was 16.7q/ha at the 4<sup>th</sup>.harvest under 400 plant density. The mean value of cumulative yield under 6m x 4m spacing (15.3 q/ha) and 5m x 4m spacing ( 15.8 q/ha) were more than 10m x 5m spacing (10.4 q/ha). With a wider spacing high dose of fertilizer supported the maximum cumulative yield/ha. but with a narrow spacing 150 Kg N + 50 Kg P<sub>2</sub>O<sub>5</sub> + 50 Kg K<sub>2</sub>O per hectare had positive effect on cumulative yield (Table 2.25 and 2.26 ).

**Table 2.25 : Effect of tree density and fertilizer application on annual yield (Kg/ha) at Jhargram**

Treatments	Annual yield (Kg/ha)			Mean
	M1	M2	M3	
<b>MP/SP</b>				
<b>S1</b>	1041.4	809.7	1215.5	<b>1022.2</b>
<b>S2</b>	1484.3	1647.0	1385.6	<b>1505.6</b>
<b>S3</b>	1534.8	1587.8	1525.7	<b>1549.4</b>
<b>Mean</b>	<b>1353.5</b>	<b>1348.2</b>	<b>1375.6</b>	
<b>MP/SP- S.Em ±</b>	<b>238.7</b>			
<b>C.D. at 5%</b>	<b>520.1</b>			
<b>CV %</b>	<b>30.42</b>			

**Table 2.26 : Effect of tree density and fertilizer application on cumulative nut yield (Quintal /ha) at Jhargram**

Treatments	Cumulative nut yield (Quintal /ha)			Mean
	M1	M2	M3	
<b>MP/SP</b>				
<b>S1</b>	10.6	8.3	12.3	<b>10.4</b>
<b>S2</b>	15.1	16.7	14.1	<b>15.3</b>
<b>S3</b>	15.5	16.2	15.6	<b>15.8</b>
<b>Mean</b>	<b>13.7</b>	<b>13.7</b>	<b>14.0</b>	
<b>MP/SP- S.Em ±</b>	<b>2.407</b>			
<b>C.D. at 5%</b>	<b>5.245</b>			
<b>CV %</b>	<b>30.16</b>			

## PILICODE

Spacing did not influence the plant height. Highest trunk girth was observed with lower plant density ( 200 plants /ha). Spread of the plants in E W direction was highest with medium density ( 400 plants). Wider spaced plants (200 plants/ha, 10x5m) had highest canopy area (17.32 m<sup>2</sup>). Closer spacing resulted in higher number of flowering branches (14.81/ m<sup>2</sup>). Male: bisexual flower ratio increased with closer spacing. Yield per plant and yield per hectare were highest in medium density (1.87 Kg/plant and 7.51 g/ha respectively).

The highest plant height (3.77 m) was observed with highest fertilizer dose. The number of flowering panicles was maximum (15.99/m<sup>2</sup>) in lowest fertilizer dose

and male to bisexual flower ratio was highest (8.35) in M2 i.e., the highest fertilizer dose. Yield per plant was highest (1.91 Kg/plant) when the fertilizer dose was maximum (225:75:75 Kg NPK/ha).

The doses of fertilizers and the plant density found to interact significantly in influencing growth and yield characteristics of variety MDK-1. The maximum yield/plant (2.92 Kg/pl) and maximum yield/ha (11.71 q/ha) were recorded in S3 (600 pl/ha) with moderate fertilizer dose (150:50:50 Kg NPK/ha).

The plant height was found to be highest (3.99 m) with lowest plant density and highest dose of fertilizers (S1M3-200 plants/ha 225:75:75kg/ha), while trunk girth was highest (52.61 cm) with higher plant density and lowest fertilizer dose (S3M1). Lower spacing with higher dose of fertilizers (S1M3) had the highest member of flowering branches /m<sup>2</sup> (17.02) (Tables 2.27, 2.28 and 2.29 ).

**Table 2.27: Effect of spacing on vegetative characters and yield of cashew at Pillicode**

Treatment	Girth (cm)	Spread of the plant		Canopy area (m <sup>2</sup> )	No of panicle per m <sup>2</sup>	Male: Bisexual flowers ratio	Yield (kg) per plant	Yield (q/ha)
		E-W (m)	N-S (m)					
S1	48.160 <sup>a</sup>	4.279 <sup>c</sup>	4.434 <sup>b</sup>	17.364 <sup>a</sup>	14.456 <sup>b</sup>	5.660 <sup>c</sup>	1.501 <sup>b</sup>	3.00 <sup>c</sup>
S2	46.120 <sup>c</sup>	4.646 <sup>a</sup>	4.389 <sup>b</sup>	17.045 <sup>b</sup>	13.318 <sup>c</sup>	7.330 <sup>b</sup>	1.878 <sup>a</sup>	7.51 <sup>a</sup>
S3	46.990 <sup>b</sup>	4.302 <sup>b</sup>	4.568 <sup>a</sup>	16.279 <sup>c</sup>	14.817 <sup>a</sup>	9.151 <sup>a</sup>	1.269 <sup>c</sup>	6.34 <sup>b</sup>
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>CD@ 5%</b>	<b>0.311</b>	<b>0.028</b>	<b>0.055</b>	<b>0.183</b>	<b>0.039</b>	<b>0.134</b>	<b>0.095</b>	<b>40.62</b>

**Table 2.28 : Effect of Fertilizer on vegetative characters and yield of cashew at Pilicode**

Treatment	Plant height (m)	Girth (cm)	Spread of the plant		No of panicle per m <sup>2</sup>	Male: Bisexual flowers ratio	Yield per plant (kg)	Yield (q/ha)
			E-W (m)	N-S (m)				
M1	3.802 <sup>a</sup>	47.134 <sup>b</sup>	4.266 <sup>b</sup>	4.434 <sup>b</sup>	15.993 <sup>a</sup>	8.273 <sup>a</sup>	1.682 <sup>b</sup>	6.04 <sup>b</sup>
M2	3.579 <sup>b</sup>	45.617 <sup>c</sup>	4.264 <sup>b</sup>	4.389 <sup>c</sup>	12.928 <sup>c</sup>	5.511 <sup>b</sup>	1.052 <sup>c</sup>	3.69 <sup>c</sup>
M3	3.779 <sup>a</sup>	48.519 <sup>a</sup>	4.698 <sup>a</sup>	4.568 <sup>a</sup>	13.669 <sup>b</sup>	8.357 <sup>a</sup>	1.914 <sup>a</sup>	7.12 <sup>a</sup>
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>CD @ 5%</b>	<b>0.095</b>	<b>0.477</b>	<b>0.078</b>	<b>0.078</b>	<b>0.028</b>	<b>0.330</b>	<b>0.095</b>	<b>54.43</b>

**Table 2.29 : Interaction effect of spacing and doses of fertilizer application on growth and yield of cashew at Pilicode**

Treatment	Plant height (m)	Spread of the plant		Canopy area (m <sup>2</sup> )	No of flowering panicle/m <sup>2</sup>	Male: Bisexual flowers ratio	Yield per plant (kg)	Yield/ha (Q)
		E-W (m)	N-S (m)					
S1M1	3.90 <sup>b</sup>	4.00 <sup>g</sup>	4.71 <sup>b</sup>	17.28 <sup>c</sup>	15.77 <sup>b</sup>	5.00 <sup>g</sup>	1.84 <sup>b</sup>	3.67 <sup>f</sup>
S1M2	3.51 <sup>e</sup>	4.47 <sup>c</sup>	4.10 <sup>e</sup>	15.32 <sup>f</sup>	15.19 <sup>d</sup>	9.06 <sup>c</sup>	1.59 <sup>d</sup>	6.35 <sup>d</sup>
S1M3	3.99 <sup>a</sup>	4.33 <sup>d</sup>	4.49 <sup>c</sup>	17.36 <sup>c</sup>	17.02 <sup>a</sup>	10.76 <sup>a</sup>	1.62 <sup>c</sup>	8.10 <sup>b</sup>
S2M1	3.46 <sup>f</sup>	4.06 <sup>f</sup>	4.50 <sup>c</sup>	15.27 <sup>f</sup>	11.90 <sup>i</sup>	5.75 <sup>f</sup>	1.20 <sup>g</sup>	2.39 <sup>h</sup>
S2M2	3.71 <sup>d</sup>	4.50 <sup>c</sup>	4.32 <sup>d</sup>	16.73 <sup>d</sup>	12.56 <sup>g</sup>	4.46 <sup>h</sup>	1.12 <sup>h</sup>	4.47 <sup>e</sup>
S2M3	3.57 <sup>e</sup>	4.24 <sup>e</sup>	4.35 <sup>d</sup>	15.11 <sup>f</sup>	14.33 <sup>e</sup>	6.32 <sup>e</sup>	0.84 <sup>i</sup>	4.21 <sup>e</sup>
S3M1	3.77 <sup>d</sup>	4.78 <sup>b</sup>	5.02 <sup>a</sup>	19.54 <sup>a</sup>	15.70 <sup>c</sup>	6.23 <sup>e</sup>	1.47 <sup>e</sup>	2.94 <sup>g</sup>
S3M2	3.89 <sup>c</sup>	4.97 <sup>a</sup>	4.66 <sup>b</sup>	19.03 <sup>b</sup>	12.20 <sup>h</sup>	8.47 <sup>d</sup>	2.93 <sup>a</sup>	11.71 <sup>a</sup>
S3M3	3.67 <sup>d</sup>	4.34 <sup>d</sup>	4.03 <sup>f</sup>	16.37 <sup>e</sup>	13.10 <sup>f</sup>	10.37 <sup>b</sup>	1.34 <sup>f</sup>	6.70 <sup>c</sup>
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>CD @ 5%</b>	<b>0.068</b>	<b>0.048</b>	<b>0.068</b>	<b>0.366</b>	<b>0.024</b>	<b>0.17</b>	<b>0.017</b>	<b>34.61</b>

## VRIDHACHALAM

The yield in 6 x 4m was 2800 kg/ha which is higher than the yield obtained in 10 x 5 m spacing. The yield in 5 x 4 m spacing was 1625 kg/ha in the limb pruned trees. These limb pruned trees are maintained with regular annual pruning to get maximum yield per unit area (Table 2.30 ).

**Table 2.30 : Effect of fertilizer application and spacing on vegetative characters and yield of cashew in Vridhachalam**

<b>Treat ments</b>	<b>Plant height (m)</b>	<b>Trunk girth (cm)</b>	<b>Canopy spread (m)</b>	<b>Canopy area (m<sup>2</sup>)</b>	<b>Yield /tree (kg)</b>	<b>Estimated Yield /ha(kg)</b>
S <sub>1</sub> M <sub>1</sub>	8.50	46.5	6.50	29.00	7.50	1500
S <sub>1</sub> M <sub>2</sub>	8.70	46.5	6.80	29.00	7.50	1500
S <sub>1</sub> M <sub>3</sub>	8.75	46.8	6.80	29.00	7.50	1500
S <sub>2</sub> M <sub>1</sub>	8.65	44.2	6.50	27.50	7.00	2800
S <sub>2</sub> M <sub>2</sub>	8.60	44.5	6.85	27.50	7.00	2800
S <sub>2</sub> M <sub>3</sub>	8.70	46.5	6.85	28.00	7.00	2800
S <sub>3</sub> M <sub>1</sub>	4.50	40.5	3.50	15.50	3.25	1625
S <sub>3</sub> M <sub>2</sub>	4.60	42.5	3.50	15.50	3.25	1625
S <sub>3</sub> M <sub>3</sub>	5.00	43.0	3.50	16.00	3.25	1625
<b>CD(0.05%)</b>						
<b>M</b>	0.114**	0.506**	0.356	0.362	0.417**	
<b>S</b>	0.432**	0.240**	0.112	NS	0.254**	
<b>M at S</b>	0.620**	0.597**	NS	NS	NS	
<b>S at M</b>	0.585**	0.416**	NS	NS	NS	

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

### ***Centres : East Coast :***

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

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### ***West Coast :***

Madakkathara and Vengurla

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### ***Plains / others :***

Chintamani and Jagdalpur

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

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## **SUMMARY:**

### **Experimental Details :**

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

## **BAPATLA**

During the year 2009-10, maximum growth and yield were recorded with plots spaced at 4x4m except for mean canopy diameter and nut weight ([Table 2.31](#) ).

**Table 2.31 : Data on growth and yield parameters of high density planting and normal planting at Bapatla**

Spacing	Canopy surface area (m <sup>2</sup> )	Mean nut weight (g)	Mean apple weight (g)	Nut yield (kg/tree)	Nut yield (Kg/ha)	Cum. yield (Kg/tree) (3 hvsts)	Cum. yield (Kg/Ha)
4mx4 m	20.01	5.11	49.80	0.94	587.5	2.01	1256.25
8mx8 m	19.68	5.68	46.35	0.91	142.0	1.69	265.20

### **BHUBANESWAR**

As the plants in this trial had attained a maximum height of 6.4 m and as exposed canopy area was reduced, the plants have been pruned. The yield recorded was 3150.5 kg / ha during the year 2009-10 and the cumulative yield for 9 harvests is 14538.0 kg/ha.

### **CHINTAMANI**

The mean annual nut yield per plant was lower values under high density planting (0.55 kg/tree during 9<sup>th</sup> harvest) compared to normal planting (7.02 kg/tree during 9<sup>th</sup> harvest). However, the mean nut yield kg/ha (344 kg/ha) and mean cumulative nut yield (6297 kg/ha) which were higher compared to normal planting (mean nut yield 1094 kg/ha and cumulative nut yield 5285 kg/ha). The yield per plant in high density planting was reduced for last two years due to canopy coverage (Table 2.32).

**Table 2.32 : Effect of high density planting on growth and yield of Cashew at Chintamani**

Parameters	High density planting (4 x 4m)			Normal planting (8 x 8m)		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
Plant height (m)	4.30	3.60	3.95	6.30	4.5	5.40
Stem girth (cm)	65.0	46.0	55.5	92.00	82	87
Canopy spread (m)						
E - W	5.30	3.70	4.50	9.50	8.2	8.85
N - S	5.50	3.80	4.65	8.90	8.1	8.50
Yield (kg/tree)	0.85	0.25	0.55	8.15	5.88	7.02
Yield (kg/ha)	531	156	344	1271	917	1094
<b>Cumulative Yield of 9 harvests</b>						
Kg/tree	15.60	4.55	10.08	39.9	27.85	33.88
Kg/ha	9750	2844	6297	6224	4345	5285

#### **MADAKKATHARA**

The yield per tree was 7.66 kg under normal density, as compared to high-density planting system (5.50 kg) during the thirteenth year of planting. There was interlocking of canopy during the year under report under high density planting, leading to shading. However, the mean data under normal planting (8x8 m) indicated canopy spread values (6.74 and 6.97 m) lower than the spacing, indicating absence of shading. Tree height, tree girth and canopy spread were appreciably high in normal density planting (Table 2.33).



**Table 2.33 : Effect of high density planting on growth and yield attributes and yield of cashew during thirteenth year at Madakkathara**

Parameters	High density planting	Normal planting
	Mean	
Tree height (m)	5.92	7.10
Trunk girth (cm)	91.6	93.6
Canopy spread - NS (m)	6.01	6.74
Canopy spread - EW (m)	6.40	6.97
Yield (kg/tree/annum)	5.50	7.66
Yield (kg/ha/annum)	3438	1195
Cumulative yield (kg/ tree) in ten harvests	37.57	42.062
Cumulative yield (kg/ha in nine harvests)	23481	6562

The cumulative yield per tree of ten years was higher under normal density planting by 4.49 kg (42.06 vs 37.57) over high density planting. The cumulative per ha yield for ten harvests was considerably high under high density system as compared to normal density planting (23481 vs 6562 kg/ha which was 3.58 times than that of normal density planting)

## VENGURLA

The mean height of the plants 3.6 m and canopy area was 17.76 m<sup>2</sup>. The mean cumulative yield for 5 harvests was 4.46kg/plant (Table 2.34 )

**Table 2.34: Growth and yield observations of high density planting at Vengurla**

Mean Height (m)	Mean Girth (cm)	Mean Canopy Diameter (m)	Canopy Height (m)	Mean Canopy Area (m <sup>2</sup> )	Mean Canopy surface Area (m <sup>2</sup> )
3.84	91.55	4.25	2.48	22.28	14.42
3.70	84.81	3.81	2.42	18.53	12.70
3.51	79.25	3.65	2.17	16.56	10.63
3.47	79.50	3.45	2.06	15.17	9.76
3.63	80.66	3.79	2.20	17.61	11.56
3.76	84.66	3.96	2.40	19.80	12.66
3.50	80.33	3.68	2.25	17.15	10.94
3.68	78.45	3.74	2.22	16.97	11.31
3.79	92.81	3.96	2.36	19.37	12.65
3.45	90.77	3.45	1.95	14.21	9.38
3.63	84.27	3.77	2.25	17.76	11.60

### **Agr.3: Drip irrigation trial**

#### **Centres : East Coast :**

Vridhachalam

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#### **West Coast :**

Vengurla

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#### **Plains / others :**

Chintamani

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

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### **SUMMARY**

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#### **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).

Planting material	=	Softwood grafts		
Variety	=	Chintamani	:	Chintamani-1 @ 7 x 7m
		Vengurla	:	Vengurla-7 @ 5 x 5 m
		Vridhachalam	:	VRI-3 @ 4 x 4 m

#### **CHINTAMANI**

Among different levels of irrigation, irrigating the crop at 80% CPE (I<sub>5</sub>) recorded significantly highest plant height (4.86 m) and stem girth (85.29 cm). The canopy spread (E-W, 8.90 m & N-S, 8.80 m, nut yield of 12.91 kg/tree with a nut weight of 7.4 g. and shelling per cent of 32.1 and cumulative yield of 4 harvests (39.80 kg) was observed in 80% CPE ([Table 2.35](#) ).

**Table 2.35 : Effect of Drip irrigation levels on growth and yield of Cashew at Chintamani**

Treatments	Plant ht. (m)	Stem girth (cm)	Canopy spread (m)		Nut yield (kg/tree)	Cu. yield (kg/tree) of 4 harvests	Nut Wt. (g)	Shelling (%)
			E - W	N - S				
I <sub>1</sub> : No irrigation	4.42	76.83	8.29	8.34	7.02	23.56	6.9	29.5
I <sub>2</sub> : Irrigation at 20% CPE	4.59	81.33	8.37	8.44	8.78	28.90	7.1	30.0
I <sub>3</sub> : Irrigation at 40% CPE	4.71	83.83	8.44	8.47	10.20	32.06	7.3	31.4
I <sub>4</sub> : Irrigation at 60% CPE	4.79	85.00	8.59	8.70	12.12	37.43	7.3	31.5
I <sub>5</sub> : Irrigation at 80% CPE	4.86	85.29	8.90	8.80	12.91	39.80	7.4	32.1
S. Em ±	0.10	0.29	0.08	0.13	0.20	-	-	-
C.D. at 5%	-	0.89	0.24	-	0.60	-	-	-

### VENGURLA

The irrigation treatments did not differ significantly with respect to all vegetative characters. The cumulative yield for seven harvests was maximum in the irrigation treatment at 40 percent C.P.E. i.e. 21.41 Kg/tree (Table 2.36 ).

**Table 2.36 : Effect of drip irrigation on growth and yield of Cashewnut at Vengurla**

Treatment	Mean Stem Girth (cm)	Mean Canopy area m <sup>2</sup>	Mean No. of panicle /m <sup>2</sup>	Mean Yield kg/tree	Mean Yield t/ha	Cumulative yield for 7 harvests	Mean Nut Weight (g)
T <sub>1</sub> : No Irrigation	78.0	39.20	21.2	0.41	0.16	19.49	8.7
T <sub>2</sub> : Irrigation 20% CPE	82.0	44.38	26.7	0.34	0.13	19.53	8.3
T <sub>3</sub> : Irrigation 40% CPE	81.0	48.60	23.3	0.39	0.15	21.41	8.4
T <sub>4</sub> : Irrigation 60% CPE	78.3	40.92	23.3	0.34	0.14	20.19	8.9
T <sub>5</sub> : Irrigation 80% CPE	80.0	42.5	22.2	0.41	0.16	20.45	9.7
SEm±	2.3	2.9	1.6	0.08	0.03	-	0.40
CD at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	-	N.S.

## VRIDHACHALAM

Irrigating the cashew plants at 80% of cumulative pan evaporation favoured the growth parameters (plant height, Trunk girth, Canopy spread) (Table 2.37 )

**Table 2.37: Effect of drip irrigation on growth of cashew at Vridhachalam**

Treatments	Plant Height (m)	Trunk Girth (cm)	Canopy spread (m)	Mean Weight/nut (g)	Yield (kg/tree)
T1 - No irrigation	2.42	21.2	2.06	5.8	0.742
T2 - Irrigating 20% of CPE	2.78	22.6	2.24	6.4	0.846
T3 - Irrigating 40% of CPE	2.96	23.4	2.44	6.6	0.922
T4 - Irrigating 60% of CPE	3.20	24.4	2.52	6.8	0.948
T5 - Irrigating 80% of CPE	3.46	24.8	2.60	7.0	1.242
<b>SE d</b>	0.08	0.12	0.32		
<b>CD (0.05%)</b>	0.18	0.26	0.64		

## Agr.6: Intercropping in Cashew

**Centres : East Coast :**

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

**West Coast :**

Madakkathara and Vengurla

The objectives of this trial are to identify compatible intercrops with cashew in the initial stages of orchard development, to study the economic benefits of intercropping system, and to work out a soil fertility management strategy for the intercropping system.

### SUMMARY:

#### 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

The inter cropping of marigold with cashew recorded the highest net profit of Rs.65, 967/- per hectare (Table 2.38 ).

**Table 2.38 : Yield and net returns of intercrops in cashew inter crop trial at Bapatla**

Treatment details	Yield of intercrop		Yield of cashew		Cost of Cultivation (Rs./ha)	Returns (Rs./ha)	
	Kg/plot	Q/ha	Kg/tree	Q/ha	Cashew + Intercrop	Total	Net
<b>T1 - Cashew + Cluster bean</b>	46.75	73.05	2.75	4.29	71,934	94,500	22,566
<b>T2 - Cashew+ Marigold</b>	38.50	60.16	2.63	4.10	74,853	1,40,820	65,967
<b>T3 - Cashew alone</b>	--	---	2.72	4.24	---	21,200	3,172

**Sale price (Rs./Kg)**      Raw cashew nuts = `50=00,  
 Cluster bean = `10=00,      Marigold = ` 20=00

## JHARGRAM

This experiment has been concluded and the seven years data is being compiled.

## MADAKKATHARA

Only two intercrops viz., colocasia and tapioca could be successfully harvested during the first year and the experiment was repeated for four years (2005-06 to 2008-09) at Madakkathara in a young cashew plantation aged six years. The area available for intercropping was 4244 m<sup>2</sup>/ha which was less by 21% as compared to that of previous year. All the growth attributes of cashew viz., height, girth and canopy spread (NS and EW) recorded increased values in intercropped plots over the pure crop of cashew. This led to increased yield of cashew in intercropped plots (Tables 2.40 and 2.14 ).

**Table 2.40 : Growth and yield of cashew as influenced by intercropping at Madakkathara**

	With intercropping	Without intercropping
Height of tree (m)	4.65	4.39
Girth of tree (cm)	67.96	63.21
Canopy spread (NS) (m)	6.17	5.49
Canopy spread (EW) (m)	6.07	5.90
Yield (kg/tree/annum)	3.41	3.16

**Table 2.41 : Economics of intercropping of tuber crops in cashew at Madakkathara**

Name of intercrop	Tuber mean yield		Total return from intercrop (₹/ha)	Net profit (₹/ha)	C: B ratio
	(Kg/ plot of 22.68 m <sup>2</sup> )	t / ha *			
Coleus	32.5	6082	65382	23590	1.56

Colocasia	36.0	6737	62317	22112	1.55
Tapioca	46.5	8701	63082	26466	1.72
Sweet potato	30.5	5707	61350	18859	1.44
Amorphophallus	44.5	8327	66616	19205	1.41

Price of produce (Rs/ kg): Coleus- 10.75      Colocasia - 9.25  
Tapioca- 7.25      Sweet potato - 10.75  
Amorphophallus- 8.00

Cost of cultivation (Rs/ ha): Coleus- 41792      Colocasia- 40205  
Tapioca - 36616      Sweet potato - 42491  
Amorphophallus - 47411

In terms of tuber yield, tapioca recorded the maximum yield (8.70 t/ha) followed by amorphophallus (8.33 t/ha). The highest total returns (₹ 66,616/-) value was recorded by amorphophallus, followed by coleus (₹ 65,382/-). The highest net return (₹ 26,466) and C: B ratio (1.72) was recorded by tapioca followed by coleus (₹ 23,590/- and 1.56, respectively).

## VENGURLA

Tubers of Lesser Yam (Kangar) *Dioscorea esculanta*, Greater Yam (Ghorkand) *Dioscorea alata*, Aerial Yam (Karanda) *Dioscorea bulbifera*, Elephant foot Yam (Suran) *Amorphophallus paniofolius*, and Tapioca (*Manihot esculanta*) were procured and used as intercrops in a newly laid out trial.

## VRIDHACHALAM

*Aloe vera* and *Ocimum* yielded better with high BCR of 3.0 and 2.3 respectively when compared to other crops. *Catharanthus roseus* recorded an yield of 2.0 tonnes per ha of cashew with a BCR of 0.6. *Phyllanthus* recorded a benefit cost ratio of 0.37. The results have shown that *Ocimum* and *Aloe vera* are profitable and could be grown as an intercrop in cashew during its pre-bearing age. *Coleus forskohlii* and *Stevia rebaudiana* did not establish in the field (Table 2.42 ).



**Table 2.42 : Performance of intercrops at Vridhachalam 2009-10**

Treatments	Yield from intercrops		Total returns From intercrops (Rs./ha)	Net profit (Rs/ha)	BCR	Sole crop yield of intercrops(t/ha)
	Plot yield (kg/25 m <sup>2</sup> )	Estimated yield (t/ha of cashew with intercrop)				
<i>Ocimum sanctum</i> (leaves and stem)	8.5	3.2	42000	29250	2.30	10.0
<i>Catharanthus roseus</i> (leaves and stem)	7.0	2.0	20000	7500	0.60	6.5
<i>Phyllanthus niruri</i> (leaves and stem)	8.5	1.75	10720	2920	0.37	6.0
<i>Aloe vera</i> (leaves)	17.0	6.5	60000	45000	3.00	20.0
Cashew alone	Two years old	-	-	-	-	-
<b>SEd CD(0.05)</b>	0.319 0.713**					

## **Agr.7: Organic Management of Cashew**

### ***Centres : East Coast :***

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

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### ***West Coast :***

Madakkathara and Vengurla

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### ***Plains / others :***

Chintamani and Jagdalpur

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

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#### **Treatments:**

- T<sub>1</sub>** - 100 % N as FYM
- T<sub>2</sub>** - 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB)  
200 g
- T<sub>3</sub>** - 50 % N as FYM + Bio-fertilizers (200 g)
- T<sub>4</sub>** - 100 % N as Vermicompost + Bio-fertilizers (200 g)
- T<sub>5</sub>** - Recycling of organic residue with the addition of 20 % cow dung slurry  
(20.0 % weight of organic residue as cow dung)
- T<sub>6</sub>** - In situ green manuring / green leaf manuring to meet 100 % N
- T<sub>7</sub>** - 25 % N as FYM + Recycling of organic residue + In situ green  
manuring / green leaf manuring + Bio-fertilizers (200 g)
- T<sub>8</sub>** - Recommended doses of fertilizer + 10 kg FYM (Control)

## BHUBANESWAR

There was no significant difference in plant height, trunk girth and plant spread due to various organic treatments. The treatment T<sub>8</sub> i.e. recommended doses of fertilizer + 10 kg FYM (Control) exhibited maximum plant height (2.9 m), trunk girth (31.9 cm) and spread of the plant in both E-W (3.8 m) and N-S (3.9 m) directions. Under the treatment T<sub>6</sub> i.e. In situ green manuring / green leaf manuring to meet 100 % N resulted maximum number of panicles / sq. m. (6.5) and T<sub>3</sub> i.e. 50 % N as FYM + Bio-fertilizers (200g) resulted maximum yield / plant (0.393 kg / plant) (Table 2.43 )

**Table 2.43 : Vegetative characters of organic cashew plot at Bhubaneswar**

Treatment		Plant Height (m)	Trunk girth (cm)	Spread (m)		No. of panicles / sq.m	Yield (kg / plant)
				E-W	N-S		
T <sub>1</sub>	100 % N as FYM	2.6	26.8	3.6	3.5	3.7	0.220
T <sub>2</sub>	100 % N as FYM + Bio-fertilizers (Azotobacter + Azospirillum + PSB) 200 g	2.6	26.9	3.5	3.5	4.8	0.140
T <sub>3</sub>	50 % N as FYM + Bio-fertilizers (200 g)	<b>2.7</b>	<b>28.8</b>	<b>3.7</b>	<b>3.6</b>	4.6	<b>0.393</b>
T <sub>4</sub>	100 % N as Vermicompost + Bio-fertilizers (200 g)	2.5	23.8	3.0	3.1	5.5	0.160
T <sub>5</sub>	Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	2.5	26.9	3.4	3.2	4.2	0.337
T <sub>6</sub>	In situ green manuring / green leaf manuring to meet 100 % N	2.6	26.3	3.3	3.5	6.5	0.160
T <sub>7</sub>	25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	<b>2.7</b>	<b>28.8</b>	3.6	3.5	4.8	0.230
T <sub>8</sub>	Recommended doses of fertilizer + 10 kg FYM (Control)	<b>2.9</b>	<b>31.9</b>	<b>3.8</b>	<b>3.9</b>	4.5	0.267
F 'test'		NS	NS	NS	NS	NS	NS
SEM <sub>±</sub> CD (0.05)		0.16 -	1.56 -	0.21 -	0.23 -	1.31 -	0.074 -

## JHARGRAM :

Significant differences were noticed among the treatments in terms of their effect on plant height. Maximum height (2.6m) was with T2 treatment (100% N as FYM + Biofertilizers (Azospirillum + Azotobactor + PSB) followed by T5 (Recycling of organic residue + 20 % cow dung slurry). Canopy area was maximum (5.9 sq.m) in case of T7 (25 % N as FYM + Recycling of organic residue + 20 % cow dung slurry + green leaf manure + biofertilizers( azospirillum + azotobactor+ PSB) (Table 2.39 ).

**Table 2.39 : Growth performance of BPP – 8 under organic management**

Treatment	Plant height (m)	Trunk girth (cm)	Canopy height (m)	Canopy spread (m)	Canopy area (sq.m)
T 1	2.1	18.7	1.2	1.5	3.3
T 2	2.6	17.7	1.2	1.7	3.9
T 3	1.6	15.7	1.2	1.6	3.5
T 4	1.8	15.0	1.3	1.6	4.0
T 5	2.5	15.3	1.5	1.5	4.1
T 6	1.6	13.0	1.2	1.9	5.0
T 7	2.3	16.0	1.7	1.9	5.9
T 8 (Control)	2.2	11.3	1.6	1.6	5.4
S.Em $\pm$	0.219	0.916	0.143	0.178	0.821
C.D. at 5%	0.470	1.96	0.307	0.382	1.761
C.V%	17.7	10.4	18.0	18.5	32.3

## MADAKKATHARA

No significant variation occurred among the treatments with respect to any of the growth parameters viz., height, girth and canopy spread (N-S and E-W) of young cashew trees was recorded during the first year of treatment imposition. However, the maximum height was recorded by T3 (50% N as FYM + Biofertilizers) followed by

T6 (Green leaf / green manuring). T5 (recycling organic residues) recorded the maximum girth and canopy spread (both N-S and E-W) (Table 2.44 ).

**Table 2.44 : Effect of treatments on the growth of graft planted young cashew trees at Madakkathara**

Treatments	Height (m)	Girth (cm)	Canopy spread N-S (m)	Canopy spread E-W (m)
T1 – 100 % N as FYM	1.59	14.5	1.74	1.77
T2 – 100% N as FYM + BF	1.53	13.5	1.78	1.84
T3 – 50% N as FYM + BF	1.84	14.9	1.84	1.99
T4 – 100% N as VC + BF	1.53	14.1	1.85	2.22
T5 – Recycling organic residues	1.71	16.3	2.14	2.28
T6 – Green leaf/ green manuring	1.82	15.6	2.05	1.96
T7 – 25% N as FYM + recycling organic residues + green leaf/ green manuring + BF	1.78	14.8	2.13	1.88
8 – RDF + 10 kg FYM (Control)	1.24	12.9	1.63	1.78
CD (0.05)	NS	NS	NS	NS

## VENGURLA

There was no significant difference among the various treatments in respect of growth attributes. However, treatment T<sub>8</sub> (RDF+10 Kg FYM –control) recorded more mean height (2.40 m) and mean canopy height (1.99 m<sup>2</sup>) whereas, stem girth (20.7 cm), mean canopy spread (2.69 m), mean canopy area (10.11 m<sup>2</sup>) and mean canopy surface area (5.73 m<sup>2</sup>) was observed maximum in treatment T<sub>6</sub>.(Table 2.45 ).

**Table 2.45 : Growth observations of organic farming trial in cashew at Vengurla**

Treatment	Mean Plant Height (m)	Mean Stem Girth (cm)	Mean Canopy Spread (m)	Canopy height (m <sup>2</sup> )	Mean Canopy area (m <sup>2</sup> )
T <sub>1</sub>	2.05	15.8	2.30	1.66	9.91
T <sub>2</sub>	1.99	14.7	2.05	1.65	8.15
T <sub>3</sub>	1.90	14.6	2.23	1.61	6.84
T <sub>4</sub>	2.06	15.0	2.40	1.71	8.15
T <sub>5</sub>	1.97	16.7	2.24	1.64	7.10
T <sub>6</sub>	2.31	20.7	2.69	1.95	10.11
T <sub>7</sub>	1.81	14.0	1.94	1.47	5.39
T <sub>8</sub>	2.40	17.9	2.67	1.99	9.24
SEm±	0.13	1.71	0.22	0.14	1.44
CD at 5%	N.S.	N.S.	N.S.	N.S.	N.S.

## **VRIDHACHALAM**

Planting of VRI 3 grafts taken up in two acres after soil analysis of physical properties and chemical properties. Green manure crop sun hemp was raised for providing green leaf manure for the treatments alongwith a perennial leguminous crop *Sesbania grandiflora* which has been planted as border crop around the trial to use the green leaves as manure in specific treatments.

### **III. CROP PROTECTION**



### III. CROP PROTECTION

#### Ent. 1: Chemical Control of pest complex in cashew Expt. 3. Evaluation of insecticides for control of TMB and other insect pests

**Centres : East Coast :**

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

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**West Coast :**

Madakkathara and Vengurla

---

**Plains / others :**

Chintamani and Jagdalpur

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

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#### **SUMMARY:**

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##### **Experimental details:**

T1 = Recommended sprays for the region	T4 = $\lambda$ -cyhalothrin 0.003%
T2 = Chlorpyrifos 0.05%	T5 = Profenophos 0.05%
T3 = Triazophos 0.1%	T6 = Control

##### **BAPATLA**

The activity of different important foliage, flower and nut feeding pests of cashew was low- medium during the season. All the treatments were found on par and superior over the un-treated control against leaf and blossom webber at 30 days after 3<sup>rd</sup> spray. .Though Profenophos and L-Cyhalothrin showed better efficacy in controlling the pest in 1<sup>st</sup> and 2<sup>nd</sup> sprays, but recorded on par with the other treatments by the end of third spray In un- treated control wherein highest percent (16%) of damaged shoots was recorded.

None of the insecticides were safe either to spiders or ants as significantly higher nos. of spiders (11.5) and ants (9.1) were observed in un-treated control at 30 days after 3<sup>rd</sup> spray.

Thrips damage on apple and nut was found to be low in all the treated trees compared to control, The lowest damage score (0.8) was recorded in recommended spray for the region (T1). All the treatments effectively controlled the shoot tip caterpillar and apple and nut borer, there was no significant difference among the treatments at any stage of the three sprays applied.

Similarly, in respect of apple and nut borer also the same trend was observed and all the treatments on par but superior over control which record 18.9 per cent damage by apple and nut borer where as the lowest damage recorded in treatment with L.cyhalothrin (Table 3.1 and 3.2 ).

**Table 3.1 : Efficacy of certain new insecticides against pest complex in cashew at Bapatla**

Treatment		Thrips damage grade at 30 days after 3 <sup>rd</sup> spray (0-4 scale)	Leaf and blossom webber damaged shoots (%)		
			Before spray	30 days after 2 <sup>nd</sup> spray	30 days after 3 <sup>rd</sup> spray
T1	Monocrotophos 0.05% at flushing, Chlorpyriphos 0.05% at lowering and carbaryl 0.1% at fruit & nut development stage.	0.8 a	12.5	1.8 a	0.1 a
T2	Chlorpyriphos 0.05%	1.1 a	13.7	5.0 b	1.8 a
T3	Triazophos 0.1%	0.9 a	13.8	5.2 b	1.1 a
T4	L- Cyhalothrin 0.003%	1.2 a	13.1	1.4 a	0.0 a
T5	Profenofos 0.05%	1.0 a	13.6	1.3 a	0.1 a
T6	Un treated control	3.3 b	14.3	16.0 c	14.8 b
	CD (0.05)	0.65	1.74	1.81	1.72

Figures in parentheses are arc sin transformed values

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

**Table 3.2 : Efficacy of certain new insecticides against minor pest complex in cashew at Bapatla**

Treatment		Shoot tip caterpillar damaged shoots (%)			Apple and nut borer damage (%)		
		Before spray	30 days after 2 <sup>nd</sup> spray	30 days after 3 <sup>rd</sup> spray	Before spray	30 days after 2 <sup>nd</sup> spray	30 days after 3 <sup>rd</sup> spray
T1	Monocrotophos 0.05% at flushing, Chlorpyriphos 0.05% at lowering and carbaryl 0.1% at fruit & nut development stage.	2.4	0.1 a	0.0 a	15.5	4.9 a	0.9 a
T2	Chlorpyriphos 0.05%	2.7	0.2 a	0.0 a	15.7	8.6 c	5.4 b
T3	Triazophos 0.1%	2.7	0.2 a	0.0 a	15.7	7.8 c	2.5 a
T4	L- Cyhalothrin 0.003%	2.4	0.0 a	0.0 a	18.1	4.7 a	0.2 a
T5	Profenofos 0.05%	2.2	0.0 a	0.0 a	18.3	6.5 b	0.4 a
T6	Un treated control	2.7	3.2 b	3.3 a	18.9	16.0 d	16.3 c
	CD (0.05)	0.77	0.92	0.12 b	1.51	1.24	2.43

Figures in parentheses are arc sin transformed values

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

## BHUBANESWAR

L- cyhalothrin exhibited minimum pest incidence of shoot tip caterpillar (STC) 0.62 %, as compared to recommended spray (0.9%). Minimum incidence of STC (0.45) in L- cyhalothrin treatment was observed after 2<sup>nd</sup> spray. The inflorescence thrips led to minimum damage score (0.13) in L-cyhalothrin treatment, which was significantly lower than recommended spray.

The nut yield revealed an increase of 18.0 to 39.2 % in all the treatments over the control plot. The maximum increase was in L-cyhalothrin spray (39.2%) followed by recommended spray (27.0%). It was observed that the profit was maximum (Rs.76.00 per tree over control) in L-cyhalothrin treated plot while it was (Rs.53.00 per tree over control) in recommended spray schedule applied trees (Table 3.3 ).

**Table 3.3 : Evaluation of insecticides against different insect pests of cashew at Bhubaneswar**

Treatment	% Shoot damage by STC Before spray	% Damage by STC after 2 <sup>nd</sup> spray	Damage grade by inflorescence thrips after 3 <sup>rd</sup> spray	Average nut yield per tree in kg	% Increase over control	Profit per tree over control in Rs.
T <sub>1</sub>	5.0 (3.11)	0.88 (1.56)	0.17 (1.09)	4.93	27.0	53
T <sub>2</sub>	4.9 (3.08)	1.05 (1.66)	0.16 (1.08)	4.83	24.5	48
T <sub>3</sub>	5.0 (3.12)	1.00 (1.63)	0.17 (1.09)	4.73	21.9	43
T <sub>4</sub>	4.5 (2.98)	0.45 (1.30)	0.13 (0.79)	5.40	39.2	76
T <sub>5</sub>	5.38 (3.23)	0.85 (1.55)	0.17 (1.09)	4.58	18.0	35
T <sub>6</sub>	4.75 (3.05)	4.38 (2.94)	0.70 (1.46)	3.88	-	-
Sem(+)	0.09	0.04	0.02	0.23		
CD (5%)	NS	0.12	0.06	0.71		

There was significant reduction of natural enemy and pollinators population in almost all the treated trees. The different natural enemies were spiders (*Argeopes* sp., *Oxyopes* sp.), Ladybird beetle (*Vigna cinta*, *Menochilus sexmaculata*), pollinations like black ant *Campanotus* sp. and honeybees (*Apis cerana indica*). The honeybees appearance was negligible in the experimental plot.

## CHINTAMANI

The damage of TMB during 2009-10 ranged between 0.27 to 1.04, 0.29 to 1.12 and 0.32 to 1.17 at 30 days after 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> sprays. L. cyhalothrin (0.003%) was found effective in suppressing the TMB population and was on par with the recommended spray schedule. However, the treatments triazophos (0.10%), chlorpyriphos (0.05%) and profenofos (0.05%) were found least effective in reducing the pest population (Table 3.4 ).

**Table 3.4 : Effect of insecticides on the incidence of TMB at Chintamani**

Treatments	30 Days after I spray (0-4)	30 Days after II spray (0-4)	30 Days after III spray (0-4)
Recommended spray for the region	0.39	0.42	0.47
Chlorpyriphos 0.05 %	0.65	0.68	0.69
Triazophos 0.1 %	0.41	0.45	0.49
L Cyhalothrin 0.003 %	0.27	0.29	0.32
Profenofos 0.05 %	0.92	0.94	0.95
Unsprayed check	1.04	1.12	1.17
C.D at 5%	0.37	0.29	0.26

The incidence of thrips, aphids, mealy bugs and nut borer during 2009-10 were on par in the treatments triazophos (0.10%), chlorpyriphos (0.05%) and recommended spray for the region. The treatment L. cyhalothrin 0.003% was found to be superior over rest of the treatments in reducing pest complex at different reproductive stages of the tree (Table 3.5 ).

**Table 3.5 : Evaluation of insecticides for the control of TMB and other insect pests at Chintamani**

Treatments	Thrips (0-4)		Aphids (%)	Mealy bugs (%)	Leafminer (%)	Apple and nut borer (%)
	Apple	Nut				
Recommended spray for the region	0.60	0.58	0.35	0.94	1.18	0.67
Chlorpyriphos 0.05 %	0.75	0.70	0.98	1.03	2.20	1.08
Triazophos 0.1 %	0.69	0.66	0.75	0.77	0.89	0.54
L..cyhalothrin 0.003 %	0.62	0.59	0.63	0.62	0.75	0.43
Profenofos 0.05 %	1.22	1.15	1.37	1.19	2.13	1.97
Unsprayed check	1.52	1.47	3.04	1.21	3.82	2.64
C.D at 5%	0.13	0.11	0.48	0.39	1.12	0.60

### **JAGDALPUR**

L-cyhalothrin (0.003%) gave consistently good response in 1<sup>st</sup> and 2<sup>nd</sup> sprays with 20.91% and 24.35% leaf damage, respectively followed by Profenophos (0.05%) whereas, in 3<sup>rd</sup> spray the recommended spray schedule had minimum damage (18.42%) due to leaf caterpillar. In Leaf Folder damage, L-cyhalothrin (0.003%) gave good control with 19.99 and 21.40 per cent damage due to leaf folder, respectively in 1<sup>st</sup> and 3<sup>rd</sup> spray.

The mean damage grade by thrips at 30 days after 3<sup>rd</sup> spray was significantly lowest (1.25) in L-cyhalothrin (0.003%) on nut; which was at par with recommended spray schedule and Triazophos 0.1% . The per cent Leaf Miner damage was significantly low (4.27%) in Profenophos 0.05% during 1<sup>st</sup> spray and during 2<sup>nd</sup> spray L-cyhalothrin (0.003%) had minimum leaf mines (3.08%) which was at par with Profenophos 0.05%.

The yield was highest (186.10 kg/ha) in Triazophos 0.1% which was at par with L-cyhalothrin (0.003%) (155.49 kg/ha) and Profenophos 0.05% (139.37 kg/ha). The ant population was maximum (2.69) in Triazophos 0.1% treated plots. The population of spider was maximum (0.38) in Profenophos 0.05% treated plots comparison to untreated plots (Tables 3.6 and 3.7 ).

**Table 3.6: Damage due to minor pests under insecticidal trials at Jagdalpur**

Treatment	Percent incidence of minor pest of Cashew					
	% Leaf Caterpillar damage			% Leaf Folder damage		
	30 DAS after I <sup>st</sup> spray	30 DAS after II <sup>nd</sup> spray	30 DAS after III <sup>rd</sup> spray	30 DAS after I <sup>st</sup> spray	30 DAS after II <sup>nd</sup> spray	30 DAS after III <sup>rd</sup> spray
T-1: Monocrotophos 0.05% at flushing, Endosulfan 0.05% at flowering and Carbaryl 0.1% at fruiting stage.	29.44 (32.70) ab	40.15 (39.31) d	18.42 (25.38) a	34.06 (35.61) b	33.01 (35.02) b	23.93 (29.18) <sup>abc</sup>
T-2 : Chloropyriphos 0.05%	35.5 (36.52) b	36.45 (37.09) cd	32.41 (34.48) b	32.15 (34.51) b	38.63 (38.27) b	33.07 (35.06) <sup>d</sup>
T-3 : Triazophos 0.1%	31.78 (34.05) b	26.82 (30.72) abc	34.59 (35.72) b	36.11 (36.92) b	21.38 (27.29) a	24.67 (29.74) <sup>ab</sup>
T-4 : L-Cyhalothrin 0.003%	20.91 (27.18) a	24.35 (29.19) ab	36.7 (37.18) b	19.99 (26.29) a	35.96 (36.73) b	21.40 (27.52) <sup>a</sup>
T-5 : Profenophos 0.05%	28.27 (32.06) ab	21.69 (27.70) a	35.62 (36.39) b	32.70 (34.71) b	34.02 (35.64) b	35.82 (36.73) <sup>cd</sup>
T-6 : Unsprayed check	37.56 (37.79) b	40.74 (39.65) d	41.76 (40.24) b	40.98 (39.79) b	39.5 (38.92) b	36.39 (37.05) <sup>d</sup>
<b>CD at 5%</b>	<b>6.43</b>	<b>7.75</b>	<b>8.53</b>	<b>6.28</b>	<b>7.12</b>	4.94

\*Figure in parenthesis are angular transformed values



**Table 3.7 : Efficacy of insecticides against minor insect pest of cashew at Jagdalpur 2009-10.**

Treatment	Percent incidence of minor pest of Cashew				
	Thrips Mean damage grade at 30 days after 3 <sup>rd</sup> spray (0- 4 scale)	% Leaf Miner damage			Yield Kg/Ha
	Nut Thrips	30 DAS after I <sup>st</sup> spray	30 DAS after II <sup>nd</sup> spray	30 DAS after III <sup>rd</sup> spray	
T-1: Monocrotophos 0.05% at flushing, Endosulfan 0.05% at flowering and Carbaryl 0.1% at fruiting stage.	1.60 <sup>abc</sup>	12.59 (19.88) <sup>abcd</sup>	12.42 (20.58) cd	0.00 (0.00)	99.56 <sup>c</sup>
T-2 : Chloropyriphos 0.05%	2.36 <sup>d</sup>	7.21 (14.90) <sup>abc</sup>	7.16 (15.49) <sup>c</sup>	1.56 (3.62)	114.19 <sup>c</sup>
T-3 : Triazphos 0.1%	1.33 <sup>ab</sup>	14.25 (21.15) abcd	12.74 (20.73) cd	0.78 (2.55)	186.10 <sup>a</sup>
T-4 : L-cylohexthrin 0.003%	1.25 <sup>a</sup>	5.19 (12.97) <sup>ab</sup>	3.08 (10.01) a	1.56 (3.62)	155.49 ab
T-5 : Profenophos 0.05%	2.18 <sup>cd</sup>	4.27 (11.63) <sup>a</sup>	4.14 (10.14) ab	0.00 (0.00)	139.37 abc
T-6 : Unsprayed check	2.61 <sup>d</sup>	17.37 (24.42) <sup>d</sup>	16.69 (24.05) <sup>d</sup>	2.34 (6.16)	76.60 <sup>c</sup>
<b>CD at 5%</b>	<b>0.62</b>	<b>(8.95)</b>	<b>(5.26)</b>	<b>NS</b>	<b>66.53</b>

- \* Figure in parenthesis are angular transformed values

## JHARGRAM

The recommended spray (T<sub>1</sub>) was the most effective treatment. Profenophos (T<sub>5</sub>) recorded 4.7% leaf miner damage and 1.1% damage by leaf and blossom webber and 6.3% shoot tip caterpillar damage across the entire spray regime. The lowest apple and nut borer damage (2.6%) was recorded in T<sub>5</sub> (Profenophos ) while in T<sub>1</sub> (recommended spray) it was 2.1%. Least thrips damage scores were recorded in T<sub>1</sub> (recommended regional spray) and T<sub>2</sub> (chlorpyrifos 0.05%) (0.13 and 0.22) respectively (Table 3.8 ).

**Table 3.8 : Evaluation of insecticides for control of TMB and other insect pests at Jhargram.**

Treatment	% ANB damage	Thrips damage score	Mean % leaf miner damage	Mean % STC damage	Mean % LBW damage
			After III spray	After III spray	After III spray
T <sub>1</sub>	3.2 (10.31)	0.13	7.8a (16.22)	9.2ca (17.66)	2.8a (9.63)
T <sub>2</sub>	2.8 (9.63)	0.22	9.5b (17.95)	10.2a (18.63)	6.2b (14.42)
T <sub>3</sub>	4.3 (12.17)	0.24	9.9b (18.34)	10.6a (19.00)	5.9b (14.06)
T <sub>4</sub>	6.2 (14.42)	0.25	10.6b (19.00)	11.4a (19.73)	6.8b (15.12)
T <sub>5</sub>	2.6 (9.28)	0.19	8.2a (16.64)	9.2ca (17.66)	3.2a (10.31)
T <sub>6</sub>	5.2 (13.18/)	0.34	18.8c (25.70)	22.8b (28.52)	20.8c (27.13)
T <sub>7</sub>	4.2 (11.83)	0.35	19.5c (26.21)	24.5b (29.67)	22.9c (28.59)

ANB = Apple and nut borer      STC = Shoot tip caterpillar  
LBW = Leaf and blossom webber

\* Figures ending with same alphabet in a column did not differ significantly on the basis of DMRT at 5% level of significance.

## MADAKKATHARA

Though damage was observed on shoots during pre-treatment observation, no damage was observed on shoots 30days after spraying at flowering and nut initiation stages in any of the treatments. In the case of panicles, the damage was generally high during the flowering stage as compared to fruiting stage except in the case of Chlorpyriphos and Triazophos (Table 3.9 ).

**Table 3.9 : Effect of different insecticides on damage score in cashew due to TMB infestation at Madakkathara**

Treatments	Incidence of TMB (Tea mosquito bug) Mean score for 52 leader shoots (0-4 scale)			Nut yield (kg/tree/ annum)
	Panicle			
	pre-treatment	30 days after		
		2nd spray	3rd spray	
T-1: POP	0.23	0.72	0.02	8.00
T-2: Chlorpyriphos	0.03	0.62	0.62	3.60
T-3:Triazophos	0.23	0.56	0.51	1.90
T-4:λ-cyhalothrin	0.14	0.30	0.05	5.40
T-5:Profenophos	0.13	0.44	0.05	6.50
T-6:Control	0.05	0.38	0.06	7.50

Among the treatments λ-cyhalothrin was found to be effective in reducing TMB infestation on panicles after the spray at flowering. Observation after the spray at nut initiation indicated that recommended spray schedule recorded the lowest damage score (0.02) followed by profenophos and λ-cyhalothrin (0.05 each) The annual yield data showed that POP recommendation recorded the highest yield (8.00kg/tree) followed by Profenophos (6.50 kg/tree) and λ-cyhalothrin (5.40 kg/tree).

## VENGURLA

All the insecticidal treatments significantly reduced the incidence of TMB over control in cashew. Amongst the insecticidal treatments, the treatment, Lambda-cyhalothrin (0.003%) was observed to be significantly superior over rest of the treatments after first, second and third spray, except the treatment of Profenophos 0.05% which was at par with it. Considering the average cumulative incidence, the treatment of Profenophos was found to be the second best treatment for the management of TMB (Table 3.10 ).

**Table 3.10 : Incidence of tea-mosquito bug in various treatments at Vengurla**

Sr. No.	Treatment details	Per cent incidence 30 days after		
		First spray	Second spray	Third spray
T <sub>1</sub>	Recommended spray schedule	4.64 (12.40)	5.33 (13.30)	5.36 (13.36)
T <sub>2</sub>	Chlorpyriphos 0.05%	4.94 (12.20)	5.06 (12.98)	5.07 (12.99)
T <sub>3</sub>	Triazophos 0.01%	4.21 (11.81)	5.23 (13.20)	4.70 (12.50)
T <sub>4</sub>	Lambda-cyhalothrin 0.003%	2.95 (9.84)	3.01 (9.96)	1.91 (9.31)
T <sub>5</sub>	Profenophos 0.05%	3.35 (10.49)	4.37 (11.95)	2.66 (10.73)
T <sub>6</sub>	Control	7.57 (15.96)	8.35 (15.78)	8.25 (16.80)
T <sub>7</sub>	Triazophos, Profenophos, Carbaryl.	4.65 (12.44)	4.97 (12.88)	5.00 (12.78)
	S.E.±	0.29	0.37	0.32
	C.D. at 5%	0.87	1.10	0.95

- **Figures in parenthesis are arcsine values**

All the treatments significantly reduced the incidence of Inflorescence thrips and Apple and Nut borer over control. In case of Inflorescence thrips, Treatment T<sub>4</sub> (Lambda-cyhalothrin 0.003%) was found to be significantly superior over rest of the treatments, with respect to damage score on apple and nut by recording 3.26 and 2.72 damage scores respectively..

In case of Apple and nut borer, the treatment T<sub>4</sub> (L-cyhalothrin 0.003%) which recorded 1.13% damage was found to be significantly superior over rest of the treatments (Table 3.11 ).

**Table 3.11: Incidence of minor pests in various treatments in cashew at Vengurla**

Sr. No.	Treatment details	Thrips		Apple and Nut borer
		30 days after 3 <sup>rd</sup> spray		30 days after 3 <sup>rd</sup> spray
		Apple	Nut	
T <sub>1</sub>	Recommended spray schedule	7.92 (16.34)	6.90 (15.21)	3.60 (11.04)
T <sub>2</sub>	Chlorpyriphos 0.05%	7.57 (15.97)	6.47 (14.73)	2.76 (9.53)
T <sub>3</sub>	Triazophos 0.01%	6.25 (14.47)	5.50 (13.55)	2.1 (8.81)
T <sub>4</sub>	Lambda-cyhalothrin 0.003%	3.26 (10.38)	2.72 (9.47)	1.32 (6.59)
T <sub>5</sub>	Profenophos 0.05%	4.55 (12.30)	3.70 (11.07)	1.65 (7.35)
T <sub>6</sub>	Control	8.60 (17.04)	8.10 (16.52)	4.2 (11.81)
T <sub>7</sub>	Triazophos, Profenophos, Carbaryl.	7.42 (15.80)	6.32 (14.56)	2.40 (9.18)
	<b>S.E.±</b>	<b>0.11</b>	<b>0.22</b>	<b>0.20</b>
	<b>C.D. at 5%</b>	<b>0.35</b>	<b>0.66</b>	<b>0.61</b>

- **Figures in parenthesis are arcsine values**

## VRIDHACHALAM

The efficacy of different insecticides tested was at par, but statistically superior over untreated control after first, second and third spraying. The pre-treatment damage score of TMB was almost uniform and non-significant in all the six treatments including the untreated control. Gradual reduction of fresh infestation was observed two weeks after each round of spray. After first spray, the damage score was low in T1 (the recommended spray) and T4 (L Cyhalothrin 0.003%), followed by T5 (Profenophos 0.05%), T3 (Triazophos 0.1%), and T2 (Chlorpyriphos 0.05%) ranging between 0.30 and 0.36 as against 1.33 in the control.

After the second spray, the damage score was nil in standard spray and chlorpyriphos treated trees. In other spray treatments also intensity of damage further reduced to 0.30-0.33 in different treatments as against an increased damage score of 1.66 in untreated control. Thirty days after third spray, the damage score was nil in all the insecticidal treatments as against an increased score of 2.66 in control. The overall efficacy ranked in the order: standard spray > Chlorpyriphos (0.05%) > Lambda cyhalothrin (0.003%) > Profenophos (0.05%) > Triazophos (0.1%) > Control (Table 3.12 ).

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

Treatment		Pre-treatment damage score (0-4)	Post treatment mean damage score (0-4)			
			30 days after I spray	30 days after II spray	30 days after III spray	Mean
1.	Recommended spray for the region	0.43 <sub>a</sub>	0.30 <sub>a</sub>	0.00 <sub>a</sub>	0.00 <sub>a</sub>	0.10
2.	Chlorpyriphos 0.05%	0.49 <sub>a</sub>	0.33 <sub>a</sub>	0.00 <sub>a</sub>	0.00 <sub>a</sub>	0.11
3.	Triazophos 0.1%	0.43 <sub>a</sub>	0.36 <sub>a</sub>	0.33 <sub>a</sub>	0.00 <sub>a</sub>	0.23
4.	L-Cyhalothrin 0.003%	0.40 <sub>a</sub>	0.30 <sub>a</sub>	0.30 <sub>a</sub>	0.00 <sub>a</sub>	0.20
5.	Profenophos 0.05%	0.43 <sub>a</sub>	0.33 <sub>a</sub>	0.33 <sub>a</sub>	0.00 <sub>a</sub>	0.22
6.	Untreated check	0.40 <sub>a</sub>	1.00 <sub>b</sub>	1.33 <sub>b</sub>	2.66 <sub>b</sub>	1.66
CD		0.32	0.51	0.43	0.32	-

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

The population trend of TMB and other foliar feeding insects was recorded. Thirty days after 3<sup>rd</sup> spray, all the insecticidal treatments were able to control TMB populations to zero as against 4.4 bugs/ 52 leader shoots observed in untreated control (Table 3.13 ).

**Table 3.13 : Efficacy of insecticides on TMB population/52 leader shoot at Vridhachalam**

Treatments		Pre treatment count/52 leader shoots	Post-treatment count (Mean TMB population/52 leader shoots)			
			30 days after I spray	30 days after II spray	30 days after III spray	Yield (Kg/ tree)
1.	Standard spray	3.1 <sub>a</sub>	1.0 <sub>a</sub>	0.0 <sub>a</sub>	0.0 <sub>a</sub>	7.9
2.	Chlorpyriphos 0.05%	3.0 <sub>a</sub>	1.6 <sub>b</sub>	1.2 <sub>b</sub>	0.0 <sub>a</sub>	7.6
3.	Triazophos 0.1%	2.8 <sub>a</sub>	1.3 <sub>b</sub>	1.3 <sub>b</sub>	0.0 <sub>a</sub>	7.3
4.	L Cyhalothrin 0.003%	3.2 <sub>a</sub>	1.0 <sub>a</sub>	0.3 <sub>a</sub>	0.0 <sub>a</sub>	7.3
5.	Profenophos 0.05%	2.7 <sub>a</sub>	1.0 <sub>a</sub>	0.3 <sub>a</sub>	0.0 <sub>a</sub>	7.7
6.	Untreated check	2.8 <sub>a</sub>	3.2 <sub>c</sub>	3.9 <sub>c</sub>	4.4 <sub>b</sub>	3.6

The per cent damage of leaf miner, leaf folder, leaf and blossom webber and nut borer was low in all insecticides treated plots compared to control plots (Table 3.14).

**Table 3.14 : Efficacy of insecticides against foliar pests of cashew at Vridhachalam**

Treatment		Mean per cent damage 30 days after 3 <sup>rd</sup> spray					Yield (kg/tree)
		TMB damage (%)	Leaf miner damaged leaves (%)	Leaf folder damaged leaves (%)	Leaf and blossom damaged shoots (%)	Apple and nut borer damaged nuts (%)	
T <sub>1</sub>	Recommended spray	1.60	1.30	1.20	1.30	0.0	7.9
T <sub>2</sub>	Chlorpyriphos 0.05%	2.43	1.16	2.30	2.60	0.0	7.6
T <sub>3</sub>	Triazophos 0.1%	2.33	1.36	2.30	2.40	0.0	7.3
T <sub>4</sub>	L Cyhalothrin 0.003%	2.40	1.50	1.60	1.63	0.0	7.3
T <sub>5</sub>	Profenophos 0.05%	2.36	1.33	1.66	1.93	0.0	7.7
T <sub>6</sub>	Untreated check	11.33	4.30	5.30	6.33	4.20	3.6



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

### Expt. 2. Curative control trial

#### **Centres : East Coast :**

Bapatla, Bhubaneswar, Jhargram and Vridhachalam

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#### **West Coast :**

Madakkathara and Vengurla

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#### **Plains / others :**

Chintamani and Jagdalpur

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

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#### **SUMMARY:**

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#### **Treatments :**

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

#### **BAPATLA**

During 2009-10, among the insecticides evaluated as post extraction prophylaxis, chlorpyrifos 0.2% offered protection to the tune of 90.9 % trees without re-infestation or persistent attack followed by monocrotophos 0.2% with 80.0 percent trees without re-infestation or persistent attack. The other treatments viz., carbaryl 1.0%, and treated check with neem oil offered 77.7 and 71.4 percent protection without re-infestation or persistent attack and are superior over the control treatment which recorded 66.6 percent trees without re-infestation or persistent attack. Irrespective of the insecticides tried, 20.93 percent of the trees

showed yellowing even after treatment. Preferential zone of attack is collar + stem in 44.11 percent of trees followed by collar + root in 38.23 percent of trees (Table 3.15 and 3.16 ).

**Table 3.15: Efficacy of insecticides as curative control (post extraction prophylaxis) against Cashew Stem and Root Borer at Bapatla**

Treatment	% Trees without reinfestation/ persistent attack
Carbaryl 1.0%	77.7
Chlorpyrifos 0.2%	90.9
Monocrotophos 0.2%	80.0
Un treated check (only removal of CSR B grubs)	66.6
Treated check with most effective treatment under prophylactic trails	71.4

**Table 3.16 : Physical parameters of cashew trees after treatment with insecticides as curative measures at Bapatla**

Parameters		Total trees treated	No. of trees in each category	
			Without Re-infestation	With Reinfestation/ Persistent Infestation
Stem girth (cm.)	< 60	43	---	---
	60-80		7	4
	80-100		9	3
	> 100		18	2
	Total		34	9
Age (Years)	< 5	43	---	---
	5-10		3	2
	10-15		20	5
	> 15		11	2
	Total		34	9
% Bark circumference damaged	< 25	43	24	1
	25-50		10	6
	50-75		---	2
	> 75		---	---
	Total		34	9
Zone	C+R	43	13	6
	C+S		15	1
	R		4	2
	S		2	---
	C+R+S		---	---
	Total		34	9
Canopy yellowing	a) Yellowed	43	---	4
	b) No yellowing		34	5
	Total		34	9

## BHUBANESWAR

Maximum recovery of 76 % was obtained from chlorpyrifos (0.2%) treatment. Maximum cost (Rs. 48 / treatment/year) was involved in neem oil treatment with a recovery of 58%. Both in chlorpyrifos and monocrotophos treatments, maximum recovery (67.8 to 76%) with minimum cost (Rs. 24.50 to 28.00/treatment/year) was recorded.

It was observed that the stem girth of 60-80 cm led to higher re-infestation. Again the plants when age group of 5 to10. Reinfestation was less in 5-10 year old plants but as the age increased the infestation also increased. The zone of attack when restricted to the stem and collar regions, such treated plants recovered quickly whereas, in the root-affected and collar + root + stem affected plants the re-infestation was higher (Table 3.17 and 3.18).

**Table 3.17 : Percentage recovery of CSRB affected tree under curative trial at Bhubaneswar**

<b>Treatments</b>	<b>Average % of trees without reinfestation / persistence of attack</b>
T <sub>1</sub> - Carbaryl (1 %)	68.0
T <sub>2</sub> - Chlorpyrifos (0.2 %).	91.0
T <sub>3</sub> - Monocrotophos (0.2 %).	77.5
T <sub>4</sub> - Chlorpyrifos (0.1%)	76.5
T <sub>5</sub> - Untreated check (only removal of CSRB grubs)	11.0
T <sub>6</sub> – Neem oil (5%)	35.0

For each treatment 31 infested plants were taken.

**Table 3.18 : Physical parameter of cashew stem and root borer in curative trials at Bhubaneswar**

Physical parameters		No. of trees in each category	
		Without re-infestation	With re-infestation
Stem girth (cm)	<60	125	1
	60-80	15	43
	80-100	3	2
	>100	0	1
		<b>143</b>	<b>47</b>
Age (Years)	<5	0	0
	5 –10	95	1
	10-15	37	21
	> 15	11	25
% Bark circumference damaged	<25	101	2
	25-30	27	36
	50-75	15	8
	>75	0	1
Zone of attack	C+R	3	5
	C+S	120	1
	R	4	7
	S	15	11
	C+R+S	1	23
		<b>143</b>	<b>47</b>
Canopy yellowing	Yellow	33	
	Not yellow	157	

### CHINTAMANI

Reinfestation of the grubs were totally absent in the trees treated with the chlorpyrifos (0.2%). The other treatments also maintained their superiority suppressing the population over untreated control. The treated check, where grubs extraction was adopted, 77.78% trees could recover. Canopy yellowing was observed in 18.18 per cent of the treated trees, the zone of attack was noticed in collar + root + stem. The bark circumference damaged was less than 25 per cent in 93.19 per cent of the infested trees (Table 3.19 and 3.20).

**Table 3.19 : Physical parameters of treated cashew trees re-infested/without re- infestation under curative control trial at Chintamani**

Physical parameters		No. of trees infested	% of total trees treated	No. of trees not reinfested	% of total trees not reinfested
Stem girth	< 60 cm	09	20.46	08	21.62
	60-100 cm	16	36.36	13	35.14
	> 100 cm	19	43.18	16	43.24
Total		44	-	37	-
Age of the tree	<10 years	-	-	-	-
	10-15 years	-	-	-	-
	>15 years	44	100	37	100
Total		44	-	37	-
Zone of attack	C + R	06	13.64	05	13.51
	C + S	33	75.00	28	75.68
	C + S + R	05	11.36	04	10.81
Total		44	-	37	-
Yellowing of canopy	Canopy yellowing	08	18.18	08	21.62
	Canopy not yellowing	36	81.82	29	78.38
Total		44	-	37	-
% of bark circumference damaged	< 25	41	93.19	34	91.90
	26-50	01	2.278	1	2.70
	51-75	01	2.27	1	2.70
	>75	01	2.27	1	2.70
Total		44	-	37	-

**Table 3.20 : Efficacy of certain insecticides as curative treatment against CSRB at Chintamani**

Treatments	Tress without re-infestation/ persistent attack (%)
Carbaryl 1.0%	83.33
Chlorpyriphos 0.2%	100.00
Monocrotophos 0.2%	80.00
Chlorpyriphos 0.1%	87.50
Treated check	85.71
Untreated check	77.78

## JAGDALPUR

Chlorpyrifos (0.2%) (T<sub>2</sub>) led to maximum recovery 75.76 per cent trees without re-infestations. The cashew trees have 60-100 cm of stem girth were more prone to attack of CSRB. More than 15-year-old cashew trees were more susceptible to attack of this pest.

The physical parameters of different treated trees indicated that preferential zone of attack of re-infestation by stem and root borer in cashew tree were stem zone followed by collar & stem zone with 10.49 and 7.41 per cent re-infested trees, respectively. The canopy of majority of cashew trees infested by CSRB was not yellowed. This pest re-infested in maximum (11.73 %) trees in which bark circumference damage was 25-50 per cent followed by 25 per cent bark circumference damaged tree (11.11%).

In observational trial involving insecticides and kerosene it was observed that re-infestation level is higher as compared to other treated treatments (Table 3.21) .

**Table 3.21: Efficacy of certain insecticides as curative control against CSRB at Jagadapur**

Treatment	% of trees without re-infestation/ persistent attack
T1 : Carbaryl (1.0%)	66.67
T2 : Chlorpyrifos (0.2%)	75.76
T3 : Monocrotophos (0.2%)	63.64
T4 : Chlorpyrifos (0.1%)	63.64
T5 : Untreated check (only removal of CSRB grubs followed)	51.52
<b>Observational Trial</b>	
DDVP (10 ml) + Kerosene (50 ml)	57.58
Chlorpyrifos (10 ml) + Kerosene (50 ml)	54.55

## JHARGRAM

Carbaryl (1.0%) and Chlorpyrifos(0.2%) were equally the most effective treatments and there none of the treated trees had reinfestation. In the treated check (T<sub>6</sub>), 50% of the trees showed reinfestation. Monocrotophos (0.2%) and Lindane (0.2%) could not save more than 50% trees from re-infestation. In treated check (T<sub>6</sub>), 50% trees remained free from re-infestation.

## MADAKKATHARA

Among the insecticides checked for curative control, chlorpyrifos (0.2%) was found effective with 50% of trees without re- infestation, after treatment imposition.

However the treated and untreated checks also recorded comparable values (Table 3.22 ).

**Table 3.22: Efficacy of different insecticides for curative control against CSRB (post prophylaxis treatments) at Madakkathara**

Treatments		Percentage trees without re-infestation/ persistent attack
T-1	Carbaryl (1%)	25
T-2	Chlorpyrifos (0.2%)	50
T-3	Monocrotophos (0.2%)	25
T-4	Chlorpyrifos (0.1%)	25
T-5	Untreated check (grub-extraction only)	50
T-6	Treated check (neem oil swabbing plus sevidol application)	50%

## VENGURLA

The treatment T<sub>2</sub> (Chlorpyrifos 0.2%) recorded 93.33 per cent trees without reinfestation followed by Carbaryl (1%) T<sub>1</sub> (86.66 per cent) and Monocrotophos (0.2%) T<sub>3</sub> recorded (80.00 per cent) trees without reinfestation. Reinfestation was more in Control (T<sub>6</sub>) (60.00 %) followed by (Lindane 0.2%), T<sub>4</sub> (73.33 %) and T<sub>5</sub> (73.33 %) (Table 3.33 ).

**Table 3.33 : Effect of curative treatments against Cashew Stem and Root Borer (CSRB) at Vengurla**

Treatment	Percentage of trees without reinfestation / persistent attack
T <sub>1</sub> -Carbaryl (1%)	86.66
T <sub>2</sub> -Chlorpyrifos (0.2%)	93.33
T <sub>3</sub> -Monocrotophos (0.2%)	80.00
T <sub>4</sub> -Lindane (0.2%)	73.33
T <sub>5</sub> -Effective treatment in prophylactic trail (Swabbing Neem oil 5% during Oct.- Nov., Jan. – Feb. and April-May)	73.33
T <sub>6</sub> Control	60.00

## VRIDHACHALAM

Maximum recovery of 45.5% was noted in chlorpyrifos (0.2%) treated trees, which was closely followed by monocrotophos (0.2%) treated trees with 45.0% recovery. Treatments with carbaryl (1.0%), Lindane (0.2%) and neem oil (5.0%) lead to 38.1, 35.0 and 31.3.0% recovery respectively as against 7.8% recovery in untreated control (Table 3.34 ).



**Table 3.34 . Efficacy of certain insecticides as curative control against CSRB at Vridhachalam**

Treatment		No. of trees treated	Frequency of treatment	Mean % recovery of trees from CSRB	Cost of treatment/ tree
T <sub>1</sub>	Carbaryl (1%)	4	21	38.1	44.0
T <sub>2</sub>	Chlorpyrifos (0.2%)	3	22	45.5	39.0
T <sub>3</sub>	Monocrotophos (0.2%)	3	20	45.0	39.0
T <sub>4</sub>	Lindane (0.2%)	4	17	35.3	40.0
	Chlorpyrifos (0.1%)	3	03	33.3	36.0
T <sub>5</sub>	Untreated check (removal of grubs)	3	13	7.8	30.0
T <sub>6</sub>	Treated check (Neem oil 5%)	4	16	31.3	52.0
<b>Total</b>		-	<b>112</b>	-	-

The extent of reinfestation/recovery was influenced by various physical parameters of trees. More than 63% trees which recovered had less than 25% damaged bark circumference, while trees have 26-50% bark damage recorded only 5.8% recovery. Trees with 51-75% and more than 75% bark damage with yellowing of canopy did not show any recovery (Table 3.35 ).

**Table 3.35 . Details of physical parameters of treated cashew trees with re-infested/ without re-infestation at Vridhachalam**

Physical Parameters		Total no of trees treated	% of trees reinfested	% of trees not reinfested
Stem girth (cm)	< 60	26	15.4	84.6
	60-80	28	53.6	46.4
	80-100	28	89.3	10.7
	> 100	30	93.3	6.7
	<b>Total</b>	<b>112</b>	<b>64.3*</b>	<b>35.7*</b>
Age of the tree (years)	< 5	26	15.4	84.6
	5- 10	27	51.9	48.1
	10-15	29	89.7	10.3
	> 15	30	93.3	6.7
	<b>Total</b>	<b>112</b>	<b>*</b>	<b>*</b>
Zone of attack	C+R	23	78.3	21.7
	C+S	23	30.4	69.6
	R	24	83.3	16.7
	S	20	25.0	75.0
	C+S+R	22	100.0	0.0
	<b>Total</b>	<b>112</b>	<b>*</b>	<b>*</b>
Yellowing of canopy	Canopy yellowed	8	100.0	0.0
	Canopy not yellowed	104	61.5	100
	<b>Total</b>	<b>112</b>	<b>*</b>	<b>*</b>
% of bark circumference damaged	< 25	60	36.7	63.3
	26-50	34	94.2	5.8
	51-75	12	100.0	0.0
	>75	06	100.0	0.0
	<b>Total</b>	<b>112</b>	<b>*</b>	<b>*</b>

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

#### ***Centres : East Coast :***

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

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#### ***West Coast :***

Madakkathara and Vengurla

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#### ***Plains / others :***

Chintamani and Jagdalpur

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

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#### **SUMMARY:**

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#### **BAPATLA**

The activity of leaf and blossom webber was relatively high during December second fortnight to March months. The maximum temperature ( $r = -0.5377$ ) and minimum temperature ( $r = -0.6839$ ) were found to exercise a significant negative influence on the activity of the pest, whereas the relative humidity (m) ( $r = 0.4220$ ) showed significant positive influence.

The leaf miner appeared during July and continued up to April. The percent damaged leaves by leaf miner were maximum (10.45%) during third week of March. Among the abiotic factors, rainfall showed negative significant influence ( $r = -0.3751^*$ ) on the incidence of leaf miner.

Leaf folder started infesting on the crop from October to December and touched a damage level of 10.25 percent during the last week of January. Among the abiotic factors, the maximum temperature ( $r = -0.5253$ ) and minimum

temperature( $r=-0.6384$ ) showed significantly negative influence and Relative humidity (m)( $r=0.4490$ ) exercised significantly positive influence.

Inflorescence thrips were active only during the months of February to April with a highest incidence of 31.40 per 10 inflorescences. Minimum Temperature( $r=0.2980$ ) showed significant positive influence and rainfall ( $r= -0.3214$ ) showed negatively significant influence on the activity of inflorescence thrips.

The activity of apple and nut borer was observed only during the last week of February with a very low damage of 0.46 percent and extended up to April ending with a highest 8.80 percent in March. Rainfall showed significant negative effect ( $r= -0.3333^*$ ) on the activity of the pest.

During the surveys conducted the incidence of cashew stem and root borer was observed to be high (10-15%) in different coastal districts of Andhra Pradesh and the activity of other foliage, flower and nut feeders was almost negligible (Table 3.36 ).

**Table 3.36 : Influence of abiotic factors on the activity of pest complex of cashew at Bapatla [**

Weather Parameters	Correlation coefficients (r) for pests				
	Lbw	Anb	Lm	It	Lf
Maximum temperature °C	- 0.5377*	0.1314	-0.0657	0.2132	- 0.5253*
Minimum temperature °C	- 0.6839*	0.1733	-0.1560	0.2980*	- 0.6384*
Relative humidity(m) (%)	0.4220*	0.0874	0.2199	0.0386	0.4490*
Relative humidity (e) (%)	-0.0001	0.1775	0.0068	0.2767	-0.0675
Rainfall	-0.1079	- 0.3333*	-0.3751*	-0.3214*	-0.1872

Lbw: Leaf and blossom webber

Anb: Apple and nut borer Lm : Leaf miner

Lf: Leaf folder

It: Inflorescence thrips

\*Significant at 0.05 level

## BHUBANESWAR

The extent of insect pest infestation and natural enemies along with weather data was recorded at weekly interval from 12 selected cashew trees under unsprayed condition. The data for 2009 -2010 was presented in month wise and correlated. The RH had positive significant correlation with the incidence of the pest Shoot tip caterpillar (*Hypatiama haligramma*).

Yellow thrips, *Frankliniella schultzei* T.population was (6.5 to 9.5 no. / 10 panicles as compared to the black thrips *Haplothrips ceylonicus* Sch . population (4.5 to 7.5 no. / 10 panicles) during February and March. Evening RH had significant negative correlation with incidence of the Inflorescence thrips. Both temperature and rainfall had negative correlation with the incidence of Leaf miner:

*Acrocercops syngamma*. Maximum Temperature had positive significant correlation with the incidence of the apple and nut borer, *Nephopteryx* sp..

Maximum Temperature had positive and morning RH had negative significant correlation with the incidence of leaf and blossom webber:, *Lamida monoculalis*. Rainfall and RH had positive influence on population of leaf beetle: *Menolepta longitarsus* and bright sunshine hour had negative significant correlation towards incidence of the pest.

The activity of Cashew stem and root borer: *Plocaederus ferrugineus* was observed throughout the year but its activity was negligible during colder month i.e. during December and January Maximum temperature had positive significant correlation with the incidence of the pest.

### **Natural enemies :**

Maximum parasitisation of shoot tip caterpillar (3.5%) by *Elasmus* sp. leaf and blossom webber (3.0 %) by *Bracon brevicornis* and leaf miner (7.1 %) by *Sympiesis* sp., were observed during the study. The peak period of parasitization coincided with the peak incidence of the pest.

The different predators present in cashew ecosystem were spiders (*Argeopes* sp., *Oxyopes* sp.), Ladybird beetle (*Vigna cinta*, *Menochilus sexmaculata*) and pollinator, Black ant (*Camponotus* sp.) ([Table 3.37](#) ).

**Table 3.37 : Correlation of weather parameters with the pests of regional importance (2009-2010) at Bhubaneswar**

Name of the result	Temperatures		RH		Rainfall in (mm)	BSH (%)
	Maximum	Minimum	Maximum	Minimum		
	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>		
STC (Y <sub>1</sub> )	-0.28	-0.12	0.29	0.16	0.06	0.03
YT (Y <sub>2</sub> )	0.39	-0.06	0.06	-0.51	-0.50	0.51
BT (Y <sub>3</sub> )	0.41	-0.02	0.07	-0.47	-0.48	0.49
LM (Y <sub>4</sub> )	-0.21	-0.11	0.19	0.10	-0.02	0.11
A & NB (Y <sub>5</sub> )	0.63	0.20	-0.06	-0.43	-0.47	0.50
L&BW (Y <sub>6</sub> )	0.68	0.45	-0.64	-0.14	-0.26	0.33
LB (Y <sub>7</sub> )	-0.09	0.43	0.57	0.76	0.73	-0.69
CSRB (Y <sub>8</sub> )	0.81	0.57	-0.57	-0.09	-0.25	0.33

\* = 'r' at 5 % level of significance

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

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

L & BW: Leaf and blossom webber

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

## JAGDALPUR

Maximum temperature, wind velocity and evaporation were significantly positively influenced the activity of TMB on shoot ( $r=0.288$ ,  $0.307$  and  $0.316$  respectively).

The maximum temperature and evaporation was positively correlated ( $r=0.355$  and  $0.389$ , respectively) with the incidence of panicle thrips. The abiotic factors were not influence the activity of leaf caterpillar. The rainfall and wind velocity were significantly negatively correlated ( $r= -0.346$  and  $-0.326$ ); while bright sunshine hours positively influenced ( $r=0.269$ ) with the activity of leaf folder.

The incidence of leaf miner had significant negative correlations with maximum temperature, wind velocity and evaporation ( $r = -0.340, -0.464$  and  $-0.394$ , respectively); whereas, relative humidity (evening) ( $r = 0.299$ ) had positive influence (Table 3.38).

**Table 3.38: Correlation of weather parameters with the pests of regional importance at Jagdalpur**

Weather Parameters	Correlation coefficient values <sup>®</sup> of pests of regional importance						
	Max. Temp	Min. Temp	Rainfall	Relative Humidity		Evap.	Bright Sunshine
	°C	°C	(mm)	(morning +)	(afternoon ≠)	(mm)	hours
% Shoot on TMB	0.288*	0.060	0.200	-0.112	-0.162	0.316*	0.020
% Panicle on TMB	0.217	0.031	0.231	-0.044	-0.138	0.333*	0.078
Panicle Yellow Thrips	0.355*	0.018	0.016	0.069	-0.219	0.389**	0.248
Black thrips	-0.234	0.079	0.250	-0.022	0.291*	-0.263	-0.289*
% LC	-0.205	0.074	0.116	0.063	0.125	-0.213	-0.213
% LF	-0.012	-0.237	-0.346*	0.255	-0.130	-0.130	0.269*
% LM	-0.340*	-0.232	-0.219	-0.026	0.299*	-0.394**	0.076

\* Value of 'r' significant at 5% level.    \*\* Value of 'r' significant at 5% level.  
 LC = Leaf Caterpillar    LF = Leaf folder    LM = Leaf Miner

## VENGURLA

The Correlation between the pest incidence and weather parameters were determined and the correlation coefficients indicated that the TMB infestation showed positively significant relationship with rainy days(0.728). It showed negative relationship with maximum temperature (-0.373), morning and evening relative humidity (-0.356 & -0.075) and rainfall and it showed positive relationship with minimum temperature. The infestation of Thrips showed negative correlation with minimum temperature (-0.236), rainy days (-0.502). Leaf miner showed negative relationship with minimum temperature (-0.358) and rainy days(-0.409) Whereas Apple and nut borer showed negative relationship with relative humidity (evening) (-0.537) , and number of rainy days (-0.472) (Table 3.39 )



**Table 3.39 : Correlation between the pest incidence and weather parameters at Vengurla**

	<b>TMB</b>	<b>Thrips</b>	<b>Leaf miner</b>	<b>Apple &amp; Nut Borer</b>
<b>Maximum Temperature</b>	-0.373	0.308	0.258	0.333
<b>Minimum Temperature</b>	0.318	-0.236	-0.358	-0.472
<b>Morning Humidity</b>	-0.356	0.327	-0.124	0.051
<b>Evening Humidity</b>	-0.075	-0.435	0.527	-0.537
<b>Rainy days</b>	0.728**	-0.502	-0.409	-0.482
<b>Rainfall</b>	-0.195	-0.179	-0.105	-0.105

\* - 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 have negative correlation with maximum temperature (Table 3.40 ).

**Table 3.40 : 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) (Y <sub>1</sub> )	0.63*	0.25	0.24	*0.22	-0.36	0.52	*0.41
Leaf and blossom webber (Y <sub>2</sub> )	-0.76*	-0.43	-0.35*	-0.27	-0.23	-0.30	0.53
Apple and nut borer (Y <sub>3</sub> )	0.50	0.42	0.63	-0.34	0.30	-0.33	0.45
Leaf miner (Y <sub>4</sub> )	-0.23	0.38	0.47	0.53	0.62	0.47*	-0.40
Leaf roller (Y <sub>5</sub> )	-0.60*	-0.43	-0.38*	-0.25	-0.36	-0.34	0.46
Shoot tip caterpillar (Y <sub>6</sub> )	-0.23	0.25	0.48	0.33	0.49	0.46*	-0.41
Aphids (Y <sub>7</sub> )	-0.22	0.24*	0.49*	0.57*	0.54	0.41*	-0.44
Cashew Stem and Root Borer (Y <sub>8</sub> )	0.66*	0.58	-0.23	-0.52	-0.46	-0.44	0.52

\* = Significant at 0.05 level

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

##### ***Centres : East Coast :***

Bapatla, Bhubaneswar, Jhargram and Vridhachalam

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##### ***West Coast :***

Madakkathara and Vengurla

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##### ***Plains / others :***

Chintamani, Jagdalpur

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

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#### **SUMMARY:**

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#### **BAPATLA**

During 2009-10 among the important foliage and flower feeders the incidence of leaf and blossom webber and shoot tip caterpillar was observed to a low extent in different germplasm entries. The entries viz., T.No.275, T.No.274, T.No.4/5, T.No.1/1, T.No.4/3, T.No.8/7 were found tolerant to the leaf and blossom webber which recorded 1.9 to 2.4 percent damage as against the highest damage of 7.2 percent in T.No.40/1.

The germplasm line T.No.274 recorded the lowest damage by shoot tip caterpillar (STC) of 1.6 per cent where as Vetapalem has recorded the highest damage of 6.1 per cent due to shoot tip caterpillar ([Table 3.41](#)).

**Table 3.41 : Screening of germplasm against major pests of cashew at Bapatla during 2009-2010**

Entry	ICNO	Leaf and blossom webber damaged shoots (%) (a)	No.of Inflorescence thrips/ 10 panicles (b)	Shoot tip caterpillar damaged shoots (%) (a)
T.No.275	249982	1.9(7.94)	5.1(2.37)	2.5(9.04)
T.No.274	302488	2.2(8.51)	7.65(2.85)	1.6(7.13)
T.No.1/1	---	2.4(8.77)	5.15(2.37)	2.4(8.77)
T.No.8/7	302437	2.4(8.95)	4.95(2.32)	2.4(8.95)
T.No.4/3	302442	2.4(8.93)	7.85(2.88)	2.4(8.95)
T.No.4/5	---	2.3(8.70)	7.35(2.73)	2.4(8.93)

Figures in parentheses are arc sin transformed values.

Figures in parentheses are sqr. root (x + 0.5) transformed values

## BHUBANESWAR

Almost all the accessions were infested by both shoot tip borer (0-5%) and leaf and blossom webber (0-5 %). Inflorescence thrips (Yellow Thrips and Black Thrips) population was with a range of 0-10 numbers/ inflorescence (Table 3.42 ).

**Table 3.42 : Screening of germplasm to locate tolerant / resistant to major pests of the region at Bhubaneswar**

Pest	Germplasm	Min. occurrence	Germplasm	Max. Occurrence
<b>STC</b>	OC8,OC10, OC75, OC83,OC65	0.5 to 1.5%	OC22,OC67, OC70,OC73, OC74, OC80,OC56	>02 to 5%
<b>IT</b>	OC4,OC10,OC40, OC39 ,OC12,OC41,OC12 , OC58,OC64	0.5 to 5 No. / panicle	OC29,OC44, OC22,OC65, OC68,OC72,	> 5 to 10 No /panicle
<b>LBW</b>	OC5,OC22,OC9,O C28 ,OC29,OC46	0.5 to2.0%	OC58,OC61, OC79, OC81, OC82,OC49	> 2 to 5 %

## CHINTAMANI

The reaction of germplasm maintained at the centre were observed against TMB. Among 108 germplasm, the germplasm accessions, ME-4/4 and 1/64-Madhuranthakam were found flushing and flowering early, hence they escape from the TMB infestation.

## JAGDALPUR

Out of the Eleven released varieties and promising hybrids screened It was observed that the TMB mean damage was absent in NRCC Sel-1, Ullal-1 and Ullal-2 either on shoot on panicle. The population of *Myloccerus* beetle was not observed in Mdk-1, Mdk-2, K-22, VRI-1 and VRI-2. The inflorescence thrips population was minimum (0.02 numbers per 10 panicles) in MDK-2, VRI-1 and VRI-2 (Table 3.43 ).

**Table 3.43: Screening of germplasm to regional pest incidence at Jagadapur during 2009-10.**

Accession No.	TMB mean damage score 0-4 scale in 52 leader shoots		Inflorescence thrips (mean No. per 10 panicle)
	Shoot	Panicle	
NRCCSel - 1	0.00	0.00	0.10
NRCCSel - 2	0.00	0.18	0.40
V - 1	0.00	0.13	0.29
V - 4	0.00	0.13	0.21
Ullal- 1	0.00	0.00	0.52
Ullal - 2	0.00	0.00	0.65
MDK - 1	0.48	0.46	0.13
MDK - 2	0.26	0.35	0.02
K - 22	0.23	0.00	0.06
VRI - 1	0.00	0.67	0.02
VRI - 2	0.16	0.24	0.02

## **MADAKKATHARA**

The TMB damage score varied from 0.08 (Anagha) to maximum 0.82 in Poornima. The leaf miner infestation was moderate to severe throughout the season (Oct-Dec) coinciding the bud break and flushing. Mean percentage infestation of leaf miner occurred during Oct-Mar and varied between 0.25 (minimum in Goa-1) to 12.19 (maximum in Sulabha). Shoot webber per tree recorded were within the range of 0.16 (Ullal-3, V-6, V-1, Jhargram-1, Chintamani-1, BPP-4 and Dhana) to 1.83 (Dharasree). Leaf caterpillar incidence was absent in most of the varieties while Ullal-1, V- 4, Anagha, Raghav, K-22-1 and Kanaka were found to be infested.

## **VENGURLA**

The observations on incidence of TMB on cashew were recorded throughout the year with an interval of 8 days. The variety Vengurla-7 recorded lowest TMB infestation (2.16%) followed by Vengurla-3 (2.48%) and Vengurla-2 (2.52%) whereas the maximum per cent damage was recorded in 30/1 (6.67%) followed by Vengurla - 4 (6.05%).

## **VRIDHACHALAM**

The damage score for TMB infestations in various MLT entries ranged from 0.0–1.0. The score was nil in H 33/3 and ME 20/1. In other entries, the mean damage score was 1.0. However, none of the entries have shown resistant reactions to TMB infestation. In the case of F<sub>1</sub> hybrids, all the cross combinations were susceptible to TMB infestation. However, the damage score was low in H 11 (0.6) followed by H14 with a mean damage score of 0.8.

## **CHAPTER II : ORGANISATION**



## **CHAPTER II : ORGANISATION**

## 1. HISTORY, OBJECTIVES, GROWTH AND SALIENT ACHIEVEMENTS

The All India Coordinated Spices and Cashew nut Improvement Project (AICS & CIP) was started during the fourth five year Plan in 1971. The AIC & CIP had five centres (four University Centres and one ICAR Institute based centres) identified for conducting research on cashew. These centres were located at Bapatla (Andhra Pradesh), Vridhachalam (Tamil Nadu), Anakkayam (Kerala) (Later shifted to Madakkathara), Vengurla (Maharashtra) and CPCRI, Regional Station, Vittal (Karnataka). During the fifth Plan period, one centre at Bhubaneswar (Orissa) and in sixth plan period two centres one at Jhargram (West Bengal) and another at Chintamani (Karnataka) were added. During VIII Plan period one centre at Jagdalpur (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.

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 of Karnataka at Chintamani, Chhattisgarh at Jagdalpur and at Darisai in Jharkhand and three cooperating 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; and

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

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

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

## **ACHIEVEMENTS :**

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

- Since its inception, a total of 29 high yielding cashew varieties have been developed and released to the farmers by different centres of AICRP Cashew.
- Collected local germplasm materials with desirable characters such as high yield, cluster bearing habit, bold sized nuts, short duration of flowering, off season flowering types from different cashew growing regions and are being vegetatively multiplied and field planted in different centres. Number of cashew accessions so far collected and conserved by the Coordinating Centres in Regional Cashew Field Gene Bank comes to 1225.
- At Bhubaneswar, 47 accessions had bold nut character with a nut weight ranging from 7.00g to 15.00 g (OC-128), 81 accessions had shelling percentage ranging from 28.00 to 38.50 (OC-110). At Jagdalpur, the accession NRC-131 had a high shelling percentage of 32.72
- At Vengurla, accessions RFRS 173 and RFRS 177 had higher number of panicles/m<sup>2</sup> being 17.33 and 16.50 respectively.
- A local collection, CARS-10 was found to be tolerant to short spells of low temperature (2 – 2.5°C) at Jagdalpur Centre, which had no leaf shedding as in other collections.
- Four cashew trees indicating possible tolerance to salt water inundation have been identified from Tsunami affected plantations at Cuddalore and Nagapattinam.
- Multi-location trials of cashew have been laid out at different centres to study the yield and other parameters of varieties developed and its suitability at different regions.
- Under spacing trials the cumulative yield for 5 years was highest in 600pl/ha (83.4q/ha) followed by 400pl/ha (74.68q/ha) and 200pl/ha (38.39q/ha) at Bhubaneswar.

- A package of practices has been developed for fertilizer application, spacing and thinning. Application of 500g N; 125g P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O each per tree per year was found to be suitable.
- Intercropping with ginger, turmeric, cluster bean, black gram, horse gram, ground nut, vegetables such as colocasia, tapioca, brinjal, bhindi, cucumber, chillies and medicinal plants with cashew as main crop during the initial stage of orchard development were evaluated and recommended for the economic upliftment of farmers at different locations.
- Under intercropping trials conducted at Bhubaneswar, total net returns per hectare from inter-crops as well as main crop after 4 years revealed that maximum return was received from colocasia (Rs 66,216/-) followed by bhindi (Rs. 58,155/-), while in control it was Rs 40,075/-. At Jhargram, the benefit cost ratio of 2.44 in cashew + bottle gourd which was the most profitable followed by cashew + amaranths (1.93).
- Under hybridization trials, H-68 performed the best at Bhubaneswar by yielding 38kg/tree for 9 harvests during 2004-05 while H-7 and H-17 yielded 76.44kg/tree and 71.35kg/tree for 13 harvests at Madakkathara centre during 2005-06.
- L-cyhalothrin (0.003%), Profenophos (0.05%), Triazopohos (0.1%) could effectively check the damage by tea mosquito bug, leaf and blossom webber, leaf miner, apple and nut borer as well as thrips in most of the centres.
- Chlorpyriphos was the best post extraction treatment resulting in consistently more than 70 per cent of the treated trees without reinfestation at Vengurla, Jhargram, Bhubaneswar, Chintamani and Jagdalpur. Chlorpyriphos 0.2% resulted in 83.33% trees without re-infestation or persistent attack as post extraction prophylaxis at Bapatla, while maximum recovery (90%) was obtained at Bhubaneswar,
- The centres have also been producing quality-planting materials for the respective regions to meet the requirement of farmers and developmental agencies.

**Salient achievements of the Project during 2009-10 :**

**TO BE ADDED**

## **1 a. REPORT OF THE NATIONAL GROUP MEETING OF SCIENTISTS OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW-2009**

The National Group Meeting of Scientists of All India Coordinated Research Project on Cashew-2009 was held during 13-15<sup>th</sup> November 2009 at Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. The National Group Meeting was inaugurated by Dr. P. Subbian, Dean, TNAU on 13<sup>th</sup> November 2009 and in his Inaugural Address he mentioned about the fast expansion of cashew in non-traditional areas and stressed the need for adoption of recent scientific techniques in cashew production. Dr. M.G. Bhat, Director, Directorate of Cashew Research and Project Coordinator, AICRP on Cashew, presented the Project coordinator's report regarding the salient achievements under AICRP-Cashew for the past two years. Dr. M. Paramathma, Director of Research, TNAU in his Keynote address mentioned about the potential of cashew in non-traditional areas and also stressed better utilization of cashew apple to enhance net returns for the cashew farmers. Dr. T. Jayaraj, Director, Tamil Nadu Rice Research Institute, Aduthurai in his special address stressed on meeting the challenges in international cashew market for which reorientation of research programmes need to be done. He emphasized intensification of hybrid development programmes, pest management and better transfer of technology.

The Technical Sessions on Crop Improvement, Crop Management and Crop Protection were held during 13-15<sup>th</sup> November 2009. The research results obtained from different trials at the AICRP centers viz., Bapatla, Bhubhaneswar, Chintamani, Jagadapur, Jhargram, Madakkathara, Pilicode, Vengurle and Vridhachalam were presented by the scientists of the respective disciplines from each Centre. Results from the trials on germplasm collection and maintenance, varietal evaluation, performance of released varieties, hybridization and selection were presented in Crop Improvement session. Results from trials on NPK fertilizer experiments, fertilizer requirements in high density planting, drip irrigation trials, intercropping trial and information on planting for organic farming trial were presented in Crop Management session. Findings from the trials on chemical control of pest complex in cashew (Tea Mosquito Bug and other foliage pests), control of cashew stem and root borer, biotic and abiotic factors influencing incidence of Pests etc., were presented in Crop Protection session. A session on Interaction between Development Departments and Research Centres was also held in which extension activities and development programmes were discussed after presentations by

representatives of State Cashew Corporations and Directorate of Cashewnut and Cocoa Development. The technical programmes of different projects and trials were discussed.

The Plenary Session was chaired by Dr. H.P. Singh, Dy. Director General (Hort.), ICAR and in his remarks he stressed about orienting the research activities based on the field problems. He also suggested purification of clones by adopting selfing of high yielding seedlings. He also recommended higher number of frontline demonstration on ultra high density planting in cashew along with drip irrigation. The recommendations of different technical sessions were presented subsequently. The recommendations for trials on crop improvement comprising of relationship of biometrical observations on yield and also maintaining uniformity in multilocation trials. It was recommended that polyclonal hybridization and recombination breeding be taken up. The entries H 303, H 320 and NRCC Sel.2 were found to be performing well in almost all centres and hence need to be considered for release as varieties / recommended for cultivation in case of already released varieties, as the case may be. It was decided that hybridization of Vengurla-4 with other local varieties to be made in all centres in order to develop suitable high yielding hybrids. The general recommendations made in crop management session included a need for soil test based fertilizer recommendation. It was also recommended that biomass removed during canopy management should be quantified and the same needs to be demonstrated in the farmers plots. Economics of the best treatment in high density planting system needs to be worked out. Efficacy of L-cyhalothrin, profenophos and triazophos on foliage pests of cashew was deliberated in the crop protection session. All the centres should report the effectiveness of Lambda cyhalothrin against tea mosquito bug (TMB), other pests and natural enemies. Caution should be exercised by entomologists while using Lambda cyhalothrin, a synthetic pyrethroid which may pose problems like resurgence of sucking pests. The possibility of using entomopathogenic nematodes (EPN) for the management of cashew stem and root borers (CSRB) be explored and the methodology of application of EPN should be standardized. Discussion regarding modifying the common name of tea mosquito bug led to a conclusion that the same common name may be retained. In the session on "Interaction between development departments and Research Centres", the strategies suggested were active involvement by State Govt. agencies, thematic campaigns, establishment of demonstration plots, role of AICRP Cashew centres and promoting self-help groups in the vicinity of research centres.





**Inaugural Session of NGM – 2009**



**Dr.H.P.Singh, Deputy Director General (Hort.) addressing the Plenary session.**

## 2. TRANSFER OF TECHNOLOGY :

A total of 3,78,549 grafts were produced during 2009-10 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:

<b>Centre</b>	<b>No. of grafts produced</b>
Bapatla	3000
Bhubaneswar	28200
Chintamani	7500
Jagdalpur	44000
Jhargram	2500
Madakkathara	72000
Pilicode	75000
Vengurla	85949
Vridhachalam	60400
<b>TOTAL</b>	<b>378549</b>

### **BAPATLA**

Entomologist of this station conducted extensive survey of cashew plantations in various villages of Guntur, Prakasam, West Godavari, Khammam, East Godavari and Vishakapatnam districts for pest incidence during the cropping season of 2010. The scientists also participated in live interactive programme telecast organized by Doordarshan at RARS-Anakapalli during March 2010 to discuss about various aspects of cashew production technology..

### **BHUBANESWAR**

Scientists of this Centre imparted training on cashew production technology to 100 trainees deputed by State Department of Horticulture. They also participated in training programmes for Self-Help Groups (SHGs), Gardeners & Grafters trainees under State Horticulture Department of Orissa and 150 farmers of Ganjam Cashew

Cluster, on the cashew production technology. Scientists of Cashew research station actively participated as members in the joint verification programme for evaluation of replanting programme of cashew executed by OSCDC and OFDC under financial assistance of DCCD, Kochi, Kerala.

### **CHINTAMANI**

Scientists of this centre participated in TV interview on “Plant protection in cashew”, telecast in Annadata of E-TV channel and delivered a radio talk on “Improved cultivation of Cashew” in Kannada from AIR, Bangalore. They were involved in exhibitions wherein activities of AICRP(C) were displayed at Sericulture College, Chintamani during August, 2009 and at the Krishi Mela, UAS (Bangalore) during November, 2009. Four campaigns on management of cashew stem and root borers (CSRB) were organized in association with DCR, Puttur, DCCD, Kochi and AICRP (C), Chintamani on symptoms of CSRB and its management at Anoor village of Sidlagatta, Murukanakunte village of Mulbagal, Kundalpurki village of Sidlaghatta and Kagathi village of Chintamani on 23<sup>rd</sup> to 26<sup>th</sup> February 2010. The scientists of Chintamani centre participated as resource persons and delivered 17 lectures in the trainings organized by State Department of Agriculture, State Marketing Board, Bangalore and KVK, Chintamani. More than 66 field visits were made on various aspects of cashew and suitable suggestions were provided to the cashew farmers.

### **JAGDALPUR**

Scientists of this centre were involved in Front Line Technology Demonstration Cashew in Bastar region which was funded by Directorate of Cashew & Cocoa Development Kochi, Kerala and other aligned departments, Jilla panchayats and Watershed Programme for expanding area under Cashew plantation. Farmers

trainings on “Rejuvenation of old cashew plantation” ,“Cashew graft plantation techniques”, “Utilization of cashew apple “ were also organized by this centre. Scientists of this centre have also been involved in field visits to create awareness about cashew cultivation amongst farmers in the Bastar region.

### **JHARGRAM**

Scientists of this Centre were involved as Resource Person in Farmers Training Programmes on Cashew cultivation technology, Nursery management in cashew for SHGs and local farmers. This Centre is also functioning as a cooperating Centre for National Agricultural Innovation Project for Establishing Cashew based Livelihood Development among the farmers of Patashimul Gram .Panchayat under Jhargram block. Demonstration plots were laid out regarding high density plantation and fertilizer evaluation at different blocks of Jhargram were maintained and suggestions were provided as and when needed.

### **MADAKKATHARA**

Scientists of this Centre organized training classes on “Cashew production technology”, “Recent advances in production and processing technologies for cashew”, State level farmers training programme on Cashew, and five pilot demonstrations on “Cashew apple processing” funded by DCCD, Kochi. Scientists of this Centre were part of the expert team constituted by the KAU to identify the reasons for the occurrence of large scale flower drying and die back in Plantation Corporation of Kerala Ltd.

“Cashew field day” was organised at Kelakam, Kannur district with the financial support of DCCD, Kochi in which 330 progressive cashew farmers participated.

Technical guidance was provided for establishment of The Kelakam Cashew Apple Processing Unit, and commercial launching of cashew apple syrup, cashew apple-mango mixed jam and cashew apple candy was done. The scientists also delivered radio talks on Challenges in cashew cultivation in Kerala Cashew cultivation – scientific management practices

Technologies for the processing of cashew apple viz., Clarification of cashew apple juice with sago Off- season storage of cashew apple juice, pulp and green pieces and procedure for preparation of cashew apple syrup, cashew apple RTS beverage, cashew apple- pine apple squash cashew apple - mango mixed fruit jam, pickle, candy, wine and vinegar were also standardized by this Centre.

### **PILICODE**

The cashew demonstration plots laid out by the Centre are in fourth year of maintenance Scientists of this Centre have conducted 23 trainings and seminars have been conducted on various aspects of cashew cultivation. A radio talk on “Organics in Plantation crops” was broadcast from AIR, Kannur. The scientist of this centre has functioned as resource person in trainings on Cashew Production Technology and Cashew Apple Processing.

### **VENGURLA**

Scientists of this centre were involved in various extension activities viz., demonstrations on cashew soft wood grafting technique, cashew blossom protection, management of cashew stem and root borer etc. in which farmers, agriculture officers participated. Trainings were conducted on planting technology and after

care of newly planted cashew grafts, nutrient management in cashew and management of CSRB, cashew apple processing, cashew nuts and apple processing and storage of cashew nuts. State level cashew workshop and exhibition and workshop on cashew production, processing and marketing were also organized by the Centre. Farmer's and Scientist Forum is set up by this Centre and interactive meetings are organized every month at Research Station and at farmer's field.

### **VRIDHACHALAM**

The centre has laid out 28 new demonstration plots in Cuddalore and Pudukottai districts to popularize high density planting. Trainings were organized on Cashew Production technology in which more than 100 farmers had participated.

Large Scale Demonstration in cashew to increase productivity through high density planting and improved package of practices-with improved variety VRI 3, nutrient management and foliar spray funded by ICAR-TNAU has been started during this year. Frontline demonstration on scientific cashew farming funded by the DCCD, Kochi has also been conducted by the centre. A state level workshop on cashew cultivation and pilot demonstration on utilization of cashew apple Utilization were organized by this Centre. In order to popularize the use of cashew apple for various edible product preparations among the cashew farming community, method demonstrations were also organized by this Centre, in which 125 women beneficiaries had participated.

### **3. STAFF POSITION**

#### **HEADQUARTERS**

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

#### **PROJECT CENTRES**

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

Horticulturist : Dr.K.T.Venkata Ramana  
Asstt. Horticulturist : Dr. T. Padmalatha (From 01.4.2009)  
Asstt. Entomologist : Dr.P.Lakshmi Soujanya (till 05.4.2009)  
Mr.Ch.Chinnabbai (From 27-11-2009 )  
Sr. Technical Assistant : Sri. M. Sambasiva Rao  
Jr. Technical Assistant : Mr. K. Ranga Rao (Upto 31.07.2009)  
Mr.Samuel (From 21-12-2009)  
Grafter : Mr. V. Kantha Rao

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

Horticulturist : Dr. A.K. Pattnaik  
Jr. Horticulturist : Dr. K.C. Mohapatra (till Dec.2009)  
Jr. Entomologist : Dr. P.C. Dash  
Sr. Technical Assistant : Sri A. Mansingh  
Jr. Technical Assistant : Sri R. N. Dash  
Grafter : Mr. Laxman Biswal

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

Horticulturist	: Mr. M.N. Narasimha Reddy
Jr. Horticulturist	: Dr. K.M. Rajanna
Entomologist	: Ms. Vidya Mulimani ( From 15.12.2009)
Sr. Technical Assistant	: Mr. Babu V. ( from 26.6.2009)
Sr. Technical Assistant	: Mr. G.V. Narayanaswamy
Grafter	: Mr. R. Lokeshbabu

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

Jr. Horticulturist	: Mr. L.S. Verma (From March 2009)
Jr. Entomologist	: Mr. Khoobhi Ram Sahu
Sr. Technical Assistant	: Vacant
Grafter	: Mr. Jagdev

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

Horticulturist	: Vacant
Jr. Horticulturist	: Dr. Mini Poduval
Jr. Entomologist	: Dr. S. Chakraborti (upto Oct. 2009)
Sr. Technical Assistant	: Vacant
Jr. Technical Assistant	: Vacant
Grafter	: Vacant



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

Horticulturist	: Dr. Jose Mathew
Jr. Breeder	: Mr. Gregory Zachariah
Jr. Entomologist	: Dr. Haseena Bhaskar (till 30.3.2010)
Sr. Technical Assistant	: Dr. A. Sobhana
Jr. Technical Assistant	: Mr. M.K. Manoj
Grafter	: Vacant

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

Jr. Horticulturist	: Dr. B. Jayaprakasha Naik
Jr. Technical Assistant	: Mr.Sudish Kumar (From 31.1.2010)

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

Horticulturist	: Dr. M. S. Gawankar
Jr. Breeder	: Shri. R.T. Bhingarde
Jr. Entomologist	: Mr. V.N. Jalgaonkar
Sr. Technical Assistant	: Mr. R.D. Sawale
Jr. Technical Assistant	: Mr.N.R.Parab (from 15.8.2009)

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

Horticulturist	: Dr. S. Jeeva
Jr. Horticulturist	: Dr. M. S. Aneesa Rani
Jr. Entomologist	: Dr. V. Ambethgar
Sr. Technical Assistant	: Vacant
Jr. Technical Assistant	: Mr. C. Jayachandran
Grafter	: Mr. C. Gopalakrishnan

#### 4. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2009-10

Allocation

(Rs. in lakhs)

Centre	Details of sanctioned provision					ICAR share	State share
	Pay and Allowances	TA	Recurring contingency	Non-Recurring contingency	Grand Total		
Bapatla	10.00	0.50	3.00	0.00	13.50	10.13	3.37
Bhubaneshwar	21.00	0.70	4.50	0.00	26.20	19.65	6.55
Chintamani	16.34	0.60	3.00	0.00	19.94	14.95	4.98
Jagdapur	6.00	0.35	2.00	0.00	8.35	6.26	2.09
Jhargram	5.00	0.50	2.80	0.00	8.30	6.23	2.08
Madakkathara	15.14	0.60	3.00	0.00	18.74	14.05	4.69
Pilicode	5.26	0.20	1.00	0.00	6.46	4.84	1.61
Vengurla	13.34	0.70	4.50	0.00	18.54	13.90	4.64
Vridhachalam	14.88	0.60	3.00	0.00	18.48	13.86	4.62
Paria	4.50	0.25	1.80	0.00	6.55	4.91	1.64
<b>Cooperating Centres</b>							
KRCCH, Arabhavi	0.00	0.25	2.00	0.00	2.25	1.69	0.56
ICAR Res. Compl. For Goa, Goa	0.00	0.25	2.00	0.00	2.25	1.69	0.56
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.25	2.00	0.00	2.25	1.69	0.56
Unforeseen research needs funds (RRS, Virdhachalam)	0.00	0.00	4.20	0.00	4.20	3.15	1.05
<b>Total</b>	<b>111.46</b>	<b>5.75</b>	<b>38.80</b>	<b>0.0</b>	<b>156.01</b>	<b>117.00</b>	<b>39.00</b>

## Actual Expenditure

(Rs. in lakhs)

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	12.13	0.17	1.53	0.00	13.83	10.37
Bhubaneshwar	27.45	0.19	1.71	0.00	29.35	22.01
Chintamani	15.66	0.34	3.00	0.00	19.00	14.25
Jagdalpur	7.45	0.26	2.10	0.00	9.82	7.36
Jhargram	4.51	0.00	2.29	0.00	6.80	5.10
Madakkathara	26.88	0.56	3.00	0.00	30.44	22.83
Pilicode	7.48	0.19	0.67	0.00	8.34	6.25
Vengurla	16.21	0.69	3.31	0.00	20.21	15.16
Vridhachalam	22.87	0.56	3.00	0.00	26.43	19.82
Paria	4.50	0.25	1.80	0.00	6.55	4.91
<b>Cooperating Centres</b>						
KRCCH, Arabhavi	0.00	0.25	2.00	0.00	2.25	1.69
ICAR Res. Compl. For Goa, Goa	0.00	0.25	2.00	0.00	2.25	1.69
ICAR Res. Compl. For NEH Region, Barapani	0.00	0.25	2.00	0.00	2.25	1.69
Unforeseen research needs funds (RRS, Virdhachalam)	0.00	0.00	4.20	0.00	4.20	3.15
<b>Total</b>	<b>145.14</b>	<b>3.96</b>	<b>32.61</b>	<b>0.0</b>	<b>181.72</b>	<b>136.28</b>

## **5. MONITORING OF PROJECT BY PROJECT COORDINATOR**

Project Coordinator reviewed the progress made by the Centres by correspondence and discussion and visited the centres at Bhubaneswar, Jharkhand and Pilicode and monitored the progress of these Centres. In Jharkhand, identified Darisai as a suitable location to establish the centre of AICRP on Cashew.

## **6. FUNCTIONING OF EACH CENTRE**

### **BAPATLA**

The centre has been established during 1971. At present there are three scientists working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist respectively. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. Technical advice has been provided by scientists of the centre to cashew farmers. The scientists also participated in live telecast interactive programme organized by Doordarshan at RARS-Anakapalli during March 2010, to discuss about various aspects of cashew production technology..

### **BHUBANESWAR**

The centre has been established in 1975. At present there are three scientists working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. also participated in training programmes for Self-Help Groups (SHGs), Gardeners & Grafters trainees under State Horticulture Department of Orissa and 150 farmers of Ganjam Cashew Cluster, on the cashew production technology. Scientists of Cashew research station actively participated as members in the joint verification programme for evaluation of replanting programme of cashew executed by OSCDC and OFDC under financial assistance of DCCD, Kochi, Kerala.

## **CHINTAMANI**

The centre has been established in 1980. At present there are three scientists working under the project in the posts of Horticulturist, Jr. Horticulturist and Jr. Entomologist. Presently three projects in Crop Improvement, six in Crop Management and four in Crop Protection are being carried out. Scientists of this centre acted as resource persons in training programmes organized by State Department of Agriculture at Chikkballapur and Kolar districts and delivered several lectures on cashew production technology and other aspects. A T.V. programme on “Plant protection in cashew” , was telecast in Annadaatha of E-TV channel and delivered a radio talk on “Improved cultivation of Cashew” in Kannada from AIR, Bangalore. The scientists of Chintamani centre participated as resource persons and delivered 17 lectures in the trainings organized by State Department of Agriculture, State Marketing Board, Bangalore and KVK, Chintamani.

## **JAGDALPUR**

The centre has been established in 1993. At present there are two scientists working under the posts of Jr. Horticulturist and Jr. Entomologist under the project. Presently there are three projects in Crop Improvement, two in Crop Management and four in Crop Protection, which are allotted to the centre. Scientists of this centre are involved in Watershed Programme for Cashew plantation, Drought Prone Area Programme & Integrated Waste Land Development Programme. Scientists of this centre were involved in Front Line Technology Demonstration Cashew in Bastar region which was funded by Directorate of Cashew & Cocoa Development Kochi, Kerala and other aligned departments, Jilla panchayats and Watershed Programme for expanding area under Cashew plantation. This centre is also associated with National Horticulture Mission and providing technical support and grafts.

## **JHARGRAM**

The centre has been established in 1982. At present there are two scientists working under the project in the posts of Junior Horticulturist and Junior Entomologist. One post of Horticulturist is lying vacant. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. Demonstration plots were freshly laid out regarding high density plantation and fertilizer evaluation at different blocks of Jhargram. This Centre is also functioning as a cooperating Centre for National Agricultural Innovation Project for Establishing Cashew based Livelihood Development among the farmers of Patashimul Gram .Panchayat under Jhargram block.

## **MADAKKATHARA**

The centre has been established in 1972. At present there are three scientists working under the project in the posts of Horticulturist, Junior Breeder and Junior Entomologist. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. Technologies for the processing of cashew apple viz.,Clarification of cashew apple juice with sago Off-season storage of cashew apple juice, pulp and green pieces and procedure for preparation of cashew apple syrup, cashew apple RTS beverage, cashew apple-pine apple squash cashew apple - mango mixed fruit jam, pickle, candy, wine and vinegar were also standardized by this Centre. Technical guidance was provided for establishment of The Kelakam Cashew Apple Processing Unit, and commercial launching of cashew apple syrup, cashew apple- mango mixed jam and cashew apple candy was done.

## **PILICODE**

The centre has been established in 1993. At present there is one scientist working under the project in the post of Junior Horticulturist. Presently three projects, two in Crop Improvement and one in Crop Management. Training and seminars have been conducted on cashew propagation, cashew cultivation and cashew apple utilization. Field visits were undertaken by scientists of this centre to alleviate problems regarding pests, diseases, water logging and management in cashew for which suitable recommendations were given. Scientists of this Centre have conducted 23 trainings and seminars have been conducted on various aspects of cashew cultivation. A radio talk on “ Organics in Plantation crops” was broadcast from AIR,Kannur.

## **VENGURLA**

The centre has been established in 1970. At present there are three scientists working under the project in the posts of Horticulturist, Junior Breeder and Junior Entomologist. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. Trainings were conducted on planting technology and after care of newly planted cashew grafts, nutrient management in cashew and management of CSRB, cashew apple processing, cashew nuts and apple processing and storage of cashew nuts. Farmer’s and Scientist Forum is set up by this Centre and interactive meetings are organized every month at Research Station and at farmer’s field.

## **VRIDHACHALAM**

The centre has been established in 1971. At present three scientists are working as Horticulturist, Junior Horticulturist and Junior Entomologist. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being

carried out. The centre has laid out 15 new demonstration plots in Cuddalore and Pudukottai districts. Frontline demonstration on organic farming has also been conducted by the centre. A state level workshop on cashew cultivation and pilot demonstration on utilization of cashew apple were also organized by this Centre in which 50 participants were involved.

### **PARIA**

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

Another new centre at Darisai, East Singhbhum Dist in Jharkhand has been established in 2010 during XI Plan, under Birsa Agricultural University.

### **CO-OPERATING CENTRES**

Three cooperating centres are also functioning under AICRP-Cashew. They are Kittur Rani Chennamma College of Horticulture, Arabhavi, Karnataka; ICAR Research Complex for Goa, Ela Old Goa, Goa and ICAR Research Complex for NEH, Tura, Meghalaya. Various trials on Crop Improvement or on Crop Management have been allotted to these Centres.



## 7. METEOROLOGICAL DATA OF DIFFERENT CENTRES FOR THE YEAR 2009-10

### BAPATLA

Month& Year	Max. temp (°C)	Min. Temp (°C)	RH (%) (m)	RH (%) (e)	Rainfall (mm)	No. of Rainy days
April 09	35.2	25.9	77	70	--	--
May 09	37.2	27.3	72	69	38.2	6
June 09	40.4	28.3	57	44	27.4	7
July 09	37.3	27.5	61	52	30.4	11
Aug. 09	36.1	26.2	75	64	213	16
Sep. 09	34.4	25.5	79	70	216.1	16
Oct. 09	33.4	24.4	80	67	3.6	5
Nov. 09	30.7	22.7	89	82	147.9	17
Dec. 09	30.0	19.1	88	70	5.0	1
Jan. 10	30.1	19.0	92	70	14.1	3
Feb. 10	30.8	19.3	90	69	--	--
Mar 10	33.4	23.6	86	73	--	--
<b>TOTAL:</b>	--	--	--	--	<b>695.7</b>	<b>82</b>

### BHUBANESWAR

Month & Year	Temp. (Max)	Temp. (Min)	RH (Max)	RH (Min)	Rainfall	No. of rainy days	BSH
April 2009	38.7	25.8	90.7	43.5	-	-	8.2
May	37.5	26.5	86.2	53.3	66.1	4	8.1
June	38.3	26.8	86.9	51.2	85.8	7	7.0
July	31.4	25.5	93.7	78.8	410.3	25	2.0
August	33.1	26.0	93.5	74.5	392.3	21	4.1
September	33.2	25.9	95.5	71.5	252.4	16	4.9
October	33.8	22.7	93.3	56.7	135.0	7	7.6
November	31.2	20.0	89.7	51.6	32.8	3	7.6
December	29.3	15.3	92.9	40.2	-	-	8.0
Jan. 10	28.3	14.1	88.2	38.7	5.6	1	7.7
Feb. 10	33.4	18.4	93.7	33.6	0	0	8.4
Mar 10	37.4	24.3	91.8	48.0	0	0	5.4

## CHINTAMANI

Month & Year	Temp. (Max)	Temp. (Min)	RH (Max)	RH (Min)	Rainfall	No. of rainy days	BSH
April 09	32.83	25.75	61.43	26.13	7.93	21.2	2
May 09	31.12	25.91	67.97	42.23	7.24	136.8	7
June 09	29.29	24.73	71.1	52.33	7.32	44.4	1
July 09	27.75	24.05	72.35	57.94	4.11	5.6	1
Aug. 09	28.19	23.7	74.71	55.71	7.27	153.2	5
Sep. 09	26.41	23.29	79.03	64.4	5.51	208.2	9
Oct. 09	26.46	23.89	67.13	53.35	7.45	10.4	1
Nov. 09	24.44	21.8	84.03	70.67	5.22	66.47	9
Dec. 09	23.74	19.96	82.42	67.65	5.69	9.8	2
Jan. 10	25.66	20.01	73.06	43.94	7.06	-	-
Feb. 10	30.13	22.71	59.21	27.00	9.10	-	-
Mar 10	32.88	27.27	45	24.84	8.30	2.8	1

## JAGDALPUR

Month	Max. Temp 0C	Min. Temp 0C	Rainfall (mm)	Relative Humidity		Bright Sunshine Hours
				I	II	
April 09	30.1	17.2	0.0	57	17	1.0
May 09	30.0	15.4	0.0	53.0	18.0	1.0
June 09	27.5	20.0	106.3	56.0	14.0	0.0
July 09	23.5	20.0	476.7	76.0	61.0	0.0
Aug. 09	25.0	20.5	251.0	19.9	58.0	0.0
Sep. 09	28.0	21.0	109.1	71.0	55.0	0.5
Oct. 09	28.0	11.0	63.0	68.0	36.0	1.8
Nov. 09	23.5	7.6	58.4	62.0	33.0	0.0
Dec. 09	25.0	5.0	0.0	48.0	71.0	1.5
Jan. 10	25.0	4.0	28.9	8	36	1.5
Feb. 10	26.6	6.6	4.5	84	27	3.4
Mar 10	30.0	1.0	0.0	75.0	24.0	1.8

## JHARGRAM

Month	Temp ° C		RH %		Total Rainfall (mm)	No. of rainy days
	Max	Min	Max	Min		
April 09	39.9	26.6	68.5	49.0	49.5.0	6
May 09	40.8	28.3	68.7	45.6	80.5	9
June 09	36.5	26.9	66.0	69.5	201.2	17
July 09	36.9	25.9	72.3	77.9	309.2	16
Aug. 09	35.8	26.3	74.7	82.0	333.0	19
Sep. 09	34.7	26.0	78.3	70.0	290.4	17
Oct. 09	34.8	24.0	70.4	58.6	20.4	5
Nov. 09	29.8	18.8	61.6	52.4	0	0
Dec. 09	25.5	12.2	65.2	51.0	0	0
Jan. 10	20.73	12.83	60.6	49.0	0	0
Feb. 10	33.67	14.62	77.2	47.6	0	0
Mar 10	39.0	20.2	70.0	49.9	0	0

## MADAKKATHARA

Month & Year	Temperature (°C)		Relative Humidity (%)	Sunshine hours (h)	Rainfall (mm)	Rainy days (No.)
	Max.	Min.	Average			
Apr 09	34.5	25.3	74	173.2	16.5	2
May 09	33.0	24.8	77	170.1	199.5	10
June 09	30.0	23.7	84	116.0	656.0	19
July 09	28.6	22.8	88	53.1	985.8	29
Aug 09	30.2	23.2	85	125.7	421.4	21
Sept 09	30.0	23.2	83	120.0	276.0	15
Oct 09	32.0	23.2	77	209.1	166.8	5
Nov 09	31.5	23.7	76	171.4	180.6	9
Dec 09	31.8	23.9	62	241.6	42.7	1
Jan 10	32.5	22.7	61	280.0	00.0	0
Feb 10	34.9	23.7	59	253.6	00.0	0
Mar 10	36.2	24.8	65	258.9	12.9	1

## PILICODE

Month & year	Temperature ( °C)		Relative humidity (%)		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
April 09	35.4	20.8	84	62	83.6	6
May 09	38.5	22.4	85	66	100.8	9
June 09	33.2	21.1	93	71	597.8	27
July 09	32.6	21.1	96	84	1497.7	31
Aug. 09	31.7	20.4	95	77	427.8	25
Sep. 09	31.1	19.6	96	79	271.8	24
Oct. 09	32.7	20.0	92	71	97.5	7
Nov. 09	34.0	18.6	92	67	217.4	13
Dec. 09	33.8	15.4	91	57	11.5	3
Jan. 10	33.7	16.3	92	53	0.0	0
Feb. 10	34.1	18.0	88	57	0.0	0
Mar 10	35.5	19.0	87	60	0.0	0

## VENGURLA

Month	Temperature (0c)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	Forenoon	Afternoon		
April 09	33.86	24.75	82.39	61.84	0.00	0.0
May 09	33.70	25.10	81.90	67.91	52.10	2.0
June 09	30.50	24.62	86.56	77.95	636.26	28.0
July 09	29.56	24.78	90.09	86.74	1534.00	30.0
Aug. 09	29.50	26.66	88.91	78.83	254.00	25.0
Sep. 09	30.49	24.20	91.05	80.87	345.60	18.0
Oct. 09	31.19	23.23	90.17	75.09	660.40	8.0
Nov. 09	32.05	21.94	86.29	66.95	132.00	8.0
Dec. 09	30.74	19.50	88.26	60.02	1.00	1.0
Jan. 10	32.95	18.87	87.85	56.75	0.60	1.0
Feb. 10	32.29	18.96	89.25	62.71	0.00	0.0
Mar 10	33.53	21.89	90.18	64.59	0.00	0.0

**VRIDHACHALAM**

<b>Month &amp; Year</b>	<b>Temperature °C</b>		<b>Relative Humidity (%)</b>		<b>Rainfall (mm)</b>	<b>No. of rainy days</b>
	<b>Max.</b>	<b>Min.</b>	<b>A.M.</b>	<b>P.M.</b>		
April 09	36.78	37.02	82.80	44.28	27.2	2
May 09	38.89	38.52	72.10	20.70	112.4	3
June 09	38.40	38.27	67.70	22.79	9.6	1
July 09	38.11	37.94	69.71	41.47	56.8	4
Aug. 09	36.90	36.68	75.65	56.90	236	7
Sep. 09	35.98	37.12	82.30	65.72	107.8	9
Oct. 09	36.00	36.50	78.00	67.00	37.8	3
Nov. 09	31.17	31.12	87.63	82.79	470.2	17
Dec. 09	29.73	29.63	85.39	79.50	143	10
Jan. 10	31.00	18.35	90.03	81.39	33.6	4
Feb. 10	33.45	20.02	90.54	76.36	-	-
Mar 10	36.96	22.40	90.55	64.68	-	-

## **8. RESEARCH PUBLICATIONS**

### **JAGDALPUR**

Chaudhary, J.L. and Sahu, K.R. 2009. Association of weather parameters with population fluctuations of Tea Mosquito bug of cashew in Bastar region of Chhattisgarh. *J. of Agro-meteorology* 11 (Special Issue): 153-155 (2009)

Sharma, D., Sahu K.R. and Singh, J. 2009. Studies of flowering behavior in cashew (*Anacardium occidentale* L.). *Indian J. of Horticulture*. Vol. 66(4), pp.429-432 (2009).

### **MADAKKATHARA**

Jose Mathew, Sobhana, A. and Mini. C. 2009. Technologies for commercial production of cashew apple products- their impact on livelihood security and economic growth (Invited paper). Abstracts, International Conference on Horticulture 2009, 9- 12 November 2009, Bangalore

Sobhana, A, Mini.C and Jose Mathew 2009. Cashew apple processing for vinegar production. Abstracts, International conference on Food Technology (INCOFTECH 2009), IICPT, Thanjavur, 28- 30<sup>th</sup> August 2009

Jose Mathew, Sobhana A and Mini, C. 2009. Multiple uses of cashew apple and opportunities for commercial exploitation. Proc. 7<sup>th</sup> National Seminar on “Cashew development in India – enhancement of production and productivity”, 2-3 November, 2009, Bhubaneswar, pp 49 – 57

Elsy C.R., Jose Mathew, and Arun, S. 2009. Protection of geographical indications of cashew products for enhancing market potential. Proc. 7<sup>th</sup> National Seminar on “Cashew development in India – enhancement of production and productivity”, 2-3 November, 2009, Bhubaneswar, pp 79 – 81

Jose Mathew, Sobhana A and Mini, C. 2009. Technological advancements in cashew apple processing and potentials for commercial applications. Proc. 7<sup>th</sup> National Seminar on “Production system management in adverse conditions for higher productivity”, 22- 24 December 2009, Port Blair, pp. 32.

Jose Mathew, A. Sobhana, Mini. C. 2010. Opportunities for income enhancement from cashew plantation through cashew apple processing. 2<sup>nd</sup> International Cashew Conference, 27 – 29 April 2010, Kampala, Uganda

## **PILICODE**

Babylatha, A.K. and Jayaprakash Naik, B., Preliminary Studies on the impact of training on the utilization of the cashew apple, 2009, The Cashew and Cocoa Journal, April- June

## **VENGURLA**

S. A. Chavan and M. S. Gawankar. (2009). Present Status and Future Strategies for Enhancement of Cashew Productivity and Production in Maharashtra. Paper presented in Cashew Quest held in Goa at the International Lalit Goa Resort on 11-13 September, 2009. Souvenir 2009. pp 9-12.

S. A. Chavan and M . S. Gawankar. (2009). Prospects of On farm Processing in Cashew. Paper presented during the National Seminar on Cashew held at at Bhubaneswar, Orissa during 02-03 November,2009. Souvenir pp.64 -67.

## **9. LIST AND ADDRESSES OF CENTRES OF AICRP ON CASHEW**

### **HEADQUARTERS**

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

### **New Centres added in the XI Plan**

1. Agricultural Experimental Station,  
Navsari Agricultural University,  
Paria, Pardi Taluk, Valsad Distt.,  
GUJARAT
2. Zonal Research Station,  
Birsa Agricultural University,  
East Singhbhum  
JHARKHAND

### **Co-operating Centres**

1. KRC College of Horticulture,  
Arabhavi – 591 310,  
Gokak Taluk, Belgaum Distt.  
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Phone : 08332 – 284 502 (O)
2. ICAR Research Complex for Goa,  
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3. ICAR Research Complex for NEH Region  
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Meghalaya  
Phone : 0364-2570257 (O)  
E-mail : [director@icarneh.ernet.in](mailto:director@icarneh.ernet.in)

## 10. LIST OF DCR PUBLICATIONS

Sl. No.	Publication	Price Rs.
1	Cashew Production Technology (Revised)	50.00
2	Softwood grafting and nursery management in cashew	35.00
3	a) Annotated Bibliography on Cashew (1985-1994)	75.00
	b) Annotated Bibliography on Cashew (1995-2007)	205.00
4	Catalogue of Minimum Descriptors of Cashew	
	Germplasm accessions – I	165.00
	Germplasm accessions –II	125.00
	Germplasm accessions –III	128.00
5	Status of Cashew Germplasm Collection in India (Bulletin)	
6	Compendium of Concluded Research Projects (1986-2001)	
7	Sudharitha Geru Besaaya Kramagalu (Booklet in Kannada)	15.00
8	Nutritive Value of Cashew - Revised (Brochure)	
9	Database on Cashewnut Processing in India (2003)	100.00
10	Directory of Cashewnut Processing Industries in India (2003)	100.00
11	Process Catalogue on Development of an Economically viable On-farm Cashewnut Processing	45.00
12	Cashew Cultivation Practices	
13	Soil and water management in cashew plantations	30.00
14	Biochemical characterisation of released varieties of Cashew	85.00

Please send your enquiries to the Director, Directorate of Cashew Research (DCR), Puttur – 574 202, DK, Karnataka.

Price indicated above does not include postage.

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## **9. LIST AND ADDRESSES OF CENTRES OF AICRP ON CASHEW**

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6	Status of Cashew Germplasm Collection in India (Bulletin)	
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8	Compendium of Concluded Research Projects (1986-2001)	
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