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

वार्षिक प्रतिवेदन
ANNUAL REPORT
2008-09

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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Dr. M. Gopalakrishna Bhat
Director
Directorate of Cashew Research, Puttur
Phone : (08251) 231530; EPABX : (08251) 230902, 236490
FAX : 08251 – 234350
E-mail: dircajures@yahoo.com, dircajures@gmail.com, dircajures@rediffmail.com
Grams: CAJUKENDRA, PUTTUR

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

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Edited by

Dr. T.N. Raviprasad
Dr. M. Gopalakrishna Bhat

Word-processed by

Dr. T.N. Raviprasad
Mrs. Reshma K

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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 मैं 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 है।

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

इस प्रतिवेदन मे दो अध्याय है, जैसे,

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

(एम गोपालकृष्ण भट)
निदेशक एवं परियोजना समन्वयकर्ता

पुत्तुर - 574 202
दिनांक : 5.12.2009

ABOUT THIS REPORT

This is the twenty fifth 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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परियोजना समन्वयकर्ता की रिपोर्ट

अखिल भारतीय समन्वित मसाला व काजू अनुसंधान पारयोजना 1971 में चौथी पंच वार्षिक योजना में शुरु की गई, जिसका मुख्यालय केंद्रीय रोपण फसल अनुसंधान संस्थान कासरगोड में था। सातवी पंचवार्षिक योजना में इस परियोजना को दो स्वतंत्र परियोजनावों - एक काजू व दूसरी मसाले में 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 छटठी 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 बढाना 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 2008-09 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

Under the trials on germplasm collection, conservation, evaluation, characterization and cataloguing, the total number of accessions conserved so far in various Regional Cashew Field Gene Banks (RCFGBs) is 1225. At Bapatla, maximum annual nut yield/tree (19.10Kg) was recorded in T.No. 15/4 in the 8^{th} harvest. Out of 94 accessions evaluated at Bhubaneswar, 21 accessions had bold nut with nut weight ranging from 7.00g (OC-66) to 9.60 g (OC-129). At Chintamani, 44/1-ARSC (Vengurla-5) recorded highest cumulative yield of 348.53kg/tree in 20 harvests. High shelling percentage exceeding 30.0 per cent was observed in accessions JGM-147 to JGM-151 at Jhargram. At Vengurla, accessions RFRS 173 and RFRS 177 had higher number of panicles/m^2 being 17.33 and 16.50 respectively. RFRS 179 had highest nut weight of 11.00g.

Under varietal evaluation trials, the variety T.No 10/19 produced the highest cumulative nut yield (78.69 kg / tree) followed by T.No. 30/1 (66.49 kg/ tree) in 14 harvests at Bapatla. At Bhubaneswar, the number of flowering laterals/m^2 was maximum in M-44/3 (18.0). Highest nut yield of 9.72 kg/tree was recorded in H-320 at Chintamani followed by M-44/3 (8.86 kg/tree). The nut weight and apple weight was maximum in H-367 (9.60g and 77.20g respectively) at Vengurla.

Under the trials on multi location trial-III, the variety BPP-8 showed longer duration of flowering (152days) with maximum number of flowering laterals per square meter (18.75) at Bapatla while BH-85 and H-14 had maximum number of flowering laterals per square meter (16.00) at Bhubaneswar. At Chintamani highest cumulative nut yield was recorded in H 1593 (8.49kg/pl/ha) followed by Goa 11/6 (7.61kg/pl) while at Madakkathara, highest cumulative yield was recorded by Goa 11/6 (7.77 kg) followed by H-1593 (7.47 kg) for 3 harvests.

Under hybridization trials, the highest cumulative yield for 7 harvests at Bapatla was obtained in H-36 (24.80kg) followed by H-10 (20.03kg). At Bhubaneswar, hybrid A6 (BH-6) recorded the highest cumulative nut yield (kg/plant) of 52.6 for 9 harvests. At Chintamani, the average nut weight of promising hybrids H-151, H-188, H-191 and H-216 were 9.60, 10.20, 10.70 and 11.90 g respectively. At Jhargram, the best yielding hybrid was H – 41 (Annual yield of 14.70 Kg/tree) followed by H – 57 (13.60 Kg/tree) and H – 23 (13.2Kg/tree). At Madakkathara H - 36 performed well for annual yield (13.30kg/tree) and H - 21 performed well for cumulative yield for 12 harvests (139.92 kg/tree). At Vengurla, three hybrids were found performing well for yield in 4th harvest (H 1306, H 969, H 886).

CROP MANAGEMENT

Under trials on evaluation of NPK fertilizer experiment at Bapatla, the highest cumulative nut yield was recorded in the treatment N2P1K1 (75.97 Kg/tree) followed by N2P2K1 (70.96 Kg/tree). At Chintamani, on the limb pruned trees, higher nut yield (4.46 kg / tree) were recorded by application of 500:250:250 g. NPK / tree /

year during third year. At Madakkathara, the highest nut yield was recorded by DCR dose (750 : 187.5 : 187.5g NPK/tree) followed by KAU dose (750 : 325 : 750g NPK/tree). At Vridhachalam, the treatment 1000:125:250 g NPK / plant recorded the highest nut yield of 10.50 kg/tree.

Under fertilizer application in high density cashew plantations, , the cumulative yield at 7th harvest was highest in M_2 150 kg N, 50 kg P_2O_5, 50 kg K_2O (9494.1 kg) followed by M_3 225 kg N, 75 kg P_2O_5, 75 kg K_2O (9276.6 kg) at Bhubaneswar. At Chintamani, the highest nut yield per ha. was recorded by S_3 600 plants/ha (5m x 4m) (18.08 q/ha) and lowest was recorded by S_1 200 plants/ha (10m x 5m) (11.52 q/ha). There was no significant difference among the spacing and fertilizer treatments for any growth character at Vengurla and Vridhachalam.

Under observational trials on high density, at Chintamani, the mean yield kg/ha (1000kg/ha) and mean cumulative nut yield (5951 kg/ha) were higher compared to normal planting. At Madakkathara, the per hectare yield was significantly higher (3.27 times) under high density planting (2766 kg) as compared to normal density (846 kg). The cumulative yield per ha for nine harvests was significantly higher under high density system (20044kg/ha) as compared to normal density planting (5366 kg/ha).

Under drip irrigation trial, at Chintamai, nut yield of 8.10 kg/tree with a nut weight of 7.4 g. and shelling per cent of 32.1 and cumulative yield of 3 harvests (26.89kg) was observed in irrigation at 80% CPE. At Vengurla, mean yield was maximum (3.32 kg/tree) in the irrigation treatment at 20 % C.P.E. and the cumulative yield for six harvests was maximum in the irrigation treatment at 40 % C.P.E. (21.02 Kg/tree).

Under trial on intercropping in cashew, at Bhubaneswar, the maximum net return was received from colocasia (Rs 69,956) followed by bhindi (Rs. 59,420). At Jhargram, the yield of cashew was 6.00 Q/ha without an intercrop while it was 9.87Q/ha with amaranthus. The benefit cost ratio of 2.44 in cashew + bottle gourd was the most profitable followed by cashew + amaranths (1.93). In terms of tuber yield at Madakkathara, tapioca recorded the maximum yield (11.3 t/ha) and C: B ratio (1.96) followed by amorphophallus (10.3 t/ha). At Vridhachalam, with medicinal plants as intercrops, *Ocimum* had highest BCR of 2.4.

CROP PROTECTION

Under experiments for evaluation of insecticides for control of TMB and other insect pests At Bhubaneswar, TMB damage incidence was lowest in L-cyhalothrin (0.85%) as compared to the control (2.48%). The apple and nut borer incidence was lowest in λ Cyhalothrin treatment (0.5 %) which also led to minimum thrips damage score (0.16 %). At Chintamani minimum damage due to thrips on apple (0.6%) and nuts (0.5%) was observed in L-cyhalothrin treatment. At Jagdalpur, the nut yield was highest (175. 13 kg/ha) in Triazphos 0.1% , which was at par with L-cylohalothrin 0.003% (136.17 kg/ha). Least thrips damage scores were recorded in T_1 (recommended regional spray) (0.11) at Jhargram. At Vridhachalam, the damage score was nil in recommended spray schedule, L Cyhalothrin 0.003% and Profenophos 0.05% after third spray.

Under curative control trial for management of cashew stem and root borer (CSRB), at Bapatla, chlorpyriphos 0.2% resulted in 83.33% trees without re-infestation or persistent attack as post extraction prophylaxis. At Bhubaneswar, maximum recovery (90%) was obtained in chlorpyriphos 0.2% treatment followed by monocrotophos 0.2% (78.5%). At Chintamani, chlorpyriphos (1.0%) was most effective with 90.45% trees without reinfestation. At Jagdalpur, treatment with chlorpyriphos-0.2% led to maximum recovery of 88.89 % trees without re-infestation. At Jhargram, Chlorpyriphos and Carbaryl were equally the most effective treatments in which none of the treated trees had reinfestation by CSRB. Chlorpyriphos (0.2%) recorded cent per cent trees without reinfestation followed by Carbaryl (1%) and Monocrotophos (0.2%) which recorded 86.66 per cent trees without reinfestation at Vengurla. At Vridhachalam, maximum recovery of 66.6% was noted in chlorpyriphos (0.2%) treated trees, followed by monocrotophos (0.2%) in which 63.2% of treated trees had no reinfestation.

Under studies on influence of biotic and abiotic factors on the incidence of pest complex of cashew, population of tea mosquito bug had positive correlation with relative humidity and maximum temperature at Jagdalpur and Vridhachalam and had strong negative correlation with maximum temperature and relative humidity at Vengurla. Leaf and blossom webber was positively influenced by both maximum and minimum temperature at Bapatla. Leaf miner was influenced negatively by

maximum temperature and relative humidity at Jagdalpur and Vengurla. Shoot tip caterpillar was positively influenced by relative humidity at Vridhachalam while maximum temperature and rainfall negatively influenced the pest population at Bapatla and Vengurla. Apple and nut borer populations were positively influenced by maximum temperature at Bhubaneswar negatively influenced by rainfall and relative humidity at Vengurla.

Screening of germplasm to locate tolerant / resistant types to major pests of the region indicated that the entries T 12/8, T18/3 and T 40/1 were tolerant to incidence of leaf and blossom webber at Bapatla by recording less than 2% damage. At Chintamani, the early duration accessions viz., ME 4/4 and 1/64 Madhuranthakam were found to escape TMB incidence. The accession CARS-5 did not have incidence of flower thrips and apple and nut borer at Jagdalpur.

TRANSFER OF TECHNOLOGY

A total of more than 1.77 lakh were produced during the current year and distributed to several government and non-government organizations as well as to cashew cultivators.

The scientists of Bapatla participated in the Raithu Chaitanya Yatra in which technology dissemination to farmers on various aspects of cashew cultivation was undertaken. Scientists of Bhubaneswar centre were involved in evaluation of replanting programme of cashew undertaken by OSCDC. Scientists of Chintamani centre acted as resource persons in training programmes organized by State Department of Agriculture at Chikkballapur and Kolar districts and delivered several lecturers on cashew production technology and other aspects. Scientists of Jagdalpur centre are involved in Watershed Programme for Cashew plantation, Drought Prone Area Programme & Integrated Waste Land Development Programme. This centre is also associated with National Horticulture Mission and providing technical support and grafts.

Scientists of Madakkathara centre conducted an international training programme on “Development of high yielding varieties, production of elite planting material and cashew apple processing” for participants from Senegal, West Africa. Scientists of Pilicode, Vengurle and Vridhachalam centres have laid out demonstration plots on various aspects of cashew cultivation and conducting regular field visits to provide recommendations for the problems faced by cashew farmers.

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, Bhubaneshwar, Jhargram and Vridhachalam. This zone receives low to medium rainfall ranging from 800 mm to 2000 mm annually and is distributed over a period of 7-8 months from June to January. The soil is mainly sandy, red sandy loam, red loam and laterite. Bapatla centre is situated at an elevation of 54.9 m from mean sea level (MSL) with 40° 54' latitude and 80° 28' longitude. At Bapatla the annual average rainfall is 1167 mm and the temperature ranges from 17.3 to 37.8° C; the soil is sandy soil with low organic matter, medium N, low P_2O_5 and K_2O. Average water holding capacity (AWC) of soil is 100 mm and the climate is sub humid (dry). At Bhubaneshwar average rainfall is 1550 mm and the temperature ranges from 14.3 to 37.1° C. The soil is red soil, red loamy and laterite. The climate is sub humid (dry), AWC 100 mm. The Jhargram centre is located 87° longitude and 78.8° latitude. At Jhargram average rainfall is 1622 mm and the temperature ranges from 11.3 to 39.4° C. The soil is red, laterite, shallow depth gravels, low in organic matter, N and high in P_2O_5 and K_2O. The climate is sub humid (dry), AWC 200 mm. At Vridhachalam average rainfall is 1215 mm and the temperature ranges from 18.7 to 35.7° C, the soil is red laterite, low in organic matter and N, medium in P_2O_5 and high in K_2O. The climate is semi arid (dry), AWC 125 mm.

The centres in the West Coast are located at Madakkathara, Pilicode 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_2O_5 and high in K_2O. The climate is semi arid (dry), AWC is 150mm. Jagdalpur is located at 17^o 45' to 20^o 34' N and 80^o 15'to 82^o 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^o C and 6^o 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

West Coast

Madakkathara, Pilicode and Vengurla

Plains / others

Chintamani and Jagdalpur

The objectives of the project are:

(a) To evaluate the existing germplasm of cashew in different centres

(b) To collect local germplasm material with desirable characters such as high yield, cluster bearing habit, bold sized nuts, duration of flowering, off season flowering types from different cashew growing regions and,

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

SUMMARY:

The total number of accessions conserved so far in various Regional Cashew Field Gene Banks (RCFGBs) is 1225. At Bapatla, maximum annual nut yield/tree (19.10Kg) was recorded in T.No. 15/4 in the 8th harvest. Out of 94 accessions evaluated at Bhubaneswar, 21 accessions had bold nut with nut weight ranging from 7.00g (OC-66) to 9.60 g (OC-129). At Chintamani, 44/1-ARSC (Vengurla-5) recorded highest cumulative yield of 348.53kg/tree in 20 harvests. High shelling percentage exceeding 30.0 per cent was observed in accessions JGM-147 to JGM-151 at Jhargram. At Vengurla, accessions RFRS 173 and RFRS 177 had higher number of panicles/m^2 being 17.33 and 16.50 respectively. RFRS 179 had highest nut weight of 11.00g.

Germplasm Collection:

During the current year, 13 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 1225 (Table 1.1).

During the current year, at Bhubaneswar centre one collection (RP-5) having bold nut with a nut weight 11.50 g was collected from Ranasingpur, Khurda which had estimated nut yield of 1.50 kg/plant.

One germplasm (BCKV-13) was collected by Jhargram centre from the farmers field from Godbeta Block- III of Paschim Medinipur district which had upright and compact canopy (4m), intensive branching type with 12

flowering laterals per square meter with 6 nuts/panicle.The nut weight was 7.77g, shelling percentage was 31.86% and yield was approximately 22 kg/tree.

Table 1.1: Cashew germplasm holding in different centres.

Centre	No. of accessions		
	Earlier existing	Collected during 2007-08	Existing
East Coast			
Bapatla	132	-	132
Bhubaneshwar	97	1	98
Jhargram	118	1	119
Vridhachalam	208	-	208
West Coast			
Madakkathara	128	2	130
Pilicode	43	-	43
Vengurla	297	5	302
Plains tract/others			
Chintamani	128	--	128
Jagdalpur	61	4	65
Total	**1212**	**13**	**1225**

Germplasm Evaluation :

The growth and yield parameters of cashew germplasm available at different AICRP-Cashew Centres have been evaluated during 2008-09 and the relevant results are reported here.

BAPATLA

Maximum annual nut yield/tree (19.10Kg) was recorded in T.No. 15/4 followed by T.No.71 (19.0 Kg) in the 8th harvest. Among the promising accessions, the highest cumulative nut yield for 8 harvests was recorded in the entry T.No.8/7 (48.69 Kg/ per tree) (Table 1.2).

Table 1.2 : Growth and yield parameters of accessions/ varieties at Bapatla

Accession Number	Plant height (m)	Plant spread (m) E-W	Plant spread (m) N-S	Nut weight (g)	Annual nut yield/tree (Kg) (8th harvest)	Cum. nut yield/tree(Kg) 8 harvests
T.No.71	6.60	5.50	7.00	6.68	19.00	42.97
T.No.268	5.93	9.93	7.10	6.25	12.00	45.06
2/15	7.50	8.80	11.00	6.42	12.50	26.32
3 /4	7.05	7.10	7.70	5.60	14.80	27.65
4/5	6.74	9.90	7.85	4.99	15.00	28.91
5/1	7.06	10.10	8.86	3.07	16.98	31.16
8/7	6.96	8.56	7.84	6.02	14.80	48.69
15/4	5.90	7.00	6.10	7.98	19.10	32.95
Hy-95-4	7.60	11.50	11.10	4.51	10.80	30.38

BHUBANESWAR

Due to occurrence of heavy hailstorm during February 2008, the crop was drastically affected and hence no yield was obtained.

Out of 94 accessions, 21 accessions had bold nut with nut weight ranging from 7.00g (OC-66) to 9.60 g (OC-129), 53 accessions had shelling percentage ranging from 29.0 (OC-131) to 36.0 (OC-146) and 12 nos. of accessions had 3 to 4 nuts/panicle (OC-12, OC-78 & OC-147). At 3rd harvest the cumulative nut yield (kg/plant) ranged from 3.10 (OC-69) to 4.20 (OC-109).

CHINTAMANI

Out of 128 germplasm collections maintained at ARS, Chintamani, 107 accessions are yielding.

Among the promising four accessions, during the year 2008-09 the accession 44/1- ARSC (Vengurla-5) recorded highest nut yield of 42.00 kg/tree followed by 41/3 ARSC (5/37 Manjeri) which recorded nut yield of 18.40 kg/tree. The accession 41/3- ARSC (5/37 Manjeri) recorded highest nut weight of 7.50 g with 29.10 shelling per cent followed by 56/1- ARSC (K-3-C) with 6.30 g nut weight and 30.20 per cent shelling.

Among four promising accessions of the germplasm collections 44/1-ARSC (Vengurla-5) recorded highest cumulative yield of 348.53kg/tree

followed by 41/3-ARSC (5/37 Manjeri) (307.74 kg/tree) for 20 harvests (Table 1.3).

Table 1.3: Yield performance of promising germplasm accessions at Chintamani

Accession	Year of planting	Nut Yield (kg/tree)	Cum. nut yield (kg/tree)	Mean nut weight (g)	Shelling (%)
3/108 Gubbi (2/6 ARSC)	1982	10.50	268.62 (24hvts)	5.80	28.70
5/37 Manjeri (41/3 ARSC)	1985	18.40	307.74 (20hvts)	7.50	29.10
Vengurla - 5 (44/1 ARSC)	1985	42.00	348.53 (20hvts)	5.70	28.50
K-3-C (56/1 ARSC)	1993	12.80	111.10 (11hvts)	6.30	30.20

JAGDALPUR

The nut yield/tree was highest for NRC- 137 (8.95 Kg), followed by NRC–193 (7.73 Kg). The cumulative nut yield was highest in NRC-137 (39.65 Kg) with 10 harvests. Mean nut weight was found to be highest for NRC-190 (10.00 g) followed by NRC-131 and NRC-138 with 8.40 g. Shelling percentage was found to be highest in NRC- 131 (31.50%) (Table 1.4).

Table 1.4 : Performance of cashew germplasm accessions (planted during 1996-97) at Jagdalpur

Accession	Mean weight/ nut (g)	Mean weight/ apple (g)	Yield during 2008-09 (Kg)	Cum. yield Kg/plant (10 No. of harvests)	Shelling (%)
NRC- 130	7.50	47.00	3.17	15.29	29.80
NRC- 131	8.40	34.60	4.17	17.36	31.50
NRC- 136	7.00	24.00	3.96	15.81	29.50
NRC- 137	6.00	18.60	8.95	39.65	31.20
NRC- 138	8.40	58.00	5.21	28.22	31.50
NRC- 140	8.20	50.04	4.68	21.52	28.70
NRC- 190	10.00	20.00	2.25	11.92	30.80
NRC- 191	6.17	33.00	5.42	28.05	31.10
NRC- 192	8.00	65.00	5.56	13.57	28.40
NRC- 193	5.60	35.40	7.73	25.83	30.10

JHARGRAM

Among the local collections (primary collections) 6 germplasms planted during 2004 are found to be promising.

JGM – 148 had maximum numbers of nuts per square meter (38.10) and nuts per panicle (9.80). JGM – 148 had a nut weight of 6.0 and the shelling was 33.40%. Annual yield was highest (7.32 Kg/tree) and cumulative yield was also highest in case of JGM – 148 (7.43Kg/tree) (Table 1.5).

Table 1.5 : Yield attributes of promising cashew primary germplasm collections (planted during 2004) at Jhargram

Accession No.	Flowering /m^2	Nuts/ m^2	Nuts/ panicle	Nut weight (g)	Yield (Kg/tree)	Cum. yield Kg/tree (2^{nd}. harvest)	Shelling %
JGM – 147	12.30	20.80	7.80	5.90	4.01	4.63	33.10
JGM – 148	7.00	38.10	9.80	6.00	7.32	7.43	33.40
JGM – 149	10.70	17.10	4.50	5.40	2.69	3.13	33.30
JGM – 150	8.90	8.10	2.10	6.80	1.56	1.58	30.00
JGM – 151	5.90	20.80	5.80	6.20	3.51	4.32	33.80
JGM – 152	12.10	15.90	3.10	7.30	3.11	3.54	28.30
S Em +	2.240	2.803	1.729	0.006	0.477	0.652	0.055
C.D.at 5%	4.991	6.244	3.852	0.013	1.062	1.453	0.123
CV%	40.80	24.10	54.40	0.20	22.30	25.30	0.30

Among the secondary germplasm collections, it was observed that JGM –222 produced nuts with maximum weight (8.40g) followed by JGM – 251 (7.90g). Maximum shelling percentage was noticed with JGM – 228 (39.90%) followed by JGM – 222 (38.60%) and JGM- 251 (35.50%). Maximum yield /m^2 was reported with JGM – 222 (301.30g). Mean apple weight was the maximum with JGM – 251 (68.80g) (Table 1.6).

Table 1.6 : Performance of promising secondary germplasm accessions (planted during 2005) at Jhargram

Accession No.	Mean nut wt (g)	Mean Apple wt (g)	Yield/m^2 (g)	Annual nut yield (kg/tree) (1^{st} harvest)	Cum. yield (kg/tree) (1 harvest)	Shelling %
JGM – 222	8.40	42.50	301.30	2.91	2.91	38.60
JGM – 228	6.70	30.00	162.50	1.57	1.57	39.90
JGM – 231	6.50	40.00	115.00	2.95	2.95	31.40
JGM – 252	6.80	45.00	65.80	0.55	0.55	32.20
JGM – 251	7.90	68.80	122.60	2.25	2.25	35.50

MADAKKATHARA

Accession Kainur recorded maximum height (5.95 m), maximum girth (80.00 cm) and highest canopy spread (7.15 m). Highest yield was recorded by Pathanoor (4.20 kg/tree) followed by Kunjithai (4.00 kg/tree) during the current season (Table 1.7).

Table 1.7: Growth characters of accessions of the germplasm collection planted during 2002-2003 at Madakkathara

Accession	Height (m)	Girth (cm)	Canopy spread EW (m)	canopy spread NS (m)	Mean canopy spread (m)	Yield kg/tree/ year
KTR-1	3.87	52.25	4.05	4.25	4.15	2.80
KTR-3	4.68	69.50	5.85	6.05	5.95	2.20
Kiralur	4.87	79.10	5.40	5.80	5.60	2.00
Mannur	5.60	78.75	5.88	5.75	6.71	2.00
Kainur	5.95	80.00	8.20	6.10	7.15	3.20
Ummanoor	4.89	65.00	6.30	5.10	5.75	3.00
Kottukkal	4.12	67.20	5.15	5.80	5.31	1.60
Peechi	4.17	51.00	4.23	4.43	4.33	1.90
Kunjithai	4.89	60.00	4.83	4.70	4.56	4.00
Pathanoor	4.32	54.50	3.95	4.24	4.10	4.20
ARL-1	4.08	43.00	3.93	4.96	4.44	1.20
KTR-2	4.43	53.00	4.57	3.87	4.22	1.80
ARL-2	4.45	52.00	4.02	3.96	3.98	2.75
ODR	4.12	47.40	3.90	3.80	3.85	2.60

PILICODE

PLD – 4 was found to be superior in annual nut yield (7.26kg) and cumulative nut yield (22.64kg) followed by PLD-12 (19.35 kg/tree) and PLD-1 (18.73 kg/tree). The number of panicles per square meter was highest in PLD 57 (6.32) followed by PLD-4 (5.25) (Table 1.8).

Among the germplasm planted during 2003, the accession, PLD 62 was found to be superior in yield (4.37kg) (Table 1.9).

Table 1.8 : Performance of cashew germplasm accessions (planted during 1998& 2000) at Pilicode

Accession No./Variety	Height (m)	Stem girth (cm)	Canopy spread(m)		No. of panicle/ sqm	Yield of nuts/tree (Kg)	Cum. nut yield /tree (Kg)
			E-W	N-S			
PLD-1	7.85	72.60	5.27	5.69	2.20	6.22	18.73
PLD-3	8.79	83.90	5.28	5.86	3.20	5.23	12.03
PLD-4	7.50	79.38	5.63	5.61	5.25	7.26	22.64
PLD15	7.20	63.25	5.53	5.15	6.20	2.95	6.70
PLD-16	6.83	65.75	4.20	3.88	2.40	4.26	11.78
PLD-12	8.35	87.50	7.25	6.75	2.07	6.42	19.35
PLD-18	8.33	74.50	5.80	5.48	4.02	2.92	5.21
PLD-17	8.55	82.50	8.20	7.90	2.20	2.50	3.84
PLD-19	8.60	72.00	7.10	5.60	2.62	2.95	4.72
PLD-20	8.73	84.00	4.60	5.46	2.03	3.20	4.67
PLD 57	1.17	31.10	3.17	3.10	6.32	0.47	1.02
CD 0.05	Ns	NS	1.32	1.11	0.76	0.65	0.67

Table 1.9 : Performance of cashew germplasm (planted during 2003) at Pilicode

Accession No./Variety	Plant Height (m)	Collar Girth (cm)	Canopy Spread (m)		No.of Panicle/ sqm	Yield of nuts/tree (Kg)
			E-W	N-S		
PLD 75	5.50	30.00	2.29	2.62	0.10	2.50
PLD 44	2.60	24.00	2.40	1.95	0.47	1.45
PLD 54	4.01	50.30	4.41	4.33	0.24	3.83
PLD 74	2.20	19.00	1.80	4.40	0.35	3.75
PLD 31	6.00	71.67	5.06	5.96	0.28	2.85
PLD 62	6.00	68.00	5.60	6.00	0.27	4.37
PLD 56	5.17	48.50	3.42	3.41	0.28	3.90
PLD 82	5.30	52.00	2.80	2.90	0.94	2.80
PLD 64	3.60	47.50	5.37	5.80	0.20	2.50
PLD 45	6.10	55.00	5.60	5.50	0.36	3.60
CD 0.05	1.09	14.91	0.99	1.68	0.36	0.78

VENGURLA

Among the 14 types, RFRS 184 recorded lowest mean height (2.90m) where as, mean laterals and flowering panicles per sq.m. were highest in RFRS 173 type i.e. 30.66 and 17.33 per sq.m. respectively. As far as yield is concerned RFRS 178 recorded highest yield i.e. 4.45 Kg followed by RFRS 177 (2.20 Kg/plant) at 4th harvest RFRS 179 had highest nut weight (11.00g) (Table 1.10).

Table 1.10 : Performance of cashew germplasm conserved at Vengurla

Accession	Mean height (m)	Mean stem girth (cm)	Mean Spread (m)		Mean panicles /Sq. m	Fruit set / m^2	Mean Yield (Kg) (4th harvest)	Mean Nut weight (g)
			E.W.	N.S.				
RFRS 171	4.60	59.00	5.80	5.90	13.00	11.50	-	-
RFRS 172	4.20	56.30	5.50	5.50	13.33	11.00	-	-
RFRS 173	4.90	55.30	5.30	5.40	17.33	12.70	0.50	6.80
RFRS 174	5.80	63.00	4.60	5.40	13.33	8.30	-	-
RFRS 175	6.00	46.70	4.30	4.30	13.33	7.70	-	-
RFRS 176	4.70	52.70	5.50	4.20	15.66	9.00	1.60	6.00
RFRS 177	4.70	53.00	5.90	6.00	16.50	22.50	2.20	6.50
RFRS 178	6.10	59.00	5.50	7.10	13.50	24.00	4.45	5.00
RFRS 179	4.80	41.00	5.00	3.90	7.66	19.30	1.05	11.00
RFRS 180	6.10	55.30	6.30	5.20	11.66	8.30	0.45	5.00
RFRS 181	5.30	40.30	4.30	4.70	12.33	15.70	0.60	5.00
RFRS 182	5.10	43.00	4.30	4.80	9.00	30.00	0.65	7.00
RFRS 183	5.70	68.00	9.20	7.50	14.00	14.00	0.30	5.50
RFRS 184	2.90	20.30	2.50	2.70	11.33	19.00	-	-

VRIDHACHALAM

The cashew accession TK 1 recorded the highest cumulative nut yield of 20.73 kg/tree in seven harvests. The accession KK 1 recorded the highest nut weight of 7.60g and SL 1 recorded the highest shelling percentage of 28.40 (Table 1.11).

Table 1.11 : Performance of cashew germplasm accessions (planted during 1999) at Vridhachalam

Accn. No	Mean weight/ apple (g)	Mean weight/ nut (g)	Nut yield / tree (Kg)	Cum. nut yield / tree (Kg) (7 th harvest)	Shelling %
VSK 1	42.60	6.40	3.45	18.56	27.80
VSK 2	63.80	6.80	3.21	19.69	28.00
SL 1	55.20	7.00	2.92	18.71	28.40
TK 1	35.50	5.80	3.54	20.73	27.70
NK 1	62.50	6.60	3.33	18.63	28.00
KK 1	52.50	7.60	3.60	16.91	28.20
PV 1	55.50	6.20	2.60	17.15	28.20
AM	50.20	6.40	3.32	17.02	27.40

Gen.3. Varietal Evaluation Trials

2. Multi Location Trial – II

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY :

The variety T.No 10/19 produced the highest cumulative nut yield (78.69 kg / tree) followed by T.No. 30/1 (66.49 kg/ tree) in 14 harvests at Bapatla. At Bhubaneswar, the number of flowering laterals/m^2 was maximum in M-44/3 (18.0). Highest nut yield of 9.72 kg/tree was recorded in H-320 at Chintamani followed by M-44/3 (8.86 kg/tree). The nut weight and apple weight was maximum in H-367 (9.60g and 77.20g respectively) at Vengurla.

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

The genotype T. No 3/33 recorded the highest plant height (5.85 m) followed by T.No. 10/19 (5.38m) and whereas T.No 3/33 recorded the maximum trunk girth (112.17cm) followed by H-320 (110.96 cm). The duration of flowering in the genotypes was maximum in H-68, T.No 40/1 (137 days), where as H-255 recorded the least number of flowering days (116 days) The number of nuts was maximum in M-44/3 (6.75). The genotype T.No 10/19 gave the highest cumulative nut yield (78.69 kg / tree) followed by T.No. 30/1 (66.49 kg/ tree) in 14 harvests. Maximum nut weight of 10.11g was recorded in H-367 (Table 1.12 and 1.13).

Table 1.12 : Vegetative characters of cashew types in MLT-II at Bapatla

Variety/ Genotype	Canopy spread (m)		Duration of Flowering
	E-W	N- S	
Hy-3/28	8.73	9.57	132
T.No.3/33	11.18	11.51	125
T.No.10/19	9.51	10.71	130
T.No.30/1	8.47	8.52	131
H-68	12.24	10.28	137
H-367	9.70	8.91	135
H-303	10.65	10.23	130
H-255	7.63	9.16	116
H-320	13.66	12.13	121
M-44/3	7.64	7.08	133
M-15/4	6.78	7.18	130
T.No.107/3	8.38	7.98	132
T.No. 40/1	9.03	8.95	137
CD at 5%	2.96	2.71	-

Table 1.13 : Yield attributing characters of cashew types in MLT-II at Bapatla

Variety/ Genotype	No. of flowering laterals/m^2	No. of nuts/ m^2	Cum. nut yield / tree (14 harvests) (kg)	Nut yield / Tree (kg)	Nut weight
Hy-3/28	20.00	3.00	49.36	2.18	6.17
T.No.3/33	25.25	2.25	50.98	3.85	7.53
T.No.10/19	27.50	6.00	**78.69**	2.56	7.79
T.No.30/1	23.25	3.25	**66.49**	2.02	8.87
H-68	24.25	5.00	48.33	2.60	4.29
H-367	25.75	6.25	43.24	1.73	**10.11**
H-303	20.0	1.50	41.52	1.16	5.39
H-255	21.75	2.25	35.81	3.37	9.41
H-320	20.25	1.75	42.60	1.52	9.43
M-44/3	25.50	6.75	65.87	1.60	4.61
M-15/4	23.25	4.50	61.00	1.16	6.31
T.No.107/3	28.00	5.25	37.28	2.24	6.19
T.No. 40/1	28.75	6.50	46.12	2.74	6.78
CD at 5%	**0.41**		**2.42**	**0.34**	0.52

BHUBANESWAR

Maximum height was observed in H-255 (6.70m) followed by BPP-10/19 (6.20m). In H-255 maximum tree trunk girth of 120cm was recorded followed by 109cm, both in BPP-10/19 and BPP-3/28.. The number of flowering laterals / m^2 was maximum in M-44/3 (18.0) followed by 16.0 each in H-68, H-255 and H-320 (Table 1.14).

Table 1.14 : Vegetative & flowering characters of cashew types in MLT-II at Bhubaneswar

Variety / Genotype	Canopy spread (m)		No. of flowering laterals / m^2	Duration of flowering (days)
	E-W	N– S		
NRCC Sel.-1	9.10	8.90	10	65
NRCC Sel.-2	10.20	10.70	13	59
M 44/3	3.70	4.60	18	70
M 15/4	7.70	9.20	11	66
BPP 3/33	9.00	10.10	13	76
BPP 10/19	9.70	11.20	14	61
BPP 30/1	9.40	9.70	11	96
BPP 3/28	10.40	10.30	11	76
H 303	9.30	8.80	13	90
H 320	10.90	9.50	16	89
H 255	8.20	11.30	16	71
H 367	9.70	8.80	13	80
H 68	11.50	11.20	16	66

The yield and yield attributing traits of 13 types revealed that, highest cumulative nut yield at 11th harvest was recorded in H-303 (80.3 kg/plant) followed by H-320 (72.9), NRCCSel. -2 (71.5) and H-68 (70.2). These four types are bold nut types having nut weight more than 7.0 g and shelling percentage more than 28.00. Out of the 13 cashew types, NRCC Sel. -2, H-303 and H-68 had nut weight ranging from 8.8g to 9.7g, cumulative nut yield (kg/plant) at 11th harvest ranging from 70.2 to 80.3 and shelling percentage (%) ranging between 30.4 to 31.30 (Table 1.15).

Table 1.15 : Yield and yield attributing characters of cashew types in MLT-II at Bhubaneswar

Variety / Genotype	Cum. Yield (kg/ tree) (11th harvest)	Nut weight (g)	Apple weight (g)	Shelling (%)
NRCC Sel-1	30.80	8.60	45	32.10
NRCC Sel-2	71.50	9.70	53	31.30
M 44/3	29.40	6.40	29	30.00
M 15/4	28.00	8.00	65	30.30
BPP 3/33	49.00	7.20	43	30.00
BPP 10/19	35.50	6.40	41	31.20
BPP 30/1	60.50	6.00	36	27.40
BPP 3/28	45.80	7.80	49	31.00
H 303	80.30	8.80	65	31.00
H 320	72.90	7.10	42	29.20
H 255	36.50	10.10	68	29.40
H 367	57.00	10.20	76	29.60
H 68	70.20	9.10	84	30.40

CHINTAMANI

The highest number of flowering laterals / m^2 were observed in TN-30/1 (10.46) followed by TN 3/33 (10.44) and M 15/4 (9.67). The entries H-320 and TN-3/33 had highest nut weight of 8.8g each followed by H-68 (8.7g). The shelling percentage was highest in TN-10/19 (32.1%) followed by M-44/3 (31.9%) and H-320 (31.0%).

Significantly highest nut yield of 9.72 kg / tree was recorded in H-320 followed by M-44/3 (8.86 kg/tree). Over a period of 14 harvests, H-320 had highest cumulative yield (119.09 kg/ tree) followed by the entries NRCC Sel-2 (106.12 kg/tree) and M-15/4 (90.06 kg/tree) (Table 1.16).

Table 1.16 : Yield and yield attributing characters of cashew entries in MLT-II at Chintamani.

Cashew entries	No. of fruits/ panicle	Apple weight (g)	Nut weight (g)	Shelling (%)	Nut yield (Kg/tree)	Cum. yield (kg/tree) 14 harvests
H -68	5.20	85.00	8.70	30.90	4.52	41.60
H-367	5.40	95.00	8.70	30.70	6.30	70.60
H- 303	4.80	55.00	8.10	27.70	7.24	84.88
H- 255	5.70	50.00	8.30	29.50	7.86	73.86
H- 320	6.50	90.00	8.80	31.00	9.72	119.09
M- 44/3	5.90	40.00	6.00	31.90	8.86	89.34
M -15/4	5.70	55.00	7.70	29.50	7.27	90.06
NRCC -1	5.50	40.00	8.10	30.20	6.78	75.50
NRCC -2	5.60	55.00	8.10	30.20	8.14	106.12
TN -30/1	4.80	60.00	6.80	28.20	6.75	78.72
TN -3/33	5.00	75.00	8.80	30.10	5.89	63.52
TN -10/19	5.20	30.00	5.30	32.10	4.78	61.82
TN -3/28	6.10	70.00	7.50	30.60	8.10	78.45
Ullal – 1	5.80	35.00	7.20	30.80	8.44	73.44
C.D @5%	-	-	-	-	1.02	-

JAGDALPUR

The canopy spread VRI-1 was found to have largest coverage (E-W/N-S =6.27/3.26m). The nut yield (kg/tree) was markedly highest for H-3/33 (7.06kg). The cumulative yield (kg/tree) was highest for H-303 (13.19 kg) for 6 harvests. Nut and apple weight were highest for H-10/19 (9.40 and 65.10g, respectively). Maximum shelling percentage of 30.86 was observed in VRI-1 (Table 1.17).

Table 1.17 : Performance of different varieties under MLT- II at Jagdalpur

Varieties/ Genotype	Canopy Spread (cm)		Nut yield (kg/tree) (6th harvest)	Cum. nut yield (6 harvests)	Nut weight (g)	Apple weight (g)	Shelling %
	E--W	N--S					
3/28	280.83	282.67	4.02	7.48	8.30	47.40	30.22
3/33	217.50	244.42	7.06	10.03	7.00	23.50	28.95
30/1	151.67	138.42	3.74	7.98	8.60	41.30	27.73
10/19	307.92	311.67	3.45	7.93	9.40	65.10	29.85
VRI-1	626.92	325.92	5.30	7.27	7.40	29.70	30.86
VRI-2	215.83	226.58	3.79	5.51	4.80	20.10	29.57
H-68	262.58	285.25	2.45	10.91	4.30	31.30	28.72
H-255	212.75	208.08	4.35	8.31	6.00	34.30	29.73
H-367	73.75	73.92	3.75	7.97	6.00	23.30	28.99
H-320	255.92	285.00	4.74	9.26	6.90	31.10	27.53
H-303	253.33	262.92	5.25	13.19	6.80	22.40	29.11
Sel-1	285.58	303.17	5.55	8.51	7.30	31.80	30.69
Sel-2	182.08	172.92	2.85	6.31	4.70	19.00	27.99
V-4	302.00	322.83	4.06	10.37	4.80	22.50	30.79
SE(m)	**122.28**	**55.67**	**1.46**		**0.11**	**0.83**	**0.023**
CD 5%	**251.41**	**114.46**	**3.01**		**0.22**	**1.71**	**0.049**

JHARGRAM

The canopy spread was maximum in H–255 (6.14m) followed by T.No. 10/19 and T.No. 3/28 both having 4.93m canopy spread. Canopy area was highest with H –255 (44.8 m^2) followed by T.No. 3/28 (30.54 m^2) and T.No. 10/19 (30.09 m^2). Precocious flowering was observed with H – 367, H – 255 and M –15/4, while late flowering occurred in varieties NRCC –Sel- 2, H – 303. Longest duration of flowering was noticed in varieties H –255 (80days) followed by H –367 (78 days), M- 15/4 (72 days) (Table 1.18).

Table 1.18 : Growth parameters of different varieties under MLT – II at Jhargram

Variety	Canopy Spread (m)	Canopy area (m^2)	Duration (Days)	Flowering /m^2
T.No.30/1	3.57	20.59	64	9.80
T.No.3/33	3.84	25.61	69	9.20
T.No.10/19	4.93	30.09	68	3.90
T.No.3/28	4.93	30.54	58	4.90
H – 68	3.82	19.87	58	7.30
H – 367	3.84	20.56	78	4.10

H – 303	3.82	21.73	61	11.00
H – 255	6.14	44.75	80	13.30
H – 320	4.92	29.0	62	7.10
M – 44/3	4.13	24.23	58	11.90
M – 15/4	3.86	23.55	72	10.90
NRCC Sel-1	3.41	18.94	70	1.20
NRCC Sel-2	4.31	25.43	61	15.10
S. Em (+)	0.494	4.518	-	1.788
C.D. at 5%	1.019	9.325	-	3.691
CV	20.0	30.34	-	36.7

NRCC Sel-2 had the highest number of flowering laterals / m^2 (15.1) followed by H – 255 (13.3). M–44/3 had maximum of 35.6 nuts /m^2 T.No. 30/1 had maximum number of nuts per panicle (11.4) followed by H – 303 (9.00). Nut weight was maximum with NRCC Sel-1 (8.0g) followed by H-303 (7.8g) and H –255 (7.6 g).

H – 255 was the highest yielder (6.34 Kg/tree) followed by M – 15/4 (5.09Kg/tree) and M – 44/3 (4.88 Kg/tree). Cumulative yield for 3 harvests was maximum for H-255 (7.24kg/tree). Statistical comparison among the varieties indicated that H-255, M-15/4 and M - 44/3 were good yielders (Table 1.19).

Table 1.19 : Yield parameters of different varieties under MLT – II at Jhargram

Variety	Vegetative flush/m^2	Nuts/m^2	Nuts/ panicle	Nut weight (g)	Apple weight (g)	Yield (Kg/tree)	Cum. yield (Kg/tree) 3rd harvest	Shelling %
T.No.30/1	11.60	14.20	11.40	6.20	37.50	2.36	2.91	27.70
T.No.3/33	14.10	27.30	5.40	5.50	32.00	3.48	4.14	33.90
T.No.10/19	24.40	11.40	6.80	6.50	50.00	2.74	3.73	31.50
T.No.3/28	21.60	17.70	5.20	6.90	62.20	3.80	5.04	34.40
H – 68	10.80	16.30	5.20	6.50	57.70	2.17	2.58	30.50
H – 367	13.00	5.90	2.60	6.60	34.70	0.69	1.64	32.30
H – 303	3.80	28.40	9.00	7.80	27.50	4.08	4.79	31.80
H – 255	3.20	18.30	5.30	7.60	38.40	6.34	7.24	28.50
H – 320	16.90	15.80	4.50	7.50	61.00	3.64	4.52	28.90
M – 44/3	8.20	35.60	6.40	5.30	34.50	4.88	5.47	31.10
M – 15/4	5.10	27.90	5.90	5.60	22.80	5.09	5.49	32.30
NRCC Sel-1	7.90	4.30	4.00	8.00	67.70	0.91	1.409	29.20
NRCC Sel-2	7.10	25.80	6.30	6.50	55.20	4.32	4.571	30.70
S. Em (+)	2.338	4.892	2.414	0.228	2.976	1.354	1.500	1.469
C.D. at 5%	4.903	10.097	4.982	0.471	6.142	2.794	3.096	3.032

MADAKKATHARA

Variety T 107/3 recorded highest canopy spread (10.05 m) followed by T/33 (9.61m). Flowering duration was maximum for T 107/3 and M 15/4 (147 days) and minimum for H-367 and H-255 (105 days). Highest flowering intensity/m^2 was recorded in H-303 (12.54) and lowest by H- 320 (6.83) (Table 1.20).

Table 1.20 : Vegetative characters of different varieties under MLT II at Madakkathara

Variety	Canopy spread -EW (m)	Canopy spread- NS (m)	Duration of flowering	Flowering intensity/ m^2
T 30/1	8.57	9.76	144	11.10
T 3/33	9.84	9.38	138	10.30
T 10/19	8.55	8.24	142	10.44
T 3/28	8.62	8.79	119	8.80
Hy 68	9.92	8.98	144	7.05
Hy 367	7.88	8.69	105	9.11
Hy 303	8.83	9.01	143	12.54
Hy 255	9.25	9.04	105	10.70
Hy 320	8.61	8.46	124	6.83
M 44/3	7.26	8.26	119	7.08
M 15/4	8.74	9.78	147	11.02
NRCC Sel-1	9.96	10.13	147	9.03
NRCC Sel-2	8.63	9.51	142	7.68
H1608	7.98	8.77	119	10.42
	2.127	2.238	18.580	2.744

The entry NRCC Sel-1 had the highest apple weight followed by H 367. The highest nut weight was recorded by variety H-303 (12.30g) followed by NRCC Sel-1 (11.65 g). The highest yield was recorded by H-303 (11.00 kg per tree per year) followed by H320 (9.60 kg). The highest cumulative yield was recorded by H 303 (48.70 kg) (18 harvests) followed by H 320 (42.47 kg) (16 harvests) (Table 1.21).

Table 1.21 : Yield and yield attributes of cashew types in MLT II at Madakkathara

Variety	Nut yield (kg/tree)	Cum. nut Yield (kg/tree)	Harvest No.	Nut wt (g)	Apple wt. (g)	Shelling %
T30/1	3.40	21.15	16	10.40	40.00	24.50
T 3/33	3.35	18.99	6	10.80	57.00	22.90
T 10/19	3.10	13.35	6	10.95	42.00	23.67
T 3/28	4.00	28.76	13	10.25	58.00	24.50
Hy 68	2.95	20.49	12	8.70	78.00	26.30
Hy 367	4.15	22.12	8	11.20	80.00	24.10
Hy 303	11.00	48.70	18	12.30	57.20	21.30
Hy 255	3.60	19.78	9	10.80	62.00	22.40
Hy 320	9.60	42.47	16	9.74	54.10	22.87
M 44/3	5.15	26.54	11	9.40	62.15	23.40
M 15/4	5.25	34.98	11	10.10	46.70	24.20
NRCC Sel-1	3.00	20.90	15	11.65	88.20	24.30
NRCC Sel-2	4.10	25.20	10	10.00	59.63	24.70
H 1608	8.30	38.02	11	9.90	40.20	23.16
CD (0.05)	1.889	-	-	1.695	18.719	0.57

VENGURLA

The performance of the varieties did not differ significantly, for growth characters while differed significantly for mean lateral/m^2 and mean flowering panicles/m^2. Similarly, the yield of the varieties did not differ significantly. The nut weight and apple weight were maximum in H-367 (9.60g and 77.20g respectively). The highest mean yield/tree (6.62 kg/tree) was observed in 30/1 and maximum cumulative yield for last six harvests (18.33 kg/tree) was recorded in the H-303 (Table 1.22 and 1.23).

Table 1.22 : Growth and yield observations MLT-II at Vengurla

Variety /type	Mean Spread (m)		Mean Flowering panicles /m^2	Mean Flowering duration (Days)
	E.W.	E.W.		
Hy .No. 255	8.90	8.70	18.80	108.10
Hy. No. 303	6.00	6.00	18.60	111.40
Hy. No. 320	7.30	7.10	18.10	105.90
Hy.No.367	6.50	7.10	21.70	109.20
NRCC Sel.1	8.40	9.00	19.80	107.60
NRCC Sel.2	7.30	7.80	17.80	107.70
M-44/3	5.30	5.40	30.30	108.80
M-15/4	6.80	7.20	21.80	111.30
10/19	9.20	8.50	17.80	109.20
3/28	5.10	5.60	10.40	72.90
3/33	6.80	7.50	16.30	107.40
30/1	9.60	8.70	19.90	109.60
SEm ±	1.10	1.10	2.90	10.80
CD at 5%	N.S.	N.S.	8.40	N.S.

Table 1.23 : Growth and yield observations MLT-II at Vengurla

Variety /type	Mean yield (kg/ tree)	Mean yield (t/ ha)	Cum. Yield kg/ tree (6^{th} harvest)	Mean nut weight (g)	Mean apple weight (g)	Mean shelling (%)
Hy .No. 255	6.40	1.28	16.00	9.00	68.30	29.67
Hy. No. 303	6.12	1.22	18.33	8.50	61.60	29.33
Hy. No. 320	3.84	0.77	10.58	8.60	66.50	29.43
Hy.No.367	3.86	0.57	11.09	9.60	77.20	29.00
NRCC Sel.1	4.43	0.88	11.86	7.40	63.30	30.17
NRCC Sel.2	3.19	0.63	8.01	7.40	65.60	30.33
M-44/3	1.31	0.26	6.49	5.50	54.20	30.40
M-15/4	1.98	0.40	6.86	8.00	68.20	28.53
10/19	3.18	0.64	9.21	6.50	59.80	28.63
3/28	1.27	0.25	6.45	5.00	46.50	0.00
3/33	2.42	0.48	10.41	6.80	60.40	30.27
30/1	6.62	1.32	15.72	7.40	68.00	30.00
SEm ±	1.31	0.27		0.80	8.00	0.47
CD at 5%	N.S.	N.S.		2.30	N.S.	1.37

VRIDHACHALAM

A consistently higher annual nut yield was observed in M-15/4. The entry H-320 had the highest nut weight of 7.8g. Highest shelling percentage of 28.6 was recorded in VTH-107/3 and H-367 (Table 1.24).

Table 1.24 : Yield and yield attributing characters of cashew types in MLT II at Vridhachalam

Variety/ Genotype	Duration of flowering	Yield (kg/tree)	Cum. Yield (kg/tree) (11 harvests)	Nut weight (g)	Shelling (%)
T. 30/1	65	5.34	25.87	7.00	27.60
T. 3/33	69	4.98	25.02	7.20	28.20
T.10/19	72	5.58	25.42	7.20	28.00
T. 3/28	68	5.60	28.26	6.80	28.40
H 68	67	4.80	26.03	6.40	27.80
H 367	69	4.88	26.06	6.60	28.60
H 303	66	4.90	29.10	6.80	28.00
H 255	67	5.20	25.16	7.60	28.20
H 320	67	5.66	29.73	7.80	28.40
M 44/3	70	4.22	33.92	5.40	28.50
M 15/4	71	6.68	30.84	6.80	28.50
VTH 107/3	69	5.48	24.75	7.00	28.60
VTH 40/1	64	5.62	29.18	7.20	28.20
SEd		0.24		0.22	NS
CD 5%		0.51		0.46	

3. Multi Location Trial – III

Centres: East Coast

Bapatla, Bhubaneshwar and Vridhachalam

West Coast

Madakkathara and Vengurla

Plains / others

Chintamani

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

SUMMARY :

The variety BPP-8 showed longer duration of flowering (152days) with maximum number of flowering laterals per square meter (18.75) at Bapatla while BH-85 and H-14 had maximum number of flowering laterals per square meter (16.00) at Bhubaneswar. At Chintamani highest cumulative nut yield was recorded in H 1593 (8.49kg/pl/ha) followed by Goa 11/6 (7.61kg/pl) while at Madakkathara, highest cumulative yield was recorded by Goa 11/6 (7.77 kg) followed by H-1593 (7.47 kg) for 3 harvests.

Experimental Details :

The trial has been initiated in 2003. The trial comprises of 10 test varieties and 1 local check variety.

Sponsoring centre	Promising hybrids	TMB tolerant type
CRS, Bhubaneswar	BH 6, BH 85	--
CRS, Madakkathara	H 1597	K 22-1
RFRS, Vengurla	H 662, H 675	--
RRS, Vridhachalam	--	H 11 & H 14
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

The variety BPP-8 had the maximum canopy spread (3.71m E-W & 3.68m N-S), longer duration of flowering (152 days), maximum number of flowering laterals per square meter (18.75) and nut yield per tree (2.31kg) (Table 1.25).

Table 1.25 : Vegetative characters of cashew types in MLT-III at Bapatla

Variety/ Genotype	Plant height (m)	Stem girth (cm)	Canopy spread (m)		Duration of Flowering	Number of flowering laterals /m^2	Nut yield per tree (kg)
			E-W	N- S			
Goa – 11/6	2.32	37.11	3.58	3.57	151	16	0.33
H – 662	1.90	17.33	2.71	2.43	153	10.5	0.88
H – 32/4	2.52	34.22	2.52	3.16	150	15.0	*1.07*
K – 22 – 1	1.95	39	2.97	2.97	121	17.0	0.91
H – 11	2.11	36.53	3.4	3.30	146	13.75	0.83
H – 675	1.83	31.08	2.63	2.65	141	13.50	0.61
H – 14	2.3	34.56	2.81	2.87	151	14.0	0.76
BPP – 8	2.43	40.22	3.71	3.68	*152*	18.75	2.31
H – 1597	2.14	44.06	3.40	3.63	*156*	15.25	1.33
CD at 5%	0.47	10.90	0.32	0.32	-	-	0.03

BHUBANESWAR

The maximum plant height of 3.40 m and stem girth 40.00 cm was observed in H-32/4. Maximum canopy spread 4.80 m in E-W and 4.50m in N-S direction was observed in BH-85. The number of flowering laterals was maximum (16/m^2) in BH 85 and H 14 (Table 1.26).

Table 1.26 : Vegetative character of cashew types at Bhubaneswar

Varieties	Plant height (m)	Stem Girth (cm)	Canopy spread (m)		No. of flowering laterals / m^2
			E-W	N-S	
BH 6	3.00	34.70	4.00	4.10	12
BH 85	3.20	38.70	4.80	4.50	16
H 1597	3.20	37.70	4.50	4.40	12
K 22-1	3.00	33.00	3.90	3.60	15
H 662	2.80	25.00	3.30	3.20	7
H 675	2.80	32.00	3.40	3.50	14
H 11	2.10	33.00	4.30	4.30	14
H 14	3.00	29.00	3.70	3.90	16
H 32/4	3.40	40.00	4.40	4.40	9
Goa 11/6	3.40	37.70	4.40	4.40	12
H 2/16 (Local Check)	3.70	36.70	4.20	4.50	10

At second harvest, highest cumulative nut yield (3.20kg/plant) was observed in BH 6. BH 6 also had maximum nut weight of 8.70g and K-22-1 had maximum shelling percentage of 33.20 (Table 1.27).

Table 1.27 : Yield and yield attributing characters of cashew types at Bhubaneswar

Cashew types	Nut yield till 2008 (kg/ plant) 2rd harvest	Apple weight (g)	No. of Nuts / panicle	Nut weight (g)	Shelling (%)
BH-6	3.20	56	3	8.70	32.80
BH-85	2.53	49	4	7.60	30.40
H-1597	2.43	52	2	8.40	29.50
K-22-1	2.42	51	3	5.60	33.20
H-662	2.46	45	2	6.90	31.00
H-675	1.39	32	3	4.60	31.00
H-11	2.85	56	3	6.10	30.20
H-14	1.14	36	3	5.40	31.10
H-32/4	2.60	63	3	7.50	30.70
Goa-11/6	1.78	46	3	7.10	30.50
H-2/16 (Local check)	2.91	64	3	8.20	28.20

CHINTAMANI

Significantly highest plant height was recorded by Goa 11/6 (3.93 m) followed by H-32/4 (3.92 m). The stem girth varied significantly and was highest in H-32/4 (55.86 cm) followed by Goa-11/6 (54.83 cm). The lowest stem girth was observed by H-14 (35.83 cm). The highest E-W & N-S spread was recorded by H-32/4 (7.02 and 6.23 m respectively).

The highest nut weight was recorded by BH 6 (8.40g) followed by BH-85 and H 32/4 (8.30g each). Significantly highest nut yield was recorded by H-1593 (4.18 kg/tree) followed by Goa-11/6 (3.36 kg/tree). The cumulative yield for 3 harvests was highest in H-1593 (8.49 kg/plant) followed by Goa-11/6 (7.61 kg/plant) and lowest was in H-675 (4.58 kg/plant). All the entries had exhibited shelling percentage of more than 30 per cent (Table 1.28).

Table 1.28 : Growth and yield performance of cashew entries – MLT - III at Chintamani

Entries	Plant height (m)	Stem girth (cm)	Canopy spread (m)		Nut yield (kg/tree)	Cum. yield (kg/tree) of 3 harvests	Nut Wt. (g)	Shelling (%)
			E-W	N-S				
BH – 6	3.34	52.67	6.71	6.59	2.68	6.87	8.40	32.00
BH – 85	3.38	51.08	5.49	5.54	2.94	6.64	8.30	32.00
H - 1593	3.24	52.92	6.04	6.24	4.18	8.49	8.10	32.20
H – 662	3.24	43.25	5.55	5.46	2.45	4.82	5.70	30.90
H – 675	3.05	40.42	5.17	4.97	2.32	4.58	5.00	31.80
H – 32/4	3.92	55.86	7.02	6.23	2.86	6.44	8.30	31.90
K - 22/1	3.49	50.42	5.29	5.55	2.92	6.04	6.30	31.70
H –11	3.39	50.00	6.48	6.24	1.96	6.03	5.90	31.80
H – 14	2.60	35.83	4.45	4.47	1.90	4.77	4.90	31.10
Goa – 11/6	3.93	54.83	6.22	6.25	3.36	7.61	7.60	31.50
Chintamani – 1	3.34	48.13	6.18	6.02	3.12	6.57	7.10	31.20
S.Em ±	0.16	2.79	0.36	0.38	0.36	-	-	-
C.D at 5%	0.47	8.22	1.05	1.12	1.06	-	-	-

MADAKKATHARA

Maximum height was recorded in H 32/4 (4.76 m) followed by BH 85 (4.72 m) and maximum stem girth was observed in BH-85 (61.25 cm) followed by H -675 (61.05 cm). Maximum canopy spread occurred in H - 14 (6.25 m) followed by Goa 11/6 (5.95 m). H-1593 had maximum nut yield/ tree (4.10 kg) followed by Goa 11/6 (3.90 kg). The highest cumulative yield was recorded by Goa 11/6 (7.77 kg) followed by H-1593 (7.47 kg) for 3 harvests (Table 1.29).

Table 1.29 : Morphological and yield characters of cashew genotypes under MLT III at Madakkathara

Variety	Plant height (m)	Stem girth (cm)	Canopy spread (m)	Flowering intensity (m^2)	No. of fruits/ panicle	Yield (kg/tree/ year)	Cum. yield (kg/tree)
Dhana	4.19	58.90	4.96	6.00	3	3.76	6.33
H-11	4.45	60.83	5.41	7.00	2	2.80	5.00
H-32/4	4.76	59.91	4.95	7.67	2	3.10	5.50
H-1593	3.75	53.58	4.97	6.67	4	4.10	7.47
BH-6	3.71	58.05	5.12	6.00	3	2.20	4.05
H-662	4.47	60.91	5.58	5.00	2	3.30	5.96
H-675	4.62	61.05	4.96	10.00	2	2.30	4.17
BH-85	4.72	61.25	4.91	9.00	2	3.10	5.18
H-22-1	4.16	60.41	4.87	7.67	2	2.40	4.78
Goa 11/6	4.43	60.42	5.95	8.00	3	3.90	7.77
H-14	4.34	60.08	6.25	7.33	2	3.40	6.07

VENGURLA

The trial has been relaid and the grafts of 11 identified varieties were planted during December, 2008. The crop is in the initial stage of growth.

VRIDHACHALAM

The trial has been relaid and the grafts of 11 identified varieties were planted during December, 2008. The crop is in the initial stage of growth.

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

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara, Pilicode and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

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 intial stages of growth.

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

BHUBANESWAR

Planting of 22 released varieties has been taken up during 2008 planting season.

CHINTAMANI

Among the entries, plant height ranged from 1.00 to 2.00m and stem girth varied from 11 to 18 cm. The in-situ grafting will be taken up for the remaining varieties for which stock plants have been raised in the main field (Table 1.30).

Table 1.30 : Growth performance of released varieties at Chintamani

Varieties	Plant height (m)	Stem girth (cm)
BPP-4	1.20	16.00
BPP-6	2.00	13.00
BPP-8	1.45	15.50
Chintamani -1	1.32	12.50
Madakkathara-2	1.15	14.50
K-22-1	1.13	13.00
Dhana	1.80	18.00
Amrutha	1.50	16.00
Vengurla -1	1.00	14.67
Vengurla -4	1.37	15.67
NRCC-Sel-2	1.25	15.50
Ullal-1	1.53	17.25
Ullal-4	1.55	16.00
UN-50	1.68	16.25
Bhaskara	1.12	14.00
H-2/16	1.40	18.00
NDR-2-1	1.30	11.00

MADAKKATHARA

Among the released varieties evaluated, Ullal-4 had maximum height (2.75 m) followed by Madakkathara–I (2.60 m). V-4 recorded highest stem girth (26.25 cm) followed by UN-50 and Madakkathara-1 (24.80 cm each) (Table 1.31).

Table 1.31 : Morphological characters of cashew varieties under MLT-V at Madakkathara

Variety	Height (m)	Girth (cm)
Goa -1	2.21	22.33
UN-50	2.35	24.80
Ullal-1	2.15	19.20
Ullal-3	2.25	18.00
Ullal-4	2.75	23.40
NRCC-sel-2	1.88	18.00
V-1	2.00	17.50
V-4	2.31	26.25
V-6	2.31	22.75
Jhargram-1	2.31	23.25
Chintamani-1	2.20	18.80
BPP-4	2.43	19.50
Kanaka	2.30	21.00
Priyanka	2.38	20.75
Dhana	1.95	21.00
Amrutha	2.43	21.75
Vridhachalam-3	2.10	22.40
K-22-1	2.05	21.40
Madakkathara-1	2.60	24.80
Madakkathara-2	2.35	20.60

PILICODE

The plant height, collar girth and north-south spread of canopy differed significantly between varieties. Plant height was highest in Madakkathara-2 (1.59m) and lowest in Goa-1 (0.29m). Stem girth was maximum in Madakkathara-2 (13.29cm) and lowest in Dhana (4.41cm) (Table 1.32).

Table 1.32: Performance of released cashew varieties under MLT-V at Pilicode

Accession No./ Variety	Plant height (m)	Stem girth (cm)	Canopy Spread (m)	
			E-W	N-S
NRCC-sel-2	1.29	11.46	0.99	1.18
MDK-1	0.87	7.79	0.97	1.01
MDK-2	1.59	13.29	1.10	1.17
BPP-6	1.37	12.75	1.09	1.12
Ullal-1	1.53	10.55	0.95	1.06
Ullal-3	1.06	7.95	0.62	0.76
Ullal-4	0.46	4.52	0.38	0.42
UN-50	1.03	8.05	1.50	1.46
Bhaskara	1.52	9.94	0.55	0.64
Kanaka	0.45	5.60	--	--
VRI-3	0.93	8.25	1.06	0.98
V-4	0.89	8.12	0.55	0.64
V-7	0.86	7.51	2.93	0.79
Priyanka	1.35	11.77	1.21	1.14

Amritha	0.92	7.52	0.69	0.68
Dhana	0.50	4.41	--	--
K-22-1	0.98	7.71	0.88	0.85
Bhubaneshwar	0.50	4.79	3.85	0.42
Goa-1	0.29	4.5	--	--
BPP-8	0.44	4.82	--	--
CD 0.05	0.31	2.26	NS	0.32

VRIDHACHALAM

The released varieties (25) identified for the trial have been planted during January 2008. The crop is at initial stage of growth.

Gen.4. Hybridization and Selection

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY:

The highest cumulative yield for 7 harvests at Bapatla was obtained in H-36 (24.80kg) followed by H-10 (20.03kg). At Bhubaneswar, hybrid A6 (BH-6) recorded the highest cumulative nut yield (kg/plant) of 52.6 for 9 harvests. At Chintamani, the average nut weight of promising hybrids H-151, H-188, H-191 and H-216 were 9.60, 10.20, 10.70 and 11.90 g respectively. At Jhargram, the best yielding hybrid was H – 41 (Annual yield of 14.70 Kg/tree) followed by H – 57 (13.60 Kg/tree) and H – 23 (13.2Kg/tree). At Madakkathara H - 36 performed well for annual yield (13.30kg/tree) and H - 21 performed well for cumulative yield for 12 harvests (139.92 kg/tree). At Vengurla, three hybrids were found performing well for yield in 4th harvest (H 1306, H 969, H 886).

BAPATLA

During the year 2008 – 09, the highest nut yield per tree was observed in H-36 (7.30 kg/tree) followed by H-75 (6.50kg/tree). The highest cumulative yield for 7 harvests was obtained in H-36 (24.80kg) followed by H-10 (20.03kg) (Table 1.33).

Table 1.33: Performance of hybrids planted during 1997 at Bapatla

Hybrid No.	Cross combination	Yield/ tree(kg)	Cum. yield/tree (kg) (7 harvests)
H-9	T 273 x T 71	4.76	18.88
H-10	T 273 x T 71	5.30	20.03
H-16	T228 x T2/22	4.90	10.15
H-19	T 228 x T2/22	5.30	14.55
H-27	F.No.3 x T228	5.15	10.18
H-31	BPP-5 x T2/22	4.10	11.30
H-34	BPP-5 x T2/22	4.85	16.95
H-36	F.No.3 xT30/1	7.30	24.80
H-42	T 228 x T 30/1	4.20	12.06
H-51	BPP-8 x T2/22	4.85	15.35
H-61	T 71 x T 273	4.40	13.30
H-64	T 71 x T 273	4.75	19.75
H-67	T 71 x T 273	6.10	15.25
H-69	T 71 x T 273	4.55	17.95
H-72	T 71 x T 273	4.85	15.95
H-73	T 71 x T 273	4.65	14.05
H-75	T 71 x T 273	6.50	11.68
H-76	T 71 x T 273	4.40	14.25

BHUBANESWAR

From the hybrids planted in 1995, cluster bearing habit (2-4 nuts/ panicle), mostly bold nuts (8.2 to 9.2 g.) and shelling percentage ranging from 28.0 to 34.0 were recorded. A-6 recorded the highest cumulative nut yield (kg/plant) of 52.6 for 9 harvests followed by A9 (29.2) and E1 (23.4).

In the 1997 hybrid block, amongst the 9 promising hybrids highest cumulative nut yield (kg/plant) for 7 harvests was observed in A1-85 (49.7) followed by A1-105 (36.0) . Of the 9 hybrids obtained the shelling percentage ranged from 26.0-32.0 with cluster bearing habit and bold nuts. Eight nos. of hybrids were identified as promising types in 1998 hybrid block having cluster bearing habit (1-5 nuts/panicle) with shelling percentage (24-32%) and bold nuts. Highest cumulative nut yield

(kg/plant) at 6th harvest was observed in B2-39 (18.6) followed by A2-22 (15.5) and B2-32 (14.2).

Among the 1999 hybrid block, 5 hybrids recorded promising performance, having cluster-bearing habit (3-4nuts/panicle), bold nuts (7.1-7.5 g.) and having higher shelling percentage (26-32%). Highest cumulative nut yield (kg/plant) at 5th harvest was observed in D3-11 (16.9). Encouraging results from the promising hybrids of 2003 hybrid block with nut yield (kg/plant) at 1st harvest ranging from 1.1 to 2.5, shelling percentage 25 to 39% and nut weight 6.4 to 9.8g borne in clusters were obtained (Table 1.34).

Table 1.34 : Yield and yield attributing traits of promising cashew hybrids at Bhubaneswar

Year of planting	Hybrid no.	Cross Combinations	Nut weight (g)	Shelling %	Cum. nut yield (kg / plant)
1995					**9th harvest**
	A6	Bhubaneswar C-2 x VTH 711/4	8.2	33	52.60
1997					**7th harvest**
	A1-16	Bhubaneswar-1 x H2/16	7.8	28	29.30
	A1-85	Bhubaneswar-1 x H2/16	7.9	32	49.70
	A1-105	Bhubaneswar-1 x H2/16	7.3	29	36.00
1998					**6th harvest**
	B2-32	H 2/16 x M 44/3	6.3	24	14.200
	A2-22	M 44/3 x H 2/16	8.2	29	15.50
	B2-39	H 2/16 x M 44/3	7.2	31	18.60
1999					**5th harvest**
	D3-11	M 44/3 x H 2/15	7.1	31	16.90
2003					**1st harvest**
	B6-3	V-2 x VTH 711/4	7.2	32	2.20
	C2-6	RP-2 x Kankady	9.1	31	2.50
	C2-24	RP-2 x Kankady	9.2	26	2.00
	E6-3	OC 56 x OC 60	8.4	29	2.30

CHINTAMANI

The highest cumulative yield of three harvests was recorded by H-188 (4.18kg/plant). The average nut weight in H-151, H-188, H-191 and H-216 were 9.60, 10.20, 10.70 and 11.90 g respectively and shelling percentage were 30.40, 36.20, 29.40 and 30.20 respectively (Table 1.35).

Table 1.35 : Performance of selected F_1 Hybrids at Chintamani

Hybrid No. & Cross combination	Plant ht. (m)	Stem girth (cm)	Canopy spread (m)		Yield (kg/ tree)	Cu. Yield (Kg/tree) of 3hvts	Nut wt. (g)	Shelling (%)
			E-W	N-S				
H-151 (NRCC-2 x Vetore-56)	2.20	26	2.9	3.2	0.32	1.29	9.6	30.4
H-188 (V-5 x Vetore-56)	3.00	50	5.1	4.0	2.15	4.18	10.2	36.2
H-191 (Ullal-3 x Vetore-56)	2.70	46	4.0	3.7	1.82	3.78	10.7	29.4
H-216 (2/77-Tuni X Vetore-56)	3.70	56	5.3	4.4	1.25	3.99	11.9	30.2

JHARGRAM

Precocious flowering was noticed in case of the hybrids H – 6, H- 58, H- 59, H – 23, H – 1, H- 49 and H – 65. The duration of flowering ranged between 62 – 96 days and the longest duration of flowering was in case of H –6 (96 days). Nuts/m^2 was highest with H – 23 (73.8) followed by H – 57 (61.8) and H-1 (58.5). All the F1 progenies had cluster bearing habit. Nut weight was maximum with the hybrids H – 58 (7.8g) followed by H –75 (7.3g). The best yielding hybrid was H – 41 (Annual yield of 14.70 Kg/tree) followed by H – 57 (13.60 Kg/tree) and H – 23 (13.2Kg/tree). The shelling percentage was more than 30 per cent in all hybrids except H – 113 (23.0) (Table 1.36).

Table 1.36 : Performance of promising cashew hybrids at Jhargram

Hybrid No.	Year of planting	Duration of flowering	Nuts/m^2	Nut weight (g)	Apple weight (g)	Yield Kg/tree	Shelling %
H –6	2002	96	21.50	6.30	53.0	4.91	31.80
H - 72	2003	89	19.00	7.00	46.7	4.90	31.20
H –23	2002	65	73.80	4.40	35.7	13.20	33.20
H –1	2002	72	58.50	4.70	50.0	8.80	35.10
H- 113	2004	75	46.80	5.70	26.7	8.60	23.00
H – 159	2005	70	15.30	6.90	27.5	1.20	34.20
H- 136	2004	67	39.30	5.50	35.3	6.30	36.50
H - 30	2002	68	32.30	5.30	25.8	8.20	34.50
H- 111	2004	66	33.50	5.80	39.0	6.40	33.90
H - 41	2002	71	42.00	6.30	28.0	14.70	35.40
H –58	2002	67	22.50	7.80	45.6	10.90	35.90

H –57	2002	63	61.80	5.90	36.0	13.60	33.20
H –59	2002	80	28.00	5.60	52.7	6.60	29.70
H –65	2002	81	31.50	5.40	39.8	7.30	34.10
H –69	2002	72	27.50	5.90	51.0	8.30	32.70
H - 75	2003	62	7.80	7.30	32.0	1.80	30.30
H - 98	2003	65	30.50	5.80	28.8	6.20	34.10
H –49	2002	70	37.80	4.60	47.0	8.90	35.60

MADAKKATHARA

Out of the 56 hybrids planted in 1993, the highest yield was recorded by H- 36 (13.30 kg/tree) followed by H-8 (8.75 kg/tree). Highest cumulative yield for 12 harvests was given by H-21 (139.92 kg) and H-24 (134.14 kg/tree). All the high yielders had one common male parent P-3-2 and female parent was BLA-139-1 or BLA 39-4 (Table 1.37).

Table 1.37 : Performance of selected F1 hybrids planted during 1993 at Madakkathara

Hy. No.	Cross combinations	Annual yield (kg/tree)	Cum yield (kg/tree) for 12 harvests	Nut wt. (g)	Shelling %
8	BLA -139-1 X P-3-2	8.75	74.97	8.20	26.40
21	BLA -39-4 X P-3-2	4.60	139.92	10.10	27.40
22	BLA -39-4 X P-3-2	2.80	76.60	10.00	25.86
23	BLA -39-4 X P-3-2	0.72	80.99	8.00	26.50
24	BLA -39-4 X P-3-2	1.30	134.14	8.10	24.75
32	V-5 X H-1591	1.50	63.46	10.00	26.90
35	V-5 X H-1591	5.00	104.60	9.20	26.38
36	V-5 X H-1591	13.30	91.28	9.80	25.30

Out of 26 hybrids planted in 1994, highest annual yield/ tree were given by H 63 (7.00 kg/tree) followed by H 79 (5.00 kg/tree). The highest cumulative yield/tree were given by H 74 (74.10 kg/tree) followed by H 73 (72.90 kg/tree) for 11 harvests (Table 1.38).

Table 1.38 : Performance of selected F1 hybrids planted during 1994 at Madakkathara

Hy. No.	Cross combinations	Annual yield (kg/tree)	Cum yield (kg/tree) for 11 harvests	Nut wt. (g)	Shelling %
58	BLA -139-1 X P-3-2	0.00	46.10	8.00	27.30
69	BLA -39-4 X P-3-2	1.20	55.20	11.00	29.70
70	BLA -39-4 X P-3-2	2.55	57.20	18.00	27.20
71	BLA -39-4 X P-3-2	0.25	63.25	9.50	21.99
72	BLA -39-4 X P-3-2	0.15	59.55	7.10	26.50
73	BLA -39-4 X P-3-2	3.60	72.90	8.10	24.30
74	BLA -39-4 X P-3-2	4.05	74.10	7.90	29.68

Out of the 92 hybrids planted during 1995, all the trees recorded negligible yield except H-87 (annual yield 8.10 kg/tree) and H 110 (annual yield 5.00 kg/tree) (Table 1.39).

The hybrids H-111 to H-176 were planted at a closer spacing of 4 m x 4 m and hence the plants were lanky. Thinning (Removal) of weak trees was done to give space for vigorous ones. Even then most of the trees failed to give yield and the trees that yielded gave negligible yield.

Table 1.39 : Performance of selected F1 hybrids planted during 1995 at Madakkathara

Hy. No.	Cross combinations	Annual yield (kg/tree)	No. of harvests	Cum yield (kg/tree) for 10 harvests	Nut wt. (g)	Shelling %
87	V-5 X H-1591	8.10	42	62.26	6.75	32.11
95	BLA -39-4 X P-3-5	0.00	27	40.25	9.10	27.21
97	BLA -39-4 X P-3-7	3.50	32	51.73	8.80	25.50
98	BLA -39-4 X P-3-8	0.00	34	50.27	10.20	25.40
105	BLA -139-1 X P-3-2	0.00	24	34.68	8.00	27.50

During 2001, 124 hybrid seedlings were planted from 15 cross combinations. The parents identified for the crosses were A1, V-56, Kilianthara, K-30-1, V5, K 22-1, Sulabha, MDK-1 and M 44/3. The highest annual yield was recorded by hybrid No. 13 and 14 (1.70 kg/tree).

The highest annual yield from among 2002 planted hybrids was recorded by Hybrid No. 21 (1.80 kg/tree) followed by Hybrid No. 22 (1.50 kg/tree).

PILICODE

PLD-57 is a genotype with dwarf stature which was involved in crossing. Among the characteristics recorded the plant height and number of panicles/m^2 found significantly varying among the hybrids as well as parents and PLD-57 graft (Table 1.40).

Table 1.40 : Mean of growth characteristics of different crosses involving PLD 57 planted in 2001

Hybrid	Height (m)	Girth (cm)	Tree spread (m)		No. of Panicle /sqm	Male to Bis ratio
			N-S	E-W		
MDK-1 X PLD57	2.4	22.83	2.47	2.47	0.93	4.43
ANK-1 X PLD 57	2.3	23.57	3.20	3.3	1.27	5.90
PLD 57 X ANK-1	3.27	37.00	3.87	3.47	0.17	3.02
PLD 57 (OP)	0.67	16.77	2.37	2.18	5.60	13.08
MDK-1	2.43	21.67	2.23	2.4	3.00	0.52
PLD 57 graft	2.27	28.1	2.83	2.95	6.07	16.9
CD 0.05	1.24	-	-	-	2.30	-

VENGURLA

On the basis of standard selection criteria viz; compact canopy, cluster bearing habit, nut weight (more than 8 g), shelling percentage (more than 28%) and high yield, 32 F_1 hybrid seedlings were initially found as promising hybrids. Out of 3000 F_1 hybrids 2094 F_1 hybrids are in fruiting stage. Among 2001 planted hybrids the hybrid No. 1306 (Hy.2/16 x V-4) had highest yield (6.96 kg/tree) followed by the hybrids; No. 969 (V-4 x Hy.2/16) 6.17 kg/tree and hybrid No. 886 (5.00 kg/plant) in 4th harvest (Table 1.41).

Table 1.41 : Growth and Yield Performance of promising hybrids at Vengurla

Hybrid No.	Year of planting	Cross combination	Plant Height (m)	Plant Girth (Cm)	Spread		Flowering panicles/ m^2	Av. Nut wt. (g)	Yield (kg/tree)
					EW (m)	NS (m)			
3043	2004	Jawahar-1 x Kolgaon	4.85	45.00	4.10	3.80	11.00	12.90	0.68
3139	2004	Microcarpum x V-7	2.40	40.00	2.50	4.30	11.00	11.00	0.45
3062	2004	C.Y.T.176 x B.T.65	3.55	32.00	2.90	3.40	7.00	11.00	1.17
2914	2004	Nanoda x B.T.65	2.80	40.00	3.20	4.10	8.00	11.00	0.50
1679	2002	V-4 x Hy. 2/16	4.75	35.00	3.90	3.40	9.00	11.75	0.93
868	2001	V-4 x Hy. 2/16	7.00	72.00	7.10	6.70	13.00	10.37	2.16
735	1999	V-2 x B.T.65	7.40	95.00	6.10	8.50	14.00	11.33	5.13
969	2001	V-4 x Hy.2/16	7.20	85.00	6.55	7.20	15.00	10.24	6.17
886	2001	V-4 x Hy.2/16	7.25	73.00	5.30	7.40	13.00	11.25	5.00
1306	2001	Hy.2/16 x V-4	5.0	70.00	7.20	7.30	19.00	10.06	6.96

VRIDHACHALAM

Eight superior hybrids were evaluated. The cross combination of the selected hybrids are

1. M 10/4 x M 26/1
2. M 10/4 x M 45/4
3. M 10/4 x M 75/3
4. M 26/2 x M 26/1
5. M 26/2 x M 45/4
6. M 26/2 x M 75/3
7. M 44/3 x M 26/1
8. M 44/3 x M 45/4

The seeds obtained from these hybrid combination have been planted for evaluation.

x Hy.2/16 combinati

II. CROP MANAGEMENT

Agr.1: NPK Fertilizer Experiment

Centres : East Coast :

Bapatla, Jhargram and Vridhachalam

West Coast :

Madakkathara

Plains / others :

Chintamani

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

SUMMARY:

At Bapatla, the highest cumulative nut yield was recorded in the treatment N2P1K1 (75.97 Kg/tree) followed by N2P2K1 (70.96 Kg/tree). At Chintamani, on the limb pruned trees, higher nut yield (4.46 kg / tree) were recorded by application of 500:250:250 g. NPK / tree / year during third year. At Madakkathara, the highest nut yield was recorded by DCR dose (750 : 187.5 : 187.5g NPK/tree) followed by KAU dose (750 : 325 : 750g NPK/tree). At Vridhachalam, the treatment 1000:125:250 g NPK / plant recorded the highest nut yield of 10.50 kg/tree.

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 2008-09, significant differences for annual nut yield were observed for Nitrogen, Potassium, Phosporus and NP, PK, NK and NPK interactions. The highest annual nut yield was recorded in N2P1K1 (3.57 kg/tree) followed by N2P2K1 (3.56 Kg/tree) but were statistically on par

with each other. The highest cumulative nut yield was recorded in the treatment N2P1K1 (75.97 Kg/tree) followed by N2P2K1 (70.96 Kg/tree) (Table 2.1, 2.2 and 2.3).

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

	P0	P1	P2	Mean	K0	K1	K2
N0	1.66	2.57	1.83	**2.01**	2.48	1.54	2.03
N1	3.09	2.55	2.79	**2.81**	2.80	2.74	2.90
N2	2.35	2.91	3.10	**2.78**	2.73	2.77	2.86
Mean	**2.36**	**2.67**	**2.57**		**2.67**	**2.35**	**2.59**
K0	2.21	2.32	2.56				
K1	3.32	2.17	2.55				
K2	2.47	2.57	2.65				

F-Test	N	P	K	NP	NK	PK
CD 5%	0.7896			1.367		

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

	P0	P1	P2	Mean	K0	K1	K2
N0	37.40	35.29	39.08	**37.25**	37.05	36.73	37.98
N1	55.35	50.18	56.27	**53.93**	51.36	55.92	54.51
N2	47.60	59.28	63.63	**56.83**	50.09	65.21	55.21
Mean	**46.78**	**48.25**	**52.99**		**46.16**	**52.62**	**49.24**
K0	45.14	48.77	46.44				
K1	43.81	54.49	46.45				
K2	49.54	54.61	54.82				

F-Test	N	P	K	NP	NK	PK
Significance	*	*	*	*	*	NS
CD 5%	0.0033			0.0058		

Table 2.3 : Effect of NPK fertilizer and their interaction on yield of cashew at Bapatla

Treatment	Annual nut yield /tree (kg) (2008-09)	Cumulative Nut Yield/tree (kg) (1999-2009)
N0P0K0	1.87	40.08
N0P0K1	1.63	39.92
N0P0K2	1.46	32.21
N0P1K0	3.23	31.02
N0P1K1	1.48	36.40

N0P1K2	2.63	38.12
N0P2K0	1.98	39.72
N0P2K1	1.51	33.89
N0P2K2	1.99	43.63
N1P0K0	2.82	57.95
N1P0K1	3.33	56.90
N1P0K2	2.87	50.90
N1P1K0	3.32	46.26
N1P1K1	1.77	51.46
N1P1K2	*2.57*	52.85
N1P2K0	2.25	49.87
N1P2K1	2.87	59.21
N1P2K1	3.24	59.73
N2P0K0	1.93	37.40
N2P0K1	1.75	49.27
N2P0K2	3.35	56.14
N2P1K0	3.07	53.82
N2P1K1	**3.57**	**75.97**
N2P1K2	2.43	48.39
N2P2K0	3.17	59.05
N2P2K1	**3.56**	**70.96**
N2P2K2	2.78	61.12
SE.m	1.14	0.0048
CD at 5%	2.36	0.010

CHINTAMANI

After imposition of NPK treatments on the limb pruned trees during third year, higher plant height (4.63 m), stem girth (100.80cm) and nut yield (4.46 kg / tree) were recorded by application of 500:250:250 g. NPK / tree / year (Table 2.4).

Table 2.4 : Performance of Cashew in response to NPK fertilizer treatments at Chintamani

Treatments	Plant ht (m)	Trunk girth(cm)	Yield(kg/tree)
$N_0P_0K_0$	3.14	93.00	2.68
$N_0P_0K_1$	3.33	87.88	2.88
$N_0P_0K_2$	3.59	94.63	2.98
$N_0P_1K_0$	3.65	97.38	3.03
$N_0P_1K_1$	3.61	97.25	3.11
$N_0P_1K_2$	4.10	96.25	3.28

$N_0P_2K_0$	3.70	106.90	2.98
$N_0P_2K_1$	4.22	93.63	3.18
$N_0P_2K_2$	4.14	101.00	3.28
$N_1P_0K_0$	3.40	91.63	3.05
$N_1P_0K_1$	3.74	94.38	3.18
$N_1P_0K_2$	3.81	87.50	3.33
$N_1P_1K_0$	4.29	99.75	3.68
$N_1P_1K_1$	4.03	95.13	3.71
$N_1P_1K_2$	4.05	96.12	3.85
$N_1P_2K_0$	4.02	94.71	3.92
$N_1P_2K_1$	3.71	102.88	3.98
$N_1P_2K_2$	4.63	100.80	4.46
$N_2P_0K_0$	3.74	88.50	4.13
$N_2P_0K_1$	3.68	101.38	4.28
$N_2P_0K_2$	3.75	88.00	4.36
$N_2P_1K_0$	3.93	98.38	4.45
$N_2P_1K_1$	3.53	90.63	4.54
$N_2P_1K_2$	3.70	96.50	4.65
$N_2P_2K_0$	4.06	106.50	4.53
$N_2P_2K_1$	3.89	95.13	4.61
$N_2P_2K_2$	3.68	93.29	4.78

JHARGRAM

There were no significant differences found among the treatments with respect to different doses of fertilizer application (Table 2.5).

Table 2.5 : Growth Characters of cashew variety BPP –8 under different fertilizer treatments at Jhargram

Treatment	Plant height (m)	Trunk girth (cm)	Canopy spread (m)	Trunk height (m)
N_{500} $P_{125}K_{125}$	1.53	10.6	1.41	0.58
N_{1000} $P_{250}K_{250}$	1.52	10.5	1.39	0.47
$N_{1500}P_{250}K_{375}$	1.49	10.6	1.37	0.55
S.Em ±	NS	NS	NS	NS
C.D. at 5%				
C.V%	4.92	5.64	9.43	28.64

MADAKKATHARA

Application of increasing doses of fertilizer increased the nut yield and maximum yield was obtained at 750:325:750 g NPK/tree. The highest nut yield was recorded by DCR dose (750 : 187.5 : 187.5g NPK/tree) followed by KAU dose (750 : 325 : 750g NPK/tree). The lowest yield was recorded by the farmers practice (fully organic dose), followed by 200 % DCR dose (1000:250:250g NPK/tree) (Table 2.6).

Table 2.6 : Nut yield (g/tree/annum) of cashew under on- farm fertiliser trial at Madakkathara

Fertilizer schedule (g NPK/tree)	2005-06	2006-07	2007-08	2008-09
T-1 500:125:125 (NRCC)	2500	2775	5038	6475
T-2 750:187.5: 187.5 (150% NRCC)	2738	3067	3613	8188
T-3 1000: 250: 250 (200% NRCC)	2806	3108	3819	5894
T-4 750: 325: 750 (KAU)	3950	4175	4550	6850
T -5 Fully organic (Farmers' practice)	2450	2940	3427	5619

VRIDHACHALAM

The plant height (7.20 m) and trunk girth (54.5 cm) and canopy area (32.50 m^2) were maximum in treatment 1000:125:250 g NPK/plant. Canopy diameter, canopy height in this treatment was on par with treatments of higher fertilizer doses. Date of flowering, duration of flowering, nut weight and apple weight were not influenced by fertilizer doses. Higher nut yield was recorded in treatments with higher fertilizer doses. The treatment 1000:125:250 g NPK / plant recorded the highest nut yield of 10.50 kg/tree. The highest cumulative yield of 35.83 kg nuts /tree for 9 years was recorded in treatment 1000:125:250 g NPK / plant (Table 2.7).

Table 2.7 : Performance of cashew in response to NPK fertilizer treatments at Vridhachalam

Treatment details	Trunk girth (cm)	Canopy surface area (m^2)	Duration of flowering(No. of days)	Nut Yields (Kg/tree)	Cum yield (kg/tree) for 8 years
$N_0P_0K_0$	49.5	29.50	68	7.00	26.53
$N_0P_0K_1$	49.5	29.50	68	7.20	26.73
$N_0P_0K_2$	49.0	29.00	68	7.50	21.66
$N_0P_1K_0$	47.5	26.50	68	7.50	25.75
$N_0P_1K_1$	46.5	27.00	68	7.50	23.26
$N_0P_1K_2$	43.75	25.00	68	7.25	26.66
$N_0P_2K_0$	43.50	26.50	68	7.25	21.70
$N_0P_2K_1$	48.50	27.00	68	7.50	24.58
$N_0P_2K_2$	50.50	27.00	68	7.50	24.98
$N_1P_0K_0$	45.60	27.50	68	7.50	26.95
$N_1P_0K_1$	44.50	26.50	68	7.75	28.58
$N_1P_0K_2$	42.50	25.50	68	8.00	27.70
$N_1P_1K_0$	45.60	26.50	68	8.50	29.60
$N_1P_1K_1$	45.50	29.00	68	8.50	28.60
$N_1P_1K_2$	44.50	29.00	68	8.50	28.83
$N_1P_2K_0$	45.75	29.50	68	8.25	30.43
$N_1P_2K_1$	45.50	29.50	68	8.50	30.75
$N_1P_2K_2$	46.50	29.00	68	9.00	30.88
$N_2P_0K_0$	45.50	29.75	68	9.25	31.77
$N_2P_0K_1$	47.00	29.50	68	9.50	32.27
$N_2P_0K_2$	47.00	29.50	68	9.50	32.08
$N_2P_1K_0$	52.00	29.50	68	9.50	30.84
$N_2P_1K_1$	53.00	30.50	68	10.00	32.23
$N_2P_1K_2$	54.50	32.50	68	10.50	35.83
$N_2P_2K_0$	53.00	30.50	68	10.00	32.90
$N_2P_2K_1$	52.25	30.75	68	10.00	33.79
$N_2P_2K_2$	52.00	30.50	68	10.00	33.98

	Trunk girth		Canopy area		Nut yield / Tree	
	SEd	CD(0.05)	SEd	CD(0.05)	SEd	CD(0.05)
N	0.058	0.106	0.043	0.081*	0.048	0.112**
P	0.058	0.106	0.043	0.081*	0.048	0.112**
K	0.058	0.106	0.043	0.081*	0.048	0.112**
NP	0.075	0.176	0.068	0.146	0.091	0.194**
PK	0.075	0.176	0.068	0.146	0.091	0.194**
NK	0.075	0.176	0.068	0.146	0.091	0.194**
NPK	0.158	0.314	0.163	0.234*	0.146	0.342**

Agr.2: Fertilizer application in high density cashew plantations

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara, Pilicode and Vengurla

Plains / others :

Chintamani, Jagdalpur

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

SUMMARY:

At Bhubaneswar, the cumulative yield at 7th harvest was highest in M_2 150 kg N, 50 kg P_2O_5, 50 kg K_2O (9494.1 kg) followed by M_3 225 kg N, 75 kg P_2O_5, 75 kg K_2O (9276.6 kg). At Chintamani, the highest nut yield per ha. was recorded by S_3 600 plants/ha (5m x 4m) (18.08 q/ha) and lowest was recorded by S_1 200 plants/ha (10m x 5m) (11.52 q/ha). There was no significant difference among the spacing and fertilizer treatments for any growth character at Vengurla and Vridhachalam.

Experiment Details :

Design	:	Split plot		
Main plot : Plant density	:	S_1 200 plants/ha (10m x 5m)		
		S_2 400 plants/ha (6m x 4m)		
		S_3 600 plants/ha (5m x 4m)		
Sub-plot : Fertilizer dose/ha:		M_1 75 kg N, 25 kg P_2O_5, 25 kg K_2O		
		M_2 150 kg N, 50 kg P_2O_5, 50 kg K_2O		
		M_3 225 kg N, 75 kg P_2O_5, 75 kg K_2O		
Total area	:	2.5 ha		
Fertilizers application level :		1^{st} year	:	$1/5^{th}$
		2^{nd} year	:	$2/5^{th}$
		3^{rd} year	:	$3/5^{th}$
		4^{th} year	:	$4/5^{th}$
		5^{th} year	:	Full dose

BHUBANESWAR

Significantly maximum trunk girth (68.08 cm) due to spacing was recorded in S1 (200 plant density / ha) during 2009. Similarly significantly maximum plant spread of 6.6 m and 8.53 m due to spacing was recorded in S1 (200 plant density / ha) in E-W and N-S directions respectively during 2009.

Due to doses of fertilizer there was no significant variation in vegetative characters like plant height, trunk girth and spread of the plants in both the years. However, M_3 (225: 75:75 kg NPK /ha) recorded maximum plant height (5.38 m) followed by M_2 (5.34 m) and M_1 (5.32 m). No significant variation was observed in the plant height, trunk girth, spread of the plant due to interaction effect of spacing and doses of fertilizer in both the years except plant spread in N-S direction during 2009.

The number of flowering panicles was significantly more in S_1 (21.57) as compared to S_2 (19.78) and S_3 (14.47). The number of nuts per panicle was maximum in S_1 (7.7) and minimum in S_3 (4.16). The apple weight was maximum (55.0 g) in S_1. Significantly highest yield per plant due to spacing was recorded in S_1 (9.45 kg) i.e. with a plant density of 200 / ha .

Significantly highest annual nut yield was recorded in S_1 (9.45 kg) and the cumulative nut yield per plant for 7 harvests was found maximum in S_1 (31.21 kg) followed by S_2 (24.87 kg) and minimum in S_3 (21.93 kg). During 2009, highest nut yield / ha was recorded in S_1 (1889.70 kg) followed by S_3 (1496.40 kg) and minimum in S_2 (1381.60 kg). However, the cumulative yield / ha for 7 harvests was found to be maximum in S_3 (10965.10 kg) (Table 2.8).

Table 2.8 : Effect of fertilizer and spacing on vegetative character at Bhubaneswar

a). Effect of spacing (Main plot)								
Treatment	**Plant height (m)**		**Girth (cm)**		**Spread (m)**			
					E-W		**N-S**	
	2008	**2009**	**2008**	**2009**	**2008**	**2009**	**2008**	**2009**
S_1	5.11	5.18	62.42	68.08	6.53	6.60	8.32	8.53
S_2	5.13	5.39	58.13	62.33	5.83	5.86	7.05	7.08
S_3	5.04	5.47	56.61	60.08	5.78	5.82	6.00	6.28
F 'test'	NS	NS	NS	S	S	S	S	S
SE (m) ±	0.097	0.168	1.602	1.162	0.182	0.062	0.233	0.147
CD 5%	-	-	-	4.022	0.632	0.216	0.807	0.508

b) Effect of doses of fertilizer (sub plot) at Bhubaneswar

Treatment	**Plant height (m)**		**Girth (cm)**		**Spread (m)**			
					E-W		**N-S**	
	2008	**2009**	**2008**	**2009**	**2008**	**2009**	**2008**	**2009**
M_1	5.06	5.32	59.46	63.42	6.10	6.15	7.18	7.23
M_2	5.18	5.34	60.29	64.00	6.06	6.08	7.30	7.47
M_3	5.04	5.38	57.41	63.08	5.98	6.04	6.88	7.19
F 'test'	NS	NS	NS	NS	NS	NS	NS	S
SE (m) ±	0.087	0.077	0.619	0.812	0.099	0.099	0.160	0.062
CD5%	-	-	-	-	-	-	-	0.184

Ten to twelve days early flowering was observed with higher doses of fertilizer. No significant variation was observed on the number of flowering panicles / m^2 due to different doses of fertilizer. The number of nuts per panicle was maximum in higher doses of fertilizer M3 (8.5). The apple weight was maximum in M1 (58.0 g) . The nut weight was maximum in M1 (8.37 g) followed by M2 (7.93g) and M3 (7.27 g). As regards the nut yield per plant, M2 (6.27 kg) was found significantly superior to M1 (3.39 kg) but at par with M3 (6.23 kg) due to varying doses of fertilizer application. Cumulative yield at 7th harvest was highest in M2 (27.48 kg) and minimum in M1 (24.0 kg). Significant variation in nut yield per ha due to different doses of fertilizer was observed wherein, M3 (1959.3 kg) was at par with M2 (1822.8 kg) which was significantly superior to M1 (985.5 kg). The cumulative yield at 7th harvest was highest in M2 (9494.1 kg) followed by M3 (9276.6 kg) and M1 (8385.2 kg) (Table 2.9 and Table 2.10a & 2.10b).

No significant variation was observed among the treatments with respect to flowering and yield attributes. The nut yield per plant was maximum in S_1M_2 (11.91 kg) and minimum in S_3M_1 (1.74 kg). Similarly, the nut yield per ha was maximum in S_1M_2 (2381.6 kg) and minimum in S_2M_1 (802.9 kg). But the cumulative yield for 7 harvests was maximum in S_3M_2 (11535.4 kg) and minimum in S_1M_1 (5663.7 kg) (Table 2.11).

Table 2.9 : Effect of fertilizer and spacing on vegetative character at Bhubaneswar

Treatment	Plant height (m)		Girth (cm)		Spread (m)			
					E-W		N-S	
	2008	2009	2008	2009	2008	2009	2008	2009
S_1M_1	5.10	5.18	62.00	68.00	6.60	6.60	8.45	8.60
S_1M_2	5.18	5.03	64.95	69.25	6.40	6.45	8.98	8.85
S_1M_3	5.05	5.33	60.30	67.00	6.58	6.75	7.53	8.15
S_2M_1	5.05	5.45	59.45	63.50	5.93	6.13	7.05	7.00
S_2M_2	5.28	5.45	58.48	62.00	5.78	5.80	7.08	7.18
S_2M_3	5.08	5.28	56.48	61.50	5.80	5.65	7.03	7.08
S_3M_1	5.03	5.33	56.93	58.75	5.78	5.73	6.05	6.10
S_3M_2	5.10	5.55	57.45	60.75	6.00	6.00	5.85	6.38
S_3M_3	5.00	5.53	55.45	60.75	5.58	5.73	6.10	6.35
F 'test'	NS	NS	NS	NS	NS	NS	NS	NS
SE (m)±	0.151	0.133	1.072	1.406	0.172	0.171	0.280	0.107
CD (0.05)	-	-	-	-	-	-	-	0.318

Table 2.10: Effect of doses of fertilizer and spacing on flowering & yield attributes at Bhubaneswar.

a) Effect of spacing (Main plot)										
Treat-ments	No. of Flowering panicles/m^2	No. of nuts panicle	Apple weight (g)	Nut weight (g)	Yield (kg/plant)		Cum. Yield per plant (kg) 7^{th} harvest	Yield (Kg/ha)		Cum. yield per ha (Kg)
					2008	2009		2008	2009	
S_1	21.57	7.20	55.00	7.97	-	9.45	31.21	-	1889.7	6241.3
S_2	19.78	7.23	49.00	7.93	-	3.45	24.87	-	1381.6	9949.6
S_3	14.47	7.70	50.33	7.67	-	2.99	21.93	-	1496.4	10965.1
F 'test'	S				-	S		-	NS	
SE (m) ±	0.296				-	0.986		-	264.04	
CD 5%	1.025					3.412		-	-	

b) Effect of doses of fertilizer (Subplot) at Bhubaneswar

Treat-ments	No. of Flowering panicles/m^2	No. of nuts /panicle	Apple weight (g)	Nut weight (g)	Yield (kg/plant)		Cum. Yield per plant (Kg) 7^{th} harvest	Yield (Kg/ha)		Cum. yield per ha (Kg)
					2008	2009		2008	2009	
M_1	18.00	6.50	58.00	8.37	-	3.39	24.00	-	985.5	8385.2
M_2	19.22	7.13	51.67	7.93	-	6.27	27.48	-	1822.8	9494.1
M_3	18.60	8.50	44.67	7.27	-	6.23	26.54	-	1959.3	9276.6
F 'test'	NS				-	S		-	S	
SE (m) ±	0.380				-	0.489		-	162.94	
CD 5%	-					1.453			484.12	

Table 2.11 : Effect of doses of fertilizer and spacing on flowering and yield attributes at Bhubaneswar

Treat-ment	No. of Flowering panicles /m^2	No. of nuts/ panicle	Apple weight (g)	Nut weight (g)	Yield (Kg/plant)		Cum. Yield per plant (Kg) 7^{th} harvest	Yield (Kg/ha)		Cum. yield per ha (Kg)
					2008	2009		2008	2009	
S_1M_1	19.96	6.20	62	8.40	-	6.43	28.32	-	1285.7	5663.7
S_1M_2	21.25	6.70	57	8.10	-	11.91	34.01	-	2381.6	6801.6
S_1M_3	21.12	8.70	46	7.40	-	10.01	31.30	-	2001.8	6258.8
S_2M_1	16.08	6.40	54	8.60	-	2.01	23.43	-	802.9	9369.9
S_2M_2	17.10	7.10	49	7.90	-	3.72	25.37	-	1486.5	10145.5
S_2M_3	18.12	8.20	44	7.30	-	4.64	25.84	-	1855.4	10333.4
S_3M_1	15.21	6.90	58	8.10	-	1.74	20.25	-	868.0	10122.0
S_3M_2	17.28	7.60	49	7.80	-	3.20	23.07	-	1600.4	11535.4
S_3M_3	16.94	8.60	44	7.10	-	4.04	22.47	-	2020.8	11237.8
F 'test'	NS				-	NS		-	NS	
SE (m) ±	0.678				-	0.847		-	282.2	
CD 5%	-					-			1 -	

The leaf nitrogen % was maximum in S_2 (2.07%) followed by S_1 (2.05%) and S_3 (1.83%). The leaf Nitrogen % increased due to higher doses of fertilizer application. M_3 recorded maximum leaf Nitrogen 2.16% followed by M_2 (2.01%) and minimum in M_1 (1.78%). S_1M_3 recorded maximum leaf N (2.31%) and minimum in S_3M_1 (1.57%).

The leaf P2O5 content recorded in treatment S2 and S3 was found to be 0.041%, followed by S1 (0.036%). Similarly, maximum leaf P2O5 content was recorded in M3 (0.043%) and minimum in M2 (0.037%). S3M3 recorded maximum P2O5 content (0.046%) and minimum in S1M1 (0.031%).

Maximum K_2O content in leaf was recorded in S_3 (0.40%), followed S_2 (0.37%) and minimum in S_1 (0.33%). In case of doses of fertilizer maximum K_2O % was recorded in M_2 (0.47 %) followed by M_3 (0.39%) and minimum in M_1 (0.26%). S_2M_2 recorded highest K_2O % (0.48%) followed by S_3M_2 (0.47%), and minimum in S_1M_1 (0.19%) (Table 2.12 a, 2.12 b & 2.12c).

Table 2.12 : Nitrogen, Phosphorous and Potassium content (%) of cashew leaf due to the effect of spacing and levels of fertilizer at Bhubaneswar.

Table2.12 (a). Leaf Nitrogen content (%) due to the effect of spacing and levels of fertilizer.

	S1	S2	S3	Average
M1	1.81	1.96	1.57	1.78
M2	2.02	2.15	1.85	2.01
M3	2.31	2.09	2.08	2.16
Average	2.05	2.07	1.83	

Table 2.12 (b). Leaf phosphorous content (%) due to the effect of spacing and levels of fertilizer at Bhubaneswar.

	S1	S2	S3	Average
M1	0.031	0.045	0.037	0.038
M2	0.035	0.037	0.039	0.037
M3	0.041	0.041	0.046	0.043
Average	0.036	0.041	0.041	

Table 2.12 (c). Leaf Potassium content (%) due to the effect of spacing and levels of fertilizer at Bhubaneswar.

	S1	S2	S3	Average
M1	0.19	0.25	0.33	0.26
M2	0.45	0.48	0.47	0.47
M3	0.36	0.39	0.41	0.39
Average	0.33	0.37	0.40	

CHINTAMANI

The plant height, stem girth and canopy spread did not vary significantly among the different plant densities or fertilizer levels. The nut yield per plant varied significantly among the plant densities. The highest nut yield per plant was recorded by S_1 (5.76 kg/plant) and lowest in S_3 (3.62kg/plant). The highest nut yield per ha. was recorded by S_3 (18.08 q/ha) and lowest was recorded by S_1 (11.52 q/ha). The highest yield kg/plant was noticed in M_2 (4.75kg) and highest yield (q/ha) was also observed in M_2 (16.13q/ha) (Table 2.13).

Table 2.13 : Effect of Plant density and fertilizer levels on growth and yield of Cashew at Chintamani

Treatments	Plant height (m)	Stem girth (cm)	Canopy spread (m)		Yield (kg/ plant)	Cu. yield (kg/tree) of 4 harvests	Yield (q/ ha.)
			E-W	N-S			
Densities	-	-	-	-	-	-	-
S_{1-200}	3.65	53.06	5.75	6.02	5.76	15.09	11.52
S_{2-400}	3.73	55.11	5.76	6.44	3.99	11.29	15.97
S_{3-500}	3.59	50.14	5.46	5.89	3.62	10.47	18.08
S .Em ±	0.06	1.46	0.17	0.16	0.10	-	0.26
C.D at 5%	-	-	-	-	0.36	-	0.91
Fertilizer levels	-	-	-	-	-	-	-
$M_{1-75:25:25}$	3.69	55.97	6.13	6.69	4.11	11.81	14.04
$M_{2-150:50:50}$	3.75	51.29	5.62	6.02	4.75	12.41	16.13
$M_{3-225:75:75}$	3.53	51.06	5.21	5.64	4.52	12.65	15.40
S. Em ±	0.14	2.30	0.27	0.36	0.04	-	0.11
C.D at 5%	-	-	-	-	0.14	-	0.40

Interaction effect of densities and fertilizers did not varied significantly among growth parameters. Yield (kg/plant) varied significantly among interactions. The highest yield was obtained in S_1M_2 (6.20kg/plant) followed by S_1 M_3 (5.82kg/plant) and lowest was in S_3 M_1 (3.38kg) (Table 2.14).

Table 2.14 : Interaction effect between plant density and fertilizer levels on growth and yield of Cashew at Chintamani

Interactions	Plant ht. (m)	Stem girth (cm)	Canopy spread (m)		Yield (kg/ plant)	Cu. yield (kg/tree) of 4 harvests	Yield (q/ ha.)
			E-W	N-S			
S_1 M_1	3.74	58.91	6.51	6.85	5.26	13.82	10.52
S_1 M_2	3.81	49.91	5.45	5.72	6.20	14.91	12.40
S_1 M_3	3.42	50.37	5.29	5.48	5.82	14.63	11.65
S_2 M_1	3.77	57.38	6.21	6.83	3.68	10.60	14.73
S_2 M_2	3.86	56.17	5.89	6.69	4.24	11.12	16.96
S_2 M_3	3.55	51.78	5.17	5.82	4.06	11.31	16.23

$S_3 M_1$	3.55	51.62	5.68	6.39	3.38	9.67	16.88
$S_3 M_2$	3.59	47.77	5.51	5.66	3.81	10.18	19.04
$S_3 M_3$	3.62	51.04	5.18	5.63	3.67	10.85	18.33
S.Em ±	0.25	3.98	0.46	0.63	0.07	-	0.20
C.D at 5%	NS	NS	NS	NS	0.21	-	-

JHARGRAM

Fertilizer application 150 Kg N + 50 Kg P_2O_5 + 50 Kg K_2O per hectare had maximum positive effect on canopy spread and canopy height. Vegetative laterals per square meter was highest under 6m x 4m spacing (11.5) and 5m x 4m spacing (17.3) with the treatment of 150 Kg N + 50 Kg P_2O_5 + 50 Kg K_2O per hectare i.e. 11.5 and 17.3 respectively. While in case of 10m X 5m spacing vegetative laterals per square meter was highest with the fertilizer dose of 225 Kg N + 75 Kg P_2O_5 + 75 Kg K_2O per hectare. Maximum number of nuts per square meter (33.8) was found with 10m x 5m spacing with higher doses of fertilizers

Highest nuts / panicle were found under 10m x 5m spacing (11.1 – 15.9 nuts / panicle). No significant differences were noticed in nut weight but significant differences were observed in apple weight. Apple weight was highest (53g) under 6m X 4m spacing and with a fertilizer dose of 150 Kg N + 50 Kg P_2O_5 + 50 Kg K_2O per hectare. The trees spaced at a distance of 10m X 5 gave maximum yield (5.07 to 5.41 Kg /tree). followed by 6m X 4m spaced plants (4.31 Kg/tree). Biomass removal was more with high plant densities (Table 2.15).

Table 2.15 : Growth parameters of high density planting at Jhargram

Parameters	Fertilizer Treatments	Spacing			CV %	S.Em. ±	C.D.at 5%
		S_1	S_2	S_3			
Plant Height (m)	M_1	3.77	4.08	4.11	3.57	0.083	1.181
	M_2	3.84	4.02	4.24			
	M_3	3.79	4.21	4.14			
Trunk Girth (Cm)	M_1	50.0	54.7	44.3	9.98	2.685	5.851
	M_2	47.7	46.3	47.0			
	M_3	42.0	47.0	40.3			
Canopy Spread	M_1	5.13	5.13	5.09	3.05	0.089	0.195

(m)	M_2	4.96	5.26	5.17			
	M_3	4.97	5.06	5.03			
Canopy Height (m)	M_1	3.23	3.65	3.47	4.42	0.089	0.194
	M_2	3.33	3.73	3.60			
	M_3	3.32	3.78	3.49			
Canopy Area (m^2)	M_1	32.91	35.61	34.06	12.55	2.331	5.079
	M_2	33.17	35.97	21.04			
	M_3	32.39	36.32	28.14			
Duration of flowering	M_1	99	96	99			
	M_2	88	93	82			
	M_3	91	63	55			
Flowering /m^2	M_1	8.9	8.9	9.6	28.62	1.908	4.157
	M_2	14.7	12.2	9.1			
	M_3	14.9	13.4	12.3			
Veg Flush /m^2	M_1	16.7	5.8	11.5	57.08	3.821	8.326
	M_2	6.8	11.5	17.3			
	M_3	17.0	5.8	11.9			
Nuts/m^2	M_1	30.6	21.1	14.6	31.19	4.374	9.531
	M_2	33.7	18.0	21.0			
	M_3	33.8	21.2	24.5			
Nuts/Panicle	M_1	11.1	8.9	9.8	39.95	2.418	5.268
	M_2	15.9	8.6	9.8			
	M_3	11.3	9.0	9.9			
Nut Weight (g)	M_1	5.1	5.5	5.5	11.18	0.333	0.726
	M_2	4.8	5.5	5.6			
	M_3	4.6	5.0	4.9			
Apple Weight (g)	M_1	37.0	20.8	35.3	14.65	3.352	7.303
	M_2	32.2	53.2	42.9			
	M_3	28.7	39.7	36.8			
Yield (Kg/Tree)	M_1	5.13	4.31	2.69	32.77	0.795	1.732
	M_2	5.41	3.62	3.79			
	M_3	5.07	3.86	3.92			
Biomass Removed (Kg/tree)	M_1	4.07	7.9	9.0	35.38	1.335	2.909
	M_2	3.3	6.4	6.9			
	M_3	3.7	9.0	8.4			

Maximum percentage of ground area covered by plants under 5m x 4m spacing irrespective of fertilizer application followed by 6m x 4m spacing. In both the spacings the moderate dose of fertilizer application i.e. 150 Kg N + 50 Kg P_2O_5 + 50 Kg K_2O per hectare covered maximum ground area (102.03%).

Yield per hectare was maximum under 5m X 4m spacing (19.58 Q/ha) which showed positive effect on yield /hectare (Table 2.16 and Table 2.17).

Table 2.16 : Effect of tree density and fertilizer application on ground coverage by canopy (%) at Jhargram

Treatments	Ground coverage by canopy (%)			Mean
MP/SP	M1	M2	M3	
S1	41.42	38.75	38.83	39.67
S2	86.20	91.26	83.78	87.08
S3	102.03	104.80	99.71	102.18
Mean	76.55	78.27		
MP/SP- S.Em ±	3.239			
C.D. at 5%	7.058			
CV %	7.35			

Table 2.17 : Effect of tree density and fertilizer application on annual yield (Quintal/ha) at Jhargram

Treatments	Ann. Nut yield (q/ha)			Mean
MP/SP	M1	M2	M3	
S1	10.24	10.81	10.13	10.39
S2	17.24	14.45	15.41	15.70
S3	13.40	18.97	19.58	17.32
Mean	13.63	14.74	15.64	
MP/SP- S.Em ±	2.972			
C.D. at 5%	6.476			
CV %	35.57			

Significantly maximum cumulative yield (30.47Q/ha) was observed in case of 5m X 4m spacing. At the fertilizer dose of 150 Kg N + 50 Kg P_2O_5 + 50 Kg K_2O per hectare cumulative yield was 30.47Q/ha at the third harvest. The mean cumulative yield under 6m X 4m spacing and 5m X 4m spacing were more than 10m X 5m spacing. The different doses of fertilizers did not influence on cumulative yield/ha.

The 5m X 4m spacing as well as 6m X 4m spacing led to more yield/unit area than 10m X 5m spacing but on the basis of yield /tree 10m X 5m spaced trees produced maximum nut yield (Table 2.18).

Table 2.18 : Effect of tree density and fertilizer application on cumulative nut yield (Quintal /ha) at Jhargram

Treatments	Cum. nut yield (q/ha)			Mean
MP/SP	M1	M2	M3	
S1	15.04	16.70	15.23	15.66
S2	28.87	25.24	27.26	27.12
S3	19.34	30.47	29.72	26.51
Mean	21.08	24.14	24.07	
MP/SP- S.Em ±	2.893			
C.D. at 5%	6.303			
CV %	21.69			

MADAKKATHARA

Tree densities, fertilizer doses and their interactions did not significantly influence any of the growth parameters. The nut yield / ha. from 500 trees /ha was higher by 605 kg (138%) as compared to 200 trees/ha.

The maximum annual nut yield of 5.58 kg/tree was recorded by the tree density of 600 trees/ha. The treatment having 600 trees/ha recorded an increase of 1743 kg/ha (166 %) over the treatment having 200 trees/ha in the cumulative yield. The medium fertilizer level of 150:50:50 kg NPK/ha recorded the maximum tree height (4.51 m) and tree girth (70.7 cm) (Table 2.19 and Table 2.20).

Table 2.19 : 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)	Yield (kg/tree) (2008-09)		Cumulative yield (kg/ha) (2004-09) (4 years)	
					kg/tree	kg/ha	kg/tree	kg/ha
Densities								
S_1 - 200	4.42	68.8	4.61	4.68	2.189	438	5.239	1048
S_2 -400	4.48	67.6	4.83	4.86	2.056	822	5.510	2204
S_3 -500	4.46	66.8	4.43	4.56	2.086	1043	5.581	2791
CD (0.05)	NS	NS	NS	NS	NS	-	NS	-
SEm	0.09	1.71	0.19	0.11	0.05	-	0.2	-
Fertilizer doses								
M_1- 75:25:25	4.41	67.9	4.43	4.74	2.100	770	5.397	1979
M_2- 150:50:50	4.51	70.7	4.63	4.68	2.298	843	5.529	2027
M_3- 225:75:75	4.43	64.7	4.80	4.68	1.932	708	5.403	1981
CD (0.05)	NS	NS	NS	NS	NS	-	NS	-
SEm	0.12	1.88	0.13	0.11	0.13	-	0.23	-

Table 2.20 : 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)	Yield (08 – 09) (kg/tree/year)	Cumulative yield (kg/ tree/ year) (2004-09)
S_1 M_1	4.53	69.9	4.55	4.63	2.518	6.016
S_1 M_2	4.38	70.8	4.58	4.68	2.395	5.383
S_1 M_3	4.35	65.7	4.70	4.75	1.655	4.331
S_2 M_1	4.33	70.0	4.50	4.85	1.992	5.151

S_2 M_2	4.58	69.0	4.90	4.83	2.185	5.579
S_2 M_3	4.53	63.9	5.08	4.90	1.990	5.797
S_3 M_1	4.38	63.7	4.23	4.75	1.790	5.037
S_3 M_2	4.58	72.2	4.43	4.53	2.315	5.624
S_3 M_3	4.43	64.4	4.63	4.40	2.153	6.086
CD (0.05)	NS	NS	NS	NS	NS	NS
SEm	0.20	3.3	0.23	0.19	0.22	0.40

PILICODE

Only nut yield varied significantly among the different densities of planting and levels of fertilizers tried. The interaction effects of fertilizer and planting densities did not exhibit significant variation with the treatments tried. The nut yield per hectare was significantly superior in the higher density of planting (ie. S3: 5m x 4 m, 600 plants / ha.) (11.23Q/ha).

The nut yield /ha in fertilizer doses M1 and M2 were on par and higher in the M3 level of fertilizer. Among the interaction effects of fertilizer doses and spacings the treatment S3M3 (5m x 4m and 225Kg N: 75 Kg P2O5: 75Kg K2O) was superior in nut yield / ha (16.29 q/ha) (Tables 2.21, 2.22 and 2.23).

Table 2.21 : Effect of spacing on vegetative characters and yield of Cashew variety MDK-1 at Pilicode

Treatment	Plant Height (m)	Girth (cm)	Spread of the plant		Canopy area(m^2)	No of flowering panicle /m^2	Yield (kg) per plant	Yield /ha (Q)
			E-W (m)	N-S (m)				
S1	3.46	44.66	4.26	4.2	42.38	10.98	2.74	7.17
S2	3.45	43.77	4.15	4.39	42.04	10.36	1.84	7.70
S3	3.52	44.76	4.16	4.33	41.90	11.58	2.49	11.23
F test	NS	NS	NS	NS		NS	NS	5.36

Table 2.22 : Effect of Fertilizer on vegetative characters and yield of Cashew variety MDK-1 at Pilicode

Treatment	Plant Height (m)	Girth (cm)	Spread of the plant		Canopy area(m^2)	No of flowering panicle /m^2	Yield(kg) per plant	Yield/ ha (Q)
			E-W (m)	N-S (m)				
M1	3.46	43.50	4.13	4.24	41.73	11.75	1.98	8.40

M2	3.50	43.58	4.36	4.37	43.35	11.98	2.62	6.26
M3	3.48	46.11	4.07	4.32	41.23	9.19	2.48	11.44
CD 0.05	NS	NS	NS	NS	NS	NS	NS	5.36

Table 2.23 : Interaction effect of spacing and doses of fertilizer application on growth and yield of cashew variety MDK -1 at Pilicode

Treatment	Plant Height(m)	Girth(cm)	Spread of the plant		Canopy area (m^2)	No of flowering panicle /m^2	Yield (kg/pl)	Yield/ha (Q)
			E-W (m)	N-S (m)				
S1M1	3.55	43.61	4.34	4.22	46.07	11.91	2.40**	7.64
S1M2	3.34	42.35	4.29	4.10	40.97	9.82	3.95**	3.90
S1M3	3.48	48.01	4.15	4.29	40.09	9.23	1.88	9.97
S2M1	3.28	41.45	3.82	4.32	36.62	13.85	2.15**	7.52
S2M2	3.58	42.98	4.30	4.37	44.70	8.88	1.69	7.53
S2M3	3.52	46.88	4.31	4.50	44.79	8.37	2.69**	8.05
S3M1	3.56	45.43	4.22	4.19	42.50	9.49	1.41	10.05
S3M2	3.57	45.40	4.51	4.62	44.39	17.24	2.22**	7.36
S3M3	3.43	43.44	3.76	4.18	38.81	8.0	3.87**	16.29**
CD 0.05	NS	NS	0.58	NS	NS	4.77	1.80	5.36

VENGURLA

There was no significant difference among the spacing and fertilizer treatments for any growth character except height. The tree height was significantly influenced by spacing and S_3 recorded 7.1 m plant height. Plants from S_3 treatment i.e. 5 m X 4m (500 plants/ha) were pruned as per the decision of NGM-2007 and henceno yield was obtained during the fruiting season of 2008-09 (Tables 2.24 and 2.25).

Table 2.24: Effect of spacing and fertilizer on growth and yield of cashew at Vengurla

Treatments	Mean Height (m)	Mean Girth (cm)	Mean Spread (m)	Mean Canopy height (m)	Mean Canopy area (m^2)
S_1	5.70	84.20	7.60	4.80	74.20
S_2	5.50	69.20	6.00	4.40	51.70
S_3	7.10	81.50	6.60	6.70	76.40
SE m±	0.30	4.20	0.40	0.40	8.10
CD at 5%	1.10	N.S.	N.S.	N.S.	N.S.
M_1	6.00	77.70	6.60	5.30	65.20
M_2	6.20	80.20	6.90	5.40	70.60
M_3	6.00	77.10	6.70	5.30	66.50
SEm±	0.10	1.60	0.20	0.20	3.00
CD at 5%	N.S.	N.S.	N.S.	N.S.	N.S.

Table 2.25 : Interaction effect of spacing and fertilizer on growth and yield of cashew at Vengurla.

Treat.	Mean Height (m)	Mean Girth (cm)	Mean Canopy Spread (m)	Mean Canopy area (m^2)	Cum. yield (Kg /tree)	
S_1M_1	5.50	83.00	7.40	69.40	6.40	Cum. yield for 6 harvest (Kg /tree)
S_1M_2	5.90	88.30	7.80	79.70	6.71	
S_1M_3	5.60	81.40	7.50	73.40	9.26	
S_2M_1	5.30	66.40	5.70	47.10	3.88	
S_2M_2	5.90	71.90	6.40	56.30	4.38	
S_2M_3	5.40	69.40	6.00	51.60	5.38	
S_3M_1	7.30	83.70	6.60	79.00	4.60	Cum. yield for 5 harvest (Kg /tree)
S_3M_2	6.80	80.40	6.60	75.70	4.05	
S_3M_3	7.00	80.50	6.70	74.50	3.92	
SEm±	0.25	2.84	0.31	5.12	-	
CD at 5%	N.S.	N.S.	N.S.	N.S.	-	

VRIDHACHALAM

The trees in 10 x 5 m recorded an yield range of 7.2 – 7.5 kg / tree, 461 – 480 kg per plot of 0.8 acre and an estimated yield of 1440-1500 kg per ha in various fertilizer treatments. The 6 x 4 m spacing yielded and yield range of 7.0-7.5 kg per tree, 896-960 kg per plot and 2800- 3000 kg per hectare in various fertilizer treatments. The trees in 5x4m spacing were limb pruned and have started flowering and bearing during 2008 (Tables 2.26 and 2.27).

Table 2.26 : Effect of fertilizer application and spacing on vegetative characters and yield of cashew at Vridhachalam

Treatments	Plant height(m)	Trunk girth(cm)	Canopy spread (m)	Canopy area(m^2)	Canopy height (m)
M_1S_1	8.00	46.50	6.00	28.50	6.50
M_1S_2	8.50	46.50	6.50	28.75	6.80
M_1S_3	8.50	46.80	6.50	26.75	7.00
M_2S_1	8.00	44.20	6.20	26.80	6.50
M_2S_2	8.00	44.50	6.50	26.80	6.50
M_2S_3	8.50	46.50	6.50	27.00	6.80
M_3S_1	4.00*	40.20	3.50	15.50	2.38
M_3S_2	4.50*	42.00	3.50	15.50	2.50
M_3S_3	4.80*	42.60	3.50	15.80	2.50

- The trees were limb pruned

Table 2.27 : Effect of fertilizer application and spacing on vegetative characters and yield of cashew at Vridhachalam

Treatments	Duration of flowering (days)	Apple weight (g)	Nut weight (g)	Yield /tree (kg)	Actual Yield /plot (0.80 acre)	Yield /ha(kg)
M_1S_1	73	49.50	7.00	7.20	461	1440
M_1S_2	73	48.00	7.00	7.50	480	1500
M_1S_3	73	50.00	7.00	7.50	480	1500
M_2S_1	73	48.50	7.00	7.00	896	2800
M_2S_2	73	49.50	7.00	7.50	960	3000
M_2S_3	73	50.00	7.00	7.50	960	3000
M_3S_1	68	48.00	7.00	0.50	80	250
M_3S_2	68	48.50	7.00	0.50	80	250
M_3S_3	68	48.50	7.00	0.50	80	275

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

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY:

At chintamani, the mean yield kg/ha (1000kg/ha) and mean cumulative nut yield (5951 kg/ha) were higher compared to normal planting. At Madakkathara, the per hectare yield was significantly higher (3.27 times) under high density planting (2766 kg) as compared to normal density (846 kg). The cumulative yield per ha for nine harvests was significantly higher under high density system (20044kg/ha) as compared to normal density planting (5366 kg/ha).

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 2008-09, maximum growth and yield per tree were recorded in the plots spaced at 4x4m in comparison to normal spacing density (Table 2.28).

Table 2.28 : Data on Growth parameters of high density planting at Bapatla

Parameter	Mean	
	8x8m plot	4x4m plot
Pl. Height (m)	1.93	2.30
Trunk girth(cm)	31.4	35.80
Canopy spread E-W (m)	2.43	2.98
Canopy spread N-S (m)	3.10	3.37
Yield (kg/tree)	0.46	0.64
C.Yield (Kg/tree)	0.78	1.07

BHUBANESWAR

The trees were pruned during June. Though 2.97 tons nuts / ha was recorded in 2007, the cashew plants were severely damaged by hailstorm during 2008 and no yield was obtained.

CHINTAMANI

The mean growth and yield parameters per plant recorded lower values under high density planting (1.60 kg/tree during 8^{th} harvest) compared to normal planting (6.14 kg/tree during 8^{th} harvest). But, the mean yield kg/ha (1000kg/ha) and mean cumulative nut yield (5951 kg/ha) which were higher compared to normal planting. In normal planting the mean nut yield of 8^{th} harvest obtained was 957 kg/ha with a cumulative nut yield of 4190 kg/ha (Table 2.29).

Table 2.29: 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	3.00	3.65	6.20	4.20	5.20
Stem girth (cm)	63.0	40.0	51.50	91.00	75.0	83.0
Canopy spread (m) E - W	5.20	3.30	4.25	9.60	8.0	8.80
N - S	5.40	3.50	4.45	9.30	7.80	8.55
Yield (kg/tree)	2.40	0.80	1.60	7.15	5.12	6.14
Yield (kg/ha)	1500	500	1000	1115	799	957
Cumulative Yield of 7 harvests						
Kg/tree	14.75	4.30	9.53	31.75	21.97	26.86
Kg/ha	9213	2688	5951	4953	3427	4190

JHARGRAM

The yield of BPP – 8 was 3.17 Kg/tree at the third harvest. Yield per block, Yield per hectare and cumulative yield per hectare were also highest in case of BPP – 8 (Tables 2.30 and 2.31).

Table 2.30 : Growth parameters of cashew plants planted under high density planting observational trial at Jhargram

Repl. No.	Treatment	Plant Height (m)	Trunk girth (cm)	Mean canopy diameter (m)	Canopy height (m)	Canopy area (Sq. m.)
1.	5m x 5m	4.5	45	3.50	4.00	23.9
2.	5m x 5m	4.0	48	3.75	3.25	22.1

Table 2.31 : Yield parameters of cashew plants planted under high density planting observational trial at Jhargram

Repl. No.	Treatment	No.of plants /block	No. of nuts /tree	Yield			Cumulative yield (3^{rd}. harvest) Q / ha
				Kg/tree	Kg/block	Q/ha	
1.	5m x 5m	40	383.8	3.17	126.80	19.81	2.63
2.	5m x 5m	40	198.8	1.17	46.84	7.32	1.46

MADAKKATHARA

The yield per tree was higher under normal density (5.43 kg) to the tune of 22.6%, as compared to high-density planting system (4.43 kg) during the twelfth year of planting. The per hectare yield was significantly higher (3.27 times) under high density planting (2766 kg) as compared to normal density (846 kg). Tree height and canopy spread were significantly higher in normal density planting.

The cumulative yield per tree of nine years was 2.33 kg higher under normal density planting over high density planting. The cumulative yield per ha for nine harvests was significantly high under high density system as compared to normal density planting (20044kg/ha vs 5366 kg/ha). The increase was 3.74 times than that of normal density planting (Table 2.32).

Table 2.32 : Effect of high density planting on growth and yield attributes and yield of cashew during twelth year at Madakkathara

Parameters	High density planting			Normal planting
	Max.	Min.	Mean	
Tree height (m)	6.50	4.60	5.66	7.04
Trunk girth (cm)	100.00	80.00	90.60	87.60
Canopy spread - NS (m)	6.00	4.30	5.32	6.57
Canopy spread - EW (m)	6.20	3.80	5.43	7.05
Yield (kg/tree/annum)	7.00	2.25	4.43	5.43
Yield (kg/ha/annum)			2766.00	846.00
Cumulative yield (kg/ tree) in nine harvests			32.07	34.40
Cumulative yield (kg/ha in nine harvests)			20044	5366

VENGURLA

Average height of the plant was 7.2 m and canopy area was 63.9 m^2. The mean cumulative yield for 5 harvests was 4.46kg/plant. Trees were pruned during November, 2008 as per the decision taken in the National Group Meeting – 2007 hence yield was not obtained during 2009 (Tables 2.33 and 2.34).

Table 2.33 : Growth and yield observations of high density planting at Vengurla

Row No.	Mean Height (m)	Mean Girth (cm)	Mean Canopy Diameter (m)	Canopy Height (m)	Mean Canopy Area (m^2)
1.	7.80	87.90	6.40	7.20	78.70
2.	7.90	76.80	5.20	7.40	64.30
3.	8.00	74.30	5.20	7.40	63.50
4.	7.70	72.80	5.00	7.30	60.00
5.	7.60	73.50	5.70	7.10	67.50
6.	7.90	75.10	5.50	7.30	67.30
7.	8.00	76.70	6.00	7.40	74.90
8.	8.20	68.70	5.40	7.50	67.80
9.	8.20	84.50	6.00	7.60	75.90
10.	7.90	84.70	6.60	7.20	82.80
Mean	7.20	70. 50	5.20	6.70	63.90

Table 2.34 : Average Yield Kg / Plant in High Density trial at Vengurla

Row No.	Average Yield kg/plant					Cumulative yield Kg/plant. (5 harvest)
	* 2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	
1	0.09	-	0.13	1.55	1.31	2.99
2.	0.02	0.06	0.35	4.16	2.24	6.82
3	0.03	-	0.09	1.10	2.70	3.89
4	0.01	-	0.42	5.06	3.83	9.32
5	0.20	0.01	0.10	1.24	2.83	4.17
6	0.10	-	0.03	0.37	2.06	2.56
7	0.13	0.01	0.25	3.02	2.38	5.65
8	0.09	-	0.05	0.55	2.38	3.06
9	0.12	0.05	0.03	0.41	2.43	2.87
10	0.21	0.07	0.08	0.96	1.96	3.27
Mean	0.1	0.012	0.15	1.84	2.41	4.46
* Yield started from 2003-04						

Agr.3: Drip irrigation trial

Centres : East Coast :

Vridhachalam

West Coast :

Vengurla

Plains / others :

Chintamani

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

SUMMARY

At Chintamai, nut yield of 8.10 kg/tree with a nut weight of 7.4 g. and shelling per cent of 32.1 and cumulative yield of 3 harvests (26.89kg) was observed in irrigation at 80% CPE. At Vengurla, mean yield was maximum (3.32 kg/tree) in the irrigation treatment at 20 % C.P.E. and the cumulative yield for six harvests was maximum in the irrigation treatment at 40 % C.P.E. (21.02 Kg/tree).

Experimental Details :

Treatments : 5

T1 : No Irrigation

T2 : Irrigation 20% of cumulative pan evaporation (CPE).

T3 : Irrigation 40% of cumulative pan evaporation (CPE).

T4 : Irrigation 60% of cumulative pan evaporation (CPE).

T5 : Irrigation 80% of cumulative pan evaporation (CPE).

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

CHINTAMANI

Among different levels of irrigation, irrigating the crop at 80% CPE (I_5) recorded significantly highest plant height (4.99 m). Stem girth (82.38 cm) at 60% CPE. The canopy spread (E-W, 8.14 m & N-S,8.26m in 60% CPE), nut yield of 8.10 kg/tree with a nut weight of 7.4 g. and shelling per cent of 32.1 and cumulative yield of 3 harvests (26.89kg) 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) 3 harvests	Nut Wt. (g)	Shelling (%)
			E - W	N - S				
I_1 : No irrigation	4.86	72.57	7.51	7.61	5.12	16.54	6.90	29.50
I_2 : Irrigation at 20% CPE	4.91	77.19	7.57	7.65	6.18	20.12	7.10	30.00
I_3 : Irrigation at 40% CPE	4.99	79.63	8.11	7.85	6.8	21.86	7.20	31.40
I_4 : Irrigation at 60% CPE	5.05	82.38	8.14	8.26	7.55	25.31	7.20	31.30
I_5 : Irrigation at 80% CPE	5.16	82.13	8.13	8.12	8.10	26.89	7.40	32.10
S. Em ±	0.03	1.72	0.15	0.16	0.22	-	-	-
C.D. at 5%	0.09	5.30	0.46	0.50	0.68	-	-	-

VENGURLA

The growth and yield parameters amongst the varieties were found to be non-significant. However, mean yield was maximum (3.32 kg/tree) in the irrigation treatment at 20 percent C.P.E. Similarly, cumulative yield for six harvests were maximum in the irrigation treatment at 40 percent C.P.E. i.e. 21.02 Kg/tree (Table 2.36).

Table 2.36 : Yield data of drip irrigation trial in cashew at Vengurla

Treatments	Yield kg nut /tree						Cumulative yield for 6 harvest kg/tree
	*2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	
T_1	1.31	1.36	1.88	7.02	4.66	2.85	19.08
T_2	1.38	1.14	2.13	6.57	4.75	3.32	19.29
T_3	1.65	1.55	1.87	7.14	6.17	2.64	21.02
T_4	1.36	1.50	1.61	8.36	4.48	2.54	19.85
T_5	1.79	1.70	1.78	7.34	4.14	3.29	20.04
SEm±	0.23	0.29	0.25	0.39	0.63	0.21	-
CD at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	-
*** Yield started from 2003-04**							

VRIDHACHALAM

Irrigating the cashew plants at 80% of CPE favoured the growth parameters viz., plant height (3.46m), trunk girth (24.8cm) and canopy spread (2.60m). The nut yield is yet to be obtained (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)
T1 - No irrigation	2.42	21.2	2.06
T2 - Irrigating 20% of CPE	2.78	22.6	2.24
T3 - Irrigating 40% of CPE	2.96	23.4	2.44
T4 - Irrigating 60% of CPE	3.20	24.4	2.52
T5 - Irrigating 80% of CPE	3.46	24.8	2.60
SE d	0.08	0.12	0.32
CD (0.05%)	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 inter-cropping system, and to work out a soil fertility management strategy for the intercropping system.

SUMMARY:

At Bhubaneswar, the maximum net return was received from colocasia (Rs 69,956) followed by bhindi (Rs. 59,420). At Jhargram, the yield of cashew was 6.00 Q/ha without an intercrop while it was 9.87Q/ha with amaranthus. The benefit cost ratio of 2.44 in cashew + bottle gourd was the most profitable followed by cashew + amaranths (1.93). In terms of tuber yield at Madakkathara, tapioca recorded the maximum yield (11.3 t/ha) and C: B ratio (1.96) followed by amorphophallus (10.3 t/ha). At Vridhachalam, with medicinal plants as intercrops, *Ocimum* had highest BCR of 2.4.

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

BHUBANESWAR

Minimum plant height, girth and spread of the plant were recorded in control i.e. without intercrop. Significantly highest plant height was recorded in T_3 i.e. cowpea as intercrop (5.6 m) and T_6 i.e. colocasia as intercrop (5.5 m). The girth of the plant varied from 43.0 cm in T_7 (Cashew alone) to maximum of 51.7 cm in T_6 (Cashew + colocasia). The spread of the plant varied from 5.2 m to 6.5 m in N-S direction and 5.1 m to 6.7 m in E-W direction. Minimum spread was observed in control i.e. without intercrop (Table 2.38).

Table 2.38 : Vegetative characters of main crop cashew at Bhubaneswar

Treatment		Height (m)	Girth (cm)	Spread N-S (m)	Spread E-W (m)	Yield Q/ha (Main crop) 2009
T_1	Cashew + brinjal	5.0	44.7	5.9	6.6	5.4
T_2	Cashew + chilli	4.8	46.0	6.0	6.3	5.1
T_3	Cashew + cowpea	5.4	50.3	6.3	6.7	6.5
T_4	Cashew + bhindi	4.8	51.0	6.0	6.2	6.1
T_5	Cashew + pumpkin	5.1	49.3	6.0	6.7	5.2
T_6	Cashew + colocasia	5.4	51.7	6.5	6.6	5.8
T_7	Cashew alone	4.5	43.0	5.2	5.1	6.0
F 'test'		S	S	S	S	S
SE (m) $\pm$		0.090	0.989	0.105	0.112	0.149
CD 5%		0.278	3.050	0.323	0.346	0.461

Due to hailstorm, no yield of cashew was obtained during 2008, however, significantly highest yield of the main crop i.e. cashew at 5th harvest (2009) was recorded in T3 (650.0 kg/ha) i.e. in cowpea as intercrop which is at par with T4 (610.0 kg/ha) i.e. in bhindi as intercrop. Minimum yield of main crop was recorded in T2 (510.0 kg/ha).

The net area under various intercrops (treatments) was 55%, 33%, 20%, 16% and 10% during the year 2004, 2005, 2006, 2007 and 2008 respectively. The yield and total net returns per hectare from inter-crops as well as main crop after 5 years revealed that maximum net return was received from colocasia (Rs 69,956) followed by bhindi (Rs. 59,420), cowpea (Rs 58,842), brinjal (Rs 58,286), chilli (Rs. 54,679), pumpkin (Rs 52,376) and control (Rs 42,350) (Tables 2.39 and 2.40).

Table 2.39 : Yield and returns from main crop and intercrops at Bhubaneswar.

Treatment		Yield Q/ha (10% area)	Expenditure (Rs / ha)	Total return (Rs / ha)	Net return (Rs / ha)	Yield Q/ha (Main crop) 2009	Net return (Rs) (Main crop) 2009	Net return (Rs) (Main crop + intercrop)
T1	Cashew + brinjal	18.30	3000	3660	660	5.4	18900	19560
T2	Cashew + chilli	5.00	620	1750	1130	5.1	17850	18980
T3	Cashew + cowpea	6.00	1100	1200	100	6.5	22750	22850
T4	Cashew + bhindi	7.50	1000	1500	500	6.1	21350	21850
T5	Cashew + pumpkin	8.40	800	1008	208	5.2	18200	18408
T6	Cashew + colocasia	20.00	1050	2800	1750	5.8	20300	22050
T7	Cashew alone	-	-	-	-	6.0	21000	21000

Sale rate Rs. / Qtl.

a) Brinjal Rs. 200/-.
b) Chilli` Rs.350/-.
c) Cowpea Rs. 200/-.
d) Bhindi Rs. 200/-.
e) Pumpkin Rs. 120/-.
f) Colocasia Rs. 140/-.
g) Cashew Rs. 3500/-

Table 2.40 : Cumulative yield and net return from inter-crops and main crop after 5 years at Bhubaneswar

Treatment		Cumulative Intercrop yield (Q/ha) 2004-2008	Total expenditure on Intercrop (Rs./ha) 2004-2008	Total return from Intercrop (Rs./ha) 2004-2008	Net return from Intercrop (Rs./ha) 2004-2008	Cumulative Main crop yield (Q/ha) 2005-2009	Net return from Main crop (Rs./ha) 2005-2009	Net return from Main crop + Intercrop (Rs./ha) 2005-2009
		1	2	3	4(3-2)	5	6	7(4+6)
T_1	Cashew+brinjal	262.4	39700	52486	12786	13.0	45500	58286
T_2	Cashew+chilli	92.5	8520	22599	14079	11.6	40600	54679
T_3	Cashew+cowpea	68.1	14400	20042	5642	15.2	53200	58842
T_4	Cashew+bhindi	115.4	13700	23070	9370	14.3	50050	59420
T_5	Cashew+pumpkin	194.7	10650	21726	11076	11.8	41300	52376
T_6	Cashew+colocasia	272.9	14100	38206	24106	13.1	45850	69956
T_7	Cashew alone	-	-	-	-	12.1	42350	42350

Sale rate: Rs. / Qtl.

a) Brinjal Rs. 200/-. b) Chilli Rs.350/- c)Cowpea Rs. 200/-

d) Bhindi Rs. 200/- e) pumpkin Rs. 120/- f)Colocasia Rs. 140/-.

g) Cashew Rs. 3500/-

JHARGRAM

Intercrops such as bottle gourd, amaranthus, pumpkin, cucumber and bitter gourd were evaluated in this trials. Maximum yield was obtained in cucumber (10.607 Q/ha) followed by bottle gourd (9.615 Q/ha) and amaranths (5.160 Q/ha). The yield of cashew was only 6.00 Q/ha without an intercrop while it was 9.87Q/ha with amaranthus. . The benefit cost ratio (2.44) confirms that cashew + bottle gourd was the most profitable practice followed by cashew + amaranths (benefit cost ratio = 1 : 1.93) and cashew + cucumber (benefit cost ratio:: 1: 1.81) (Table 2.41).

Table 2.41 : Performance of intercrops in between cashew Plantation at Jhargram

Treatment No.	Treatment Details	Yield of Intercrop		Yield Of Cashew (Kg/ha)	Cost of Cultivation (Rs./ha)			Returns (Rs.)				Cost : Benefit
		Kg/plot	Q/ha		Cashew	Intercrop	Cashew + Intercrop (Rs./ha)	Cashew @Rs. 40/Kg	Intercrop (Rs./ha)	Total (Rs./ha)	Net	
T1	Cashew + Bottle gourd	30.767	9.615	9.137	10,340	3655	13995	36548	11538	48086	34091	2.44
T2	Cashew + Amaranths	16.500	5.160	9.870		3680	14020	39480	1549.8	41029.8	27009.8	1.93
T3	Cashew + Pumpkin	8.680	2.710	8.367		3500	13840	33468	1355.0	34823	20983	1.52
T4	Cashew + Cucumber	33.940	10.607	7.420		4000	14340	29680	10607	40287	25947	1.81
T5	Cashew + Bitter gourd	13.330	4.167	8.676		3700	14040	34704	4167.0	38871	24831	1.77
T6	Cashew (alone)	--	--	6.001		--	10340	24004	--	24004	13664	1.32
S.Em ±		2.019	0.631	1.3932								
C.D. at 5%		4.50	1.407	3.104								

Price of intercrops :

1. Bottle gourd : Rs. 12/Kg
2. Amaranths : Rs. 3/Kg
3. Pumpkin : Rs. 5/Kg
4. Cucumber : Rs. 10/Kg
5. Bitter gourd : Rs. 10/Kg

MADAKKATHARA

The average canopy coverage was 23.75 m^2 per tree, worked out based on the average canopy radius (NS and EW) of 2.75 m. After deducting the canopy coverage area of 4651 m^2 for 178 trees, the area available for intercropping worked out to 5349 m^2/ha.

All the tuber crops yielded less during the reporting year due to the increased influence of shading by the cashew. In terms of tuber yield, tapioca recorded the maximum yield (11.3 t/ha) followed by amorphophallus (10.3 t/ha). The lowest tuber yield was recorded by sweet potato (7.7 t/ha).

The total returns from all the tested crops were found to be more than Rs. 50000/- except in the case of colocosia. However the net returns varied significantly due to the drastic variation in the cost of cultivation of the different crops. Amorphophallus incurred the highest cost of cultivation and lowest cost of cultivation was incurred by tapioca. Accordingly, the highest net return (Rs. 24935) and C: B ratio (1.96) was recorded by tapioca followed by coleus (Rs. 22966/- and 1.78, respectively). The lowest net return (Rs. 18538) and C: B Ratio (1.57) was recorded by amorphophallus (Table 2.42).

Table 2.42 : Economics of intercropping of tuber crops in cashew at Madakkathara

Name of intercrop	Tuber mean yield		Total return from intercrop (Rs./ ha)	Net profit (Rs. /ha)	C: B ratio
	(Kg/ plot of 22.68 m^2)	t / ha *			
Coleus	32.8	7735	52211	22966	1.78
Colocasia	35.6	8396	48277	20024	1.71
Tapioca	48.0	11321	50945	24935	1.96
Sweet potato	32.5	7665	51739	22057	1.74
Amorphophallus	43.5	10259	51295	18538	1.57

* Areas planted with inter crops/ha: 5349 m^2

Price of produce (Rs/ kg):		Cost of cultivation (Rs/ ha):	
Coleus	- 6.75	Coleus	- 29245
Colocasia	- 5.75	Colocasia	- 28253
Tapioca	- 4.50	Tapioca	- 26010
Sweet potato	- 6.75	Sweet potato	- 29682
Amorphophallus	- 5.00	Amorphophallus	- 32757

VENGURLA

Tubers of Lesser Yam (Kangar) *Dioscorea esculanta*, Greater Yam (Ghorkand) *Dioscorea alata*, Aerial Yam (Karanda) *Dioscorea bulbifera*, Elephant foot Yam (Suran) *Amorphophyallus paniofolius*, and Tapioca (*Manihot esculanta*) were procured during June, 2008. However, to have required quantity for replicated trial, tubers were planted for multiplication. Replicated trial is laid in June 2009 in old cashew orchards.

Yield was maximum in case of Greater Yam (Ghorkand) *Dioscorea alata* (22.17t/ha) which was followed by tuber yield of 12.78t/ha in case of Lesser Yam (Kangar) *Dioscorea esculanta*. Tuber yield was minimum in case of Tapioca (*Manihot esculanta*) (Table 2.43).

Table 2.43 : Yield of tubers obtained during 2007 at Vengurla

Inter Crops	Plot size sq.m	Yield Kg/ plot	Yield t/ha
Lesser Yam (Kangar) *Dioscorea esculanta*	21.12	27.0	12.78
Greater Yam (Ghorkand) *Dioscorea alata*	9.02	20.0	22.17
Aerial Yam (Karanda) *Dioscorea bulbifera*	20.7	11.16	Waiting for tuber growth
Elephant foot Yam (Suran) *Amorphophyallus paniofolius*	10.79		
Tapioca *Manihot esculanta*	21.12		5.39
Yield of Cashew (V1)		10 Kg/tree	2.0

VRIDHACHALAM

In this trial with medicinal plants as intercrops, *Ocimum* had highest total returns of Rs.43200/ha and had higher BCR of 2.4 when compared to other crops. *Phyllanthus* recorded a benefit cost ratio of 1.3 (Table 2.44).

Table 2.44 : Performance of intercrops in cashew during 2007-08 at Vridhachalam

Treatments	Yield from intercrops		Total cost of production for intercrops/ cashew (Rs./ha)	Total returns From intercrops (Rs./ha)	Net profit (Rs/ha)	BCR	Sole crop yield of intercrops (t / ha)
	Plot yield (kg/25 m^2)	Estimated yield (t/ha of cashew with intercrop)					
Ocimum sanctum (leaves and stem)	10.5	3.6	12750	43200	30450	2.4	10.0
Catharanthus roseus (leaves and stem)	7.8	2.5	12500	20000	7500	0.6	6.5
Phyllanthus niruri (leaves and stem)	10.5	2.2	7800	17600	9800	1.3	6.0
Cashew alone	Yet to yield	-	6000	-	-	-	-

Agr.7: Organic Management of Cashew

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

This trial has been intiated in Bapatla, Bhubaneswar, Chintamani, Jagdalpur, Jhargram, Madakkathara and Vridhachalam Centres of AICRP-Cashew and the results are awaited.

BHUBANESWAR

The experiment was laid out during the year 2007 in Randomized Block Design with three replications. Cashew variety H 2/16 was planted at a spacing of 7m x 7 m. Only farmyard manure was applied to all the plants during planting.

Treatments:

- **T_1 -** 100 % N as FYM
- **T_2 -** 100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g
- **T_3 -** 50 % N as FYM + Bio-fertilizers (200 g)
- **T_4 -** 100 % N as Vermicompost + Bio-fertilizers (200 g)
- **T_5 -** Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)
- **T_6 -** In situ green manuring / green leaf manuring to meet 100 % N

T_7 - 25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)

T_8 - Recommended doses of fertilizer + 10 kg FYM (Control)

There was no significant difference in plant height, trunk girth and plant spread due to various organic treatments. However, treatment T8 i.e. recommended doses of fertilizer + 10 kg FYM (Control) exhibited maximum plant height (2.2 m), trunk girth (27.7 cm) and spread of the plant in both E-W (3.1 m) and N-S (3.0 m) directions (Table 2.45).

Table 2.45 : **Vegetative characters of organic cashew plant at Bhubaneswar**

Treatment		Plant height (m)	Trunk girth (cm)	Spread (m)	
				E-W	N-S
T1	100 % N as FYM	1.9	24.7	2.4	2.4
T2	100 % N as FYM + Bio-fertilizers (Azatobacter + Azospirillum + PSB) 200 g	1.6	23.0	2.3	2.4
T3	50 % N as FYM + Bio-fertilizers (200 g)	1.9	24.0	2.4	2.5
T4	100 % N as Vermicompost + Bio-fertilizers (200 g)	1.5	20.3	2.0	1.9
T5	Recycling of organic residue with the addition of 20 % cow dung slurry (20.0 % weight of organic residue as cow dung)	1.6	25.3	2.2	2.2
T6	In situ green manuring / green leaf manuring to meet 100 %	1.7	24.0	2.2	2.3
T7	25 % N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Bio-fertilizers (200 g)	1.9	25.0	2.3	2.3
T8	Recommended doses of fertilizer + 10 kg FYM (Control)	2.2	27.7	3.1	3.0
	SEM±	0.162	1.636	0.240	0.255
	CD (0.05)	-	-	-	-

CHINTAMANI

This experiment will be undertaken in virgin soils with eight identified treatments using Chintamani – 1 variety during this season.

JHARGRAM

The growth parameters of cashew variety BPP - 8 under organic management. There were significant differences in terms of organic treatments on trunk girth and canopy spread. Maximum girth was noticed with T 7 (6cm) followed by T1 and T4 (5cm). Canopy spread was maximum in case of T3 treatment (0.52m) followed by T 8 (0.5m) (Table 2.46).

Table 2.46 : Growth performance of cashew Variety BPP – 8 under organic management at Jhargram

Treatment	Plant height (m)	Trunk girth (cm)	Canopy spread (m)
T 1	0.61	5.3	0.47
T 2	0.49	4.8	0.47
T 3	0.59	4.3	0.52
T 4	0.49	5.3	0.34
T 5	0.55	4.7	0.45
T 6	0.58	5.0	0.42
T 7	0.58	6.0	0.40
T 8	0.49	4.7	0.50
S.Em ±	NS	0.429	0.061
C.D. at 5%		0.920	0.132
C.V%		14.8	23.8

MADAKKATHARA

The experiment has been initiated with identified treatments and the vegetative growth of the plants was satisfactory.

VENGURLA

The trial was planted during November, 2007 as per the guidelines. Initial physical and chemical properties of the soil were estimated and given below.

Sl. No.	Properties	Content
1	PH (1:2.5)	4.40
2	EC ds m^{-1}	0.08
3	MWHC %	42.0
4	Bulk density g/cc	1.19
5	Particle density g/cc	2.47
6	Organic carbon	1.48
7	Available K kg/ha	268.8
8	Available P kg/ha	20.84
9	Zn ppm	0.668
10	Cu ppm	2.98
11	Fe ppm	52.92
12	Mn ppm	75.15

VRIDHACHALAM

Treatments were imposed as per schedule. Recycling of organic residues will be done after composting of organic residues. Green manuring was carried out with sowing and in-situ ploughing of sunhemp.

III. CROP PROTECTION

Ent. 1: Chemical Control of pest complex in cashew

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

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara 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.

SUMMARY:

At Bhubaneswar, TMB damage incidence was lowest in L-cyhalothrin (0.85%) as compared to the control (2.48%). The apple and nut borer incidence was lowest in λ Cyhalothrin treatment (0.5 %) which also led to minimum thrips damage score (0.16 %). At Chintamani minimum damage due to thrips on apple (0.6%) and nuts (0.5%) was observed in L-cyhalothrin treatment. At Jagdalpur, the nut yield was highest (175. 13 kg/ha) in Triazphos 0.1% , which was at par with L-cylohalothrin 0.003% (136.17 kg/ha). Least thrips damage scores were recorded in T_1 (recommended regional spray) (0.11) at Jhargram. At Vridhachalam, the damage score was nil in recommended spray schedule, L Cyhalothrin 0.003% and Profenophos 0.05% after third spray.

Experimental details:

T1 = Recommended sprays for the region
T2 = Chlorpyriphos 0.05%
T3 = Triazophos 0.1%
T4 = λ-cyhalothrin 0.003%
T5 = Profenophos 0.05%
T6 = Control

BAPATLA

All the insecticidal treatments [T1-T6] were found on par with each other in keeping the leaf and blossom webber under check at 30 days after 3rd spray but superior over jatropa oil 0.5% and the untreated control which recorded the maximum damage of 1.25%. The botanical pesticide, jatropa oil 0.5% also differed significantly from the untreated control in controlling the leaf and blossom webber at 30 days after 3rd spray but inferior to the synthetic pesticides. Triazophos 0.1% was significantly superior against thrips followed by the treatment involving

profenofos 0.05% at flushing, triazophos 0.1% at flowering and carbaryl 0.1% at nut development stage, which recorded a damage score of 0.30 and 0.31, respectively as against the highest score of 1.24 in the un treated control. Significantly higher nos. of spiders (8.25) and ants (23.63) were observed in un-treated control at 30 days after 3rd spray. The yields were on par in all the treatments including control as the pest load during the season was low (Table 3.1).

Table 3.1: Efficacy of certain new insecticides against pest complex (minor) in cashew at Bapatla

Treatment	Thrips damage grade at 30 days after 3rd spray (0-4 scale)	Leaf and blossom webber damaged shoots (%)			Yield (kg/tree)
		Before spraying	30 days after 2nd spray	30 days after 3rd spray	
[Monocrotophos 0.05% at flushing], endosulfan 0.05% at flowering and carbaryl 0.1% at nut development stage	0.70b	0.21	0.00a	0.00a	1.16
Chlorpyriphos 0.05% (2sprays)	0.69b	0.00	0.00a	0.00a	1.14
Triazophos 0.1% (2sprays)	0.30a	0.00	0.21b	0.00a	1.19
L- Cyhalothrin 0.003% (2 sprays)	0.73b	0.00	0.00a	0.00a	1.19
Profenophos 0.05% (2 sprays)	0.66b	0.22	0.00a	0.00a	1.35
[Profenofos 0.05% at flushing], triazophos 0.1% at flowering and carbaryl 0.1% at nut development stage	0.31a	0.11	0.00a	0.00a	1.35
Jatropa oil 0.5% (2 sprays)	1.14c	0.21	0.53c	0.53b	1.24
Un treated control	1.24d	0.41	0.93d	1.25c	1.19
CD (0.05)	0.07	--	0.19	0.12	--NS--

Figures followed by same alphabet (s) are not differing significantly at 5% level.
Note: Among the major lepidopteran pests only the leaf and blossom webber was observed during the season. 1st spray was not given due to very low pest load

BHUBANESWAR

The TMB damage incidence was also lowest in insecticide treatments (0.85 % to 1.78 %) as compared to the control (2.48%).

Further it was observed that 30 days after first spraying the Shoot Tip Caterpillar (STC) infestation was reduced in all the insecticidal treatments except control (1.50 % to 2.50%) as compared to untreated check (7.38%). λ Cyhalothrin (0.003%) proved superior exhibiting minimum pest incidence (1.55 and 0.5%) as compared to other insecticides. After 30 days of third spraying the STC incidence was negligible.

The apple and nut borer incidence was maximum in control (6.5 %) as compared to the insecticide treated plants (0.50 % to1.75 %) and was lowest in λ Cyhalothrin treatment (0.5 %) which was at par with the recommended spray schedule.

Treatment with λ-Cyhalothrin led to minimum thrips damage score (0.16 %), which was significantly lower than other insecticide treated plants and control (0.78 %) (Table 3.2).

That there was significant reduction in natural enemies and pollinator population in all insecticide treated plants as compared to control. Severe yield loss due to hail storm during February 2008 reduced yield severely and hence no yield comparisons could be done.

Table 3.2 : Evaluation of insecticides on different insect pests, natural enemies and pollinator population on cashew at Bhubaneswar

	Treatment	% of shoot tip damage by STC before spray	% of shoot tip damage by STC30 days after first spray	% of shoot tip damage by STC 30 days after second spray	% of damage by A&NB 30 days after third spray	Damage score of TMB 30 days after third spray	Damage grade by inflorence thrips 30 days after third spray (0-4 scale)	Spiders	Black ant	Ladybird beetle
T1	Monocrotophos(0.05%) at flushing, Endosulfan (0.05%) at flowering and Carbaryl (0.15) at fruiting	7.78 (3.83)	1.63 (1.55)	0.8 (1.44)	0.63 (1.41)	1.5 (1.88)	0.23 (1.10)	1.75 (2.00)	2.43 (2.27	1.05 (1.64)
T2	Chlorpyriphos (0.05%)	7.37 (3.74)	1.73 (1.72)	1.00 (1.62)	1.65 (1.95)	1.43 (1.85)	0.24 (1.15)	1.83 (2.03)	1.95 (2.08)	1.28 (1.77)
T3	Triazophos (0.1%)	7.37 (3.74)	2.50 (1.77)	1.00 (1.62)	1.75 (2.00)	1.48 (1.87)	0.24 (1.15)	1.80 (2.02)	1.90 (2.06)	1.58 (1.92)
T4	Lambda-Cyhalothrin (0.003%)	7.25 (3.71)	1.50 (1.36)	0.5 (1.33)	0.50 (1.33)	0.85 (1.55)	0.16 (1.08)	1.10 (1.68)	1.20 (1.74)	0.95 (1.60)
T5	Profenophos (0.05%)	7.63 (3.80)	2.25 (1.75)	1.00 (1.63)	1.63 (1.94)	1.78 (2.01)	0.23 (1.14)	2.03 (2.12)	1.90 (2.06)	1.58 (1.92)
T6	Untreated check	7.25 (3.71)	7.38 (3.71)	6.63 (3.55)	6.5 (3.52)	2.48 (2.30)	0.78 (1.50)	2.68 (2.37)	4.13 (2.86)	3.53 (2.67)
T7	Profenophos (0.05%) at flushing,Triazophos (0.1%) at flowering and Carbaryl (0.1%) at fruiting	7.37 (3.74)	2.50 (1.86)	1.33 (1.79)	1.75 (2.00)	1.45 (1.86)	0.22 (1.13)	1.63 (1.94)	1.83 (2.03)	1.60 (1.93)
	SE (m) ±	0.065	0.051	0.071	0.059	0.037	0.017	0.047	0.052	0.066
	CD (0.05)	NS	0.161	0.212	0.176	0.110	0.052	0.139	0.155	0.195

CHINTAMANI

The damage of TMB during 2008-09 ranged between 0.52 to 2.63, 0.58 to 2.81 and 0.60 to 3.10 at 30 days after different sprays. Among the test insecticides L. cyhalothrin (0.003%) was found effective in suppressing TMB population and was on par with the recommended spray schedule. However, the treatments Chloropyriphos (0.05%) and Profenofos (0.05%) were found to be least effective in reducing the pest population (Table 3.3).

Table 3.3 : 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	057	0.58	0.72
Chlorpyriphos 0.05	1.82	2.30	2.40
Triazophos 0.1	0.60	0.66	0.78
L Cyhalothrin 0.003	0.52	0.58	0.60
Profenofos 0.05	2.22	2.36	2.52
Unsprayed check	2.63	2.81	3.10
C.D (0.05)	0.87	0.67	1.05

However, the incidence of thrips, aphids, mealy bugs and nut borer during 2008-09 were on par in treatments triazophos (0.10%) and chloropyriphos (0.05%) recommended spray for the region. The treatment with L-cyhalothrin 0.003% was found to be superior over rest of the treatments in reducing the insect pest complex (Table 3.4).

Table 3.4 : Evaluation of insecticides for the control of other insect pests at Chintamani

Treatments	Thrips (0-4)		Aphids (%)	Mealybugs (%)	Leaf miner (%)	Apple and nut borer (%)
	Apple	Nut				
Recommended spray for the region	0.58	0.50	0.81	1.10	1.15	1.21
Chlorpyriphos (0.05)	0.90	0.80	2.72	2.30	2.15	1.85
Triazophos (0.1)	0.70	0.60	0.98	0.90	0.83	0.92
L.cyhalothrin (0.003)	0.60	0.52	0.92	0.83	0.70	0.74
Profenofos (0.05)	1.15	1.01	3.24	2.63	2.10	2.18
Unsprayed check	1.40	1.22	5.16	3.92	3.70	3.64
C.D (0.05)	0.31	0.24	0.77	0.58	0.52	0.64

JAGDALPUR

The incidence of TMB damage was very low during whole experiment period therefore all the treatments are at par both in shoot and panicle.

For leaf caterpillar damage T4 ; L-cylohalothrin 0.003% gave good response consistently in all three sprays (19.29%, 18.74% and 21.35% leaf damage in 1st, 2nd & 3rd spray, respectively) followed by T3 Triazphos 0.1% and T1;recommended spray schedule (Table 3.5). In leaf folder damage, T1 has shown good control against this insect with 19.79, and 23.36 per cent leaf damaged, respectively during 1st and 2nd spray which was at par with T5 in 1st & 2nd spray; whereas in 3rd sprays, all the treatments were found non-significant (Table 3.5). The thrips mean damage grade at 30 days after 3rd spray was lowest in T4 L-cylohalothrin 0.003% on nut (0.54 mean damage score) followed by T5 Profenophos 0.05% and T1 recommended spray schedule. The percent leaf miner damage was significantly low in T5 of 1st & 2nd spray (7.27% & 3.41% leaf damage); while in 3rd sprays all the treatments were non-significant (Table 3.6).

The yield was highest (175. 13 kg/ha) in T3 Triazphos 0.1% , which was at par with T4 L-cylohalothrin 0.003% (136.17 kg/ha) (Table 3.6).

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

Treatment	Percent incidence of minor pest of Cashew					
	% Leaf Caterpillar damage			% Leaf Folder damage		
	30 DAS after I[st] spray	30 DAS after II[nd] spray	30 DAS after III[rd] spray	30 DAS after I[st] spray	30 DAS after II[nd] spray	30 DAS after III[rd] spray
T-1: Monocrotophos 0.05% at flushing, Endosulfan 0.05% at flowering and Carbaryl 0.1% at fruiting stage.	28.34 (32.08)[b]	31.22 (33.92) ab	22.07 (27.95) ab	19.79 (26.29) a	23.36 (28.46) ab	18.75 (25.54)
T-2 : Chloropyriphos 0.05%	33.09 (35.07) b	34.26 (35.68)	28.01 (31.78) b	28.49 32.22) ab	28.02 (31.47) ab	23.02 (28.18)
T-3 : Triazphos 0.1%	28.21 (32.02) b	20.89 (25.87) ab	29.69 (32.84) b	33.43 (35.21)	17.28 (24.36) a	24.62 (28.90)
T-4 : L- cyhalothrin 0.003%	19.29 (26.02)[a]	18.74 (25.58) [a]	21.35 (27.48) ab	25.83 (30.32) b ab	28.41 (31.93)	22.91 (27.99)
T-5 : Profenophos 0.05%	32.39 (34.60) b	33.43 (35.28)	14.03 (21.17) a	21.19 (27.21) ab	22.19 (28.07) b	29.24 (32.52)
T-6 : Unsprayed check	37.85 (37.94)	38.25 (38.20)	36.26 (37.02)	38.70 (38.43)	36.37 (37.06)	30.69 (33.62)
CD at 5%	**(5.05)**	**(8.36)**	**(7.15)**	**(6.65**	**(7.37)**	**NS**

***Figure in parenthesis are angular transformed values**

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

Treatments	Percent incidence of minor pest of Cashew				
	Thrips mean damage grade at 30 days after 3rd spray (0-4 scale)	% Leaf Miner damage			Yield Kg/ha
	ON NUT	30 DAS after Ist spray	30 DAS after IInd spray	30 DAS after IIIrd spray	
T-1: Monocrotophos 0.05% at flushing, Endosulfan 0.05% at flowering and Carbaryl 0.1% at fruiting stage.	1.06 (1.23)* ab	11.42 (19.09) ab	8.96 (15.07) ab	2.92 (6.92)	112.81
T-2 : Chloropyriphos 0.05%	1.36 (1.36) b	10.81 (18.85) ab	10.95 (19.13) b	2.56 (6.51)	90.65
T-3 : Triazphos 0.1%	1.47 (1.40) b	21.58 (27.19) b	10.65 (18.23) b	7.43 (13.75)	175.13
T-4 : L-cyhalothrin 0.003%	0.54 (1.00) a	15.49 (22.93) ab	7.40 (15.26) ab	9.38 (15.44)	136.17
T-5 : Profenophos 0.05%	0.95 (1.20) ab	7.27 (12.89) a	3.41 (7.27) a	5.73 (11.45)	116.81
T-6 : Unsprayed check	1.61 (1.44)	28.81 (32.41)	18.45 (24.65)	11.14 (19.44)	69.89
CD at 5%	**(0.23)**	**10.09**	**(8.62)**	**NS**	**58.93**

*Figure in parenthesis are square root transformed values.

JHARGRAM

The recommended spray (T_1) was the most effective treatment. Profenophos (T_5) appeared to be more effective than other new chemicals. After spray I, it recorded 3.8% leaf miner, damage 1.1% leaf and blossom webber damage and 5.4% shoot tip caterpillar damage. The lowest apple and nut borer damage (1.2%) was recorded in T_5 (Profenophos) while in T_1 (recommended spray) it was 2.1%. Least thrips damage scores were recorded in T_1 (recommended regional spray) and T_3 (0.11 and 0.21) respectively (Table 3.7).

Table 3.7 : 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 I spray	After II spray	After III spray	After I spray	After II spray	After III spray	After I spray	After II spray	After III spray
T1	Recommended sprays for the region	2.1 (8.51)	0.11	3.2a (10.31)	4.5a (12.25)	6.8a (15.12)	5.2a (13.18)	7.4a (15.79)	8.2 (16.64)	1.1a (6.02)	2.8a (9.63)	3.8a (11.24)
T2	Chlorpyriphos 0.05%	3.1 (10.14)	0.23	4.5b (12.25)	6.4b (14.65)	8.5b (16.95)	7.1b (15.34)	8.5b (16.95)	9.2 (17.66)	3.8b (11.24)	4.2b (11.83)	7.2b (15.56)
T3	Triazophos 0.1%	3.2 (10.31)	0.21	4.9b (12.79)	6.7b (15.00)	9.2b (17.66)	6.2b (14.42)	7.9b (16.32)	9.6 (18.06)	4.2b (11.83)	4.8b (12.66)	6.9b (15.23)
T4	L-Cyhalothrin 0.003%	2.8 (9.63)	0.25	5.6b (13.69)	6.4b (14.65)	9.6b (18.05)	7.2b (15.56)	8.6b (17.05)	10.4 (18.81)	6.2c (14.42)	7.5c (15.89)	7.8b (16.22)
T5	Profenophos 0.05%	1.2 (6.29)	0.26	3.8a (11.24)	4.8a (12.66)	7.2a (15.56)	5.4a (13.44)	7.8a (16.22)	8.1 (16.54)	1.1a (6.02)	2.5a (9.10)	4.2a (11.83)
T 6	Unsprayed check	2.5 (9.10)	0.35	13.8d (21.81)	15.4d (23.11)	18.4c (25.40)	19.6c (26.28)	21.6c (27.69)	23.5 (29.00)	18.4d (25.40)	19.8d (26.42)	23.9c (29.27)

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.

VENGURLA

All the insecticidal treatments significantly reduced the incidence of TMB over control in cashew. Amongst the insecticidal treatments, the treatment T_4, 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 (T_5) with which it was at par. Considering the mean cumulative incidence, the treatment of Profenophos (T_5) was found second best treatment for the management of TMB (Table 3.8).

Table 3.8 : Incidence of tea-mosquito bug in various treatments at Vengurla

Sl. No.	Treatment details	Per cent incidence 30 days after			
		First spray	Second spray	Third spray	Cum. Av.
T_1	Recommended spray schedule	4.02 (11.54)	5.73 (13.81)	5.17 (13.11)	4.97 (12.64)
T_2	Chlorpyriphos 0.05%	3.88 (11.39)	5.59 (13.69)	4.62 (12.39)	4.70 (12.18)
T_3	Triazophos 0.01%	3.55 (10.78)	5.05 (12.92)	4.46 (12.25)	4.35 (11.89)
T_4	Lambda-cyhalothrin 0.003%	1.84 (7.71)	3.13 (10.14)	1.96 (8.13)	2.31 (8.60)
T_5	Profenophos 0.05%	2.30 (8.72)	3.48 (10.78)	3.10 (10.14)	2.96 (9.42)
T_6	Control	6.23 (15.18)	8.88 (18.04)	7.59 (16.26)	7.56 (15.89)
	S.E.±	0.49	0.45	0.69	0.23
	C.D. at 5%	1.46	1.34	2.05	0.71

*** 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, T_4 (Lambda-cyhalothrin 0.003%) was found to be significantly superior over rest of the treatments, when observations recorded on apple and nut. The treatment (T_3) Triazophos was at par with Profenophos (T_5) when observation recorded on apple surface (Table 3.9).

In case of apple and nut borer damage, the treatment T_4 recorded lowest incidence but it was at par with the treatment of Triazophos (T_3) and significantly superior over rest of the treatments.

Table 3.9 : Incidence of minor pests in various treatments in cashew at Vengurla

Sr. No.	Treatment details	Thrips		Apple and Nut borer
		30 days after 3rd spray		30 days after 3rd spray
		Apple	Nut	
T_1	Recommended spray schedule	8.65	7.92	3.40
		(17.16)	(16.32)	(10.55)
T_2	Chlorpyriphos 0.05%	7.53	6.85	2.26
		(15.89)	(15.12)	(8.58)
T_3	Triazophos 0.01%	5.78	6.02	1.69
		(13.94)	(14.18)	(7.25)
T_4	Lambda-cyhalothrin 0.003%	3.17	2.21	1.22
		(10.31)	(8.53)	(6.26)
T_5	Profenophos 0.05%	4.88	5.31	2.38
		(12.79)	(13.31)	(8.91)
T_6	Control	11.50	13.42	2.64
		(19.82)	(21.47)	(14.03)
	S.E.±	**0.38**	**0.45**	**0.82**
	C.D. at 5%	**1.15**	**1.34**	**2.48**

- **Figures in parenthesis are arcsine values**

VRIDHACHALAM

The efficacy of different insecticides tested against TMB was at par, but superior over untreated control after first, second and third 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 0.33 and 0.38 as against 1.30 in the control (Table 3.10). After the second spray, the damage intensity further reduced to 0.30-0.36 in different treatments *viz.,* recommended spray, L cyhalothrin (0.003%),

Profenophos (0.05%), Triazophos (0.1%) and Chlorpyriphos (0.05%) as against an increased damage score of 2.60 in untreated control (Table 3.10).

After third spray, the damage score was nil in T1 (standard spray), T 4 (L Cyhalothrin 0.003%) and T5 (Profenophos 0.05%), proving superiority over other treatments in controlling the tea mosquito bug. In untreated control, the damage score increased to 3.20 after 30 days of third spray (Table 3.10).

Table 3.10 : 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	0.66_a	0.30_a	0.30_a	0.00_a	0.20
2.	Chlorpyriphos 0.05%	0.63_a	0.38_a	0.36_a	0.30_a	0.31
3.	Triazophos 0.1%	0.63_a	0.36_a	0.35_a	0.20_a	0.29
4.	L-Cyhalothrin 0.003%	0.66_a	0.30_a	0.32_a	0.00_a	0.23
5.	Profenophos 0.05%	0.63_a	0.33_a	0.33_a	0.00_a	0.24
6.	Untreated check	0.60_a	1.30_b	2.60_b	3.20_b	2.40
CD		0.66	0.53	0.43	0.36	0.44

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

Among the treatments, standard spray, lambda-cyhalothrin (0.003%) and profenophos (0.05%) remained superior by reducing the TMB population to nil as against 18.0 bugs recorded per 52 leader shoots in untreated control 30 days after third spray.

L-cyhalothrin, profenophos, triazophos and recommended spray schedule lead to 1% TMB damaged shoots which were on par and superior in comparison to control (23.6% damaged shoots). Leaf miner damage was minimum in L-cyhalothrin (1.0%) followed by profenophos (1.3%). Similarly, minimum damage by leaf folder and apple and nut borer was also recorded in L-cyhalothrin (1.0% and 0.0% respectively) followed by profenophos (1.6% and 0.20% respectively). Maximum nut yield of 8.6 kg/tree was recorded in recommended spray schedule which was closely followed by profenophos 8.5kg/tree and 8.4kg/tree (Table 3.11).

Table 3.11 : Efficacy of insecticides against foliar pests of cashew at Vridhachalam

Treatment		Mean per cent damage 30 days after 3rd 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_1	Recommended spray	1.0	1.6	1.3	1.3	0.26	8.6
T_2	Chlorpyriphos 0.05%	1.3	2.6	2.6	3.3	0.60	7.6
T_3	Triazophos 0.1%	1.0	1.6	2.3	3.6	0.53	7.9
T_4	L Cyhalothrin 0.003%	1.0	1.0	1.0	1.3	0.00	8.4
T_5	Profenophos 0.05%	1.0	1.3	1.6	1.3	0.20	8.5
T_6	Untreated check	23.6	13.6	12.3	13.6	5.33	2.5

All the insecticides reduced the population of predatory spiders, coccinellids, ants and braconid wasp after each round of insecticidal spray.

Ent. 2: Control of cashew stem and root borer

Expt. 2. Curative control trial

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY:

At Bapatla, chlorpyriphos 0.2% resulted in 83.33% trees without re-infestation or persistent attack as post extraction prophylaxis. At Bhubaneswar, maximum recovery (90%) was obtained in chlorpyriphos 0.2% treatment followed by monocrotophos 0.2% (78.5%). At Chintamani, chlorpyriphos (1.0%) was most effective with 90.45% trees without reinfestation. At Jagdalpur, treatment with chlorpyriphos-0.2% led to maximum recovery of 88.89 % trees without re-infestation. At Jhargram, Chlorpyriphos and Carbaryl were equally the most effective treatments in which none of the treated trees had reinfestation by CSRB. Chlorpyriphos (0.2%) recorded cent per cent trees without reinfestation followed by Carbaryl (1%) and Monocrotophos (0.2%) which recorded 86.66 per cent trees without reinfestation at Vengurla. At Vridhachalam, maximum recovery of 66.6% was noted in chlorpyriphos (0.2%) treated trees, followed by monocrotophos (0.2%) in which 63.2% of treated trees had no reinfestation.

Treatments :

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

BAPATLA

During 2007-08, among the insecticides evaluated as post extraction prophylaxis, chlorpyriphos 0.2% offered protection to the tune of 83.33% trees without re-infestation or persistent attack followed by treated check involving three sprays of neem oil 5.0% with 66.67 per cent trees without re-infestation or persistent

attack. Other insecticides *viz*., carbaryl 1.0%, monocrotophos 0.2% and chlorpyriphos 0.1% offered only 50.00 per cent protection without re-infestation or persistent attack and were not superior over the control treatment which recorded 33.33 per cent trees without re-infestation or persistent attack (Table 3.12). Irrespective of the insecticides tried, 30.55 per cent of the trees showed yellowing even after treatment (Table 3.13).

Preferential zone of attack is collar + root in 69.44 per cent of trees (25/36) followed by collar + stem in 30.55 per cent of trees (11/36).

Table 3.12: Efficacy of certain insecticides as curative control measure against cashew stem and root borer at Bapatla

Treatment	% Trees without reinfestation/ persistant attack
Carbaryl 1.0%	50.00
Chlorpyriphos 0.2%	83.33
Monocrotophos 0.2%	50.00
Chlorpyriphos 0.1%	50.00
Treated check (3 sprays of neem oil 5.0%)	66.67
Un treated check (only removal of grubs)	33.33

Table 3.13 : Physical parameters of cashew trees reinfested/ unreinfested by cashew stem and root borer after treatment with insecticides as curative measures at Bapatla

Parameters		Total trees treated	No. of trees in each category	
			Without re-infestation	With re-infestation/ persistant infestation
Stem girth (cm.)	< 60	2	1	1
	60-80	2	2	0
	80-100	12	7	5
	> 100	20	10	10
	Total	**36**	**20**	**16**
Age (Years)	< 5	0	0	0
	5-10	0	0	0
	10-15	0	0	0
	> 15	36	20	16
	Total	**36**	**20**	**16**
% Bark circumference damaged	< 25	19	12	7
	25-50	17	8	9
	50-75	0	0	0
	> 75	0	0	0

	Total	**36**	**20**	**16**
Zone	C+R	25	14	11
	C+S	11	6	5
	R	0	0	0
	S	0	0	0
	C+R+S	0	0	0
	Total	**36**	**20**	**16**
Canopy yellowing	a)Yellowed		0	11
	b) No yellowing		25	0
	Total		**25**	**11**

BHUBANESWAR

Maximum recovery (90%) was obtained in chlorpyriphos 0.2% treatment followed by monocrotophos 0.2% (78.5%). In medium stage trees recovery percentage was only 10% to 45%, whereas in advanced stage of infestation the recovery percentage was considerably reduced to 0 to 17 % in all the treatments. Frequency of treatment also increased in control (10 times) as compared to chlorpyriphos 0.2% (4 times) (Table 3.14).

The trees with stem girth of 60 cm to 80 cm were more prone to attack by CSRB (86.7%).The plant at the age group of 5 to 10 years reinfestation problem was less and reinfestation increased with age of the plant. Trees with 25 % to 50% bark circumference damaged, had severe reinfestation (78.3%). The cashew trees infested only in collar and stem (C+S) recovered quickly.

Table 3.14: Physical parameter of cashew stem and root borer (CSRB) in curative trial at Bhubaneswar

Physical parameter		**No. of trees Reinfested**	**Percentage of total trees treated**	**No. of trees not reinfested**	**Percentage of total Trees treated**
Stem girth	< 60 cm	3	3.6	155	82.9
	60 – 80 cm	72	86.7	24	12.8
	80 – 100 cm	5	6.0	8	4.3
	> 100 cm	3	3.6	0	
	Total	**83**		**187**	
Age of the tree	< 5 years	0	0	3	1.6
	5 –10 years	2	2.4	122	65.2
	10 – 15 years	40	48.2	46	24.6

	> 15 years	41	49.4	16	8.6
	Total	**83**		**187**	
Zone of attack	C+R	12	14.5	5	2.7
	C+S	2	2.4	145	77.5
	R	6	7.2	1	0.5
	S	13	15.7	35	18.7
	C+S+R	50	60.2	1	0.5
	Total	**83**		**187**	
Yellowing of canopy	Canopy yellowed			32	17.1
	Canopy not yellowed			238	12.7
	Total			**270**	
Percentage of bark Circumference damaged	< 25	4	4.8	145	77.5
	26 –50	65	78.3	37	19.8
	51 –75	14	16.9	5	2.7
	> 75	2	2.4	0	-
	Total	**83**		**187**	

NB: Observation based on 270 CSRB infested trees.

CHINTAMANI

Chlorpyriphos (1.0%) was proved effective with 90.45% trees without reinfestation, However, the other treatments also maintained their superiority in suppressing the population over control. The treated check, where grubs extraction was adopted, 72.50% trees could recover. Canopy yellowing was not observed in any 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 most of the infested trees (Tables 3.15 and 3.16).

Table 3.15 : Efficacy of certain insecticides as curative treatment against cashew stem and root borer at Chintamani

Treatments	Trees without re-infestation/ persistent attack (%)
Carbaryl 1.0%	62.75
Chlorpyriphos 1.0%	90.45
Monocrotophos 0.2%	47.28
Lindane 0.2%	55.70
Treated check	72.50
Untreated check	28.72

Table 3.16 : Physical parameters of treated cashew trees re-infested/without re- infestation under curative control trial at Chintamani

Physical Parameters		No. of trees in each category	
		Without re-infestation	With re-infestation/ persistent infestation
Stem girth (Cm)	<60	25	4
	60-80	17	15
	80-100	08	5
	>100	-	-
Age of the tree (Cm)	5-10	35	-
	10-15	10	27
	>15	05	12
% Bark circumference damaged	<25	35	5
	25-30	15	38
	50-75	-	7
Zone	C+R	10	5
	C+S	15	20
	R	-	-
	S	25	22
	(C+R+S)	-	3
Canopy yellowing	Yellowed	-	8
	Not yellowed	-	42

JAGDALPUR

Treatment with chlorpyriphos-0.2% (T2) led to maximum recovery of (88.89 %) trees without re-infestation . The cashew trees having 60-100cm and more than 100 cm of stem girth were more prone to attack of CSRB. Cashew trees aged more than 15 yrs were more susceptible to attack of this pest (Tables 3.17).

Preferential zone of attack of re-infestation by stem and root borers was stem and collar (16.0%) & stem zone (14.0%). The canopy of majority of cashew trees infested by CSRB was not yellowed. This pest re-infested in maximum trees, which bark circumference damaged was 25-50 percent (Table 3.18).

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

Treatment	% of trees without reinfestation/persistant attack
T1 : Carbaryl (1.0%)	81.48
T2 : Chlorpyriphos (0.2%)	88.89
T3 : Monocrotophos (0.2%)	81.48
T4 : Lindane (0.2%)	66.67
T5 : Metarrhizium anisoplae (250g/tree) + Neem cake (500g/tree)	62.96
T6 : Untreated check (only removal of CSRB grubs followed)	59.26

Note : Data obtained by treating 27 CSRB infested trees

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

Physical parameters		No. of tees re-infested	Percentage of total trees treated	No. of tees not re-infested	Percentage of total trees treated
Stem girth	<60 cm	14	8.64	5	3.09
	60-100 cm	53	32.72	16	9.88
	>100 cm	53	32.72	21	12.96
Total	**162**	**120**	**74.07**	**42**	**25.93**
Age of tree	<10 years	0	0.00	0.00	0
	10-15 years	3	1.85	12	7.41
	>15 years	40	24.69	107	66.05
Total	**162**	**43**	**26.54**	**119**	**73.46**
Zone of attack	C	5.00	3.09	19.00	11.73
	C+R	4.00	2.47	11.00	6.79
	C+S	14.00	8.64	48.00	29.63
	R	0.00	0.00	4.00	2.47
	S	16.00	9.88	29.00	17.90
	S+R	1.00	0.62	2.00	1.23
	C+S+R	2.00	1.23	7.00	4.32
Total	**162**	**42**	**25.93**	**120**	**74.07**
Canopy yellowing	a)Canopy Yellowed	3	1.85	22	13.58
	b)Canopy Not yellowed	0	0.00	137	84.57
Total	**162**	**3**	**1.85**	**159**	**98.15**
% of bark circumference damaged	<25	20	12.35	67	41.36
	25-50	17	10.49	46	28.40
	50-75	3	1.85	3	1.85
	>75	1	0.62	5	3.09
Total	**162**	**41**	**25.31**	**121**	**74.69**

*Zone of attack:

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

JHARGRAM

T_2 (Chlorpyriphos) and T_1 (Carbaryl) were equally the most effective treatments and there none of the treated trees had reinfestation. In treated check (T_6), 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_6), 50% trees remained free from re-infestation (Table 3.19).

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

Treatment	% of trees without reinfestation/persistant attack
T1 : Carbaryl (1.0%)	100.00
T2 : Chlorpyriphos (0.2%)	100.00
T3 : Monocrotophos (0.2%)	50.00
T4 : Lindane (0.2%)	50.00
T5 : Metarrhizium anisoplae (250g/tree) + Neem cake (500g/tree)	50.00
T6 : Untreated check (only removal of CSRB grubs followed)	50.00

Note : Data obtained by treating 12 CSRB infested trees

VENGURLA

The treatment T_2 (Chlorpyriphos 0.2%) recorded cent per cent trees without reinfestation followed by Carbaryl (1%) T_1 and Monocrotophos (0.2%) T_3 recorded 86.66 per cent trees without reinfestation. Reinfestation was more in Control (T_6) (66.66 %) followed by Lindane (0.2%), T_4 (73.33) and T_5 (80.00%) (Table 3.20).

Table 3.20 : **Effect of curative treatments against Cashew Stem and Root Borer (CSRB) at Vengurla.**

Treatment	Percentage of trees without reinfestation / persistent attack
T_1-Carbaryl (1%)	86.66
T_2-Chlorpyriphos (0.2%)	100.00
T_3-Monocrotophos (0.2%)	86.66
T_4-Lindane (0.2%)	73.33
T_5- Swabbing Neem oil 5% during Oct.- Nov., Jan - Feb and April- May	80.00
T_6 -Control	66.66

VRIDHACHALAM

Among the curative treatments, maximum recovery of 66.6% was noted in chlorpyriphos (0.2%) treated trees, followed by monocrotophos (0.2%) treated trees with 63.2% recovery. Treatments with carbaryl and lindane led to 55.0% and 45.0% recovery respectively. The results indicate that chlorpyriphos and monocrotophos are at par in terms of efficacy in mitigating the CSRB infestation (Table 3.21).

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

Treatment		No. of trees treated	No. of trees without reinfestation	Mean % recovery of trees from CSRB	Frequency of treatment	Cost of treatment /tree
T_1	Carbaryl (1%)	20	11	55.0	4	40.0
T_2	Chlorpyriphos (0.2%)	21	14	66.6	3	36.0
T_3	Monocrotophos (0.2%)	19	12	63.2	3	39.0
T_4	Lindane (0.2%)	20	9	45.0	4	40.0
T_5	Untreated check (removal of grubs)	12	2	16.6	3	30.0
T_6	Treated check (Neem oil 5%)	16	10	62.5	4	48.0

The results indicate that chlorpyriphos and monocrotophos are at par in terms of efficacy in mitigating the CSRB infestation. The extent of recovery was influenced by various physical parameters of trees. More than 82% trees recovered had less than 25% damaged bark circumference, while trees of 26-50% bark damage responded moderately with about 28% recovery. Trees with 51-75% bark damage responded very poorly. The trees with more than 75% bark damage with yellowing of canopy did not recover from the attack (Table 3.22).

Table 3.22 : Details of physical parameters of treated cashew trees with re-infested/ without re-infestation at Vridhachalam

Physical Parameters		Total no. of trees treated	No. of trees reinfested	% of trees reinfested	No. of trees not reinfested	% of trees not reinfested
Stem girth (cm)	< 60	26	3	11.5	23	88.5
	60-80	26	10	38.5	16	61.5
	80-100	27	15	55.6	12	44.4
	> 100	29	22	75.9	7	24.1
	Total	**108**	**50**	**-**	**58**	**-**
Age of the tree (years)	< 5	26	4	15.4	22	84.6
	5- 10	26	10	38.5	26	61.5
	10-15	27	14	51.9	13	48.1

	> 15	29	22	75.9	7	24.1
	Total	**108**	**50**	**-**	**58**	**-**
Zone of attack	C+R	21	10	47.6	11	52.4
	C+S	23	5	21.7	18	78.3
	R	20	12	60.0	8	40.0
	S	20	3	15.0	17	85.0
	C+S+R	24	20	83.3	4	16.7
	Total	**108**	**50**	**-**	**58**	**-**
Yellowing of canopy	Canopy yellowed	8	8	100.0	0.0	0.0
	Canopy not yellowed	100	42		58	100
	Total	**108**	**50**	**-**	**58**	**-**
% of bark circumference damaged	< 25	58	10	17.2	48	82.8
	26-50	32	23	71.9	9	28.1
	51-75	12	11	91.6	1	8.4
	>75	6	6	100.0	0.0	0.0
	Total	**108**	**50**	**-**	**58**	**-**

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

Centres : East Coast :

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani and Jagdalpur

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

SUMMARY:

Population of tea mosquito bug had positive correlation with relative humidity and maximum temperature at Jagdalpur and Vridhachalam and had strong negative correlation with maximum temperature and relative humidity at Vengurla. Leaf and blossom webber was positively influenced by both maximum and minimum temperature at Bapatla. Leaf miner was influenced negatively by maximum temperature and relative humidity at Jagdalpur and Vengurla. Shoot tip caterpillar was positively influenced by relative humidity at Vridhachalam while maximum temperature and rainfall negatively influenced the pest population at Bapatla and Vengurla. Apple and nut borer populations were positively influenced by maximum temperature at Bhubaneswar negatively influenced by rainfall and relative humidity at Vengurla.

BAPATLA

The maximum temperature (r = 0.1899) and minimum temperature (r = 0.2084) were found to exercise a non significant positive influence on the activity of the leaf and blossom webber, whereas the relative humidity (m) (r = - 0.2158) and (e) (r = - 0.1309) showed negative influence. Among the abiotic factors only the maximum temperature (r = - 0.2930) was found to exercise a significant negative influence on the activity of the leaf miner during the season.

The maximum temperature (r = - 0.4063) and minimum temperature (r = - 0.3093) were found to exercise a significant negative influence on the activity of the leaf folder, whereas, the relative humidity (m) (r = 0.3595) and (e) (r = 0.2700) showed positive influence. The maximum temperature (r = -0.3482) and minimum

temperature (r = -0.4286) were found to exercise a significant negative influence on the activity of the shoot tip caterpillar. None of the weather parameters showed any influence on the activity of the inflorescence thrips and apple and nut borer (Table 3.23).

Table 3.23 : Influence of abiotic factors on the activity of pest complex of cashew at Bapatla

Weather Parameters	Lbw	Lm	Stc	It	Lf
Maximum temperature ºC	0.1899	-0.2930*	-0.3482*	0.1436	-0.4063*
Minimum temperature ºC	0.2084	-0.2133	-0.4286*	0.2189	-0.3093*
Relative humidity(m) (%)	-0.2158	0.1804	0.3257*	-0.1816	0.3595*
Relative humidity (e) (%)	-0.1309	0.2433	0.1136	-0.1218	0.2700*
Rainfall	-0.0541	0.1271	-0.1969	-0.1995	-0.0812
Rainy days	-0.0381	0.0563	-0.1989	-0.2185	-0.0191

Lbw: Leaf and blossom webber Lm: Leaf miner Stc: Shoot tip caterpillar
Lf: Leaf folder It: Inflorescence thrips
*Significant at 0.05 level

BHUBANESWAR

TMB was observed from December to April with maximum intensity during February (9.5 adult & nymph / 52 leader shoots) Evening RH had negative significant correlation with the incidence of the Tea mosquito bug (TMB) (*Helopeltis antonii*). Shoot tip caterpillar (Hypatima haligramma) and Leaf miner (Acrocercops syngramma) were not significantly influenced by any of the weather factors. Afternoon relative humidity (RH) had significant negative correlation with incidence of the yellow thrips *(Franklniella schultzii* T.) & black thrips (*Haplothrips ceylonicus Sch*.)

The activity of this pest coincided with the fruiting stage of the plant from March to May with maximum during April (5.5%). Maximum temperature had positive significant correlation with the incidence of apple and nut borer *(Nephopteryx* sp.) and Leaf and Blossom Webber (*Lamida moncusalis*). Rainfall, evening RH had positive and bright sunshine (BSH) had negative significant correlation with incidence of the Leaf Beetle (*Menolepta longitarsus*). Maximum temperature had positive significant correlation with the incidence of the Cashew stem and root borer (CSRB) (*Plocaederus ferrugineus*) (Table 3.24).

Table 3.24 : Correlation of weather parameters with the pests of regional importance at Bhubaneswar

Insect pest	Temperature ^{0} C		RH %		Rainfall		BSH (Hrs.)
	Max.	Min.	AM	PM	mm	Days	
STC	-0.445	-0.048	-0.160	0.266	0.227	0.083	-.0.005
YT	0.406	-0.336	0.272	-0.722 *	-0.463	-0.552	0.486
BT	0.542	-.0161	0.124	-0.644 *	-0.407	-0.482	0.439
LM	-0.292	0.166	-.0094	0.373	0.307	0.188	-0.061
A & NB	0.717 *	0.248	-0.220	-0.346	-0.292	-0.315	0.471
L & BW	0.780 *	0.426	-0.532	-0.121	-0.143	-0.142	0.455
LB	-0.292	0.488	-0.001	0.781 *	0.715 *	0.683 *	-0.569 *
CSRB	0.839 *	.0307	-0.366	-0.374	-0.293	-0.286	0.385
TMB	0.175	-0.396	0.372	-0.607 *	-0.380	-0.460	0.392

- **= '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;

CSRB: - Cashew stem and root borer; **TMB**: - Tea mosquito bug

JAGDALPUR

The maximum temperature significantly positively influenced (r=0.396 and 0.314) the activity of TMB both on shoot and panicle. The relative humidity (morning) was significantly negatively influenced (r= - 0.322) the activity of Cashew stem and root borer. The relative humidity (evening) had negatively correlated with the thrips damage on panicle (r= -0.471) and bright sunshine hours had positively correlated (r= 0.397) with panicle thrips. The minimum temperature and evaporation were significantly negatively correlated (r= -0.548 and -0.357); while relative humidity (morning) was positively influenced (r=0.348) the activity of leaf folder.

The minimum temperature significantly negatively correlated (r = -0.394) with incidence of leaf miner. In case of natural enemies, the fluctuation in population of spider ranged from 0.06 to 3.19 with maximum number in first week of November. The variation in population of *Brumus sp*. varied from 0.02 to 0.23 with maximum activity in first week of July (Table 3.25).

Table 3.25 : Correlation of weather parameters with the pests of regional importance at Jagdalpur

Weather Parameters	Correlation coefficient values (r) of pests of regional importance						
	Max. Temp.	Min. Temp.	Rainfall	RH I	RH II	Evap. mms	Bright hours Sunshine
TMB in shoot	0.396**	0.172	-0.144	-0.216	-0.136	0.323*	0.110
TMB in Panicle	0.314*	0.127	-0.090	-0.149	-0.310	0.218	0.171
%CSRB	0.247	0.237	-0.043	-0.322*	-0.122	0.200	0.064
% LC	-0.272	-0.191	-0.047	0.185	0.133	-0.191	0.000
% LF	-0.218	-0.548**	-0.068	0.348*	0.038	-0.357**	0.088
% LM	-0.202	-0.394**	-0.172	0.185	-0.098	-0.098	0.238
Leaf Thrips	0.199	0.272	-0.127	-0.492**	-0.375**	0.352*	0.206
Panicle Thrips	0.284*	-0.259	-0.231	-0.211	-0.471**	0.115	0.397**
Black thrips	0.080	-0.299*	-0.159	0.025	-0.081	-0.082	0.220

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

VENGURLA

TMB infestation showed significantly negative correlationship with minimum temperature and relative humidity (evening). The infestation of Thrips showed significantly negative correlationship with relative humidity (evening), whereas it showed negative correlation with minimum temperature, rainfall and relative humidity (morning) and positive relationship with maximum temperature. Leaf miner showed negative correlationship with minimum temperature, rainfall and relative humidity (evening & morning) and positive correlationship with maximum temperature. Apple & nut borer showed negative correlationship with evening humidity and rainfall and positive correlationship with maximum temperature and morning humidity, Shoot Tip Caterpillar showed negative correlationship with relative humidity (morning & evening) and rainfall and positive correlationship with maximum temperature and minimum temperature (Table 3.26)

Table 3.26 : Correlation between the pest incidence and weather parameters at Vengurla

	TMB	Thrips	Leaf min	A&N Bor	Aphids	Mealy Bug	Shoot Tip
Maximum Temperature	0.559**	0.352	0.273	0.283	0.015	0.162	0.058
Minimum Temperature	-0.854**	-0.585*	-0.095	-0.494	-0.742**	0.127	0.043
Morning Humidity	0.151	-0.177	-0.308	0.172	0.382	-0.144	-0.433
Evening Humidity	-0.699**	-0.693**	-0.280	-0.550	-0.449	-0.038	-0.187
Rainfall	-0.518	-0.499	-0.266	-0.399	-0.231	-0.165	-0.215

* - 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 correction studies on the TMB revealed that maximum temperature, relative humidity and sunshine had a positive relation with the activity of *H. antonii*, whereas negative correlation was established with rainfall (Table). Aphid population had positive correlation with relative humidity and minimum temperature (Table 3.27).

Table 3.27 : Correlation coefficient (r) for abiotic factors and insect pests at Vridhachalam

Insect-pests	Temperature		Relative Humidit		Rainfall	Rainy days	Sunshine hours
	Max	Min	AM	PM			
Tea mosquito bug (population) (Y_1)	0.69*	0.26	0.29	*0.25	-0.41	0.56	*0.40
Leaf and blossom webber (Y_2)	-0.73*	-0.43	-0.32*	-0.23	-0.28	-0.35	0.52
Apple and nut borer (Y_3)	0.56	0.43	0.63	-0.31	0.31	-0.31	0.45
Leaf miner (Y_4)	-0.26	0.33	0.42	0.54	0.69	0.52*	-0.40
Leaf roller (Y_5)	-0.60*	-0.43	-0.36*	-0.22	-0.32	-0.36	0.47
Shoot tip caterpillar (Y_6)	-0.23	0.26	0.48	0.38	0.49	0.49*	-0.42
Aphids (Y_7)	-0.20	0.23*	0.44*	0.55*	0.53	0.47*	-0.44
Cashew Stem and Root Borer (Y_8)	0.79*	0.62	-0.026	-0.51	-0.43	-0.40	0.57

* = Significant at 0.05 level

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

Centres : East Coast :

Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast :

Madakkathara and Vengurla

Plains / others :

Chintamani, Jagdalpur

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

SUMMARY:

The entries T 12/8, T18/3 and T 40/1 were found to be tolerant to incidence of leaf and blossom webber at Bapatla by recording less than 2% damage. At Chintamani the early duration accessions ME 4/4 and 1/64 Madhuranthakam were found to escape TMB incidence. The accessions CARS-5 did not have incidence of flower thrips and apple and nut borer at Jagdalpur.

BAPATLA

During 2007-08, among the important foliage and flower feeders, only the incidence of leaf and blossom webber was observed but at very low level in different germplasm entries, the damage of which varied from 0.86 to 3.96 per cent. The entries *viz*., T.No.12/8, T.No.18/3 and T.No. 40/1 were found relatively tolerant compared to other entries. The highest damage of 3.96 per cent was recorded in T.No.275.

BHUBANESWAR

The germplasm accessions planted during 2002 were screened for STC, L & BW and IT. None of the entries were free from TMB damage (Table 3.28).

Table 3.28 : Screening of germplasm accessions to locate tolerant /resistant to major pests of the region at Bhubaneswar

Pest	Germplasm	Min Occurrence	Germplasm	Max. Occurrence
Shoot tip caterpillar	OC8, OC10, OC65, OC75, OC83	0.5 to 1.5%	OC22, OC56, OC67, OC70, OC74, OC73 OC80	>5 to 15%
Infloresence thrips	OC4, OC50, OC64, OC49, OC12, OC10	0.5 to 5 No. /panicle	OC29, OC44, OC72, OC12, OC30, OC68	>5 to 15 No./panicle
Leaf and blossom webber	OC5, OC22 OC9, OC46 OC28	0.5% to 2%	OC58, OC61 OC62, OC79, OC81, OC82	>2 to 5%

CHINTAMANI

The reaction of germplasm maintained on the farm were observed against TMB. Among 107 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

The TMB damage was not observed in majority of entries. Only cultivars Ullal-1, Ullal-2, VRI-2, Hy-1598, NRC- 191and NRC- 192 had damage by TMB either on shoot or panicle.

The inflorescence thrips and apple and nut borer infestation was not found in CARS-5. Whereas, all other germplasm were infested by these insects.

JHARGRAM

None of the accessions screened appeared tolerant / resistant to leaf and blossom webber and shoot tip caterpillar.

VENGURLA

The variety NRCC Selection- 2 recorded lowest TMB infestation (1.99%) followed by M- 44/3 (2.00%) and NRCC Selection- 1 (2.05%) whereas the maximum

per cent damage was recorded in Vengurla -4 (4.02%) followed by Vengurla -1 (3.94%) (Table 3.29).

Table 3.29 : Screening (April, 2008 to April, 2009) at Vengurla

Varieties	TMB (%)	Varieties	TMB (%)
Vengurla -1	3.94	Hy-303	2.15
Vengurla -2	2.62	M- 44/3	2.00
Vengurla -3	2.34	30/1	3.64
Vengurla -4	4.02	10/19	2.05
Vengurla -5	3.25	3/28	2.35
Vengurla -6	2.99	NRCC Selection- 1	2.05
Vengurla -7	2.82	NRCC Selection- 2	1.99
Vengurla -8	2.77	Puttur 3	2.85
Hy - 320	3.10	15/4	2.20

VRIDHACHALAM

All the MLT entries and hybrids showed varying degree of susceptibility towards TMB and other foliar feeding insects.

The mean damage score due to TMB infestations in various MLT entries ranged from 0.6–1.2. The score was low in H 33/3 and H 2/16 with a mean scoring of 0.6 and 0.8 respectively. None of the entries showed immune or resistant to TMB infestation (Table 3.30).

Table 3.30 : Screening of MLT entries against major pests of cashew at Vridhachalam

MLT entries	TMB mean damage score 0-4 scale in 52 leader shoots	Leaf & blossom webber % shoot damaged / 52 leader shoots	Leaf roller (% of rolled leaves) on five laterals	Leaf miner (% of mined leaves) on five laterals	Inflorescence caterpillars (% of damaged panicle out of 52 panicles)
H 1598	1.00	12.30	3.60	6.00	5.80
H 1600	0.90	11.60	4.30	6.50	5.00
H 1608	0.90	10.00	5.00	5.00	4.30
H 1610	0.90	10.00	3.80	6.00	5.20
H 129	0.90	10.50	4.00	6.30	5.80
H 40	0.90	11.30	4.00	6.30	4.50
H 2/15	1.20	10.00	3.50	4.60	7.50
H 2/16	0.80	10.50	4.60	6.00	8.00
H 33/3	0.60	10.00	2.50	6.00	4.60
H 44/3	1.20	10.00	3.20	5.50	6.30
M 26/2	1.00	11.60	3.90	7.30	6.00
VTH 30/4	1.00	10.30	3.60	5.50	6.50
VTH 59/2	1.00	10.60	2.00	5.00	2.00
V 2	1.20	12.50	2.30	4.90	4.20
V 3	1.20	15.60	2.00	6.30	4.50
V 4	1.00	13.30	5.60	6.00	4.60
V 5	1.00	11.50	4.50	6.00	4.00

With respect to F_1 hybrids, all the cross combinations were susceptible to TMB infestation. However, the damage score was low in H 17 (1.3) followed by H16 (1.4), H 15 and H 13 (1.6) (Table 3.31).

Table 3.31 : Screening of F_1 hybrids for tolerance to cashew pests at Vridhachalam

Hybrid Number	Cross combination	TMB mean damage score 0-4 scale in 52 leader shoots	Leaf & blossom webber % shoot damaged / 52 leader shoots	Leaf roller (% of rolled leaves) on five laterals	Leaf miner (% of mined leaves) on five laterals	Apple & Nut borer (% of apples damaged /52 panicles)
H 10	M 10/4 x M 26/1	1.80	10.30	6.40	6.50	0.00
H 11	M 10/4 x M 45/4	1.40	8.60	6.00	6.60	1.00
H 12	M 10/4 x M 75/3	2.00	11.60	4.80	8.00	0.60
H 13	M 26/2 x M 26/1	1.60	12.50	6.40	8.20	1.00
H 14	M 26/2 x M 45/4	1.60	10.00	6.20	8.00	0.00
H 15	M 26/2 x M 75/3	1.50	12.60	6.50	9.70	0.00
H 16	M 44/3 x M 26/1	1.40	11.80	4.80	9.50	1.00
H 17	M 44/3 x M 45/1	1.30	8.00	4.40	8.20	0.60

None of the cashew entries showed immune or resistant to TMB and other foliar insect pests.

CHAPTER II : ORGANISATION

1. HISTORY, OBJECTIVES, GROWTH AND SALIENT ACHIEVEMENTS

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

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 eight coordinating Centres and one sub Centre, four in the East Coast viz., Bapatla. Bhubaneswar, Jhargram, Vridhachalam, three in the West Coast viz., Madakkathara, Vengurla, Pilicode and one in the maidan parts of Karnataka – Chintamani and one in the Central India at Jagdalpur.

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 and in ICAR Research Complex for Goa, Goa in 2007.

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 27 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
- A local collection, CARS-10 was found to be tolerant to short spells of low temperature (2 – 2.5ºC) at Jagdalpur Centre, which had no leaf shedding as in other collections.
- Four cashew trees indicating possible tolerance to salt water inundation have been identified from Tsunami affected plantations at Cuddalore and Nagapattinam.
- Multi-location trials of cashew have been laid out at different centres to study the yield and other parameters of varieties developed and its suitability at different regions.
- Under spacing trials the cumulative yield for 5 years was highest in 600pl/ha (83.4q/ha) followed by 400pl/ha (74.68q/ha) and 200pl/ha (38.39q/ha) at Bhubaneswar.
- A package of practices has been developed for fertilizer application, spacing and thinning. Application of 500g N; 125g P_2O_5 and K_2O each per tree per year was found to be suitable.
- Intercropping with ginger, turmeric, cluster bean, black gram, horse gram, ground nut, vegetables such as colocasia, tapioca, brinjal, bhindi, cucumber, chillies and medicinal plants with cashew as main crop during the initial stage of orchard development were evaluated and recommended for the economic upliftment of farmers at different locations.Under intercropping trials conducted at Bhubaneswar, total net returns per hectare from inter-crops as well as main crop after 4 years revealed that maximum return was received from colocasia (Rs 66,216/-) followed by bhindi (Rs. 58,155/-), while in control it was Rs 40,075/-.

- 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.
- 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 2008-09 :

- Under germplasm evaluation, high shelling percentage exceeding 30.0 per cent was observed in accessions JGM-147 to JGM-151 at Jhargram. At Vengurla, accessions RFRS 173 and RFRS 177 had higher number of panicles/m^2 being 17.33 and 16.50 respectively.
- Under varietal evaluation trials, the variety T.No 10/19 produced the highest cumulative nut yield (78.69 kg / tree) followed by T.No. 30/1 (66.49 kg/ tree) in 14 harvests at Bapatla.
- Under the trials on multi location trial-III, at Chintamani highest cumulative nut yield was recorded in H 1593 (8.49kg/pl/ha) followed by Goa 11/6 (7.61kg/pl) while at Madakkathara, highest cumulative yield was recorded by Goa 11/6 (7.77 kg) followed by H-1593 (7.47 kg) for 3 harvests.
- Under hybridization trials, at Jhargram, the highest annual yield of 14.7kg/tree was obtained in H – 41 followed by H – 57 (13.60 Kg/tree) and H – 23 (13.2Kg/tree). At Madakkathara H - 36 performed well for annual yield (13.30kg/tree) and H - 21 performed well for cumulative yield for 12 harvests (139.92 kg/tree).
- Under trials on evaluation of NPK fertilizer experiment at Bapatla, the highest cumulative nut yield was recorded in the treatment 500:125:125g NPK/pl (75.97 Kg/tree) followed by 500:250:125g NPK/pl (70.96 Kg/tree).
- Under fertilizer application in high density cashew plantations, the cumulative yield at 7th harvest was highest in M2 150 kg N, 50 kg P2O5, 50 kg K2O (9494.1 kg) followed by M3 225 kg N, 75 kg P2O5, 75 kg K2O (9276.6 kg) at Bhubaneswar. At Chintamani, the highest nut yield per ha. was recorded by S3 600 plants/ha (5m x 4m) (18.08 q/ha) and lowest was recorded by S1 200 plants/ha (10m x 5m) (11.52 q/ha).
- Under trial on intercropping in cashew, at Bhubaneswar, the maximum net return was received from colocasia (Rs 69,956) followed by bhindi (Rs. 59,420). 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 experiments for evaluation of insecticides for control of TMB and other insect pests At Bhubaneswar, TMB damage incidence was lowest in L-cyhalothrin (0.85%) as compared to the control (2.48%).
- At Jagdalpur, the nut yield was highest (175. 13 kg/ha) in Triazphos 0.1% , which was at par with L-cylohalothrin 0.003% (136.17 kg/ha).
- Under curative control trial for management of cashew stem and root borer (CSRB), chlorpyriphos 0.2% resulted in 83.33% trees without re-infestation or persistent attack as post extraction prophylaxis at Bapatla, while at Bhubaneswar, maximum recovery (90%) was obtained in chlorpyriphos 0.2% treatment.
- Screening of germplasm to locate tolerant / resistant types to major pests of the region indicated that the entries T 12/8, T18/3 and T 40/1 were tolerant to incidence of leaf and blossom webber at Bapatla by recording less than 2% damage.

2. TRANSFER OF TECHNOLOGY :

A total of 177631 grafts were produced during the current year and distributed to several government and non-government organizations as well as to cashew cultivators. The centre wise production of cashew grafts is given below:

Centre	No. of grafts produced
Bapatla	6900
Bhubaneswar	25000
Chintamani	8160
Jagdalpur	15500
Jhargram	2500
Madakkathara	00
Pilicode	6000
Vengurla	00
Vridhachalam	113571
TOTAL	**177631**

BAPATLA

Scientists of this Centre arranged a technical exhibition of cashew production in connection with silver jubilee celebrations of Agricultural Engineering College, Bapatla. The scientists also participated in the Raithu Chaitanya Yatra in which technology dissemination to farmers on various aspects of cashew cultivation was undertaken.

BHUBANESWAR

Scientists of this Centre were involved in conducting trainings on cashew production technology and trained the gardeners & grafters trainees sponsored by the State Horticulture Department of Orissa, participants from self-help groups and farmers from cashew cluster, Ganjam. Scientists of this centre were involved in evaluation of replanting programme of cashew undertaken by OSCDC. Scientists also participated in the Interactive meeting on "Cashew Processing related Problems and Probable Solutions" at NRCC, Puttur.

CHINTAMANI

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 lecturers on cashew production technology and other aspects. Regular field visits/discussions were undertaken to evaluate demonstration plots and provide suggestions and solutions on various aspects of cashew cultivation.

A T.V. programme on "Suitable cashew varieties for maidan parts of Karnataka and their cultivation" was telecasted in Kasturi Channel and an interview in Kannada on improved cultivation aspects of cashew were broadcast by AIR, Bangalore.

Technical personnel of this centre set up a display stall to explain the activities of AICRP(C), at the Krishi Mela of UAS (B) at GKVK, Bangalore.

JAGDALPUR

Scientists of this centre are involved in Watershed Programme for Cashew plantation, Drought Prone Area Programme & Integrated Waste Land Development Programme. This centre is also associated with National Horticulture Mission and providing technical support and grafts.

For successful establishment of cashew plantations and effective transfer of production technologies, training were imparted to farmers from various parts of Bastar region. Training on Cashew Production Technology was organised for benefit of farmers and field workers of Hort / Agril. Department of Chhattisgarh.

JHARGRAM

Demonstration plots were freshly laid out regarding high density plantation and fertilizer evaluation at different blocks of Jhargram. Four campaigns on plant protection involving cashew farmers were conducted in Contai (Midnapur East) Barjora Panchal (Bankura). Scientists of this centre acted as resource persons for Training for the forest front line staffs regarding scientific cultivation of cashew. A cashew day was conducted on 20.2.2009 to create awareness about techniques of cashew cultivation among local farmers.

MADAKKATHARA

Scientists of this centre were involved in various training programmes on “multiple uses of cashew apple” “cashew apple processing” and “pests and disease management in cashew”. An international training programme on “Development of high yielding varieties, production of elite planting material and cashew apple processing” was organized for participants from Senegal, West Africa which was sponsored by USAID Economic Growth Programme. Scientists of this centre established state level model cashew apple processing unit, product refinement and testing unit and state level training centre for cashew apple processing at Madakkathara under the NHM- funded project on cashew apple processing.

Three model cashew apple processing demonstration units were established under the NHM project by extending technical and financial assistance to selected self help groups at Kannur and Kollam districts.

PILICODE

Training and seminars have been conducted on cashew propogation, cashew cultivation and cashew apple utilization. A cashew seminar was also organized by the centre at Kodam Belur to create awareness about cashew cultivation techniques. 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. Radio talks were presented on “Production and marketing of cashew”, “Cashew grafting and planting technique” and “Cashew apple processing” in Malayalam from AIR, Kannur.

VENGURLA

Scientists of this centre were involved in various extension activities viz., demonstrations on 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, management of CSRB 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.

VRIDHACHALAM

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.

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.M.B.Nageswara Rao (From 03-04-2007 to 16-01-2009) Dr. C.Chandrasekhara Rao (From 16-01-2009)
Asstt. Horticulturist	:	Dr. T. Padmalatha (From 01.4.2009)
Asstt. Entomologist	:	Dr. Gouse Mohammed (Upto 09.1.2009) Dr.P.Lakshmi Soujanya (From 09.1.2009 to 05.4.2009)
Sr. Technical Assistant	:	Sri. M. Sambasiva Rao (From 7.6.2007)
Jr. Technical Assistant	:	Mr. K. Ranga Rao (Upto 31.07.2009)
Grafter	:	Mr. V. Kantha Rao

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

Horticulturist	:	Dr. A.K. Pattnaik
Jr. Horticulturist	:	Dr. K.C. Mohapatra
Jr. Entomologist	:	Dr. P.C. Dash (12.12.2007)
Sr. Technical Assistant	:	Sri A. Mansingh (14.6.2007)
Jr. Technical Assistant	:	Sri R. N. Dash (01.07.2008)
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	:	--
Sr. Technical Assistant	:	Mr. Babu V. (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. M.S. Paikra (Upto March 2009) 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
Sr. Technical Assistant	:	Mr. S. Sirkar
Jr. Technical Assistant	:	Mrs. K. Bose
Grafter	:	Mr. Jagannath Shaw

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

Horticulturist	:	Dr. Jose Mathew
Jr. Breeder	:	Mr. Gregory Zachariah
Jr. Entomologist	:	Dr. Haseena Bhaskar (From 2.2.2009)
Sr. Technical Assistant	:	Dr. A. Sobhana (From 30.9.2008)
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	:	Ms. Rachana P.M. (28th November 2008 to 9th June 2009)

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

Horticulturist	:	Dr. M. S. Gawankar (From 28.5.2007)
Jr. Breeder	:	Mr. R.C. Gajbhiye (Upto 18.6.2008) Shri. R.T. Bhingarde (Upto 19.6.2008)
Jr. Entomologist	:	Mr. V.N. Jalgaonkar
Sr. Technical Assistant	:	Mr. R.D. Sawale
Jr. Technical Assistant	:	Shri. S.G.Jadhav (From 19.6.2009)

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 (From 17.11.08)
Grafter	:	Mr. C. Gopalakrishnan

4. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2008-09

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	13.13	0.35	2.40	0.00	15.88	11.91	3.97
Bhubaneshwar	16.68	0.35	2.40	0.00	19.43	14.57	4.86
Chintamani	19.51	0.35	2.40	0.00	22.26	16.69	5.57
Jagdalpur	8.25	0.25	1.60	0.00	10.10	7.58	2.52
Jhargram	8.26	0.35	2.40	0.00	11.01	8.26	2.75
Madakkathara	19.80	0.35	2.40	0.00	22.55	16.91	5.64
Pilicode	8.54	0.15	0.80	0.00	9.49	7.12	2.37
Vengurla	10.34	0.35	2.40	0.00	13.09	9.82	3.27
Vridhachalam	16.10	0.35	2.40	0.00	18.85	14.14	4.71
Total	**120.61**	**2.85**	**19.20**	**0.00**	**142.66**	**107.00**	**35.66**

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

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	15.31	0.12	2.38	0.00	17.81	13.36
Bhubaneshwar	20.22	0.00	1.10	0.00	21.32	15.99
Chintamani	17.39	0.35	2.40	0.00	20.14	15.11
Jagdalpur	6.84	0.16	1.69	0.00	8.69	6.52
Jhargram	6.08	0.19	2.40	0.00	8.67	6.50
Madakkathara	19.49	0.15	2.39	0.00	22.03	16.52
Pilicode	7.06	0.00	0.40	0.00	7.46	5.60
Vengurla	10.82	0.29	2.40	0.00	13.51	10.13
Vridhachalam	17.72	0.35	2.40	0.00	20.47	15.35
Total	**120.93**	**1.61**	**17.56**	**0.0**	**140.10**	**105.08**

5. MONITORING OF PROJECT BY PROJECT COORDINATOR

Project Coordinator reviewed the progress made by the Centres by correspondence and discussion.

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. Scientists of this Centre arranged a technical exhibition of cashew production in connection with silver jubilee celebrations of Agricultural Engineering College, Bapatla. The scientists also participated in the Raithu Chaitanya Yatra in which technology dissemination to farmers on various aspects of cashew cultivation was undertaken.

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. Scientists of this centre were involved in evaluation of replanting programme of cashew undertaken by OSCDC. Scientists also participated in the Interactive meeting on “Cashew Processing related Problems and Probable Solutions” at NRCC, Puttur.

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

lecturers on cashew production technology and other aspects. Regular field visits/discussions were undertaken to evaluate demonstration plots and provide suggestions and solutions on various aspects of cashew cultivation. A T.V. programme on “Suitable cashew varieties for maidan parts of Karnataka and their cultivation” was telecasted in Kasturi Channel and an interview in Kannada on improved cultivation aspects of cashew were broadcast by AIR, Bangalore.

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. 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. Four campaigns on plant protection involving cashew farmers were conducted in Contai (Midnapur East) Barjora Panchal (Bankura).

MADAKKATHARA

The centre has been established in 1972. At present there are three scientists working under the project in the posts of Horticulturist, Junior Breeder and Junior Entomologist. Presently three projects in Crop Improvement; six in Crop Management and four in Crop Protection are being carried out. Scientists of this

centre were involved in various training programmes on “multiple uses of cashew apple” “cashew apple processing” and “pests and disease management in cashew”. An international training programme on “Development of high yielding varieties, production of elite planting material and cashew apple processing” was organized for participants from Senegal, West Africa which was sponsored by USAID Economic Growth Programme. Three model cashew apple processing demonstration units were established under the NHM project by extending technical and financial assistance to selected self help groups at Kannur and Kollam districts.

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 propogation, 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. Radio talks were presented on “Production and marketing of cashew”, “Cashew grafting and planting technique” and “Cashew apple processing” in Malayalam 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, management of CSRB 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.

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.

A new centre has been established in 2009 in Paria, Pardi Taluk, Valsad District in Gujarat during XI Plan and another centre has been sanctioned to Birsa Agricultural University, Jharkhand in the same Plan and the exact location would be identified soon. Three cooperating centres were also included in AICRP-Cashew Project in 2009 in XI Plan. 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, Barapani/Tura, Meghalaya.

7. METEOROLOGICAL DATA OF DIFFERENT CENTRES FOR THE YEAR 2008-09

BAPATLA

Month & Year	Mean Temp (^{0}C)		Mean RH (%)		Rainfall (mm)	No.of Rainy days
	Max.	Min.	(m)	(e)		
Apr-08	33.60	24.80	81	71	13.30	1
May-08	41.90	27.60	56	43	01.70	3
June-08	37.60	26.90	70	58	121.70	13
July-08	35.20	25.80	77	67	177.20	17
Aug-08	32.70	25.00	84	77	193.50	15
Sept-08	33.70	25.30	77	70	90.40	13
Oct-08	32.70	23.90	81	72	79.10	7
Nov-08	30.80	21.60	87	74	214.00	8
Dec-08	30.40	19.30	91	71	2.20	2
Jan-09	30.10	17.30	91	66	0.00	0
Feb-09	31.60	19.60	91	70	0.00	0
Mar-09	33.20	22.20	85	70	0.00	0

BHUBANESWAR

Month & Year	Mean Temp (^{0}C)		Mean RH (%)		No. of rainy days	Rainfall (mm)	BSH
	Max	Min	AM	PM			
Apr-08	31.30	15.60	97.40	43.40	3	24.40	8.50
May-08	29.20	17.30	91.50	49.50	2	33.80	6.60
June-08	36.80	23.00	82.00	44.00	2	5.10	8.20
July-08	37.10	26.30	92.00	51.00	3	30.40	9.00
Aug-08	37.50	25.90	89.60	57.20	8	129.80	8.20
Sept-08	32.50	25.60	92.20	73.50	19	416.60	3.80
Oct-08	32.20	25.60	93.60	75.50	21	234.50	2.50
Nov-08	33.50	27.40	94.20	74.50	23	293.00	4.90
Dec-08	32.00	25.00	93.90	77.50	20	610.70	5.30
Jan-09	32.60	23.70	92.20	59.90	4	31.80	7.60
Feb-09	30.90	18.90	89.90	50.30	2	5.90	7.30
Mar-09	30.10	17.10	95.50	46.20	-	-	6.90

CHINTAMANI

Month	Mean Temp (^{0}C)		Mean RH (%)		No. of rainy days	Rainfall (mm)	BSH
	Max	Max	AM	PM			
Apr-08	33.88	19..82	71.80	31.40	1	7.50	8.36
May-08	32.85	21.15	74.00	50.75	6	74.10	7.80
June-08	30.00	20.63	74.25	50.00	3	27.50	4.43
July-08	29.50	19.75	77.50	56.75	7	103.90	3.80
Aug-08	27.9	19.72	80.60	62.80	6	161.90	3.26
Sept-08	28.42	18.85	79.00	59.25	6	153.40	-
Oct-08	27.65	19.00	82.25	68.75	10	105.80	-
Nov-08	27.17	14.32	68.75	46.75	-	-	-
Dec-08	27.04	11.24	73.40	36.40	4	62.8	8.47
Jan-09	27.12	11.37	75.25	36.75	-	-	8.47
Feb-09	30.42	12.27	60.00	27.25	-	-	9.77
Mar-09	32.96	16.26	56.80	20.60	3	7.8	7.68

JAGDALPUR

Month	Mean Temp (^{0}C)		Mean RH (%)		Rainfall mm	BSH
	Max.	Min.	AM	PM		
Apr-08	36.2	21.0	79	25	0.8	8.6
May-08	39.62	24.23	62	43	24.00	8.11
June-08	30.9	21.6	89	70	300.0	2.4
July-08	28.1	20.3	91	75	447.8	3.5
Aug-08	27.7	20.3	93	80	325.6	2.2
Sept-08	24.2	18.0	86	52	260.8	0.0
Oct-08	28.4	10.6	78	33	0.0	2.3
Nov-08	29.6	12.6	92	54	0	7.2
Dec-08	29.4	7.4	90.9	39.6	0.0	8.8
Jan-09	27.2	3.8	80	18	0.0	8.0
Feb-09	30.0	7.0	76	18	0.0	7.7
Mar-09	32.0	10.0	61	26	12.4	1.4

JHARGRAM

Month	Mean Temp (^{0}C)		Mean RH (%)		Total Rainfall (mm)	No. of rainy days	MBSH / day
	Max	Min	AM	PM			
Apr-08	35.6	26.9	80.6	45.6	23.9	5	4.5
May-08	39.2	29.9	84.3	45.2	62.3	7	5.0
June-08	36.9	26.1	84.3	52.9	189.9	8	5.5
July-08	32.1	24.9	82.6	75.3	296.9	14	2.0
Aug-08	31.8	24.3	90.2	87.2	360.5	18	2.5
Sept-08	30.8	24.9	92.6	81.5	396.9	19	2.0
Oct-08	30.1	24.3	80.6	54.2	63.8	4	5.3
Nov-08	28.9	23.6	75.3	49.5	19.4	2	7.2
Dec-08	25.1	11.3	76.6	49.7	10.2	2	5.8
Jan-09	24.9	12.8	74.2	48.7	61.7	4	4.6
Feb-09	24.8	13.5	72.8	48.2	40.3	4	7.0
Mar-09	31.2	25.1	73.8	54.2	14.3	2	6.5

MADAKKATHARA

Month & Year	Mean Temp (^{0}C)		Mean Temp (^{0}C)	Rainfall (mm)	Rainy days (No.)	Sunshine hours (h)
	Max	Max	Average			
Apr-08	35.30	24.90	75	65.60	3	189.90
May-08	35.80	24.70	73	11.50	0	188.60
June-08	33.10	23.50	85	636.70	25	59.00
July-08	32.00	23.20	84	416.30	22	84.90
Aug-08	32.00	23.60	82	321.90	12	106.50
Sept-08	32.40	23.20	80	314.20	14	159.50
Oct-08	34.60	23.40	76	380.80	12	176.20
Nov-08	33.60	23.10	70	21.70	2	180.30
Dec-08	33.20	22.50	60	2.60	0	238.90
Jan-09	35.20	21.90	54	0.00	0	290.00
Feb-09	37.40	22.10	57	0.00	0	277.20
Mar-09	36.70	24.40	70	29.00	3	245.20

PILICODE

Month & year	Mean Temp (^{0} C)		Mean RH (%)		Rainfall (mm)	No. of rainy days
	Max.	Min.	AM	PM		
Apr-08	31.73	24.96	87.63	65.62	113.60	6
May-08	31.63	24.19	86.61	66.03	68.00	6
June-08	30.31	23.40	95.13	80.13	886.10	26
July-08	29.51	22.75	95.16	78.10	538.10	21
Aug-08	29.25	23.02	94.35	79.71	573.90	17
Sept-08	30.26	22.88	91.33	72.50	348.80	12
Oct-08	31.50	22.93	89.35	70.52	232.90	14
Nov-08	32.85	22.13	86.43	58.43	000.0	0
Dec-08	32.90	21.72	85.75	56.88	000.0	0
Jan-09	32.01	19.05	85.16	49.97	000.0	0
Feb-09	32.78	21.67	87.89	56.71	000.0	0
Mar-09	33.36	23.66	85.06	60.19	14.20	3

VENGURLA

Month	Temperature (^{0}c)		Mean RH (%)		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
Apr-08	33.22	23.82	83.65	67.17	0	0
May-08	33.23	24.84	79.39	68.21	50.4	6.0
June-08	30.7	25.00	84.75	80.25	662.8	26.0
July-08	30.45	25.00	86.70	79.67	625	26.0
Aug-08	29.54	24.99	89.99	82.21	803.2	31.0
Sept-08	30.24	23.85	89.41	79.53	154.8	0.0
Oct-08	31.84	24.29	84.78	66.18	23.00	3.0
Nov-08	33.50	20.72	77.01	61.57	3.0	0.0
Dec-08	35.62	18.82	89.01	59.93	5.4	3.0
Jan-09	32.31	17.07	90.30	59.46	0	0
Feb-09	32.45	18.07	88.17	57.24	0	0
Mar-09	32.99	21.48	88.96	62.56	0	0

VRIDHACHALAM

Month	Temperature (^{0}c)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days
	Max.	Min.	A.M.	P.M.		
Apr-08	36.23	29.13	84.12	55.10	21.6	1
May-08	38.25	26.23	71.92	55.31	70.8	2
June-08	36.94	25.03	82.61	72.17	49.4	6
July-08	36.03	23.71	84.73	61.12	112.8	4
Aug-08	34.99	22.79	97.16	55.04	61.08	9
Sept-08	35.13	22.98	86.91	51.69	62.2	4
Oct-08	33.06	22.51	84.84	64.19	171.8	12
Nov-08	31.07	19.14	74.42	66.64	484.5	12
Dec-08	29.88	17.65	82.16	60.24	88.6	5
Jan-09	30.54	18.39	88.43	51.36	3.4	1
Feb-09	32.80	19.65	88.61	57.82	-	-
Mar-09	35.22	22.45	89.29	56.25	22.10	2

8. RESEARCH PUBLICATIONS

BHUBANESWAR

Mohapatra, K. C.; Pattnaik, A.K. and Lenka, P.C. (2008). Processing of raw cashew apple juice – A methodology for preparation of preserved products. State Level Exhibition cum Seminar on Horticulture Production and Post Harvest Management in Orissa. Souvenir. August 12th – 13th, 2008 p 24 – 26.

Lenka, P.C. and A.K. Pattnaik (2008) Cashew Research and Development. The Horticulture Society of India. Recent initiative in Horticulture: 266-274

JAGDALPUR

Sahu K.R. and Sharma, D. 2008. Management of cashew stem and root borer (*Plocaederrus ferrugineus* L.) by using microbial and plant products. J. of Biopesticide. Vol. 1(2), pp.121-123 (2008).

Sahu K.R. and Sharma, D. 2008. Bio-ecology of leaf miner, *Acrocercops syngramma* M. on cashew. In Souvenir cum Abstracts: *VII-National Symposium on Emerging Trends of Researches in Insect Pest Management and Environment Safety*, September 24-26, 2008. The Uttar Pradesh Zoological Society, Muzzaffarnagar-251 001 (U.P.). pp. 33.

Sahu, K.R., Sharma, D., Shukla, B.C., Thakur, B.S. and Patil, S.K. 2008. Status of cashew insect in Chhattisgarh. In Abstract: *National Conference on Pest Mangement strategies for Food Security.* May 2-3, 2008, Indira Gandhi Krishi Vishwavidhyalay, Raipur (C. G.). Pp-26-27.

Sahu K.R., Sharma D., Katlam B.P. and Paikra, M.S. 2008. Bio-efficacy of some insecticides against the foliage feeder insect pests of cashew. In *Abstract: National Conference on Pest Mangement strategies for Food Security*. May 2-3, 2008, Indira Gandhi Krishi Vishwavidhyalay, Raipur (C. G.). Pp- 86-87.

Sahu, K.R., Shukla, B.C., Thakur, B.S., Naik, R.K. and Patil, S.K. 2008. Mahila swasahayat samuh dwara Kaju avanm iske tana va jad bedhak keet ki jankari tatha uske niyatran se hone wale labh. *In Souvenir cum Abstract: National level Seminar on Women empowerment in Chhattisgarh and Agriculture Development.* September 18, 2008, Indira Gandhi Krishi Vishwavidhyalay, Raipur (C. G.). Pp- 79.

Sahu, K.R., Sharma D., Katlam B.P. and Paikra, M.S. 2008. Eco-friendly management of cashew stem and root borer (Plocaederus ferrugineus L.) by using bio-pesticides in Chhattisgarh. In *National Conference on Organic Farming in horticultural crop*. Held at Central Plantation Crops Research Institute, Kasargod (Kerala) from 15th -18th October, 2008.

MADAKKATHARA

Jose Mathew. 2008. Nutrient Management for cashew. Hand book for PG Diploma in Plantation Management, IGNOU, New Delhi

Jose Mathew and Mini,C. 2008. Opportunities for income enhancement from cashew through nut and apple processing. Lead paper, Proc. National Seminar on "Food security through innovations in food processing and entrepreneurship development", Kerala Agricultural University, Vellanikkara, 29-30 September 2008, pp. 36-41

Mini, C., Jose Mathew and Simi Davis. 2008. Replacement of sugar with jaggery for the preparation of cashew apple syrup. Abstract, National Seminar on "Food security through innovation in food processing and entrepreneurship development", Kerala Agricultural University, Vellanikkara, 29-30 September 2008, pp. 145

Mini, C., Jose Mathew and Sheeba, M.S. 2008. Utilising cashew apple for home scale wine production. Abstract, "Food security through innovation in food processing and entrepreneurship development", Kerala Agricultural University, Vellanikkara, 29-30 September 2008, pp. 149

Mini, C. and Jose Mathew. 2008. Effect of priming on seed viability and vigour in cashew. Seed Research 36 (1): 37-41

Jose Mathew, Mini.C and Gregory Zachariah. 2008. Organic nutrition in cashew nursery and plantation. Abstracts, National Seminar on "Organic farming in horticultural crops with special reference to plantation crops" 15-18th October 2008, CPCRI, Kasaragod, pp 49

Jose Mathew and Mini, C. 2008. Manipulation of tree densities for yield and income maximization in cashew. Abstract, 3rd Indian Horticulture Congress on "New R & D initiatives in horticulture for accelerated growth and prosperity", November 6-9, 2008, Bhubaneswar, pp. 54

Mini, C., Jose Mathew & Krishnan, S. 2008. Refinement and commercialization of technology for the preparation of pickle from cashew apple. Abstracts, 3rd Indian Horticulture Congress on "New R & D initiatives in horticulture for accelerated growth and prosperity", November 6-9, 2008, Bhubaneswar, pp. 54

Jose Mathew and Mini. C. 2008. Economic potentials of tuber crops for intercropping in young cashew plantation. J. Planatation Crops 36 (3): 366-367

Mini.C, Jose Mathew and Indira. V. 2008. Changes in chemical and microbial quality of mixed cashew apple jams during storage. J. Plantation Crops 36 (3): 496-499

Pathummal Beevi. S and G.K. Mahapatro. 2008. Species- spectrum and inter relationship between ant and spider fauna in cashew agro – ecosystem. J. Plantation Crops 36 (3): 375- 381

Jose Mathew. 2009. Current cashew scenario and scientific management of cashew plantations with experiences from India. *In:* Training manual for International training, 24-28 February 2009, Cashew Research Station, KAU, Madakkathara, pp 1-10.

Gregory Zachariah. 2009. Morphology and characteristics of cashew. *In:* Training manual for International training, 24-28 February 2009, Cashew Research Station, KAU, Madakkathara, pp 11-27

Gregory Zachariah. 2009. Germplam collection, conservation, cataloguing and evaluation. *In:* Training manual for International training, 24-28 February 2009, Cashew Research Station, KAU, Madakkathara, pp 28-39

Sobhana. A. 2009. Propagation in cashew. *In:* Training manual for International training, 24-28 February 2009, Cashew Research Station, KAU, Madakkathara, pp 40-51

Haseena Bhaskar. 2009. Pests and disease management in cashew. *In:* Training manual for International training, 24-28 February 2009, Cashew Research Station, KAU, Madakkathara, pp 52-67

Jose Mathew. 2009. Multiple uses of cashew apple. *In:* Training manual for International training, 24-28 February 2009, Cashew Research Station, KAU, Madakkathara, pp 68-80

Sobhana. 2009. Cashew apple syrup, squash, RTS and jam. *In:* Training manual for International training, 24-28 February 2009, Cashew Research Station, KAU, Madakkathara, pp 94-95

VRIDHACHALAM

Nilakanda Pillai,K.,S.Jeeva., M.S.Aneesa Rani.2008.Bio Diversity in Cashew in India. In: Forest Biodiversity. Vol.II.Ed.K.Muthuchelian, S.Kannaiyan and A.Gopalan.Publ.Vedam Books, New Delhi.Associated pub. X.314p.ISBN no.81-85211-77-9

Aneesa Rani, M. S. Jeeva, S., Ambethgar, V. and M. Balusamy. 2006. Cashew production technology. Sri Hare Krishna Offset Printers, Vridhachalam

Aneesa Rani, M. S. Jeeva and PL.Viswanathan, 2008. High density planting in cashew. Valarum Velanmai. 24 (6) p16-18.

Ambethgar, V., K. Sachithanantham, M. S .Aneesa Rani., S. Jeeva, and PL. Viswanathan, 2008. Cashew– Plant Protection. TNAU Press**.**

POPULAR ARTICLES

BHUBANESWAR

Mohapatra, K.C. and Lenka, P. C (2008). Adhika Amalakhyama Shankar Jatiya Lanka Amba Kisam “Jagannath” o “Balabhadra”. Chasira Sansar (University Foundation Day Issue), July-August, p 31-32. Published by Directorate of Extension Education, OUAT, Bhubaneswar.

Mohapatra, K. C.; Lenka, P. C. and Pattnaik, A. K. (2008). Odisha Pain Unnat Lanka Amba Kisama. Krushak Bandhu Annapurna (Agri Monthly of Orissa), August-2008, p 24.

CHINTAMANI

Rajanna, K.M., Sivappa, Narasimha Reddy, M.N. and Manja Naik,C.,2008. Pre-flowering management of cashew to obtain higher yield. Annadata, Kannada monthly, December, pp: 24-27.

Rajanna, K.M., Sivappa, Narasimha Reddy, M.N. and Manja Naik,C.,2009. Management of TMB and CSRB in cashew. Annadata, Kannada monthly, January, pp: 11-13.

MADAKKATHARA

Mini. C and Jose Mathew. 2008. New products from cashew apple (In Malayalam). Karshakan (April 2008) 18 (4) : 10-12

Jose Mathew and Gregory Zachariah. 2008. Poornima- New cashew hybrid from Madakkathara (In Malayalam). Karshakan (April 2008) 18 (4) : 15

Mini, C., Jose Mathew and Augustine, A. 2009. Vinegar from cashew apple (In Malayalam). *Karshakasree* 14 (7): 56

Jose Mathew. 2009. New varieties and scientific cultivation of cashew (Interview in Malayalam). *Karshakasree* 14 (7): 8

9. LIST AND ADDRESSES OF CENTRES OF AICRP ON CASHEW

HEADQUARTERS

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

UNIVERSITY CENTRES – EAST COAST

1. Cashew Research Station,
Andhra Pradesh Horticultural University,
BAPATLA – 522 101,
Guntur Dist,
Andhra Pradesh
Phone No. : 08643 – 225304
FAX No. : 08643 – 225304
E-mail : sscrs@sancharnet.in

2. Cashew Research Station,
Department of Horticulture,
Orissa University of Agriculture and Technology
BHUBANESWAR – 751 003, Orissa.
Phone No. : 0674-2395383
FAX No. : 0674-2397780
E-mail : aicrpcashew_bbsr@yahoo.co.in

3. Regional Research Station,
Tamil Nadu Agricultural University
VRIDHACHALAM – 606 001,
Cuddalore Dist., Tamil Nadu.
Phone No. : 04143-238231, 260412
FAX No. : 04143-238120
E-mail : cdl_phrrsvri@sancharnet.in

4. Regional Research Station,
Bidhan Chandra Krishi Vishwa Vidyalaya
Jhargram Farm Post,
JHARGRAM – 721 507,
Midnapore (West) District, West Bengal.
Phone No. : 03221-255593
E-mail : spcamit@rediffmail.com
schakraborti_ento@rediffmail.com

UNIVERSITY CENTRES – WEST COAST

1. Cashew Research Station,
Kerala Agricultural University
MADAKKATHARA – 680 651,
Thrissur District, Kerala.
Phone No. : 0487-2370339
FAX No. : 0487-2370339
E-mail : kaucaju@rediffmail.com

2. Regional Agricultural Research Station,
Kerala Agricultural University
PILICODE – 671 353,
Kasaragod District, Kerala.
Phone No. : 0467-2260632
FAX No. : 0467-2260554
E-mail : adrrarspil@rediffmail.com
cashewnaik@yahoo.com

3. Regional Fruit Research Station,
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
VENGURLA – 416 516,
Sindhudurg District, Maharashtra.
Phone No : 02366-262234, 263275, 262693
FAX No : 02366-262234
E-mail : rfrs@sancharnet.in

UNIVERSITY CENTRES – PLAINS TRACT / OTHERS

1. Agricultural Research Station,
University of Agricultural Sciences
CHINTAMANI – 563 125,
Chikkaballapura District, Karnataka.
Phone No. : 08154-252118, 250420
FAX No. : 08154-251046

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

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   Navsari Agricultural University,
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1. KRC College of Horticulture,
   Arabhavi – 591 310,
   Gokak Taluk, Belgaum Distt.
   Karnataka
   Phone : 08332 – 284 502 (O)

2. ICAR Research Complex for Goa,
   Ela, Old Goa, Goa-403 402.
   Phone : 0832 – 2284677 (O)
   E-mail : director@icargoa.res.in

3. ICAR Research Complex for NEH Region
   Barapani – 793 103
   Meghalaya
   Phone : 0364-2570257 (O)
   E-mail : director@icarneh.ernet.in

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15	Cashew Cultivation Practices	
16	Annotated Bibliography of Cashew 1995-2007	205.00

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