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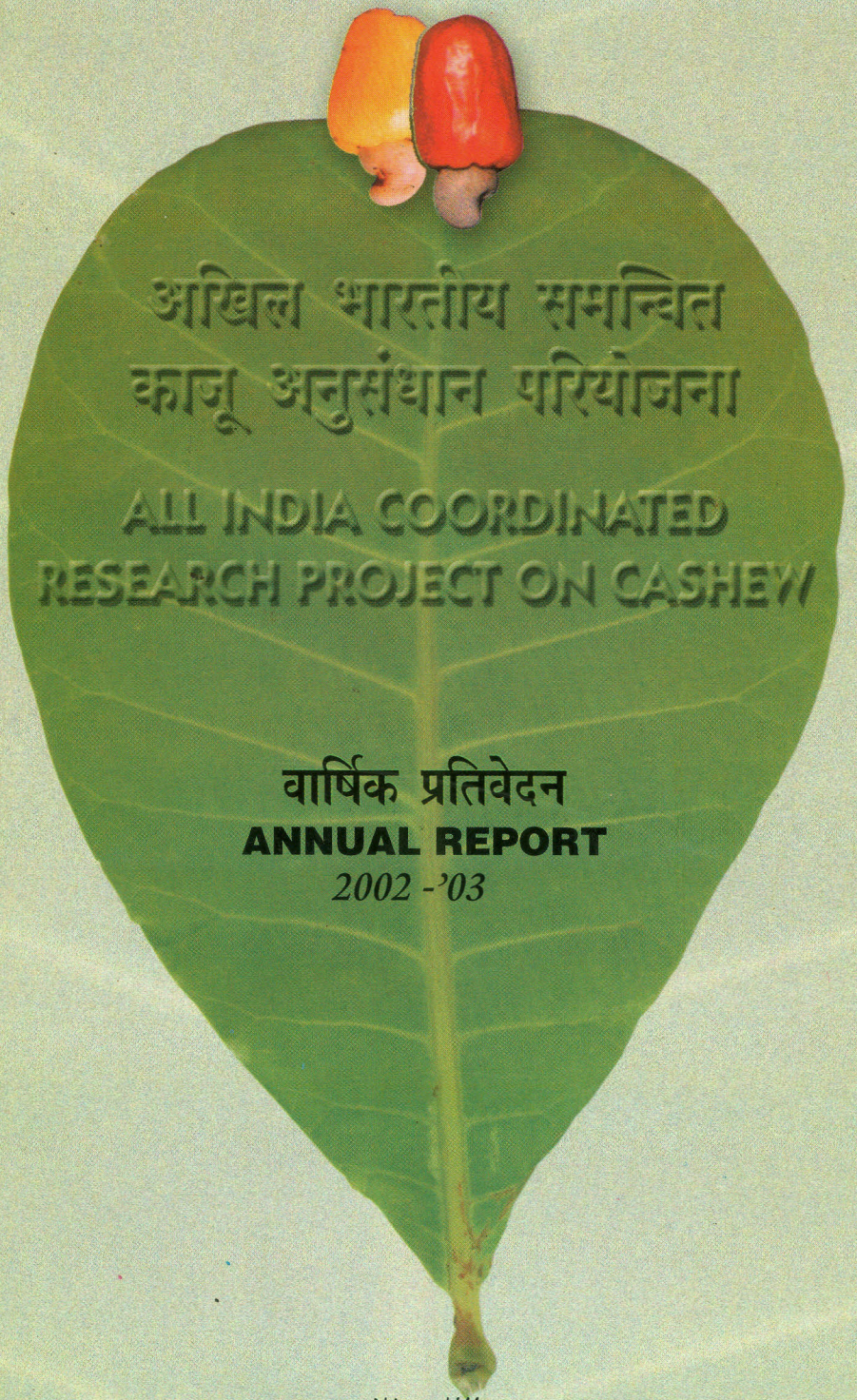

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना

ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW

वार्षिक प्रतिवेदन
ANNUAL REPORT
2002 -'03

भाकृअनुप
ICAR
राष्ट्रीय काजू अनुसंधान केन्द्र
(भारतीय कृषि अनुसंधान परिषद्)
पुत्तूर, दक्षिण कन्नड, कर्नाटक - 574 202

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(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
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ANNUAL REPORT 2002-03

परियोजना समन्वयकर्ता
PROJECT COORDINATOR

डा. ई.वी.वी. भास्कर राव
Dr. E.V.V. Bhaskara Rao
(up to 15-3-2003)

राष्ट्रीय काजू अनुसंधान केंद्र
(भारतीय कृषि अनुसंधान परिषद्)
पुत्तूर, दक्षिण कन्नड, कर्नाटक

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Dedicated to the Fond Memory Of

Late Dr. EVV. Bhaskara Rao, Former Director and Project Coordinator (Cashew) National Research Centre for Cashew, Puttur

OBITUARY

Dr. E.V.V. Bhaskara Rao, Director, National Research Centre for Cashew, Puttur, Dakshina Kannada, Karnataka, expired on 15th March 2003 at 9.50 PM at Kasturba Hospital, Manipal. Dr. Bhaskara Rao was born on 17th July 1948 in West Godavari District of Andhra Pradesh and obtained his Master's and Doctoral Degrees from Andhra University in Cytogenetics and Plant Breeding. He started his career as an Assistant Botanist in coconut breeding at Central Plantation Crops Research Institute (CPCRI), Kasaragod in 1976. He had undergone a specialised training in Germplasm Cataloguing and Management at Birmingham University and IRHO, Ivory Coast, under IPGRI/FAO Fellowship. He was the project leader for the first systematic collection of coconut germplasm from South Pacific Islands (Papua New Guinea, Fiji, American Samoa, Solomon Islands, French Polynesia, Western Samoa and Tonga). Since assuming the charge as Project Coordinator (Cashew) in 1986, he had guided and monitored the cashew research in the country. He was associated with the establishment of National Research Centre for Cashew, Puttur (Karnataka) since its inception and has served as its Director since 1995. Under his guidance 15 cashew varieties were released in the country. His significant contribution to cashew was the large scale commercial production of clonal planting material. This has revolutionised the production potential of cashew in the country. He has also served as FAO consultant in Vietnam and Myanmar. By his death, the country has lost an eminent Researcher and Administrator. He has left behind his wife, a son and a daughter, two grand children, and many colleagues, friends and relatives, to mourn this irreparable loss to science. The staff of AICRP on Cashew prays for eternal peace for the departed soul.

प्राक्कथन

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की उन्नीसवीं वार्षिक प्रतिवेदन प्रस्तुत है । इस प्रतिवेदन में वर्ष 2002 जनवरी से दिसंबर तक की अनुसंधान उपलब्धियाँ तथा वित्तीय वर्ष 2002-03 की अन्य जानकारी सम्मिलित की गई है ।

इस परियोजना में कुल आठ केंद्र और एक उप केंद्र है जैसे पूर्व तट पर बापट्ला (आंध्र प्रदेश), भुवनेश्वर (उड़ीसा), ज्ञारग्राम (प. बंगाल) और वृद्धाचलम् (तमिल नाडु); पश्चिम तट पर माडक्कतरा केंद्र और पिलिकोड अपकेंद्र (केरल) तथा वैगुर्ले (महाराष्ट्र); मैदानी भाग में दो केंद्र, एक चिंतामणि (कर्नाटक) और दूसरी जगदलपुर (छत्तीसगड़) स्थित है ।

प्रतिवेदन में चालू बारह अनुसंधान विषयों की उपलब्धियों को क्षेत्रीय स्तर पर और विषयानुसार जैसे सस्य प्रजनन (3), सस्य विज्ञान (5), और कीट विज्ञान (4) संकलित कर प्रस्तुत की गई है ।

1. तकनीकी परियोजना और क्षेत्रीय तौर पर प्राप्त तकनीकी प्रायोगिक उपलब्धियाँ, और
2. इतिहास, कर्मचारी, वित्तीय प्रावधान, मौसम की आँकड़े और शोध प्रकाशन आयोजन पर प्रकाशित है ।

एम. गोपालकृष्ण भट

(एम. गोपालकृष्ण भट्ट)

कार्यकारी निदेशक एवं परियोजना समन्वयकर्ता

पुत्तूर - 574 202

दिनांक : 31-12-2003

ABOUT THIS REPORT

This is the ninteenth Annual Report of the All India Coordinated Research Project on Cashew. This report covers the research results for the calendar year January to December 2002 with all other information pertaining to the financial year 2002-03.

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

There are twelve research projects pertaining to disciplines such as, Breeding (3), Agronomy (5) and Entomology (4). The results reported by each centre are compiled region-wise and discipline wise and presented in this report.

This report consists of two chapters, they are:

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

M. Gopalakrishna Bhat

(M. GOPALAKRISHNA BHAT)
ACTING DIRECTOR AND PROJECT COORDINATOR

Puttur - 574 202
Dated: 31-12-2003

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CHAPTER II: ORGANISATION

CHAPTER I : TECHNICAL

समन्वयकर्ता की रिपोर्ट

अखिल भारतीय समन्वित मसाला व काजू अनुसंधान पारयोजना 1971 में चौथी पच वार्षिक योजना में शुरू की गई, जिसका मुख्यालय केंद्रीय रोपण फसल अनुसंधान सस्थान कासरगोड में था । सातवी पंचवार्षिक योजना में इस परियोजना को दो स्वतंत्र परियोजनावों - एक काजू व दूसरी मसाले में विभजित किया गया। अखिल भारतीय समन्वित काजू अनुसंधान पारयोजना का मुख्यालय नव निर्मिन राष्ट्रीय काजू अनुसंधान केंद्र पुत्तूर में 1986 को स्थानांतरित किया गया ।

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना के आठ केंद्र और एक उपकेंद्र है, जिस में चार केंद्र 1971 में अखिल भारतीय समन्वित मसाले व काजू अनुसंधान परियोजना के शुरूवात में बापट्ला (ए.एन.जी.आर.ए.यू पहले ए.पी.ए.यू) माडक्कतरा (केरल कृषि विश्वविद्यालय, आनक्कयम से स्थानांतरित), वेंगुर्ले (डॉ. बाला साहेब कोकण कृषि विद्यापीठ) और वृद्धाचलम (तमिल नाडु कृषि विश्वविद्यालय) में प्रारंभ किया गया। पाँचवीं पंचवार्षिक योजना में एक केंद्र भुवनेश्वर (ओ.यू.ए.टी.) और छठी पंच वार्षिक योजना में दो केंद्र - झारग्राम (बी.सी.के.वी.) और चिंतामणि (यू.ए.एस.) को सम्मिलित किया गया । आठवीं योजना में एक केंद्र - जगदलपुर (आई.जी.ए.यू.) और एक उपकेंद्र पिलिकोड (के.कृ.वि.) प्रारंभ किया गया । अखिल भारतीय समन्वित काजू अनुसंधान परियोजना के यह केंद्र 8 काजू वर्धित राज्यों में स्थित है और यह विभिन्न राज्य कृषि विश्वविद्यालयों के प्रशासनिक नियंत्रण में है ।

परियोजना का 2002-03 में बजट आबंटन रु.106.66 लाख (रु.80.00 लाख भा.कृ.अ.प.का अंश) था और व्यय रु.95.14 लाख (रु.71.36 लाख भा.कृ.अ.प.का.अंश) था ।

निम्न विधियों से काजू की उत्पादन क्षमता बढाना इस पारयोजना के लक्ष्य है:

1. निर्यात स्तर की अष्टी, रोग एवं कीट क्षमता / रोध के उच्च उपज प्रदत्त प्रजातयों का विकास ।
2. विभिन्न सस्य जलवायु परिस्थितियों में काजू फसल के लिए कृषि प्रौद्योगिकी का मानकीकरण ।
3. लागत प्रभावी, दक्ष रोक एवं रोग प्रबंधन विधियों का विकास ।

फसल सुधार :

इस वर्ष प्रादेशिक काजू जनन द्रव्य संग्रहण (आर.सी.जी.बी.) में कुल 24 प्रजातियों को विभिन्न परियोजना केंद्रों में प्रविष्ट किया गया और इन केंद्रों में कुल 1162 प्रजतियों का संग्रहण किया जा चुका है । इन में, कुल 716 अधिमिलन को देशी संग्रहण संख्या (आय.सी. नंबर) राष्ट्रीय काजू अनुसंधान केंद्र (रा.का.अ.कें.) द्वारा एन.बी.पी.जी.आर. नई दिल्ली से प्राप्त किया गया । इस रिपोर्ट की अंतर्गत सबसे ज्यादा उपज 30 कि.ग्रा. हर ताड 35/3 ए.आर.एस.सी. किस्म के लिए चिंतामणी में 14 वीं वार्षिक फसल में मिला ।

विभिन्न परियोजना केंद्रों द्वारा विकसित किस्मों को बहुस्थानीय मानांकन प्रयोग से परीक्षण किया जा रहा है । इस मानांकन की चार विभिन्न परीक्षण जारी हैं। आठ परियोजना केंद्रों में जारी बहुक्षनीय परीक्षण 1992 से रोपण की गई किस्मों में बापट्ला पर वृद्धाचलम से प्राप्त एम 44/3 (6.52 कि.ग्रां. हर ताड), भुवनेश्वर पर वेंगुर्ले से प्राप्त किस्म एच-367 (क्रमानुसार 11.7 कि.ग्रां. और 4.26 कि.ग्रां.) उपज से सबसे अच्छे मानांकित किये गये ।

बौनी किस्म के.जी.एन-1 की एक नई परीक्षण स्थानीय किस्म के साथ तुलना के लिए सभी परियोजना केंद्रों में शुरू किया गया है। विभिन्न परियोजना केंद्रों में अन्य केंद्रों से विमोचित किस्मों के निष्पादन परीक्षण भी जारी है ।

संकरण कार्यक्रम में उच्छतम मूल के सस्यों की स्थानीय किस्मों के साथ प्रतिबद्धता परीक्षण किया जा रहा है। इस कार्यक्रम

में 239 विभिन्न संकरणों के कुल चार हज़ार से ज्यादा संकर किस्मों को प्राप्त किया गया है। बापट्ला में 19 विभिन्न संकरणों से 90 संकर पौधों की प्राप्ति हुई है। चिंतामणी में 63 संकरणों से 80 संकर गुठलियाँ, झारग्राम में 9 संकरणों से 70 गुठलियाँ, माडक्कत्तरा में 35 संकरणों से 169 गुठलियाँ तथा वेंगुर्ले में 94 संकरणों से 2190 संकर गुठलियाँ प्राप्त हुई हैं। भुवनेश्वर में सकर किस्म एच-7 रोपण के नौ साल बाद 13.23 कि.ग्रां. की उपज से अच्छा पाया गया।

फसल सुधार :

उर्वरक प्रयोग के दो परीक्षण विभिन्न काजू परियोजना केंद्रों में चालू हैं। एन.पी.के. का परीक्षण परियोजना केंद्र की रोपण में तथा स्थानीय फार्म रोपणों में किया जा रहा है। विभिन्न घनता के रोपणों में एन.पी.के. उर्वरक का प्रभाव का परीक्षण विभिन्न परियोजना केंद्रों में चालू है। ए.पी.एफ.डी.सी.के रोपणों में उर्वरक की मात्रा 1000 ग्रां. एन 250 ग्रां.फा.और पोटाँष से 10.50 कि.ग्रां. हर ताड का उपज प्राप्त हुआ। चिंतामणी, वेंगुर्ले और वृद्धाचलम में रोपकों के बागानों में की गई परीक्षणों में उर्वरक की प्रभाव प्रकटित नहीं देखी गई। माडक्कत्तरा में सिर्फ 1000 ग्रां. एन. की प्रयोग से ही 7.51 कि.ग्रां. हर ताड की अच्छी उपज प्राप्त हुआ। भुवनेश्वर में सुपार्षित मात्रा के उर्वरक डालने से एक हेक्टर में 629 ताडवाली रोपण में तीसरी वार्षिक उपज में ही 1.25 टन की उपज प्राप्त हुआ।

भुवनेश्वर में काजू रोकण के बीच हल्दी लगाने से सुपार्षित मात्रा की उर्वरक डालने से असली आय हर हेक्टर में रु. 7,250/- मिली। झारग्राम में उडद की अंतराल फसल से निव्वल आय रु. 6,137/- हर हेक्टेर के लिए मिली। माडक्कत्तरा में औषधीय सस्य और कंदमूल के पौधे अंतराल फसल के रूप में उगाए जा रहे हैं। इन पौधों का प्रवर्धन उपज तक नहीं पहुँचा है। वेंगुर्ले में ककडी के फसल से एक हेक्टेर में कुल रु. 33,659/- की आय मिला। वृद्धाचलम में मूँगफली से रु. 22,389/- हर हेक्टेर से मिला।

फसल संरक्षण :

काजू के कीट नियंत्रण के लिए कीटनाशक रसायन छिडकाव विभिन्न केंद्र के परीक्षणों में किए जा रहे है। चिंतामणी में चाय मच्छर कीडे का नियंत्रण 0.1% कार्बरिल पुष्पण के समय और 2% नीम का तेल फलन के समय छिडकाने से पाया गया और 8.16 कि.ग्रां हर ताड की उपज भी प्राप्त हुआ। सुपार्षित 0.05% मोनोक्रोटोफास, 0.05% एन्डोसलफान और 1% कार्बरिल की उद्भावन, पुष्पण और फलन के समय छिडकाव करने से जगदलपुर, झारग्राम, माडक्कत्तरा, वेंगुर्ले और वृद्धाचलम पर चाय मच्छर कीडे का सफल नियंत्रण पाया गया।

भुवनेश्वर, झारग्राम और वृद्धाचलम में सुपार्षित रासायनिक ही अन्य नये रासयनिकों के मुकाबले बेहतर सिद्ध हुए। चिंतामणी में 0.05% के छिड़काव 7.88 कि.ग्रां. की अच्छी उपज से अन्य रसायनों से बेहतर पाया गया।

काजू के स्कंध और जड़े छेदक इल्ली की निरोधक संरक्षण काजू के स्कंधों को 5% नीम के तेल से साल में तीन बार कूर्चन करने से बापट्ला और वृद्धाचलम; साल में दो बार करने से भुवनेश्वर झारग्राम और वेंगुर्ले में पाये गये। पीडा से सुधारणात्मक प्रयोग 0.2% लिण्डेन से बापट्ला, माडक्कत्तरा और वेंगुर्ले में इल्लियों को निकालने के बाद 5% नीम का तेल से कूर्चन करने से कीट बाधा की प्रतिशत कम और काजू की संरक्षण में बडोत्री हुई। झारग्राम में सिर्फ इल्लियों को निकालने से अच्छा नियंत्रण पाया गया। वृद्धाचलम में मोनोक्रोदोफोस 50% को झड़ों को मिलाने से छेदक इल्लियों से संपूर्ण नियंत्रण पाया गया।

बापटला में 53 जनन द्रव्य संग्रहण से 12 संग्रहण पत्ते और पुष्पगुच्छ आच्छादक कीटों से बाधाशून्य रहे। माडक्कत्तरा में 40 में से 8 द्रव्य संग्रहण स्कधाग्र कीडे प्रतिरोधक पाए गये और वीटीएच-30 पुष्पगुच्छ काटों से प्रतिरोधक पाया गया। वेंगुर्ले में वी-1 किस्म चाय मच्छर से प्रतिरोधक पाया गया, वृद्धाचलम में एच 1608 और वी.टी.एच. 59/2 चाय मच्छर से, एम-44/3 एवं एच-

40 स्कंधाग्र एवं पुष्पगुच्छ आच्छादक कीट से और एच-1598 एवं एच-1600 पत्ते छेदक रसाद कीट से अत्यंत कम बाधापूर्ण सिद्ध हुए ।

प्रौद्योगिकी का हस्तांतरण :

इस वर्ष काजू के प्रदर्शनी रोपण कृषकों के जमीन पर 12 जगह में लगाए गये । विभिन्न परियोजना केंद्रों में 21 प्रशिक्षण कार्यशालवों का आयोजन किया गया था, जो सस्य संरक्षण पर था । इन के अलावा विभिन्न केंद्रों के वैज्ञानिक अन्य एजन्सियों से आयोजित कार्यक्रमों में भी भाग लिए । विभिन्न परियोजना केंद्रों में कुल 6,55,400 कलम के पौंधे तैयार किए गये जिन्हें सरकारी, गैर सरकारी एजेन्सियों के लिए तथा कृषकों के लिए वितरण किए गये ।

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

The AICRP on Cashew has presently eight centres and one sub-centre of which four were started at the inception of AICS & CIP in the year 1971 [Bapatla (ANGRAU the then APAU); Madakkathara (KAU, shifted from Anakkayam); Vengurle (Dr. BSKKV the then KKV) and Vridhachalam (TNAU)]. During V Plan period, one centre at Bhubaneswar (OUAT) and in VI Plan, two centres, one at Jhargram (BCKVV) and another at Chintamani (UAS) were added. During VIII Plan, one centre at Jagdalpur (IGAU) and a sub centre at Pilicode (KAU) were also started. These centres of AICRP on Cashew are located in eight cashew-growing states of the country and are under the administrative control of different State Agricultural Universities.

The budget allocation of the project for the year 2002-2003 was Rs.106.66 lakhs (Rs. 80.00 lakhs ICAR Share) and the expenditure was Rs. 95.14 lakhs (Rs. 71.36 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 agro- techniques for the cashew crop under different agro-climatic conditions.
3. Evolving cost effective and efficient pest and disease management practices.

CROP IMPROVEMENT

Cashew germplasm holding in the Regional Cashew Gene Banks (RCGBs) situated in different states comes to a total of 1162 accessions including current year collection of 24 accessions. Among the collections, 716 accessions have been assingned with Indigenous Collection Numbers (ICNs). During the period under report, higher yield per tree was recorded for 35/3 ARSC at ARS, Chintamani with a yield of 30 kg tree^{-1} under the RCGB for 14th annual harvest.

Varieties developed by different centers are under multi-location trial to test its suitability for other regions.Four experiments are being conducted under this programme. Under MLT-92 at Bapatla, M-44/3 from Vridhachalam (6.52 kg tree^{-1}) at Bubhaneshwar H68 (8.97 kg tree^{-1}) from Vengurle, H367 at Chintamani (11.7 kg tree^{-1}) and Jagdalpur (4.26 kg tree^{-1}) from Vengurle performed well. A new trial, on evaluation of dwarf accession KGN-1 have been initiated by some centers and is in initial stages of evaluation. Performance of released varieties at different regions is also being evaluated at different centres.

Hybridisation work was carried out by crossing promising varieties with local varieties/ types in different centers. Under this programme, more than four thousand hybrids were produced out of 239 different cross combinations. At Bapatla out of 19 combinations 90 hybrids, at Bhubaneshwar out of 19 combinations 730 hybrids,

at Chintamani out of 63 cross combinations 80 hybrids, at Jhargram out of 9 combinations 70 hybrids, at Madakattara out of 35 combinations 169 hybrids and at Vengurle out of 94 combinations 2190 hybrids were obtained. At Bhubaneshwar, hybrid H-7 could produce a yield of 13.23 kg tree^{-1} after 9 years of planting and found promising.

CROP MANAGEMENT

There are two experiments under fertilizer application trial under different centers of AICRP on cashew. One experiment on NPK fertilizer application is being carried out at AICRP centers as well as on the other regional farm plots. Another experiment on fertilizer application on different planting densities is also being carried out, which is planted with local promising variety and is initial stages at different centers. Under NPK experiment at Bapatla, highest yield of 7.31 kg tree^{-1} could be obtained for application of 1000g N & 250g P_2O_5, whereas in APFDC plantations, for application of 1000g N, 250g P_2O_5 & 250g K_2O a yield of 10.50 kg tree^{-1} could be obtained. At Chintamani, Vengurle and Vridhachalam there was no significant improvement in yield due to fetilizer application in farmers plots. At Madakkathara, 7.51 kg tree^{-1} yield could be realized for application of 1000g N only. With recommended dose of fertilizer in 629 plants ha^{-1} a yield of 1.25 tonnes could be realized at Bhubaneswar for third harvest.

At Bhubaneswar, growing cashew with turmeric as intercrop with recommended dose of fertilizer could earn maximum net returns of Rs. 7,250/- per year from one hectare. At Jhargram, Blackgram was found profitable with the net returns of Rs. 6,137/- per hectare in a year. At Madakkathara medicinal plants and tuber crops are being evaluated as intercrops. Economically harvestable growths of intercrops have to be achieved yet. At Vengurle cucumber as intercrops could fetch Rs. 33,659/- from one hectare in a year. At Vridhachalam, groundnut could fetch Rs. 22,389/- net profit for one hectare in a year.

CROP PROTECTION

Chemical control of pests of cashew is being carried out at different centers. At Chintamani, control of TMB could be done at its best by the use of carbaryl (0.1%) at flowering stage and neem oil (2%) at fruiting stage, which could result in a yield of 8.16 Kg tree^{-1}. Standard spray of monochrotophos (0.05%), endosulfan (0.05%) and carbaryl (0.1%) at flushing, flowering and fruiting stages respectively could give effective control at Jagdalpur, Jhargram, Madakkathara, Vengurle and Vridhachalam.

At Bhubaneswar, Jhargram and Vridhachalam standard spray was superior over the new chemicals tested. At Chintamani, a superior yield of 7.88 Kg tree^{-1} for trees sprayed with profenophos (0.05%). The same chemical was effective at Vengurle also.

Effective prophylactic control of cashew stem and root borer (CSRB) could be achieved by swabbing with neem oil 5% only thrice in a year at Bapatla and Vridhachalam; twice in a year at Bhubaneswar, Jhargram and Vengurle. Curative trials of infested trees at Bapatla, Madakkathara and Vengurle treated with lindane 0.2% after removal of grubs and swabbing the trunk with neem oil 5% could result in better survival percentage. Removal of grubs itself was effective at Jhargram. At Vridhachalam root feeding of monocrotophos (50%) could give complete control over infested trees.

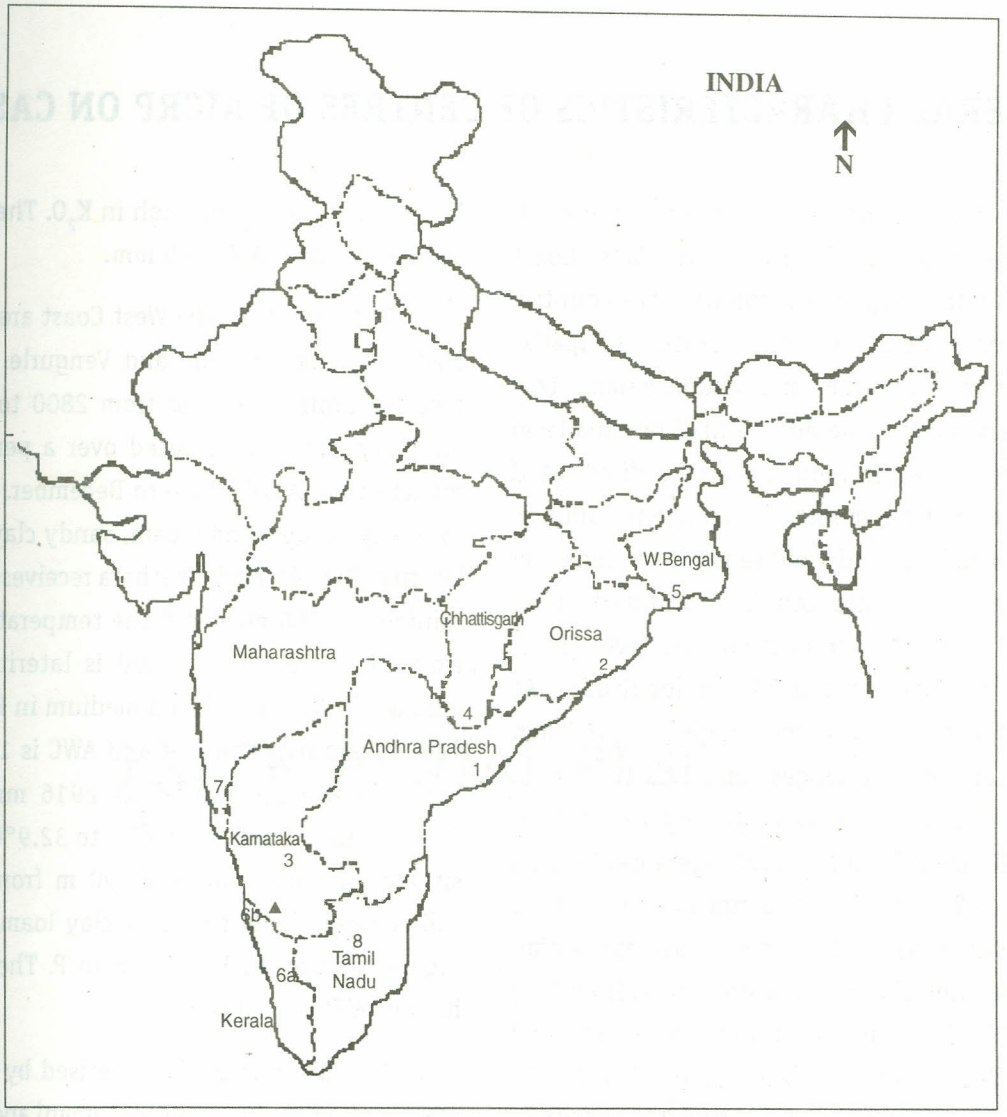
At Bapatla, among 53 germplasm entries, 12 have shown tolerance against leaf and blossom webbers. At Madakkthara 8 accessions were found resistant to shoot tip caterpillar out of screened 40 germplasm accessions. At Jhargram, among 24 accesions, Ansur-1 was tolerant to shoot tip caterpillar and VTH-30 to infloroscence thrips. At

Vengurle, VI was tolerant against TMB. At Vridhachalam, H1608 and VTH 59/2 were tolerant to TMB, M44/3 and H-40 were less damaged by shoot and blossom webber, in H-1598 and H-1600 thrips damage was minimum

TRANSFER OF TECHNOLOGY

During the year, 12 demonstration plots have been laid down in farmers field with high density planting. Forty eight training programmes and 21 crop protection campaigns were conducted by different AICRP centers and also the scientists have participated in various seminars conducted by different agencies. A total of 6,55,400 grafts were produced in different centres of AICRP on Cashew and distributed to different government and non-government agencies as well as farmers.

CENTRES OF ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW



Headquarters of AICRP on cashew

▲ National Research Centre for Cashew, Puttur 574 202

AICRP on Cashew Centres:

1. Cashew Research Station, (ANGRAU), Bapatla, 522 101, Guntur District, Andhra Pradesh.
2. Cashew Research Station, (OUAT), Bhubaneswar 751 003, Orissa.
3. Agricultural Research Station, (UAS), Chintamani 563 125, Kolar District, Karnataka.
4. Zonal Agricultural Research Station, (IGAU), Jagdalpur 494 005, Bastar District, Chhattisgarh.
5. SG College of Agriculture and Research Station, (BCKV), Jhargram 721 507, Midnapore District, West Bengal.
6. (a) Cashew Research Station, (KAU), Madakkathara 680 656, Thrissur District, Kerala.
6. (b) Regional Agricultural Research Station, (KAU), Pilicode 671 353, Kasaragod District, Kerala.
7. Regional Fruit Research Station, (Dr. BSKKV), Vengurle 416 516, Sindhudurg District, Maharashtra.
8. Regional Research Station, (TNAU), Vridhachalam 606 001, Cuddalore District, Tamil Nadu.

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 (plateau region) 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. Bapatla centre is siutated at an elevation of 54.9 m from mean sea level (MSL) with 40° 54' latitude and 80° 28' longitude. At Bapatla the annual average rainfall is 1167 mm and the temperature ranges from 17.3 to 37.8°C; the soil is sandy soil with low organic matter, medium N, low P_2O_5 and K_2O. Average water holding capacity (AWC) of soil is 100 mm and the climate is sub humid (dry). At Bhubaneswar average rainfall is 1167 mm and the temperature ranges from 14.3 to 37.1°C. The soil is red soil, red loamy and laterite. The climate is sub humid (dry), AWC 100 mm. The Jhargram center is located 87° longitude and 78.8° latitude. At Jhargram average rainfall is 1622 mm and the temperature ranges from 11.3 to 39.4°C. The soil is red, laterite, shallow depth gravels, low in organic matter, N and high in P_2O_5 and K_2O. The climate is sub humid (dry), AWC 200 mm. At Vridhachalam average rainfall is 1215 mm and the temperature ranges from 18.7 to 35.7°C, the soil is red laterite, low in organic matter and N, medium in P_2O_5 and high in K_2O. The climate is semi arid (dry), AWC 125 mm.

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

Maidan tract is characterised by even land. The coordinating centres Chintamani and Jagdalpur fall in this region. Chintamani comes under region III (Southern dry region), zone V (Eastern dry zone) of Karnataka and receives average rainfall of 789 mm and the temperature ranges from 13.9 to 34.5°C. Centre is situated at an elevation of 300 m from MSL, the soil is red sandy loam, deficient in N, medium in P_2O_5 and high in K_2O. The climate is semi arid (dry), AWC is 150 mm.

EXPERIMENTAL RESULTS

1. CROP IMPROVEMENT

1. CROP IMPROVEMENT

Germplasm collection, maintenance and description of types

Centres : East Coast
Bapatla, Bhubaneswar, Jhargram, and Vridhachalam

West Coast
Madakkathara, Pilicode, and Vengurle

Maidan tracts/ others
Chintamani and Jagdalpur

The objectives of the project are:

(a) To evaluate the existing germplasm of cashew in different centres,
(b) To collect local germplasm materials with desirable characters such as high yield, cluster bearing habit, bold sized nuts, short duration of flowering, off season flowering types from different cashew growing regions, and
(c) To establish clonal germplasm conservation blocks in different centres.

Summary

Cashew germplasm holding in the Regional Cashew Gene Banks (RCGBs) situated in different states amounts to 1162 of which the current years collection of 24 accessions also is included. Among the collections, 716 accessions have been assingned with Indigenous Collection Numbers (ICNs). During the period under report, higher yield per tree was recorded for 35/3 ARSC at ARS, Chintamani with a yield of 30 kg tree^{-1} under the RCGB for 14th annual harvest.

1) Germplasm collection and conservation

The Regional Cashew Gene Bank (RCGB) holding has been 1138 cashew accessions which were conserved and being maintained in different Centres. During the year 24 accessions were collected and field planted to bring the total to 1162. Among the conserved germplasm, for 716 accessions Indigenous Collection Numbers (IC No.) have been assigned by the NBPGR, New Delhi (Table 1.1).

Details of the centre by which collection has been made, source of collection, number of collections made and salient features are given in Table 1.2.

Table 1.1: Cashew germplasm holding in different centres.

Centre	No. of accessions			
	Existing	Collected during 2002	Total	Indigenous collection number assigned
East Coast				
Bapatla	131	-	131	80
Bhubaneswar	49	7	56	5
Jhargram	118	2	120	49
Vridhachalam	264	-	264	250
West Coast				
Madakkathara	143	7	150	73
Pilicode	64	-	64	64
Vengurle	239	4	243	142
Maidan tract/others				
Chintamani	120	4	124	53
Jagdalpur	10	-	10	
Total	**1138**	**24**	**1162**	**716**

Table 1.2: Cashew germplasm collected during 2002 by different centres.

Centre	Source of collection	No. of collections	Salient features
Bhubaneswar (Orissa)	RFRS, Vengurle	6	Bold nut types
	Bhuipur, Khurda District	1	Purple leaf, cluster bearing type
Chintamani (Karnataka)	Farmers field	4	High yielding types
Jhargram (West Bengal)	Raghunathpur and Sebayatan	2	Cluster bearing, boldnut types
Madakkathara (Kerala)	Srikrishnapuram, Kannoor	1	High yielding type
	Kiraloor	1	High yielding type
	RFRS, Vengurle	5	High yielding type
Vengurle (Maharashtra)	Thane and Raighad	4	High yielding types
	Total	**24**	

2) Germplasm evaluation

Evaluation of cashew germplasm at different centres has been carried out during the year 2002. The characteristics of promising accessions in different centres are presented in Table 1.3 - 1.9.

BAPATLA

During the year, the plant height, girth and the canopy spread were recorded. Among the accessions planted in 1997, 9/8 had least plant height (1.40m) which has also produced maximum annual nut yield (2.5kg/tree). T.No.268 produced

maximum stem girth (41.8cm) and maximum mean spread (4.49m). Maximum number of bisexual flowers per panicle were recorded in T.No.275 (160.5) followed by T.No.4/5 (115.75). The performance of promising accessions is presented in Table 1.3.

Table 1.3: Performance of promising germplasm accessions planted in 1997 at Bapatla.

Accession	Plant Height (cm)	Plant Girth (cm)	Canopy spread (cm)	Sex ratio (Bisexual: male)	Nut yield (kg tree^{-1}) I annual harvest
T.No.40	180	30.0	2.95	0.12	2.50
T.No.268	326	41.8	4.49	0.12	2.540
9/8	140	18.8	1.77	0.16	2.50
15/4	286	30.0	2.87	0.15	2.10

BHUBANESWAR

At Bhubaneswar, after the super cyclone occurred during the year 1999, most of the germplasm accessions have been completely/partially damaged. Out of these 45 accessions have been reassembled. In the year 2001, 4 elite types and in the year 2002, 7 elite types have been collected and all these are clonaly multiplied. These 56 types have been transplanted in a new site of the farm. Observations on these accessions will be recorded as per the workshop recommendations.

CHINTAMANI

At Chintamani, the yield and yield characteristics were recorded during evaluation of germplasm accessions during the year. The highest yield (30.0 kg tree^{-1}) was reported in 35/3 ARSC (ME 4/4) followed by 41/3 ARSC (5/37 Manjeri). Maximum shelling percentage (30.5%) was recorded for M 44/3. The highest nut weight was observed in V-3 (7.94g). The data on promising germplasm accessions are presented in Table 1.4.

Table 1.4: Performance of promising germplasm accessions at Chintamani.

Accession Number	Year of Planting	Cumulative Yield (kg tree^{-1})	Yield (kg tree^{-1})	Mean Yield (kg tree^{-1})	Nut Wt. (g)	Shelling %
2/6 ARSC (3/108 Gubbi)	1982	170.60 (18 ann. har.)	9.00	9.40	4.10	28.0
35/3 ARSC (ME 4/4)	1985	137.80 (14 ann. har.)	30.00	9.84	6.30	30.0
41/3 ARSC (5/37 Manjeri)	1985	1528.59 (14 ann. har.)	24.00	10.80	7.18	29.5
44/1 ARSC (Vengurla-5)	1985	147.93 (14 ann. har.)	21.00	10.50	4.08	27.4
44/5 ARSC (Vengurla-5)	1985	142.50 (14 ann. har.)	21.50	10.20	4.08	27.4

JHARGRAM

Maximum yield was recorded in JGM-58/12 (15.36 kg tree^{-1}) followed by JGM-74/6 (13.20 kg tree^{-1}). Cumulative yield was highest in JGM-80/2 (128.49 kg tree^{-1}) for 14 annual harvests. JGM-48/4 could produce nuts with 6g weight and 30 per cent shelling.

Table 1.5: Performance of promising germplasm accessions at Jhargram

Accession	Year of Planting	Yield kg tree^{-1}	Cumulative Yield kg tree^{-1} for 14 harvests	Nut wt. (g)	Apple wt. (g)	Shelling per cent
JGM 1/4	1983	10.87	100.07	4.74	28.8	28.4
JGM 10/3	1983	12.74	84.86	4.10	45.0	30.6
JGM 11	1983	12.17	76.77	5.40	47.2	30.2
JGM 16/1	1983	9.58	111.34	6.85	30.0	31.8
JGM 17/1	1983	8.78	103.29	5.14	29.0	32.7
JGM 19/1	1984	10.4	105.14	4.74	38.8	33.6
JGM 20/6	1983	12.31	104.77	3.76	28.5	34.5
JGM 29/8	1984	12.08	93.32	5.39	20.1	32.7
JGM 31/1	1984	11.57	97.22	4.68	22.0	29.6
JGM 48/4	1985	8.95	101.54	6.43	32.0	33.9
JGM 58/12	1985	15.36	107.95	6.85	30.0	26.4
JGM 66/7	1983	13.02	125.12	5.33	50.0	30.2
JGM 74/6	1983	13.20	122.56	4.59	35.0	31.3
JGM 80/2	1984	12.65	128.49	4.65	25.0	33.5
JGM 79/5	1984	12.80	107.11	6.90	33.0	38.0

MADAKKATHARA

All the accession of germplasm recorded a poor yield. Highest yield was recorded for H 719 (3.10 kg) followed by H 76 (2.78 kg). The boldest nut (11.2g) has been observed in H 1589. However, cumulative yield was maximum (21.82 kg tree^{-1}) in Anakkayam-1 for eleven harvests. Molecular characterization of thirty three cashew varieties with Randomly amplified polymorphic DNA (RAPD) markers was done using 20 random primers (Table 1.6).

PILICODE

Observations on growth parameters of grafts planted during 1996 in the cashew germplasm conservation block were carried out (Table 1.7). Vigorous growth was shown by the accession PCC 9.

VENGURLE

A total of 161 elite types of cashew and 74 bold nut types are present in the germplasm collection at the Centre. In 1993, bold nut types from ICAR Research Complex, Goa were collected and field planted in 1994. Highest yield was obtained from the variety Paikul (3.48 Kg tree^{-1}) for third annual harvest. The data on these bold nut types is presented below in Table 1.7.

Table 1.6: Performance of promising germplasm accessions at Madakkathara.

Year of planting/ Accession No.	Yield		Nut Wt.(g)	Apple Wt.(g)
	Current Year (kg tree^{-1})	Cumulative (kg tree^{-1})		
1988				
Anakkayam-1	2.02	21.82	5.2	32
Vapala	0.50	11.07	7.5	46
BLA 39-4	-	12.65	-	-
K 22-1	0.52	9.92	5.3	40
NDR 2-1	-	12.56	-	-
H 3-13	2.07	12.72	7.0	48
H 3-17	-	12.69	-	-
1989				
H 719	3.10	15.40	4.9	40
H 1589	1.36	14.32	11.2	70
H 1591	1.80	14.12	10.8	77
H 1597	0.93	10.88	8.0	52
H 1598	-	10.4	-	-
H 1600	1.23	14.13	8.2	65
H 1602	0.4	9.10	10.0	50
H 1608	0.9	10.15	8.5	70
A-6-1	1.53	10.40	6.5	60
H 3-9	0.47	11.22	7.6	83
H 7-6	2.78	10.75	8.6	70

Table 1.7: Performance of germplasm accessions planted in 1994 from Goa at Vengurle

Accession	Yield kg (tree^{-1}) 2002	Cumulative yield for 2 annual harvests	Nut Wt. (g)	Shelling (%)
Bali-1	1.23	3.58	6.00	29
N.P.	1.19	4.92	7.5	25
Paikul	3.48	6.48	6.5	27
Bali-2	1.50	9.53	6.5	24
Baikul	1.69	7.67	8.5	29
Fermagudi	0.55	1.72	8.5	26
Dodamarg	1.42	5.32	7.5	27
Nanaoda-2	1.72	4.97	8.5	24

VRIDHACHALAM

Among the 130 types of old germplasm, the NF 40 collected from Narumanam forest of Cuddalore region recorded high yield of 1.110 kg followed by M 66/1 and M 4/3. Among the new germplasm, the highest nut yield/plant of 1.550 kg was observed in M 71/4 accession collected from Pudur village of Cuddalore region followed by M 84/2 and M 13/3. The performance of promising new germplasm (Table 1.8) old germplasm accessions is given in Table 1.9.

Table 1.8 : Performance of promising new germplasm accessions at Vridhachalam

Accession No.	Year of planting	Yield (kg tree^{-1})	Shelling (%)
M 70/1	1994	0.863	27.2
M 10/1	1994	0.966	26.5
TAF 12	1994	0.918	25.6
TAF 13	1994	0.983	26.0
M 83/1	1994	0.900	27.1
M 84/2	1994	1.025	26.8
M 30/1	1994	0.967	27.1
M 40/2	1994	0.975	26.2
M 13/3	1994	1.025	26.4
M 71/4	1994	1.500	27.3

Table 1.9 : Performance of promising old germplasm accessions at Vridhachalam

Accession No.	Year of planting	Yield (kg tree^{-1})	Shelling (%)
M 4/3	1989	0.950	26.7
M 66/1	1989	0.985	26.5
M 45/4	1989	0.850	28.2
M 63/4	1989	0.800	27.6
NF 65	1989	0.850	27.7
M 45/4	1989	0.850	28.2
NF 40	1989	1.10	26.8

Varietal evaluation

1. Multilocation trial-92 with varieties from Bapatla, Vengurle, Vridhachalam, and NRC Cashew, Puttur

Centres: East Coast
Bapatla, Bhubaneswar, Jhargram and Vridhachalam

West Coast
Madakkathara and Vengurle

Maidan tracts
Chintamani and Jagdalpur

The objective of the experiment is to evaluate the performance of new high yielding varieties in different locations.

Summary

Varieties developed by different centers are under multi-location trial to test its suitability for other regions. Four experiments are being conducted under this programme. Under MLT-92 at Bapatla, M-44/3 from Vridhachalam (6.52 kg tree^{-1}) at Bubhaneshwar H68 (8.97 kg tree^{-1}) from Vengurle, at Chintamani H367 (11.7 kg tree^{-1}) from Vengurle and at Jagdalpur (4.267 kg tree^{-1}) from Bapatla performed well. A new trial, on evaluation of dwarf accession KGN-1 has been initiated by some centers and are in initial stages of evaluation.

Experimental details:

Design	:	RBD
Replications	:	Three
Varieties	:	No. of entries - 13
Bapatla	:	3/28, 3/33, 10/19, 30/1
Vengurle	:	H 68, H 255, H 303, H 320, H 367
Vridhachalam	:	M 15/4, M 44/3
Puttur	:	VTH 107/3, VTH 40/1
Year of planting	:	1992 (Bapatla 1993, Jhagram 2002, Vridhchalam 1994)

BAPATLA

During the year with regard to duration of flowering the entry M-44/3 (104.67 days) followed by H-255(115.66 days) recorded lowest number of days. The entry M-44/3 (16.75) followed by T.No.30/1 (11.16) recorded maximum number of panicles per square meter. The maximum mean annual nut yield per tree was recorded in the T.No.10/19 (7.210 kg) followed by M-44/3 (6.520 kg). And the cumulative nut yield per tree was recorded highest in M-44/3 (22.93 kg) followed by 10/19 (22.475 kg) in seven annual harvests. And the highest nut weight recorded in the H-320 (8.267 g) followed by H-303 (8.200g) during the period. The data on flowering characteristics and yield are presented in Table 1.10.

Table 1.10: Performance of varieties under MLT 92 planted in 1993 at Bapatla

Variety/ Genotype	Flowering intensity/m^2 (mean of all sides)	Number of fruits/ panicle.	Yield (kg $tree^{-1}$) (Harvest No.7)	Cumulative Yield (kg $tree^{-1}$) (Harvest No.7)	Nut weight (g)	Apple weight (g)	Shelling (%)
Hy-3/28	10.667	3.000	4.087	15.687	8.100	68.00	27.33
T.No.3/33	10.417	3.250	5.521	14.766	5.867	36.00	31.00
T.No.10/19	10.285	2.549	7.210	22.475	5.731	53.96	21.07
T.No.30/1	11.167	3.833	4.519	16.748	6.100	50.67	31.00
H-68	8.583	5.000	2.916	10.146	6.200	58.00	26.33
H-367	8.333	4.667	2.482	9.930	7.300	73.67	24.33
H-303	8.167	3.333	2.228	9.365	8.200	62.67	23.00
H-255	6.333	3.000	2.182	6.710	7.067	41.00	26.00
H-320	6.333	4.083	2.222	8.899	8.267	65.67	31.67
M-44/3	16.750	3.667	6.520	22.933	4.433	27.67	28.33
M-15/4	9.167	3.250	5.627	21.367	5.033	38.00	27.00
T.No.107/3	9.500	3.500	3.308	12.045	6.100	49.67	26.00
T.No. 40/1	9.250	3.000	4.241	13.062	6.900	69.00	25.33
CD at 5%	1.418	0.487	3.156	—	0.298	3.80	3.21

BHUBANESWAR

Highest nut yield was observed in H 68 (8.97 kg $tree^{-1}$) followed by NRCC-2 (7.78 kg $tree^{-1}$) and H 320 (7.54 kg $tree^{-1}$). In the other hand encouraging nut yield was also observed in H 303 (7.28 kg $tree^{-1}$). Cumulative nut yield (kg/plant) at the 7 harvest was recorded the highest in H 320 (31.48 kg $tree^{-1}$) followed by BPP 30/1 (30.59 kg $tree^{-1}$) and H 303 (29.33 kg $tree^{-1}$). Kernel recovery was recorded maximum in M 15/4 (33.6%) followed by BPP 3/33 (32.8%) and H 255 (31.6%). Maximum no. of nuts/panicle was observed in H 303 (4.3) followed by BPP 30/1 (4.0) and BPP 3/28 (3.7). Heaviest nut was harvested form H 255 (9.5g) followed by H 367 (9.4g) and H 303 (8.4g). Highest apple weight was recorded in H 367 (77.1g) followed by NRCC-2 (66.1g) and H 303 (59.5g). The data is presented in the Table 1.11.

CHINTAMANI

During the year maximum yield (11.70 kg $tree^{-1}$) was recorded for Hy 367. However, highest cumulative yield for seven annual harvests was recorded for HY 303 (26.96 kg $tree^{-1}$). Highest nut weight was observed in Hy 255 (8.27 g.) and highest shelling percentage was recorded in NRCC-1 (30.7%). The data on growth and yield characteristics of varieties under MLT-92 is presented under Table 1.12.

JAGDALPUR

Multilocation trial was newly laid out during the year 2000 with eleven (11) varieties. Plant height (1.76m) and stem girth (13.58cm) were found maximum in H-68 followed by H- 303 and H- 367. However, No. of primary branches/m2 was found maximum in H- 367 (8.58) which followed by H- 255 (8.44). Highest nut yield was found in H - 30/1 (6.277 kg $tree^{-1}$) followed by H - 367(4.258 kg $tree^{-1}$). Data on morphological and reproductive characters were collected from the experimental plants (Table-1.13).

Table 1.11: Yield characters of cashew types in MLT - 1992 at Bhubaneswar.

Cashew types	No. of flowering laterals/m^2	Yield (kg/$tree^{-1}$)	Cumulative yield (kg/$tree^{-1}$) 7 harvests	No. of nuts/ panicle	Nut weight (g)	Apple weight (g)	Shelling (%)
NRCC-1	13.5	1.88	10.71	1.5	6.1	49.9	27.2
NRCC-2	19.3	7.78	21.44	3.0	8.0	66.1	28.1
M 44/3	25.0	2.80	14.52	3.0	6.0	37.3	30.7
M 15/3	19.7	2.87	15.64	2.3	6.7	55.3	33.6
BPP 3/33	19.5	3.19	20.41	2.5	6.7	51.4	32.8
BPP 10/19	17.7	3.06	16.56	1.0	5.2	45.4	30.8
BPP 30/1	18.3	6.73	30.59	4.0	6.0	35.9	28.7
BPP 3/28	18.7	5.17	20.09	3.7	7.3	52.8	30.1
H 303	18.3	7.28	29.33	4.3	8.4	59.5	30.4
H 320	19.7	7.54	31.48	3.3	7.4	56.6	26.7
H 255	19.3	3.44	19.21	1.0	9.5	56.9	31.6
H 367	21.3	5.87	22.81	2.0	9.4	77.1	26.0
H 68	21.0	8.97	19.91	3.3	6.4	43.5	28.1
SE (m) ±		0.69	-	-	-	-	-
CD (5%)		2.02	-	-	-	-	-

Table 1.12: Flowering and yield characteristics under MLT planted in 1992 at Chintamani.

Variety	Canopy Shape	Yield (kg $tree^{-1}$)	Cum. yield (kg $tree^{-1}$) 6th harvest	Nut Wt (g)	Shelling %
H 68	Compact	-	11.32	-	-
H 367	Medium	11.7	22.66	7.9	29.6
H 302	Medium	10.0	26.96	7.3	27.7
H 255	Medium	4.0	10.97	8.3	29.8
H 320	Medium	-	14.89	-	-
M 44/3	Compact	-	14.92	-	-
M 15/4	Compact	-	9.20	-	-
NRCC-1	Compact	2.66	17.61	6.6	30.7
NRCC-2	Sparse	-	19.04	-	-
T 30/1	Compact	7.00	16.96	4.7	29.0
T 3/33	Compact	-	7.30	-	-
T 10/19	Compact	-	4.09	-	-
T 3/28	Compact	-	9.18	-	-
Ullal-1	Medium	-	7.63	-	-
SEm (±)					

Table 1.13 : Growth and yield performance of cashew varieties at Jagdalpur

Variety	Year of planting	Height (m)	Girth (cm)	Canopy Spread (cm)		No. o f primary branches m^{-2}	Yield (kg $tree^{-1}$)	Flowering period
				E - W	N - S			
H-3/28	1996	1.55	12.05	99.30	94.69	6.75	2.73	Late
H-3/33	1997	1.15	9.58	71.50	72.50	5.41	-	Late
H-30/1	1996	1.25	10.50	92.91	103.75	6.47	6.28	Late
H-10/19	1997	1.34	12.16	94.91	94.16	6.83	0.33	Late
VRI-1	1996	0.93	6.33	46.00	79.25	5.25	0.54	Mid
VRI-2	1996	0.62	6.02	40.74	40.08	4.88	0.34	Mid
H-68	1996	1.76	13.58	97.91	104.58	7.58	2.56	Late
H-255	1996	1.49	12.69	121.66	121.11	8.44	-	Late
H-367	1996	1.55	13.16	112.50	127.91	8.58	4.26	Mid
H-320	1996	1.56	10.75	145.55	147.43	8.02	-	Mid
H-303	1996	1.56	12.08	100.00	115.58	5.53	1.46	Late

JHARGRAM

Due to some unavoidable circumstances, this experiment could not be conducted at Jhargram Centre during the year 2002.

MADAKKATHARA

In M 15/4 highest number of panicles/ m2 (16.3) was recorded followed by No. 40/1 (15.9) and Hy-255 (14.8). Highest nut yield (0.76 kg $tree^{-1}$) was obtained from the variety HY-367 followed by 40/1 (0.68 kg $tree^{-1}$). All the varieties were susceptible for tea mosquito damage. The lowest score (3.44) was observed for Hy- 367. The data is presented in Table 1.14.

Table 1.14 : Growth and yield performance of cashew varieties at Madakkathara

Variety	Flowering panicles (m^2)	Yield (kg $tree^{-1}$)	Total (5 harvests)	Mean
M 15/4	16.3	0.43	8.32	1.66
3/28	10.5	0.00	5.04	1.01
Dhana	12.0	0.13	5.06	1.01
M 44/3	13.6	0.00	4.74	0.95
H-320	14.4	0.42	5.14	1.03
H-255	14.8	0.00	3.97	0.79
H-367	14.2	0.76	4.59	0.92
T 30/1	11.0	0.00	3.49	0.70
40/1	15.9	0.68	4.03	0.81
10/19	9.9	0.12	3.29	0.66
H-303	13.5	0.18	3.32	0.66
VTH-107/3	7.4	0.00	2.33	0.47
H-68	13.6	0.45	2.78	0.56
VTH-3/33	10.9	0.08	2.10	0.42
CD (0.05)	3.84	0.84		

During the year 2002 the highest yield was obtained for variety HY-367 (0.76 Kg tree^{-1}) followed by No. 40/1 (0.68 Kg tree^{-1}) and Hy-68 (0.45 Kg tree^{-1}). Unprecedented leaf drying and defoliation was observed in multi locational trial, planted in 1993. During the 4th week of November 2001, two trees started shedding green leaves. It was followed by drying up of green leaves and panicles on the same tree. Young shoot tips dried up due to Tea Mosquito Bug. The petiole region of the leaves got blackened and got defoliated at green stage which was complete with in a week. All the leaves got dried up and fell down. With in a week time, this symptom was shown by 31 trees in a compact area. Leaf samples were collected for pathological assay. Considering the damage by the tea mosquito bug and suspecting the involvement of fung, the following treatments were given as an ad hoc measure.

Pruning of dried twigs and leaves, and burning; Combined application of monocrotophos (1.5 ml per l) and carbendazim (1 g per l); Irrigating the trees once in a week to induce new flushes; and The trees temporarily survived with new flushes.

VENGURLE

Maximum tree height was observed in H 30/1 (3.41 m). In the variety 3/33 minimum tree height (2.03 m) has been recorded. Maximum girth was recorded in M 44/3 (0.367 m). The canopy spread was maximum in Hy 367 (1.79 m). The vegetative growth data is presented in Table 1.15.

VRIDHACHALAM

Maximum plant height and plant girth were observed in NRCC Sel. 1 (5.0m & 66.9 cm) and minimum height was observed in T. No. 3/33 (3.90 m). Yield was generally low during the year. Highest yield was obtained in M 44/3 (0.788 Kg tree^{-1}) and cumulative yield (12.2 Kg tree^{-1}). The shelling outturn was below 30 per cent in all the varieties. However, maximum shelling percentage (28%) was observed in NRCC Sel.1. The growth and yield data are presented in Table 1.16.

Table 1.15: The growth parameters of different varieties under MLT-92 at Vengurle.

Variety	Plant Height (cm)	Plant Girth (cm)	Canopy spread (m)
H 255	2.77	26.0	2.69
H 303	3.16	29.0	3.39
H 320	3.32	32.0	3.64
H 367	2.14	22.0	2.60
NRCC - 1	3.35	37.0	4.08
NRCC - 2	2.41	27.7	3.88
M 44/3	3.18	36.7	5.21
M 15/4	2.65	28.7	2.96
10/19	2.71	28.0	2.91
3/28	2.72	32.7	4.02
3/33	2.03	29.3	3.67
30/1	3.41	40.7	4.17
SE(m) ±	0.29	0.3	0.46
CD 5%	0.87	0.90	1.33

Table 1.16: Performance of different varieties under MLT planted in 1994 at Vridhachalam

Variety	Height (m)	Girth (cm)	Canopy Spread (m)	Yield (kg tree^{-1})	Cum. yield (kg tree^{-1}) No. of harvest	Flowering period	No. of fruits panicle^{-1}	Nut Wt (g)	Shelling %
T 30/1	4.6	50.60	4.9	0.421	4.30	Early	62.4	2.5	6.8
T 3/33	3.9	45.35	5.0	0.371	4.02	Mid	38.2	1.5	6.5
T 10/19	5.1	60.35	6.6	0.443	3.44	Early	41.9	2.0	7.0
T 3/28	4.1	50.30	6.3	0.387	4.41	Early	47.3	1.0	6.5
H 68	4.1	50.85	6.3	0.533	4.76	Early	48.7	2.5	5.6
H 367	4.0	54.10	6.2	0.750	5.29	Early	61.3	3.0	6.3
H 303	5.0	60.70	6.4	0.825	8.00	Mid	34.3	3.5	7.5
H 255	4.5	50.60	5.3	0.344	3.21	Mid	58.4	2.0	7.2
H 320	4.3	47.50	6.3	0.450	5.71	Mid	45.4	2.5	8.0
M 44/3	4.5	48.90	6.0	0.533	4.76	Early	48.7	2.5	5.6
M 15/4	4.7	62.10	6.8	0.750	5.29	Early	61.3	3.0	6.3
NRCC-1	5.0	66.90	6.4	0.500	2.68	Mid	53.0	2.5	6.7
NRCC-2	4.3	50.60	6.0	0.283	5.84	Mid	36.8	2.0	6.8

2. Performance of released varieties

Centres : East Coast
Bapatla, Bhubaneswar, Jhargram, and Vridhachalam

West Coast
Madakkathara and Vengurle

Maidan tracts/ others
Chintamani

The objectives of the experiment are to evaluate the performance of released varieties in different locations.

BAPATLA

Mean maximum canopy spread has been recorded in BPP-3 (3.675m) followed by BPP-4 (3.450m). Maximum number of male flowers (745.75) per panicle in the entry BPP-4 has been recorded followed by Vengurle-1 (688.5) and the maximum bisexual flowers per panicle was recorded in Kanaka (241.75) followed by Dhana (205.75). The highest mean nut yield per tree (1.812kg) was recorded in BPP-4 followed by Vengurle-5 (1.290 kg) in the second harvest. The growth and yield data are presented in Table 1.17.

Table1.17: Growth and flowering data of released varieties

Variety	Plant height (m)	Stem Girth (cm)	Canopy Spread (m)	No.of Male Flowers	Bisexual flowers	Nut Yield (kg tree^{-1})
BPP-1	2.275	32.50	3.50	558.25	97.00	0.550
BPP-2	2.016	35.60	3.67	541.75	72.50	0.960
BPP-3	1.840	29.00	2.96	495.50	74.50	0.650
BPP-4	2.450	37.25	3.68	745.75	103.25	1.812
BPP-5	1.966	23.00	2.27	434.00	90.25	0.910
BPP-6	1.900	27.30	2.40	733.50	144.00	0.430
BPP-8	1.210	30.60	3.12	466.50	115.50	1.000
BPP-9	1.466	23.60	2.32	422.25	118.25	0.175
Kanaka	2.500	31.60	3.08	366.75	241.75	0.830
Dhana	1.866	29.00	2.77	680.50	205.75	0.350
Priyanka	2.300	34.30	8.38	657.00	63.25	0.450
Vengurle-1	2.000	33.20	2.78	688.50	67.50	0.390
Vengurle-2	1.925	31.75	2.64	456.75	119.25	0.550
Vengurle-3	1.975	31.00	2.24	429.75	126.75	0.330
Vengurle-4	1.960	34.60	2.88	367.25	54.75	0.940
Vengurle-5	2.280	39.80	2.96	684.50	81.50	1.290
BBSR-1	1.766	25.30	3.01	682.00	169.75	0.350
VRI-2	1.566	29.60	2.00	527.00	102.50	1.150
Chintamani-1	0.966	15.00	2.97	-	-	-
Ullal-1	0.950	14.25	1.15	-	-	-
Ullal-4	1.250	15.25	1.34	-	-	-
Ullal-5	1.366	18.30	1.43	-	-	-
Jhargram	1.275	19.50	1.69	-	-	-

JAGDALPUR

Maximum No. of pacnicles/m2 was recorded in Vridhachalam-1 (35.05) followed by Bapatla-4 (33.50). The nut yield(kg tree^{-}) was found highest in Vridhachalam - 2 (6984.31g) followed b Madkkatra-1(6.9 g), Ullal - 2 (6.5g),Vridhachalar - 1 (6.4g) and Vengurle - 4 (5.4g). (Table 1.18)

Table1.18 : Evaluation of released varieties at Jagdalpur

Variety	Year of planting	Height (m)	Girth (cm)	Canopy spread (m)	No. of primary branches m^{-2}	No. of panicle m^{-2}	Yield (kg $tree^{-1}$)	Flowering period
CHIN-1	1997	1.68	20.52	177.16	8.30	15.85	.963	Mid
BPP-8	1997	1.13.	11.00	69.38	5.00	Na	-	NA
BPP-6	1997	0.80	8.50	68.50	10.00	Na	-	NA
BPP-5	1997	1.35.	12.25	82.00	10.00	Na	-	NA
BPP-4	1997	1.76	22.75	173.13	9.87	33.50	.800	Mid
BPP-2	1997	1.64	32.91	263.80	8.16	27.08	1.237	Early
BPP-1	1997	0.80	7.00	42.00	4.00	13.75	-	Mid
SEL-1	1996	3.00	46.50	404.67	11.98	20.45	4.542	Early
SEL-2	1996	2.75	42.66	409.69	10.95	15.20	4.132	Mid
ULLAL-1	1996	3.06	55.72	548.73	12.99	23.69	6.255	Mid
ULLAL-2	1996	3.02	52.86	709.65	12.70	23.85	6.535	Mid
K22-1	1996	2.45	44.47	391.60	9.92	15.28	3.379	Late
VRI-1	1996	2.77	50.57	444.13	12.36	35.05	6.427	Early
VRI-2	1996	2.96	50.30	53.83	12.13	14.37	6.984	Late
VEN-1	1996	2.81	48.63	433.26	10.98	13.27	.3627	Early
VEN-4	1996	2.81	60.22	496.42	14.44	12.71	5.459	Early
MAD-1	1996	2.79	58.77	455.37	13.97	20.13	6.974	Mid
MAD-2	1996	2.54	44.66	350.02	13.37	14.62	4.562	Mid
H 1591	1996	2.37	34.00	164.46	8.44	16.33	2.513	Mid
H 1598	1996	2.69	43.61	376.20	12.08	12.76	2.534	Mid
H 1608	1996	2.55	43.30	358.65	11.55	24.00	3.463	Late

MADAKKATHARA

All the accessions collected from other centres recorded poor yield during the year under report. Only five BPP accessions gave yield. BPP-2 gave the highest yield of 9 kg/tree/year. The data is presented in Table 1.19.

Table 1.19: Yield attributes of released varieties at Madakkathara

Acc. No.	Source	Year of planting	Date of flowering	Mean nut wt.	Yield (kg tree^{-1})
BPP-1	Bapatla	1990	30.11.01	3.9	N.Y
BPP-2	"	1990	30.11.01	9.0	0.57
BPP-3	"	1990	30.11.01	4.7	N.Y
BPP-4	"	1990	30.11.01	7.3	0.55
BPP-5	"	1990	30.11.01	7.3	N.Y
BPP-6	"	1990	30.11.01	N.Y	N.Y
V-1	Vengurla	1990	N.F	N.Y	N.Y
V-2	Vengurla	1990	N.F	N.Y	N.Y
V-3	"	1990	30.11.01	N.Y	N.Y
V-4	"	1990	11.12.01	N.Y	N.Y
V-5	"	1990	30.11.01	N.Y	0.35
V-6	"	1993	11.12.01	N.Y	N.Y
VTH-711	Vittal	1991	N.F	N.Y	0.50
VTH-711/4	Vittal	1991	23.11.01	N.Y	N.Y
Jhargram	Jhargram	1991	5.12.01	N.Y	0.95
Rajapalayam	Bapatla	1991	30.11.01	N.Y	N.Y
NRCC-Sel-1	NRCC, Puttur	1991	11.12.01	N.Y	N.Y
NRCC-Sel-2	NRCC, Puttur	1993	11.12.01	N.Y	N.Y
UL-1	Ullal	1997	18.12.01	N.Y	N.Y
UL-2	Ullal	1997	18.12.01	N.Y	N.Y
UL-3	Ullal	1997	11.12.01	N.Y	N.Y
UL-4	Ullal	1997	1.12.01	N.Y	N.Y
UN-50	Ullal	1997	18.12.01	N.Y	N.Y
Goa 11\6	NRCC, Puttur	1998	N.F	N.Y	N.Y

N.F - Not Flowered N.Y - No Yield

Hybridisation and selection

Centres : East Coast
Bapatla, Bhubaneswar, Jhargram, and Vridhachalam

West Coast
Madakkathara and Vengurle

Maidan tracts/ others
Chintamani

The objective of this experiment is to utilize the high yielding genotypes selected from germplasm for crossing with other genotypes having desirable traits like bold nuts, cluster bearing habit, compact canopy, short flowering period, late synchronized flowering types and high shelling percentage.

Summary

Hybridisation work was carried out by crossing promising varieties with local varieties/ types in different centers. Under this programme, more than four thousand hybrids were produced out of 239 different cross combinations. At Bapatla out of 19 combinations 90 hybrids, at Bhubaneshwar out of 19 combinations 730 hybrids. at Chintamani out of 63 cross combinations 80 hybrids, at Jhargram out of 9 combinations 70 hybrids, at Madakattara out of 35 combinations 169 hybrids and at Vengurle out of 94 combinations 2190 hybrids were obtained. At Bhubaneshwar, hybrid H-7 could produce a yield of 13.23 kg tree^{-1} 9 years after planting and found promising

BAPATLA

The total number of 90 F1 hybrid nuts were obtained from the 19 cross combinations identified by the NRCC, Puttur for Bapatla centre during the year 2002. (Table-4) A total of 2,224 flowers of female parents used for crossing and the mean fruit set of 4.27 was recorded.

The highest fruit set of 11.6 % was recorded in the cross combination of EG-3 X Sel-2. The above 90 F1 hybrid nuts were sown in the polythene bags for further studies. Out of 90 F1 hybrids 24 F1 hybrid seedlings were planted in the main field of F1 hybrid block during the year 2002.

BHUBANESWAR

During 2002, hybridization work has been done with 19 cross combinations and a total of 730 nuts were obtained, the details of which is 1.21.

The seedlings raised from these hybrid nuts have already been transplanted in the main field for future evaluation. The hybrid seedlings planted in the previous years are in bearing and the performance of certain promising hybrids amongst them have been recorded as shown in Table 1.22.

CHINTAMANI

During the year 63 different crosses were made and 800 hybrid nuts were obtained. Out of which 700 good seed nuts will planted in the field at close spacing to collect scions for further evaluation (Table 1.23).

JHARGRAM

During the year hybridization was taken up using different cross combinations of Jhargram-1, M 44/3, BLA 39-4, Ansur No.1 WBDC-V, Digha-8, D.C. 5, etc. The success rate of cross-pollination was 0.2%. The F1 plants were planted in the nursery at closer spacing. Details of crossing carried out are presented in Table 1.24

Table 1.20: The details of crossing programme at Bapatla:

Cross combinations	Total number of flowers pollinated	Number of nuts obtained during the year	Percent of fruit set
BPP-8 X BPP-4	99	5	5.00
BPP-8 X BPP-3	143	7	4.80
BPP-6 X Sel-1	173	5	2.80
BPP-6 X Sel-2	173	4	2.30
EG-3 X Sel-2	120	14	11.60
VPL-1 X Sel-2	125	5	4.00
RAJH-1 X Sel-2	135	11	8.10
Kavali-1 X Sel-2	116	2	1.70
RAJH-2 X Sel-2	123	9	7.30
CHG-1 X F.No.5	140	2	1.40
ASRPT X F.No.5	145	3	2.10
VPL-3 X F.No.5	52	2	3.80
ABT-3 X Sel-2	170	5	2.90
Muttayapalem-1 X F.No.5	95	3	3.20
Kavali-1 X F.No.5	40	2	5.00
Kavali-2 X F.No.5	20	1	5.00
ABT -2 X Sel-2	180	5	2.70
WG-1 X Sel-2	125	2	1.60
Kavali -2 X Sel-2	50	3	6.00
Total:	2224	90	(Mean) 4.27

Table 1.21: Details of crossing programmes at Bhubaneshwar.

Cross combinations	No. of crosses effected	No. of matured hybrid nuts harvested
M 44/3 x Kalyanpur Bold nut	554	32
BPP 30/1 x Kalyanpur Bold nut	443	34
Lokipur 1 x Kalyanpur Bold nut	172	11
RP-1 x Kalyanpur Bold nut	851	145
RP-2 x Kalyanpur Bold nut	175	34
Lahanga x Kalyanpur Bold nut	162	2
Vittol 44/3 x Kalyanpur Bold nut	204	9
BPP 30/1 x VTH 711/4	484	18
M 44/3 x VTH 711/4	582	51
Lokipur 1 x VTH 711/4	379	8
Vittol 44/3 x VTH 711/4	469	29
RP-2 x VTH 711/4	453	85
RP-1 x VTH 711/4	847	122
Lahanga x VTH 711/4	207	7
M 44/3 x Kankadi	761	13
Lokipur 1 x Kankadi	285	6
Vittol 44/3 x Kankadi	506	4
RP-2 x Kankadi	649	64
RP-1 x Kankadi	945	56
TOTAL	9328	730

Table 1.22: Performance of promising hybrids at Bhubaneshwar

Year of planting	Cross combination	Hybrid number	Nut yield (kg tree^{-1})	Cumulative yield (kg tree^{-1})	Nut weight (g)	Shelling (%)
			5 harvests			
1995	Bhubaneswar-1 x VTH 711/4	C 14	1.1	5.8	8.0	31.8
	Bhubaneswar-'C'-2 x VTH 711/4	A 6	2.0	7.9	10.0	33.7
	Bhubaneswar-1 x Kankadi	D 6	0.8	3.7	8.4	32.1
			3rd harvest			
1997	Bhubaneswar-1 x H 2/16	A 1-5	2.1	5.1	7.4	31.3
		A 1-9	1.6	3.6	7.5	33.3
		A 1-16	2.3	3.9	7.2	27.8
		A 1-20	1.6	3.5	7.5	32.3
		A 1-29	2.0	2.9	7.3	30.1
		A 1-34	1.0	3.0	7.3	32.0
		A 1-35	1.3	2.6	8.2	26.8
		A 1-50	1.7	3.2	8.2	28.0
		A 1-54	1.0	2.9	8.0	28.8
		A 1-55	1.6	2.6	7.2	32.6
		A 1-69	1.6	3.9	7.3	32.8
		A 1-78	1.1	3.4	7.4	32.6
		A 1-85	3.0	6.7	7.5	33.3
		A 1-105	2.3	5.7	7.2	30.6
	Bhubaneswar-1 x VTH 711/4	B 1-15	0.5	2.8	7.1	31.3
		B 1-33	0.6	3.1	8.7	32.2
1998	M 44/3 x H 2/16	A 2-13	0.6	0.8	8.5	32.0
		A 2-19	0.8	0.9	7.3	27.0
		A 2-20	0.3	0.6	7.8	33.3
		A 2-21	0.8	1.1	7.6	25.3
		A 2-25	0.8	1.4	7.5	31.1
		A 2-26	0.7	1.0	7.2	29.2
	H 2/16 x M 44/3	B 2-2	1.0	1.1	7.5	28.0
		B 2-25	0.7	0.9	7.0	32.7
		B 2-29	0.4	0.4	7.5	30.7
		B 2-32	0.6	0.9	7.5	31.5
		B 2-39	1.3	1.4	7.2	30.0
		B 2-48	1.3	1.5	7.0	29.0
	H 2/16 x M 26/2	C 2-10	1.3	1.3	7.2	29.6
		C 2 -16	1.4	1.4	7.0	28.9
		C 2-40	1.5	1.5	7.0	29.0
		C 2-47	1.6	1.7	7.0	31.5

Year of planting	Cross combination	Hybrid number	Nut yield (kg tree^{-1})	Cumulative yield (kg tree^{-1})	Nut weight (g)	Shelling (%)
	M 44/3 x Kankadi	D 2-4	0.4	0.7	7.4	28.4
		D 2-6	0.6	1.5	7.3	31.5
		D 2-12	0.5	0.9	8.0	31.3
		D 2-16	0.8	1.0	7.5	29.3
		D 2-20	0.8	0.8	7.0	31.0
		D 2-26	0.4	0.4	7.6	28.8
		D 2-27	0.4	0.6	7.5	33.3
	M 44/3 x H 2/15	E 2-2	1.5	1.6	7.4	27.0
		E 2-4	0.9	0.9	7.0	27.1
		E 2-7	0.5	0.9	8.2	28.0
		E 2-12	0.4	0.8	7.1	32.8
		E 2-13	0.7	1.1	7.3	33.0
	Bhubaneswar-1 x	F 2-1	0.6	0.7	9.0	30.0
	Kankadi	F 2-29	0.6	0.6	8.1	32.3
	Bhubaneswar-1 x H 2/15	G 2-4	0.3	0.3	6.8	23.4
1998	Bhubaneswar-1 x	H 2-10	0.4	0.7	9.4	31.9
	VTH 711/4	H 2-15	0.1	0.2	9.1	32.2
		H 2-22	0.2	0.2	10.8	29.6
		H 2-23	0.1	0.3	10.3	32.0
		H 2-33	0.2	0.3	10.9	29.4

Table 1.23: Details of hybridization being done at Chintamani

Cross combination	No. of crosses made	No. of nuts obtained
Kothur-1 x Vetore-56/1	74	13
Kothur-2 x Vetore-56/1	162	16
Kothur-4 x Vetore-56/1	210	32
Kothur-5 x Vetore-56/1	160	25
Kothur-7 x Vetore-56/1	105	11
Hebri-1 x Vetore-56/1	230	25
9/2 Ullal x Vetore 56/1	180	24
1/26 Nileshwar xVetore 56/1	95	9
6/21 Moodabidri x Vetore 56/1	112	3
4/43 Wynad x Vetore 56/1	210	24
4/62 Alangudi x Vetore 56/1	185	19
1/64 Madhuranthakam x Vetore 56/1	130	20
3/67 Chrompet x Vetore 56/1	220	26
Kothur-2 x Vetore-56/2	95	8
Kothur-5 x Vetore-56/2	64	3

Cross combination	No. of crosses made	No. of nuts obtained
Kothur-7 x Vetore-56/2	72	3
Hebri-1 x Vetore-56/2	115	9
9/2 Ullal x Vetore 56/2	58	2
1/26 Nileswar x Vetore 56/2	65	3
4/62 Alangudi x Vetore 56/2	135	15
1/64 Madhuranthakam x Vetore 56/2	172	21
3/67 Chrompet x Vetore 56/2	124	15
Kothur-1 x Kankady-1	54	3
Kothur-2 x Kankady-1	71	5
Kothur-4 x Kankady-1	112	14
Kothur-5 x Kankady-1	96	16
Kothur-7 x Kankady-1	98	13
9/2 Ullal x Kankady-1	96	20
1/26 Nileswar x Kankady-1	85	8
4/43 Wynad x Kankady-1	106	13
4/62 Alangudi x Kankady-1	85	15
1/64 Madhuranthakam x Kankady-1	78	6
3/67 Chrompet x Kankady-1	106	19
Kothur-1 x Kankady-2	38	4
Kothur-2 x Kankady-2	84	8
Kothur-4 x Kankady-2	74	9
Kothur-5 x Kankady-2	95	13
Kothur-7 x Kankady-2	68	8
Hebri-1 x Kankady-2	112	17
9/2 Ullal x Kankady-2	92	17
1/26 Nileshwar x Kankady-2	86	11
6/21 Moodabidri x Kankady-2	71	7
4/43 Wynad x Kankady-2	125	24
4/62 Alangudi x Kankady-2	91	16
1/64 Madhuranthakam x Kankady-2	95	14
3/67 Chrompet x Kankady-2	115	20
Kothur-2 x NRCC-2	64	9
Kothur-4 x NRCC-2	111	20
Kothur-5 x NRCC-2	58	4
Kothur-7 x NRCC-2	48	2
Hebri-1 x NRCC-2	112	24
9/2 Ullal x NRCC-2	64	7
1/26 Nileswar x NRCC-2	72	6
6/21 Moodabidri x NRCC-2	56	5
4/43 Wynad x NRCC-2	84	80
4/62 Alangudi x NRCC-2	156	33
1/64 Madhuranthakam x NRCC-2	104	27
3/67 Chrompet x NRCC-2	92	26

Table 1.24: Details of hybridization being done at Jhargram

Sl.No.	Cross combination	No. of crosses made	No. of nuts obtained
1	BLA 39-4 x WBDC-V-5	20	5
2	Digha-8 x BLA 39-4	115	21
3	Local x 2/9 Dicherla	77	15
4	Red Hazari x WBDC-V	37	7
5	WBDC-5 x Jhargram-1	45	1
6	Jhargram-1 x BLA 39-4	42	1
7	Jhargram-1 x Red Hazari	25	4
8	BLA 39-4 x DC - 5	60	8
9	WBDC-V x Red Hazari	153	8

MADAKKATHARA

Hybridisation was started during January 1993 and a total of 213 hybrids were field planted by the year 2002. Out of the 56 hybrids planted during 1993 only 35 hybrids yielded in 2002. Hybrid 7 (BLA 139-1 x P-3-2) recorded the maximum yield of 13.23 Kg followed by H-21 (4.8 kg tree^{-1}), H-8 (4.67 kg tree^{-1}), H 51 (4.6 kg tree^{-1}). Highest nut weight recorded by H-3 (13.67 g) followed by H 34 (13.09g). Data on yield for the hybrids planted during 1993 is given in Table 1.25.

Out of the 85 hybrids planted during 1995, 37 hybrids yielded during 2002. H 145 recorded highest yield (5.59 kg tree^{-1}) followed by H 121 (2.9 kg tree^{-1}) and H 143 (2.33 kg tree^{-1}). Highest nut weight was recorded for H 147 (10.29g). Data on yield for the hybrids planted during 1995 is given in Table 1.27.

Among the hybrids planted during 1996 and 9 hybrids flowered in 2002 and only H 181 recorded a yield of 0.35 kg tree^{-1}. It has a nut weight of 9.18g and apple weight 73.35 kg tree^{-1}. Out of 124 hybrids planted in 2001, 31 hybrids dried due to severe stem borer attack.

During the year 2002, A total of 2705 pollinations were made, out of which 169 nuts were harvested giving an overall average of 6.24%. A total of 135 hybrids were field planted during the year 2002. Details of pollinations done and the cross combinations are given in Table 1.28.

Out of the 27 hybrids planted during 1994, 12 hybrids yielded during 2002. Highest yield recorded by H 71 (2.75 kg tree^{-1}). The yield of trees ranged from (0.20 - 2.75 kg tree^{-1}). H 80 recorded the highest nut weight (10.21 g). Data on yield for the hybrids planted during 1994 is given in Table 1.26.

Altogether 2705 pollinations involving 35 combinations were done during 2001-2002. However, only 30 pollinations for the cross Priyanka x Ullal 12-1, 33 pollinations for the cross H-1593 x Ullal-12-2 and 5 pollinations for the cross MDK-1 x Dhana. All the above crosses made, failed to set any fruit. Though only 2 pollination were done for the cross Dhana x NRCC Selection 2, we could get one fruit set. MDK-1 , Dhana, Priyanka and Ullal 12-1 when used in other combinations have resulted in fruit setting.

Eventhough the cross combinations A-1 x Brazil-244, A-1 x Kiliyanthara, A-1 x P-3-2, A-1 x P-6-2, A-1 x Ullal 12-1, Dhana x A-1, Dharasree x A-1, Kanaka x A-1, Kiliyanthara x A-1 and Ullal-12-1 x A-1 showed initial fruit set, no mature nuts could be harvested due to fruit drop (physiological disorders and tea mosquito attack). But A-1 x Kiliyanthara, A-1 x P-3-2, A-1 x P-6-2 had produced nuts during 2000-2001 crossing. Kiliyanthara x

A-1 did not set fruit during 2000-01 and 2001-02. Kiliyanthara accessions available in the germplasm are over matured with very high branches and was severely affected by tea mosquito in the two seasons. During 2000-01, A-1 x Sulabha, Sulabha x A-1, M 44/3 x Sulabha, M 44/3 x V-56, MDK-1 x V-56, MDK-1 x Kankady, Priyanka x A-1, Dhana x A-1, Kanaka x A-1 and H-3-17 x A-1 eventhough showed an initial fruit set, no mature nuts could be harvested. Specific reason for the fruit drop could not be deduced, however, there was severe tea mosquito attack during the season.

Table 1.25: Yield of the hybrids planted during 1993 at Madakkathara

Hybrid No.	Mean yield (kg tree^{-1}) for last 7 years.	Highest yield (kg tree^{-1}) & year	Yield (kg tree^{-1})	Cum. Yield (kg tree^{-1})	Appl. wt. (g)	Nut wt.(g)
2	0.74	2.42 (01-02)	2.42	5.21	73.41	8.58
3	0.88	0.13 (01-02)	0.13	6.22	76.92	13.67
6	0.10	0.3 (01-02)	0.30	0.3	74.17	8.55
7	2.03	13.23 (01-02)	13.23	14.23	84.4	9.64
8	0.88	4.67 (01-02)	4.67	6.22	80.1	7.12
9	0.33	0.57 (01-02)	0.575	2.34	122.38	8.82
10	0.34	0.78 (98-99)	0.50	.80	100.30	11.0
13	0.35	1.1 (99-00)	0.85	2.50	59.06	6.52
14	0.23	0.85 (01-02)	0.85	1.65	60.69	9.57
15	0.37	1.54 (01-02)	1.54	2.64	41.96	8.36
18	0.43	1.1 (95-96)	0.15	3.0	36.4	6.69
19	0.52	1.8 (01-02)	1.80	3.67	32.20	9.43
21	0.68	4.8 (01-02)	4.80	4.80	23.96	9.45
22	0.13	0.40 (01-02)	0.40	0.95	39.7	8.10
23	0.09	0.375 (01-02)	0.375	0.67	104.58	8.82
24	0.13	0.6 (01-02)	0.60	0.90	25.07	8.19
25	0.31	2.18 (01-02)	2.18	2.18	37.68	9.27
26	0.75	2.65 (01-02)	2.65	5.25	41.75	9.78
27	1.01	4.07 (01-02)	4.07	7.07	4.56	6.46
28	0.13	0.50 (99-00)	0.47	0.97	60.25	8.21
29	0.02	0.1 (01-02)	0.10	0.10	61.83	8.38
30	0.12	0.85 (01-02)	0.85	0.85	50.12	9.40
31	0.18	1.3 (01-02)	1.30	1.30	112.92	9.23
32	0.06	0.47 (01-02)	0.475	0.47	88.80	9.25
34	0.05	0.37 (01-02)	0.37	0.37	79.78	13.09
36	0.06	0.47 (01-02)	0.47	0.47	114.66	10.28
39	0.08	0.5 (01-02)	0.51	0.51	84.86	8.30
41	0.11	0.8 (98-99)	No yield	0.80	84.80	6.70
42	0.61	2.9 (98-99)	No yield	3.70	68.50	5.30
48	0.10	0.6 (00-02)	0.60	0.60	79.86	7.80
49	0.12	0.5 (01-02)	0.50	0.85	102.92	10.74
50	0.20	1.42 (01-02)	1.42	1.42	38.11	7.09
51	0.10	0.7 (01-02)	1.42	1.42	104.4	8.36
52	0.70	4.8 (01-02)	4.80	4.80	39.20	7.02
54	0.12	0.80 (01-02)	0.85	0.85	78.20	8.30

Table 1.26: Yield of the hybrids planted during 1994 at Madakkathara

Hybrid No.	Yield (kg tree^{-1})	Cum. Yield (kg)	Appl. wt. (g)	Nut wt. (g)
58	0.40	0.40	100.50	7.80
59	0.20	0.20	90.50	7.50
60	0.50	0.50	92.00	8.92
65	0.60	0.60	37.43	7.11
66	0.20	0.20	81.13	8.93
69	0.50	0.50	84.83	9.76
70	1.08	1.07	60.94	10.05
71	2.75	2.75	113.4	9.44
72	0.20	0.20	48.95	7.91
73	1.60	1.60	52.53	6.05
80	0.70	0.70	100.53	10.21
83	0.45	0.45	47.50	6.91

Table 1.27: Yield of hybrids planted during 1995 at Madakkathara

Hybrid No.	Yield (kg tree^{-1})	Cum. Yield (kg tree^{-1})	Appl. wt. (g)	Nut wt. (g)
120	0.55	1.88	72.45	8.74
121	1.30	2.90	106.68	8.34
123	0.30	1.50	70.91	6.94
128	0.22	0.22	62.92	7.37
129	0.20	1.41	89.51	8.11
130	2.10	2.10	73.50	7.90
132	0.90	0.90	46.63	8.12
137	0.70	0.70	77.58	9.50
138	2.88	2.88	68.88	6.87
139	2.30	2.30	76.5	7.70
140	0.72	1.87	47.17	6.65
141	0.68	1.88	122.20	9.96
142	0.83	0.83	50.99	7.10
143	2.33	2.33	78.11	8.57
144	1.28	1.28	86.8	8.00
145	4.36	5.59	123.2	10.8
147	1.19	1.19	99.18	10.29
148	0.93	0.93	73.29	6.22
150	0.83	2.38	72.43	5.2
151	2.00	3.08	90.41	8.8
152	0.45	0.45	38.99	7.09
153	1.34	1.34	74.99	7.34
154	1.46	3.10	52.14	0.76
156	1.03	1.02	18.22	6.15
157	0.65	0.65	54.64	6.05
158	0.72	0.72	73.10	8.59
162	0.75	0.75	90.89	7.55
163	0.40	0.40	49.3	8.19
164	2.20	2.20	70.83	7.78
165	1.00	1.00	114.58	9.44
168	0.72	0.72	102.5	8.82
169	0.52	0.52	82.18	8.89
171	0.95	1.91	123.7	8.07
172	0.70	0.70	80.76	7.08
173	1.12	1.12	64.80	9.58
175	0.40	0.40	52.3	7.7
176	0.25	0.25	74.21	7.7

Table 1.28: Details of pollinations and fruit set in 2002

Cross combination	No. of pollination	No. of fruit set	No. of nuts harvested	No. of nuts sown	No. germinated
A-1 x Brazil (244)	100	10	0	NA	NA
A-1 x KGN	54	20	2	2	1
A-1 x Kilianthara	40	10	0	NA	NA
A-1 x P-3-2	40	10	0	NA	NA
A-1 x P-6-2	25	5	0	NA	NA
A-1 x U-12-1	25	6	0	NA	NA
A-1 x VTH 711/4	65	10	2	2	2
Amrutha x A1	5	1	1	1	1
Amrutha x Dhana	25	12	4	4	4
Amrutha x NRCC sel-2	10	5	2	2	2
Amrutha x Ullal-3	100	30	21	20	18
Amrutha x UN-50	30	15	1	1	1
Dhana xA-1	5	1	0	NA	NA
Dhana x MDK-1	100	30	10	10	7
Dhana x UN-50	25	10	4	4	4
Dhana x NRCC sel-2	2	1	1	1	1
Dharasree x A-1	12	2	0	NA	NA
H-1593 x Ullal 12-2	33	0	0	NA	NA
K-22-1 x Dhana	125	39	12	12	12
K-22-1 x Kanaka	50	40	12	12	10
K-22-1 x Priyanka	122	30	20	20	12
K-22-1 x UN-50	100	54	13	13	10
K-22-1 x Ullal-3	15	9	1	1	1
Kanaka x Ullal-4	71	36	20	20	19
Kanaka x A-1	16	2	0	NA	NA
Kilianthara x A-1	13	4	0	NA	NA
MDK-1 x Dhana	5	0	0	NA	NA
MDK-1 x UN-50	93	10	8	8	6
Priyanka x MDK-2	21	2	0	NA	NA
Priyanka x NRCC sel-2	10	8	5	5	4
Priyanka x Ullal 12-1	30	0	0	NA	NA
Priyanka x Ullal -3	95	28	18	18	11
Sulabha x MDK-1	31	20	11	10	8
U-12-1 x A-1	52	8	0	NA	NA
U-12-1 x P-3-2	160	9	1	1	1
Total	2705		169	169	135

* NA - Not applicable

VENGURLE

During the year 94 different cross combinations were undertaken and 2190 hybrid seeds were obtained. These crossings include parents such as V-1, V-2, V-3, V-4, V-5, V-6,V-7, BT-1, BT-22, BT-65, BT-6, BT-10, Kolagaon, Kankadi, Hy 2/16, Bali, A. microcarpum, -3, M 26/2, M 44/3, Hy-80, Hy-320, Hy 367, Hy 1598, Hy 1600, Tulas, Ullal-1, Ullal-2, Ullal-3 Ansur, Hy 509, Hy 445 and Hy 303.

VRIDHACHALAM

The performance of 8 different selected F1 hybrids were evaluated during 2002-03 also. The highest cumulative yield/kg tree^{-1} (45.10 kg) was observed in H 10 (M 10/4 x M 26/1) cross combination. The hybrids H 13 (M 26/2 x M 26/1) recorded the highest nut yield/kg tree^{-1} (1.020 kg) and was cluster bearing in nature. The H 14 (M 26/2 x M 15/4) recorded the highest shelling out turn of 27.40 percent. The maximum apple weight was observed in H 16 (M 44/3 x M 26/1). The details of hybridization are given in Table 1.29.

Table 1.29: Performance F1 hybrids at Vridhachalam

Hybrid Number	Cross combination	Specific characters	Mean yield (kg tree^{-1})	Highest yield obtained (kg tree^{-1})	Cumulative yield (kg tree^{-1}) for 11 years	Nut weight (g)	Shelling %	Apple colour & weight (g)
H 10	M 10/4 x M 26/1	High yield	0.900	4.9	45.10	6.65	26.30	Yellow (11.0)
H 11	M 10/4/ x M 45/4	TMB	0.650	3.2	27.05	6.20	26.70	Yellow (8.4)
H 12	M 10/4 x M 75/3	High yield	0.700	3.6	28.40	6.28	27.00	Pinkish (10.5)
H 13	M 26/2 x M 26/1	High yield	1.020	4.6	39.42	6.20	27.30	Pink (8.0)
H 14	M 26/2 x M 45/4	TMB	0.815	3.8	31.12	6.00	27.40	Pink (8.5)
H 15	M 26/2 x M 75/3	High yield	0.800	3.8	29.40	6.26	26.50	Red (7.3 g)
H 16	M 44/3 x M 26/1	High yield	0.900	3.9	38.70	6.20	26.00	Yellow (10.5)
H 17	M 44/3 x M 45/1	TMB	0.750	4.2	33.85	6.50	26.50	Yellow (7.5)
A	ME 3/2 x VRI 2	High yield	1.300			6.35	26.50	Yellow (9.5)
B	M 33/3 x ME 3/2	High yield	1.500			6.30	26.45	Red (8.4)
C	VRI 2 x M 33/3	High yield	1.150			6.56	27.20	Red (9.6)
D	VRI 2 ME 3/2	High yield	1.600			6.45	26.80	Pink
E	M 33/3 x VRI 2	High yield	0.590			6.60	27.40	Red (8.2)

2. CROP MANAGEMENT

2. CROP MANAGEMENT

NPK Fertilizer experiment

Centers : East Coast
Bapatla, Jhargram, and Vridhachalam

West Coast
Madakkathara, and Vengurle

Maidan tracts/ others
Chintamani and Jagdalpur

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

Summary

There are two experiments under fertilizer application trial under different centers of AICRP on cashew. One experiment on NPK fertilizer application is being carried out at AICRP centers as well as on the other regional farm plots. Another experiment on fertilizer application on different planting densities is also being carried out, which is planted local promising variety and is initial stages at different centers. Under NPK experiment at Bapatla, highest yield of 7.313 kg tree^{-1} could be obtained for application of 1000g N & 250g P_2O_5, whereas, in APFDC plantations, for application of 1000g N, 250g P_2O_5 & 250g K_2O a yield of 10.50 kg tree^{-1} could be obtained. At Madakkathara, 7.51 kg tree^{-1} yield could be realized for application of 1000g N only. With recommended dose of fertilizer in 629 plants ha^{-1} a yield of 1-25 tonnes could be realized at Bhubaneswar for third harvest.

Experimental details:

Design	:	Three factorial confounded design with 27 treatment combinations
Replications	:	Two
Treatments	:	N - 0,500, and 1000 g/plant P - 0,125, and 250 g/plant K - 0,125, and 250 g/plant.
No. of plants per plot	:	Six

BAPATLA

The treatment N_2P_2K0 (1000g of nitrogen and 250 g of P_2O_5 without potash) gave significant highest nut yield of 7.3125 kg tree^{-1} followed by the 1000g N and 250g P_2O_5 and 125g of K_2O gave 7.125 kg tree^{-1} and on par with each other indicates the nitrogen requirement is essential and combination of phosphorus will increase the yield of the crop substantially. The yield data for different treatments is presented in Table 2.1.

On farm trial was carried out in APFDC Plantations. The T2 treatment i.e., gave higher nut yield (9.75 kg tree^{-1}) per tree than T1 treatment (7.25 kg tree^{-1}) however T3 treatment is on par with the T2 treatment during the previous year.

The effect of higher doses of fertilizer of NPK on the yield of cashew was observed during the year. The treatment T3 recorded the highest nut yield of 10.5 kg tree^{-1} which is on par with the T2 treatment 9.5 kg tree^{-1} over control. However, the

number of panicles per square meter is highest in T2 treatment than T1 treatment. The data on growth and yield characteristics of the on-farm trial is presented in Table 2.2.

Table 2.1: Effect of N P K fertilizers application on yield performance of cashew at Bapatla.

Treatment	Mean nut yield (kg tree^{-1}) (2001-2002)	Cumulative mean nut yield (kg tree^{-1}) (4 harvests)
N0P0K0	3.3000	11.1750
N0P0K1	1.6100	6.4700
N0P0K2	1.5900	7.0250
N0P1K0	1.7500	6.6100
N0P1K1	1.9100	6.3700
N0P1K2	3.0570	6.2600
N0P2K0	2.0570	7.7170
N0P2K1	2.6853	5.9035
N0P2K2	2.1100	7.4050
N1P0K0	6.3125	13.9025
N1P0K1	5.8200	16.8850
N1P0K2	6.3460	12.7760
N1P1K0	4.5000	9.9150
N1P1K1	6.1125	12.1075
N1P1K2	3.6335	12.3185
N1P2K0	4.7710	11.7260
N1P2K1	4.8475	12.0815
N1P2K1	5.2650	13.0900
N2P0K0	3.0750	4.8650
N2P0K1	4.0625	9.4475
N2P0K2	5.9000	10.2750
N2P1K0	5.0525	13.1200
N2P1K1	5.4225	17.7975
N2P1K2	3.3025	10.7685
N2P2K0	7.3125	15.9375
N2P2K1	7.1250	13.0050
N2P2K2	4.7475	14.9575
CD at 5 %	—	—

Table 2.2: Effect of higher doses of fertilizer conducted in APFDC plantation.

Treatment	Girth (cm)	Spread (m)	Number of panicles m^{-2}	Nut yield (kg tree^{-1})
T1	135.5	13.0	17.0	8.25
T2	141.5	13.5	19.0	9.50
T3	142.5	14.0	18.5	10.50

CHINTAMANI

The various dosages of N, P, and K fertilizers influenced the vegetative growth of cashew. Plant height, girth and canopy spread were significantly influenced by P_2O_5, 250g tree^{-1} (5.47 m, 100.73 cm & 9.37-9.58 m respectively) and canopy spread did not show any significant increase. The effect of N, P, and K fertilizers is presented in Table 2.3.

Table 2.3: Effect of NPK and their interaction on plant height at Chintamani

	P0	P1	P2	Mean	K0	K1	K2
N0	5.31	5.39	5.54	5.41	5.39	5.46	5.40
N1	5.00	5.61	5.38	5.30	5.28	5.33	5.38
N2	5.08	5.53	5.50	5.37	5.33	5.42	5.36
Mean	5.13	5.51	5.47	—	5.33	5.40	5.38
K0	4.83	5.54	5.28	—	—	—	—
K1	5.13	5.40	5.51	—	—	—	—
K2	5.08	5.18	5.29	—	—	—	—

CD 5% for P= 0.15
CD 5% for N/P/K = NS
CD 5% for NP/NK /PK= NS
SEm± for P = 0.05
SEm± For N/P/K = 0.05
SEm± For NP/NK/PK = 0.10

Two on farm trials are under maintenance by the center in farmers field, which are planted in 1996. Both of these are located in Kolar District with variety Chintamani-1. Yield obtained from the above trials are 3.48 and 3.42 kg tree^{-1} respectively.

JHARGRAM

At Jhargram the interaction effect showed that the treatment combination N1P1K0 resulted in maximum height (7.09 m), N0P1K2 in maximum girth (97.33 cm) and N1P1K0 in maximum canopy spread (193.43m^2) under NPK fertilizer trial imposed in Jhargram-1 cashew grafts. The details of the NPK interaction on growth characteristics of cashew are presented in Table 2.4.

MADAKKATHARA

At Madakkathara All operations were done following the package of practices of KAU, except fertiliser application. Fertiliser application was done during September 2000. Urea, Mossoorie phosphate and MOP were used to supply N, P and K as per the approved technical programme. Four months after imposing the treatment, during January 2002, observations on tree height, girth, canopy spread and yield were recorded.Trees applied with nitrogen @ 1000 g per tree were the tallest (Table 2.5). Application of phosphorus and potassium did not influence the tree height (Table 2.6 and 2.7). Among the first order interactions influence the plant height was highest with the treatment N_2P_0 (1000g N, 0g P_2O_5)(Table 2.8, 2.9 and 2.10). Among the second order interaction, trees received the treatment $N_2P_0K_1$ (1000 g N, 0 g P_2O_5 and 125 g K_2O) were the tallest (Table 2.11). During the year under report, in terms of tree girth, canopy spread and yield of cashew, there was no significant influence observed for different treatments.

Table 2.4: Effect of NPK fertilizer and their interaction on growth at Jhargram

Treatment	Plant Height (m)	Plant Girth (cm)	Canopy spread (m)
N0P0K0	6.00	86.00	5.53
N0P0K1	5.47	84.33	4.25
N0P0K2	6.20	70.67	5.18
N0P1K0	6.07	76.00	4.83
N0P1K1	5.39	89.67	4.08
N0P1K2	6.47	97.33	5.25
N0P2K0	5.73	86.33	4.33
N0P2K1	6.23	79.00	4.87
N0P2K2	6.45	80.67	5.22
N1P0K0	5.65	82.17	5.03
N1P0K1	.23	73.17	3.94
N1P0K2	5.23	74.50	4.08
N1P1K0	7.09	87.67	5.90
N1 P1K1	5.33	76.00	5.05
N1 P1K2	5.85	83.67	4.60
N1P2K0	4.79	69.00	3.67
N1 P2K1	5.81	80.00	4.75
N1 P2K2	6.24	82.83	5.33
N2P0K0	5.33	73.67	4.65
N2 P0K1	5.68	81.33	4.63
N2 P0K2	4.85	67.33	3.65
N2P1K0	5.82	81.00	4.66
N2P1K1	6.08	82.00	5.18
N2P1K2	6.58	76.67	5.48
N2P2K0	5.83	78.33	4.82
N2P2K1	5.04	80.33	3.97
N2P2K2	5.68	81.33	4.52
SEm±	0.358	4.874	0.424
CD 5%	1.04	14.16	1.11

Table 2.5: Effect of nitrogen on height, girth, canopy spread and yield at Madakkathara

Levels of N	Height (m)	Girth (cm)	Canopy spread (m)	Yield (kg tree^{-1})
N0	5.35	74.50	6.62	3.00
N1	5.60	72.00	7.00	3.49
N2	5.91	75.91	7.53	3.70
SE	0.14	3.01	0.25	0.61
CD (0.05)	0.29	6.16	0.51	NS

Table 2.6: Effect of phosphorous on height, girth, canopy spread and yield at Madakkathara

Levels of P	Height (m)	Girth (cm)	Canopy spread (m)	Yield (kg tree^{-1})
P0	5.64	76.96	7.15 3.60	
P1	5.66	73.24	6.88	3.01
P2	5.57	72.20	7.13	3.58
SE	0.14	3.01	0.25	0.61
CD (0.05)	0.29	NS	NS	NS

Table 2.7: Effect of potassium on height, girth, canopy spread and yield at Madakkathara

Levels of K	Height (m)	Girth (cm)	Canopy spread (m)	Yield (kg tree^{-1})
K0	5.60	73.72	7.11	3.72
K1	5.69	76.19	7.01	3.40
K2	5.57	72.50	7.03	3.07
SE	0.14	3.01	0.25	0.61
CD (0.05)	0.29	6.16	0.51	NS

Table 2.8: Effect of N and P on height, girth, canopy spread and yield at Madakkathara

Levels of N and P	Height (m)	Girth (cm)	Canopy spread (m)	Yield (kg tree^{-1})
N0P0	5.06	77.22	6.56	2.97
N0P1	0.59	74.89	6.31	2.26
N0P2	5.41	71.39	6.98	3.77
N1P0	5.70	74.39	7.09	3.25
N1P1	5.64	70.44	6.88	3.47
N1P2	5.47	71.17	7.04	3.76
N2P0	6.16	79.28	7.80	4.57
N2P1	5.75	74.39	7.44	3.31
N2P2	5.82	74.06	7.35	3.22
SE	0.25	5.21	0.43	1.06
CD (0.05)	0.50	10.67	0.88	NS

Table 2.9: Effect of N and K on height, girth, canopy spread and yield at Madakkathara

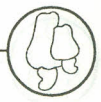
Levels of N and K	Height (m)	Girth (cm)	Canopy spread (m)	Yield (kg tree^{-1})
N0K0	5.26	72.50	6.74	2.97
N0K1	5.71	80.50	6.88	3.77
N0K2	5.09	70.50	6.22	2.26
N1K0	5.58	66.78	6.84	2.95
N1K1	5.50	71.56	6.79	3.16
N1K2	5.73	77.67	7.38	4.36
N2K0	5.97	81.89	7.74	5.23
N2K1	5.63	70.61	6.78	4.37
N2K2	5.90	69.33	7.48	2.59
SE	0.25	5.21	0.43	1.06
CD (0.05)	0.50	NS	NS	NS

Table 2.10: Effect of P and K on height, girth, canopy spread and yield at Madakkathara

Levels of P and K	Height (m)	Girth (cm)	Canopy spread (m)	Yield (kg tree^{-1})
P0K0	5.67	78.00	7.33	4.17
P0K1	5.69	77.89	7.17	3.22
P0K2	5.55	75.00	6.95	3.40
P1K0	5.61	76.67	7.17	3.72
P1K1	5.64	73.83	6.51	2.72
P1K2	5.72	69.22	6.94	2.61
P2K0	5.53	66.50	6.83	3.26
P2K1	5.73	76.83	7.36	4.28
P2K2	5.45	73.28	7.18	3.21
SE	0.25	5.21	0.43	1.06
CD (0.05)	NS	NS	NS	NS

Table 2.11: Effect N, P and K on growth characters and yield at Madakkathara

Treatment	Height (m)	Girth (cm)	Canopy spread (m)	Yield (kg tree^{-1})
N0P0K0	5.19	68.83	6.50	3.26
N0P0K1	5.20	91.17	7.13	3.41
N0P0K2	4.79	71.67	6.06	2.76
N0P1K0	5.24	78.83	6.93	2.56
N0P1K1	6.02	74.83	6.18	1.87
N0P1K2	5.50	71.00	5.82	2.35
N0P2K0	5.35	69.83	6.81	3.08
N0P2K1	5.90	75.50	7.34	6.55
N0P2K2	4.99	68.83	6.79	1.68
N1P0K0	5.64	80.17	7.53	3.43
N1P0K1	5.75	70.50	6.80	2.91
N1P0K2	5.70	72.50	6.93	5.10
N1P1K0	5.79	65.50	6.60	3.35
N1P1K1	5.23	65.83	6.19	3.65
N1P1K2	5.90	80.00	7.84	3.41
N1P2K0	5.31	54.67	6.41	3.78
N1P2K1	5.52	78.33	7.38	2.92
N1P2K2	5.58	80.50	7.35	4.59
N2P0K0	6.18	85.00	7.96	7.51
N2P0K1	6.13	72.00	7.58	3.85
N2P0K2	6.18	80.83	7.86	2.35
N2P1K0	5.80	85.67	7.99	5.25
N2P1K1	5.68	80.83	7.17	2.63
N2P1K2	5.76	56.67	7.18	2.06
N2P2K0	5.91	75.00	7.28	2.93
N2P2K1	5.76	76.67	7.38	3.37
N2P2K2	5.78	70.50	7.40	3.37
SE	0.42	9.02	0.74	1.83
CD (0.05)	0.87	NS	NS	NS



VENGURLE

At Vengurle, among the interactions of N and P the N2P2 (3.85 kg tree^{-1}) interaction was significantly superior over other treatments. Among N and K interaction, N2K2 (3.28 kg tree^{-1}) was significantly superior over other interactions. Among the P and K interaction the P2K2 (2.95 kg tree^{-1}) was superior over other treatments. The details of growth and yield in response to NPK fertilizers are presented in Table 2.12.

VRIDHACHALAM

The trial has been laid out with VRI 2 cashew grafts and the fertilizer dose has been applied as per the schedule. The observations were recorded for tree height, trunk girth, canopy diameter, canopy height, and canopy area and nut yield per plant.

The canopy area was the highest in N2P3K2 (500 g N, 250 g P_2O_5 and 125 g K_2 0). The nut yield was maximum (0.785 kg/tree^{-1}) in the N3P2K3 (1000 g N 125 g, P_2O_5 and 250 g K_2O) treatment. The cumulative yield per plant was also maximum in the N3P2K3 treatment.

Table 2.12: Effect of N, P and K interaction on yield at Vengurle.

Treatments	K1	K2	K3
N1P1	0.57	0.93	1.35
N1P2	2.09	2.83	2.61
N1P3	2.33	3.03	3.85
N2P1	1.42	1.84	1.73
N2P2	2.36	2.05	2.38
N3P3	2.54	2.32	2.95
N3P1	0.77	0.93	1.15
N3P2	2.73	2.17	2.63
N3P3	2.82	3.11	3.28
CD 5% N, P, K	0.108	SEm	0.037
CD 5% NP, NK, PK	0.188	SEm	0.065
CD 5% NXPXK	0.325	SEm	0.112

Table 2.13: Performance of cashew in response to N, P, K fertilizers treatments at Vridhachalam

Treatment	Plant height (m)	Trunk girth (cm)	Canopy diameter (m)	Canopy height (m)	Canopy area (m^2)	Nut yields (kg $tree^{-1}$)	Cum yield kg $tree^{-1}$ for 2 years
N1P1K1	3.30	43.6	5.35	2.08	28.11	0.649	0.979
N1P1K2	3.15	48.1	5.10	1.90	25.46	0.635	0.940
N1P1K3	3.10	40.5	4.55	2.30	23.14	0.417	0.867
N1P2K1	3.15	40.8	4.30	1.70	21.87	0.767	1.167
N1P2K2	2.55	33.4	4.65	1.62	20.08	0.550	0.935
N1P2K3	2.80	34.2	4.70	1.60	20.88	0.650	1.106
N1P3K1	2.80	33.2	4.00	1.64	16.24	0.350	0.806
N1P3K2	3.12	40.2	4.60	1.80	21.08	0.505	0.935
N1P3K3	2.80	44.5	4.77	1.65	21.26	0.455	0.955
N2P1K1	2.50	27.0	3.70	1.60	14.24	0.380	0.860
N2P1K2	2.50	23.9	4.20	1.58	18.19	0.496	0.970
N2P1K3	2.90	33.3	4.50	1.60	20.92	0.427	0.932
N2P2K1	2.90	27.5	4.35	1.75	20.45	0.531	0.981
N2P2K2	3.20	36.4	4.90	2.00	24.31	0.495	0.981
N2P2K3	2.60	27.5	4.10	1.60	17.05	0.314	0.939
N2P3K1	3.20	35.5	4.55	1.88	21.08	0.478	1.103
N2P3K2	3.40	37.1	5.25	2.28	28.69	0.634	1.379
N2P3K3	2.80	37.1	4.35	1.67	18.85	0.750	1.510
N3P1K1	2.80	35.5	4.30	1.88	19.04	0.488	1.258
N3P1K2	3.40	35.3	4.82	1.75	22.55	0.568	1.258
N3P1K3	3.20	35.8	3.80	1.70	19.35	0.470	1.270
N3P2K1	2.60	28.7	4.67	1.63	20.96	0.596	1.396
N3P2K2	2.50	32.4	3.90	1.67	17.91	0.622	1.492
N3P2K3	3.10	38.6	5.00	2.00	25.20	0.785	1.785
N3P3K1	3.10	42.6	4.90	1.81	23.46	0.320	1.360
N3P3K2	2.80	37.9	4.10	1.68	17.83	0.425	1.405
N3P3K3	3.60	53.7	4.90	1.85	23.62	0.489	1.499

Fertilizer application in high density cashew plantations

Centers : East Coast
Bapatla, Bhubaneswar, Jhargram, and Vridhachalam

West Coast
Madakkathara, Pilicode, and Vengurle

The objective of this experiment is to study the response of vegetatively propagated material of cashew to different doses of NPK fertilizers at different spacings for a given regional variety.

Design: Split-plot
Main plot: Plant density
S1 200 plants/ha (10m x 5m)
S2 400 plants/ha (6m x 4m)
S3 500 plants/ha (5m x 4m)

Subplot: Fertilizer dose

M1	75 kg N,	25 kg P_2O_5,	25 kg K_2O/ha
M2	150 kg N,	50 kg P_2O_5,	50 kg K_2O/ha
M3	225 kg N,	75 kg P_2O_5,	75 kg K_2O/ha

Total area: 2.5 ha

Fertilizers application level:
1st year: 1/5th
2nd year: 2/5th
3rd year: 3/5th
4th year: 4/5th
5th year: Full dose

The experiment is in its initial stages in all the Coordinating Centres and the detailed layout and experimental progress will be reported after establishing the experiment. At Bapatla, the trial has been laid out with BPP-8 variety in three replications in the new garden during the year 2001. At Chintamani, the experiment was laid out with Chintamani-1 grafts in four replications during 2001-02. At Madakkathara, the trial is laid out with variety Madakkathara-1 and treatments were applied as per schedule. At Pilicode, the experiment has been laid out with Madakkathara-1 grafts during August 2000 and treatments were applied as per schedule

BHUBANESWAR

The experiment was started during the year 2000 August with variety H 2/16. The 2/5th of the recommended fertilizer was applied in the month of August 2002. The biometrical observation on height, girth and spread of the plant is presented in the table.There is no significant variation in the vegetative characters due to spacing and fertilizer application. The height of the plant varied from 1.5m to 2.1m in height. The girth of the plant varied from 17.0cm to 20.72cm. The spread of the plant covered an average 1.90m in both directions. The plants planted in S2 (6m x 4m) and S3 (5 x 4) covered 50% of the canopy year within two years of the growth period.

Table 2.14: Effect of fertilizer application on vegetative characters of cashew variety H 2/16 at Bhubaneswar

	Treatment	Plant height (m)	Girth (cm)	Spread of the plant (m) E - W	N - S
(a)	Spacing				
	S1	1.77	18.69	1.92	1.96
	S2	1.85	18.49	1.93	1.96
	S3	1.65	18.38	1.92	1.90
	F 'test'	NS	NS	NS	NS
(b)	Doses of fertilizer				
	M1	1.82	18.81	2.04	1.94
	M2	1.76	18.96	1.92	1.97
	M	1.65	17.90	1.80	1.91
	F 'test'	NS	NS	NS	NS
(c)	Combination effect of spacing and fertilizer				
	S1M1	1.8	18.6	1.97	1.95
	S1M2	1.8	19.7	2.02	2.12
	S1M3	1.7	17.77	1.75	1.80
	S2M1	2.1	20.72	2.20	2.05
	S2M2	1.65	17.0	1.82	1.87
	S2M3	1.80	17.75	1.77	1.97
	S3M1	1.70	17.10	1.95	1.82
	S3M2	1.80	19.88	1.92	1.92
	S3M3	1.50	18.17	1.82	1.95
	F'test'	NS	NS	NS	NS
	SE (m) ±				

The leaf samples were collected in the month of October and analysis report is presented in the Table 2.15. It is indicated from the table that the leaf N declined as the spacing increases. However, there is no consistency in P_2O_5 & K_2O content of the leaf. The doses of fertilizer showed that leaf N & P content increased with increases in the fertilizer application. However, the K20 content did not show any linear increase.

At Chintamani, the experiment was laid out with Chintamani-1 grafts in four replications during 2001-02. At Madakkathara, the trial is laid out with variety Madakkathara-1 and treatments were applied as per schedule. At Pilicode, the experiment has been laid out with Madakkathara-1 grafts during August 2000 and treatments were applied as per schedule.

VENGURLE

At Vengurle, the experiment has been initiated with V-7 grafts with four replications during 2000. Growth observations have been recorded and presented in the Table 2.16.

Table 2.15: Effect of leaf nutrient content NPK due to spacing and doses of fertilizer at Bhubaneswar.

a) Effect of spacing

Treatment	N%	P_2O_5%	K_2O%
S1	2.05	0.056	0.35
S2	1.87	0.046	0.32
S3	1.69	0.057	0.37

b) Doses of fertilizer application

M1	1.74	0.047	0.35
M2	1.93	0.056	0.37
M3	1.93	0.057	0.34

c) Effect of spacing and doses of fertilizer

Treatment	N%	P_2O_5%	K_2O%
S1M1	1.88	0.036	0.35
S1M2	2.08	0.076	0.37
S1M3	2.19	0.056	0.32
S2M1	1.71	0.052	0.29
S2M2	2.06	0.038	0.33
S2M3	1.84	0.050	0.34
S3M1	1.64	0.052	0.40
S3M2	1.67	0.054	0.41
S3M3	1.76	0.066	0.36

Table 2.16: Growth parameters of spacing trial at Vengurle

Treatment	Plant Height (m)			Plant Girth (cm)			Canopy Spread (m)			Canopy height (m)			Canopy area (m)		
	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
S1	1.63	1.45	1.69	0.20	0.18	0.20	2.27	2.16	2.18	1.23	1.03	1.21	5.96	5.06	5.57
S2	1.32	1.58	1.53	0.16	0.16	0.18	1.69	1.68	1.80	0.85	1.09	1.07	3.18	3.63	3.95
S3	1.64	1.52	1.60	0.22	0.23	0.21	2.15	2.63	2.22	1.18	1.05	1.12	5.39	6.95	5.50
SE m (±)			0.04			0.01			0.15			-			-
CD 5%			N.S.			0.02			N.S.			-			-

Spacing and high density planting trials - High density planting trial

Centers: East Coast
Bapatla and Bhubaneswar

West Coast
Vengurle

Maidan tracts/ others
Chintamani

BAPATLA

The trial has been laid out with 4 m x 4 m (625 plants ha^{-1}) and 8 m x 8 m (156 plants ha^{-1}) in fresh plot, with BPP-5 in three replications in an area of 0.90 ha.

BHUBANESWAR

The trial was laid out with 4 m x 4 m (625 plants ha^{-1}) during 1996 with variety H 2/16. During the year 2002 in the high density plot 1.75 t. ha^{-1} yield was recorded. Similar trial has been laid out in farmers' field with variety V-4. Recommended dose of fertilizer was also applied and 1.25 t. ha^{-1} yield was recorded for third annual harvest.

CHINTAMANI

During 1997 high density planting was established using Chintamani-1 grafts at a spacing of 4 m x 4 m. During the year 25 trees were randomly sampled for recording observations. The growth and yield parameters are presented in Table 2.17.

Table 2.17: Growth characteristics of Chintamani-1 grafts at Chintamani.

Parameters	Plant height (m)	Plant Girth (cm)	Canopy spread (m)	Yield (kg $tree^{-1}$)
Maximum	3.4	31.0	3.40	0.25
Minimum	1.45	10.0	1.85	1.45
Mean	1.87	13.33	2.63	0.84

Cashew based cropping system

Centers: East Coast
Bapatla, Bhubaneswar, Jhargram, and Vridhachalam

West Coast
Madakkathara and Vengurle

The objectives are to:

(a) Identify compatible inter-crops with cashew in the initial stages of orchard development.
(b) Study the economic benefits of inter-cropping system.
(c) Work out a soil fertility management strategy for the inter-cropping system.

Summary

At Bhubaneswar, growing cashew with turmeric as intercrop with recommended dose of fertilizer could earn maximum net returns of Rs. 7,250/- per year from one hectare. At Jhargram, Blackgram was found profitable with the net returns of Rs. 6,137/- per hectare in a year. At Madakkathara medicinal plants and tuber crops are being evaluated as intercrops. Economically harvestable growth of intercrops have to be achieved yet. At Vengurle cucumber as intercrops could fetch Rs. 33,659/- from one hectare in a year. At Vridhachalam, groundnut could fetch Rs. 22,389/- net profit for one hectare in a year.

Experimental details:

Main plot : 4
Sub-plot -3 : 3
F0 - No additional fertilizer to inter-crop
F1 - Additional fertilizer application to the inter-crops as per the state recommendation.
F2 - 50% of the additional fertilizer application to the intercrop.
No. Of replications : 3
Design : Split plot

BAPATLA

During the year due to severe drought intercropping experiment could not be conducted.

BHUBANESWAR

The cashew plants were spaced at 10 m x 10 m as a main crop and the other intercrops were grown at different spacing. The cashew intercropped with turmeric also with recommended dose of fertilizer fetched net profit of Rs. 7,250/-. The details of yield obtained for the main crop as well as for intercrop is presented in Table 2.18.

In case of turmeric cashew leaves were used as mulching material to suppress weed growth and to provide organic fertilizer.

JHARGRAM

During the period under report, intercropping was done with Black gram, Green gram and radish along with cashew at the center. The data on yield and cost of cultivation are given in table 2.19.

Table 2.18: Performance of cashew and its intercrops at Bhubaneswar.

Treatments	Cashew yield Q ha^{-1}	Intercrop yield	Returns (Rs.)				
			Cashew @ Rs. 3000 q^{-1}	Inter-crop	Total return	Cost of cultivation of intercrops	Net return from intercrop (Rs.)
Cashew + Cowpea with no fertilizer	8.0	5.6	24000	1680	25680	1900	(-)220
Cashew + Cowpea with recommended fertilizer (25:50:25 Kg ha^{-1})	9.5	12.5	28500	3750	32250	2400	1350
Cashew + Cowpea with 50% recommended fertilizer	9.0	9.6	27000	2880	29880	2150	730
Cashew + Pumpkin with no fertilizer	8.0	12.0	24000	3000	27000	3500	(-) 500
Cashew + Pumpkin with recommended fertilizer (50:30:75 Kg ha^{-1})	8.6	22.6	25800	5650	31450	4200	1450
Cashew + Pumpkin with 50% recommended fertilizer	8.4	18.6	25200	4650	29850	3900	750
Cashew + Turmeric with no fertilizer	7.0	30.0	21000	15000	36000	21200	(-) 6200
Cashew + Turmeric with recommended fertilizer (60:30:90 Kg ha^{-1})	7.6	62.5	22800	31250	54050	24000	7250
Cashew + Turmeric with 50% recommended fertilizer	8.1	50.6	24300	25300	49600	22800	2500
Cashew + Green gram with no fertilizer	7.2	0.56	21600	840	22440	900	(-) 60
Cashew + Green gram with recommended fertilizer (25:50:25 Kg ha-1)	8.0	1.2	24000	1800	25800	1060	740
Cashew + Green gram with 50% recommended fertilizer	9.0	0.75	27000	1125	28125	970	155

Table 2.19: Performance of intercrops along with cashew at Jhargram

Treatments	Yield (kg/plot)	Yield Q. ha^{-1}	Cost of intercropping (Rs. ha^{-1})	Total returns from intercrop (Rs. ha^{-1})	Net profit (Rs. ha^{-1})
Black gram	1.985	2.360	943.36	7080.00	6136.64
Green gram	1.590	1.890	943.36	5670.00	4726.64
Radish	20.0	23.810	1063.36	4762.00	3698.64

MADAKKATHARA

The trial was relaid out in 2002 with four tuber crops and three medicinal plants and treatments are as follows.

Cashew alone;
Cashew + tapioca;
Cashew + coleus;
Cashew + sweet potato;
Cashew + colocasia;
Cashew + *Chethikoduveli;*
Cashew + *Chittadalodakam;*
Cashew + *Karinkurinji*

Irrigation facilities were provided for the experiment. However, among the medicinal plants only *Chittadalodakam* is performing well and *Chethikoduveli* and *Karinkurinji* failed to establish. All the tuber crops performed reasonably well and first season mean yields are given below.

Tuber crops	Mean yield t. ha^{-1}
Coleus	14.00
Sweet potato	12.00
Tapioca	14.00
Colocasia	9.75

Chittadalodakam will be harvested only after two years. The tuber crops will be planted again in the coming *kharif.*

VENGURLE

During the period under report, ridge gourd (Konkan Harita), bitter gourd (Konkan Tara), cucumber (Sheetal), snake gourd (Konkan Shweta), and bottle gourd (Pusa Navin) were grown as intercrops with cashew each at a spacing of 60 cm x 90 cm. Maximum yield was obtained for cucumber and has been found remunerative followed by bottle and ridge gourd. Yield obtained from intercrops and economics of growing are presented in Table 2.20.

VRIDHACHALAM

The experiment was conducted during the year 2002-2003 with plot size of 7 m x 7m with four different intercrops. The yields of intercrops were 789, 264.5 224.5 and 1973 kg ha^{-1} for black gram, cowpea, red gram and groundnut respectively. The revenue was Rs. 15,780, 5,250, 6,735 and 35,514 respectively for black gram, cowpea, red gram and groundnut. The groundnut as intercrop has given the highest returns (35,514 Rs. ha^{-1}). From the result, it was found that intercropping with groundnut gave the highest revenue. The details of the performance of intercrops under cashew plantations are given in Table 2.21.

Table 2.20: Performance of intercrops in cashew plantations at Vengurle

Intercrop	Yield kg plot^{-1}	Yield kg ha^{-1}	Cost of cultivation	Total returns Rs. ha^{-1}	Net profit Rs. ha^{-1}
Snake gourd	23.45	47.88	13574.00	33514.50	19939.90
Ridge gourd	23.83	48.64	12254.90	34047.90	21793.00
Bitter gourd	15.83	32.31	12182.40	25848.50	13666.10
Bottle gourd	27.78	56.71	12109.50	28355.00	16245.50
Cucumber	34.40	70.23	15501.80	49160.50	33658.70
SEm (±)	0.401	0.819			
CD 5%	1.237	2.525			

Table 2.21: Performance of cashew and its intercrop at Vridhachalam.

Treatments	Yield from intercrops		Total returns from intercrops/ha (Rs. ha^{-1})	Total cost of intercrops (Rs. ha^{-1})	Net profit (Rs. ha^{-1})	C:B ratio
	Plot (kg)	Ha (kg)				
Cashew + Black gram (Rs. 20/kg)	3.87	789.00	15,780	3,525	12,255	1:4.5
Cashew + Cowpea (Rs. 20/kg)	1.30	264.50	5,250	3,125	2,125	1:1.68
Cashew + Red gram (Rs. 30/kg)	1.15	224.50	6,735	3,750	2,985	1:1.80
Cashew + Groundnut (Rs.18/kg)	9.67	1973.00	35,514	13,125	22,389	1:2.71
Cashew sole crop	-	-	-	-	-	-

Drip irrigation trial

Centers: East Coast
Vridhachalam

West Coast
Vengurle

Maidan tracts/ others
Chintamani

The objective is to study the response of cashew to supplementary irrigation during flushing and flowering phases and to work out the critical stages of irrigation.

Experimental details:

Treatments	:	Five
T1	:	No irrigation
T2	:	Irrigating 20% of cumulative pan evaporation
T3	:	Irrigating 40% of cumulative pan evaporation
T4	:	Irrigating 60% of cumulative pan evaporation
T5	:	Irrigating 80% of cumulative pan evaporation
Spacing	:	7m x 7m
Planting material	:	Softwood grafts
Variety	:	Chintamani : Chintamani-1
		Vengurle : Vengurla-7
		Vridhachalam : VRI-3

CHINTAMANI

Planting of 240 grafts of Chintamani-1 has been done during September 1997. The establishment of plants is quite satisfactory at Chintamani Centre. Drip irrigation experiment has been initiated in January 2003.

VENGURLE

At Vengurle, this trial has been laid out at Agricultural Research Station, Mulde, Kudal, and Sindhudurg District. Soft wood grafts of Vengurla-7 were planted at a spacing of 5 m x 5 m for the purpose of implementing the trial. The drip irrigation treatments have been imposed from January 2000. Effect of drip irrigation on growth parameters in cashew is presented in Table 2.22.

Table 2.22: Effect of drip irrigation on growth parameters in cashew at Vengurle

Treatment	Plant height (m)	Plant girth (cm)	Canopy spread (m)	Canopy height (m)	Canopy area (M2)
T1	2.61	29.0	3.99	1.86	17.09
T2	2.67	32.5	4.06	1.89	17.68
T3	2.60	30.8	4.14	1.82	17.92
T4	2.49	26.8	3.62	1.73	14.23
T5	2.37	29.0	3.80	1.63	14.94
SEm (±)	0.11	1.48	0.23	-	-
CD 5%	N.S.	0.02	N.S.	-	-

3. CROP PROTECTION

3. CROP PROTECTION

Chemical control of pest complex in cashew

1. Control of major pest: Tea mosquito bug, *Helopeltis antonii* &
2. Control of minor pests

Centres : East Coast
Jhargram and Vridhachalam

West Coast
Madakkathara and Vengurle

Maidan tracts/ others
Chintamani and Jagdalpur

The objective of the project is 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 alternate chemicals in comparison with standard insecticidal spray schedule against pests of cashew.

Summary

Chemical control of pests of cashew is being carried out at different centers. At Chintamani, control of TMB could be done at its best by the use of carboryl (0.1%) at flowering stage and neem oil (2%) at fruiting stage, which could result in a yield of 8.16 kg tree^{-1}. Standard spray of monochrotophos (0.05%), endosulfan (0.05%) and carboryl (0.1%) at flushing, flowering and fruiting stages respectively could give effective control at Jagdhalpur, Jhargram, Madakkathara, Vengurle and Vridhachalam.

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

CHINTAMANI

In trees, which received spray at flowering and fruiting stages, least incidence of TMB was recorded. However, the population of natural enemies was highest in untreated control (T10) during all the stages. The yield was highest in T9 (8.16 kg tree^{-1}), which was significantly higher than all other treatments. The percent incidence of TMB and the number of natural enemies at flowering, fruiting and harvesting stages in different treatments are presented in Table 3.1.

Table 3.1: Incidence of tea mosquito bug and natural enemies at Chintamani.

Treatment	TMB (%)		Inflorescence thrips		Natural enemies (No.)		Yield (kg tree^{-1})
	30 days after II spray	30 days after III spray	30 days after II spray	30 days after III spray	30 days after II spray	30 days after III spray	
T1	6.20	3.36	14.02	17.06	2.02	3.42	3.02
T2	0.55	2.68	1.86	2.86	1.32	2.02	5.02
T3	7.62	0.02	15.12	16.83	4.52	2.62	3.85
T4	0.56	3.12	14.16	15.47	0.68	1.96	5.26
T5	0.52	0.10	1.66	2.64	0.75	0.42	7.96
T6	6.68	0.16	13.22	16.63	1.48	0.68	3.65
T7	0.62	0.12	1.53	2.76	1.30	0.62	7.68
T8	0.51	0.15	1.65	2.78	1.26	0.52	8.02
T9	0.56	0.16	1.18	2.96	1.38	0.58	8.16
T10	6.78	3.56	14.97	17.29	4.60	4.80	3.69
SEm±	0.46	0.38	0.38	0.40	-	-	0.36
CD 5%	1.39	1.14	1.14	1.20	-	-	1.07

JAGDALPUR

The incidence of TMB and other minor pests were recorded in two critical stages namely flushing and flowering and presented in table 3.2- and 3.3. The combination of two spray each after 30 days interval were given significant control of TMB and minor insect pests when monocrotophos (0 .05%) and Endosulfan (0.05%) sprayed at flushing and flowering. The observation on minor pests were recorded pre and post spray of the insecticides as per the technical programme. Among all the treatments T_5 i.e monocrotophos 0.05% at flushing ,endosulfan 0.05% at flowering stage and carbaryl (0.1%) at fruiting stage gave less incidence of leaf miner (3.34%; 30 days after 1st spray), leaf roller (0.39%; 30 days after 1st spray), leaf miner (1.69%; 30 days after 2nd spray)), leaf caterpillar (1.24%; 30 days after 2nd spray), TMB (0.81%; 30 days after 2nd spray in leaf) and TMB(3.89%; 30 days after 2nd spray inflower) followed by T4 and T1.

Table 3.2 : Efficacy of different insecticide against major pest of cashew at Jagdalpur.

S. No.	Treatment	Percent incidence of TMB (Tea mosquito bug)		
		Leaf		Flower
		30days After Ist Spray	30days After IInd Spray	30 days After Ist Spray
1.	T1	0.72	1.20	25.13
2.	T2	1.56	1.10	21.92
3.	T3	2.89	1.98	32.04
4.	T4	0.72	0.84	7.17
5.	T5	0.76	0.81	3.89
6.	T6	0.79	1.14	27.17
7.	T7	1.68	1.35	19.72
8.	T8	1.56	1.64	12.33
9.	T9	1.78	1.38	10.91
10.	T10	1.67	2.02	35.56
SE m ±		2.92	0.23	3.28
CD (0.05)		0.82	0.69	9.74

Table 3.3 : Efficacy of different insecticide against minor pests of cashew at Jagdalpur.

Treatment	Per cent incidence of minor pest of Cashew								
	Pre treatment count			30 days After Ist spray			30days After IInd spray		
	Leaf miner	Leaf caterpillar	Leaf roller	Leaf miner	Leaf caterpillar	Leaf roller	Leaf miner	Leaf caterpillar	Leaf roller
T1	3.07	8.02	2.38	2.19	3.54	0.52	2.45	2.34	-
T2	2.77	2.82	1.18	3.73	4.41	2.75	3.01	2.23	-
T3	1.87	2.72	1.76	3.74	4.33	3.37	2.84	3.34	-
T4	7.38	5.52	2.13	2.40	3.87	0.48	1.82	1.78	-
T5	5.11	7.03	1.92	3.34	5.50	0.39	1.69	1.24	-
T6	4.98	6.89	2.06	3.16	4.09	0.52	2.02	2.98	-
T7	2.25	2.83	0.84	3.59	5.35	2.10	2.55	2.57	-
T8	2.06	2.41	1.07	3.61	5.98	3.38	1.81	2.42	-
T9	1.91	3.19	1.39	4.62	4.89	3.09	2.55	2.08	-
T10	2.31	3.00	2.53	3.71	6.61	3.07	3.76	3.52	-
SE±				0.32	0.22	0.20	0.40	0.56	-
CD(0.05)				0.98	0.66	0.61	1.19	1.66	-

JHARGRAM

Due to the low population (0.2- 0.4%) of TMB at Jhargram, the experiment of control on major pest - TMB was not carried out during the year. After first round of spray, the incidence of leaf miner, shoot and blossom webber and shoot tip caterpillar were very low in T1, T4, T5 and T6 treatments. Lowest incidence of leaf miner, leaf and blossom webber and shoot tip caterpillar was recorded 2.1 (T6), 1.6 (T5) and 3.5 (T4) respectively. It was observed that insect control is effective when the plants were sprayed two to three rounds of treatments T4 and T5. The details of incidence of different pests of cashew are presented in Table 3.4.

MADAKKATHARA

Tea mosquito population was comparatively less during 2002 season and hence damage was also negligible. But in the later stages damage due to apple and nut borer was found to be more than tea mosquito damage. Details are presented in table 3.5.

Spraying was not done during flushing, flowering and nut initiation stage as the level of infestation by major and minor pests was comparatively less.

VENGURLE

During the first spray, T5 was significantly superior over control and at par with the othertreatments. After second spray the treatments were non-significant. However,the cumulative incidence recorded 30 days after 3rd spray indicated that the treatment T5 wasobserved to be significantly superior over other treatments except T2 and T7. The observations recorded 30 days after each spray on percentage shoot/ panicle damage by TMB in response to various pesticide treatments is presented in Table 3.6.

Table 3.4: Incidence of minor pests of cashew at Jhargram

Treatments	Pre-treatment count			After 1st spray			After 2nd spray			After 3rd spray			Mean thrips damage (Score)
	Leaf miner	L&B Webber	Shoot tip caterpillar	Leaf miner	L&B Webber	Shoot tip caterpillar	Leaf miner	L&B Webber	Shoot tip caterpillar	Leaf miner	L&B Webber	Shoot tip caterpillar	
T1	2.6 (9.8)	1.6 (7.27)	3.5 (10.78)	2.9 (9.81)	2.1 (8.33)	4.3 (11.97)	4.3 (11.97)	4.9 (12.79)	5.2 (13.18)	5.2 (13.18)	5.3 (13.19)	7.2 (15.56)	0.30
T2	2.4 (8.91)	1.8 (7.71)	3.2 (10.31)	2.7 (9.46)	3.9 (11.39)	4.4 (12.11)	6.8 (15.12)	6.4 (14.56)	5.3 (13.31)	7.4 (15.79)	6.8 (15.12)	5.7 (13.81)	0.33
T3	2.1 (8.33)	1.4 (6.80)	4.2 (11.83)	2.8 (9.63)	4.2 (11.83)	4.9 (12.79)	7.4 (15.79)	7.2 (15.56)	6.7 (15.00)	7.9 (16.32)	6.6 (14.89)	7.4 (15.79)	0.36
T4	2.5 (9.10)	1.7 (7.49)	3.4 (10.63)	2.6 (9.28)	1.8 (7.71)	3.5 (10.78)	2.8 (9.63)	2.4 (8.91)	3.7 (11.09)	2.9 (9.81)	2.6 (9.28)	3.8 (11.24)	0.14
T5	2.1 (8.83)	1.2 (6.29)	3.8 (11.24)	2.3 (8.72)	1.6 (7.27)	3.6 (10.94)	2.6 (9.28)	2.8 (9.63)	3.6 (10.94)	3.1 (10.14)	2.9 (9.81)	3.9 (11.39)	0.08
T6	1.9 (7.92)	1.8 (7.71)	3.9 (11.39)	2.1 (8.33)	2.2 (8.53)	3.9 (12.39)	3.9 (11.39)	2.9 (9.81)	4.2 (11.83)	4.6 (12.39)	3.2 (10.31)	4.3 (11.97)	0.16
T7	2.4 (8.91)	1.6 (7.27)	3.9 (11.39)	2.8 (9.63)	4.6 (12.39)	4.4 (12.11)	5.4 (13.15)	5.9 (13.97)	6.2 (14.62)	4.9 (12.79)	6.1 (14.61)	6.8 (15.21)	0.21
T8	2.6 (9.28)	1.3 (6.55)	3.8 (11.25)	2.9 (9.81)	4.1 (11.68)	5.6 (13.69)	6.7 (15.00)	7.1 (15.45)	6.8 (15.11)	7.7 (16.11)	8.6 (17.05)	6.9 (15.23)	0.24
T9	2.2 (8.53)	1.9 (7.92)	3.6 (10.94)	2.8 (9.63)	4.3 (11.97)	5.8 (13.94)	7.6 (16.00)	7.3 (15.68)	7.2 (15.56)	8.2 (16.64)	8.2 (16.64)	7.3 (15.68)	0.32
T10	2.7 (9.46)	1.6 (7.27)	3.9 (11.39)	4.2 (11.83)	5.6 (13.69)	7.8 (16.22)	9.6 (18.05)	12.8 (20.96)	11.9 (21.05)	13.4 (21.47)	14.6 (22.46)	13.6 (21.64)	0.39
CD 5%	0.21	0.12	0.10	0.30	0.21	0.12	0.60	0.51	0.51	0.61	0.71	0.61	

*L&B = Leaf and Blossom

Table 3.5: Observation on tea mosquito bug and other pests at Madakkathara

Treatment	Mean damage score of TMB (on 52 leader shoots)				Mean no. of insects/ other species in 52 inflorescence after 30 days after spraying				Mean nut damage % due to apple and nut borer 30 days after 3rd spray	Mean damage grade due to thrips 30 days after 3rd spray	Mean of shoots damaged (%) due to shoot tip caterpillar				Mean damage (%) due to leaf and blossom webber			
	Before spray	30 days after 1st spray	30 days after 2nd spray	30 days after 3rd spray	Spiders	Mirids	Ants	Caterpillars			Before spray	30 days after 1st spray	30 days after 2nd spray	30 days after 3rd spray	Before spray	30 days after 1st spray	30 days after 2nd spray	30 days after 3rd spray
T1	-	-	0.14	0.25	10.31	2.45	24.66	3.11		-	-	-	-	0.45	4.33	-	6.33	-
T2	-	-	-	-	6.28	-	18.55	-	6.55	-	-	-	-	3.55	-	6.55	-	6.85
T3	-	-	-	0.11	4.65	1.46	9.67	1.58	3.33	-	-	-	-	-	-	-	5.50	-
T4	-	-	0.03	0.18	13.55	3.45	20.55	4.83		-	-	-	-	-	2.09	8.55	2.55	3.90
T5	-	-	-	-	9.23	-	14.3	1.65	8.50	-	-	-	-	1.65	-	4.33	3.07	2.55

Table 3.6: Incidence of tea mosquito bug (TMB) at Vengurle

Treatment	Percent damage after 30 days					
	I Spray		II Spray		III Spray	
	Per cent	Transformed value	Per cent	Transformed value	Per cent	Transformed value
T1	5.59	(13.67)	14.79	(22.59)	30.80	(33.66)
T2	5.84	(13.62)	16.81	(24.19)	27.63	(28.37)
T3	9.18	(17.59)	12.90	(20.78)	28.85	(32.46)
T4	3.70	(10.95)	14.26	(21.96)	25.26	(30.13)
T5	2.93	(9.79)	13.48	(21.44)	19.37	(26.00)
T6	7.68	(15.99)	12.32	(20.43)	29.51	(32.88)
T7	6.25	(14.42)	14.95	(22.67)	24.49	(29.66)
T8	6.86	(15.16)	17.73	(24.89)	27.02	(31.31)
T9	8.11	(16.17)	15.86	(23.41)	28.62	(32.28)
T10	9.39	(17.69)	21.04	(27.27)	34.34	(36.05)
SEm±	1.51		1.53		1.72	
CD 5%	4.47		NS		5.11	

Figures in paranthesis are transformed (ARCSIN) values.

Treatments T5, T2, T3 and T1 were found to be equally effective in managing inflorescence thrips. Treatment T5 was effective at peanu pebble nut as well as mature nut stage. In peanu and pebble nut stage, T3 and T6 were also at p with T5. The details of incidence of minor pest cashew are presented in Table 3.7.

Table 3.7 : Incidence of inflorescence thrips on cashew at Vengurle

Treatment	Average nut surface damaged at		
	Pea nuts	Pebble nuts	Matured nuts
T1	17.31 (24.55)	24.87 (29.90)	26.97 (31.28)
T2	19.65 (24.24)	23.94 (29.29)	25.81 (30.54)
T3	17.48 (24.72)	24.32 (29.51)	27.26 (31.47)
T4	20.52 (26.92)	26.61 (31.06)	27.35 (31.52)
T5	17.17 (24.47)	22.33 (28.18)	22.88 (28.59)
T6	18.99 (25.84)	26.38 (30.91)	25.92 (30.61)
T7	20.72 (27.05)	26.44 (30.96)	28.17 (32.06)
T8	21.34 (27.49)	28.27 (32.12)	27.23 (31.45)
T9	19.49 (26.17)	26.33 (30.89)	27.67 (31.71)
T10	23.59 (29.04)	31.08 (33.89)	33.83 (35.55)
SEm±	0.93	0.75	0.67
CD at 5%	2.78	2.23	2.00

VRIDHACHALAM

At Vridhachalam, during 2001-2002, pre-treatment damage score was between 1.5 to 2.8. After three rounds spraying of the damage score was nil in T5 and it was 0.5 to 0.7 in T_6, T_7, T_8 and T_9. The yield was maximum (6.2) in T_5 followed by T_8 (5.2) (Table3.8).

Observations were made for the incidence of various minor insect pests. In general, the incidence of pink leaffolder *Anigraea albomaculata* Hamp., green leaffolder *Sylepta aurantiacalis* Fisch., nut borer, *Thylocopula panerosema* M. and other minor pestswas minimum (Table 8). During 2001-2002, three scheduled spraying consists of monocrotophos during flushing, endosulfan during flowering and carbaryl during fruiting stages recorded minimum pest incidence of leaf and blossom webber (5.6% damaged laterals), leaf miner (11.2% damaged laterals and 12.4% leaf damage). The number of leaf and blossom webber (0.3 nos. / quadrate) and leaf thrips (0.0 nos. / leaf) corky growth on apples and nuts by inflorescence thrips 30 days after third spray as only 1.2 score in the same treatment as against 3.4 in control.. The data is presented in Table 3.9.

Table 3.8: Incidence of tea mosquito bug (TMB) at Vridhachalam

Treatment	TMB score (30 DAS)				Yield (kg tree^{-1})
	Pre treatment	I spray	II spray	III spray	
T1	2.1	0.8	1.0	2.0	4.0
T2	1.5	2.0	0.8	1.3	3.8
T3	1.8	2.3	2.6	1.7	3.6
T4	2.8	0.9	0.3	1.0	5.0
T5	2.1	0.8	0.2	0.0	6.2
T6	2.0	0.9	1.2	0.7	4.3
T7	1.9	2.1	1.0	0.6	4.2
T8	1.8	2.0	0.7	0.7	5.2
T9	2.0	1.9	0.7	0.5	4.8
T10	1.8	2.5	3.0	3.6	3.2
SE m±	0.18	0.12	0.14	0.11	0.28
CD 5%	0.38	0.25	0.30	0.22	0.59

Table 3.9 : Incidence of minor pests of cashew at Vridhachalam

Treatment	% laterals damaged by (30 DAS)								% leaves damaged by leaf miner (30 DAS)			
	Leaf and blossom webber				Leaf miner							
	Pre treat	I spray	II spray	III spray	Pre treat	I spray	II spray	III spray	Pre treat	I spray	II spray	III spray
T1	9.6	6.2	10.4	10.1	26.8	19.4	22.3	24.3	34.4	22.2	24.6	22.3
T2	14.8	16.3	10.8	12.6	28.6	34.2	24.6	26.3	37.8	38.3	31.2	24.2
T3	12.2	15.8	17.6	10.4	29.7	35.4	37.6	28.6	31.6	32.2	36.2	19.6
T4	12.1	10.3	8.1	11.3	27.7	22.4	16.4	22.4	29.4	24.6	19.2	14.4
T5	15.6	13.2	10.2	5.6	26.4	21.4	15.2	11.2	32.4	27.2	21.4	12.4
T6	12.8	9.4	14.6	11.4	33.2	26.4	32.6	21.4	24.4	20.6	23.2	17.4
T7	14.3	17.2	14.8	9.6	28.3	33.2	21.4	16.4	31.6	32.4	28.2	21.3
T8	13.8	18.4	12.6	8.4	31.4	35.4	27.6	16.3	39.8	37.4	32.4	21.3
T9	16.3	18.2	11.3	7.4	30.7	34.6	27.3	15.6	42.4	42.4	36.2	22.8
T10	14.3	17.6	21.6	26.8	27.7	31.4	34.6	38.4	36.1	39.1	41.4	32.6
SE m±	0.97	1.43	1.22	1.44	1.63	1.92	1.92	1.85	2.39	1.95	1.69	1.43
CD 5%	2.06	3.01	2.57	3.03	3.44	4.03	4.03	3.89	5.03	4.1	3.56	3.02

Table 3.10: Incidence of some other minor pests of cashew at Vridhachalam

Treatment	No. of insects (30 DAS)								Inflorescence thrips score (III spray)
	Leaf and blossom webber				Leaf thrips				
	Pre treat	I spray	II spray	III spray	Pre treat	I spray	II spray	III spray	
T1	2.3	1.0	1.0	1.3	4.7	2.3	0.3	0.0	2.6
T2	3.6	3.3	0.7	1.0 5	.3	5.0	3.3	2.0	3.0
T3	3.3	3.0	2.6	0.7	3.3	3.6	2.6	1.7	2.8
T4	2.7	2.0	0.7	1.3	6.3	0.6	0.0	0.0	2.0
T5	4.0	2.6	0.7	0.3	3.7	2.7	2.3	0.0	1.2
T6	2.6	1.3	1.3	0.7	4.3	0.3	2.3	1.6	2.2
T7	3.3	3.0	1.6	0.7	3.7	1.6	0.7	1.3	2.0
T8	2.7	3.0	1.7	1.0	4.7	0.0	4.6	2.3	2.8
T9	4.6	3.6	2.0	1.3	5.3	2.3	3.7	0.0	2.6
T10	3.3	3.4	3.3	3.0	5.6	4.0	3.3	2.7	3.4
SE m±	.14	.12	0.11	0.14	0.29	0.28	0.21	0.83	0.23
CD	.31	.26	0.24	0.29	0.61	0.58	0.45	1.76	0.49

3. Evaluation of new chemicals for control of TMB and other pests

Centres : East Coast
Bapatla, Bhubaneswar and Vridhachalam

West Coast
Madakkathara and Vengurle

Maidan tracts/ others
Chintamani and Jagdalpur

Summary

At Bhubaneswar, Jhargram and Vridhachalam standard spray was superior over the new chemicals tested. At Chintamani, a superior yield of 7.88 kg tree^{-1} for trees grouped with profenophos (0.05%). The same chemical was effective at Vengurle also.

Treatments:

T 1 : Recommended sprays for the region
T 2 : Chlorpyriphos 0.05%
T 3 : Triazophos 0.1%
T 4 : L-Cyhalothrin 0.003%
T 5 : Profenophos 0.05%
T 6 : Control

BAPATLA

During the cropping season of 2002 all the new insecticides and the recommended spray schedule were found on par with each other, the damage of which ranged from 0.15 to 0.42 percent and 0.27 to 0.41 percent respectively at 30 days after 3rd spray in different treatments but superior over untreated control which recorded the damage of 2.64 and 1.92 percent by the leaf and blossom webber and shoot tip caterpillar respectively. The nut damage by apple and nut borer ranged from 2.65 to 8.96 percent in different treatments. Chlorpyriphos 0.05% recorded the least nut damage of 2.65 percent and found superior over the recommended spray schedule but on par with triazophos 0.05%, L- cyhalothrin 0.003% and profenophos 0.05% which are in turn on par with the recommended spray schedule. However, all the insecticides are significantly superior over the untreated control which recorded highest nut damage of 8.96 percent. Regarding thrips, triazophos 0.05% L-cyhalothrin 0.003% and profenophos 0.05% were found affective and onpar with each other and superior over the recommended spray schedule, chlorpyriphos 0.05% and the untreated control which are inturn onpar with each other. Untreated control recorded the highest number of spiders (19 Nos.) and ants(22 Nos.) and all the insecticidal treatments are found detrimental to these species as significantly less number of spiders and ants were recorded in all the treated plots.The data on incidence of miner pests of cashew for spray schedule of new insecticides is presented in Table 3.11.

Table 3.11: Incidence of minor pests of cashew at Bapatla.

Sl. No	Treatment	Mean No. per 52 inflorescence at 30 days after 3rd spray		Apple and nut borer damaged nuts at 30 days after 3rd spray (%)	Thrips damage grade at 30 days after 3rd spray (0-4 scale)	Shoot tip caterpillar damaged shoots (%)				Leaf and blossom damaged shoots (%)			
		Spiders	Ants			Before spraying	30 days after 1st spray	30 days after 2nd spray	30 days after 3rd spray	Before spraying	30 days after 1st spray	30 days after 2nd spray	30 days after 3rd spray
1.	Monocrotophos 0.05% at flushing, endosulfan 0.05% at flowering and carbaryl 0.1% at nut development stage	4 a	5 a	4.17 a	1.37 a	5.49	1.19	0.48	0.40 a	1.73	0.27	0.28	0.40 a
2.	Chlorpyriphos 0.05%	3 a	5 a	2.65 b	1.11 b	4.36	1.11	0.50	0.35 a	1.46	0.26	0.41	0.42 a
3.	Triazophos 0.1%	5 a	6 a	2.82 ab	1.07 bc	5.19	1.08	0.64	0.35 a	0.84	0.35	0.30	0.33 a
4.	L- Cyhalothrin 0.003%	6 a	8 a	2.32 ab	0.94 bc	4.28	0.91	0.47	0.27 a	0.97	0.34	0.20	0.15 a
5.	Profenophos 0.05%	6 a	12 a	2.75 ab	1.01 bc	3.61	0.86	0.43	0.41 a	1.34	0.21	0.35	0.36 a
6.	Un treated control	19 b	22 b	8.96 c	1.30 ab	3.33	2.95	2.95	1.92 b	1.49	2.36	2.74	2.64 b

Figures followed by same alphabet (s) are not differing significantly as per " t " test at 5% level

BHUBANESWAR

The infestation of shoot tip caterpillar inflorescence thrips were the two major pests recorded during the experimental period. Also the pest apple and nut borer was infested very minutely. The Tea Mosquito Bug infestation was not at all observed during the period.

The data presented in table-3.13 indicated that the pest infestation was 7.59 to 9.94 percent before spraying of the insecticide.Immediately after 1st spray the shoot tip caterpillar infestation was reduced from 0.32 to 1.92 percent in almost all treatments which is significantly low as compared to untreated check.The treatment T_4(L-cyhalothrin) is at par with the treatment T_1 (Recommended spray) and significantly different from other new chemicals like T_2, T_3, and T_5. However 30 days after 2nd spray almost all the chemicals are at par and significantly different from control. But 30 days after 3rd spray the pest appearance was negligible even in control plots. Data on the indicence of inflorescence thrips (Table-3.1) indicated that 30 days after 3rd spray the damage scorewas reduced to 0.13 to 0.23 which is significantly low than the untreated check (0.67). Almost all the chemicals are at par in checking the infestation by flower thrips. The infestation by apple and root borer pest was very low even 0.58 percent in untreated check. However by application of new chemicals the pest infestation was reduced significantly in T_4 (L. cyhalothrin), T_1 (Recommended spray schedule) and T_5 (Profenophos) The natural enemies observed in the experiment were spiders (Unidentified), predators (Argeop Sp), Mirid bug, lady bird beetle and pollinators like blank ants .Almost all the natural enemies were significantly reduced by application of any chemicals than untreated check plants.

Table 3.12: Effect of direct new chemicals on different insects of cashew at Bhubaneswar

Treat-ments	Mean no. of shoots damaged (%) due to shoot tip caterpillar				Mean nut damage due to apple and nut borer 30 days after 3rd spray	Mean damage grade due to thrips 30 days after 3rd spray	Yield/ kg tree^{-1}
	Before spray	30 days after 1st spray	30 days after 2nd spray	30 days after 3rd spray			
T_1	7.72	0.96^{ac}	0.32^{a}	-	0.08^{ac}	0.23^{a}	3.250
T_2	9.61	1.44^{ad}	1.12^{a}	-	0.17^{bc}	1.13^{a}	2.925
T_3	9.94	1.92^{ad}	1.12^{a}	-	0.17^{bc}	0.199^{a}	2.850
T_4	7.69	0.32^{ac}	0.16^{a}	-	0.00^{ac}	0.21^{a}	3.100
T_5	9.46	1.60^{ad}	0.80^{a}	-	0.08^{ac}	0.197^{a}	2.800
T_6	8.49	7.21^{b}	2.44^{b}	-	0.58^{b}	0.67^{b}	2.200

Table 3.13: Effect of direct new chemicals on natural enemies/pollinators at Bhubaneswar

Treatments	Mean no. of insects/natural enemies in 52 inflorescence after 30 days after 3rd spray			
	Spiders	Blackants	Lady bird beetle	Mirid bugs
T_1	0.83^{a}	3.17^{a}	0.67^{a}	1.17^{a}
T_2	0.83^{a}	2.67^{a}	0.50^{a}	0.92^{a}
T_3	0.75^{a}	2.50^{a}	0.64^{a}	1.00^{a}
T_4	0.42^{a}	2.08^{a}	0.33^{a}	0.67^{a}
T_5	0.75^{a}	3.25^{a}	0.58^{a}	0.92^{a}
T_6	1.83_{b}	6.83^{b}	1.75^{b}	2.5^{b}

CHINTAMANI

The results indicated that new chemicals tried were comparable to the standard chemicals in control of TMB, leaf and blossom webber and inflorescence thrips. Highest yield of 5.92 kg/tree was recorded in T4. The details of the incidence of pests of cashew are presented in Table 3.14.

Table 3.14: Incidence of pests recorded after spraying with new chemicals at Chintamani.

Treatment	TMB (%)		Inflorescence thrips		Yield (kg/tree^{-1})
	30 DAS II spray	30 DAS III spray	30 DAS II spray	30 DAS III spray	
T1	0.58	0.10	3.02	2.63	7.22
T2	0.56	0.12	1.74	1.84	6.93
T3	0.62	0.15	1.42	1.32	7.46
T4	—	—	—	—	—
T5	0.56	0.16	1.63	1.86	7.88
T6	7.78	3.36	15.14	17.92	4.84
SEm±	0.38	0.36	0.24	0.30	0.36
CD 5%	1.15	1.07	0.72	0.89	1.08

JAGDALPUR

The incidence of TMB and other minor pest are recorded and presented of two critical stages i.e. flushing and flowering in table-3.15. The combination of two spray each after 30 days interval were given to control the major and minor pest of cashew considering two critical stages namely flushing and flowering stage. Observation indicated that among all the chemicals tried at an interval of 30 days, considering two critical stages i.e. flushing and flowering, Ethofenprox 0.015% was found the best among all the treatment.

Table 3.15 : Efficacy of different new chemical against major pest of cashew at Jagdalpur.

Treament	Percent incidence of TMB (Tea mosquito bug)			
	Leaf			Flower
	30 days After Ist Spray	30 days After IInd Spray	30 days After IIIrd Spray	30 days After Ist Spray
T_1	1.65	1.44	1.01	54.43
T_2	1.47	1.70	1.08	66.36
T_3	0.85	0.70	1.47	37.51
T_4	0.65	0.58	0.77	35.95
T_5	0.76	0.77	1.48	47.91
T_6	1.64	1.75	2.93	83.85
SE m	0.24	0.35	0.14	2.53
CD 5%	0.74	1.05	0.43	7.62

JHARGRAM

Among the new chemicals, T5 was the most effective treatment in which 4.28% damage was observed due to shoot tip caterpillar and 2.72% damage due to leaf and blossom webber. Same trend was noticed in first, second and third round of spays. Lowest damage due to apple and nut borer was observed in T1 and T5. Thrips damage was lowest in T1 (0.09) followed by T5 (0.11). Highest yield was recorded for T1 (4.184 kg tree^{-1}) followed by T5 (4.023 kg tree^{-1}) Table 3.16.

MADAKKATHARA

Tea mosquito population was comparatively less during 2002 season and hence damage was also negligible. But in the later stages damage due to apple and nut borer was found to be more than tea mosquito damage.

VENGURLE

The insecticide profenophos (T5) has been observed to be significantly effective over the other treatments and significantly superior over control. Regarding the flower thrips, the results indicated that all the treatments were effective. Treatment T5 was found to be significantly superior over T3 and was at par with T1 and T2. The details of incidence of TMB in response to new chemicals are presented in Table 3.17. Statistical comparison of the various treatements has been presented in the table 3.18.

VRIDHACHALAM

The trial has been laid out in 8 years old cashew plantation of VRI 2 and the treatments were imposed as per the recommendation of XIII Biennial Workshop. During 2001-2002, after three sprays, profenophos was comparable (0.3 score) with scheduled spraying of monocrotophos, endosulfan and carbaryl (0.0 score) in controlling TMB. Considering the safety to natural enemies, chlorpyriphos was found more safe compared to other chemicals. The number of caterpillars and thrips score was 3.6 and 2.8 in profenophos which was comparable with scheduled spray. Per cent damage by leaf and blossom webber was minimum in chlorpyriphos (4.4%) followed by profenophos (4.6%). The yield was maximum (6.2 kg tree^{-1}) in scheduled spray treatment followed by profenophos (5.8 kg tree^{-1}) (Table 3.19).

Table 3.16: Incidence of pests recorded after spraying with new chemicals at Jhargram

Treatments	Mean No. for 52 inflorescence				ANB(%)	Thrips score	STC(%)				L & B webber(%)				Yield kg tree^{-1}
	Spiders	Ants	Ladybird bettle	Braconids			Before spray	After 1st spray	After 2nd spray	After 3rd spray	Before spray	After 1st spray	After 2nd spray	After 3rd spray	
T1	30	43	74	6	0.1	0.09	3.89	4.12	4.32	4.96	1.62	2.62	3.24	3.62	4.184
					(1.81)	(1.72)	(11.37)	(11.76)	(11.99)	(12.98)	(7.29)	(9.31)	(10.35)	(10.97)	
T2	28	24	30	0	0.6	0.28	4.50	6.08	7.46	8.43	1.62	3.86	6.42	7.42	3.824
					(4.44)	(3.03)	(12.25)	(14.33)	(15.84)	(16.92)	(7.29)	(11.28)	(14.68)	(15.83)	
T3	100	119	116	3	0.4	0.22	4.70	6.74	8.12	9.40	1.82	4.14	7.62	7.89	3.674
					(3.63)	(2.69)	(12.52)	(15.06)	(16.57)	(17.85)	(7.74)	(11.72)	(16.04)	(16.31)	
T4	6	16	4	0	0.3	0.24	3.96	6.86	8.42	9.62	1.60	3.92	6.89	8.92	3.318
					(3.14)	(2.81)	(11.43)	(15.17)	(16.89)	(18.09)	(7.27)	(11.43)	(15.22)	(17.39)	
T5	152	169	129	12	0.1	0.11	4.12	4.28	4.36	5.06	1.94	2.72	3.38	3.82	4.023
					(1.81)	(1.90)	(11.71)	(11.92)	(12.05)	(12.98)	(7.97)	(9.49)	(10.60)	(11.27)	
T6	120	143	150	16	2.6	0.36	4.60	9.12	13.4	16.82	2.2	6.74	13.6	15.9	2.729
					(9.28)	(3.44)	(12.39)	(17.59)	(21.47)	(24.24)	(8.53)	(15.06)	(21.64)	(23.50)	

Table 3.17: Incidence of pests recorded after spraying with new chemicals at Vengurle

Treatment	Average per cent shoots/ panicles damaged 30 days after			Average nut surface damaged by flower thrips during stage
	I spray	II spray	III spray	III spray
T1	24.62	26.26	28.03	28.52
T2	23.88	24.88	27.27	27.45
T3	22.61	25.06	25.00	28.49
T5	21.05	23.41	24.00	25.98
T6	26.18	28.51	31.38	37.10

Table 3.18: Comparison of treatment with new chemicals at Vengurle

Comparison	Calculated 't'	
	TMB	Flower Thrips
T1 vs T3	3.11*	0.03**
T1 vs T4	3.86*	1.64**
T2 vs T4	2.77*	0.76**
T3 vs T4	1.09**	3.21*
T5 vs T1	4.07*	7.01*
T5 vs T2	3.78*	6.46*
T5 vs T3	5.87*	14.54*
T5 vs T4	9.46*	12.21*

*treatment significant ** treatment not significant

Table 3.19: Evaluation of new chemicals for the control of TMB and other pests at Vridhachalam

Treatment	TMB Score (30 DAS)				Spiders	Ants	Caterpillars	Thrips score	Leaf and blossom webber (% damage)				Yield (kg tree^{-1})
	Pre Treatment	I spray	II spray	III spray					Pre Treatment	I spray	II spray	III spray	
T1	2.1	0.9	0.4	0.0	2.6	14.6	4.6	2.6	16.3	13.8	8.4	6.8	6.2
T2	2.0	1.5	1.0	0.8	5.4	22.2	5.4	3.2	17.8	15.5	7.8	4.4	5.0
T3	2.3	1.5	1.0	0.9	5.4	6.8	6.2	2.8	17.3	14.4	10.8	8.8	4.9
T4	1.8	1.3	0.8	0.8	4.2	12.2	8.2	3.0	18.3	16.2	12.4	10.8	5.2
T5	2.4	0.9	0.5	0.3	3.4	8.4	3.6	2.8	16.8	14.6	8.4	4.6	5.8
T6	2.4	2.6	2.8	3.7	7.8	32.4	10.4	3.4	17.8	15.4	17.8	22.8	3.2
SEm±	0.15	0.15	0.19	0.16	1.31	1.09	0.73	0.21	0.83	0.93	1.17	5.62	0.18
CD	0.33	0.32	0.42	0.34	2.79	2.33	1.56	0.46	1.88	1.99	1.48	11.9	0.38

Control of stem and root borer

1. Prophylactic control trial

Centres : East Coast
Bapatla, Bhubaneswar, Jhargram, and Vridhachalam

West Coast
Madakkathara, Pilicode, and Vengurle

The objective is to evaluate different pesticides and neem products for prophylaxis against attack by stem and root borer.

Summary

Effective prophylactic control of cashew stem and root borer (CSRS) could be achieved by swabbing with neem oil 5% only thrice in a year at Bapatla and Vridhachalam; twice in a year at Bhubaneswar, Jhargram and Vengurle. Curative trials of infested trees at Bapatla, Madakkathara and Vengurle treated with lindane 0.2% after removal of grubs abd swabbing the trunk with neem oil 5% could result in better survival percentage. Removal of grubs itself was effective at Jhargram. At Vridhachalam root feeding of monocrotophos (50%) could give complete control over infested trees.

Treatments:

Swabbing with Neem oil 5% in 25 trees
T1 Twice + Sevidol 75g
T2 Thrice + Sevidol 75g
T3 Four times + Sevidol 75g
Swabbing with coal tar + kerosene (1:2) in 25 trees or mudslurry + carbaryl
T4 Twice + lindane 0.2%
T5 Thrice + lindane 0.2%
T6 Four time + lindane 0.2%
T7 Control

BAPATLA

Among the prophylactic treatments evaluated application of neem oil 5% thrice (T3) at an interval of three months during October-November, January-February and April-May, no infestestation was recorded even after seven months after application of treatment, where as 26.66 percent of the treated trees were found infested after 184 days in the treatment involving application of neem oil 5%twice during October-November and January-February (T2). Single application of neem oil 5% (T1) protected the trees only upto 116 days with 26.66% infestation.

In respect of fungal pathogens viz; *Metarrhizium anisopliae* and *Beauveria bessiana* 33.3% infestation occurred within 87 and 103 days respectively and the effectiveness of these pathogens is on par with the control in preventing cashew stem and root borer infestation in which infestation occurred within 90 days in 33.33 percent of the trees.

The zone of attack of cashew stem and root

borer in affected trees was collar and root in 73.9 percent cases (17/23) and collar and stem in 26.1 percent cases (6/23).

BHUBANESWAR

It has been observed that the treatment T_1 could protect the plant from the infestation for 150 days i.e. after application of neem oil (T_1) in the month of October, infestation started in the month of March. Only one tree out of 15 trees was infested. No infestation was observed in other treatments. In untreated check, '3' trees were infested out of 15 trees. The zone of attack and stem girth is presented in the table-3.20.

Table 3.20: The zone of attack by CSRB at Bhubaneswar

Treatment	Mean duration free from pest attack (in days)	Physical parameters of trees			
				No. of trees infested	Not infested
T_1	150	Stem girth	< 60	1	14
		Age	10-15	-	-
		Zone	S	-	-
T_2					15
T_3					15
T_4					15
T_5					15
T_6		Stem girth	< 60	1	
			60 - 80	2	12
		Age	10 - 15	3	12
		Zone	C + S	2	
			C + R	1	

JHARGRAM

Swabbing of neem oil (5%) was most effective prophylactic control in two application schedules per year. The infestation of CSRB was negligible in T1 and T2 i.e, swabbing neem oil (5%) during October-November and same treatment twice (October-November, January-February). The occurrence of CSRB in prophylactic control experiment is presented in Table 3.21.

MADAKKATHARA

Swabbing with mudslurry carbaryl four times along with lindane 0.2% was found to be more effective followed by swabbing with neem oil 5% + indane 0.2%. data on prophylactic control of CSRB has been presented in Table 3.22

VENGURLE

From the data recorded, swabbing neem oil (5%) during Oct.-Nov. and Jan.-Feb was found to be promising. Trees above 5 years of age were more prone to pest attack. Maximum infested trees were in C+R zone. The details of treatment against CSRB are presented in Table 3.23.

Table 3.21: Occurrence of CSRB in prophylactic trial at Jhargram

Treatment	Mean duration free from pest attack (in days)	Physical parameters of trees			
				No. of trees infested	Not infested
T1	263.2	Stem girth(cm)	< 60	-	2
			60-80	-	9
			80-100	-	1
		Age(years)	10-15	3	12
		Zone	C+R	-	-
			C+S	2	
			R	-	
			S	1	
			C+R+S -		
T2	276.6	Stem girth	< 60	1	1
			60-80	2	8
			80-100	-	3
		Age	10-15	3	12
		Zone	C+R	-	-
			C+S	2	
			R	1	
			S	-	
			C+R+S -		
T3	300	Stem girth	< 60	-	2
			60-80	1	10
			80-100 -	2	
		Age	10-15	1	14
		Zone	C+R	-	-
			C+S	1	
			R	-	
			S	-	
			C+R+S	-	
T4	239.3	Stem girth	< 60	2	2
			60-80	3	6
			80-100	-	2
		Age	10-15	5	10
		Zone	C+R	2	-
			C+S	2	
			R	-	
			S	1	
			C+R+S	-	
T5	227.0	Stem girth	< 60	1	3
			60-80	3	6
			80-100	1	1
		Age	10-15	5	10
		Zone	C+R	1	-
			C+S	2	
			R	-	
			S	2	
			C+R+S	-	
T6	160.4	Stem girth	< 60	2	2
			60-80	3	5
			80-100	1	2
		Age	10-15	6	9
		Zone	C+R	2	-
			C+S	2	
			R	-	
			S	1	
			C+R+S	1	

C=collar, S=stem, R=root

Table 3.22: Stem and root borer infestation as influenced by prophylatic treatment at Madakkathara

Treatment	Mean duration free from pest attack (in days)	Physical parameters of trees			Total No. of trees	No. of trees infested	Not infested
		Stem girth	Age (year)	Zone of attack			
T1- Neem oil 5% Twice + Lindane 0.2%	53.75	>100	29	C+R+S	20	8	12
T2- Neem oil 5% thrice + Lindane 0.2%	63.9	>100	29	C+R+S	20	9	11
T3- Neem oil 5% four times + Lindane 0.2%	73.4	>100	29	C+R+S	20	7	13
T4- Mudslury + Carbaryl twice + Lindane 0.2%	60.5	>100	29	C+R+S	20	8	12
T5- Mudslury + Carbaryl thrice + Lindane 0.2%	65.8	>100	29	C+R+S	20	9	11
T6- Mudslury + Carbaryl four times + Lindane 0.2%	77.9	>100	29	C+R+S	20	10	10
T7- Untreated control	41.5	>100	29	C+R+S	20	9	11

C=collar, S=stem, R=root

Table 3.23: Occurrence of CSRB in prophylactic trial at Vengurle

Treatment	Mean duration(days) without infestation
T1	131.20
T2	179.20
T3	111.50
T4	120.30
T5	135.00
T6	78.20

VRIDHACHALAM

During 2001-2002, the duration of infestation ranged from 88 to 245 days in different treatments as compared to 91 days in untreated check. The insects were kept away for maximum of 245 days when the trees were swabbed with neem oil 5% at three times during October-November, January-February and April-May. The per cent re-infestation was also minimum of 5% in the neem oil treatment. In addition to the treatments effects the stem girth played an important role on the incidence of the borer. No trees having stem girth of < 60 cm was re-infested. The re-infestation was maximum in the trees with stem girth of 80-100 cm. Root and collar region was attacked in the neem oil treated plants and stem part was attacked in the neem cake applied treatments (Table 3.24).

Table 3.24: Prophylactic control of CSRB at Vridhachalam

Treat-ment	Duration of attack free (Days)	Per cent attack		Stem girth (cm)			Zone of attack				
				< 60	60 - 80	80 - 100	C + R	C + S	R	S	C + R + S
T1	122	10	Infested	-	-	2	1	-	-	-	-
			Not infested	8	6	4	-	-	-	-	-
T2	146	10	Infested	-	1	1	-	1	1	-	-
			Not infested	4	11	3	-	-	-	-	-
T3	245	5	Infested	-	-	1	-	1	-	-	-
			Not infested	5	9	5	-	-	-	-	-
T4	86	15	Infested	-	2	1	-	-	-	-	-
			Not infested	8	7	2	-	1	-	2	-
T5	88	10	Infested	-	-	2	-	-	-	2	-
			Not infested	7	10	1	-	-	-	-	-
T6	91	20	Infested	-	1	3	1	2	-	1	-
			Not infested	7	5	4	-	-	-	-	-

2. Curative trial

Centres : East Coast

Bapatla, Bhubaneswar, Jhargram, and Vridhachalam

West Coast

Madakkathara, Pilicode, and Vengurle

Treatments:

T1 : Extraction of grubs

T2 : Swabbing twice with neem oil 5% or
Mudslurry + carbaryl or
Coal tar + kerosene (1:2)
Anyone of the above which is most effective

T3 : T1 + T2 + lindane soil application 0.2%

T4 : T1 + T2 + Sevidol 8 G 75g/tree

T5 : T1 + T2 + *Metarrhizium anisopliae* - Spore suspension

T6 : Control

Design : CRD

BAPATLA

Among the curative treatments, lindane 0.2% was relatively better with 54.54 percent trees without re-infestation followed by carbaryl 0.1% with 45.45 percent trees without re-infestation. Other treatments are inferior as the percentage trees withoutreinfestation were on par with the control.

Preferential zone of attack of re-infestation by stem and root borer in cashew trees is collar and root zone and the infestation is to the tune of 75% (24/32) followed by collar and stem zone with 25% (8/32) attack. Percentage of bark circumference damaged seems to be the key factor which decides the survival of the tree as 62 percent (34/55) of the trees had a bark damage of 25-75 percent either at initial attack or re-infestation succumbed as evident by 60% (33/55) of the treated trees yellowed even after treatment application. Data are presented in Table 3.25.

BHUBANESWAR

Table-4 indicated that the different treatments the recovery was 57 to 71 percent. The treatment chloropyriphos (T2) causes maximum recovery (71.9%) of plants. In control only 42.8 % recovery is achieved. The infested plants show canopy yellowing. The data on curative control trial is presented in Table 3.26.

In physical parameter study (Table 3.27) most of the plants were studied within stem girth of < 60 cm. Also infestation is more in 10 - 15 year plants. Less than 50% damage plants are recovered. More than 50% of damaged plants show reinfestation. The collar plus root and stem infested trees showed more infestation than collar + stem or collar + root alone.

Table 3.25: Infestation of CSRB under curative trial at Bapatla

Parameters		Total Trees Treated	No. of Trees in each category	
			Without reinfestation	With reinfestation/ Persistant infestation
Stem girth	< 60		--	--
	60-80		--	--
	80-100		--	--
	> 100		23	32
	Total	55	23	32
Age	< 5		--	--
	5-10		--	--
	10-15		--	--
	> 15		23	32
	Total	55	23	32
% Bark circumference damaged	<25		17	4
	25-50		6	10
	50-75		--	--
	> 75		--	--
	Total	55	23	32
Zone	C+R		18	24
	C+S		5	8
	R		--	--
	S		--	--
	C+R+S		--	--
	Total	55	23	32
Canopy yellowing	a) Yellowed		4	29
	b) Not yellowed		19	3
	Total		23	32

Table 3.26: Percentage infestation of CSRB under curative control trial at Bhubaneswar.

Treatments	No. of trees treated	No. of trees without reinfestaton	% of trees without reinfestaton
T1	14	8	57.1
T2	14	10	71.4
T3	14	9	64.3
T4	14	8	57.1
T5	14	6	42.8

Table 3.27: Physical parameters of trees observed at Bhubaneswar.

		No. of trees in each category	
		Without reinfestation	With reinfestation
Stem girth (in cm)	< 60	35	15
	60 - 80	3	9
	80 - 100	3	5
Age	5 - 10	21	10
	10 - 15	20	17
	> 15	-	4
	< 15	6	-
% of bark circumference damage	25 - 50	29	12
	50 - 75	6	17
	C + R	12	9
Zone of attack	C + S	20	11
	C + R + S	8	22
Canopy yellowing	Yellowed	29	
	No yellowing	41	

R = Root C = Collar S = Stem

JHARGRAM

The treatment T1 was the most effective treatment and there was no re infestation or persistent attack. Treatment T2 was also effective where as in the untreated control only 20% of the trees were not attacked by the pest. The details of occurrence of CSRB in curative trial are presented in Table 3.28.

MADAKKATHARA

Percentage of trees without reinfestation up to a period of 3 to 4 months duration is obtained in the case of T3 followed by T2 and T4 (duration upto 60 to 70 days). In T6 treatment persistant attack is noted upto 80%. But in T7 phytosanitation alone gives 40% of the trees without reinfestation. Data is presented in table 3.29.

VENGURLE

Maximum control of CSRB in infested trees was observed in chlorpyriphos (T2) and lindane 0.2% (T4).Maximum infested trees were in C+R and C+S zone (25-50% damage). At advanced stages both the treatments could give only 20% recovery. The data on curative control of CSRB in infested trees at Vengurle is presented in Table 3.30.

VRIDHACHALAM

During 2001-2002, cent per cent re-infestation was prevented when monocrotophos @ 20 ml + water 20 ml was given through root feeding as against 100 per cent infestation in control. The re-infestation was maximum in the trees with stem girth of 80-100 cm irrespective of the treatments. The age of tree and re-infestation was positively correlated. Re-infestation was maximum in the trees with the age of 10-15 years. In the re infested trees, the bark in cumbrance damaged was 25-50 per cent in most of the trees. Collar and stem region was attacked in maximum trees. The yellowing was noticed in chlorpyriphos 0.2% treatment and control (Table 3.31).

Table 3.28: Occurrence of CSRB under curative trial treatments at Jhargram.

Treatment	Per cent trees undamaged	Physical parameters of trees					
		Tree No.	Stem girth (cm)	Age (yrs)	% damage	Zone of attack	Canopy senescence (+/-)
T1	100	1	62	>15	30	C	+
		2	85		40	C+S	-
		3	64		40	C+S+R	+
		4	56		46	S	-
		5	70		30	S	-
T2	80	1	45	>15	22	S	-
		2	63		30	R+S	+
		3	70		40	C+R+S	+
		4	46		48	R+C	-
		5	68		45	R+C	-
T3	40	1	50	>15	30	R+C	-
		2	58		36	C+S	-
		3	64		40	C+S	+
		4	70		25	R+C	+
		5	46		25	S	+
T4	60	1	62	>15	40	R+S	+
		2	45		46	R+C	+
		3	70		30	S	-
		4	72		25	S	-
		5	80		49	R+S+C	+
T5	20	1	50	>15	30	S	-
		2	68		30	S	-
		3	46		25	C+S	-
		4	72		40	C+R+S	+
		5	65		30	S+C	-

R=Root C=Collar S=Stem

Table 3.29: Control of CSRB - curative trial at Madakkathara

Treatment	No. of trees treated	% of trees without reinfestation	Persistant attack
T1- Carbaryl 0.1%	6	50	
T2- Chloriphyriphos 0.2%	6	66.7	
T3- Monocrotophos 0.2%	6	83.3	
T4- Lindane 0.2%	6	66.7	
T5- M. anisopliae + N. cake	5	50.0	
T6- B. bassiana + N. cake	5	0.00	80%
T7- Untreated control	5	40.0	

Table 3.30: Occurrence of CSRB under curative trial treatments at Vengurle.

Treatment	Per-cent without damage
T1	80.00
T2	88.23
T3	80.00
T4	88.23
T5	74.07

Table 3.31: Curative Control of Cashew Stem and Root Borer During 2002-03

Treat ment	% trees without re-infestation	Not re-infested / Re-infested	Stem girth (cm)				Age (Years)		
			< 60	60-80	80-100	>100	<5	5-10	10-15
T1	62.5	Not re-infested	2	2	1	-	1	3	1
		Re-infested	-	-	3	-	-	1	2
T2	37.5	Not re-infested	-	2	1	-	-	2	1
		Re-infested	-	2	2	1	-	2	3
T3	100.0	Not re-infested	2	2	3	1	-	4	4
		Re-infested	-	-	-	-	-	-	-
T4	62.5	Re-infested	2	-	2	1	1	3	2
		Not re-infested	-	-	1	2	-	1	2
T5	00.00	Not re-infested	-	-	-	-	-	-	-
		Re-infested	-	2	3	3	-	4	4

Table 3.31: continued

Treatment	% bark in cumbrance damaged				Zone of attack					Canopy yellowing	
	<25	25-50	50-75	>75	C + R	C + S	R	S	C + R + S	Yes	No
T1	1	2	-	-	1	2	-	-	-	-	3
T2	-	2	2	1	-	2	-	2	1	2	3
T3	-	-	-	-	-	-	-	-	-	-	-
T4	1	2	-	-	-	2	-	1	-	-	3
T5	2	2	4	-	2	2	-	-	4	3	5

Bio-ecology of pests of regional importance and survey of pest complex and natural enemies

Centres : East Coast
Bapatla, Bhubaneswar, Jhargram, and Vridhachalam

West Coast
Madakkathara and Vengurle

Maidan tracts/ others
Chintamani and Jagdalpur

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

BAPATLA

Trees were selected randomly in the cashew plantations visited in the surrounding areas of Bapatla and in certain villages of West Godavari, East Godavari, Guntur and Prakasam districts and the different pests occurring and their intensities were recorded. Collection of pest infested samples at weekly intervals and maintaining in the laboratory for observation of emergence of parasites The incidence of leaf and blossom webber was observed throughout the year, the damage of which ranged from a minimum of 1.25 per cent to a maximum of 4.95 per cent with relatively high incidence during summer and rainy seasons. Among the abiotic factors only the maximum temperature was found to have a significant positive influence (r = 0.298) on the activity of the leaf and blossom webber.

The activity of apple and nut borer was recorded from 3rd week of February till 1st week of May with a highest nut damage of 10.74 percent during last week of March. None of the weather parameters were found to exercise a significant role on the activity of apple and nut borer except rainy days which showed a significant negative influence (r = - 0.315).

The leaf miner appeared from 2nd week of August till last week of February, the damage of which ranged from 0.03 percent to a maximum of 5.83 percent during 1st week of December. The activity of leaf miner disappeared during March to July. The relative humidity both morning (r = 0.530) and evening (r = 0.463) was found to have a significant positive influence while the maximum temperature (r = - 0.553) and minimum temperature (r = - 0.388) had a significant negative influence on the activity of leaf miner on cashew.

The shoot tip caterpillar occurred on the crop from last week of October and continued upto 1st week of May with a peak damage of 20.0 percent during 9th meteorological week. All the weather parameters were fond to exercise a significant influence on the activity of shoot tip caterpillar except the relative humidity (evening). Both maximum (r = - 0.539) and minimum (r = - 0.710) temperatures, rainfall (r = - 0.350) and rainy days (r = - 0.516) exercised a significant negative influence where as relative humidity (morning) had a significant positive influence (r = 0.516).

Leaf thrips were observed on the crop all through the year except the cooler months of December and January. However the incidence was relatively more during summer months. Both the maximum (r = 0.805) and the minimum (r =

0.632) temperatures were observed to have a significant positive influence and the relative humidity both morning (r = - 0.755) and evening (r = - 0.520) had a significant negative influence on the activity of leaf thrips.

The activity of inflorescence thrips was restricted to the periods of panicle emergence till nut development stages during February to May.

Leaf folder was recorded from September to February, the damage of which ranged from 0.22 to 4.89 percent with a peak during December month. As in the case of leaf miner both the temperatures had a significant negative influence (r = - 0.544 & - 0.515) and the relative humidity had a significant positive influence (r = 0.492 & 0.317) on the activity of leaf folder. Spiders and ants were also observed on the cashew but without any host specificity.

The hymenopteran parasitoid, *Bracon* sp was active during cooler months of the year i.e. last week of November to 3rd week of February parasitizing the leaf and blossom webber larvae and the percent parasitization ranged from 1.92 to 11.43 percent.

The surveys revealed that the incidence of cashew stem and root borer is high up to 15 percent in some of the orchards surveyed in cashew growing districts which warrant necessary curative and prophylactic measures by the growers. Details of survey data is presented in Table 3.32 and occurance in relation to meteriological parameters at Bapatla is presented in Table 3.33 and Table 3.34.

Table 3.32: Survey of cashewnut plantations and incidence of pests during 2002 season in A.P.

Sl No	District & Location	Month of Survey	Pest		Damage (%)	Intensity
			Common Name	Scientific Name		
A.	West Godavari	Feb, 2002	i. Cashew stem & Root borer	*Plocaederus ferrugineus* *Lamida moncusalis*	4-10	High
	1. Dwaraka Tirumala					
	2. Nalajerla		ii. Leaf and blossom webber	*Hipotima haligramma*	0.5-1.0	Low
	3. Thimmapuram					
	4. Rallakunta		iii. Shoot tip caterpillar		0.5-1.0	Low
	5. Marempalli					
	6. Dubacherla					
	7. Ghantavari gudem					
B.	East Godavari	Feb, 2002	i. Cashew stem & Root borer	*Plocaederus ferrugineus*	5-15	High
	1. APFDC, Rajahmundry		ii. Leaf and blossom webber	*Lamida*	0.25-1.0	Low
	2. Lelacheruvu		ii. Leaf and blossom webber	*moncusalis*	0.5-1.0	Low
	3. Diwancheruvu		iii. Shoot tip caterpillar	*Hipotima*		
	4. Sri Rampuram			*haligramma*		
	5. Sri Krishna patnam					
	6. Velugubanda					
	7. Palacherla					
	8. Madhurapudi					
	9. Burugupudi					
	10. Nadigetla					
	11. Gummuluru					
	12. Gadarada					
	13. Koti					
	14. Raghvapura					
	15. Kotikasaram					
	16. Narasapuram					
C.	Guntur	March, 2002	i. Cashew stem & Root borer	*Plocaederus ferrugineus*	3-10	High
	1. Nandirajuthota		ii. Leaf and blossom webber	*Lamida moncusalis*	2.0-3.0	Low
	2. Karlapalem		iii. Shoot tip caterpillar	*Hipotima haligramma*	2.0-5.0	Low
	3. Muthayapalem		iv. Apple & Nut borer	*Nephopteryx sp*	3.0-5.0	Low
	4. Panduranga puram					
	5. Vedullapalle					
	6. Bethapudi					

Table 3.33: Seasonal occurrence of pests and natural enemies on cashewnut at Bapatla.

Week From-To	Met. week No	Max temp °C	Min. temp °C	RH (m) (%)	RH (e) (%)	Rain fall (mm)	Rainy days (No.)	Lbw dam-aged shoots (%)	Anb damage (%)	Lm dam-aged leaves (%)	Stc dam-aged shoots (%)	No. of leaf thrips/ 10 leaves	No.of inflore scence thrips/ 10 panicles	Lf dam aged leaves (%)	No. of spiders/ 52 leaders	No.of ants /52 leaders	Parasiti-Zation of Lbw larvae by Bracon sp
02/7-	27	37.	28.	54.	43.	0.9	--	3.55	--	--	--	16	--	--	0.25	4.42	--
08/7		1	1	3	1												
09/7-	28	37.	27.	56.	41.	8.5	1	3.76	--	--	--	19	--	--	0.08	5.67	--
15/7		8	1	9	6												
16/7-	29	35.	25.	66.	52.	6.0	1	3.34	--	--	--	15	--	--	0.17	6.50	--
22/7		1	7	9	7												
23/7-	30	34.	25.	83.	75.	55.5	2	4.32	--	--	--	8	--	--	0.33	3.42	--
29/7		9	1	9	1												
30/7-	31	33.	23.	84.	77.	111.2	5	3.97	--	--	--	10	--	--	0.42	1.08	--
05/8		7	8	9	0												
06/8-	32	32.	24.	88.	78.	40.6	3	4.39	--	0.72	--	12	--	--	0.17	1.50	--
12/8		5	2	4	6												
13/8-	33	32.	24.	82.	67.	63.4	4	4.67	--	1.09	--	15	--	--	0.17	1.00	--
19/8		6	9	4	1												
20/8-	34	33.	24.	78.	78.	7.6	1	3.62	--	1.49	--	13	--	--	0.08	1.25	--
26/8		2	9	0	0												
27/8-	35	34.	25.	70.	59.	8.9	1	3.07	--	1.64	--	16	--	--	0.17	1.50	--
02/9		6	5	4	0												
03/9-	36	34.	25.	81.	78.	21.2	2	2.16	--	1.70	--	18	--	0.30	0.17	1.67	--
09/9		5	6	6	1												
10/9-	37	33.	24.	83.	80.	49.9	2	2.09	--	1.39	--	5	--	0.39	0.25	1.00	--
16/9		1	9	4	1												
17/9-	38	33.	24.	84.	76.	3.7	1	2.51	--	1.92	--	11	--	0.45	0.17	1.83	--
23/9		0	3	9	1												
24/9-	39	31.	24.	90.	85.	140.3	4	2.93	--	2.12	--	3	--	0.67	0.42	0.25	--
30/9		3	3	9	6												

Week From-To	Met. week No	Max temp °C	Min. temp °C	RH (m) (%)	RH (e) (%)	Rain fall (mm)	Rainy days (No.)	Lbw dam-aged shoots (%)	Anb damage (%)	Lm dam-aged leaves (%)	Stc dam-aged shoots (%)	No. of leaf thrips/ 10 leaves	No.of inflore scence thrips/ 10 panicles	Lf dam aged leaves (%)	No. of spiders/ 52 leaders	No.of ants /52 leaders	Parasiti-Zation of Lbw larvae by Bracon sp
01/10-	40	30.	24.	92.	85.	224.2	6	2.30	--	2.33	--	--	--	0.92	0.25	--	--
07/10		9	4	4	4												
08/10-	41	31.	24.	90.	81.	35.3	2	2.09	--	2.51	--	5	--	1.10	0.08	0.42	--
14/10		8	7	0	7												
15/10-	42	30.	24.	92.	87.	59.5	4	2.23	--	2.81	--	8	--	1.42	0.33	0.17	--
21/10		5	2	4	4												
22/10-	43	31.	23.	91.	81.	5.4	1	2.51	--	2.93	0.49	12	--	0.95	0.17	1.50	--
28/10		7	6	9	0												
29/10-	44	32.	22.	86.	71.	--	--	2.16	--	3.07	1.25	7	--	1.28	0.17	8.00	--
04/11		2	0	9	7												
05/11-	45	28.	22.	92.	91.	43.1	2	1.95	--	3.11	1.81	5	--	1.43	0.42	15.17	--
11/11		8	7	6	9												
12/11-	46	30.	23.	94.	84.	9.8	1	2.02	--	3.22	5.43	8	--	1.69	0.08	18.08	--
18/11		4	9	0	9												
19/11-	47	31.	21.	93.	82.	--	--	1.81	--	3.36	8.71	3	--	1.81	0.17	21.00	5.88(34)
25/11		2	2	7	4												
26/11-	48	30.	20.	91.	84.	--	--	1.60	--	2.72	9.20	--	--	2.26	0.42	22.5	4.76(42)
02/12			3	3	3	4											
03/12-	49	30.	17.	92.	73.	--	--	1.95	--	5.83	7.18	--	--	4.89	0.58	25.67	7.84(51)
09/12		2	8	9	0												
10/12-	50	29.	17.	95.	72.	--	--	1.81	--	3.68	8.85	--	--	4.04	0.75	3.08	10.52(38)
16/12		9	4	6	1												
17/12-	51	28.	18.	88.	71.	--	--	1.88	--	3.76	7.53	--	--	2.89	0.42	10.42	11.63(43)
23/12		6	4	4	4												
24/12-	52	28.	17.	92.	68.	--	--	1.53	--	5.02	9.89	--	--	2.65	0.67	16.92	6.67(45)
31/12		7	8	9	0												
01/1-	1	28.	16.	89.	66.	68.8	1	1.32	--	2.15	11.01	--	--	1.51	0.42	27.17	11.11(54)
07/1		1	8	4	3												

Week From-To	Met. week No	Max temp °C	Min. temp °C	RH (m) (%)	RH (e) (%)	Rain fall (mm)	Rainy days (No.)	Lbw dam-aged shoots (%)	Anb damage (%)	Lm dam-aged leaves (%)	Stc dam-aged shoots (%)	No. of leaf thrips/ 10 leaves	No.of inflore scence thrips/ 10 panicles	Lf dam aged leaves (%)	No. of spiders/ 52 leaders	No.of ants /52 leaders	Parasiti-Zation of Lbw larvae by Bracon sp
08/1-	2	28.	17.	92.	66.	0.4	--	1.46	--	1.46	9.13	--	--	1.07	0.92	21.75	11.43(35)
14/1		0	4	7.	0												
15/1-	3	28.	16.	97.	71.	--	--	1.25	--	1.24	0.94	--	--	0.47	0.75	30.08	6.98(43)
21/1		4	5	1	3												
22/1-	4	29.	21.	92.	83.	--	--	1.25	--	1.46	11.29	--	--	0.88	1.25	24.33	6.38(47)
28/1		8	1	9	7												
29/1-	5	29.	19.	94.	70.	3.6	1	3.48	--	0.26	11.92	--	9	0.67	0.33	45.42	8.69(46)
04/2		4	5	3	4												
05/2-	6	29.	18.	89.	74.	--	--	4.95	--	0.03	9.69	8	12	0.22	1.33	28.75	6.25(48)
11/2		2	2	4	0												
12/2-	7	30.	19.	95.	72.	--	--	3.25	--	0.08	7.59	4	20	0.63	0.58	27.00	4.00(50)
18/2		8	1	9	0												
19/2-	8	31.	16.	96.	66.	--	--	3.14	6.66	0.89	16.52	5	18	0.39	1.67	22.08	1.92(52)
25/2		4	8	7	4												
26/2-	9	32.	17.	95.	66.	--	--	3.76	10.7	0.20	20.00	12	16	--	0.25	19.33	--
04/3		3	9	3	9												
05/3-	10	31.	21.	85.	71.	--	--	2.86	4.81	--	15.96	10	24	--	0.33	27.33	--
11/3		3	9	6	9												
12/3-	11	32.	20.	92.	70.	--	--	3.83	7.59	--	14.91	18	28	--	0.58	35.67	--
18/3		1	2	1	0												
19/3-	12	32.	21.	88.	72.	--	--	4.32	6.25	--	12.82	22	30	--	0.50	26.50	--
25/3		6	6	3	6												
26/3-	13	32.	26.	75.	72.	--	--	4.46	10.7	--	11.36	26	32	--	0.08	12.42	--
01/4		5	4	0	6												
02/4-	14	32.	24.	80.	73.	--	--	1.74	6.17	--	12.06	21	48	--	--	15.92	--
08/4		9	7	0	3												
09/4-	15	33.	24.	74.	66.	--	--	1.32	3.62	--	7.11	28	56	--	0.17	0.25	--
15/4		0	9	9	7												

Week From-To	Met. week No	Max temp °C	Min. temp °C	RH (m) (%)	RH (e) (%)	Rain fall (mm)	Rainy days (No.)	Lbw dam-aged shoots (%)	Anb damage (%)	Lm dam-aged leaves (%)	Stc dam-aged shoots (%)	No. of leaf thrips/ 10 leaves	No.of inflore scence thrips/ 10 panicles	Lf dam aged leaves (%)	No. of spiders/ 52 leaders	No.of ants /52 leaders	Parasiti-Zation of Lbw larvae by Bracon sp
16/4-	16	33.	27.	77.	73.	--	--	1.60	5.87	--	5.50	30	52	--	0.25	0.42	--
22/4		1	1	4	6												
23/4-	17	33.	27.	78.	74.	--	--	1.46	1.33	--	2.09	33	31	--	0.25	1.08	--
29/4		8	8	3	4												
30/4-	18	34.	27.	72.	73.	--	--	2.93	1.90	--	0.83	38	12	--	0.17	1.08	--
06/5		1	5	7	0												
07/5-	19	41.	30.	52.	38.	--	--	2.58	--	--	--	42	5	--	0.25	0.42	--
13/5		5	5	1	6												
14/5-	20	40.	28.	56.	42.	6.8	1	2.37	--	--	--	48	--	--	0.17	1.17	--
20/5		2	8	4	0												
21/5-	21	39.	27.	64.	61.	16.3	1	2.23	--	--	--	32	--	--	--	1.25	--
27/5		4	0	0	0												
28/5-	22	39.	26.	63.	59.	1.9	--	2.79	--	--	--	40	--	--	0.17	0.83	--
03/6		1	8	7	3												
04/6-	23	36.	26.	82.	69.	83.1	5	3.07	--	--	--	24	--	--	0.33	1.00	--
10/6		5	3	1	9												
11/6-	24	36.	26.	73.	62.	2.2	1	3.90	--	--	--	18	--	--	0.42	10.42	--
17/6		1	9	4	1												
18/6-	25	33.	25.	77.	59.	11.3	2	4.18	--	--	--	12	--	--	0.42	2.08	--
26/6		2	2	3	6												
27/6-	26	36.	27.	61.	61.	0.5	--	4.39	--	--	--	14	--	--	0.25	9.92	--
01/7		4	0	3	3												

Table 3.34: Correlation of weather parameters with incidence of pests at Bapatla

Weather Parameters	Pests						
	Lbw	Anb	Lm	Stc	Lt	It	Lf
Maximum temperature °C	0.298*	- 0.051	- 0.553*	- 0.539*	0.805*	- 0.037	- 0.544*
Minimum temperature °C	0.179	- 0.122	- 0.388*	- 0.710*	0.632*	0.019	- 0.515*
Relative humidity(m) (%)	- 0.237	0.094	0.530*	0.516*	- 0.755*	- 0.010	0.492*
Relative humidity(e) (%)	- 0.243	0.002	0.463*	0.128	- 0.520*	0.019	0.317*
Rainfall	0.058	- 0.228	0.101	- 0.350*	- 0.220	- 0.263	- 0.040
Rainy days	0.203	- 0.315*	0.038	- 0.516*	- 0.130	- 0.356*	- 0.136

Lbw: Leaf and blossom webber Anb: Apple and nut borer Lm: Leaf miner Stc: Shoot tip caterpillar Lf: Leaf folder Lt: Leaf thrips It: Inflorescence thrips.

Figures in parentheses indicate the number of leaf and blossom larvae observed under laboratory conditions for parasitization by *Bracon* sp. * Significant at 0.05 level

BHUBANESWAR

a) Shoot tip borer *Hypatima haligramma*

The pest was active in the field from July to December and in the month of January and February. The appearance of the pest was negligible in the period of summer months i.e. from March to June. So high temp. has a negative impact on this pest. The peak incidence of the pest (16.0%) was seen in the second fortnight of October.

b) Inflorescence thrips

i) Yellow thrips *Frankliniella schultzei* T.
ii) Black thrips *Haplothrips ceylncus* Sch.

Yellow thrips was observed from January to last week of April with maximum 27.9 number in 10 number of inflorescence during 2nd week of February. The black thrips was recorded from 1st week of February to 1st week of May with maximum population of 32.3 number per 10 inflorescence was recorded during second week of March.

c) Leaf miner *Acrocercops syngramma* M.

The leaf minor infestation was noticed during July to December. The peak period of its activity (16.5%) was recorded during 3rd week of October.

d) Apple and nut borer *Nephopteryx* Sp.

Apple and nut borer infestation was below 5 percent. However its activity was limited between last week of March to 1st week of May. Maximum incidence of 4.6 % was recorded during 2nd week of April.

e) Leaf beetle *Monolepta longitarsus* Jac.

The incidence of leaf beetle was noticed during last week of June to last week of September. However maximum incidence of 7.8% was seen during last week of July and 1st week of August. The incidence of the pest is highly influenced by rainfall.

f) Leaf folder *Caloptilia tiscelaea*

The activity of leaf folder was observed from September to December. The peak incidence of the pest i.e. 16.5 % was recorded during 3rd week of October.

g) Cashew stem and root borer *Plocaederus ferrugineus* L.

The incidence of the pest was seen throughout the year. But its activity was maximum during February 2nd week to June last week. The infestation was negligible in the months of November, December and January.

Besides this the other minor pests like brown aphid (*Toxaptera ordinac*), mealy bug (*Ferrisia vingata*), Gundhi bug (*Leptocorisa acuta Thurch*), bark borer (*Indarbela tetraonis* M.) and termites (*Odontoterms* Sp.) were also observed. But their extent of damage was negligible.

Natural Enemies

Study on field parasitazation of major pests of regional importance of cashew (Table 3.35) indicated that maximum parasitazation of shoot tip caterpillar (12%) by *Elasmus* Sp., leaf and blossom webber 10 percent) by *Bracon brevicurnis* and leaf minor (16%) by *Sympiesis* sp were observed. The peak period of infestation was coincided with the peak incidence of the pest.

The other predaters present in cashew ecosystem were Spiders (*Arjeope* sp, *Oxyper* sp), Lady bird beetle (*Virania cinta*), *Menochilus sexmaculats*, Black ant (*Campanotus* Sp) Mirid bug. Most of the predaters and pollinators are seen during flower period of the crop.

Survey of pest complex and its natural enemies

Survey of insect pest of cashew and its natural enemies were carried out on various plantations in Puri, Khurda, Ganjam, Dhenkanal, Jajpur and Balasore districts. The important insect pests, natural enemies and pollinators in each locality have presented in table-3.35.

Table 3.35: Survey of pest complex of cashew in different plantations in Orissa during 2002.

Location/ district	Name of the pest		Percentage infestation range	Intensity of attack	Stage of crop
	Common name	Scientific name			
Ambapura (Ganjam)	Tea mosquito bug	Helopeltis antonii	2 -5	Low	Flowering
	Shoot tip caterpillar (STC)		2-5	Low	
	Inflorescence thrips		2-10 no./inflorescence	Low to moderate	
	CSRB		2 -8	Low	
		Natural enemies			
	Spiders		0.2 - 2		
	Lady bird beetle		0.5 - 5	Low	
	Black ant		2 - 5 nos	Low	
Golaban-dha (Ganjam)	TMB		20 - 40	Severe	Flowering
	STC		2 - 10	Low	
	Inflorescence thrips		2 -10	Low	
	Csrb		2 - 10	Low	
		Natural enemies			
	Lady bird beetle		0.2 - 1.2	Low	
	Spiders		0.1 - 2.5	Low	
	Black ants		0 - 5	Low	
Godhana-pur (Konark) Puri	Inflorescence thrips Yellow thrips		2-5 nos/ inflorescence	Low to moderate	Floweing
	Black thrips		8-10 nos / inflorescence	Low to moderate	
	CSRB	4-15		Low to moderate	
		Natural enemies			
	Lady bird beetle		5-20 nos./ quadrant		
	Inflorescence thrips Yellow thrips		2-8 nos./ inflorescence	Flowering	
	Black thrips		4-20 nos. / inflor.	Low to moderate	
Khurda	Shoot tip borer		2 - 10	Low	
	Stem borer		10 - 30	Moderate to high	
		Natural enemies			
	Spiders		0.2 - 2		
	Lady bird beetle		0.5 - 2.5		
	Black ants		2-10 nos. / quadrant		
	Yellow thrips		5-8 nos. / inflor.	Low to moderate	Flowering
	Black thrips		8-10 nos./ inflor.	Low to moderate	Flowering
Dagara Baliapala (Balasore)	Leaf and blossom webber	Lamida monarsalus	10-20		
	CSRB		4-10	Low	
		Natural enemies			
	Lady bird beetle		2 - 5	Low	
	Spiders		0.1 - 0.8		
	Black ant		2 -10		

Location/ district	Name of the pest		Percentage infestation range	Intensity of attack	Stage of crop
	Common name	Scientific name			
Raijhar (Jajpur)	STC		4 - 20	Low to moderate	Flowering
	Yellow thrips		2-8 nos. / inflor.	Low	
	Black thrips		4-20 nos./ inflor.	Low to moderate	
	CSRB		4 - 10	Low	
		Natural enemies			
	Lady bird beetle		0.2 - 2.5		
	Spiders		0.2 - 2.5		
	Black ants		2 - 5		
Bhangamal Dhenkanal	STC		4 - 15	Low	
	Yellow thrips		2-8 nos./ inflor.	Low	
	Black thrips		4-15 nos. / inflor.	Low to moderate	
	CSRB		2 - 10	Low	
		Natural enemies			
	Lady bird beetle		0.2 - 2.5		
	Spiders		0.2 - 2.5		
	Black ants		2 - 5		

i) The plantation of the southern part of Orissa i.e. in Ganjam district there is appearance of Tea Mosquito bug. The pest was severe near Gopalpur area of Ganjam district. It is not seen in northern parts like Puri, Balasore & Dhenkanal districts.

ii) The infestation of cashew stem and root borer is seen throughout Orissa. However its infestation is low., 1 - 2% in high altitude (Koraput) and interior district as compare to Puri & Khurda district (4.30%).

iii) Shoot tip caterpillar is observed in all region of the state on range of 4- 18%.

iv) The inflorescence thrips is seen almost all parts of the state within range of 2 - 12 nos. per inflorescence.

v) Among the natural enemies Lady bird beetle is seen almost all the plantations within a range of 2-10 nos per quadrants.

CHINTAMANI

Maximum tea mosquito bug population (17.08%) was seen in the first week of March. It was found to be feeding on guava from July to September and on neem from September to January. Leaf miners were found from IInd week of November to second week of February with a maximum of 14.11% during fourth week of December. Inflorescence thrips were found from the first week of April to third week of June with a peak incidence (21.92 No./panicle) in first week of April. Fruit and nut borer was noticed during the first week of April and reached maximum of 7.83% during fifth week of May and there after sudden reduction was noticed. A total of fifteen insect species feeding and breeding on different parts of cashew tree have been recorded. The seasonal occurrence of major pests of cashew at Chintamani is presented in Table 3.36.

Table 3.36: Seasonal occurrence of pests of cashew at Chintamani.

Months	Week	TMB (%)	Leaf miner (%)	Inflorescence thrips No. infl.$^{-1}$	Fruit & Nut borer (%)
Jan.	I	-	10.02	--	--
	II	-	6.08	--	--
	III	-	3.11	--	--
	IV	-	1.02	--	--
Feb.	I	1.26	0.42	--	--
	II	6.26	--	--	--
	III	14.02	--	--	--
	IV	15.16	—	1.32	--
Mar.	I	17.08	--	2.42	--
	II	11.06	--	3.08	--
	III	8.02	--	5.12	--
	IV	6.11	--	8.98	--
	V	3.92	--	10.71	--
Apr.	I	2.23	--	12.36	0.03
	II	1.84	--	16.48	0.32
	III	0.62	--	18.99	0.63
	IV	0.62	--	21.92	0.93
May	I	0.12	--	16.96	1.48
	II	--	--	10.11	2.43
	III	--	--	6.02	3.98
	IV	--	--	3.06	5.63
	V	--	--	1.11	7.83
Jun.	I	--	--	0.83	2.03
	II	--	--	--	1.02
	III	--	--	--	--
	IV	--	--	--	--
Jul.	I	--	--	--	--
	II	--	--	--	--
	III	--	--	--	--
	IV	--	--	--	--
Aug.	I	--	--	--	--
	II	--	--	--	--
	III	--	--	--	--
	IV	--	--	--	--
	V	--	--	--	--
Sep.	I	--	--	--	--
	II	--	--	--	--
	III	--	--	--	--
	IV	--	--	--	--
Oct.	I	--	--	--	--
	II	--	--	--	--
	III	--	--	--	--
	IV	--	--	--	--
Nov.	I	--	--	--	--
	II	--	--	--	--
	III	--	--	--	--
	IV	--	--	--	--
	V	--	--	--	--
Dec.	I	--	--	--	--
	II	--	--	--	--
	III	--	--	--	--
	IV	--	--	--	--

JAGDALPUR

Seasonal occurrence of cashew insect pests and their natural enemies were recorded on cashew plantation during the year 2002-03 (table 3.37 and 3.38). Termite was the most serious pest of cashew and caused severe damage in forest plantation, almost throughout the year. The activity of TMB was confined from January to May and peak of its population recorded in March and April. The attack of insect was in the order of Termite > Stem and Root borer > TMB > Leaf miner > Leaf folder > Leaf blossom webber > Apple and nut borer and Aphid. The predators and parasites appeared in cashew were the Spiders, Preying mentids, Reduvid bugs, Black ants, Wasps and Lady bird beetles (Table-3.37).

JHARGRAM

Stem and root borer was the severe pest in neglected plantations in West Bengal. The pest was recorded throughout the year. The TMB was recorded during the month of November-March, however the population was below harmful level (1%). Shoot and blossom webber was recorded from October to December. Peak period of infestation was observed in December(17.8%). Incidence of shoot tip caterpillar was found during September to February. The peak period of incidence was during October(15.6%). The thrips were observed during November to February. Both leaf thrips and inflorescence thrips were noticed in cashew trees. The period of maximum attack due to thrips was during February(120.8 nos.). The infestation of leaf miner incidence was high during August to January with peak incidence in October (16.6%) coinciding with new flush formation. Apple and nut borer was recorded during March to May, but its population was very low. Termites were found damaging the plant in red and laterite zones but the population was low. The incidence of leaf folder was noticed in flushing stage. Only few localized infestation were noticed in certain localities. The data on occurrence of pests is correlated with weather parameters at Jhargram in Table 3.39. The details of occurrence of natural enemies is given in Table 3.40.

Table 3.37: Seasonal occurrence of cashew insect pests and their enemies during the years 2002-2003 at Jagdalpur.

Common Name	Scientific Name	Month of occurrence	Intensity
Stem & Root borer	*Plocaederus ferrugineus*	Jan-June	Low
Termite	*Odontotermus obesus*	Jan-June & Oct-Dec	Severe
TMB	*Helopeltis antonii*	Dec-April	Moderate
Preying mentid	--	Jan-May	Low
Reduvid bug	--	Jan-April	Low
Spider	--	Jan-May	Low
Leaf miner	*Acrocercops syngramma*	June-Sept.	Moderate
Leaf folder	*Caloptilea tiselea*	Jan-March	Low
Aphid	*Toxoptera odinae*	July-Sept.	Moderate
Apple & nut borer	*Thylocoptilla panerosema*	March-April	Low
Leaf & blossom webber	*Lamida moncusalis*	March-April	Low
Wasp	--	March-April	Low

Table 3.38 : Seasonal incidence of Cashew insect pests and corresponding weather data during 2002-03 at Jagdalpur.

Month	Temp. (°C)		R. Humidity(%)		Rainfall (mm)	Rainy days	SARB	Termite	TMB	Preying mentid Per plant	Reduvid Bug Per plant	Spider Per plant	Leaf miner % intensity	Leaf folder % leaf damage	Aphid % incidence	Apple & nut borer % damage	Leaf & blossom webber % intensity	Wasp Per plant
	Max.	Min.	I	II			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Jan-02	26.9	11.2	94	53	52.9	3	4	5	6.0	3.0	2.0	5.0	-	-	-	-	-	-
Feb.	30.3	13.6	85	42	0.0	0	5	10	28.0	8.0	4.0	4.0	-	-	-	-	-	-
Mar.	34.4	18.0	73	29	8.6	1	5	5	50.0	12.0	5.0	5.0	-	4.0	5.2		5.8	1.5
Apr.	36.7	22.7	70	29	27.8	3	8	5	48.0	10.0	2.0	10.0	3.0	6.8	4.8	2.0	5.0	2.0
May.	38.7	25.2	61	28	82.1	4	8	4	40.0	9.8	-	10.0	4.0	8.5	3.0	10.2	10.2	3.0
June.	31.8	22.4	81	45	147.4	10	10	4	-	-	-	5.2	10.0	8.5	-	18.8	5.0	-
July.	29.9	22.7	81	56	228.7	12	-	-	-	-	-	-	8.0	7.0	-	2.0	-	-
Aug.	25.7	21.4	91	63	389.6	16	-	-	-	-	-	-		-	-	-	-	
Sep.	29.4	20.9	88	48	81.8	7	-	-	-	-	-	-	-	-	-	-	-	-
Oct.	31.4	17.7	91	45	13.4	2	5	5	-	-	-	-	5.0	-	-	-	-	-
Nov.	28.6	11.1	91	25	0	0	-	10	-	-	-	-	12.0	-	-	-	-	-
Dec.	28.3	8.9	93	25	0	0	-	18	-	-	-	-	-	-	-	-	-	-
Jan 03	28.70	9.4	90	24	0	0	4	5	5.0	-	3.0	5.0	-	-	-	-	-	-
Feb.	31.70	14.8	90	29	5.5	1	4	12	30.0	8.0	5.0	4.0	-	-	-	-	-	-
Mar.																		
Apr.																		

I - Stem and Root borer - No. of affected trees, out of 30 trees.

II - Termite - No. of affected trees, out of 30 trees .

III - TMB - Tea Mosquito Bug (%) incidence.

Table 3.39: Correlation of weather parameters with relation to pests of cashew at Jhargram.

Month	Temp (°C)		RH		Rain fall (mm)	No. of Rainy days	Percentage damage					No. of thrips in 10 panicles
	Max	Min	AM	PM			TMB	BW	LM	ANB	STC	
Jan.	22.4	11.4	76.4	44.3	16.4	4	0.25	2.4	12.6	-	9.6	120.9
Feb.	24.2	13.2	75.2	49.8	2.3	2	0.20	2.2	6.8	-	12.7	130.2
Mar.	30.4	20.6	76.2	52.6	24.2	5	0.40	1.6	0.8	0.3	3.3	119.6
Apr.	35.2	22.2	78.8	53.4	36.9	5	-	-	0.6	3.3	-	70.3
May	36.8	22.9	76.3	46.2	32.4	6	-	-	-	1.8	-	-
Jun.	37.9	25.1	85.6	51.7	106.4	10	-	-	-	-	-	-
Jul.	35.6	23.2	92.4	76.8	352.3	25	-	-	-	-	-	-
Aug.	35.2	23.6	90.8	76.2	311.4	24	-	0.8	-	-	-	-
Sep.	36.3	26.2	86.2	70.4	229.4	18	-	4.2	4.9	-	0.7	-
Oct.	29.2	21.6	80.2	56.3	165.3	14	-	12.6	16.6	-	15.6	-
Nov.	28.7	15.2	78.4	46.7	40.2	5	0.20	16.8	7.6	-	6.9	-
Dec.	24.7	12.2	73.5	42.3	14.1	4	0.30	17.8	1.1	-	1.2	4.2

TMB = Tea mosquito bug BW = Shoot and blossom webber LM = Leaf miner
ANB = Apple and nut borer STC = Shoot tip caterpillar

Table 3.40: Occurance of natural enemies at Jhargram

Month	Natural enemies of cashew pest			
	Spiders	Ants	Coccinellids	Braconids
Jan.	163	174	156	18
Feb.	169	166	167	8
Mar.	182	169	182	4
Apr.	112	70	40	-
May	90	40	16	-
Jun.	20	-	-	-
Jul.	16	-	-	-
Aug.	30	-	-	-
Sep.	26	-	-	-
Oct.	74	30	22	-
Nov.	89	106	56	17
Dec.	152	152	107	16

MADAKKATHARA

TMB damage was observed from January to May season. But percentage damage caused was less than 10 to 20%. Minor pests noted were leaf and blossom webber during October- April season (1.86 to 5.76%), apple and nut borer from March to May season (4.75 to 9.8%), leaf folder from October to November season (1.55 to 3.46%), leaf miner from August to October (0.16 to 3.55%) - Table 3.41.

VENGURLE

Tea mosquito bug and flower thrips found to attack cashew trees severely during November to May. The leaf miner and CSRB were found to infest cashew throughout the year but in low intensities. The details of occurrence of various pests and natural enemies of cashew pests are presented below in Table 3.42.

Table 3.41: Seasonal occurrence of tea mosquito bug and other pests at Madakkathara

Month of observation	TMB mean damage score (mean of 52 shoots)	Leaf and blossom webber (% shoots damaged) (52 leader shoots)	Apple & Nut borer (% of apples damaged) 52 panicles	Leaf miner (% of mined leaves)	Shoot tip caterpillar (% infested shoots) 52 leader shoots	Leaf thrips (mean no. per 10 leaves)	Inflorescence thrips (mean no. per 10 panicles)	Leaf folder (% of damaged shoot in 52 leader shoots)
Jan. 02	0.46	2.64	-	-	-	-	-	-
Feb. 02	0.49	2.46	-	-	-	-	-	-
Mar. 02	0.59	4.11	4.75	-	-	-	-	-
Apr. 02	1.08	5.76	9.68	-	-	-	-	-
May.02	-	-	9.80	-	-	-	-	-
Jun. 02	-	-	-	-	-	-	-	-
Jul. 02	-	-	-	-	-	-	-	-
Aug 02	-	-	-	0.16	-	-	-	-
Sept.02	-	-	-	1.25	-	-	-	1.55
Oct.02	-	1.86	-	3.55	-	-	-	3.46
Nov.02	-	-	-	-	-	-	-	-
Dec.02	-	-	-	-	-	-	-	-

Table 3.42: Occurrence of pests of cashew and their natural enemies at Vengurle

Common Name	Scientific Name	Month of Occurrence	Intensity (%)
Tea-mosquito bug	*Helopeltis antonii*	Nov. -May	9.37-29.70
Flower thrips	*Rhipiphorothrips sp.*	Jan-May	14.58-32.29
Stem and root borer	*Plocaederus ferrugineus*	Throughout year	8-10
Leaf miner	*Acrocercops syngramma*	Throughout year	5-10
Aphid	*Toxoptera odinae*	Jan.-Mar.	1-2
Mealy bug	*Ferrisia virgata*	Feb.-Mar.	Sporadic
Leaf eating beetles	*Manolepta sp.* *Coenoblus sp.*	Jun.-Aug	2-10
Leaf cutting weevils	*Depous Marginatus*	Jun.-Aug.	2-10
Web worm	*Orthaga Exvinacae*	Oct.-Nov.	2-5
Semilooper	-	Oct.-Nov.	1 tree^{-1}
Apple and nut borer	*Nephopleryx sp.*	Jan.-Apr.	2-10

VRIDHACHALAM

The stem and root borers, leaf weevil and termites were found throughout the year with the intensity of 8.3, 1.51 and 2.0 per cent respectively. The pest intensity was maximum with hairy caterpillar (January- February) and flower thrips (January-May) with 23.2 and 23.0 per cent intensity. The TMB was found during October-February with 12.0 per cent intensity (Table 3.43).

Considering the natural enemies, natural infection of NPV was found on larvae of hairy caterpillar (*Lymantria abuscata*) in the forest area of Kattukudalur. This is a new occurrence from this area. The infection rate was 22.7%. The larval parasitoid Cotesia was found on green leaffolder during October-January with the intensity of 11.00% parasitization Table 3.44.

Table 3.43: Bio-ecology of pests of regional importance and survey of pest complex in different parts of Tamil Nadu

Common Name	Scientific Name	Period of occurrence	Intensity %
Stem and Root borer	*Plocaederus ferrugineus*	Round the year	8.3
Tea Mosquito bug	*Helopeltis antonii*	Oct-Feb	12.0
Leaf miner	*Acrocercops syngramma*	July - Feb	11.0
Green leaf folder	*Sylepta aurantiacalis*	July-Jan	2.22
Leaf and Blossom webber	*Lamida moncusalis*	June-Mar	7.72
Diamond hairy caterpillar	*Metanastria hyrtaca*	Jan - Feb	10.70
Hairy caterpillar	*Lymantria abuscata*	Jan - Feb	23.20
Apple and nut borer	*Thylocoptila panrosema*	Dec-April	0.91
Leaf weevil	*Myllocerus* sp	Round the year	1.51
Leaf twisting weevil	*Apoderus tranquebaricus*	Dec - Jan	0.60
Leaf thrips	*Rhiphiphorothrips cruentatus*	July-Jan	2.82
Flower thrips	*Scirtothrips dorsalis*	Jan - May	23.00
Termites	*Odontotermes obesus*	Through out the year	2.00

Table 3.44: Occurrence of natural enemies of cashew pests in different locations in Tamil Nadu during 2002- 03.

Sl. No	Natural enemies	Host insects	Stage affected	Period occurrence	Intensity %
I	Parasitoids				
1	Cotesia (*Apanteles* sp)	Green leaf folder	Larvae	Oct - Jan	11.00
2	*Brachymeria* sp	Diamond hairy caterpillar	Pupae	Sep - Jan	8.00
II	Predators				
3	*Scymnus* sp	Mealy bugs	Adults and Nymphs	Jan - Feb	5.00
4	*Chryroperla carnea*	Mealy bugs and Thrips	Nymphs and adults	Sep-Feb	1.80
5	Preying Mantids	Caterpillars and moths	Nymphs and adults	Round the year	2.50
6	Spiders	Caterpillars and moths	Nymphs and adults	Round the year	5.2
III	Fungi				
7	*Metarihizum anisopliae*	Stem and root borer	Grubs & pupae	Aug - Feb	1.2
8	*Beauveria bassiana*	Stem and root borer	Grubs & pupae	Aug - Feb	2.2
IV	NPV				
9	NPV	Hairy caterpillar	Larvae	Jan - Feb	22.7

Screening of germplasm to locate tolerant/resistant types to major pests of the region

Centres : East Coast
Bhubaneswar, Jhargram, and Vridhachalam

West Coast
Madakkathara and Vengurle

Maidan tracts/ others
Chintamani

The objective is to identify germplasm accessions tolerant/resistant to the pests, of regional importance.

Summary

At Bapatla, among 53 germplasm entries, 12 have shown tolerence against leaf and blossom Webbers. At madakkthara 8 accessions were found resistant to shoottip caterpillar out of screened 40 germplasm accessions. At Jhargram, among 24 accesions, Ansur-1 was tolerant to shoottip caterpillar and VTH-30 to infloroscence thrips. At Vengurle, VI was tolorant against TMB. At Vridhachalam, H1608 and VTH 59/2 were tolerant to TMB, M44/3 and H-40 were less damaged by shoot and blossom webber, in H-1598 and H-1600 thrips damage was minimum.

BAPATLA

Among the 53 germplasm entries available in the gene bank of Cashew Research Station, Bapatla, the following entries viz, T.No.1, 10/1, Hy.94 T-4, 5/1, Hy.94 T-3, T.No.129, 40/1, ABT-1, 17/5 and BLA 39/4 were found tolerant to leaf and blossom webber by recording a minimum damage ranging from 1.90 to 2.63 percent against highest damage of 24.22 percent in ABT-3.

Regarding shoot tip caterpillar none of the entries found promising as the minimum damage recorded was 13.48 percent. However the entries viz., 15/4, 71, Hy.95 T-2, Hy95. T-4, 6/20, 10/1, Cheepurugudem, 5/1, 4/5 and T.No.129 were relatively tolerant to shoot trip caterpillar the damage of which ranged from 13.48 to 16.97 percent against a maximum damage of 35.21 percent in Priyanka (Table 3.45).

Inflorescence thrips varied from 12.67 to 20.00 per 10 panicles in different entries screened. Though, no much variation existed among the entries screened the following entries viz., T.No.275, 3/33, T.No.40, T.No.129, 12/1 recorded relatively less number of thrips (12.67 to 14.67 per 10 panicles) compared to highest incidence of 20.00 thrips in 40/1. The entries viz., T.No.129, 5/1 and 10/1 were found tolerant to more than one pest.

BHUBANESWAR

Forty germplasm accession were evaluated for resistance against shoot tip caterpillar and inflorescence thrips. It is revealed from the data (Table-3.46) that the accession no. 3, 10, 13, 16, 23, 30, 32 and 38 are free from shoot tip borer attack. Maximum of 11.5% damage was recorded in the accession no. 34. However, the population of inflorescence thrips was present in almost all the accessions with a range of 8 to 35 nos. per 10 panicles.

Table 3.45: Screening of germplasm against minor pesrsof cashew nut at Bapatla during 2002 season

Accession	Leaf and blossom webber damaged shoots (%) (a)	No.of Inflorscence thrips/ 10 panicles (b)	Shoot tip caterpillar damaged shoots (%) (a)
Priyanka	09.84 (18.27)	15.84 (4.04)	35.21 (36.39)
30/1	06.74 (13.33)	14.84 (3.91)	23.02 (28.64)
3/33	13.13 (20.83)	13.67 (3.76)	32.94 (35.00)
T.No.40	15.37 (23.07)	14.17 (3.83)	29.64 (31.98)
T.No.129	02.81 (09.00)	14.67 (3.87)	16.97 (24.20)
T.No.275	17.24 (24.39)	12.67 (3.63)	23.76 (29.16)
T.No.274	10.69 (18.97)	14.00 (3.81)	25.98 (30.57)
12/1	06.55(14.55)	13.17 (3.70)	25.13 (30.08)
12/8	07.67 (16.04)	14.84 (3.92)	25.26 (30.17)
18/3	08.34 (16.32)	15.34 (3.97)	24.52 (29.68)
PTR1-1	13.73 (21.27)	16.67 (4.14)	23.53 (29.01)
ABT-3	24.22 (29.10)	14.00 (3.81)	21.91 (27.77)
ABT-2	03.17 (10.16)	14.00 (3.81)	26.93 (31.26)
3/7	19.88 (25.56)	14.84 (3.91)	27.27 (31.45)
3 /4	10.34 (18.75)	14.17 (3.83)	22.94 (28.54)
1/1	07.44 (15.75)	16.00 (4.06)	34.53 (35.64)
T.No.1	01.90 (05.91)	18.00 (4.29)	24.35 (29.46)
8/7	23.54 (29.02)	16.50 (4.12)	19.34 (25.86)
4/3	04.13 (11.62)	15.50 (4.00)	17.29 (24.28)
4/5	10.29 (18.70)	15.50 (4.00)	16.01 (23.58)
T.No.228	02.78 (09.60)	16.50 (4.12)	18.52 (25.47)
T.No.233	02.68 (09.34)	16.17 (4.08)	19.14 (25.96)
T.No.244	09.23 (17.67)	15.50 (4.00)	21.72 (27.78)
T.No.268	06.77 (15.05)	18.50 (4.36)	19.34 (26.03)
15/4	04.15 (11.75)	17.00 (4.18)	13.48 (21.54)
BLA 139-1	08.80 (17.25)	15.34 (3.97)	22.31 (28.14)
17/5	02.63 (09.26)	15.84 (4.04)	25.37 (30.14)
BLA 39/4	02.63 (09.27)	15.84 (4.04)	25.67 (30.44)
ABT-1	02.58 (09.19)	15.84 (4.04)	18.52 (25.37)
5/1	02.05 (08.22)	16.00 (4.06)	15.78 (23.40)
2/3	06.32 (14.38)	16.00 (4.06)	22.94 (28.61)
10/2	02.79 (13.05)	17.67 (4.26)	23.69 (29.10)
7/12	04.30 (11.97)	18.00 (4.30)	23.61 (28.99)
T.No.71	08.80 (16.90)	16.00 (4.06)	13.83 (21.76)
T.No.277	04.00 (11.45)	17.00 (4.18)	18.50 (25.46)
2/14	10.69 (19.01)	14.83 (3.91)	17.61 (24.78)
5/16	11.13 (19.43)	16.00 (4.06)	22.87 (28.57)
Cheepurugudem	06.34 (14.57)	18.67 (4.37)	15.11 (22.86)
Aswaraopet	08.76 (17.21)	17.67 (4.26)	23.22 (28.79)
BBSR-1	07.19 (15.40)	17.67 (4.25)	22.06 (28.00)
40/1	02.50 (09.06)	20.00 (4.52)	20.74 (26.66)

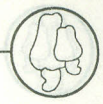
Accession	Leaf and blossom webber damaged shoots (%) (a)	No.of Inflorscence thrips/ 10 panicles (b)	Shoot tip caterpillar damaged shoots (%) (a)
6/14	03.98 (11.50)	17.00 (4.18)	29.02 (32.57)
Hy 94 T-3	02.07 (08.26)	17.17 (4.20)	19.64 (26.28)
2/5	07.93 (16.28)	17.17 (4.20)	19.05 (25.87)
2/15	05.39 (13.38)	16.34 (4.10)	18.11 (25.14)
Hy 94 T-4	02.09 (08.11)	15.84 (4.04)	21.50 (27.61)
Hy 95 T-4	03.28 (1029)	17.34 (4.23)	14.21 (22.14)
Hy 95 T-2	09.64 (17.63)	15.84 (4.04)	13.97 (21.91)
6/20	10.12 (18.46)	16.00 (4.06)	14.55 (22.42)
Hy 95 T-5	04.65 (12.30)	17.67 (4.26)	19.78 (26.41)
Hy 94 T-5	04.58 (12.21)	15.83 (4.04)	19.08 (25.78)
10/1	01.64 (07.24)	19.67 (4.49)	14.70 (22.53)
9/8	06.67 (14.87)	17.67 (4.26)	19.68 (26.30)
CD(0.05)	(07.88)	(0.41)	(06.21)
Mean	(14.91)	(4.07)	(27.48)

(a) Figures in parentheses are arc sin transformed values.

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

Table 3.46: Scrrening of germplasm against pests of cashew at Bhubaneswar

Accession No.	% infestation by shoot tip caterpillar Range	Inflorescence thrips (Mean no./ 10 panicles)	Accession No.	% infestation by shoot tip caterpillar Range	Inflorescence thrips (Mean no./ 10 panicles)
OC_1	0.96 - 1.92	18	OC_{21}	0.0 - 2.9	10
OC_2	0.0 - 0.96	20	OC_{22}	0.0 - 2.9	15
OC_3	0.0 - 0.0	15	OC_{23}	0.0 - 0.0	18
OC_4	1.92 - 3.8	30	OC_{24}	0.0 - 6.7	10
OC_5	2.9 - 4.8	20	OC_{25}	0.0 - 3.8	30
OC_6	0.96 - 1.9	25	OC_{26}	0.0 - 2.9	20
OC_7	0.0 - 0.96	10	OC_{27}	0.0 - 0.96	21
OC_8	0.0 - 0.96	10	OC_{28}	1.92 - 2.9	20
OC_9	0.0 - 3.8	12	OC_{29}	0.0 - 2.9	18
OC_{10}	0.0 - 0.0	8	OC_{30}	0.0 - 0.0	9
OC_{11}	0.0 - 0.96	10	OC_{31}	0.0 - 1.92	10
OC_{12}	0.0 - 2.9	20	OC_{32}	0.0 - 0.0	8
OC_{13}	0.0 - 0.0	9	OC_{33}	0.0 - 3.8	20
OC_{14}	0.0 - 2.9	10	OC_{34}	0.0 - 11.5	25
OC_{15}	0.0 - 6.7	15	OC_{35}	0.0 - 2.9	10
OC_{16}	0.0 - 0.0	15	OC_{36}	0.0 - 4.8	15
OC_{17}	0.96 - 6.7	20	OC_{37}	0.0 - 1.9	18
OC_{18}	0.0 - 0.96	18	OC_{38}	0.0 - 0.0	20
OC_{19}	0.0 - 2.9	19	OC_{39}	0.0 - 2.9	30
OC_{20}	0.96 - 1.9	20	OC_{40}	0.0 - 3.8	35



CHINTAMANI

As the TMB incidence during the year under report was least, the screening experiment could not be conducted at Chintamani.

JHARGRAM

Twenty-four germplasm accessions were screened against inflorescence thrips and shoot tip caterpillar. The Ansur-1 showed least attack by shoot tip caterpillar (4.4%) and VTH-30 has showed least damage due to inflorescence thrips (48 in 10 panicles). The data is presented in Table 3.47.

Table 3.47: Screening of cashew accessions for tolerance to pests at Jhargram

Accession	L & B Webber		Inflorescence thirps (%)	Shoot tip caterpillar (%)
	Mean No. in 52 shoots	Mean % in 52 shoots		
M-17/4	16	6.9	72	9.4
A-7/2	12	7.4	86	8.6
M-4/2	15	9.6	67	7.8
M-26/1	11	6.7	62	13.6
K-27/1	19	11.2	70	12.4
M-3/3	13	6.8	63	8.6
M-33/3	12	7.8	59	14.6
M-76/1	16	8.2	54	6.4
V-2	9	5.6	69	9.6
A-8/4	18	8.2	63	10.8
V-36/3	14	7.4	58	6.5
H-1608	13	7.8	72	8.4
H-4-7	17	9.4	59	9.2
Ullal-1	18	9.6	70	8.3
Ullal-2	14	8.6	74	11.5
Digha-1	13	9.6	67	7.8
Digha-4	14	8.5	50	9.2
VTH-30	10	6.9	48	7.6
VTH-59	13	6.9	50	6.8
V-5	15	8.2	74	9.3
JGM-47/6	14	8.4	80	8.4
Ansur1	10	6.4	83	4.4
M-44/3	13	6.9	63	5.9
Digha-6	14	8.1	76	8.5

MADAKKATHARA

Fortnightly observations on the incidence of tea mosquito bug and other minor pests were recorded from all the accessions available in the germplasm and presented in the Table 3.48.

VENGURLE

Eight released varieties and promising hybrids and other types were screened against TMB and the damage was recorded as percentage incidence and mean score. Least damage was observed in V-1 (17.00%). The data on screening of germplasm against TMB is presented in Table 3.49.

Table 3.48: Screening of germ plasm-occurance of major and minor pests at Madakkathara

Accession No.	TMB mean damage score 0-4 scale in 52 leader shoots	L&BW (% shoots damaged) 52 leader shoots	Inflorescence thrips (mean no. per 10 panicle)	Shoot tip caterpillar (% of attacked shoots in 52 leader shoots)
P-1	0.6	12.33	-	1.33
P-2	0.38	9.85	-	-
P3-1	0.87	6.33	-	0.81
P3-2	0.45	16.45	-	-
P4-2	0.59	-	-	-
P5-1	0.74	1.46	0.85	-
P-6-1	0.28	-	0.08	1.53
P-7-1	0.06	-	-	-
P-8-1	0.30	-	-	-
P-9-1	0.65	6.55	1.86	-
P-10-1	0.78	2.65	-	-
P-11-1	0.58	-	6.43	2.33
P-12-1	0.77	1.25	-	-
P-13-1	0.45	3.33	2.65	-
P-14-1	0.91	-	1.85	0.55
Bzl-2	1.39	3.65	-	-
Bzl-3	0.40	-	-	-
Bzl-120	0.63	5.00	-	-
Bzl-239	0.39	-	1.88	-
Bzl-241	0.28	2.45	3.90	2.25
Bzl-244	0.88	4.65	-	-
Bzl-248	0.73	-	-	1.05
ICTR-27	0.05	6.55	11.3	-
Pan-1	0.32	-	-	4.57
Vapala	0.69	1.45	-	-
Anagha	0.87	5.65	-	-
BLA39-4	0.67	2.45	6.75	-
K 22-1	0.16	-	-	-
NDR 2-1	0.23	4.33	2.45	-
H-3-13	0.38	-	-	-
H-3-17	0.13	-	1.35	-
H-1650	0.35	2.65	3.33	-
H-682	0.28	1.57	-	-
H-718	0.69	-	8.33	-
H-719	0.48	3.55	1.35	-
H-856	0.23	-	-	-
H-1588	0.58	-	-	-
H-1589	0.35	-	-	-
H-1591	0.98	2.55	-	1.33
H-1593	0.83	-	-	-
H-1596	0.74	1.35	2.8	-

Accession No.	TMB mean damage score 0-4 scale in 52 leader shoots	L&BW (% shoots damaged) 52 leader shoots	Inflorescence thrips (mean no. per 10 panicle)	Shoot tip caterpillar (% of attacked shoots in 52 leader shoots)
H-1597	0.81	-	-	-
H-1598	0.73	-	11.33	-
H-1600	0.43	2.65	-	-
H-1602	0.86	9.00	13.00	3.55
H-1608	0.67	1.33	-	-
H-1610	0.85	-	3.5 -	
M-1-2	0.95	4.55	-	-
A-26-2	0.47	-	-	-
PTR-1-1	0.90	3.45	-	-
A-6-1	0.79	1.75	2.55	-
PU-1	0.73	-	-	-
PU-2	0.88	3.45	6.85	-
PU-4	0.85	1.25	11.55	3.55
PU-6	0.94	4.75	-	2.63
PU-7	0.70	3.75	8.33	1.5
PU-8	0.85	-	6.45	-
Rajamundry	0.91	5.65	-	-
UL-12-2	0.63	-	-	-
Brazil 18	0.59	3.45	-	-
K-3-1	0.75	-	8.45	2.5
K-3-2	0.45	-	-	-
K-4-1	0.95	1.33	-	1.65
K-4-2	0.65	4.55	-	-
K-10-1	0.47	-	-	-
K-10-2	0.68	-	-	-
K-16-1	0.89	11.5	-	2.2
K-18-2	0.83	1.65	-	-
K-19-1	0.75	-	-	-
K-19-2	0.83	-	-	-
K-30-1	0.35	3.65	6.55	-
H-3-4	0.65	-	-	-
H-3-9	0.49	0.55	-	-
H-7-6	0.65	-	-	-
H-8-1	0.68	-	-	-
H-8-6	0.55	3.96	5.3	-
H-8-7	0.63	-	-	-
H-8-8	0.43	-	-	-
H-8-10	0.37	9.33	-	-
H-8-15	0.63	4.2	-	-
H-9-3	0.38	2.25	1.65	-
BLA 256/4	0.69	3.75	7.5	-

Table 3.49: Screening of germplasm against TMB at Vengurle

Name of variety/hybrid	TMB(%)	Name of variety/hybrid	TMB(%)
V-1	17.00	10/19	28.80
V-2	21.33	Hy-636	36.11
V-3	25.33	Hy-640	30.77
V-4	27.50	Hy-641	26.92
V-5	21.66	Hy-662	35.42
V-6	18.66	Hy-675	36.11
V-7	25.78	Hy-677	29.86
V-8	26.43	Hy-681	27.56
H- 303	30.83	Hy-689	34.62
H- 320	25.00	Hy-764	27.88
H- 255	35.00	Hy-784	26.04
H-26	30.47	3/28	35.00
M-44/3	24.40	3/33	38.33
M-11/3	26.66	30/1	46.66

VRIDHACHALAM

The available MLT entries and germplasm types were also screened. During 2001-2002, the TMB score was minimum in H 1608 and VTH 59/2 (2.0 score each) followed by VTH 30/4 and H-2/15. The shoot and blossom webber damage was 17.0 and 17.2 in M-44/3 and H-40. The minimum per cent thrips damage was noticed on H-1598 (4.6%) followed by on H-1600 (8.2%) (Table 3.50).

Table 3.50: Screening of MLT Entries (seedling) against cashew pests during 2002-03

MLT entries	TMB damage score	Shoot & blossom webber (%)	Per cent thrips damage
H-1598	2.5	21.1	4.6
H-1600	2.3	25.3	8.2
H-1608	2.	31.1	13.5
H-1610	3.1	26.1	13.3
H-129	3.0	18.0	12.8
H-40	3.1	17.2	13.5
H-2/15	2.2	26.2	18.3
H-2/16	3.1	23.5	12.2
H-33/3	3.0	21.8	16.2
H-44/3	3.3	17.0	9.3
M-26/2	2.9	20.6	6.3
VTH 30/4	2.2	18.3	11.9
VTH 59/2	2.0	22.1	10.4
V-2	3.5	24.3	13.4
V-3	3.1	29.0	14.2
V-4	3.1	22.1	14.3
V-5	3.0	24.6	17.3

CHAPTER II. ORGANISATION

1. HISTORY, OBJECTIVES, GROWTH AND SALIENT ACHIEVEMENTS

The All India Coordinated Spices and Cashew nut Improvement Project (AICS & CIP) was started during the fourth five Year Plan in 1971. The AIC&CIP had five centres (four University centres and one ICAR-institute based centre) identified for conducting research on cashew. These centres were located at Bapatla (Andhra Pradesh), Vridhachalam (Tamil Nadu), Anakkayam (Kerala) (later shifted to Madakkathara), Vengurle (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, and
2. All India Coordinated Spices Improvement Project.

The headquarters of the independent cashew project was shifted to National Research Centre for Cashew, Puttur in 1986. Presently, there are eight coordinating centres and one sub-centre, four in the east coast viz. Bapatla, Bhubaneswar, Jhargram, Vridhachalam, three in the west coast viz. Madakkathara, Vengurle, Pilicode and one in the Maidan Parts of Karnataka- Chintamani and one in the Central India at Jagdalpur.

The objective of the Project is to increasing production and productivity through:

1. Evolving high yielding varieties with export grade kernels, tolerant/resistant to pests and diseases;
2. Standardising agro techniques for the crop under different agro climatic conditions; and
3. Evolving cost effective and efficient pest and disease management practices.

The first Workshop of All India Coordinated Spices and Cashew nut Improvement Project was held at Kasaragod in October 1971 in which the research programmes were drawn up, identifying the problems and fixing the priorities. Subsequently, the progress of work was reviewed and research programmes modified / added as per the need in the Workshops held in Trivandrum, Kerala (1972); Coimbatore, Tamil Nadu (1975); Panjim, Goa (1978); Trichur, Kerala (1981); Calicut, Kerala (1983); Trivandrum, Kerala (1985); Bhubaneswar, Orissa (1987); Coimbatore, Tamil Nadu (1989); National Group discussion in lieu of X Biennial Workshop at Kasaragod, Kerala (1991); Bangalore, Karnataka (1993), Kasaragod, Kerala (1995) and Dapoli, Maharashtra (1997), Bhubaneswar, Orissa (1999) and Puttur, Karnataka (2001). Three group discussions were also held one in horticulture at CPCRI, Regional Station, Vittal (1986), another in NRCC, Puttur (2001) and other in entomology at Trichur (1988). One group discussion was held at Cashew Research Station, Madakkathara to discuss about High density planting with different levels of fertilizer and pruning in cashew plantation and Soil fertility based fertilizer recommendations during the year 2000.

Highlights of visit of Quinquennial Review Team (QRT):

The Indian Council of Agricultural Research constituted a Quinquennial Review Team (QRT), vide order F.No.13-5/2001-IA. V dated 3-4-2002, to review the work of the National Research Centre for Cashew and the All India Coordinated Research Project on Cashew for the period from 1.1.1997 to 31.12.2001. The QRT had Dr. S.B. Kadrekar, Former Vice Chancellor, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli as its Chairman and Dr. N. Mohanakumaran, Former Director of Research, KAU, Dr. B.R. Hegde, Former Director of Research, UAS, Bangalore, Dr. S. Palaniswamy, Professor & Head, Dept. of Agril. Entomology, TNAU and Dr. K.V.R. Ramana, Head, Fruit & Vegetable Technology, CFTRI, Mysore as its members. Dr. M.G. Bhat, Principal Scientist (Pl.Br.), NRCC, Puttur was the Member-Secretary. The team had its planning meeting with Dr. G. Kalloo, DDG (Hort.), ICAR on 28.5.2002 and visited the NRCC and all the nine centres of the AICRP on Cashew between 16th July 2002 and 13th Nov. 2002. The report was drafted and finalized between 7th and 10th Jan. 2003.

The team critically reviewed the results of research and on-going programmes for the relevant period, interacted with the scientists and administrators at the NRCC and AICRP Centres, held discussions with the representatives of processing industry and had meaningful exchange of information with the farmers involved in field demonstrations / on-farm research. During the visit to the AICRP Centres the team held discussions with the Vice Chancellors, Directors of Research and Zonal Assoc. Directors of the SAUs, concerned.

During the course of its visits and review, the team evaluated the achievements made by the NRCC and AICRP Centres, pinpointed the lacunae in the on-going programmes, and made suggestions to rectify the defects. Keeping in view the recommendations of the last QRT, the on-going programmes, the perspective plans and Vision 2020 documents, the team has prioritized the future lines of work. Wherever absolutely necessary, recommendations have been made to strengthen the infrastructure facilities and for providing Audio Visual / field / laboratory equipment.

The important observations of the team are as follows:

The SAUs should make all efforts to fill up the long pending vacancies with qualified regular staff. In the absence of this, further release of funds to the centres(s) may be restricted to the staff component in position. Jagdalpur and Jhargram centres have not fully implemented the technical programmes. Performance of these centres should be monitored closely during the next two years and a decision taken on their continuation. A manual detailing the procedures of data collection, methods of analysis of soil / plant samples, and proformae for data recording should be brought out by the NRCC and every scientist joining the NRCC and AICRP Centres may be given an orientation at the NRCC. Studies on insecticide residues may be intensified so as to reduce their ill effects on the environment, non-target organisms and the produce. A database on area and production of cashew at district, state and country level as well as on imported raw nuts, export of kernel and CNSL may be created and made available over a website. Pressure on land is felt at many coordinating centers. To overcome the problem, it is suggested that the plants of concluded / discontinued experiments be removed on priority, thereby vacating the land for future trials. Germplasm from areas not covered so far should be collected and conserved. The entire germplasm collection should be subjected to DNA finger printing, characterizing and cataloguing.

VISIT OF QUINQUENNIAL REVIEW TEAM (1997 - 2001) TO DIFFERENT CENTRES OF AICRP ON CASHEW

Cashew Research Station, Bapatla

Cashew Research Station, Bhubaneswar

Agricultural Research Station, Chintamani

Regional Research Station, Jhargram

VISIT OF QUINQUENNIAL REVIEW TEAM (1997 - 2001) TO DIFFERENT CENTRES OF AICRP ON CASHEW

Cashew Research Station, Madakkathara

Regional Agricultural Research Station, Pilicode

Regional Fruit Research Station, Vengurle

Farmers Field at Vridhachalam

Considering the scope for high density plantations in cashew, the ICAR may facilitate the import of desired genotypes from countries like Brazil. For the management of the cashew stem and root borer (CSRB) and the tea mosquito bug (TMB), emphasis may be given for identification of sex pheromones. Research on this aspect may be taken up in collaboration with the national and international institutes involved in pheromone research. Considering the growing demand for organically produced cashew in the international market, studies on organic farming including biodynamic approach need to be intensified. Commercially viable technologies for utilization of cashew apple, cashew kernel rejects, testa etc., need to be developed. Similarly, industry-related issues may be addressed preferably through sponsored research programmes. Before recommending a new technology, the benefit : cost ratio based on large plots should be worked out. Physiological and anatomical features of the dwarf and compact types available at the centres should be studied. Studies on flower bud initiation, floral biology, flowering, fruiting and nut filling in cashew need to be undertaken. Soil and water conservation research should be given priority and measures for erosion control through vegetative means should be explored. Research on sustainable cashew based farming systems involving other enterprises like poultry, goat rearing, apiculture etc. needs to be taken up.

Significant achievements of the project:

1. Regional cashew gene bank holding in the different AIRCP centers amounts to a total of 1162 accessions. Among these 716 accessiions haye been assigned with indigenous collection numbers.

2. Among the germplasm in different centers,35/3 ARSC at Chintamani could yield its best (30 Kg tree^{-1}) on 14th annual harvest.

3. Under multi-location trial 92, at Bapatla, M-44/3 from Vridhachalam(6.52 Kg tree^{-1}); at Bhubaneswar, H68 from Vengurle (8.97 Kg tree^{-1}); H 367 from Vengurle at Chintamani (11.7 Kg tree^{-1}) and Jagdalpur (4.26 Kg tree^{-1}) performed well.

4. Under hybridization a total of more than four thousand hybrids were produced from 239 cross combinations.

5. High density planting of 629 trees ha^{-1} could be produce a yield of 1.25 tonnes for third ahrvest at Bhubaneswar.

6. Intercropping turmeric at Bhubaneswar under cashew could fetch net returns of Rs.7,250/- per year from a hectare, blackgram at Jhargram could fetch Rs.6,137/-, cucumber at Vengurle could fetch Rs. 33,659/- and groundnut at Vridhachalam could fetch Rs.22,389/- per hectare from a year.

7. At Chintamani, control of TMB could be effectively done with spray of carboryl (0.1%) at flowering stage and neem oil (2%) at fruiting stage

8. Control of stem and root borer could be effectively achieved by swabbing neem oil (3%) thrice at Bapatla and Vridhachalam, twice in a year at Bhubaneswar, Jhargram and Vengurle. Removal of grubs followed by application of lindane and swabbing the trunk with neem oil could prevent re infestation of grubs at Bapatla, Madakkathara and Vengurle.

9. During the year 12 new demonstration plots were laid, forty eight programmes and 21 campaigns were conducted.

10. A total of 6,55,400 grafts of promising varieties were produced and supplied to farmers and developmental agencies.

2. TRANSFER OF TECHNOLOGY EFFORTS

During the year, 13 demonstration plots have been laid down in farmers field with high density lay out. 10 training programmes and 11 campaigns were conducted by different AICRP centres and also the scientists have participated in various seminars conducted by different agencies. A total of 5,02,105 grafts were produced and distributed to different government and non-government agencies as well as farmers. The centre-wise production of grafts is given below.

Grafts produced:

Centre	No. of grafts
Bapatla	20,517
Bhubaneswar	40,000
Chintamani	36,000
Jagdalpur	4,000
Madakkathara	2,28,221
Pilicode	5,000
Vengurle	2,06,742
Vridhachalam	1,17,920
Grand Total	6,55,400

BAPATLA

During the year, a total of six training programmes were conducted by scientists on cashew production technology and other agricultural and social aspects of cashew, in which farmers as well as departmental personnel have participated, CRS Bapatla has adopted Poondal Village near Bapatla for technical guidance and demonstration. Mr. Gouse Mohammed has delivered a radio talk on plant aspects of cashew through AIR, Vijayavada. Dr. P. Krishna Prasad has participated on a TV programme telecast from Hyderabad on cashew productions technology.

BHUBANESWAR

Eight training programmes were conducted by OSCDC in which scientists of the center have participated s experts. Three TV programme have been broadcast in which scientists from the center provided information on planting and care of cashew grafts and fertilizer management. Three demonstration plots have been established during the year with clonal material. The center has also conducted eleven plant protection campaigns in the districts oh Khurda, Dhenkanal, Ganjam, Nayagarh and Cuttack.

CHINTAMANI

Existing demonstration plots were maintained. At the center scion bank is also under maintenance.

JHARGRAM

The center has organized four training programmes on cashew grafts production and plant protection at RRS, Jhargram, farmers plots at Banstala, Dubrajpur and Pukwria respectively. The center has also conducted training programme in collaboration with Dept. of Horticulture, West Bengal on cashew production technology. Four demonstration on plots have been established during the period at Dubrajpur, Sreempur, Sevayatan and Banstala.

MADAKKATHARA

The center has organized seven training programmes on cashew grafts production during March to May in which more than 30 farm labourers, 30 farm women have participated. One short course in 'Recent trends in cashew nut production and processing' was conducted for ICAR and SAU scientists. One cashew day was also

organized in December 2002 in which 50 farmers have participated. Two programmes were broadcasted, one on control of TMB by Dr. Susnnammma Kurein and another in cashew apple processing by Dr. V.G. Jayalakshmy.

PILICODE

The center has organized six training during he year on production technology of cashew, cashew grafting and nursery management in which a total of 369 farmers and farm labourers have participated. These were conducted at different villages of Kasaragod district. Twelve demonstration plots already laid were maintained during the year with soil conservation measures.

VENGURLE

Scientists have participated in two TV programmes broadcast on cashew cultivation practice & nutmeg cultivation practice. Five demonstration plots were laid with high density layout under IVLP.

VRIDHACHALAM

In collaboration with the Dept. of Horticulture, Tamil Nadu, seventeen training programmes were conducted on cashew products technology and ten plant protection campaigns.

3. STAFF POSITION

HEADQUARTERS:

Project Coordinator	:	Dr. E.V.V. Bhaskara Rao (up to 15-3-2003)
Technical Information Officer	:	Mr. H. Muralikrishna

PROJECT CENTRES:

Cashew Research Station, (ANGRAU), Bapatla 522 101, Andhra Pradesh.

Horticulturist	:	Dr. P. Krishna Prasad
Asst. Entomologist	:	Mr. Ghouse Mohammed
Astt. Agronomist	:	Mr. B. Prasanna Kumar
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	:	Dr. P.C. Lenka
Jr. Horticulturist	:	Dr. K.C. Mohapatra
Jr. Entomologist	:	Mr. R.N. Mohapatra
Sr. Technical Assistant	:	Mr. P.C. Swain
Jr. Technical Assistant	:	Vacant
Grafter	:	Mr. R.K. Pradhan

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

Horticulturist	:	Mr. M.N.Narasimha Reddy
Jr. Entomologist	:	Mr. G.T. Thirumalaraju
Jr. Horticulturist	:	Mr. Vishnuvardhana
Sr. Technical Assistant	:	Mr. Shivappa
Sr. Technical Assistant	:	Mr. B.O. Shantanu (upto30-4-2003)
		Mr. G.V. Narayanaswamy (from 08-06-2003)
Grafter	:	Vacant

SG College of Agricultural and Research Station, (IGAU), Jagdalpur 494 005, Chhattisgarh.

Jr. Horticulturist	:	Vacant
Jr. Entomologist	:	Vacant
Sr. Technical Assistant	:	Mr. Avinash Gupta (from 12-9-2003)
Grafter	:	Mr. Jagdev

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

Horticulturist	:	Vacant
Jr. Entomologist	:	Dr. S. Chakraborty
Jr. Horticulturist	:	Mrs. Mini Poduval
Sr. Technical Assistant	:	Mr. S. Sarkar
Jr. Technical Assistant	:	Mrs. K. Bose
Grafter	:	Mr. Jagannath Shaw

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

Horticulturist	:	P.S. Jhon (from 2-1-2003)
Jr. Entomologist	:	Dr. (Mrs.) Susanamma Kurien
Jr. Breeder	:	Dr. (Mrs.) V.G. Jayalakshmy
Sr. Technical Assistant	:	Mrs. Meagle Joseph (1-1-20002 to 12-7-2002)
		Mrs. Ancy Joseph (from 15-7-2002)
Jr. Technical Assistant	:	Mr. V.V. Suresh
Grafter	:	Mr. S. Sasi

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

Jr. Horticulturist	:	Dr. B. Jayaprakash Naik
Jr.Technical Assistant	:	Mrs. Sindhu T.V (from 28.8.02 to 30.9.02)
	:	Miss. Reshma K.P. (9-12-2002 to 24-3-2002)

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

Horticulturist	:	Dr. P.M. Haldankar (from 15-9-2000 to 31-12-2002)
Jr. Entomologist	:	Mr. S.S. Athalye
Jr. Breeder	:	Mr. S.B. Deshpande
Sr. Technical Assistant	:	Mr. A.K. Dhuri
Jr. Technical Assistant	:	Mr. R.L. Mayekar

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

Horticulturist	:	Dr. D. Ananda Nayaki
Jr. Horticulturist	:	Dr. G. Prabhakaran (from 9-4-2002)
Jr. Entomologist	:	Dr. V. Ambethgar(from 19-2-2003)
Sr. Technical Assistant	:	Mr. S. Manickam
Jr. Technical Assistant	:	Mr. T. Chinnadurai
Grafter	:	Mr. P. Gopalakrishnan

4. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2002-2003

ALLOCATION (Rs. in Lakhs)

Centre	Pay & Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	12.00	0.30	1.20	-	13.50	10.13
Bhubaneswar	12.75	0.30	1.20	-	14.25	10.69
Chintamani	11.50	0.30	1.20	-	13.00	9.75
Jagdalpur	5.25	0.25	0.80	-	6.30	4.73
Jhargram	9.50	0.30	1.20	-	11.00	8.25
Madakkathara	14.00	0.30	1.20	-	15.50	11.63
Pilicode	4.61	0.20	0.40	-	5.21	3.91
Vengurle	11.90	0.30	1.20	-	13.40	10.05
Vridhachalam	13.00	0.30	1.20	-	14.50	10.88
TOTAL	94.51	2.55	9.60	-	106.66	80.00

ACTUAL EXPENDITURE (Rs. in lakhs)

Centre	Pay & Allowances	TA	Recurring contingency	Non-recurring contingency	Total	ICAR Share
Bapatla	14.79	0.19	1.2	-	16.18	12.14
Bhubaneswar	14.55	0.16	1.2	-	15.19	11.93
Chintamani	11.79	0.12	1.2	-	13.11	9.83
Jagdalpur	5.25	0.25	0.8	-	6.30	4.73
Jhargram	5.34	0.08	1.18	-	6.60	4.95
Madakkathara	11.56	0.06	0.96	-	12.58	9.44
Pilicode	2.99	0.03	0.42	-	3.44	2.58
Vengurle	11.9	0.3	1.2	-	13.40	10.05
Vridhachalam	6.24	0.18	1.2	-	7.62	5.72
TOTAL	84.41	1.37	9.36	-	95.41	71.36

5. MONITORING OF PROJECT BY COORDINATOR

Details of the visit by Project Coordinator to review the programmes being implemented at different centres is as follows:

16.8.2002	:	Vridhachalam
17.8.2002	:	Bapatla
4.9.2002	:	Jagdhalpur
6.9.2002	:	Bhubaneswar
8.9.2002	:	Jhargram
8.10.2002	:	Madakkathara
10.10.2002	:	Vengurle
12.10.2002	:	Chintamani
11.11.2002	:	Pilicode

During the visit to these centers, while accompanying QRT, the technical programmes allotted to each of the centres and the progress made so far were reviewed along with inspection of the field experiments. X Plan priorities for each centre was also discussed. University authorities were met to appraise the progress of work in the centers.

6. FUNCTIONING OF EACH CENTRE

BAPATLA

The center has been established since 1971. At present there are three scientists working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist respectively. Presently there are three projects in Crop Improvement; three in Crop Management and four in Crop Protection are being carried out. Scientists of this center have participated in a few training programmes including a programme on "Trainers training programme on production forecasting of cashew for 2002" organized by the Directorate of Cashewnut and Coca Development, Kochi at RARS, Lam. Mr. B. Prasanna Kumar has also participated in ICAR short course "Recent trends in cashew nut production and processing" at CRS, Madakkathara.

BHUBANESWAR

The center has been established since 1975. At present there are three scientists working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist respectively. Presently there are three projects in Crop Improvement; three in Crop Management and four in Crop Protection are being carried out.

CHINTAMANI

The center has been established since 1980. At present there are three scientists working under the project in the posts of Horticulturist, Jr.Agronomist and Jr. Entomologist respectively. Presently there are three projects in Crop Improvement, four in Crop Management and three in Crop Protection are being carried out.

JAGDALPUR

The center has been established since 1993. During the year 2002-03 two posts of scientists namely, Jr. Horticulturist and Jr. Entomologist under the project were lying vacant. Presently there are two projects in Crop Improvement, two in Crop Management and two in Crop Protection, which are allotted to the center. The experimental plots needed better maintenance.

JHARGRAM

The center has been established since 1982. At present there are two scientists working under the project in the posts of Junior Horticulturist and Junior Entomologist respectively. Presently there are three projects in Crop Improvement; four in Crop Management and four in Crop Protection.

The experiment on fertilizer application in HDP system was not laid out properly-only one replication out of three replications was planted in August 2002. So this experiment needs to be replanted afresh in the year 2003.

MADAKKATHARA

The center has been established since 1972. At present there are three scientists working under the project in the posts of Agronomist, Junior Breeder and Junior Entomologist respectively. Presently there are three projects in Crop Improvement; four in Crop Management and four in Crop Protection are being carried out. The scientists have attended a number of symposia and seminars organized by the University and its other centers. Two Ph.D. Scholars are working under Dr. P.S. Jhon. Dr. P.S. Jhon and Dr. V.G. Jayalekshmy are handling classes for M.Sc.(Ag.) and B.Sc.(Ag.) programmes.

PILICODE

The center has been established since 1993. At present there is one scientist working under the project in the post of Junior Horticulturist. Presently there are two projects, one in Crop Improvement, and one in Crop Management. The germplasm contains one dwarf variety. The scientists have participated in three workshop/ Symposia during the year.

VENGURLE

The center has been established since 1970. At present there are three scientists working under the project in the posts of Horticulturist, Junior Breeder and Junior Entomologist respectively. Presently there are three projects in Crop Improvement; five in Crop Management and four in Crop Protection are being carried out.

VRIDHACHALAM

The center has been established since 1971. At present there are three research associates working in the vacant post of scientists in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist respectively. Presently there are three projects in Crop Improvement; four in Crop Management and four in Crop Protection are being carried out.

7. PROBLEMS IN FUNCTIONING OF THE CENTRES

JAGDALPUR

At Jagdalpur, as both the post of scientists were vacant for the entire period, the performance of the centre was not up to the expectation. Some of the experiments were not maintained well. During the visit of QRT to Jagdalpur centre the University authorities were asked to take immediate steps to fill the vacant posts.

JHARGRAM

A post of scientist (Horticulturist) is lying vacant. Hence it needs to be filled. A experiment on fertilizer application in high density planting system need to be replanted afresh as only one replication out of three replications was planted in August 2002. As young scientists could not independently conduct research, it was felt that their work should be supervised by Senior Professor of BCKV.

VRIDHACHALAM

Regular scientists were not posted against the three scientific posts. Only research associates were posted against these posts. As working of the Regional Research Station was not up to the expectation, it was felt that Professor and Head should guide the research associates/young scientists for conducting research properly.

8. METEOROLOGICAL DATA OF DIFFERENT CENTRES FOR THE YEAR 2002

Bapatla

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	28.6	18.2	93	72	72.8	2
February	30.6	18.0	94	71	-	2
March	32.0	21.9	87	71	-	-
April	33.2	26.2	78	72	-	4
May	39.2	28.2	61	53	25.0	2
June	35.7	26.5	73	63	97.1	8
July	37.2	27.1	66	53	96.7	7
August	32.6	24.6	79	65	155.7	8
September	34.6	25.0	75	68	43.3	7
October	31.1	23.5	90	82	252.7	12
November	30.0	19.9	89	75	32.7	2
December	29.7	17.6	93	70	-	-

Bhubaneswar

Month	Temperature (°C)		Mean RH (%)		Rainfall (mm)	Sunshine (hours)
	Maximum	Minimum	AM	PM		
January	28.26	14.97	94.20	56.40	47.50	7.68
February	41.10	18.97	96.25	49.00	3.80	9.00
March	34.97	21.87	94.97	55.00	0.00	8.35
April	37.37	25.64	91.00	57.00	7.40	9.26
May	40.40	26.22	89.00	52.50	114.5	9.17
June	27.82	26.00	94.25	73.25	218.00	7.00
July	33.92	25.92	92.6	75.40	377.80	4.34
August	31.42	24.95	94.25	80.75	486.80	3.27
September	31.80	24.65	95.75	78.75	44.27	4.47
October	32.04	22.50	94.20	48.40	48.00	7.50
November	30.07	16.75	90.25	48.00	27.20	14.75
December	30.04	14.72	93.50	36.50	0.00	8.57

Chintamani

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	26.4	NR	87.6	71.0	0.00	-
February	29.2	NR	85.1	79.4	0.00	-
March	32.6	NR	88.8	-	0.00	-
April	34.4	NR	85.0	63.9	0.00	-
May	33.3	NR	87.7	74.7	59.1	2
June	26.4	NR	92.5	83.6	81.3	4
July	27.0	NR	93.4	86.5	4.60	-
August	29.4	NR	89.3	86.8	2.80	-
September	30.3	NR	85.9	82.9	246.2	4
October	28.4	NR	87.4	77.4	79.2	8
November	27.1	NR	82.0	82.0	22.9	2
December	28.1	NR	78.9	77.7	4.10	1

Jagdalpur

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	26.9	11.2	94	53	52.9	3
February	30.3	13.6	85	42	0.0	0
March	34.4	18.0	73	29	8.6	1
April	36.7	22.7	70	29	27.8	3
May	38.7	25.2	61	28	82.1	4
June	31.8	22.4	81	45	147.4	10
July	29.9	22.7	81	56	228.7	12
August	25.7	21.4	91	63	389.6	16
September	29.4	20.9	88	48	81.8	7
October	31.4	17.7	91	45	13.4	2
November	28.6	11.1	91	25	0	0
December	28.3	8.9	93	25	0	0

Jhargram

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	22.4	11.4	76.4	44.3	16.4	4
February	24.2	13.2	75.2	49.8	2.30	2
March	30.4	20.6	76.2	52.6	24.2	5
April	35.2	22.2	78.8	53.4	36.9	5
May	36.8	22.9	76.3	46.2	32.4	6
June	37.9	25.1	85.6	51.7	106.4	10
July	35.6	23.2	92.4	76.8	352.3	25
August	35.2	23.6	90.8	76.2	311.4	24
September	36.3	26.2	86.2	70.4	229.4	18
October	29.2	21.6	80.2	56.3	165.3	14
November	28.7	15.2	78.4	46.7	40.2	5
December	24.7	12.2	73.5	42.3	14.1	4

Madakkathara

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	32.8	22.7	79	45	0	0
February	34.3	22.4	21	38	0	0
March	36.2	24.1	85	40	16.2	2
April	35.0	24.8	86	55	50.8	4
May	32.6	24.5	88	67	308.4	12
June	30.0	23.3	93	78	533.5	22
July	29.8	23.1	94	74	354.2	21
August	28.9	22.9	94	78	506.6	19
September	31.1	23.0	92	62	124.0	8
October	30.8	23.2	92	74	387.2	19
November	31.8	23.4	82	60	22.1	3
December	32.3	22.1	72	45	0	0

Pilicode

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	31.3	20.4	90	55	0.0	0
February	32.0	21.7	91	57	2.2	1
March	33.0	23.7	88	58	0.0	0
April	33.8	25.3	82	62	2.2	3
May	32.2	25.2	88	70	413.9	18
June	29.7	24.0	96	82	1117.5	30
July	28.8	23.9	95	77	369.5	31
August	28.7	23.4	95	80	621.8	28
September	29.8	23.0	92	73	171.0	10
October	30.1	23.6	94	75	646.0	15
November	31.6	23.3	93	64	52.0	4
December	31.4	18.6	91	50	22.3	1

Vengurle

Month	Temperature (°C)		RH (%)	Total rain (mm)	No. of rainy days
	Maximum	Minimum			
January	31.48	17.58	65.10	-	-
February	32.50	19.73	68.71	-	-
March	32.51	19.72	78.66	-	-
April	32.35	25.47	71.12	100.00	2
May	33.30	27.80	70.46	45.00	7
June	30.71	25.44	80.71	778.00	25
July	30.44	25.66	81.32	469.00	30
August	29.02	24.39	86.59	683.00	28
September	30.17	23.94	81.11	148.00	12
October	32.30	25.18	83.01	168.00	14
November	33.19	21.72	72.84	-	-
December	32.08	18.33	70.88	-	-

Vridhachalam

Month	Temperature (°C)		RH (%)		Total rain (mm)	No. of rainy days
	Maximum	Minimum	AM	PM		
January	29.75	20.40	87.27	75.87	-	-
February	30.25	20.50	87.45	75.50	166	3
March	32.75	21.00	85.92	72.00	-	-
April	37.80	23.75	83.00	77.50	-	-
May	39.13	23.25	72.80	68.75	64	5
June	36.35	22.76	78.00	68.00	38	2
July	38.37	22.87	78.45	72.25	38	3
August	36.35	22.63	78.00	73.50	-	-
September	37.50	20.25	76.82	69.25	152	5
October	36.00	20.50	75.75	67.00	162	6
November	34.23	18.68	85.36	75.00	110	5
December	31.60	21.60	85.45	76.30	54	2

9. RESEARCH PUBLICATIONS

BAPATLA

M.Lakshminarayana Reddy, Gouse Mohammed and B.Prasanna Kumar (2001). Studies of Flowering Sex ratio in Cashew (*Anacardium occidentale* L.) germplasms selections 2001, *The Cashew* Vol.X.V No.4,18-21pp

Anonymous. 2002. Evaluation of High Yielding Clones under Bapatla conditions of nut yield and other characters.(Accepted by the Cashew Journal,DCCD, Cochin in the year 2002)

M.Lakshminarayana Reddy, Gouse Mohammed and B.Prasanna Kumar. Growth Performance of cashew (*Anacardium occidentale* L.) genotypes during pre-bearing stage under Bapatla conditions to the Cashew Journal, Phenotypic stability analysis of cashew hybrids and varieties for nut yield under rainfed environment" to the Journal of Research ANGRAU, Hyderabad.

M.Lakshminarayana Reddy, Gouse Mohammed and B.Prasanna Kumar. Evaluation of High Yielding Clones under Bapatla conditions for nut yield and other characters. (Accepted by the Cashew Journal, DCCD, Cochin in the year 2002).

BHUBANESWAR

S.Salam, P.C.Lenka, G.R.Rout, S.L.Das and K.C.Mahapatra.(2002). Genetic diffentiation among cashewnut (*Anacardium occidentale* L.) cultivars through morphological analysis. Plantation Crop Symposium. PLACROSYM-XM,10-13, December2002, Mysore, Karnataka.:25.

G.R.Rout, S.Salam, S.Nayak, Rasmi.M.Nanda, P.C.Lenka and P.Das (2002). An alternative method of plant DNA extraction (*Anacardium occidentale* L.) for randomly amplified polymorphic DNA(RAPD) analysis. *Garntenbauissenschafft*. 67 (3):114-118.

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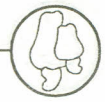
G.T.Thirumalaraju and Puttaswamy, 2003, Population dynamics of tea mosquito bug (*Helopeltis antonii Signoret*) on Guava and Neem. *Environment and Ecology*, 21(1): 222-226.

MADAKKATHARA

Scientific books:

Recent trends in cashew nut production and processing edited P.S.John and V.G.Jayalakshmi, Cashew Research Station, Madakkathara, Kerala Agricultural University, Thrissur.



Scientific articles:

Jayalakshmi V.G.2002. Genetics and breeding of cashew. *Recent trends in cashew nut production and processing* pp.14-22.

Jayalakshmi V.G. and Meagle Joseph 2002. Economic analysis of cashew graft production. *Recent trends in cashew nut production and processing.* Pp.42-49.

Jayalakshmi V.G.2002. Germplasm cvataloguing and varietal wealth of cashew. *Recent trends in cashew nut production and processing.* Pp.53-59.

Jayalakshmi V.G. 2002.Economic analysis of cashew apple processing. *Recent trends in cashew nut production and processing.* Pp.122-225

Jayalakshmi V.G. and Sree Ranga Samy S.R. Cluster analysis in coconut (*Cocos nucifera* L.) *Journal of Plantation Crops,* 2002,30 (2): 18-22.

Jayalakshmi V.G. and Abdul Salam. M.A. Cost of establishing of the cashew apple processingunit and production cost of cashew apple syrup. *The Cashew* Vo. XVI, No.2. April-June 2002.

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Deshpande, S.B., Shinde,A.K., Patil, B.P. and Haldankar, P.M. (2001). Cashew flowering,fruitset and fruit drop. Trombay farm magazine.

Deshpande, S.B., Haldankar, P.M. and Patil B.P. (2002). Trees spices propagation in Konkan Region. Horticulture news, March 2002 pp 6-7.

Haldankar, P.M., Deshpande, S.B. and Patil, B.P. (2001 importance of tender coconut in comparison with artificially flavoured soft drinks. *Daily Lokmat,* 31.8.2001

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Haldankar, P.M., Deshpande, S.B. and Patil, B.P. 2001. It is essential to develop marketing network for tender coconuts in konkan region.

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Haldankar, P.M., Deshpande, S.B. and Patil, B.P. 2002. Cultivation of tree spices in konkan region. *Horticultural news,* March 2002, pp. 83-84.

Kokate K.D., Haldankar P.M., Deshpande S.B. and Patil, B.P. 2002. Cashew kernel exports. *Shetkari,* January/February, pp 95-96.

A.K.Shinde, B.P.Patil, S.K. Godse, M.B.Dalvi, K.H.Pujari, V.G.Chavan, B.N.Sawant and P.M. Haldankar (2002). Weather relations of hermaphrodite flowers in Alphonso mango. A paper presented in National Conference on Coastal Agricultural Research, Old Goa-403402 on 6-7th April, 2002,pp.78.

Haldankar, P.M., Deshpande, S.B, Chavan, V.G,Nadkami H.R.Patil, B.P.joshi,G.D and Bhaskara Rao, E.V.V.(2002). Crop weather association in mixed population of cashewnut hybrids. *Journal of Plantation of Crops.* 30(3):37-40

Haldankar, P.M., Deshpande, S.B, Chavan, V.G, Dalvi, M.B.; Patil, B.P. and Bhaskara Rao, E.V.V. (2002). Weather associated yield variability in cashewnut variety, Vengurle-1. Accepted for *Journal of Agrometeorology.*

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10. ADRESSES OF AICRP ON CASHEW CENTRES

HEADQUARTERS

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UNIVERSITY CENTRES - EAST COAST

1. Cashew Research Station
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2. SG College of Agriculture and Research Centre
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Sl. No.	Publication	Price Rs.
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