अखिल भारतीय समन्वित काजू अनुसंधान परियोजना

ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW

वार्षिक प्रतिवेदन

ANNUAL REPORT

1997 - '98

राष्ट्रीय काजू अनुसंधान केन्द्र

NATIONAL RESEARCH CENTRE FOR CASHEW

(भारतीय कृषि अनुसंधान परिषद)

(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)

पुत्तूर PUTTUR - 574 202

द. क., कर्नाटक D. K., KARNATAKA

ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW

ANNUAL REPORT 1997-'98

PROJECT COORDINATOR

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NATIONAL RESEARCH CENTRE FOR CASHEW
(Indian Council of Agricultural Research)
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प्राक्कथन

यह अखिल भारतीय समन्वित काजू अनुसंधान परियोजना का चौदहवां वार्षिक प्रतिवेदन है। इस प्रतिवेदन में कॅलेन्डर वर्ष 1997 जनवरी से दिसम्बर तक की अनुसंधान परिणाम सम्मिलित है। इसके साथ वित्तीय वर्ष 1997-98 की जानकारी भी इस प्रतिवेदन में सम्मिलित है (भा.कृ.अनु.प. के पत्र सं. 19-2/97-टी सी, दिनांक 1-8-1997 के अनुसार)

इसमें आठ परियोजना केन्द्र एवं एक उपकेन्द्र हैं। चार केन्द्र भारत के पूर्वतटपर, बापटला (आन्ध्र प्रदेश), भुवनेश्वर (उड़ीसा), झारग्राम (प. बंगाल), और विर्द्याचलम (तमिलनाडु) दो केन्द्र और एक उपकेन्द्र पश्चिमी तट मडक्कतरा और पिलिकोड़ उपकेन्द्र (केरल), वेंगुर्ला और मैदानी भाग में एक-एक केन्द्र चिंतामणी (कर्नाटक) और जगदलपुर (म.प्र.) में स्थित है जहाँ अनुसंधान कार्य चल रहा है।

बारह अनुसंधान परियोजनाएँ विषय प्रजनन (3) सस्य विज्ञान (4), बागवानी (1) और कीटविज्ञान (4) विभाग के है। इस प्रतिवेदन में हर केन्द्र द्वारा भेजे गए परिणामों को क्षेत्रीय स्तर पर और विषयानुसार समेकित कर प्रस्तुत किया गया है।

इस प्रतिवेदन के दो अध्याय है, वे है:

1. तकनीकी - इसमें परियोजनानुसार प्रायोगिक परिणाम विभिन्न केन्द्रों से क्षेत्रीय आधार पर

और

2. संगठन - इसमें इतिहास, कर्मचारी वर्ग/स्टाफ, बजट विवरण, कार्यकारिणी, मौसम विज्ञान संबंधि आँकडे और शोध प्रकाशन है।

ई वी वी भास्कर राव

(ई.वी.वी. भास्कर राव)
निदेशक)

पुत्तूर - 574202
दिनांक 31-3-1998

ABOUT THIS REPORT

This is the fourteenth Annual Report of the All India Coordinated Research Project on cashew. This report covers the research results for the calendar year January to December 1997 with all other information pertaining to the financial year 1997-98 (as per the ICAR letter No. 19-2/97-TC of ADG (TC) dated 1st August 1997).

There are eight project centres and one sub centre, four on the east coast of India, Bapatla (Andhra Pradesh); Bhubaneswar (Orissa); Jhargram (West Bengal) and Vridhachalam (Tamilnadu), two centres and one sub centre on the west coast, Madakkathara and Pilicode (Sub centre) (Kerala); Vengurla (Maharashtra) and one each in maidan parts, Chintamani (Karnataka) and Jagdalpur (Madhya Pradesh) which are implementing the research programmes.

There are twelve research projects pertaining to Breeding (3), Agronomy (4), Horticulture (1) and Entomology (4) disciplines. The results reported by each centre are compiled regionwise and discipline wise and presented in this report.

This report consists of two chapters, they are:

1. Technical : Consisting of projectwise and regionwise experimental results from different centres

and

2. Organisation : Consisting of history, staff, budgetary provisions, functioning, meteorological data and research publications.

EVV Bhaskara Rao

Puttur 574 202
Dated: 31-03-1998

(EVV BHASKARA RAO)
DIRECTOR

CONTENTS

CHAPTER I : TECHNICAL

समन्वयकर्ता का रिपोर्ट

अखिल भारतीय समन्वित मसाले व काजू अनुसंधान परियोजना (अ.भा.सम.व.काअप) 1971 में चौथे पंचवर्षीय योजना में शुरू की गई जिसमें परियोजना समन्वयकर्ता कक्ष केंद्रीय रोपण फसल अनुसंधान संस्थान कासरगोड़ में था ।

सातवीं पंचवर्षीय योजना में, मौजूदा परियोजना को दो स्वतंत्र परियोजनाओं - एक काजू व दूसरा मसाले मे विभक्त कर दिया गया । काजू परियोजना समवन्यकर्ता कक्ष स्वतंत्र काजू परियोजना, को तब नवनिर्मित राष्ट्रीय काजू अनुसंधान केंद्र सन् 1986 में पारित कर दिया गया ।

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना के आठ केंद्र व एक उपकेंद्र है, जिसमें चार केंद्रों को सन् 1971 में अखिल भारतीय समन्वित मसाले व काजू अनुसंधान परियोजना के शुरुवात में (वापट्ला) एन जी रंगा ए.यू पहले ए.पी.ए.यू.), मड़क्कतरा (अनाकायम् से पारित) (के.ए.यू) वेंगुर्ला (के.के.वी) और विर्धाचलम् (टी.एन.ए.यू) में प्रारंभ किया । पाँचवी पंचवर्षीय योजना में एक केंद्र भूवनेश्वर (ओ.यु.ए.टी) और छठवी योजना में दो केंद्रों एक झारग्राम (बी.सी.के.वी. - और चिंतामणी (यू.ए.स) को जोडा । आठवीं योजना में एक केंद्र जगदलपुर (आई.जी.ए.यू) और एक उपकेंद्र पिलिकोड़ (के.ए.यू) में शुरु किया गया ।

परियोजना का 1997-98 में बजट नियतन रु. 40.00 लाख (रु. 30 लाख भा.कृ.अनु.प. भाग) और व्यय रु. 49.32 लाख (रु. 36.99 लाख भा.कृ.अनु.प. भाग) था ।

इस परियोजना के लक्ष्य हैं इनसे काजू की उत्पादन एवं उत्पादकता को बढ़ाना :

1. उच्च उपज वाली किस्में जिसके निर्यात स्तर के कर्नल नाश्क जीव व रोग सहिष्णु हो, विकसित करना ।
2. विभिन्न कृषिजलवायवी स्थितियों में काजू की फसल के लिए कृषि प्रौद्योगिकी का मानकीकरण ।
3. लागत प्रभावी एवं जीव प्रबंध दक्षरोग और पद्धति का विकास ।

फसल सुधार

कुल 1032 काजू जननद्रव्य का (बापटला 126, भुवनेश्वर 87, चिंतामणी 120, जगदलपुर 10, झारग्राम 113, मडक्कतरा 127, पिलिक्कोड 33, वेंगुर्ला 161 और विर्धाचलम 255) विभिन्न केन्द्रों में रखरखाव व मूल्यांकन किया जा रहा है । इस वर्ष के दौरान कुल 46 नई इच्छुक गुणों वाले जननद्रव्य का संग्रह विभिन्न केन्द्रों में (बापटला 9, भुवनेश्वर 9, चिंतामणी 14, झारग्राम 3, पिलिकोड 3, वेंगुर्ला 5 और विर्धाचलम 3) किया गया । अंततः कुल संग्रह अब विभिन्न केन्द्रों में 1078 हो गया है ।

चिंतामणी केन्द्र के तुलनात्मक उपज अभिप्रयोग में उच्चतम संचयी उपज 48.6 कि./पेड़ आँठवी कटाई में उपज वेंगुर्ला 5 में पायी गई, और बापटला 6 संचयी उपज 40.6 कि./पेड़ पायी गई बहुक्षेत्रीय अभिप्रयोग में विभिन्न केन्द्रों में विकसित किस्मों की जाँच की जा रही है । बहुक्षेत्रीय अभिप्रयोग - 1986 में उपज में वेंगुर्ला-3 और वेंगुर्ला-5 क्रमशः प्रथम (6.9 कि./पेड़) और द्वितीय (6.7 कि./पेड़) भिन्न क्षेत्रों में औसतन उपज के आधार पर पाए गये । मडक्कतरा

केन्द्र में उपज का स्तर और अधिक था। यहाँ वेंगुर्ला-3 में 15.7 कि./पेड़ उपज दर्ज की गई और एच-600 में उपज 13.1 कि./पेड़ रही। भुवनेश्वर केन्द्र में एच-1608 में उपज 9.7 कि./पेड़ रही और एच 2-16 में 8.8 कि./पेड़ रही। झारग्राम केन्द्र में अधिक उपज वी.टी.एच. 59/2 (7.9 कि.ग्राम/पेड़), एच 2/16 (6.1 कि/पेड़) और वी.टी.एच 30/4 (5.9 कि./पेड़) में पाई गई। मडक्कतरा में अधिक संचयी उपज (सातवी कटाई) एच-1598 (68.2 कि./पेड़) और एम 26/2 (67.2 कि./पेड़) पाई गई, भुवनेश्वर में छँटवी कटाई में अधिक संचयी उपज वी पी पी 8 में दर्ज की गई। बहुक्षेत्रीय अभिप्रयोग 1992 में उच्चतम उपज दुसरी कटाई में एच-255 (3.7 कि./पेड़) भुवनेश्वर में और चिंतामणी में एम 44/3 में (3.1 कि./पेड़) तिसरी कटाई में पाई गई। चिंतामणी में एम 44/3 (4.4 कि./पेड़ तिसरी कटाई) के तुलना में हायब्रिड 320 में अधिक संचयी उपज (7.1 कि./पेड़) दर्ज की गई। एफ 1 संकरों के जाँच में बापटलाके दो संकरों - 3/13 (56x40) और 4/1 (1x40) में 14.0 और 12.8 कि./पेड़ क्रमशः दर्ज की गई विर्धाचलम में हायब्रिड 13 (एम 26/2 एम 26/1) में उच्चतम संचयी उपज 27.3 कि./पेड़ आँठवी कटाई में पाई गई।

फसल प्रबंध

क. सस्यविज्ञान

एन.पी.के. अभिप्रयोग में 1000 ग्राम नायट्रोजन, 250 ग्राम फॉस्फोरस और 250 ग्राम पोटाशियम प्रति वृक्ष प्रति वर्ष देने से उपज में वृद्धी की दर्ज भुवनेश्वर और चिंतामणी में की गई। नायट्रोजन के उच्चतम मात्रा (1000 ग्राम/पेड़) देने से पेड़ के ऊँचाई और फैलाव में वृद्धी पाई गई।

झारग्राम में अंतराल अभिप्रयोग में दसवी कटाई में उच्चतम संचयी उपज (7775 कि./हे.) 5x5 मी. अंतराल के प्लॉट में दर्ज की गई। त्रिकोण पद्धती (6x6x6 मी.) में लगे पेड़ों में दसवीं कटाई में 7573 कि./हे. पाई गयी। न्यूनतम उपज 10x10 मी. अंतराल में पाई गई। वेंगुर्ला में उच्चतम उपज 5x5 मी. अंतराल में पाई गई।

अंतराल फसल के अभिप्रयोग में भुवनेश्वर में काजू और उरद के मिश्रण अधिक लाभकारी (रु. 14335/हे.) सिद्ध हुई। विर्धाचलम में मूंगफल्ली एक उत्तम अंतराल फसल (620 कि./हे.) सिद्ध हुई।

ख. बागवानी

मूल जड़ में बौनो बनने के गुणों के आवरण शोध पूर्वी व पश्चिमी तट के 4 केन्द्रों में किए जा रहे है। बापटला में 6 और भुवनेश्वर में 1 इस गुण के लिए पहचाना गया है।

फसल सुरक्षा

टी मच्छर के प्रभावी बचाव चिंतामणी, जगदलपुर और झारग्राम केन्द्रों में मोनोक्रोटोफास (0.05%) एन्डोसल्फान (0.05%) और कार्बरिल (0.01%) के छिडकाव फ्लशिंग, पुष्पन और फसल अवधि में क्रमशः करने से पाए गये। पिछले वर्ष की तरह इस वर्ष भी झारग्राम केन्द्र में तीसरे स्प्रे के स्किप करने से टी मच्छर से बचाया जा सका जो आर्थिक दृष्टि से भी लाभकारी पाया गया। कांड व जड छेदक पर अति उत्तम निरोधोपचार नीमतेल (5%) पेड़ के तने पर एक मीटर ऊँचाई तक मलने से और सेविडोल 8 जी (75 ग्राम/पेड़), बापटला, मडक्कतरा और वेंगुर्ला में पाया गया। झारग्राम और

विर्धाचलम में कार्बरिल (2%) मलने से और सेविडोल 8 जी के उपयोग से उत्तम परिणाम मिले । भुवनेश्वर में मिट्टी के घोल में कार्बरिल (2%) मिलाकर पेड़ के तने पर मलने से उत्तम परिणाम मिले ।

लीफ और ब्लासम वेब्बर के सात प्राकृतिक शत्रुओं को विविध केन्द्रों में सर्वेक्षण के दौरान पहचाना गया । टी मच्छर के प्राकृतिक शत्रुओं के समूह के बारे में भी जानकारी मिली है ।

हानिकारक मुख्य कीटों से न्यूनतम ग्रहणशिलता दिखानेवाले जननद्रव्य प्ररोहों को पहचानने का प्रयत्न जारी है । भुवनेश्वर एच 1610 और ओ.सी. - 27 में शूट टिप कॅटर पिल्लर से न्यूनतम उत्पीडन दर्ज की गयी । मडक्कतरा में टी मच्छर से न्यूनतम ग्रहणशिलता व्यक्त करने वाले सात एक्सेशन (एम ए डी 1, ए-26-2, एच 8-1, एच 8-8, एच 718, एच 3-17 और टी 856) को पहचाना गया ।

इस वर्ष 3.6 लाख से अधिक कलमों का विविध समन्वित केन्द्रों द्वारा उत्पादन हुआ है ।

COORDINATOR'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 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 on Cashew, was shifted to the newly established National Research Centre for Cashew, Puttur in 1986.

The All India Coordinated Research Project on Cashew has presently eight centres and one sub centre of which four were started at the inception of AICS and CIP in the year 1971 [Bapatla (A NG Ranga Agril.Univ. the then APAU); Madakkathara (shifted from Anakkayam) (KAU); Vengurla (KKV) and Vridhachalam (TNAU)]. During V Plan period one centre at Bhubaneswar (OUAT) and in VI Plan, two centres at Jhargram (BCKV) and Chintamani (UAS) were added. During VIII Plan one centre at Jagdalpur (IGAU) and a sub-centre at Pilicode (KAU) were started. These centres of AICRP on Cashew are located in eight cashew growing states of the country and are under the administrative control of the State Agricultural University of the state.

The budget allocation of the Project for the year 1997-98 was Rs.40.00 lakhs (Rs.30.00 lakhs ICAR share) and the expenditure was Rs.49.32 lakhs (Rs.36.99 lakhs ICAR share).

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

1. Evolving high yielding varieties with export grade kernels, tolerant/resistant to pests and diseases.
2. Standardizing agrotechniques for the cashew crop under different agroclimatic conditions.
3. Evolving cost effective and efficient pest and disease management practices.

CROP IMPROVEMENT

A total of 1032 cashew germplasm accessions (Bapatla 126; Bhubaneswar 87; Chintamani 120, Jagdalpur 10; Jhargram 113; Madakkathara 127, Pilicode 33; Vengurla 161 and Vridhachlam 255) are being maintained and evaluated in different centres. During the year, a total of 46 new collections showing promising characters were added to the germplasm at different centres (Bapatla 9; Bhubaneswar 9; Chintamani 14; Jhargram 3; Pilicode 3; Vengurla 5 and Vridhachalam 3). Thus, the total collection increased to 1078 in different centres.

In comparative yield trial at Chintamani centre, highest cumulative yield of 48.6 kg/tree for 8 harvests was recorded in Vengurla-5 followed by Bapatla-6 with a cumulative yield of 40.6 kg/tree and Vengurla-3 (34.1 kg/tree). In Multilocation trials (MLT), varieties collected from different centres are being evaluated. In MLT-86 trial for nut yield, Vengurla-3 and Vengurla-5 performed well with mean yield of 6.9 and 6.7 kg/tree respectively during the year under report. At Madakkathara centre yield levels were much higher. The highest yield of 15.7 kg/tree was recorded in Vengurla-3 followed by H 1600 (13.1 kg/tree) at Madakkathara centre. At Bhubaneswar centre, H 1608 had yield of 9.7 kg/

tree which was immediately followed by H 2/16 (8.8 kg/tree). At Jhargram centre, VTH 59/2 was the highest yielder with 7.9 kg/tree followed by H 2/16 (6.1 kg/tree) and VTH 30/4 (5.9 kg/tree). Highest cumulative yield for 7 harvests (68.2 kg/tree) was recorded in H 1598 followed by M 26/2 (67.2 kg/tree) and VRI-2 (64.2 kg/tree) at Madakkathara centre. The highest cumulative yield of 36.5 kg/tree for six harvests was exhibited by H 2/16 (BPP 8) at Bhubaneswar centre. In MLT-92 trial, highest nut yield was recorded in H 255 at Bhubaneswar centre (3.7 kg/tree) in second harvest and M 44/3 (VRI-2) at Chintamani centre (3.1 kg/tree) in third harvest. Hybrid 320 had the highest cumulative yield (7.1 kg/tree) for three harvests as against 4.4 kg/tree for M 44/3 (VRI-2) at Chintamani centre.

In evaluation of F1 hybrids, two hybrids from Bapatla viz., 3/13 (56 x 40) and 4/1 (1 x 40) gave a yield of 14.0 kg and 12.8 kg per tree respectively. At Vridhachalam, Hybrid 13 (M 26/2 x M 26/1) gave the highest cumulative yield of 27.3 kg/tree for eight years.

CROP MANAGEMENT

A. AGRONOMY

In NPK trial, application of highest dose of N, P_2O_5 and K_2O (1000g : 250g : 250g / plant) increased yield significantly over control (N0P0K0) at Bhubaneswar and Chintamani centres. Application of highest dose of N (1000 g/plant) increased the height, girth and spread significantly.

In spacing trial, highest cumulative yield for ten harvests was obtained in plots with 5m x 5m spacing with no thinning (486 kg/block or 7775 kg/ha) which was followed by 6m x 6m x 6m triangular method of planting (473 kg/block or 7573 kg/ha) at Jhargram centre. Minimum yield was recorded in 10m x 10m square method of planting. At Vengurla centre, the yield was maximum in 5m x 5m spacing plot with no thinning.

In intercropping trial at Bhubaneswar centre, the cropping system of cashew and blackgram fetched maximum return of Rs. 14335 (355 kg cashew and 280 kg blackgram/ha). At Vridhachalam centre, groundnut as intercrop yielded 620 kg/ha which was better than blackgram as intercrop in cashew plantation.

B. HORTICULTURE

Screening of rootstock for dwarfing characters is being pursued at four centres in east coast and west coast. A total of six trees were identified as dwarf trees at Bapatla, one tree as semi-dwarf at Bhubaneswar centre.

CROP PROTECTION

Spraying of monocrotophos (0.05 %) at flushing, endosulfan (0.05 %) at flowering and carbaryl (0.1 %) at fruiting stages (T-5) was found effective in controlling tea mosquito bug and also increasing yield at Chintamani, Jagdalpur and Jhargram centres. Skipping third spray (at fruiting stage) was found economical in the control of tea mosquito bug during this year also as observed in the previous year at Jhargram centre. The most effective prophylactic control measure against stem and root borer was swabbing of neem oil (5 %) upto 1 m height + application of Sevidol 8 G @ 75 g/tree to the basin at three centres, viz., Bapatla, Madakkathara and Vengurla. Swabbing with carbaryl (0.2 %) and application of sevidol 8 G to the basin at Jhargram and Vridhachalam and swabbing of carbaryl (0.2 %) in mudslurry at Bhubaneswar centre were also found to act as good prophylactic control against the pest.

Seven natural enemies were recorded on

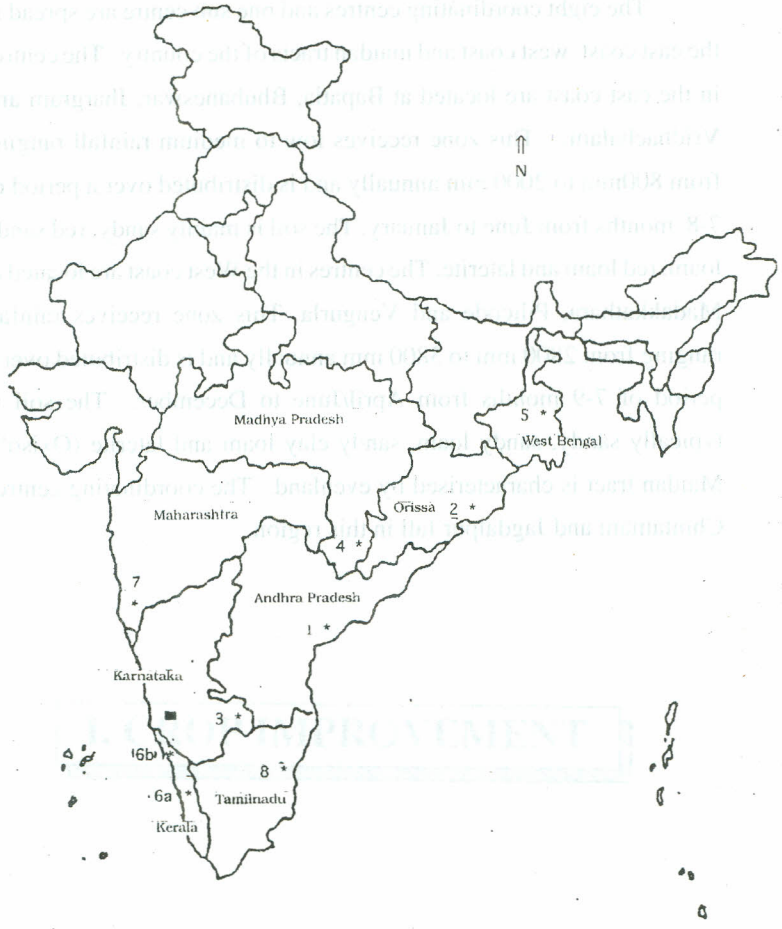
leaf and blossom webber (*Lamida moncusalis*) in different centres. The TMB had a natural enemy complex comprising of reduviid bugs, spiders and preying mantids which prevailed during the cropping season in low numbers in the plains.

Screening of germplasm to locate to lerant/resistant types to major pests of the region was carried out. At Bhubaneswar H 1610 and OC-27 showed the least infestation to shoot tip caterpillar. Seven accessions MAD-1, A-26-2, H-8-1, H-8-8, H-718, H-3-17 and T-856 at Madakkathara were found to be comparatively less susceptible to tea mosquito infestation on shoot and panicles.

Over 3.60 lakh grafts of released varieties were produced by different coordinating centres during 1997-98.

EXPERIMENTAL RESULTS

CENTRES OF
ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW



■ NATIONAL RESEARCH CENTRE FOR CASHEW, PUTTUR 574 202 - HEADQUARTERS OF AICRP ON CASHEW.

1. CASHEW RESEARCH STATION, (ANG RANGA A.U.), BAPATLA 522 101, ANDHRA PRADESH.
2. CASHEW RESEARCH STATION, (OUAT), BHUBANESWAR 751 003, ORISSA.
3. AGRICULTURAL RESEARCH STATION, (UAS), CHINTAMANI 563 125, KARNATAKA.
4. ZONAL AGRICULTURAL RESEARCH STATION, (IGAU), JAGDALPUR 494 005, MADHYA PRADESH.
5. REGIONAL RESEARCH STATION, (BCKV), JHARGRAM 721 507, WEST BENGAL.
6. (a) CASHEW RESEARCH STATION, (KAU), MADAKKATHARA 680 656, KERALA.
   (b) REGIONAL AGRICULTURAL RESEARCH STATION, (KAU), PILICODE 671 353, KERALA.
7. REGIONAL FRUIT RESEARCH STATION, (KKV), VENGURLA 416 516, MAHARASHTRA.
8. REGIONAL RESEARCH STATION, (TNAU), VRIDHACHALAM 606 001, TAMILNADU.

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 maidan tracts of the country. The centres in the east coast are located at Bapatla, Bhubaneswar, Jhargram and Vridhachalam. This zone receives low to medium rainfall ranging from 800mm 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. 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). Maidan tract is characterised by evenland. The coordinating centres Chintamani and Jagdalpur fall in this region.

I. CROP IMPROVEMENT

Project Title : Gen.I : Germplasm collection, maintenance and description of types.

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram, Vridhachalam
West Coast : Madakkathara, Pilicode, Vengurla
Maidan tract/ others : Chintamani, Jagdalpur

Objectives:

The objectives of the project are:

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

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

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

1. Germplasm collection and conservation:

A total of 1032 accessions have been conserved and are being maintained in different centres (Table 1.1). During the year 1997, a total of 46 collections were made by different centres, of which 28 have already been planted (Table 1.1). The details of source of collection, number of collections and salient features of collections are presented in Table 1.2.

Table 1.1: Cashew germplasm holding in different centres.

Centre	No. of accessions		
	Existing	Collected during 1997	Total
East Coast			
Bapatla	126	9	135
Bhubaneswar	87	9 *	96
Jhargram	113	3 *	116
Vridhachalam	255	3 *	258
West coast			
Madakkathara	127	-	127
Pilicode	33	3 *	36
Vengurla	161	5	166
Maidan tract/ others			
Chintamani	120	14	134
Jagdalpur	10	-	10
Total	**1032**	**46**	**1078**

* Clones to be planted.

Table 1.2: Cashew germplasm collected during 1997 by different centres.

Centre	Source of collection	No. of collections	Salient features
Bapatla	Cheepurugudem/ Aswaraopeta	7	Cluster bearing with medium sized nuts
	Satyavedu/ Kavali	2	High yielding with bold sized nuts
Bhubaneswar	Bahadajhola/ Bhubaneswar/ Khurdha/ Khalikote	9 *	High yielding, cluster bearing with medium - bold sized nuts.
Jhargram	Purnapani/ Pukuria	3 *	High yielding, cluster bearing, (20-30 fruits/panicle) with small medium sized nuts.
Vridhachalam	Pattanur/ Edayanchavadi	3 *	High yielding, with bold sized nuts. Accession PA-2 gives the crop twice in a year (April/May and Oct/Nov.)
Pilicode	Cheemeni	3 *	Early season flowering and cluster bearing types with small-medium sized nuts. Poor shelling percentage (16.2-26.1%).
Vengurla	Ullal	5	Released cashew varieties
Chintamani	Shidlaghatta/ Srinivasapura	14	High yielding with medium - bold sized nuts (9-15g)
	Total	**46**	

* To be planted in conservation block.

2. Germplasm evaluation:

Evaluation of cashew germplasm at different centres has been carried out during the year 1997. Promising accessions in different centres are presented in Tables 1.3-1.8.

At Bhubaneswar, of the 84 accessions evaluated, eight accessions were promising (Table 1.3). The cumulative yield of three harvests ranged from 3.06-4.08 kg/plant and the nut size was small (4.7 - 6.8g).

Table 1.3: Promising accessions of cashew germplasm at Bhubaneswar during 1997.

Accession number	Year of planting	Cumulative yield/ plant (kg) (3 harvests)	Yield/plant(kg) in 1997
03	1990	3.25	1.62
06	1990	3.93	1.31
07	1990	3.86	0.96
31	1990	3.71	1.23
43	1990	3.95	0.99
44	1990	3.25	1.08
45	1990	3.06	0.76
51	1990	4.08	1.36

At Jhargram centre, six accessions were found to be promising (Table 1.4). The cumulative yield of nine harvests ranged from 63.75 - 89.47 kg/plant, weight/nut ranged from 4.5 - 6.4g and shelling percentage ranged from 28.8 - 33.3.

Table 1.4: Promising accessions of cashew germplasm at Jhargram during 1997.

Accession number	Year of planting	Cumulative yield/plant (kg) (9 harvests)	Yield/ plant (kg) (1997)	Wt./Nut (g)	Shelling percentage
JGM 16/1	1983	65.12	11.85	5.2	33.3
JGM 66/7	1983	80.09	15.56	4.5	32.5
JGM 71/5	1983	89.47	09.26	5.0	28.8
JGM 74/6	1983	75.22	15.85	6.4	29.4
JGM 19/1	1984	63.75	10.25	5.1	30.4
JGM 80/2	1984	75.49	15.12	4.9	33.1

At Vridhachalam centre, of the 130 accessions evaluated, ten accessions were promising (Table 1.5). The cumulative yield of five harvests ranged from 5.90 - 11.8 kg/plant, weight/nut ranged from 6.1 - 8.1 g and shelling percentage ranged from 26.5 - 30.1.

Table 1.5: Promising accessions of cashew germplasm at Vridhachalam during 1997.

Accession number	Year of planting	Cumulative yield/plant (kg) (5 harvests)	Yield/ plant (kg) 1997	Weight/ nut(g)	Shelling percentage
M 1/3	1989	06.60	2.30	7.3	30.1
M 3/2	1989	06.70	3.30	6.1	29.5
M 4/3	1989	05.90	2.50	7.8	26.5
M 10/4	1989	07.00	2.70	6.1	28.0
M 15/4	1989	06.90	3.90	7.7	28.5
M 18/4	1989	05.90	2.20	7.8	27.5
M 26/2	1989	08.40	3.70	8.0	30.2
M 26/4	1989	07.90	2.80	6.9	28.7
M 33/3	1989	11.80	3.40	8.1	28.0
M 44/3	1989	09.80	3.00	6.9	28.0

At Madakkathara centre, six accessions which were planted during 1988-89 were found to be promising (Table 1.6). The cumulative yield of two harvests ranged from 4.30-5.30 kg/plant and weight/nut ranged from 4.8-8.2g in these accessions.

Table 1.6: Promising accessions of cashew germplasm at Madakkathara during 1997.

Accession number	Year of planting	Cumulative yield/plant (kg) (2 harvests)	Yield/ plant (kg) in 1997	Weight/ nut(g)
25 (Vapala)	1988	5.30	2.60	8.0
26 (Anakkayam-1)	1988	5.30	2.80	4.8
27 (BLA 39-4)	1988	5.00	2.50	6.4
64 (K 4-2)	1989	4.30	2.10	-
73 (H-7-6)	1989	5.50	2.80	7.2
80 (H-8-10)	1989	2.40	0.30	8.2

At Vengurla centre, of the 80 accessions evaluated, seven accessions were promising (Table 1.7). The cumulative yield of nine harvests ranged from 65.15-89.78 kg/plant, weight/nut ranged from 5.2-6.8g and shelling percentage ranged from 21.0 - 30.7.

Table 1.7: Promising accessions of cashew germplasm at Vengurla during 1997.

Accession number	Year of planting	Cumulative yield/plant (kg) (9 harvests)	Yield/ plant (kg) in 1997	Weight/ nut(g)	Shelling percentage
80/2/4 (M 6-1)	1977	66.91	08.95	5.2	27.2
83/5/3 (T.No.1)	1977	82.06	18.25	6.1	27.6
89/12/3 (BLA 256)	1977	89.78	15.95	5.3	30.7
94/17/5 (ST 94)	1977	83.36	3.75	7.1	23.0
98/12/4 (Seed farm collection No.4)	1977	78.55	2.20	6.3	21.0
124/15/3 (Seed farm collection No.21)	1979	65.15	10.80	6.8	29.5
126/17/2 (Seed farm collection No.23)	1980	73.19	11.25	6.0	28.5

At Chintamani centre, of the 72 accessions evaluated, five accessions were promising (Table 1.8). The cumulative yield of 9-13 harvests ranged from 52.40-113.25 kg/plant, weight/nut ranged from 4.2 -7.0g and shelling percentage ranged from 28.0-31.0.

Table 1.8: Promising accessions of cashew germplasm at Chintamani during 1997.

Accession number	Year of planting	Cumulative yield/plant (kg)	Yield/ plant in 1997 (kg)	Weight/ nut(g)	Shelling percentage
2/6 ARSC (3/108 Gubbi)	1982	113.25 (13 Harv.)	10.25	4.2	28.0
7/8 ARSC (2/77 Tuni)	1982	76.85 (13 Harv.)	5.40	6.4	30.2
35/1 ARSC (M E 4/4)	1984	71.33 (11 Harv.)	5.80	6.9	31.0
41/3 ARSC (5/37 Manjari)	1985	106.09 (10 Harv.)	9.40	7.0	29.5
44/8 ARSC (H-19)	1986	52.40 (9 Harv.)	5.20	6.5	29.0

At Bapatla cenrtre, 60 accessions of seedling origin were clonally multiplied and planted in the old garden. At Pilicode and Jagdalpur centres, the germplasm collections which were planted during 1995-96 are being maintained.

Project Title : Gen.3 : Varietal evaluation

Three varietal trials are under evaluation at five different centres.

Expt.1 : Comparative yield trials

Centre : Chintamani

Objective:

To evaluate the performance of varieties of Bapatla and Vengurla.

Design	:	RBD
Replication	:	Three
Varieties	:	No. of entries : 10
Bapatla entries	:	Bapatla-1, Bapatla-3, Bapatla-4, Bapatla-5, Bapatla-6.
Vengurla entries	:	Vengurla-1, Vengurla-2, Vengurla-3, Vengurla-4, Vengurla-5.
Year of planting	:	1986

The performance of the varieties for different characters is presented in Table 1.9.

Nut weight:

Significant differences in nut size was observed. Varieties Vengurla-3 and Vengurla-4 had nut weight of over 6.0 g.

Yield:

Significant differences in yield were observed among the varieties. The highest yield of 3.8 kg/tree was recorded in Vengurla-4 which was followed by Vengurla-2 and Vengurla-5 (2.4 kg/tree each) in eighth harvest. Lower yields were recorded during the current year due to uneven flushing and flowering and high incidence of tea mosquito bug. The highest cumulative yield of 48.6 kg/tree was recorded in Vengurla-5 for eight harvests, followed by Bapatla-6 (40.6kg/tree), Vengurla-3 (34.1 kg/tree) and Vengurla-2(33.2 kg/tree). Shelling percentage was highest in V-3 (30%).

Table 1.9: Performance of different varieties for growth characteristics, yield, nut characters at Chintamani centre in comparative yield trial during 1997-98.

Variety	Canopy shape	Flowering period	Nut yield (Kg/tree) (8th harvest)	Cumulative Yield for (8 th harvest) (kg/tree)	Nut wt. (g)	Shelling %
Vengurla-1	Compact	Medium	1.4	27.6	5.1	28.5
Vengurla-2	Medium	Long	2.4	33.2	4.8	28.0
Vengurla-3	Sparse	Medium	2.2	34.1	6.2	30.0
Vengurla-4	Sparse	Medium	3.8	21.7	6.3	29.5
Vengurla-5	Compact	Medium	2.4	48.6	4.8	28.0
Bapatla-1	Compact	Medium	1.2	21.3	4.8	29.0
Bapatla-3	Medium	Medium	1.7	24.2	4.6	28.5
Bapatla-4	Medium	Long	1.3	26.4	5.1	28.0
Bapatla-5	Compact	Medium	1.6	30.3	5.1	28.0
Bapatla-6	Compact	Medium	2.0	40.6	5.3	29.0
CD 5%			**1.46**			
CV(%)			**42.05**			

Expt.2 : **Multilocation Trial-86 with varieties from Vittal, Vridhachalam, Vengurla, Bapatla and Madakkathara (MLT 86).**

Centres:

East Coast	:	Bhubaneswar, Jhargram
West Coast	:	Madakkathara, Vengurla
Maidan tract	:	Chintamani

Objective:

To evaluate the performance of high yielding varieties in different locations.

Design	:	RBD
Replication	:	Three
Varieties	:	No. of entries : 16 + 3
Bapatla entries	:	T.No.40, T.No.129, H 2/15, H 2/16
Vengurla entries	:	V-2, V-3, V-4, V-5 (H-24), M 44/3 (VRI-2)
Vridhachalam entries	:	M 26/2, M 33/3, M 44/3 (VRI-2)
Vittal entries	:	VTH 30/4, VTH 59/2, M 44/3 (VRI-2)
Madakkathara entries	:	H 1598 (Kanaka), H 1600, H 1608 (Dhana), H 1610
Year of planting	:	1986

This trial was conducted in two centres each of east coast and west coast and one centre under maidan tract. At Vridhachalam centre, this trial has been discontinued as number of trees available in some entries is very less.

Nut weight:

At Madakkathara the highest nut weight of 10g was recorded in H 2/16 (Table 1.10) which was followed by H-1610 (9.3 g).

Vengurla-7 had nut weight of 9g at Vengurla while it had 6.9g at Chintamani. The expression of nut weight character at Chintamani was relatively less. At Bhubaneswar H 2/15 and VTH 30/4 showed nut weight of 8.8g and 8.7 g. respectively.

Table 1.10: Performance of different varieties for nut weight(g) in multilocation trial (MLT-86) in different centres during 1997-98.

Varieties	Bhubaneswar	Chintamani	Madakkathara	Vengurla
Vengurla-2	5.1	3.9	7.4	4.3
Vengurla-3	7.7	6.9	7.8	9.0
Vengurla-4	7.4	6.2	8.9	7.7
Vengurla-5(H 24)	-	3.8	4.5	4.3
T.No.40	5.0	5.2	6.2	6.5
T.No.129	4.4	4.3	6.0	7.3
H 2/15	8.8	5.7	8.8	7.1
H 2/16	8.2	5.4	10.0	7.1
H 1598	5.5	6.4	6.7	5.7
H 1600	7.1	5.7	6.8	6.7
H 1608	8.0	5.3	9.1	7.8
H 1610	8.1	6.3	9.3	7.9
VTH 30/4	8.7	4.3	6.1	5.7
VTH 59/2	6.0	6.2	8.6	7.0
M 26/2	4.7	-	8.2	-
M 33/3	-	-	8.9	-
Anakkayam-1	-	-	6.6	-
M 44/3(VRI)	5.1	4.2	3.8	5.0
M 44/3(Vittal)	5.0	5.0	-	-
M 44/3(Vengurla)	-	4.5	-	-
CD 5%		**1.21**		
CV %		**13.85**		

Nut yield:

Nut yield of the different varieties at five centres along with mean is presented in Table 1.11. The highest yield of 15.7 kg/tree was recorded in Vengurla-3 followed by H 1600 (13.1 kg/tree) at Madakkathara. At Bhubaneswar centre H 1608 gave a yield of 9.7 kg/tree which was followed by H 2/16 (8.8 kg/tree). At Jhargram centre, VTH 59/2 was the highest yielder with 7.9 kg/tree

followed by H 2/16 (6.1 kg/tree) and VTH 30/4 (5.9 kg/tree). Performance of varieties for yield in general was poor at Vengurla and Chintamani centres during the year under report. In overall mean yield, based on the performance over locations, Vengurla-3 and Vengurla-5 performed well with mean yield of 6.9 and 6.7 kg/tree respectively during the year under report.

Table 1.11: Performance of different varieties for yield/plant (kg/tree) in multilocation trial (MLT-86) in different centres during 1997-98.

Varieties	Bhubaneswar	Chintamani	Jhargram	Madakkathara	Vengurla	Mean
Vengurla-2	6.4	0.6	-	2.6	3.4	3.3
Vengurla-3	4.6	2.6	-	15.7	4.7	6.93
Vengurla-4	6.3	3.6	-	10.2	4.3	6.1
Vengurla-5(H 24)	-	3.0	-	10.6	6.6	6.7
T.No.40	6.9	1.4	5.1	5.7	2.4	4.3
T.No.129	0.9	2.8	4.9	6.3	3.1	3.6
H 2/15	5.3	2.2	5.6	7.3	4.6	5.0
H 2/16	8.8	1.8	6.1	6.2	3.4	5.3
H 1598	6.5	3.4	4.7	11.9	4.5	6.2
H 1600	5.8	2.2	4.2	13.1	3.1	5.7
H 1608	9.7	2.0	3.5	11.9	4.3	6.3
H 1610	3.0	2.0	4.2	8.0	4.3	4.3
VTH 30/4	4.2	2.8	5.9	9.0	3.3	5.0
VTH 59/2	3.6	0.7	7.9	6.9	2.2	4.3
M 26/2	4.9	-	4.2	10.5	-	6.5
M 33/3	-	-	5.4	8.2	-	6.8
Anakkayam-1	-	-		7.4	-	7.4
M 44/3(VRI)	2.4	2.5	3.8	9.3	2.6	4.1
M 44/3(Vittal)	2.2	1.6	-	-	-	1.9
M 44/3 (Vengurla)	-	1.3	-	-	-	1.3
CD 5%	**0.42**	**1.35**	**0.14**	**4.33**	**NS**	
CV %	**1.27**	**37.78**				

Cumulative yield for seven harvests at Madakkathara centre was superior (Table 1.12). Highest cumulative yield (68.2 kg/tree) was recorded in H 1598 followed by M 26/2 (67.2 kg/tree) and M 44/3 (64.2 kg/tree) at Madakkathara. The highest cumulative yield of 36.5 kg/tree for six harvests was exhibited by H 2/16 at Bhubaneswar centre. This variety also known as BPP 8 (developed in Andhra Pradesh) has been recommended for general cultivation in Orissa. At Chintamani the national variety M 44/3 was the best yielder with cumulative yield of 39.6 kg/tree.

Table 1.12: Performance of different varieties for cumulative Yield/plant (kg/tree) in multilocation trial (MLT-86) in different centres during 1997-98.

Varieties	Bhubaneswar (for 6 harvests)	Chintamani (for 8 harvests)	Madakkathara (for 7 harvests)
Vengurla-2	18.2	18.1	26.0
Vengurla-3	15.8	24.0	51.7
Vengurla-4	20.2	25.2	43.6
Vengurla-5(H 24)	-	28.1	63.0
T.No.40	16.9	20.0	28.0
T.No.129	8.0	23.6	25.3
H 2/15	14.2	24.9	38.3
H 2/16	36.5	22.0	30.6
H 1598	18.9	26.1	68.2
H 1600	13.5	28.8	52.9
H 1608	29.0	31.3	57.1
H 1610	12.4	27.8	29.8
VTH 30/4	13.2	19.7	48.3
VTH 59/2	10.5	25.1	36.4
M 26/2	15.6	-	67.2
M 33/3	-	-	42.3
Anakkayam-1	-	-	56.0
M 44/3(VRI)	9.2	39.6	64.2
M 44/3(Vittal)	9.7	23.4	-
M 44/3(Vengurla)	-	16.3	-

The varieties identified/selected based on their yield performance (annual and cumulative) in MLT 86 trial during 1997-98 in different centres located in different agroclimatic zones are as given below:-

Region	Variety	Based on performance at centres
East coast	H 2/16	Bhubaneswar Jhargram
Location specific	H 1608	Bhubaneswar
West coast	H 1598 V-5(H 24)	Madakkathara Vengurla
Location specific	V-3 M 26/2	Madakkathara
Low rainfall area (Maidan tract)	M 44/3	Chintamani
Medium to high rainfall area	VTH 59/2 H 2/16 H 2/15	Jhargram
Very high rainfall area	H 1598 V-5(H 24)	Madakkathara Vengurla

Homogeneity Test

In order to group the varieties based on their homogeneity in nut yield and nut processing characteristics, the data on cumulative yield for seven years and the processing characteristics were subjected to cluster analysis following "K-mean cluster technique" at Madakkathara centre (through SPSS Programme). Five clusters were formed among 18 cashew varieties. With respect to the nut yield and processing characters the varieties H 1598, H 1600, VTH 30/4, VTH 59/2, V-3 and Anakkayam-1 were found to be homogenous and grouped into one cluster. Similarly other clusters are formed based on homogeneity (Table 1.13).

Table 1.13: Grouping of cashew varieties based on homogeneity in yield, nut and processing characteristics (K-mean clusters).

Character Cluster	F-Value	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Cumulative Yield	5.00 *	52.23	26.42	63.58	46.37	30.57
Nut Weight	22.49 *	7.08	6.51	4.16	8.87	10.00
Shelling %	0.69 ns	33.10	32.37	34.55	31.62	30.60
W-180(%)	88.99 *	1.48	2.77	0.00	9.17	66.15
W-210 (%)	9.34 *	10.20	9.59	0.00	42.87	15.23
W-240(%)	15.61 *	47.49	32.24	0.00	28.75	0.00
W-450(%)	21.20 *	21.52	34.50	71.87	2.23	0.80
White whole	2.41 ns	68.87	71.47	48.55	75.85	75.10
Kernel Pieces	0.21 ns	14.83	13.60	17.54	14.48	7.40
Kernel rejects	1.56 ns	0.80	4.88	4.04	0.85	0.60
Husk & Rejects	0.09 ns	9.12	9.33	10.00	9.32	9.80

* Significant (0.05) NS = Not Significant (0.05)

Cluster 1 : H-1598; H-1600; VTH-30/4; VTH-59/2; V-3; AKM-1
Cluster 2 : T-129; T-40; V-2
Cluster 3 : V-5; M-44/3
Cluster 4 : H-1608; H-1610; T-2/16; V-4; M-33/3; M-26/2
Cluster 5 : T-2/16

Expt.3 : Multilocation Trial-92 with varieties from Bapatla, Vengurla, Vridhachalam, NRC Cashew, Puttur (MLT-92).

Centres:

East Coast	:	Bapatla, Bhubaneswar, Jhargram, Vridhachalam
West Coast	:	Madakkathara, Vengurla
Maidan tract	:	Chintamani, Jagdalpur

Objective:

To evaluate the performance of new set of high yielding varieties in different locations.

Design	:	RBD
Replication	:	Three
Varieties	:	No. of entries - 13
Bapatla entries	:	3/28, 3/33, 10/19, 30/1
Vengurla entries	:	H 68, H 255, H 303, H 320, H 367
Vridhachalam entries	:	M 15/4, M 44/3
NRCC, Puttur entries	:	VTH 107/3, VTH 40/1
Year of planting	:	1992

This trial was taken up in 1992 at six centres. However in Jhargram centre, as some entries were missing, it has been decided to replant the trial. In Jagdalpur centre, the grafts of entries collected from NRCC, Puttur, Madakkathara and Bapatla centres were planted in 1996. This trial could not be planted in Vengurla centre for want of land. It has now been proposed to plant this trial in the ensuing monsoon season 1998 at Regional Fruit Research Station, Vengurla by cutting the evaluated germplasm plot.

Data on yield and yield component characters are reported from Bapatla, Bhubaneswar, Chintamani and Vridhachalam centres (Tables 1.14 and 1.15).

Nut weight:

Hybrid H 367 had nut weight of 10.0g at Bhubaneswar centre and 9.5g at Vridhachalam centre. At Bapatla 10/19 and H 68 showed the maximum nut weight of 8.4g. At Chintamani nut weight of 8.1g was exhibited by H 255 (Table 1.14).

Number of nuts/panicle:

Three centres have reported the results. M 15/4 and M 44/3 varieties produced highest number of nuts/panicle (9.9 and 9.6 respectively)at Vridhachalam centre. At Bapatla centre, highest number of nuts/panicle was in by M 15/4 (5.4). At Bhubaneswar centre the highest number of nuts per panicle was produced by H 320 (Table 1.15)

Yield:

Yield figures are available from four centres (Table 1.15). H 255 at Bhubaneswar centre (3.74 kg/tree) in second harvest and M 44/3 at Chintamani centre (3.13 kg/tree) in third harvest appeared to be promising during the year under report. Cumulative yield figures for three harvests are available for Chintamani centre. Hybrid 320 had the highest cumulatie yield (7.10 kg/tree) which was followed by H 303 (6.64 kg/tree) as against 4.37 kg/tree for M 44/3 at Chintamani centre. At Bhubaneswar also H 320 topped in cumulative yield (6.57 kg/tree) for two harvests. At Bapatla, the highest cumulative yield of 2.50 kg/tree was recorded by M 15/4 for two harvests.

Table 1.14: Performance of different varieties for average number of nuts per panicle and nut weight (g) in multilocation trial (MLT-92) in some centres during 1997-98.

Variety	No. of nuts/panicle			Nut weight (g)			
	Bapatla	Bhuba-neswar	Vridha-chalam	Bapatla	Bhuba-neswar	Chinta-mani	Vridha-chalam
3/28	2.4	4.7	4.5	7.4	6.5	5.5	6.1
3/33	2.2	4.1	5.5	6.0	5.6	5.1	6.6
10/19	3.8	3.9	3.4	8.4	5.3	5.7	5.9
30/1	3.2	3.5	3.3	5.5	6.4	4.8	5.8
H 68	1.8	6.0	5.5	8.4	8.0	7.7	5.9
H 255	2.0	3.1	6.7	7.6	8.6	8.1	8.0
H 303	1.4	5.8	5.7	8.0	6.8	6.4	8.0
H 320	2.2	6.9	3.0	8.3	7.6	7.5	7.5
H 367	2.0	3.2	2.7	7.8	10.0	7.4	9.5
VTH 107/3 (NRCC Sel-1)	2.4	3.2	3.3	6.4	7.4	7.0	6.2
VTH 40/1 (NRCC Sel-2)	2.6	3.5	5.1	5.5	8.4	7.4	9.1
M 15/4	5.4	2.4	9.9	6.0	6.6	6.0	6.9
M 44/3	2.8	4.2	9.6	4.0	5.2	4.2	5.5
Ullal-1	-	-	-	-	-	6.2	-
CD 5%		**-**	**0.578**	**3.08**	**-**	**1.80**	**0.4849**
CV (%)						**16.02**	

Table 1.15: Performance of different varieties for Yield (kg/tree) and Cumulative yield (kg/tree) in multilocation trial (MLT-92) from some centres during 1997-98

Variety	Yield (kg/tree)				Cum.yield (kg/tree)		
	Bapatla (2nd har.)	Bhubaneswar (2nd har.)	Chintamani (3rd har.)	Vridhachalam (1st har.)	Bapatla (for 2 har.)	Bhubaneswar (for 2 har.)	Chintamani (for 3 har.)
3/28	0.95	1.40	1.36	0.50	1.69	2.14	3.90
3/33	0.74	1.15	1.20	0.40	1.27	2.46	2.80
10/19	1.26	1.35	0.96	0.30	1.86	2.44	1.21
30/1	1.10	1.28	1.53	0.50	1.82	2.46	4.25
H 68	0.55	1.55	1.90	0.50	0.68	3.23	5.67
H 255	0.14	3.74	0.96	0.80	0.14	4.95	3.34
H 303	0.91	3.03	2.84	0.60	1.04	4.64	6.64
H 320	0.76	4.66	1.55	0.30	0.84	6.57	7.10
H 367	0.80	1.67	1.60	0.30	0.92	2.32	1.91
VTH 107/3 (NRCC Sel.1)	0.98	0.39	2.33	0.20	1.12	1.05	2.52
VTH 40/1 (NRCC Sel.2)	0.98	1.41	1.95	0.40	1.11	2.26	6.07
M 15/4	1.75	3.30	2.07	1.40	2.50	3.91	3.00
M 44/3	1.33	1.94	3.13	1.10	1.91	2.81	4.37
Ullal-1	-	-	1.98	-	-	-	2.31
CD 5%	**0.305**	**0.66**	**NS**	**0.116**			
CV(%)			**61.37**				

har. – harvest/s

Table 1.18. Performance of hybrids at Vengurla centre.

Hybrid No.	Cross combination	Mean yield (for 10 years) kg/tree	Highest yield (kg/tree)	Yield of 1997 (kg)	Nut wt. (g)	Shelling %
248	Vengurla-3 x M 44/3	5.9	10.4	6.9	6.2	28.0
255	V-3 x M-10/4	10.7	33.4	16.6	10.0	30.5
303	V-4 x M 10/4	6.8	12.7	7.8	8.9	27.0
304	V-4 x M 10/4	6.3	8.3	10.2	6.8	29.0
320	M 44/3 x Vetore-56	7.3	14.8	10.4	7.5	31.6
367	V-4 x M 10/4	10.5	22.5	14.1	11.5	28.0
444	M 10/4 x Vetore-56	5.5	9.3	15.0	7.5	28.5
445	V-4 x Vetore-56	6.3	12.9	13.5	7.5	28.5
453	M 10/4 x Vetore-56	5.1	8.2	9.4	8.2	28.0
454	M 10/4 x Vetore-56	7.2	11.8	8.8	8.0	28.0
509	V-4 x M 44/3	6.4	9.3	6.9	6.0	29.0

Chintamani:

During the year two cross combinations (Chintamani-1 x Gubbi-3/108, and its reciprocal) were attempted at the centre. The F1 progeniess were field planted for evaluation.

II. CROP MANAGEMENT

A. AGRONOMY

Project Title : Agr.1 : NPK fertilizer experiment.

Centres:

East coast	:	Bapatla, Bhubaneswar, Jhargram, Vridhachalam
West coast	:	Madakkathara, Vengurla
Maidan tract	:	Chintamani

Objective:

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

Experimental details:

Design	:	Three factorial confounded design with 27 treatment combinations.
Replication	:	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

East coast:

Bapatla:

Significant differences in plant height, girth, spread and yield were observed between trees receiving no nitrogen (185.4 cm, 25.5 cm, 234.0 cm and 0.320 kg/plant respectively) and trees receiving 500g N (221.4 cm, 30.8 cm, 302.4 cm and 0.690 kg/plant respectively) and 1000 g/N (221.8 cm, 31.3 cm, 303.2 cm and 0.690 kg/plant respectively). (Table 2.1).

The phosphorous and potash applications had no significant effect on growth and yield of plant over the control. However, the interaction between nitrogen and phosphorouss was significant for all the growth characters.

Table 2.1: Growth parameters in N.P.K. fertilizers experiment at Bapatla centre.

Treatments	Height (cm)	Girth (cm)	Spread (cm)
N0	185.4	25.5	234.0
N1	221.4	30.8	302.4
N2	221.8	31.3	303.2
P0	203.8	29.0	266.8
P1	214.1	29.2	288.0
P2	210.5	29.4	284.5
K0	212.5	29.7	291.2
K1	210.3	29.7	283.1
K2	205.8	28.3	265.1
S.Em ± for N. P&K	7.46	1.0	12.72
C.D for at 5%	21.70	2.93	37.20
C.D for N x P at 5%	37.60	5.00	64.40

In an observational trial, it was noticed that there was an increase in girth, canopy spread, number of flowering panicles per sq.mt. and yield/tree in the case of trees receiving highest doses of fertilizer (1500 g N, 375 g P_2O_5 and 375 g K_2O/tree-T-3) as compared to trees receiving the lowest dose of fertilizers (500 g N, 125 g P_2O_5 and 125g K_2O/tree-T1). The yield has increased from 8.7 kg to 11.0 kg and 11.6 kg per tree respectively as the fertilizer dose was increased from T1 to T2 and T3 (Table 2.2).

Table 2.2: Growth and yield parameters on observation trial with higher doses of fertilizers at Bapatla centre.

Treatments		Girth (cm)	Canopy (cm)	No. of flowering panicles/ Sq.mt.	Yield/ tree (kg)
N :	P_2O_5 : K_2O				
T1	500:125:125	126.2	11.1	22.0	8.7
T2	1000:250:250	135.5	11.6	24.5	11.0
T3	1500:375:375	128.8	11.5	25.4	11.6

Bhubaneswar:

Growth parameters:

The plant height increased significantly with application of nitrogen over control. However, there was no significant difference in plant height (3.9 m each) among trees receiving 500 and 1000g N/tree (N1, N2). The application of P_2O_5 and K_2O did not show any significant difference on plant height. The second and third order interaction effects (NP, NK, PK and NPK) were observed on trunk girth, canopy spread whereas it was not observed in the case of tree height. The girth of the tree increased significantly with increased dose of nitrogen. Maximum girth was recorded in N2 (49.5 cm) followed by N1 (46.3 cm) and minimum in trees receiving no nitrogen (41.6 cm). Application of P_2O_5 and K_2O did not have any significant effect on tree girth. Interaction effect of NP, NK, PK and NPK was not observed on girth of the tree. Application of higher dose of nitrogen (1000g N/tree/year) increased spread of the tree both in N-S and E-W directions. Maximum spread was recorded in N2 levels (5.2 and 5.07 m, N-S and E-W respectively).

Yield:

Application of N, P_2O_5 and K_2O at various levels significantly increased the yield over control. Maximum nut yield of 2.7 kg/plant was recorded in N2 and was found significantly superior to N1 and control (Table 2.3). Application of P_2O_5 increased the yield over control. However there was no variation between P0 and P1. Similarly application of K1 and K2 significantly increased the yield over control. However no significant variation between K1 and K2 were observed. The interaction effect of NK increased the yield significantly (N1P1-1.9 kg, N2P2-2.8 kg, N1K1-2.0 kg, N2K2-2.9 Kg, P1K1-2.0, P2K1-3.0, P2K2 2.2 kg/tree) over control.

Table 2.3: Effect of N,P,K and their interaction on yield of cashewnut (kg/plant, 1997) at Bhubaneswar centre.

	P0	P1	P2	Mean	K0	K1	K2
N0	0.9	1.1	1.1	1.0	0.8	1.1	1.1
N1	1.7	1.9	2.4	1.9	1.6	2.0	2.3
N2	2.7	2.7	2.8	2.7	2.4	2.9	2.9
Mean	1.8	1.9	2.1	-	1.6	2.0	2.1
K0	1.6	1.8	1.8				
K1	1.4	2.0	3.0				
K2	1.8	2.1	2.2				

S.E. (m) ± for N,P,K = 0.06786
C.D. (5%) for N = 0.117
S.E. (m) + for NP, NK, PK = 0.20
C.D. (5%) N,P and K = 0.196
C.D. (5%) for NK = 0.34

Jhargram:

New NPK trial with clonal progenies of Jhargram-1 was laid out in 1996. The experiment is in initial stage.

Vridhachalam:

The trial was laid out in the new block. The grafts of the cultivar VRI-2 were planted in 1996 and the first and second dose of fertilizer were given as per schedule. The soil samples were analysed for N, P & K. The available nutrients were found to be 332.4 kg N, 6.97 kg P_2O_5 and 123.2 kg K_2O per hectare.

Madakkathara:

The experiment was laid out in 1992 with BLA 39-4 variety at Madakkathara. Uniform dose of fertilizers was applied for all the different levels of treatments this year for getting uniformity in growth and yield. This will continue for one year and treatments will be imposed after following the technique of confounding. In order to assess the effect of higher dozes of nutrition of cashew graft raised in the farmers' field an on-farm trial was laid out at Pattikkad, Thrissur district.

The fertilizer doses were as follows:

T1 : 750-325-750(g) of N, P_2O_5 and K_2O

T2 : 1125-488-1125(g) of N, P_2O_5 and K_2O

T3 : 1500-650-1500(g) of N, P_2O_5 and K_2O

(Nitrogen as urea, P as rock phosphate and K as muriate of potash)

During 1996 (2 years after planting) 50% of the dose was given, during 1997 also (3 years after planting) only 50% of the dose was given.

No consistent pattern of growth variation due to treatments is observable. Data of the coming years may provide definite indications.

Vengurla:

At Vengurla, the experiment was laid out in 1990. Increasing trend in height, girth, and spread is observed with increasing levels of

nitrogen, phosphorus and potassium. Similar trend was not observed in the case of yield. This was due to heavy incidence of tea mosquito bug in the last fruiting season (1997) resulting very low yield (Table 2.4).

Table 2.4: Effect of different levels of NPK on growth characteristics and yield at Vengurla centre.

Treatments	Girth (cm)	Height (cm)	Spread (cm) N-S	Spread (cm) E-W	Yield Kg/tree
N0	27.9	246	230	238	0.08
N500	31.9	268	267	251	0.18
N1000	31.0	259	268	281	0.09
P0	28.7	243	230	258	0.10
P125	31.0	263	262	272	0.08
P250	31.1	268	272	280	0.17
K0	31.0	253	248	217	0.08
K125	30.3	265	270	280	0.18
K250	30.0	256	246	263	0.11

Chintamani:

The experiment was laid out in 1987 at Chintamani located in maidan region. Grafts of the variety Ullal-1 were used in the experiment and planted at a spacing of 7.5 m x 7.5 m. Plant height, stem girth and canopy spread did not differ significantly due to the levels of NPK and their interaction.

Nut yield and size:

NPK levels and interaction of PK influenced the yield significantly. In general, as the level of nutrient increased, the increase in yield was observed. However, during the year under report significant increase in yield due to N was observed upto 500 g N (3.4 kg/tree, control 2.4 kg/tree) (Table 2.5).

Table 2.5: Effect of different levels of NPK and their interation on cashew yield (Kg/tree) at Chintamani centre.

	P0	P1	P2	Mean	K0	K1	K2
N0	1.8	2.5	2.7	2.4	2.0	2.2	2.9
N1	2.6	3.2	4.4	3.4	2.8	3.2	4.2
N2	3.6	3.7	4.1	3.8	3.2	3.7	4.4
Mean	2.7	3.1	3.7		2.7	3.0	3.9
K0	2.3	2.7	3.0				
K1	3.1	3.1	3.1				
K2	2.5	3.3	5.5				

	SEm ±	CD (P=0.05)
N/P/K	0.25	0.72
PK	0.74	2.16
NP/NK	0.74	NS

Application of phosphorus (250 g/tree resulted in yield (3.7 kg/tree) which was significantly higher than that of control. However, it was on par with the yield that was obtained with the application of 125 g P_2O_5/tree. Yield obtained with the application of 250 g potash/tree was significantly higher than that of control plot and the plot where 125 g potash/tree was applied.

Among PK interactions, it was observed that the trees receiving 250g each of P&K gave highest yield of 5.5 kg/tree which was significantly higher than that in other treatments.

Significant influence of P and K levels and interactions of NP and PK on nut size was observed. The maximum nut size was recorded in the trees receiving the lower level of nutrients. Among NP interaction, maximum nut size of 6.8 g was recorded in N1P1 whereas in PK interaction, the maximum nut size of 7.0g was recorded in P1K0 (Table 2.6).

Table 2.6 Effect of different levels of NPK and their interaction on cashew nut weight (g) at Chintamani centre.

	P0	P1	P2	Mean	K0	K1	K2
N0	6.6	6.5	6.4	6.5	6.4	6.7	6.4
N1	6.5	6.8	6.0	6.4	6.5	6.6	6.2
N2	6.6	6.6	6.5	6.6	6.7	6.6	6.4
Mean	6.6	6.6	6.3		6.5	6.6	6.3
K0	6.6	7.0	6.1				
K1	6.6	6.6	6.7				
K2	6.4	6.2	6.2				

	SEm ±	CD (P=0.05)
P/K	0.05	0.14
N	0.05	NS
NP/PK	0.09	0.25
NK	0.09	NS

The effect of NPK and their interactions were not consistent as to their significant influence over seven year period. When individual nutrient effects were considered, application of 500 g N, 125 g P_2O_5 or 250g K_2O/tree/year increased the yield substantially over control. Among second order interactions, N2P2 (4.2 kg/tree), N2K2 (4.5 kg/tree) and P2K2 (4.8 kg/tree) gave highest mean yield for seven years. Among NPK interactions (Table 2.7), the highest nutrient level combination i.e. application of 1000 g N, 250 g P_2O_5 and 250g K_2O gave the highest mean yield (5.5 kg/tree) followed by 500:250:250 g NPK (5.3 kg/tree), 500:250:125 g of NPK (5.0 kg/tree), 1000:125:250 g of NPK (4.8 kg/tree) and 500:125:250g of NPK (4.5 kg/tree) which were all on par.

Table 2.7: Effect of different combinations of NPK on yield of cashewnut (1991-97) at Chintamani centre.

Treatment combination	Yield kg/tree							Mean of 7 years
	1991	1992	1993	1994	1995	1996	1997	
000	1.4	0.9	1.2	2.2	3.0	0.8	1.2	1.5
001	1.7	0.6	2.2	2.7	4.9	1.4	2.3	2.2
002	2.2	0.7	4.9	3.6	4.2	1.4	2.0	2.7
010	1.7	0.5	2.6	4.1	5.5	1.3	3.6	2.7
011	2.3	0.9	2.2	4.7	5.9	1.7	2.3	2.9
012	3.3	0.7	4.3	3.0	4.6	2.2	1.7	2.8
020	2.4	0.6	2.3	2.8	4.0	1.7	1.2	2.1
021	3.0	0.8	1.5	1.8	3.2	2.0	2.0	2.0
022	2.2	0.8	2.7	2.8	9.2	2.4	5.0	3.6
100	2.0	1.0	1.8	5.7	4.8	1.3	2.7	2.8
101	1.7	0.5	3.6	6.1	3.3	1.4	2.1	2.7
102	2.4	0.9	2.1	3.2	2.2	1.4	3.0	2.2
110	2.0	1.6	1.9	2.5	5.0	1.3	2.7	2.4
111	3.0	0.9	2.6	3.7	3.0	2.1	3.2	2.6
112	3.5	1.0	6.3	6.9	7.3	2.5	3.6	4.4
120	2.2	0.8	2.4	3.4	4.5	1.6	2.9	2.5
121	3.1	1.2	2.5	3.5	2.8	1.8	4.2	5.0
122	3.8	1.1	6.8	5.8	9.2	3.3	6.2	5.2
200	2.4	0.9	1.8	3.6	5.9	1.9	3.1	3.1
201	2.1	0.5	1.8	4.9	7.1	1.9	3.6	3.1
202	2.3	0.8	3.9	6.2	4.0	2.5	4.0	3.4
210	2.1	0.5	2.4	4.4	6.2	1.5	3.2	2.9
211	3.7	0.6	3.4	4.3	3.9	2.1	3.9	3.1
212	4.2	0.9	4.4	8.3	8.7	3.3	4.0	4.8
220	2.2	0.6	2.8	5.1	6.1	1.7	3.3	3.1
221	3.3	0.9	2.6	7.4	4.3	2.4	3.7	3.5
222	3.6	1.1	5.6	11.3	7.3	4.4	5.2	5.5
	2.6	**0.8**	**3.1**	**4.7**	**5.2**	**2.0**	**3.1**	

Pooled Analysis

	SEm ±	CD (P=0.05)
Years	0.21	0.61
Treatment	0.40	1.16

Project Title : Agr.4 : Spacing trial.

Centres:

East Coast : Jhargram
West Coast : Vengurla

Objective:

The main objective of this experiment is to find out the optimum plant population per unit area at different ages of plantation for maximisation of yield.

Experimental details:

Design	:	RBD
Replication	:	3
Plot size	:	25m x 25m
Area covered	:	2.25 ha
Variety	:	Red Hazari (Jhargram); V-4 (Vengurla)
Year of planting	:	July, 1982 (Jhargram); July 1990 (Vengurla)

Spacing:

1. 5m x5m : Square with no thinning
2. 5m x 5m : Square with thinning of 50% plants (after 6 years in 1990)
3. 5m x 5m : Square with thinning of 75% plants (after 11 years)
4. 10m x 5m : Rectangular
5. 10m x 5m : Rectangular with thinning of 50% plants (after 6 years, done in 1990)
6. 10m x 10m : Square
7. 10m x 10m x 10m : Triangular
8. 8m x 8m : Square
9. 8m x 8m x 8m : Triangular
10. 6m x 6m : Square
11. 6m x 6m x 6m : Triangular
12. 5m x 5m : Square with selective thinning of 50-75% plants. During 1990, 50% plants were removed selectively.

Jhargram:

Highest yield for the year was obtained from 6m x 6m x 6m triangular method of planting and 5m x 5m square method of high density planting with no thinning (Table 2.8). Highest cumulative yield was obtained from 5m x 5m square method of planting with no thinning (486.0 kg/block or 7775 kg/ha) and 6m x 6m x 6m triangular method of planting (473.3 kg/block or 7573 kg/ha). Minimum cumulative yield was obtained from plot of 10m x 10m Square method of planting (76.8 kg/block or 1228 kg/ha) and 8m x 8m square method of planting (80.8 kg/block or 1292 kg/ha).

Vengurla:

The experiment was laid out in July 1990 and growth observations and yield were recorded and presented in Table 2.9. No significant differences in height and girth were observed due to different densities/unit area six years after planting. The data on average space indicated that there was sufficient space (N-S and E-W) between rows and between plants within a row for all treatments except in T1, T2 and T3. The yield/ha was maximum in treatments T1, T2 and T3 when spacing adopted was 5m x 5m (3 times higher yield than that in widely spaced trees). During the fruiting season 1997 the yields were very poor due to the heavy incidence of tea mosquito bug.

Table 2.8: Effect of spacing on yield at Jhargram centre.

Treatments		No.of plants per block	Canopy	No. of nuts per plant	Yield (kg/tree)	Yield		Cumulative yield (10 harvests) (1988-1997)	
						Kg/ block	Kg/ ha	Kg/block	kg/ha
5m x 5m	Square-no thinning	25	Medium	520	2.6	70.0	1119	486.0	7775
5m x 5m	Square-No thinning	13	Medium	660	2.5	36.0	575	258.3	4132
5m x 5m	Square-50% thinning	25	Medium	600	2.0	48.8	780	397.4	6358
10m x 5m	Rectangular	8	Medium	1075	4.3	34.4	550	361.8	5788
10m x 5m	Rectangular-50% thinning	4	Medium	870	3.3	13.3	212	112.8	1805
10m x 10m	Square	4	Medium	689	2.9	11.4	183	76.8	1228
10m x 10m x 10m	Triangular	7	Medium	578	2.7	18.6	297	131.4	2102
8m x 8m	Square	9	Medium	1098	4.4	39.6	634	80.8	1292
8m x 8m x 8m	Triangular	12	Medium	925	3.5	41.9	670	296.4	4742
6m x 6m	Square	16	Medium	780	4.5	54.7	875	400.3	6405
6m x 6m x 6m	Triangular	22	Medium	700	2.9	71.0	1136	473.3	7573
5m x 5m	Square-Selective thinning	13	Medium	625	2.4	35.8	573	272.8	4365
S.Em.(+/-)			**16.51**	**0.48**	**2.28**	**36.48**			
CD at 5%			**40.69**	**1.28**	**4.52**	**72.32**			

Table 2.9: Spacing trial in cashew (growth and yield data) 1997 season at Vengurla centre.

Treatments different spacings		Mean height (m)	Mean girth (cm)	Spread (m) N.S.	E.W.	Yield kg/tree	Yield Kg/ha
T-1	5 x 5m with no thinning	2.7	36.3	3.2	3.0	1.5	596
T-2	5 x 5m with 50% thinning after 6th year	2.8	36.5	3.1	2.9	1.5	612
T-3	5 x 5m with 50% thinning after 6th & 75% after 11th year	2.8	38.0	3.1	2.9	1.5	588
T-4	10 x 5m No thinning	2.7	35.1	2.8	2.7	1.2	230
T-5	10 x 10m with 50% thinning after 6th years	2.5	34.8	2.9	2.7	1.4	278
T-6	10 x 10m No thinning	2.7	33.2	2.6	2.6	1.1	114
T-7	10 x10 x 10m no thinning	2.5	29.0	2.7	2.4	1.2	135
T-8	8 x 8m No thinning	2.8	36.5	3.1	3.0	1.4	215
T-9	8 x 8 x 8m No thinning	2.5	30.9	2.3	2.6	1.4	250

Project Title : Agr.6 : Cashew based cropping system.

Centres:

East coast : Bapatla, Bhubaneswar, Vridhachalam
West coast : Madakkathara

Objective:

1. To identify compatible intercrops with cashew in the initial stages of orchard development.
2. To study the economic benefits of intercropping system.
3. To work out a soil fertility management strategy for the intercropping system.

Treatments:

Main plot : 4
Sub-plot -3 : 3
No.of replications : 3
Design : Split plot

Main crop:

1. Cashew main crop
2. Cashew + Sesamum
3. Cashew + Horsegram
4. Cashew + Blackgram

Sub-plot:

FO - No additional fertilizer to intercrop
F1 - Additional fertilizer application to the intercrops as per the state recommendation.
F2 - 50% of the additional fertilizer application to the intercrop.

East coast :

Bapatla

The intercrops during 1997 could not be sown due to drought condition prevailed till the end of September.

Bhubaneswar:

The intercrop was raised during kharif 1997. The cashewnut plants were applied with recommended doses of fertilizer i.e. 500:125:125g N:P:K/plant. Recommended fertilizer dose for intercrops (kg/ha) is as follows.

		N	P_2O_5	K_2O
1.	Sesamum	30	15	15
2.	Horsegram	12	25	0
3.	Blackgram	20	40	0

The prevailing price of cashew and intercrops per quintal are:-

1. Cashew - 3000.00
2. Sesamum - 1000.00
3. Horsegram - 700.00
4. Blackgram - 1300.00

During 1997, the yield of cashewnut and intercrops per ha in quintals are as follows (1) cashew + sesamum (327 kg + 257 kg). (2) Cashew + Horsegram (373kg, 433 kg), Cashew + blackgram (355kg, 282 kg) and cashew alone produced 385 kg. Cashew was in the second year of bearing.

The cost of cashewnut and intercrops was converted to monetary terms and statistical analysis was done. This revealed that the combination of cashew + blackgram significantly produced highest return (Rs.14,335/- ha) followed by cashew + horsegram (Rs.14,106/-), cashew + sesamum (Rs.12,000/-) and cashew alone (Rs.1,163/-). There was no significant difference between

blackgram and horsegram intercrops along with cashew (Table 2.10). Full dose of fertilizer increased the yield of intercrops significantly over 50 per cent of recommended dose of fertilizer and no fertilizer application.

Table 2.10: The effect of cashew + intercrops and fertilizer application in the intercrops on the economic return (in Rupees) at Bhubaneswar centre.

	Fo	F1	F2	Mean (Rs./ha)
Cashew	10766	11300	12700	11630
Cashew + Sesamum	10400	13433	12267	12030
Cashew + Horsegram	13110	15340	13870	14106
Cashew + Blackgram	11540	17156	14310	14335
Average	11487	14307	13286	

S.E.(m) + - for main plot(Cashew + Inter-crop)	=	242
C.D.(5%) for main plot (Cashew + Inter-crop)	=	840
S.E.(m) + - subplot (fertilizer application)	=	270
C.D subplot (fertilizer application)	=	810
S.E.(m) + - for Interaction	=	540
C.D.(5%) for Interaction	=	1620

Vridhachalam:

The intercrop trial was continued for the year 1997 in the one year old high density cashew plantation in a plot size of 4m x 4m. The yield recorded (Table 2.11) was 500 g and 990g/plot of blackgram and ground nut accounting for 500 kg and 620 kg/ha respectively. The trial is in progress in same plots with four annual crops viz., sesamum, cowpea, blackgram and ground nut.

Table 2.11: Intercropping in Cashew (1997).

Treatments	Height of the tree (cm)	Girth of the tree (cm)	Yield of cashew kg/tree	Intercrops Yield kg/ha
T1 (Cashew) + Blackgram)	114	17	-	500
T2 (Cashew + Groundnut)	116	19	-	620
Control	109	15	-	-

Madakkathara:

To identify suitable medicinal plant that can be grown as intercrop in cashew, two species viz., Adalodakam (*Adathoda beddonei*) and Iruveli (*Colieus zeylanicus*) were planted between four cashew plants in a plot size 5 x 5m at a spacing of 45cm x 30cm between plants. The cuttings of the medicinal plants (Adalodakam and Iruveli) were planted on ridges and raised under rainfed conditions. Farm yard manure was applied @ 25 kg per plot. The initial plant establishment was not satisfactory. By adopting gap filling the plant population is regulated satisfactorily. Now the crop has completed about 5 months in the field. Their biomass productivity will be recorded in due course.

Project Title : Agr.7 : Drip irrigation trial

Centres:

East coast : Vridhachalam
West coast : Vengurla
Maidan tract : Chintamani

Objective:

To study the response of cashew to supplementary irrigation through drip during flushing, flowering and fruiting phases and to work out the critical stages of irrigation.

Methodology:

Each treatment will be imposed in a block of 50 plants. Therefore a total of 250 grafts are planted in a contiguous block for this trial on drip irrigation.

For the first two years only one dripper with four litre per hour water flow rate is to be used. For the 3rd, 4th and 5th year, four drippers at 1m distance from the trunk of the plant around the base are to be placed in pits filled with coconut coir pith for the better distribution of water into the soil as well as to serve as mulch.

Treatments : 5

Treatment details:

T-1 - No irrigation
T-2 - Irrigating 20% of cumulative pan evaporation
T-3 - Irrigating 40% of cumulative pan evaporation
T-4 - Irrigating 60% of cumulative pan evaporation
T-5 - Irrigating 80% of cumulative pan evaporation

Variety:

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

Vengurla:

This trial has been laid out at Agricultural Research Station, Mulde, Tal.Kudal, Dist.Sindhudurg. Details of this trial are given below:

Spacing : 7m x 7m
Variety used : Vengurla-7
Plant material : Softwood grafts

Chintamani:

Planting of 240 grafts of Chintamani-1 was taken up during September 1997. The establishment of plants is satisfactory. Drip irrigation system has to be installed according to the treatments decided after the receipt of necessary budget for equipment and digging of borewell.

B. HORTICULTURE

Project Title : **Hort.4: Screening of root stocks for dwarfing characters.**

Centres:

East Coast : Bapatla, Bhubaneswar
West coast : Madakkathara, Vengurla

Objectives:

The objective of the trial is to identify dwarfing rootstocks at nursery stage based on morphological, anatomical, physiological characters viz. height, girth, number of stomata, bark percentage and phenolic contents.

Bapatla:

Six trees were identified as less vigourous/ dwarf trees at the centre and their growth measurements are furnished in Table 2.22.

Table 2.12: Growth characters of less vigorous 'dwarf' cashew types at Bapatla centre.

Tree No.	Age	Height (m)	Girth (cm)	Spread (m)	
				E-W	N-S
ABT-1	35	3.5	64	4.5	6.0
ABT-2	35	5.1	124	8.5	9.5
ABT-3	35	5.0	107	7.5	6.5
Irradiated tree 5/6	36	4.2	93	5.0	6.5
T.10/8	36	5.9	146	7.5	8.0
T.4/17	36	5.2	150	8.5	6.5

Inbreeding by selfing was carried out and seedling from selfed seeds for root stock screening are being raised at the centre.

Bhubaneswar:

One semi-dwarf type was identified. The grafted material is raised in the nursery for field planting.

Madakkathara:

The work on screening of two identified rootstocks is being pursued at the centre.

Vengurla:

Seventeen seedlings raised from seednuts of dwarf and vigorously growing trees were screened for morphological and anatomical characters at nursery stage. However, no significant difference among the rootstocks was recorded (Table 2.13).

Selfing programme of the seventeen identified dwarf types was undertaken and collected nuts were sown for raising seedlings.

Table 2.13: Rootstock screening for dwarfing in cashew at Vengurla centre.

Rootstock	Height (cm)			Girth (cm)		
	Initial	In 1997	Increase	Initial (July 1994)	In July 1996	Increase
Vengurla-1	28	376	348	14	45	31
V-2	32	407	375	18	42	24
V-3	38	334	296	15	38	23
V-4	29	406	377	14	39	25
V-5	32	421	389	13	37	24
T-40	33	440	407	17	43	26
M 44/3	30	369	339	13	39	26
Hy-1598	32	365	333	14	35	21
Hy-1600	26	385	359	14	40	26
Hy-1608	31	490	459	12	45	33
Hy-1610	37	388	351	12	36	24
VTH 59/2	34	379	345	14	46	32
VTH 30/4	34	385	351	16	33	21
T-129	26	358	332	17	40	23
Hy 2/15	32	423	391	14	41	27
Hy 2/16	31	426	395	16	46	30
M 26/2	31	340	309	13	26	13

III. CROP PROTECTION

Project Title : Ent 1 : Chemical control of pest complex.

Objectives:

The project is aimed to find out an effective spray schedule for the management of tea mosquito bug and other minor pests of cashew. This project also aims at testing the efficacy of certain plant products in comparison with standard insecticidal spray schedule against pests of cashew.

Expt.1: Control of major pest : Tea mosquito bug, *Helopeltis antonii.*

Centres:

East Coast	:	Bhubaneswar, Jhargram, Vridhachalam
West Coast	:	Madakkathara, Vengurla
Maidan tract	:	Jagdalpur, Chintamani

Treatments:

T1 : Monocrotophos (0.05%) one spray at flushing
T2 : Endosulfan (0.05%) one spray at flowering
T3 : Carbaryl (0.1%) one spray at fruiting
T4 : T1 and T2
T5 : T1, T2, and T3
T6 : T1 and T3
T7 : T2 and T3
T8 : Endosulfan (0.05%) at flowering stage followed by neem oil (2%)
T9 : Carbaryl (0.1%) at flowering stage followed by neem oil (2%) at fruiting stage
T10 : Control

The insecticidal treatments were given as indicated above and damage recorded one month after last spray is presented in Table 3.1. The results available from three centres (Chintamani, Jagdalpur and Jhargram) revealed that the extent of tea mosquito bug damage was very low. The skipping third spray at fruiting (T-4) was found economical at Jhargram centre as yield was equal to T-5.

Among them, T5 treatment had shown least damage and registered increased yield. Even though, insecticidal treatments caused considerable depression in predator population, they had not eliminated them completely.

Table 3.1: Efficacy of insecticides against tea mosquito bug and population of spiders/ pradators.

Treat-ments	Damage of shoots(%)			Yield (kg/tree)			No./quadrants Spiders predators	
	Chinta-mani	Jagdal-pur	Jhar-gram	Chinta-mani	Jagdal-pur	Jhar-gram	Bhuba-neswar	Chinta-mani
T1	10.0	3.4	6.3 (2.7)	0.3	1.8	2.0	0.5 (0.9)	1.6
T2	9.9	7.4	7.8 (2.9)	0.9	1.6	2.0	0.2 (0.8)	1.3
T3	2.0	11.5	8.1 (2.9)	0.3	0.9	1.7	0.5 (0.9)	1.8
T4	9.9	2.7	2.4 (1.7)	1.7	2.0	3.2	0.2 (0.8)	1.9
T5	1.3	1.4	2.2 (1.6)	3.6	2.6	3.2	1.0 (1.2)	1.5
T6	1.8	3.6	4.8 (3.2)	0.7	1.9	2.8	0.7 (1.1)	1.5
T7	1.6	10.6	5.5 (2.5)	1.0	1.2	2.3	0.9 (1.2)	1.6
T8	1.6	11.5	4.9 (2.3)	0.9	1.0	2.6	0.9 (1.1)	1.7
T9	1.8	13.3	5.7 (2.5)	0.8	0.9	2.4	0.2 (0.8)	1.8
T10	12.2	15.6	10.2 (3.3)	0.2	0.8	1.4	2.4 (1.7)	2.2
C.D 5%	**1.4**	**0.5**	**(0.1)**	**0.4**	**0.2**	**0.3**	**(0.5)**	**-**

Figures in parentheses are transformed values.

Expt.2 : **Control of minor pests.**

Centres:

East Coast	:	Bapatla, Bhubaneswar, Jhargram, Vridhachalam
West Coast	:	Madakkathara, Vengurla
Maidan tract	:	Chintamani and Jagdalpur

From the experiment 1, additional observations were also recorded in some of the centres (Bapatla, Chintamani, Jagdalpur and Jhargram) on damage/incidence of certain important minor pests viz. leaf and blossom webber, leaf miner, leaf folder/roller, leaf thrips, inflorescence thrips and leaf weevil. However, the extent of damage caused by various pests was very low except in the incidence of leaf and blossom webber at Bapatla as fruit damage where least damage was recorded in T5. At Jhargram and Vridhachalam, higher yield was recorded T5 treatment than in other treatments (Table 3.2).

Table 3.2: Effect of insecticidal treatments on the incidence of the leaf miner, leaf and blossom webber and leaf folder (% damage), leaf weevil, leaf thrips and inflorescence thrips (No.) and yield.

Treatment	Leaf and blossom webber				Leaf miner		Leaf folder/ roller		Leaf weevil	Leaf thrips	Inflorescence thrips		Yield (kg/tree)		
	Bapatla*	Jhargram	Vridhachalam		Jhargram	Jagdalpur	Bapatla	Jagdalpur	Bapatla	Chintamani	Bhubaneswar	Chintamani	Jhar gram	Vridhachalam	
			YP	OP							BT			YP	OP
T1	38.3	3.5	3.4 cde	3.9 b	3.9 (1.9)	2.6	8.5	1.6	0.0	1.3	0.4 (1.0)	15.7	1.80	1.6	9.8
T2	46.2	4.6	5.2 c	3.0 cd	5.0 (2.4)	4.6	6.5	2.2	1.0	15.4	0.6 (1.0)	14.1	1.95	1.2	10.2
T3	18.7	5.1	2.7 c	2.3 d	9.6 (3.2)	5.3	6.5	2.4	3.0	14.8	0.2 (0.8)	3.8	2.57	1.5	11.1
T4	28.8	1.6	5.0 bc	2.8 cd	1.5 (1.4)	2.6	2.0	1.6	1.0	1.3	0.5 (1.0)	15.1	3.00	1.3	11.2
T5	13.5	1.5	1.5 f	2.5 d	1.5 (1.4)	1.4	4.1	1.5	0.0	1.2	0.1 (0.8)	3.5	3.03	2.2	12.5
T6	23.3	2.3	2.7 ce	3.2 cd	5.0 (2.1)	3.0	8.5	1.6	2.3	1.3	0.4 (0.9)	3.6	2.73	1.7	11.5
T7	16.1	4.6	2.5 e	2.3 cd	6.1 (2.6)	4.6	11.5	2.2	0.0	15.0	0.6 (1.0)	3.7	2.61	1.8	11.7
T8	38.7	4.5	3.9 bc	3.0 bc	5.3 (2.4)	4.7	6.5	2.5	0.0	14.7	0.2 (0.8)	3.7	2.32	1.5	11.9
T9	17.1	5.0	4.6 b	3.2 bc	4.9 (2.3)	4.7	5.5	2.6	1.0	13.4	0.1 (0.8)	3.6	2.29	1.9	11.2
T10	35.0	8.2	9.5 a	6.4 a	11.1 (3.4)	5.5	16.5	3.8	2.0	13.6	0.8 (1.2)	16.1	1.45	0.8	8.0
CD 5%	-				**(0.1)**	**0.2**	-	**1.0**		**2.8**	**(0.1)**	**1.0**	**0.04**		

* Damage on fruits; YP & OP - Young and old plantations; figures in parentheses are transformed values.

In a column, values followed by common letter are not significant

BT - Black thrips *(Haplothrips ceylonicus Schumtz)*

Expt.3 : Control of foliage/inflorescence pests using plant products.

Treatments:

T1 : Neem oil (2%)
T2 : Neem seed kernel extract (5%)
T3 : Cotton seed oil (2%)
T4 : Neem leaf extract (2%)
T5 : Monocrotophos (0.05%), endosulfan (0.05%) followed by carbaryl (0.1%)
T6 : Commercial neem product + endosulfan (0.05%) followed by carbaryl (0.1%)
T7 : Pongamia oil (2%) followed by carbaryl (0.1%)
T8 : Control

In this trial also, the extent of damage caused by various pests was very low except by leaf and blossom webber at Vridhachalam and leaf folder at Bapatla (Table 3.3). At Jagdalpur, least damage and increased yield were recorded in T5 than in other treatments. At both Bapatla and Vridhachalam, T5 and T6 were more promising than other treatments. Among plant products, least damage of leaf folder was seen in T1 alone at Bapatla. But in other places, the performance of plant products was not consistent and inferior to T5 and T6 treatments.

Table 3.3: Efficacy of certain plant products and standard insecticides against tea mosquito bug,leaf and blossom webber, leaf miner, shoot tip caterpillar, leaf folder/roller and thrips apple and nut borer (% damage) and inflorescence thrips (No) and yield.

Treatment	TMB Jagdalpur	LBW Vridhachalam	Leaf miner Jagdalpur	STC Jhargram	Leaf folder/roller		Inflorescence thrips			Apple and nut borer		Yield (kg/tree)			
					Bapatla	Jagdalpur	Bhubaneswar	Chintamani	Jhargram	Bapatla		Bapatla	Bhubaneswar	Jagdalpur	Vridhachalam
										STC	LBW				
T1	4.0	19.0 c	3.5	2.3 (1.8)	2.0	3.7	0.4 (0.9)	7.4	2.3 (1.7)	3.0	3.5	2.7	0.6	1.5	1.7
T2	5.2	17.4 c	0.8	3.0 (1.9)	4.3	3.3	0.5 (1.0)	7.9	2.3 (1.8)	4.1	5.0	2.7	0.6	2.0	2.0
T3	4.3	19.9 b	1.3	3.3 (1.9)	8.5	1.0	0.7 (1.1)	skipped	3.0 (1.9)	10.7	8.5	2.3	0.6	1.7	1.4
T4	4.8	20.0 ab	1.6	3.4 (2.0)	8.0	3.3	0.5 (1.0)	7.7	3.2 (1.9)	8.5	12.5	2.5	0.3	0.8	1.5
T5	2.6	17.4 cd	0.5	1.8 (1.5)	2.0	1.7	0.4 (0.9)	3.1	1.2 (1.3)	2.5	1.5	3.0	0.5	2.5	2.2
T6	4.3	15.9 d	2.0	1.9 (1.6)	2.0	1.7	0.3 (0.9)	3.0	1.4 (1.4)	2.0	4.3	3.4	0.5	1.8	2.3
T7	4.0	19.5 b	3.9	2.2 (1.6)	14.0	2.3	0.5 (1.0)	6.7	1.9 (1.7)	4.7	4.0	1.9	0.4	0.9	1.7
T8	15.4	21.9 a	3.9	9.7 (3.1)	24.6	3.7	1.0 (1.2)	16.7	7.3 (2.7)	12.8	13.0	1.1	0.7	0.7	1.3
CD 5%	**0.9**	**-**	**0.9**	**(0.1)**		**0.9**	**(0.1)**	**1.3**	**(0.1)**					**0.4**	

TMB - Tea mosquito bug
LBW - Leaf and blossom webber
STC - Shoot tip caterpillar
BT - Black thrips
Figures in parantheses are transformed values. In the column value followed by common letter is not significant

Ent.2 : Control of stem and root borer.
Expt.1 : Prophylactic control trials.

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram, Vridhachalam
West Coast : Madakkathara, Vengurla

Objectives:

To evaluate different pesticides and neem products for prophylaxis against attack by stem and root borer.

Stem swabbing of neem oil 5% and application of Sevidol 8G (75g/tr) T3) resulted in lowest fresh incidence by stem and root borer at three centres namely, Vengurla (Nil), Madakkathara (4.0%) and Bapatla (5.0%). (Table 3.4). The incidence was lowest in swabbing carbaryl (0.2%) and application of Sevidol 8G (75g/tr)(T2) at two centres, Jhargram (5.0%) and Vridhachalam (6.0%). Swabbing of carbaryl (0.2%) in mudslurry (T1) showed the lowest pest incidence at Bhubaneswar centre (4.0%).

During Nov.1997, Carbaryl swabbing (0.2%), (T2), with application of Sevidol 8G, swabbing neem oil and soil application of Sevidol 8G (T3), swabbing neem oil (T4), swabbing neem seed kernel extract 5.0% (T5) were all on par, recording 8.0 per cent fresh incidence at Madakkathara.

Various treatments resulted in initial and moderate levels of attack. Swabbing carbaryl in mudslurry (T1) had more trees in moderate stages of incidence, at Bhubaneswar (4.0%) and Vridhachalam (16.0%) (Table 3.5).

Incidence was less and progress of attack was slow in trees treated with carbaryl (swabbing) and Sevidol 8G (soil application) (T2) at Jhargram, and with neem oil (5%) swabbing (T4) at Jhargram and Vridhachalam. Trees progressed to advanced stage in control (T7).

Table 3.4: Influence of prophylactic treatments on incidence of stem and root borer

Treatments	Percentage of freshly infested trees							
	East coast centres					West coast centres		
	Bapatla	Bhubaneswar		Jhargram	Vridha-chalam	Madakkathara		Vengurla
	Apr.	Apr.	Nov.	Apr.	-	Apr.	Nov.	-
T-1 Carbaryl (0.2%) in mud slurry	23.53	4.00	4.00	10.00	-	16.00	12.00	12.00
T-2 Swabbing carbaryl (0.2%) + Sevidiol 8G (75 gms/tree)	20.00	8.00	12.00	5.00	6.00	12.00	8.00	4.00
T-3 Swabbing neem oil (5%) + Sevidol 8G (75 gms/tree)	5.00	-	-	-	14.00	4.00	8.00	0.00
T-4 Neem oil (5%) swabbing	5.55	6.00	6.00	5.00	18.00	8.00	8.00	12.00
T-5 Neem cake extract (5%)	-	6.00	8.00	15.00	-	16.00	12.00	20.00
T-6 Kernel extract (5%)	12.50	6.00	6.00	15.00	18.00	20.00	8.00	16.00
T-7 control	40.00	8.00	14.00	25.00	30.00	24.00	32.00	24.00

Table 3.5: Stages of attack due to stem borer incidence under prophylactic treatments.

Treatment	% infested trees in each stage											
	East coast centres									West coast		
	Bhubaneswar			Jhargram			Vridhachalam			Madakkathara		
	E	M	A	E	M	A	E	M	A	E	M	A
T1 Swabbing Carbaryl (0.2%) in mud-slurry	0	4	0	5	5	0	0	16	0	-	-	-
T2 Swabbing carbaryl (0.2%) + Sevidol 8G application	4	6	2	5	0	0	0	12	0	4	2	0
T3 Swabbing Neem oil (5%)+ Sevidol 8G application	-	-	-	-	-	-	4	4	0	10	4	0
T4 Neem oil 5% swabbing	2	4	0	5	0	0	8	0	0	12	6	0
T5 Neem cake extract 5%	4	4	0	10	5	0	4	12	0	-	-	-
T6 Neem seed kernel extract 5%	2	2	0	10	0	0	8	12	0	8	10	0
T7 control	2	12	0	10	10	5	12	12	0	18	10	2

E - Early, M - Middle, A - Advanced

Ent.3 : **Bioecology of pests of regional importance and survey of pest complex and natural enemies.**

Centres:

East Coast	:	Bapatla, Bhubaneswar, Jhargram, Vridhachalam
West Coast	:	Madakkathara, Vengurla
Maidan tract	:	Chintamani and Jagdalpur

Objectives:

The project is aimed to study population dynamics of pests of regional importance and to correlate the same with weather parameters.

1. Cashew stem and root borer (*Plocaederus* spp.):

This pest was observed throughout the year in all the centres, causing moderate to high damage in east and west coast centres, and low to moderate damage in the plains.

2. Tea mosquito bug (*Helopeltis antonii*):

The pest prevailed from September to May in all centres. In Bapatla however, it was not recorded. Intensity of attack varied from low to severe and a mean damage score of 2.30 was reported from Vridhachalam. The highest level of infestation (46.37% shoots attacked) was observed at Chintamani (Fig.1).

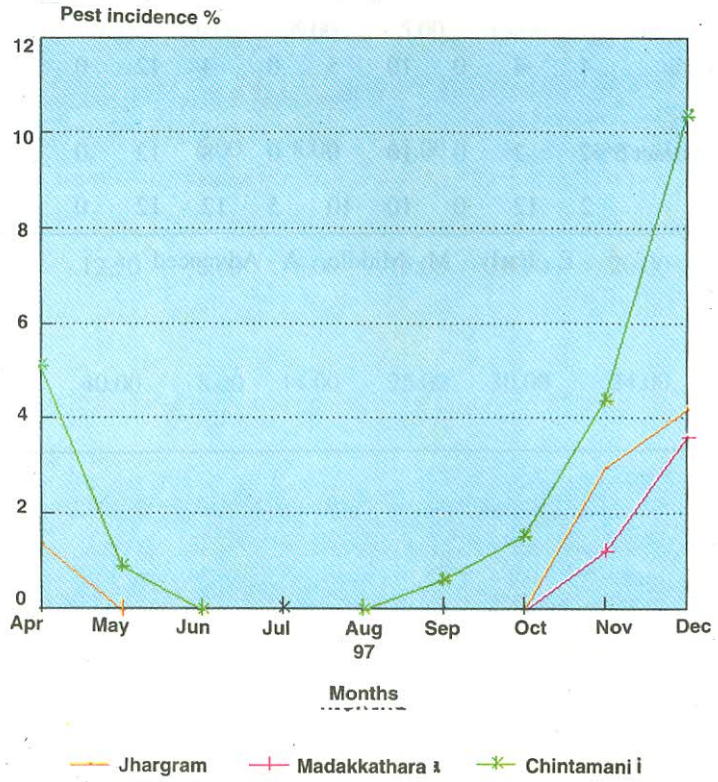


Fig.1: Seasonal occurrence of tea mosquito bug at different centres

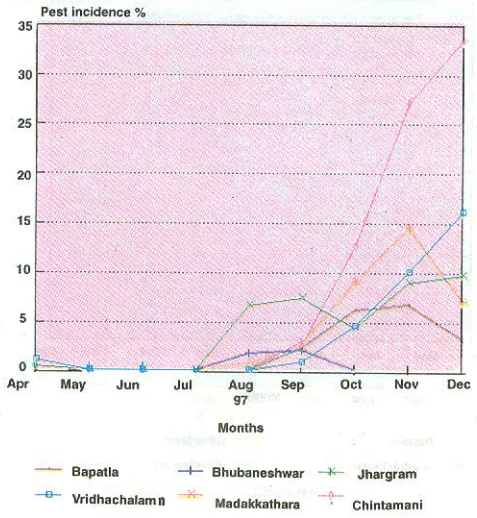


Fig.2: Seasonal occurrence of leaf miner at different centres

3. Leaf miner (*Acrocercops syngramma*):

All the eight centres had incidence of this pest during various months from August to April. The maximum damaged laterals recorded was 16.0 per cent, at Vridhachalam (East coast), 9.58 per cent at Madakkathara (West Coast) and 35.26 per cent at Chintamani (Maidan tract). (Fig.2).

4. Apple and nut borer (*Thylocoptila panerosema, Nephopteryx* spp.):

Incidence of this pest was lower (1.9 to 8.1%) in east and west coast and moderate to high (16.92%) in the maidan tract. The pest infestation was recorded from Jan to July, in different centres. (Fig.3).

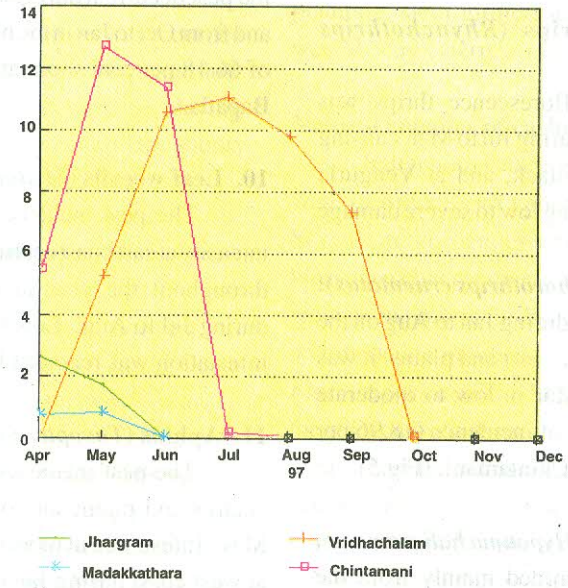


Fig.3: Seasonal occurrence of apple and nut borer at different centres

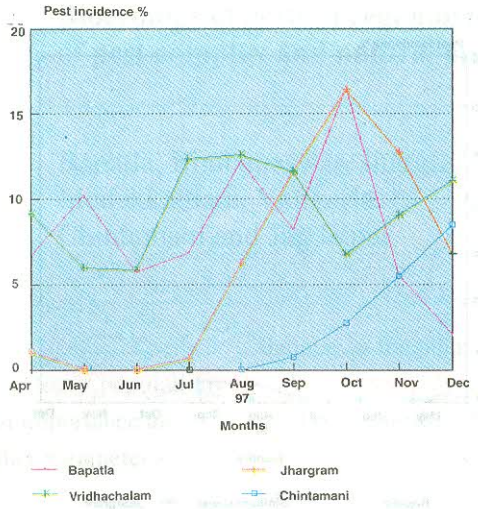


Fig.4: Seasonal occurrence of leaf and blossom webber at different centres

5. Leaf and blossom webber (*Lamida moncusalis*):

The pest attack was reported from Bapatla, during Jan-Dec. causing 2.05 to 16.5 per cent damage, on east coast and from Maidan tract, at Chintamani during September-April and at Jagdalpur during Feb to Mar. causing moderate damage (Fig.4).

6. Inflorescence thrips (*Rhynchothrips rapensis*):

Infestation by inflorescence thrips was recorded at Chintamani during Jul to Mar. causing 0.38 to 18.96 per cent attack, and at Vengurla during Nov. to Mar. causing low to severe damage

7. Leaf thrips (*Rhiphiphorothrips cruentatus*):

The pest occurred during Jan to Aug on the east coast and on the west coast and plains, it was recorded during Jul to Mar in low to moderate levels. The highest level of incidence (18.96 per cent) was reported from Chintamani. (Fig.5).

8. Shoot tip caterpillar (*Hypotima haligramma*):

The pest was recorded mainly from the endemic east coast centres and from Chintamani centre in the plains. Period of occurrence was from Oct. to Mar. in east coast centres and during Oct. to Jan. at Chintamani, the level of attack ranged from moderate to high.

9. Leaf folder (*Caloptila tiselea*):

With the exception of west coast centres, the pest occurred during Jul to Feb. on East coast and from Oct to Jan in the plains. Highest incidence of 66.18 per cent shoot attack was reported from Bapatla.

10. Leaf weevils (*Myllocerus* spp.):

The pest incidence was recorded in low intensity at east coast centres during various months throughout the year and at west coast centre during Jul to Aug. Low to moderate intensity of infestation was reported from maidan centre.

11. Aphids (*Toxoptera odinae*):

The pest incidence was low at east coast centres and plains and occurred during Dec. to May. Infestation at moderate levels was observed at west coast during Jan to Mar.

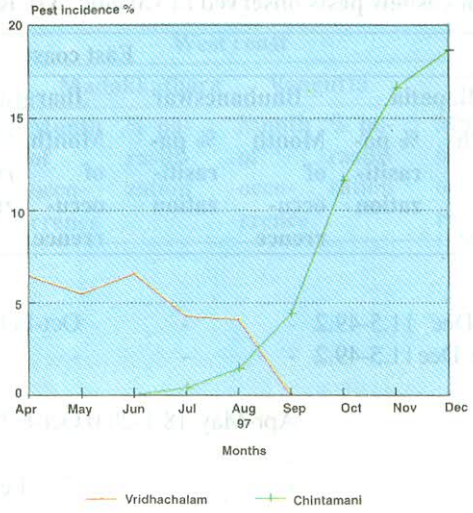


Fig.5: Seasonal occurrence of leaf thrips at different centres

12. Leaf beetle (*Monolepta longitarsus*):

Presence of this pest was recorded from east coast centres in low numbers during monsoon and post-monsoon periods. The west coast and plains centres reported low densities of the pest during Jan- Jul (Vengurla) and all over the year (Chintamani).

13. Mealy bug (*Ferrisia virgata*):

Low to moderate infestation was recorded during Jan to Jun in east coast centres and low intensities in west coast and plains during February to May upto 15.0 per cent of the shoots were attacked at Vridhachalam centre.

14. Termites: *Odontotermes* spp., *Microtermes* spp):

Moderate to severe damage by the pest was recorded from east coast (Jhargram) during Oct to June and on the plains during the whole year.

15. Bark eating caterpillar (*Indarbella* sp.):

The infestation by this pest in low to moderate levels was recorded from all the regions represented by four centres (Viz. Jhargram, Madakkathara, Chintamani and Jagdalpur). Incidence was reported throughout the year in the plains while from coastal centres, the incidence was during post monsoon (Oct-Mar).

Besides these insect pests, other pest species reported from single centres were blister beetles, treehopper, spittle bug, nut crinkler, plantbug, stem girdler, leaf roller, leaf twisting weevil, slug caterpillar and grasshopper.

Natural enemies of cashew pests:

Indigenous natural enemies of several pests were recorded from various centres (Table 3.6). Seven natural enemies were recorded on leaf and blossom webber (*Lamida moncusalis*). *Apanteles* sp. was mainly recorded during Jan-Feb in low and moderate numbers, in east coast and plains. *Elasmus johnstonii* and *Bracon brevicornis* were the other parasitoids recorded in moderate numbers in east coast and plains during Oct-May in different centres. *Tachinid* parasite, spiders and larval and pupal parasitoids were recorded on the larvae in various centres during different months.

Table 3.6: Natural enemies of cashew pests observed at various AICRP centres.

Host	Natural enemy	East coast							
		Bapatla		Bhubaneswar		Jhargram		Vridhachalam	
		Month of occurrence	% parasitization	Month of occurrence	% parasitization	Month of occurrence	% parasitization	Month of occurrence	% parasitization
1. *LBW (Lamida moncusalis)*	1. *Apanteles sp.*	Jan-Dec	11.5-49.2	-	-	Oct-Feb	Low	-	-
	2. *Elasmus johnstonii*	May-Dec	11.5-49.2	-	-	-	-	-	-
	3. *Bracon brevicornis*	-	-	Apr-May	18.1-20.0	Oct-Feb	Mod	-	-
	4. Tachinid parasite	-	-	-	-	Nov-Feb	Low	-	-
	5. Spider	-	-	-	-	Nov-Jan	Mod	-	-
	6. Larval/ pupal parasites	-	-	-	-	-	-	Sep-Dec	0.3-4.5
	7. Chrysopa	-	-	-	-	-	-	-	-
2. TMB	1. Reduvid bug	-	-	-	-	-	-	-	-
	2. Spiders	-	-	-	-	-	-	-	-
	3. Preying mantids	-	-	-	-	-	-	-	-
3. Aphids	1. Coccinellids	-	-	-	-	Jan-Mar	Low	Year round	Low-Mod
	2. Spiders	-	-	-	-	-	-	Year round	0.9-2.6
	3. Preying mantids	-	-	-	-	-	-	Oct-Dec	Low
	4. Chrysoperla cornea	-	-	-	-	-	-	Apr-May	Low
	5. Syrphids	-	-	-	-	-	-	Feb-Jul	Low
4. Shoot tip borer	1. *Elasmus* spp.	-	-	Aug-Oct	3.3-10.0	-	-	-	-
5. Leaf miner	1. *Sympiesis* spp.	-	-	Aug-Nov	8.0-26.0	-	-	-	-
	2. Black ant	-	-	-	-	Oct-Dec	Low	-	-
6. Apple and nut borer	1. Hymenopteran parasite	-	-	-	-	-	-	-	-

Contd....

Table 3.6 (Contd.)

Host	Natural enemy	West coast				Plains			
		Madakkathara		Vengurla		Chintamani		Jagdalpur	
		Month of occurrence	% parasitization	Month of occurrence	% parasitization	Month of occurrence	% parasitization	Month of occurrence	% parasitization
1. LBW (*Lamida moncusalis*)	1. *Apanteles sp.*	-	-	-	-	-	-	Oct-Feb	Low
	2. *Elasmus johnstonii*	-	-	-	-	-	-	-	-
	3. *Bracon brevicornis*	-	-	-	-	Oct-Mar	Low	-	-
	4. Tachinid parasite	-	-	-	-	-	-	-	-
	5. Spider	-	-	-	-	-	-	Aug-Jan	High
	6. Larval/ pwpal parasites	-	-	-	-	-	-		
	7. chrysopa	-	-	-	-	-	-	Mar	Low
2. TMB	1. Reduvid bug	-	-	-	-	Oct-Apr	Low	-	-
	2. Spiders	-	-	-	-	Oct-Mar	Low-Mod	-	-
	3. Preying mantids	-	-	-	-	Oct-Mar	Low	-	-
3. Aphids	1. Coccinellids	-	-	Jan-Mar	High	Dec-May	Low-Mod	-	-
	2. Spiders	-	-	Year round	low	-	-	-	-
	3. Preying mantids	-	-	Year round	Low	-	-	-	-
	4. Chrysoperla cornea	-	-	Jan-Feb	Low	-	-	-	-
	5. Syrphids	-	-	-	-	Dec-May	Low	-	-
4. Shoot tip	1. *Elasmus* spp. borer	-	-	-	-	Oct-Dec	Low	-	-
5. Leaf miner	1. *Sympiesis* spp.	-	-	-	-	-	-	-	-
	2. Black ant	-	-	-	-	-	-	Oct-Apr	High
6. Apple and nut borer	1. Hymenopteran parasite	-	-	Feb-Apr	15.0	-	-	-	-

Tea mosquito bug had a natural enemy complex comprising of reduviid bugs, spiders and preying mantids which prevailed during the cropping season in low numbers in the plains.

Coccinellid beetles, syrphids, preying mantids, *Chrysoperla* were recorded at Vengurla and Vridhachalam during most part of the year, while at Chintamani centre, the coccinellid population was observed during Dec to May.

Elasmus sp on shoot tip borer, *Sympiesis* sp and black ants on leaf miner were reported from east coast centres. An unidentified hymenopteran parasite was recorded on apple and nut borer, *Nephopteryx* sp. from Vengurla.

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

Centres:

East Coast : Bapatla, Bhubaneswar, Jhargram, Vridhachalam
West Coast : Madakkathara, Vengurla
Maidan tract : Chintamani

Objectives:

To identify germplasm accessions tolerant/ resistant to the pests, of regional importance.

Bapatla:

The germplasm accessios in three age groups 8 years old (17 accessions), 6 years old (12 accessions) and 4 years old (13 accessions) were screened against tolerance/susceptibility to (a) *Lamida moncusalis* (b) *Myllocerus* sp. (c) *Hypotima haligramma* (d) *Caloptilea tiselea* (e) *Bombetelia jacosatrix.*

The major pests recorded during Nov-Dec. (foliage season) at the centre were *Lamida moncusalis*, *Myllocerus* sp and *caloptilea tiselea.* Among the six years age group moderate tolerance towards leaf and blossom webber (*Lamida moncusalis*) on fruits and nuts in the cashew collections from Vishakapatnam district was observed as compared to entries from Srikakulam district.

Similarly, among the eight years age group, in T.241 (7.41%), Hy 7/3 (8.95%) and CG 4/4 (9.92%) moderate tolerance towards leaf folder (*Caloptilea tiselea*) and tolerance towards leaf and blossom webber (*Lamida moncusalis*) on nuts were recorded in Hy 3/6 (4.88%), T.211 (8.73%), Hy 3/4 (9.29%) and T.71 (9.92%).

Bhubaneswar:

A total of 16 MLT entries and 44 germplasm accessions were screened for resistance against shoot tip borer under field conditions (Table 3.7 and 3.8)

Among the 16 MLT entries screened in H-1610 the least damage of 2.9 per cent shoot infestation was recorded. The most susceptible entries were H-1598 (36.5%) and V-5 (31.8%)

.

Among the forty four germplasm accessions (planted during 1990- 91) none of the accessions were free from the attack of shoot tip caterpillar during its peak activity. However in OC-27 the least damage range of 1.6-4.5 per cent followed by the accession OC-44 (6.3%), OC-20 (7.7%) and OC-50 (7.9%) was recorded.

The accessions OC-41 (30.3% shoot infestation) was most susceptible, followed by OC-15 (27.6%), OC-4 (26.7%) andd OC-5 (26.4%) to damage by STC.

Table 3.7: Screening of MLT entries for their resistance/tolerance to shoot tip caterpillar during (Sept-Nov.) 1997 at Bhubaneswar Centre.

Cashew types	Percent (Range) shoot damaged
BPT 2/15	0 - 29.3
BPT 2/16	1.4 - 14.7
H-1598	10.3 - 36.5
H-1600	0.0 - 16.3
H-1608	1.5 - 4.4
H-1610	0.0 - 2.9
M-26/2	8.7 - 28.7
T.No.40	4.3 - 17.0
T.No 129	5.6 - 27.6
V-2	8.7 - 28.4
V-3	1.5 - 6.9
V-4	13.2 - 20.0
V-5	5.6 - 31.8
VRI-1	6.5 - 22.6
VTH 30/4	2.8 - 7.1
VTH 59/2	7.2 - 30.0

Jhargram:

Ten germplasm types were screened against shoot tip caterpillar and thrips (flower thrips). The mean incidence of shoot tip caterpillar was 5.1 (Ullal-1) to 12.4 (Digha-8). The mean incidence of flower thrips ranged from 4.7(VTH 30) to 8.9(H-1600).

Vridhachalam:

The available germplasm accessions, F1 hybrids, MLT entries (both clonal and seedlings), released varieties and TMB tolerant lines were screened for their tolerance to the insect pests at the centre.

In the F1 hybrids, the mean per cent damage by shoot and blossom webber ranged from 25.9 - 51.6; mean score of TMB damage

Table 3.8: Screening of germplasms for their resistance/tolerance against shoot tip caterpillar (during Sept.-Nov.1997) at Bhubaneswar centre.

Acccession No.	Percent (Range) shoot infestation
OC-27	1.6 - 4.5
OC-44	2.9 - 6.3
OC-20	5.9 - 7.7
OC-50	2.9 - 7.9
OC-41	11.0 - 30.3
OC-15	19.7 - 27.6
OC-4	4.5 - 26.7
OC-5	20.1 - 26.4

ranged from 2.8-3.3; mean per cent damage of shoot per quadrant by aphids, mealy bugs and thrips (on leaves) ranged from 2.5 - 21.0, 2.4 - 32.1 and 9.3 - 36.8 respectively (Table 3.9).

Among the seventeen seedling MLT entries, the lowest TMB incidence was recorded in VTH 59/2 (2.2) and the highest in H 2/16 (3.6). The lowest incidence of shoot and blossom webber and mealy bugs was noticed in H 44/3. In V-2 the lowest thrips damage was recorded. In V-2 and H-1610 lowest aphids damage was recorded. Among the thirteen clonal MLT entries, the least damage of shoot tip and inflorescence caterpillar (21.4%) and shoot and blossom webber (6.4%) was recorded in M 15/4.

NRCC Sel-1 and Sel-2 were free from thrips infestation. In HY 68 the least score of TMB damage was recorded.(0.8%). Among the released varieties and TMB tolerant lines VRI-1, VRI-2, M 45/4, M 99/4 and M 26/2 screened under laboratory conditions, all the entries exhibited damage symptoms. The least mean score of TMB was registered in VRI-3 (0.4).

Table 3.9: Screening of F1 hybrids for tolerance to cashew pests at Vridhachalam centre (1997).

Hybrid No.	Cross combination	Per cent damage(mean) by		Mean per cent damage/quadrant		
		Shoot blossom webber	Tea mosquito bug	Aphids (on shoots)	Mealy bug (on shoots)	Thrips (on leaves)
H-10	M 10/4 x M 26/1	46.4	3.3	3.2	2.4	15.0
H-11	M 10/4 x M 45/4	51.6	3.0	2.5	32.2	13.7
H-12	M 10/4 x M 75/3	47.4	3.1	10.3	18.2	9.3
H-13	M 44/3 x M 26/1	32.3	3.2	4.9	9.1	36.8
H-14	M 26/1 x M 26/1	32.4	3.1	10.2	15.1	24.8
H-15	M 26/1 x M 75/3	39.7	2.8	13.9	7.5	11.9
H-16	M 44/3 x M 75/3	25.9	3.1	8.2	23.3	27.9
H-17	M 44/3 x M 45/4	30.7	3.3	21.0	4.6	21.4

Table 3.10: Screening of MLT entries (Seedling) against cashew pests in Vridhachalam centre (1997).

MLT entries	TMB incidence mean damage score	Percentage damage (mean) shoot & blossom webber	Damage of shoot/ quadrant		Percent damage (mean) of leaves/ quadrant by thrips
			Aphids	Mealy bug	
H-1598	2.9	31.1	4.9	21.5	4.2
H-1600	2.9	41.8	5.2	3.3	11.0
H-1608	2.8	55.1	7.9	16.8	23.5
H-1610	3.4	41.0	2.4	7.9	16.2
T-129	3.4	21.0	11.5	13.5	10.8
T-40	2.6	31.2	12.8	7.2	11.2
H-2/15	2.5	33.2	13.1	11.4	11.3
H-2/16	3.6	30.7	13.2	3.7	13.2
H 33/3	3.3	29.8	14.6	6.4	10.8
H 44/3	3.1	20.0	27.7	2.8	5.3
M 26/2	3.5	25.0	5.5	5.4	7.3
VTH 30/4	2.5	32.3	22.6	8.8	14.3
VTH 59/2	2.2	22.1	15.2	4.3	8.4
V-2	3.3	31.0	2.4	3.1	3.4
V-3	3.4	35.0	11.8	13.2	14.8
V-4	3.3	30.1	20.5	6.8	11.3
V-5	3.5	28.4	22.4	11.0	7.9

Table 3.11: Screening of MLT entries (clonal) for tolerance to cashew pests at Vridhachalam centre (1997).

Entries	Percent damage (mean) by			Mean TMB damage score
	Shoot tip and Inflorescence caterpillar	Shoot and blossom webber	Leaf thrips	
BAPATLA				
30/1	59.9	8.3	17.2	2.1
3/33	63.3	7.6	12.6	2.1
10/19	56.5	12.5	3.5	1.5
3/28	58.4	12.6	21.4	1.2
VENGURLA				
Hy.68	57.7	15.4	29.5	0.8
Hy.255	46.2	7.5	21.0	1.3
Hy.303	41.3	8.7	18.9	2.2
Hy.320	61.5	6.9	2.2	1.2
Hy.367	59.8	7.2	11.6	2.6
VRIDHACHALAM				
M 44/3	54.9	9.0	29.5	1.4
M 15/4	21.4	6.4	9.8	1.1
NRCC, PUTTUR				
107/3 (Sel.1)	49.9	8.9	0.0	2.6
40/1 (Sel.2)	52.0	11.7	0.0	1.7

Madakkathara:

Comparitively tolerant/less susceptible varieties/types subjected to field confinement test at the centre were- Madakkathara-1, H-3-17, H-718, H-1600, A-26-2, A-6-1, PU-8, K-10-1, H-8-1, H-8-7, H-8-8, H-8-15, Tree No.856. Cage multiplication studies of the varieties A-26-2, Madakkathara-1, H-8-8, H-8-1, H-718, H-3-17 and H-856 was carried out at the centre.

Vengurla:

Eighteen germplasm accessions were field screened against tea mosquito bug at the centre. None of the types were found resistant against TMB. However, minimum incidence was recorded in CYT- 195(16.8%) followed by CYT-176 (21.1%) and H-26(1608) (22.1%).

Chintamani:

Among the 31 accessions/varieties of MLT screened for TMB pest, least TMB damage was recorded in ME 4/4 (0.3), H-1610 (0.3), 1/64 (0.4), H-1608 (0.6) and V-3 (0.7) (Table 3.12). In ME 4/4 and 1/64 though early flushing was observed the TMB damage score was the least. Field confinement studies to confirm the tolerance/ resistance of the same is to be pursued at the centre.

Table 3.12: Tea mosquito damage score on shoots in different accessions at Chintamani centre.

Accession Number	Tea mosquito damage score
Vengurla-1	3.2
V-2	1.2
V-3	0.7
V-4	2.5
V-5	1.5
Bapatla-1	2.2
Bapatla-3	2.6
Bapatla-4	3.5
Bapatla-5	3.2
Bapatla-6	2.3
H-1598	1.6
H-1600	2.4
H-1608	0.6
H-1610	0.3
TN-40	2.5
TN-129	2.4
Hyb.2/15	3.4
Hyb.2/16	1.6
Ullal-1	1.0
Ullal-2	1.3
M 44/3	1.7
V-2	2.1
V-3	2.3
V-4	2.7
M 44/3 (Ven.)	2.2
H-24	1.5
VTH-12	2.6
VTH-30	2.2
VTH-59	2.8
ME 4/4	0.3
1/64	0.4

CHAPTER II. ORGANISATION

(a) HISTORY, OBJECTIVES, GROWTH AND SALIENT ACHIEVEMENTS

The All India Coordinated Spices and Cashewnut Improvement Project (AICS & CIP) was started during the Fourth Five Year Plan in 1971 in which five centres (four University centres and one ICAR-institute based centre) were identified for conducting research on cashew.

These centres were located at Bapatla (Andhra Pradesh), Vridhachalam (Tamilnadu), 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 (Madhya Pradesh) and a sub centre at Pilicode (Kerala) were 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. The headquarters of the independent cashew project was shifted to National Research Centre for Cashew, Puttur in 1986.
2. All India Coordinated Spices Improvement Project.

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 Part 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 export grade kernels, tolerant/resistant to pests and diseases.
2. Standardising agrotechniques for the crop under different agroclimatic conditions; and
3. Evolving cost effective and efficient pest and disease management practices.

The first Workshop of All India Coordinated Spices and Cashewnut 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, Tamilnadu (1975); Panjim, Goa (1978); Trichur, Kerala (1981); Calicut, Kerala (1983); Trivandrum, Kerala (1985); Bhubaneswar, Orissa (1987); Coimbatore, Tamilnadu (1989); National Group discussion in lieu of X Biennial Workshop at Kasaragod, Kerala (1991); Bangalore, Karnataka (1993), Kasaragod, Kerala (1995) and Dapoli, Maharashtra (1997).

Two group discussions were also held one in horticulture at CPCRI, Regional Station, Vittal (1986) and other in entomology at Trichur (1988).

HIGHLIGHTS OF XIII BIENNIAL WORKSHOP OF AICRP ON CASHEW

The XIII Biennial Workshop of All India Coordinated Research Project on Cashew was hosted by Konkan Krishi Vidyapeeth at Dapoli, Maharashtra from 4-6 November 1997.

On 4th November morning the Inaugural Session of the XIII Biennial Workshop of All India Coordinated Research Project on Cashew was presided over by Dr. RN Pal and inaugurated by Dr. AG Sawant, Vice Chancellor, Konkan Krishi Vidyapeeth, Dapoli. A total of 73 delegates including the Scientists in position at the 9 Coordinating Centres, except the Jr. Entomologist from Jhargram Centre, participated in the Biennial Workshop.

Dr. AG Sawant, Vice Chancellor, KKV, inaugurating the XIII Biennial Workshop of AICRP on Cashew

There were four Technical Sessions namely, Crop Improvement - Chaired by Dr. JC Rajput, Assoc. Director of Research, RFRS, Vengurla; Crop Management - Chaired by Dr. RT Gunjate and Co-chaired by Dr. MG Magdum and Crop Protection-Chaired by Dr. CC Abraham and Co-Chaired by Dr. RB Dumbre. There was a Special Session on review of work done on tea mosquito bug and stem and root borer. The deliberations in the technical sessions were held on 4th and 5th November 1997. On 6th November morning, Dr. SP Ghosh, Dy.Director General (Hort.), ICAR delivered the Keynote address "Opportunities and Challenges for Cashew Development in India". During the keynote address the DDG (Hort.) stressed the need to exploit the hardiness of cashew

crop to withstand deficient water situations. He has also highlighted the importance of developing varieties with low fat so that the apprehension that cashew kernels are harmful to health can be overcome. The proceedings of the Technical Sessions were presented in the Special Session presided over by Dr. SP Ghosh, DDG (Hort.). "Catalogue of minimum descriptors of cashew germplasm accessions-I" was released by Dr. S. P. Ghosh.

There was a separate session for interaction with the Development Agencies & Transfer of Technology, which was chaired by Mr. PP Balasubramanian, Director, Directorate of Cashewnut Development, Cochin. One of the important decisions taken in this session was to see that the procedure adopted now for purchase of grafts and plant protection chemicals through tenders is substituted with the inspection by an Expert Committee and purchase of grafts effected only after quality is ascertained. The major recommendations of the Workshop are as follows:

1. Hitherto only one variety namely Bhubaneswar-1 is released for cultivation in Orissa, based on the evaluation conducted by AICRP on Cashew Centre, OUAT, Bhubaneswar. In the multilocation varietal trial, the performancee off Hybrid 2/16 (BPP-8) was found to be consistently superior over the years at Bhubaneswar and hence the same is recommended for cultivation in Orissa.
2. A new variety V-7 was released for cultivation in Maharashtra by AICRP on Cashew Centre, Vengurla (Regional Fruit Research Station) under Konkan Krishi Vidyapeeth. This variety has export grade kernels and yield potential of 2 t/ha.
3. In order to rationalize the fertilizer application based on the soil fertility levels in different cashew growing States, it was decided to undertake the soil fertility evaluation in 30 districts in major cashew growing states where in each an area over 5000 ha is under cashew. Soil survey maps prepared by the National Bureau of Soil Survey and Land Use Planning will be consulted beforeundertaking this work.
4. Studies on root stock will be initiated for identification of root stock for drought prone areas and also for dwarfing characters.
5. In order to finalize the package of the available technologies, namely, high density planting, pruning, supplementary irrigation and fertilization, experimental protocols may be developed for different Coordinating Centres. It was suggested that all the available technologies need not be tested at all the Centres, but the most appropriate one which can overcome the present crop constraint in the region will be taken up.
6. For the control of foliage and inflorescence pests, especially, the tea mosquito bug, newer chemicals will be tested at all the Centres.
7. The results reported on the control of tea mosquito bug and other foliage and inflorescence pests have indicated that in high rainfall areas the spraying at flowering and fruiting is beneficial. However, in other areas all the three recommended sprays are to be continued.

8. In the regions where thrips are the major problem, use of monocrotophos is necessary as endosulphan was found to be less effective.

9. For overcoming root and stem borer problem it is necessary to develop an effective curative measure. The most effective stem swabbing treatment (either coal tar and kerosene or mudslurry with carbaryl) will be tried along with different soil treatments with sevidol, lindane and *Metarhizium anisopliae*.

10. All the delegates of the Workshop strongly felt the need for reliable estimates of area and production and suggested that a Crop Estimation Cell may be started in the Directorate of Cashewnut Development to undertake this work during the IX Plan period.

The Workshop came to a close with Vote of Thanks by Dr. EVV Bhaskara Rao, Director and Project Coordinator (Cashew), NRCC.

The significant achievements of the Project are summarised below:

1. A total of 27 cashew varieties are released by the various Coordinating centres for cultiation in the respective regions. Some varieties have shown wider adaptability and are therefore recommended to those areas also. In the XIII Biennial Workshop 1997 held at Dapoli, a new variety V-7 (H- 255) was recommended for release for the Konkan region of Maharashtra and adjoining cashew growing region of Goa and Karnataka.

2. Fertilizer requirement of cashew crop was worked out to be 1000g N, 250g P_2O_5 and 250g K_2O per tree at Chintamani and Bhubaneswar centres and 500g N, 125g P_2O_5 and 125g K_2O per tree at Bapatla, Vengurla, Madakkathra and Vridhachalam centres.

3. Fertilizer application in circular trench of 25cm broad, 15cm depth and 1.5m away from the trunk was found to be beneficial in sandy loam, laterite and in slopy lands. However, in low rainfall zone fertilizer application in an area of 1.5m width, between 1.5m and 3.0m from the trunk and forking into the soil is found to be economical and most efficient.

4. Supplementing the soil application of NPK with foliar application of urea (2 to 4%) along with insecticides increased the yield of cashew both at east coast and west coast regions.

5. Softwood grafting technique was standardised for vegetative propagation of cashew.

6. In Intercropping trial clusterbean and cowpea at Bapatla and horsegram at Bhubaneswar were found profitable.

7. In on-farm trial with higher doses of fertilizers at Bapatla an increase in the yield from 7.6 kg/tree to 9.2 kg/tree to 18.7 kg/tree was noticed when the fertilizer dose was normal, doubled and tripled.

8. For control of TMB, spraying of monocrotophos (0.05%) at flushing, endosulfan (0.05%) at flowering and carbaryl (0.1%) at fruiting stage was found to be most effective at Bapatla, Chintamani, Jhargram and Vridhachalam centres.

9. Skipping of carbaryl (0.1%) at fruiting stage did not increase TMB incidence at Jhargram centre and hence skipping one spray was found economical.

10. Application of neem oil (5%) upto 1m height of the base of trunk or swabbing the main stem and exposed roots with neem oil (5%) + application of sevidol 8G @ 75g/tree to the basin or application of mudslurry with carbaryl (0.2%) was found effective prophylactic control measure against stem and root borer.

(b) TRANSFER OF TECHNOLOGY EFFORTS

Extension activities such as conducting 'cashew day', maintenance of on-going demonstration plots and laying out fresh demonstation plots in farmers' fields, arranging training programmes, giving radio talks etc. have been undertaken by centres of AICRP on Cashew. Most of the centres have conducted cashew field day. A total of 174 demonstration plots are in operation in farmers' fields including a few which have been freshly laid out. Fifteen training programmes were conducted and hundreds of farmers and officials of development departments attended the trainings during the year under report. A total of 20 radio talks were given by scientists of centres on different aspects of cashew cultivation during the year under report.

In eight centres regional nurseries have been started through the interest free loan from Directorate of Cashewnut and Cocoa Development (Government of India), Cochin. About 3.60 lakh cashew grafts of released varieties were produced by the different centre of AICRP on Cashew during the current year.

(c) STAFF POSITION

AT HEADQUARTER:

Project Coordinator	:	Dr. E.V.V. Bhaskara Rao
Senior Scientist	:	Dr. M. Gopalakrishna Bhat
Technical Information Officer	:	Dr.(Mrs) Uma Raghunathan (upto 13th March 1998)
Stenographer	:	Mrs. B. Jayashri

PROJECT CENTRES:

Cashew Research Station, (Acharya NG Ranga A U), Bapatla 522 101, Andhra Pradesh.

Horticulturist	:	Dr. M.Lakshmi Narayana Reddy
Asst.Entomologist	:	Mrs. M.Rama Devi
Asst.Agronomist	:	Mr. Y.Radhakrishna
Senior Tecnical Assistant	:	Mr. B.Krishnamurthy
Jr.Technical Assistant	:	Mr. K. Ranga Rao
Grafter	:	Mr. V.Kantha Rao

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

Horticulturist	:	Mr. P.C. Lenka
Jr.Horticulturist	:	Dr. K.C. Mohapatra
Jr. Entomologist	:	Mr. L.N. Mohapatra
Sr.Technical Assistant	:	Mr. P.C. Swain
Jr.Technical Assistant	:	Mr. R.C. Routray
Grafter	:	Mr. R.K. Pradhan

Agricultural Research Station, (UAS), Chintamani 563 125, Karnataka.

Horticulturist	:	Mr. H.B. Lingaiah
Jr.Horticulturist	:	Mr. Vishnuvardhan
Jr.Entomologist	:	Mr. G.T. Thirumalaraju
Sr.Technical Assistant	:	Mr. Shivappa
Sr.Technical Assistant	:	Mr. N.Janakiraman
Grafter	:	Vacant

Zonal Agricultural Research Station, (IGAU), Jagdalpur 494 005, Madhya Pradesh.

Jr.Entomologist	:	Dr. Sanjay Sharma
Jr. Horticulturist	:	Vacant
Sr. Technical Assistant	:	Mr. K.R.Gond
Grafter	:	Mr. Jagdeo

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

Horticulturist	:	Dr. A.Bandyopadhyay(from 1.8.1997)
Jr.Horticulturist	:	Dr. S.B. Chattopadhyaya
Jr.Entomologist	:	Dr. B.Bandyopadhyay
Sr.Technical Assistant	:	Mr. S.Sarkar
Jr.Technical Assistant	:	Mrs. K.Bose
Grafter	:	Mr. Jagannath Shaw (from 12.12.97)

Cashew Research Station,(KAU), Madakkathara, 680 656, Kerala.

Horticulturist	:	Dr. M. Abdul Salam (Associate Professor Agronomy)
Jr.Entomologist	:	Dr.(Mrs)Susanamma Kurien (Asst.Professor Nematology)
Sr.Technical Assistant	:	Mrs. B.Suma
Jr.Technical Assistant	:	Mr. KK Reghuraj (from 26.5.97)
Grafter	:	Mr.S.Sasi (from 1.8.97)

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

Jr.Horticulturist	:	Dr.B Jayaprakash Naik

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

Horticulturist	:	Dr. B.B. Sapkal (from 1.6.1996)
Jr.Entomologist	:	Mr. A.Y. Munj (from 4.7.1996)
Jr.Breeder	:	Mr. S.B. Deshpande
Sr.Technical Assistant	:	Mr. P.G. Dhuri (from 5.10.1996)
Jr.Technical Assistnat	:	Mr. R.L. Mayekar

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

Horticulturist	:	Dr. M.Selvarajan
Jr.Horticulturist	:	Mr. V.Lakshmanan
Jr.Entomologist	:	Mr. S.Douressamy (till 25.7.97)
	:	Mr. V.Ambethgar (from 25.7.97)
Sr.Technical Assistant	:	Mr. S.Manickam
Jr.Technical Assistant	:	Mr. T.Chinnadurai
Grafter	:	Mr. P.Gopalakrishnan

(d) BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 1997-98.

ALLOCATION

(Rs. in lakhs)

Centre	Pay and allow-ances	T.A.	Recurr-ing con-ting.	Non.Recu-rring co-nting.	Total	ICAR share
BAPATLA	3.70	0.25	1.20	-	5.15	3.86
BHUBANESWAR	3.70	0.25	1.20	-	5.15	3.86
CHINTAMANI	3.80	0.25	1.20	-	5.25	3.94
JAGDALPUR	2.40	0.25	0.80	-	3.45	2.59
JHARGRAM	3.70	0.25	1.20	-	5.15	3.86
MADAKKATHARA	3.25	0.25	0.80	-	4.30	3.23
PILICODE	0.90	0.25	0.40	-	1.55	1.16
VENGURLA	3.40	0.25	1.20	-	4.85	3.64
VRIDHACHALAM	3.70	0.25	1.20	-	5.15	3.86
TOTAL	**28.55**	**2.25**	**9.20**	**-**	**40.00**	**30.00**

ACTUAL EXPENDITURE

(Rs. in lakhs)

Centre	Pay and allow-ances	T.A.	Recurr-ing con-ting.	Non.Recu-rring co-nting.	Total	ICAR share
BAPATLA	5.80	0.16	1.20	-	7.16	5.37
BHUBANESWAR	5.92	0.30	1.20	-	7.42	5.56
CHINTAMANI	4.79	0.24	0.99	-	6.02	4.51
JAGDALPUR *	1.28	-	0.66	-	1.94	1.46
JHARGRAM	4.15	0.05	0.77	-	4.97	3.72
MADAKKATHARA	5.12	0.25	0.80	-	6.17	4.62
PILICODE	1.37	0.07	0.40	-	1.84	1.38
VENGURLA	4.71	0.07	1.19	-	5.97	4.48
VRIDHACHALAM	6.41	0.24	1.20	-	7.85	5.89
TOTAL	**39.55**	**1.36**	**8.41**	**-**	**49.32**	**36.99**

* upto 28-2-98

(e) MONITORING OF PROJECT BY COORDINATOR

The programmes to be implemented in different centres was reviewed during the XIII Biennial Workshop held at Dapoli, Maharashtra from 4-6 November 1997.

The visit by Project Coordinator to different centres were as follows:

10-03-1997	:	Chintamani
14-03-1997	:	Vridhachalam
4-06-1997	:	Jhargram
9-06-1997	:	Bhubaneswar
4-08-1997	:	Madakkathara
6-08-1997	:	Vengurla
8-08-1997	:	Chintamani
28.08.1997 to 29.08.1997	:	Bhubaneswar
30.08.1997	:	Vridhachalam
1.09.1997	:	Bapatla
16.09.1997	:	Dapoli, (KKV)
3.11.1997 to 6.11.1997	:	Dapoli, (KKV)
7.11.1997	:	Vengurla
3.02.1998	:	Bapatla

During the visits to the centres, the technical programmes allotted to each of the centres and the progress made was reviewed along with inspection of field experiments. University authorities were met to apprise the progress of work in the centres, QRT team visited the centres in August and September 1997 and evaluated the work being done and submitted its report for the period 1992 to 1996 in December 1997.

Ghatikia Scion Bank OSCDC Ltd., with drip irrigation

During the visit to different states, Director also participated in National Seminars Viz. AGRITECH 97 on Prosperity through farm productivity at Calcutta. At Indian Institute for Horticultural Research, Bangalore discussed with Deputy Director General (Hort.) regarding QRT review of NRCC and AICRP on Cashew centres work.

Visited Regional Nursery of Orissa State Cashew Development Corporation (OSCDC) and held discussions with Chairman and Managing Director of OSCDC, Bhubaneswar.

Visited cyclone affected areas in Andhra Pradesh along with Director, NRC Oil Palm, Director CPCRI to assess the damage and possibility of revival of plantation crops in cyclone affected areas and cashew plantation material requirement.

Visited KKV, Dapoli to finalize the arrangements for holding XIII Biennial Workshop of AICRP on Cashew in the month of November 1997. During the visit to the centres, production and availability of grafts of the released varieties was reviewed and suggested means to increase the production of grafts. Reports received from the centres in the Project Coordinator's Cell were critically reviewed and necessary guidelines as and when required were sent.

(f) FUNCTIONING OF EACH CENTRE

Bapatla (ANGRAU)

The centre was allotted experiments in the disciplines of Crop Improvement, crop management and crop protection. Multilocation varietal trial MLT-86 was discontinued at this centre.

Attempt should be made to clear the concluded experiments and lay out the new trials in a systematic way in the new block. A separate plot may be established for taking up entomology trials especially on control of foliage and inflorescence pests. The work of the centre should be streamlined and the performance of the centre needs improvement.

Drs MLN Reddy, M Ramadevi and Mr. Y Radhakrishna of Bapatla centre explaining field experiments to QRT members

Bhubaneswar (OUAT)

Performance of Bapatla variety H2/16 (BPP 8) was found to be very promising at this centre, even in drought condition. H 320 from Vengurla gave bold nuts. In hybridization trials, it is reported that flowering period of parents suggested does not coincide. Therefore, parents may be selected from the collection available at Bhubaneswar centre itself. The centre has taken up NPK trial, yield maximisation plot (high density planting at 4m x 4m spacing) using BPP 8 (H 2/16) grafts. Simurba oil (Simurba glauca) will be tested against TMB as well as CSRB. Stem and root borer treatment be shifted from May to March as the pest incidence commenced from March in Bubaneswar conditions. During QRT's visit to

the centre it was suggested that the flushing differences between the accessions be quantified in terms of physiological status. Pest infestation to be correlated with cluster bearing habit and differences between the infestation in cluster bearing and non-cluster bearing types be observed. Production of pollen in different varieties in relation to the thrips infestation be recorded. All field experiments are being conducted well and performance of the centre is assessed as good.

Drs. PC Lenka and Mohapatra of Bhubaneswar centre explaining field experiments to QRT members.

Chintamani (UAS)

All the experiments allotted to the centre were taken up by the centre. Performance of V-5 was found to be good. But the nut size is small. The centre has been advised to cross V-5 and M 44/3 (VRI-2) with locally collected bold nut types. The centre has established different types of poly-houses for the propagation programme. It is worthwhile to give the problems as PG and Ph.D student programme for quantifying the effect of different types on the success of grafting. Centre's performance is assessed as good.

Jagdalpur (IGKV)

Jagdalpur centre was started in the year 1993. The multilocation varietal trial MLT-92 and entomological trials(except Ent.2 and 4) are being pursued at the centre. Grafts of entries collected from NRCC, Puttur, Madakkathara and Bapatla centres were planted. Serious and sincere efforts are required to be made by the centre in establishment of all field experiments.

Jhargram (BCKV)

The germplasm holdings at the centre are

116. The multilocation varietal trial MLT-92 has to be replanted with same aged grafts as some entries are missing in the existing trial. The entomological trials were properly conducted.

The centre was not punctual in sending the required reports to the PC unit for compilation and several reminders had to be sent to get the reports / information. Overall performance of the centre needs improvement.

Madakkathara (KAU)

The centre is pursuing most of the trials in crop improvement, crop management and crop protection disciplines. Seed nuts from Brazil were obtained through CEPC and were added to the germplasm. In hybridization programme, BLA 139-1 was crossed with Vetore-56 and VTH 711/4. The centre has identified five centres under Kerala Agricultural University to layout demonstration plots with Priyanka grafts. QRT Team during its visit to the experimental plots and reviewing nursery programme, advised that the pest incidence may be correlated with the weather parameters and model for prediction of pest incidence may be developed. The performance of the centre is satisfactory.

Dr. RB Dumbre, Director of Research, KKV, discussing with QRT members.

Pilicode (KAU)

The centre was started during 1994. Survey of northern districts of Kerala for germplasm collection was assigned to the centre. The performance of the centre is satisfactory.

Vengurla (KKV)

The centre has undertaken the collection of bold nut types from Maharashtra and Goa. A hybrid H-255 was released as Vengurla-7 for the Konkan region of Maharashtra and adjoining areas of Goa and Karnataka. Hybridization work for improvement of nut size of V-2 and V-5 was started. During the QRT visit to the Vengurla centre, the team suggested that Vengurla centre be recognised for Doctoral programme by KKV, Dapoli. The problems on flowering pattern and self incompatibility and fruit reduction in germplasm collection may be given as problems to Ph. D. study. Vengurla centre produces every year over 2 to 3 lakhs of grafts. The centre's performance is assessed as satisfactory.

Dr. JC Rajput, Associate Director Research, explaining field experiments to QRT members at RFRS, Vengurla.

Vridhachalam (TNAU)

The centre has 255 accessions in its cashew germplasm. It has been advised to discontinue the

MLT-86 trial as plant stand is not adequate. Treatment of carbaryl (0.2%) in mudslurry and sevidol 8G granules was found effective as prophylactic control against stem and root borer. Entomological projects are going on well. During the QRT's visit to the centre it suggested to look for early flowering cashew types which completes fruiting before the beginning of severe summer, to check the compatibility of endosulfan with urea and its efficacy and to investigate the reasons for increase of yield in 3% and 4% urea spray inspite of p1p- higher TMB incidence. The performance on the centre is assessed as satisfactory.

(g) PROBLEMS IN FUNCTIONING OF THE CENTRES

For Chintamani centre although a jeep was sanctioned in the VIII Plan budget, the Council's clearance is still awaited. A post of Junior Horticulturist at Jagdalpur centre and a post of grafter at Chintamani centre need to be filled by the respective universities at the earliest.

(h) METEOROLOGICAL DATA (1997)

BAPATLA

Month	Temperature (°C)		Relative humidity %		Rain-fall m.m.	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan.	28.3	16.4	90.0	66.0	22.3	2
Feb.	30.2	18.3	91.0	71.0	0.0	0
Mar.	32.7	21.2	86.0	68.0	0.0	0
Apr.	32.2	23.7	77.0	70.0	104.6	2
May.	37.7	26.8	63.0	57.0	9.9	1
Jun.	39.4	27.6	56.0	51.0	26.7	2
Jul.	36.8	26.7	64.0	51.0	57.8	6
Aug.	35.8	25.8	68.0	61.0	216.4	15
Sep.	33.0	25.4	82.0	78.0	362.5	11
Oct.	31.8	23.4	86.0	77.0	112.4	8
Nov.	30.3	23.0	87.0	82.0	88.0	7
Dec.	29.4	21.6	92.0	79.0	118.3	8

BHUBANESWAR

Month	Temperature (°C)		Relative humidity %		Rain-fall m.m.	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan.	27.3	13.6	90	45	67.5	3
Feb.	31.1	17.1	92	39	8.0	3
Mar.	34.7	22.1	97	46	54.6	4
Apr.	34.1	21.9	91	59	135.5	10
May.	36.7	25.6	88	56	16.3	3
Jun.	36.1	25.9	89	60	184.0	13
Jul.	33.3	25.6	92	73	191.9	16
Aug.	32.0	24.8	94	80	534.7	21
Sep.	32.3	24.6	95	79	348.6	17
Oct.	32.9	22.4	94	61	32.3	4
Nov.	32.1	20.9	94	56	9.4	1
Dec.	28.4	17.4	89	57	27.7	4

CHINTAMANI

Month	Temperature (°C)		Relative humidity %		Rain-fall m.m.	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan.	26.2	NR	74.2	47.7	5.0	1
Feb.	29.9	NR	65.6	32.1	0.0	0
Mar.	32.6	NR	53.5	28.6	33.4	2
Apr.	32.8	NR	61.6	31.4	79.6	4
May	32.9	21.4	64.2	30.1	9.7	1
Jun.	31.9	21.7	77.3	41.4	119.2	8
Jul.	31.1	21.4	72.3	48.0	46.9	5
Aug.	30.7	21.1	72.6	46.7	27.7	3
Sep.	32.1	20.5	76.4	56.6	193.8	10
Oct.	31.5	20.1	73.1	54.5	85.9	5
Nov.	30.6	18.8	82.4	61.4	68.7	6
Dec.	26.7	15.3	74.0	57.3	10.1	1

JAGDALPUR

Month	Temperature (°C)		Relative humidity %		Rain-fall m.m.	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan.	26.2	9.9	93	35	18.1	1
Feb.	30.9	12.1	87	25	0.0	0
Mar.	35.7	17.9	74	74	47.8	1
Apr.	33.7	19.3	75	34	65.6	7
May	38.1	25.1	55	20	12.0	3
Jun.	34.7	24.5	71	41	141.7	8
Jul.	28.7	23.0	86	72	207.2	14
Aug.	27.0	22.7	90	74	196.3	13
Sep.	29.3	22.3	93	69	133.0	9
Oct.	29.5	18.9	95	50	39.0	2
Nov.	29.0	18.2	94	47	72.3	5
Dec.	26.5	16.5	96	53	61.0	5

JHARGRAM

Month	Temperature (°C)		Relative humidity %		Rain-fall m.m.	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan.	26.0	11.0	80.0	39.4	0.0	0
Feb.	28.8	15.4	80.2	40.7	12.0	2
Mar.	34.0	20.4	82.0	35.9	15.8	4
Apr.	37.0	24.1	81.0	43.5	49.3	6
May.	38.9	23.3	82.9	46.4	20.0	5
Jun.	38.4	22.8	86.5	65.9	178.4	10
Jul.	34.7	23.0	92.4	71.0	256.0	15
Aug.	35.2	22.6	88.0	66.9	280.2	19
Sep.	34.8	21.8	89.8	70.0	218.6	13
Oct.	30.2	22.0	84.0	60.8	156.4	11
Nov.	28.8	14.4	79.0	50.2	38.2	6
Dec.	25.1	12.7	74.2	46.9	28.0	4

MADAKKATHARA

Month	Temperature (°C)		Relative humidity %		Rain-fall m.m.	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan.	32.0	22.9	78	45	0.0	0
Feb.	33.9	21.8	82	39	0.0	0
Mar.	35.7	24.0	82	37	0.0	0
Apr.	35.2	24.5	83	50	8.2	1
May.	34.4	24.5	87	57	63.0	4
Jun.	31.2	23.0	93	71	720.5	18
Jul.	28.6	21.8	95	84	979.2	28
Aug.	29.0	22.8	95	78	636.8	23
Sep.	30.6	23.4	93	71	164.0	13
Oct.	32.2	23.6	88	65	194.7	12
Nov.	31.6	23.2	88	67	209.7	7
Dec.	31.7	23.8	83	60	66.7	2

PILICODE

Month	Temperature (°C)		Relative humidity %		Rain-fall m.m.	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan.	31.2	19.8	91.9	57.2	0.0	0
Feb.	31.1	20.3	85.4	60.9	0.0	0
Mar.	32.5	23.6	87.2	64.6	0.0	0
Apr.	33.4	24.8	78.5	54.9	0.0	0
May.	33.7	25.5	79.6	59.1	11.5	2
Jun.	30.8	23.6	89.0	79.0	1029.3	21
Jul.	27.9	23.1	98.7	90.6	1569.5	27
Aug.	28.8	23.1	97.9	84.6	760.7	25
Sep.	30.4	23.6	93.0	74.0	176.3	11
Oct.	31.4	23.8	92.0	70.0	82.0	5
Nov.	31.6	23.4	93.0	70.0	115.3	9
Dec.	31.8	23.1	94.0	67.0	59.3	5

VENGURLA

Month	Temperature (°C)		Relative humidity percentage	Rain-fall m.m.	No. of rainy days
	Maximum	Minimum	Mean		
Jan.	31.0	16.2	79.0	-	-
Feb.	28.9	14.7	77.0	-	-
Mar.	31.6	20.5	86.0	-	-
Apr.	31.0	21.9	68.0	-	-
May.	32.0	24.0	67.0	-	-
Jun.	30.9	24.0	82.0	992	22
Jul.	30.0	25.1	87.0	992	31
Aug.	29.5	24.2	89.0	829	31
Sep.	31.0	24.0	86.0	52	12
Oct.	33.0	23.6	83.0	17	5
Nov.	32.7	22.7	89.0	65	5
Dec.	31.7	20.7	83.0	84	2

VRIDHACHALAM

Month	Temperature (°C)		Relative humidity %		Rain-fall m.m.	No. of rainy days
	Maximum	Minimum	AM	PM		
Jan.	30.6	19.5	91	72	5.4	0
Feb.	33.7	19.2	91	65	0.0	0
Mar.	36.2	23.7	87	64	0.0	0
Apr.	38.2	27.8	89	61	0.0	0
May.	40.5	32.1	82	58	0.0	0
Jun.	39.1	29.3	79	49	34.7	4
Jul.	39.0	29.9	78	58	15.8	4
Aug.	35.9	28.4	83	59	74.2	4
Sep.	35.7	27.1	90	60	56.4	3
Oct.	32.5	26.3	85	78	155.5	9
Nov.	29.7	24.8	87	76	386.3	18
Dec.	27.3	NR	90	73	367.3	10

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