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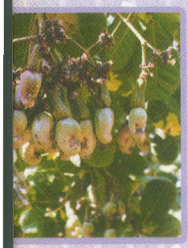
अखिल भारतीय समन्वित काजू अनुसंधान परियोजना

ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW



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ICAR

वार्षिक प्रतिवेदन
ANNUAL REPORT
2003 - '04

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

NATIONAL RESEARCH CENTRE FOR CASHEW
(Indian Council of Agricultural Research)
PUTTUR - 574 202, DAKSHINA KANNADA
KARNATAKA

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ANNUAL REPORT
2003-04

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

राष्ट्रीय काजू अनुसंधान केंद्र
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प्राक्कथन

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना की बीसवी वार्षिक प्रतिवेदन प्रस्तुत है। इस प्रतिवेदन में जनवरी 2003 से मार्च 2004 तक की अनुसंधान उपलब्धियाँ तथा वित्तीय वर्ष 2003-04 की अन्य जानकारी सम्मिलित की गई है।

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

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

इस प्रतिवेदन मे दो अध्याय है, जैसे,

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

एम. गोपालकृष्ण भट

(एम. गोपालकृष्ण भट)

कार्यकारी निदेशक एवं परियोजना समन्वयकर्ता

पुत्तुर - 574 202

दिनांक : 31-12-2004

ABOUT THIS REPORT

This is the twentieth Annual Report of the All India Coordinated Research Project on Cashew. This report covers the research results for the period from January 2003 to March 2004, with all other information pertaining to the financial year 2003-04.

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

There are twelve research projects pertaining to different 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 : 31.12.2004

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CHAPTER II : ORGANISATION

CHAPTER I : TECHNICAL

समन्वयकर्ता की रिपोर्ट

अखिल भारतीय समन्वित मसाला व काजू अनुसंधान पारयोजना 1971 में चौथी पंच वार्षिक योजना में शुरू की गई, जिसका मुख्यालय केंद्रीय रोपण फसल अनुसंधान 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 निर्मित राष्ट्रीय काजू अनुसंधान केंद्र पुत्तूर में 1986 को स्थानांतरित किया गया।

अखिल भारतीय समन्वित काजू अनुसंधान परियोजना के आठ केंद्र और एक उपकेंद्र है, 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। पाँचवी 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 2003-04 में बजट आबंटन रु. 102.66 लाख (रु. 77.00 लाख भा.कृ.अ.प. का अंश) था और व्यय रु. 86.38 लाख (रु. 64.78 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 गरी, रोग एवं कीट क्षमता/रोध के उच्च उपज प्रदत्त किस्मो का विकास।
2. विभिन्न सस्य जलवायु परिस्थितियों में काजू फसल के लिए कृषि प्रौद्योगिकी का मानकीकरण।
3. लागत प्रभावी, दक्ष कीट एवं रोग प्रबंधन विधियों का विकास।

प्रतिवेदन की अवधि में उपरोक्त लक्ष्य पूरा करने के लिए विविध परियोजनावो में प्राप्त मुख्य परिणामों, विविध परिच्छेदो में प्रस्तुत है।

फसल सुधार :

क्षेत्रीय काजू जीन बैंकों में रोपण के लिए, इस वर्ष बडे गुठलीवाली, विस्तृत शाखा प्रतिरूपवाली, गुच्छ फलनवाली तथा सेब व गुठली की साधारण संलगनवाली पेडों को पहचान गया है। आगे का प्रजनन कार्यक्रमों में उपयोग करने हेतु एक कुब्ज प्रकार,मंजेश्वर से पिलिकोड केंद्र ने पहचाना है जिसमे अगता फलन, छोटा गुटलीवाली, निर्गुच्छ फलन गुण हैं। बापटला में T.No. 4/3 अत्यधिक गुटली उपज प्रति पेड (2.58 किग्रां) तथा चिंतामणि में ARSC-35/3 (ME-4/4) अत्यधिक गुटली उपज प्रति पेड (32.0 किग्रां) दिए। झारगाम केंद्र में JGM-17/1, वार्षिक उपज 12.1 किग्रां तथा अत्यधिक संचयी उपज 142.40 किग्रां देकर उत्कृष्ट पाया गया। पिलिकोड केंद्र में 6.77 किग्रां का अधिक उपज देकर PCKC-9 उत्कृष्ट पाया गया। वृद्धाचलम में M-44/3 ने 1.77 किग्रां की अधिक गुटली उपज दिया।

विविध जगह से प्राप्त किस्मो का मूल्यांकन के बहुस्थानीय प्रयोगो में T.No. 30/1 बापटला में अत्यधिक गुटली उपज 3.41 किग्रां प्रति पेड दिया। भुवनेश्वर में H-68 किसम ने 11.8 किग्रां उपज दिया। जिसके बाद H-320 ने 9.80 किग्रां वार्षिक उपज तथा 41.3 किग्रां की संचयी उपज दिया। चिंतामणि में H-320 ने 17.67 किग्रां कि अत्यधिक वार्षिक उपज दिया जिसके तुरंत बाद NRCC set-2 की उपज था (16.00 किग्रां प्रति पेड). H-303 (1.23 किग्रां प्रति पेडा) तथा H367 (5.88 किग्रा प्रति पेड) की अत्यधिक उपज अनुक्रम जगदलपुर तथा मडक्कतरा में दिए। वेंगुर्ला में 4367 अत्यधिक पुष्पगुच्छ संख्या (11.00 प्रति मीटर वर्ग) दिखाकर, 5.97 किग्रां प्रति पेड का अत्यधिक उपज दिया, पर वृद्धाचलम मे M-15/4 (VRI-4) ने 2.29 ने किग्रां प्रति पेड का अधिक गुटली उपज दिया।

किस्मो की मूल्यांकन प्रयोगो में BPP-4, BPP-5 तथा V-5 सशक्त वृद्धि गुण दिखाई, तथा V-2, BPP-2 में प्रति पुष्पगुच्छ

में द्विलिंग पुष्प संख्या अत्यधिक रहे और बापटला में BPP-4 तथा BPP-5 में; जगदलपुर में BPP-2 से अधिक उपज मिली। कुब्ज प्रबेध KGN-1 ने भुवनेश्वर, झारगाम, पिलिकोड तथा वृद्धाचलम में जाँच पडताल किस्मो के अनुरूप वृद्धिलक्षण दिखाई। संकरण तथा चयन कार्यक्रमों में बापटला में 73, भुवनेश्वर में 1049, चिंतामणि में 600 और वृद्धाचलम हें 235 F_1 संकर बीजगुटली प्राप्त हैं। मडक्कतरा में 1993 से 2003 तक बोया गया संकर बीज का मूल्यांकन प्रगति में हैं। भुबनेश्वर में F_{2-1} में 11.00 ग्राम की अत्यधिक गुटली ल्जन दाखिल हुआ, पर A_6 छटवी कटाई में 10.6 किग्रां की संचई उपज दिया। मडक्कतरा में H-97 (1995 रोपित) ने 5.58 किग्रां तथा H-72 (1994 रोपित) ने 10.05 किग्रां की अत्यधिक उपज दिया। H-10 में 6.01 किग्रां प्रति पेड का अधिक वार्षिक उपज दिया।

फसल प्रबंध :

बापटला, चिंतामणी तथा मडक्कतरा में सिर्फ N प्रमाण ही उपज में सार्थकरूप से व्यत्यास दिखाई लेखिन P तथा K उपज पर इन केंद्रों में प्रभाव नहीं किया। बापटला में जारी क्षेत्रीय प्रयोगों में अत्यधिक औसत उपज (7.25 किग्रां प्रति पेड) 1500:375:375 ग्राम NPK प्रमाण में मिला। चिंतामणि में 1000 ग्राम N लगाने से अत्यधिक गुटली उपज (3.87 कि.ग्रां प्रति पेड) मिला है। 0 ग्रां N_2, 125 ग्रां P_2O_5 और 250 ग्रां K_2O लगाने से कांडका घेरा गरिष्ट (103.67 से.मी) पाया गया। माडक्कतरा में उपज N परिमाण पर निर्भर लगा, जैसे No में 4.16 कि ग्रां,5.41 कि.ग्रां N_1 में तथा 6.10 कि ग्रां N_2 में मिला। वृद्धाचलम केंद्र में 1000 ग्रां N_1, 250 ग्रां P तथा 250 ग्रां K डालने से गुटली उपज अत्यधिक (4.37 किग्रां) पाया गया।

अंतराल तथा अंतराल-उर्वर मात्रा की परस्पर प्रभाव से पौधा घेरा पर भुबनेश्वर और वेंगुर्ला में असर नहीं पडा। वृद्धाचलम में 75 N:25 P:25 K किग्रां प्रति हेक्टर तथा 200 पौधा प्रति हेक्टर में पेडो की ऊँचाई अत्यधिक (2.85 मी) था, लेकिन प्रति पेड की उपच (1.75 किग्रां/हेक्टर) 600 पेड/हेक्टर तथा 75 N:25 P: 25 K किग्रां प्रति हेक्टर में अत्यधिक रहा।

भुवनेश्वर में 4x4 मी अंतराल से पेड दुबला-पतला हुआ और ज्यादा मृतक लकडी पडा। यह अवलोकनार्थ प्रयोगो अन्य केंन्द्रो में जारी हैं। भुवनेश्वर में हलदी की अंतरफसल में रु 8,000 की लाभ मिला। झारग्राम में लोबिया से रु 6,250 की लाभ मिला। वृद्धाचलम में मूँगफली अंतरफसल के रूप में रु 24,580 की लाभ दिया।

फसल संरक्षण :

चिंतामणि में दूसरे फुहार में पुष्पगुच्छ थ्रिप्स कनिष्ट (1.30सं/ पुष्पगुच्छ) रहा। जगदलपुर में दुसरे फुहार से TMB संख्या कनिष्ट (0.08%) रहा। पत्ता सुरंगकीट, पत्ता तथा पुष्पगुच्छ जालकीट, और अंकुर सूँडी झारग्राम में तीन फुहार में कनिष्ट रहा और नियंत्रित उपचार से सार्थक रूप से विभिन्न रहा। अंकुर पुष्पगुच्छ प्रतिशत हानि प्रमाण मोनोक्रोटोफॉस (0.05%) के तीन फुहारो में कनिष्ट (14.04%) रहा। शिफारित फुहार ही वृद्धाचलम में अत्युत्कृष्ट पाया गया।

बापटला में परीक्षित कीटनाशियो शिफारित फुहार सूची की समान पाया गया। भुवनेश्वर में शिफारित फुहार सूची अन्य सभी कीटनाशी उपचारों से ज्यादा प्रभावी पाया गया। चिंतामणि में क्लोरोपैरीफॉस (0.05%), ट्रैअसोफॉस (0.1%) और प्रोफीनोफॉस (0.05%) परस्पर समान रहा लेकिन नियंत्रित उपचार से उत्तम पाया गया। जगदलपुर में पुष्पण समय में एण्डोसल्फान (0.05%) फुहारने से अत्यधिक औसत उपच मिला, तथा झारग्राम में शिफारित फुहार से सेब व गुटली छेदक, थ्रिप्स, अंकुर सूँडी और पत्ता और पुष्पगुच्छ जालकीट की कनिष्ट हानि से 4.68 किग्रां प्रति पेड का अत्याधिक उपज मिला। L-सौहालोथ्रीन चाय मच्छर, सेब व गुटली छेदक तथा पत्ता सुरंगकीट का अच्छा नियंत्रण मडक्कतरा में किया, लेकिन वेगुर्ला और वृद्धाचलम में क्लोरपैरीफॉस (0.05%) और प्रोफीनेफॉस (0.05%) अन्य उपचारों से सार्थक रूप से उत्कृष्ट रहा।

बापटला, भुवनेश्वर, झारग्राम, वेंगुर्ला तथा वृद्धाचलम में तीन बार नीम तेल (5%) झाडन से काजू कांड और जड छेदक का हानि रोक दिया। मिट्टी घोल में कार्बारिल मिश्रण + लिंडेन (0.2%) लगाने से मडक्कतरा में काजू कांड और जड छेदक की हानि 75.3 औसत दिनों तक रोका जा सका। लिंडेन (0.2%) से बापटला में अत्यंत ज्यादा पेडों का प्रतिशत 75.0% बिना हानि पाया गया। क्लोरपैरीफॉस (0.2%) से बिना हानि पाया गया। क्लोरपैरीफॉस (0.2%) से बिना हानि प्रतिशत पेड (83.3) और कार्बारिल से बिना हानि प्रतिशत पेड (100.0) रहकर, अनुक्रम भुवनेश्वर और झारग्राम में उत्तम पहचाना गया। वृद्धाचलम में 20

मि.ली. पानी + 20 मि.ली. मोनोक्रोटोफॉस को जड़ से देना, काजू कांड और जड छेदक हानि नियंत्रण में उत्कृष्ट रहा ।

बापटला में पत्ता, पुष्प तथा गुटली कीटो का हानि प्रमाण नगण्य रहा । फरवरी से मई तक थ्रिप्स (पत्ता और पुष्पगुच्छ) का क्रिया पराकाष्ट था । पत्ता सुरंग कीट तथा पत्ता मोडनेवाली कीटो सितंबर से नवंबर तक प्रचुरण से ताल मेल रखा था ।

अंकुर सूँडी, *हैपोटीमा हालिग्रामा* जुलाई से फरवरी तक सक्रिय था । स्थानीय प्रमुखतावाली कीटो का क्षेत्रीय परजीविता प्रमाण भी दाखिल किया गया । चिंतामणी में चाय मच्छर पर मकडी, रेडूविड और बद्धहस्त कीट परभक्षी रहा । पत्ता सूँडी जगदलपुर में प्रमुख कीट के रूप में दाखिल हुआँ और काजू कांड और जड छेदक, पत्ता और पुष्पगुच्छ जालकीट, अंकुर सूँडी झारग्राम में प्रमुख थे । मडक्कतरा में सेब और गुटली छेदक और पत्ता सुरंग कीट प्रमुख लघु कीट थे लेखिन वह मौसमी रूप में पाया गया । पुष्प थ्रिप्स तथा सेब और गुटली छेदक क्रमशः वेंगुर्ला और वृद्धाचलम में प्रमुख कीट थे । विविध जननद्रव्य, बापटला तथा भुवनेश्वर में स्थानिक प्रमुख कीट, अंकुर सूँडी का हानि प्रमाण में भिन्नता दिखाई । जगदलपुर में V-2 पत्ता और पुष्पगुच्छ जालकीट का कनिष्ट हानि (6.2%) दिखाई और VTH-30 कनिष्ट थ्रिप्स संख्या (54 प्रति पुष्पगुच्छ) दिखाई. चाय मच्छर तथा अन्य लघु कीटहानि से कोई एक्सेशन या एण्ट्री निरोधकता नहीं दिखाई ।

तकनिकी हस्तांतरण :

इस साल में खुल 5,51,021 कलमन तैयार करके विविध सरकारी तथा गैरसरकारी संस्थाओं तथा काजू कृषकों को बाँटा गया । विविध केंद्रो की वैज्ञानिकों काजू उत्पादन के विविध विचारों पर 23 प्रशिक्षण, और 19 आंधोलन आयोजित किए । खुल 77 प्रात्यक्षिक प्लाटो विविध AICRP काजू केंद्रों से चालित है, जिसमें मिट्टी व जल संरक्षण कार्य तथा शिफारित तकनिकी शामील है ।

CO-ORDINATOR'S REPORT

The All India Co-ordinated 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 (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 newly established National Research Centre for Cashew, Puttur in 1986.

The AICRP on Cashew has presently eight centers and one sub-centre; of which four were started at the inception of AICS & CIP during 1971 [Bapatla (ANAGRAU the then APAU); Madakkathara (KAU shifted from Anakkayam); Vengurle (Dr.BSKKV (the then KKV) and Vridhachalam (TNAU)]. During the V Plan, one centre at Bhubaneswar (OUAT) and in the VI the Plan two Centres, one at Jhargram (BCKKV) and another at Chintamani (UAS) were added. During the VIII plan, one centre at Jagdalpur 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 the different State Agricultural Universities. The budget allocation of the project for the year 2003-04 was Rs. 102.66 lakhs (Rs. 77.00 lakhs ICAR share) and the expenditure was Rs. 86.38 lakhs (Rs.64.78 lakhs ICAR share).

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

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

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

CROP IMPROVEMENT

During the year under report trees with bold nut types, extensive branching pattern, cluster bearing types and intermediate attachment of nuts to apples have been identified for collection for taking up planting in the Regional Cashew Field Gene Bank (RCFGB). A dwarf type having early bearing, non-cluster habit with small nuts has been identified at Manjeshwara by Pilicode centre for future breeding programme. At Bapatla, T.No.4/3 recorded the maximum nut yield per tree (2.58 kg) while at Chintamani ARSC-35/3 (ME 4/4) recorded highest nut yield (32.0 kg). The accession No. JGM-17/1 with the annual yield of 12.1 kg and highest cumulative yield of 142.40 kg performed the best at Jhargram center. The accession PCKC-9 with the highest yield of 6.77 kg was the best at Pilicode centre. At Vridhachalam, M 44/3 registered the highest nut yield of 1.77 kg.

The maximum nut yield per tree was recorded in T.No.30/1 (3.41 kg) at Bapatla in multi location trials for evaluating varieties obtained from various locations. At Bhubaneshwar, H 68 yielded 11.8 kg followed by H-320 with 9.8 kg of annual nut yield, which had the highest cumulative nut yield of 41.3 kg. In Chintamani, Hy 320 recorded highest nut yield of 17.67 kg closely followed by NRCC Sel-2 (16.00 kg/tree). H-303 (1.23 kg/tree) and H-367 (5.88 kg/tree) had the highest yield at Jagdalpur and Madakkathara respectively. At Vengurla, H-367 had highest panicle count (11.00/m^2) with highest yield of 5.97 kg/tree, while at Vridhachalam M 15/4 (VRI-4) had the maximum nut yield of 2.29 kg/tree.

Under varietal evaluation trial BPP-4, BPP-5 and V-5 had vigorous growth habit, while V-2, BPP-2 had the maximum bisexual flowers per panicle, and high yields were obtained from BPP-4 and BPP-5 at Bapatla and from BPP-2 at Jagdalpur. The precocious dwarf KGN-1 had similar growth characters as that of the check at Bhubaneshwar, Jhargram, Pilicode and Vridhachalam.

Under the hybridization and selection programme, 73 F_1 hybrid nuts have been obtained at Bapatla, 1049 nuts at Bhubaneshwar, 600 hybrid nuts at Chintamani, and 235 hybrid nuts at Vridhachalam. At Madakkathara evaluation of hybrid nuts sown during 1993 to 2003 is in progress. At Bhubaneshwar, highest nut weight of 11.0 g was observed in case of $F_{2\text{-}1}$, while A6 gave highest cumulative yield of 10.6 kg in 6th harvest. At Madakkathara H-97 (planted in 1995) gave highest yield of 5.58 kg and H-72 (planted in 1994) gave highest yield of 10.05 kg. The highest annual yield of 6.01 kg/tree was observed in H-10.

CROP MANAGEMENT

Significant differences in yield was observed only for N levels at Bapatla, Chintamani and Madakkathara while P & K levels did not induce significant differences in these centers. Under on-farm trials at Bapatla highest mean nut yields (7.25 kg/tree) were obtained at 1500:375:375g NPK. At Chintamani, 1000g N could lead to highest nut yield of 3.87 kg/tree. At Jhargram, trunk girth was maximum (103.67 cm) in 0g N_2 125g P_2O_5 and 250g K_2O. At Madakkathara, yield was shown to be dependant on N levels, 4.16 kg at No, 5.41 kg at N_1 and 6.1 kg at N_2 levels. Nut yield/tree was maximum (4.375 kg) when 1000g N, 250g P 250g K were applied at Vridhachalam center.

Plant girth was not influenced by spacing and interaction between spacing and fertilizer dosage at Bhubaneshwar and Vengurla. At Vridhachalam plant height was maximum (2.85 m) with 75 N: 25P : 25 K/ kg/ha and 200 plants/ha., but yield per tree was maximum 1.75 kg/tree in 600 plants/ha and 75 N:25P:25K/kg/ha.

At Bhubaneshwar, 4 x 4m spacing led to lanky tree growth with more dead wood. The observational trial is being continued at other centers. At Bhubaneshwar, turmeric as intercrop could lead to Rs.8,000/- as a profit. At Jhargram, cowpea could lead to a profit of Rs.6,250/-. Groundnut when cultivated as intercrop in Vridhachalam led to a profit of Rs.24,580/-.

CROP PROTECTION

At Chintamani, inflorescence thrips were minimum in second spray (1.38 No./panicle). Second spray reduced TMB population to a minimum (0.08%) at Jagdalpur Incidence of leaf miner, leaf and blossom webber and shoot tip caterpillar were minimum and significantly different from control in three rounds of sprays at Jhargram. The percent shoot/panicle damage was minimum (14.04%) in monocrotophos 0.05% spray after the third spray. The recommended spray schedule was found to be most effective at Vridhachalam.

At Bapatla, all the new insecticides tested were on par with recommended spray schedule. The recommended spray schedule was found to be superior compared to all other treatments at Bhubaneshwar. All treatments chlorpyriphos 0.05%, triazophos 0.1% and profenophos 0.05% were on par with each other and significantly superior over control at Chintamani. At Jagdalpur mean highest yield was obtained in endosulfan 0.05% at flowering, while at Jhargram recommended spray schedule led to lowest damage score by apple and nut borer, thrips, shoot tip caterpillar and leaf and blossom webber and led to highest yield of 4.68 kg/tree. L.-cyhatothrin performed better in managing tea mosquito bug (TMB), apple and nut borer as well as leaf miner at Madakkathara, chlorpyriphos (0.05%) spray and profenophos (0.05%) spray were significantly superior over other treatments, at Vengurla and Vridhachalam respectively.

Swabbing neem oil 5% thrice could prevent infestation by stem and root borer at Bapatla, Bhubaneshwar, Jhargram, Vengurla and

Vridhachalam. Mud slurry + carbaryl swabbing + lindane (0.2% at Madakkathara prevented CSRB incidence for an average of 75.3 days. lindane (0.2%) led to highest percentage of trees without reinfestation (75.00) at Bapatla, Chlorpyriphos (0.2%) with 83.3 percent of trees without reinfestation and carbaryl (1.0%) with all treated trees without reinfestation were the best at Bhubaneshwar and Jhargram respectively. Root feeding of monocrotophos 20 ml+20ml water was most effective at Vridhachalam, in checking CSRB incidence.

At Bapatla, incidence of foliage, flower and nut feeders was negligible. However peak activity of thrips (foliage and inflorescence) occurred from February-May. Leaf miners and leaf folders coincided with flushing i.e. September-November.

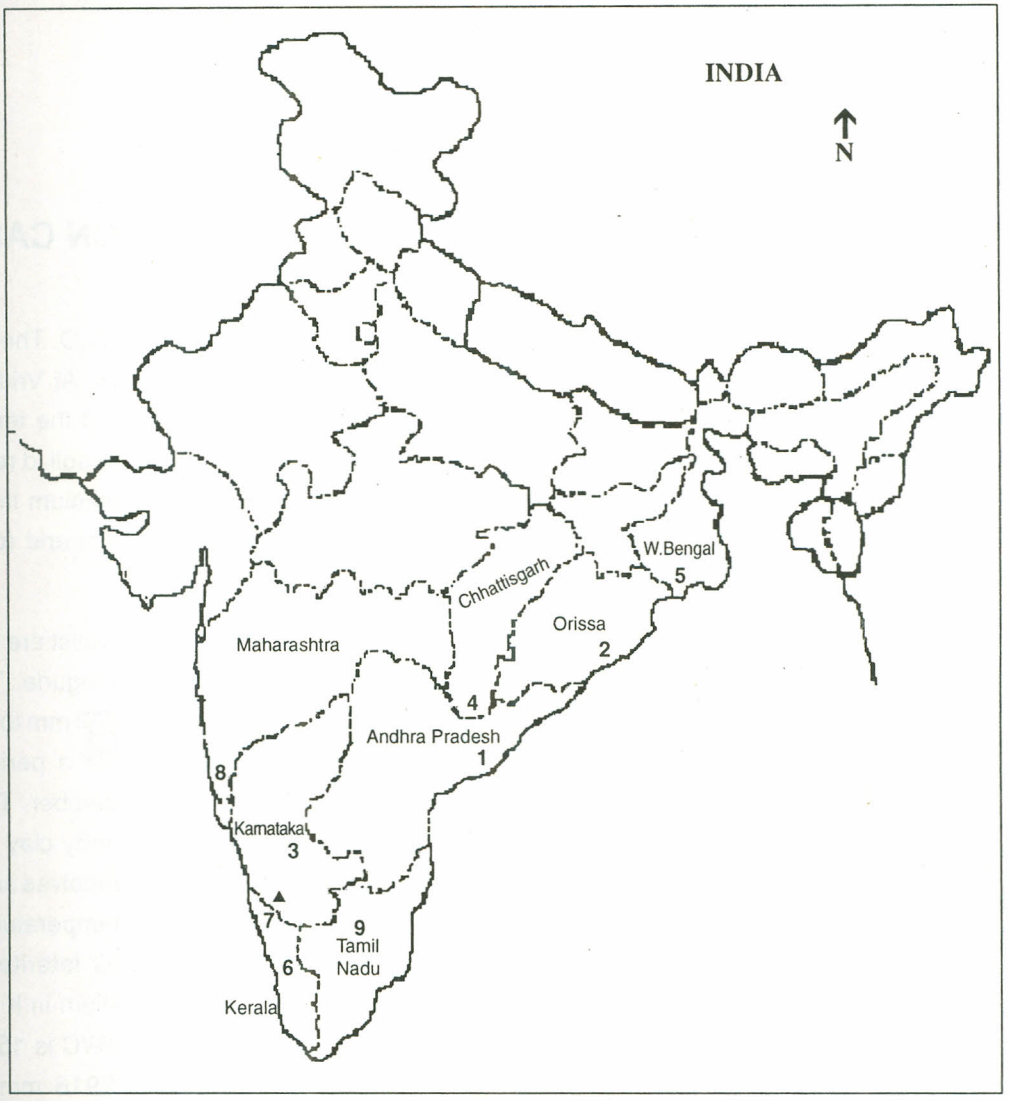
Shoot tip borer, *Hypatima haligramma* was active from July-February. At Bhubaneshwar. Field parasitisation of pests of regional importance was also recorded. Spiders, reduviids, and praying mantis were recorded to predate on TMB at Chintamani. Leaf caterpillar was recorded as an important pest from Jagdalpur, while cashew stem and root borers, leaf and blossom webbers, shoot tip caterpillars were serious at Jhargram. At Madakkathara, apple and nut borer and leaf miner were the important minor pests but were seasonal in occurrence. Flower thrips and apple and nut borer were important at Vengurla and Vridhachalam respectively.

Different germplasm showed varying incidence of shoot tip caterpillar at Bapatla and Bhubaneshwar, which is an important minor pest of the region. At Jagdalpur V-2 had minimal damage by leaf and blossom webber (6.2%) and VTH-30 had least thrips population of 54 No./panicles. None of the accession/entries screened had any resistance to TMB or other minor pests.

TRANSFER OF TECHNOLOGY

During the year under report a total of 5,51,021 grafts were produced and distributed to several government and non-government organizations as well as to cashew cultivators. Scientists of different centres were involved in conducting 23 trainings on different aspects of cashew cultivation, and organized 19 campaigns. A total of 77 demonstration plots involving soil and water conservation practices and recommended technologies have been laid out by different AICRP-Cashew centres.

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. SG College of Agricultural and Research Station, (IGAU), Jagdalpur - 494 005, Chattisgarh
5. Regional Research Station, (BCKV), Jhargram - 721 507, Midnapore West District, West Bengal
6. Cashew Research Station, (KAU),Madakkathara - 680 656, Kerala
7. Regional Agricultural Research Station, (KAU), Pilicode - 671 353, Kasaragod District, Kerala.
8. Regional Fruit Research Station, (KKV), Vengurle - 416 516, Maharashtra.
9. Regional Research Station, (TNAU), Vridhachalam - 606 001, Cuddalore District, Tamil Nadu.

GENERAL CHARACTERISTICS OF CENTRES OF AICRP ON CASHEW

The eight coordinating centers and one sub centre are spread in the East Coast, West Coast and Plains Region (plateau region) of the country. The centers of the East Coast are located at Bapatla, Bhubaneshwar, Jhargram and Vridhachalam. This zone receives low to medium rainfall ranging from 800 mm to 2000 mm annually and is distributed over a period of 7-8 months from June to January. The soil is mainly sandy, red sandy loam, red loam and laterite. Bapatla centre is situated at an elevation of 54.9 m from mean sea level (MSL) with 40° 54' latitude and 80° 28' longitude. At Bapatla, the annual average rainfall is 1167 mm and the temperature ranges from 17.3 to 37.8° C; the soil is sandy soil with low organic matter, medium N, low P_2O_5 and K_2O. Average water holding capacity (AWC) of soil is 100 mm and the climate is sub humid (dry). At Bhubaneshwar average rainfall is 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 centre is located 87° longitude and 78.8° latitude. At Jhargram average rainfall is 1622 mm and the temperature ranges from 11.3 to 39.4° C. The soil is red, laterite, shallow depth gravels, low in organic matter, N and high in P_2O_5 and K_2O. The climate is sub humid (dry), AWC 200 mm. At Vridhachalam average rainfall is 1215 mm and the temperature ranges from 18.7 to 35.7° C, the soil id 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 centers in the West Coast are located at Madakkathara, Pilicode and Vengurla. This zone receives rainfall ranging from 2800 mm to 3800 mm annually and is distributed over a period of 7-9 months from April/June to December. The soil is typically sandy, sandy loam, sandy clay loam and laterite (oxisol). Madakkathara receives an average rainfall of 3550 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 Vengurla 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 and, AWC is 150 mm.

EXPERIMENTAL RESULTS

I. CROP IMPROVEMENT

1. CROP IMPROVEMENT

Germplasm collection, maintenance and description of cashew types

Centres : East Coast

Bapatla, Bhubhaneshwar, Jhargram and Vridhachalam

West Coast

Madakkathara, Pilicode and Vengurla

Plains / others

Chintamani and Jagdalpur

The objectives of the project are :

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

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

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

Summary:

Cashew trees with bold nut types, extensive branching pattern cluster bearing types and intermediate attachment of nuts to apples have been identified for collection for taking up planting in the Regional Cashew Field Gene Bank (RCFGB). A dwarf type having early bearing, non-cluster habit with small nuts has been identified at Manjeshwara by Pilicode centre for future breeding programme. At Bapatla, T.No.4/3 recorded the maximum nut yield per tree (2.583 kg) while at Chintamani ARSC-35/3 (ME 4/4) recorded highest nut yield (6.24 kg) at Jagdalpur Centre. The accession No. JGM-17/1 with the annual yield of 12.1 kg and highest cumulative yield of 142.40 kg performed the best at Jhargram center. The accession PCKC-9 with the highest yield of 6.77 kg was the best at Pilicode centre. At Vridhachalam, M 44/3 registered the highest nut yield of 1.773 kg.

Germplasm collection:

The Regional Cashew Field Gene Banks' (RCFGB) holding was 1193 cashew accessions which were conserved and have been maintained in different centers . During the year, 57 accessions were collected and were field planted to bring the total to 1250 (Table 1.1).

At Bhubhaneswar centre, in addition to the previously reassembled 56 accessions collected up to 2002, another 25 accessions (having bold nut type and cluster bearing habit) have been incorporated during 2003 in the new germplasm conservation block, the total number of accessions conserved till date is 81. At Jagdalpur centre, during this year a total of 7 germplasms which had extensive branching pattern, upright and open tree habit, medium nut size and intermediate attachment of nut to apple, with a shelling percentage of more than 32.0 per cent were collected. Grafts of these collections have been made and are being conserved in Regional Cashew Field Gene Bank (RCFGB), detailed observations on plant growth parameters are being recorded.

Table 1.1. Cashew germplasm holding in different centers.

Centre	No. of accessions		
	Existing	Collected during 2003	Total existing 2003-04
East Coast			
Bapatla	131	-	131
Bhubaneswar	56	25	81
Jhargram	120	3	123
Vridhachalam	264	-	264
West Coast			
Madakkathara	147	6	153
Pilicode	64	1	65
Vengurla	250	15	265
Maidan tract/ others			
Chintamani	124	-	124
Jagdalpur	37	7	44
TOTAL	**1193**	**57**	**1250**

At Jhargram centre, three germplasms were collected from West Midnapore district having medium nut weight., intermediate attachment of nuts to apple, and 31.5% shelling percentage, and having extensive and intensive branching pattern and upright compact or spreading canopy type. During the year, five accessions which had bold nut type and high yields have been collected and planted at Madakkathara.

A dwarf type was identified by Pilicode centre from Manjeshwara area with early bearing non-cluster habit and small nuts which can find use in further breeding programmes. At Vengurle, 15 local types collected from Ratnagiri and Sindhudurg districts have been collected and conserved in the RCFGB.

Germplasm evaluation:

The growth parameters and yield of cashew germplasm have been evaluated at different centres during the year 2003. The characteristics of these accessions have been presented for different centres.

BAPATLA

Among the 53 accessions collected, H-95-4 recorded highest plant height (4.16m) followed by T.No 10/2 (3.96m). Maximum mean spread of canopy was recorded in T.No. 268 (4.67m) followed by H-95-5 (4.66m). Maximum number of bisexual flowers per panicle were recorded in T.No. 4/3(148.50) followed by T.No.8/7 (141.00) and T.No. 4/3 recorded maximum annual nut yield per tree (2.58kg) followed by T.No.8/7 (2.33 kg) in the clonally multiplied germplasm block (Table 1.2).

CHINTAMANI

Among the promising types, only five accessions were found to be superior in nut yield and met the minimum requirement of above 8 kg nut yield per tree/year. During 2003, the accession 35/3 ARSC (ME 4/4) recorded highest nut yield of 32.0 kg/tree followed by 41/3 ARSC (5/37 Manjeri) (26.0kg/tree), 44/1 ARSC (Vengurla–5)(23.0kg/tree) and 44/5 ARSC (Vengurla -5) (22.5.0kg/tree). The shelling percentage ranged from 27.0 to 30.0 per cent (Table 1.3).

JAGDALPUR

Of the ten accessions collected from NRCC, Puttur, the maximum flowering intensity /m^2 (5741.00) and nut weight (8.85g) was recorded in

NRC-140. The nut yield/tree was highest for NRC - 137 (3.81 Kg), followed by NRC–138 (2.63 Kg). The cumulative nut yield was highest in NRC - 137 (6.24 Kg) with 5 harvests. Shelling percentage was also found highest in NRC- 137 (32.40) indicating good yield attributes in this accession for this region. (Table 1.4).

The accessions 41/3 ARSC (5/37 Manjeri), 44/1 ARSC (Vengurla –5), 35/3 ARSC (ME 4/4) and 44/5 ARSC (Vengurla - 5) recorded more than 10 kg nuts/tree. The accession 2/6 ARSC (3/108 Gubbi) recorded 9.45 kg nuts/tree.

The accession 41/3 ARSC recorded highest nut weight (7.18g) with 29.5% shelling, followed by the accession 35/3 ARSC (ME 4/4) with a nut weight and shelling percentage of 6.30g and 30.0 per cent, respectively. The nut weight and shelling percentage were least in the accessions 44/1 ARSC as well as 44/5 ARSC (4.08 g and 27.4%, respectively). During the year under report, the grafts of the previously identified four promising local types were made and planted in the field.

JHARGRAM

The accession JGM – 34/3 having 9.11 g nut weight, 11.08 kg/tree yield and two accessions viz., JGM-16/1 and JGM 48/4 which had nut weight more than 8g and shelling percentage more than 29% and with a higher nut yield of more than 10 kg / tree have been identified during the evaluation (Table 1.5).

PILICODE

The biometric observations and yield data of the accessions planted during 1998 and 2000 were recorded for the types identified from northern Kerala. Among the accessions planted in 1998, PCKC-9 had higher nut yield (6.77 kg/tree). The dwarf type TPB-1 was used for hybridization programme with MDK-1 and ANK-1 (Table 1.6).

Table 1.2. Growth measurements and nut yield of accessions/ varieties conserved at Bapatla.

Accession Number	Plant Height (m)	Mean Canopy Spread (m)	No. of bisexual flowers/ Panicle	Annual Nut yield /tree (Kg) (2003-04)
T.No.268	3.54	4.67	54.00	1.010
T.No 4/3	3.21	4.65	148.50	2.583
T.No.8/7	3.20	4.53	141.00	2.330
T.No.10/2	3.96	4.00	88.00	0.191
H-95-4	4.16	3.83	52.25	0.540
H-95-5	2.83	4.66	81.25	0.150

Table 1.3. Yield performance of promising germplasm accessions at Chintamani.

Accession number	Year of planting	Cum. Yield (kg)	Yield during 2003 (kg)	Mean nut Yield (kg)	Mean nut weight (g)	Shelling (%)
2/6 ARSC (3/108 Gubbi)	1982	179.60 (19 yrs)	10.00	9.45	4.10	28.0
35/3 ARSC (ME 4/4)	1985	167.80 (15 yrs)	32.00	11.18	6.30	30.0
41/3 ARSC (5/37 Manjeri)	1985	176.59 (15 yrs)	26.00	11.78	7.18	29.5
44/1 ARSC (Vengurla 5)	1985	168.93 (15 yrs)	23.00	11.26	4.08	27.4
44/5 ARSC (Vengurla 5)	1985	164.00 (15 yrs)	22.50	10.93	4.08	27.4

Table 1.4. Yield performance of variety collected from NRCC during 2003 at Jagdalpur.

Variety	Year of planting	Flowering intensity /m²	Yield (Kg/tree)	Cum. Nut Yield (Kg/tree)	Nut weight (g)	Shelling (%)
NRC-130	1996	5174.66	1.17	2.47	6.70	24.40
NRC-131	1996	3136.00	1.70	3.89	7.30	24.20
NRC-136	1996	1548.00	1.50	2.73	6.46	26.10
NRC-137	1996	3665.80	*3.81*	*6.25*	5.00	*32.40*
NRC-138	1996	3015.40	2.63	4.66	7.15	28.40
NRC-140	1996	5741.00	0.55	1.48	8.85	27.20
NRC-190	1996	4415.50	0.31	0.83	5.40	32.00
NRC-191	1996	2416.66	2.54	6.08	4.95	27.10
NRC-192	1996	4567.66	0.20	0.60	5.50	30.20
NRC-193	1996	4972.66	2.15	3.35	6.52	27.00
SE(m)±		421.86	0.36	0.63	0.39	0.93

Table 1.5. Performance of promising germplasm accessions during 2003-2004 at Jhargram.

Accession No.	Mean nut wt (g)	Shelling %	Yield (Kg/tree) 2003	Cumulative yield (Kg/tree)
JGM – 34/3	9.11	27.44	11.08	135.09
JGM – 16/1	8.01	29.96	10.20	105.41
JGM – 17/1	6.71	30.08	12.10	142.40
JGM – 48/4	8.29	29.07	10.38	125.63
JGM – 57/1	7.50	28.00	7.82	95.34
JGM – 74/6	6.70	31.34	11.35	110.37
JGM – 60/2	7.20	29.20	11.51	140.33
JGM – 18/1	7.20	33.33	8.07	98.39

Table 1.6. Biometric observations of cashew germplasm (planted during 1998 and 2000) at Pilicode

No.	Accession No./Variety	Plant Height (m)	Collar Girth (cm)	Spread (m)		Bisexual flowers (%)	Nut yield (Kg/tree)
				E-W	N-S		
1	PCKC-4	6.90	62.10	5.4	5.3	6.27	3.13
2	PCKC-8	7.50	65.30	4.1	3.6	8.46	4.62
3	PCKC-9	6.90	66.80	5.1	5.6	5.97	6.77
4	BM-1	6.50	55.00	4.8	4.7	10.30	0.87
5	OCT-2	6.60	56.25	4.0	4.9	7.40	5.70
6	KC-1	6.20	53.70	4.3	4.3	3.40	2.70
7	KJ-1	5.95	58.50	4.4	4.0	3.50	2.80
8	Elapara	4.00	38.00	3.5	2.3	-	3.60
9	KM-1	5.60	74.00	5.7	3.9	4.02	-
10	Kodoliparam	5.90	60.30	4.8	5.5	5.70	0.76
11	TPB-1	1.17	8.62	0.74	0.65	-	-

VRIDHACHALAM

All the available 264 germplasm accessions were evaluated for identifying elite lines with export quality kernels. Among the 13 types of germplasm collected earlier, M 44/3 collected from Kadavarayanpattu of Cuddalore region registered the highest yield of 1.773 kg nuts per plant. Among the new germplasm, the highest nut yield / plant of 2.110 kg was observed in TAF (13) collected from TAFCORN (Table 1.7).

Table 1.7. Performance of germplasm during 2003-04

Sl. No	Accession No.	Source	Yield Kg/tree	Shelling (%)
1	M 15/4	Vazhisodanaipalayam	1.765	26.4
2	TAF (1)	TAFCORN	1.580	26.2
3	K 10/1	Kerala	1.617	27.4
4	A 24/4	Bapatla	1.560	29.5
5	M 110/2	Vijayarampuram	1.536	26.5
6	M 87/3	Serukadambur	1.815	26.3
7	M 71/4	Padur	1.950	27.2
8	M 69/4	Vazhisodanaipalayam	1.415	27.8
9	M 56/1	Kuvagam	1.850	25.8
10	ME 14/1	Karnataka	1.630	23.2
11	TAF (9)	TAFCORN	1.553	26.9
12	TAF (12)	TAFCORN	1.637	27.5
13	TAF (13)	TAFCORN	2.110	26.3
14	M 9/3	Vazhisodanaipalayam	1.490	26.3
15	M 26/2	Edyanchavadi	1.305	20.9
16	M 44/3	Kadavarayanpattu	1.773	27.6
17	M 37/3	Kadavarayanpattu	1.267	27.5
18	M 96/3	Kadavarayanpattu	1.552	26.6
19	NF 40	Narumananam Forest	1.525	26.5
20	NF 62	Narumananam Forest	1.530	27.6
21	NF 64	Narumananam Forest	1.505	28.0
22	Vk Sel. 1	Vridhachalam	1.340	26.8

Varietal evaluation

1. Multi Location Trial II with varieties from Bapatla, Vengurla, Vridhachalam and NRC for Cashew, Puttur

Centres : East Coast :

Bapatla, Bhubhaneshwar, Jhargram and Vridhachalam

West Coast:

Madakkathara, and Vengurla

Plains / others:

Chintamani and Jagdalpur

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

Summary:

The maximum nut yield per tree was recorded in T.No.30/1 (3.417 kg) at Bapatla in multilocation trials for evaluating varieties obtained from various locations. At Bhubaneshwar, H 68 yielded 11.8 kg followed by H-320 with 9.8 kg of annual nut yield, which had the highest cumulative nut yield of 41.3 kg. In Chintamani, Hy 320 recorded highest nut yield of 17.67 kg closely followed by NRCC Sel-2 (16.00 kg/tree). H-303 (1.23 kg/tree) and H-367 (5.88 kg/tree) had the highest yield at Jagdalpur and Madakkathara, respectively. At Vengurle, H-367 had highest panicle count (11.00/m^2) with highest yield of 5.97 kg/tree, while at Vridhachalam M 15/4 (VRI-4) had the maximum nut yield of 2.29 kg/tree.

Experimental details :

Design	:	RBD
Replications	:	Three
Varieties	:	No. of entries – 13
Bapatla	:	3/28, 3/33, 10/19, 30/1
Vengurle	:	H68, H 255, H 303, H 320, H367
Vridhachalam	:	M 15/4, M 44/3
Puttur	:	VTH 107/3, VTH 40/1
Year of planting	:	1992 (1993 at Bapatla, 2002 at Jhargram, 1994 at Vridhachalam)

BAPATLA

No significant differences were observed regarding plant height, stem girth and duration of flowering among the varieties evaluated. The entry M-44/3 (31.38) followed by T.No.30/1 (25.92) recorded maximum number of panicles per square meter.

Highest trunk girth of 80.7 cm was noticed in T.No.107/3 while T.No.40/1 had the next highest trunk girth of 75.2 cm.

The maximum mean annual nut yield per tree was recorded in the T.No.30/1 (3.14 kg) followed by T.No.10/19 (3.01 kg). The highest cumulative nut yield per tree was recorded in T.No.10/19 (25.48 kg) followed by M-44/3 (24.96kg) in eight annual harvests. The highest nut weight recorded in the H-255 and T.No.30/1 (9.7 g) followed by H-320 (9.4g) during the period. None of the varieties / genotypes exhibited any field tolerance to tea mosquito bug (TMB) (Table 1.8).

BHUBANESHWAR

The performance of new high yielding varieties obtained from different centres was

evaluated. The maximum height (m) was observed in H 255 (5.8) followed by H 320(5.7) and H 68 (5.6) and minimum was in M 44/3 (2.9). The tree trunk girth (cm) was maximum in H 255 (101.8) followed by BPP 3 / 33 (92.0) and minimum trunk girth was recorded in M 44/3 (45.0). Maximum canopy spread in N – S direction was observed in H 255 (9.9m) followed by BPP 10/19 (9.4m) and BPP 3/28 (9.1m). The E–W canopy spread was observed the highest in BPP 3 / 28 (9.6m) followed by H 255 (9.4m). Minimum canopy spread was found in M 44 / 3 such as 3.6m & 4.6m in N–S and E–W directions respectively. Highest number of flowering laterals/ m^2 were recorded in M 44/3 (48.5) followed by M15 / 4 (41.3) and H 367 (39.5) (Table 1.9).

Table 1.8. Performance of different varieties at Bapatla under MLT-II.

Variety/Genotype	Trunk girth (cm)	Annual Yield (kg/tree) (2003-04)	Cumulative Yield (kg/tree) (1996-03)	Net weight (g)	Shelling (%)
Hy-3/28	66.5	2.30	17.98	6.9	41.87
T.No.3/33	68.6	2.16	16.92	7.6	31.12
T.No.10/19	70.9	3.01	25.48	8.6	31.75
T.No.30/1	63.3	3.14	19.89	9.7	17.49
H-68	74.6	1.62	11.77	7.2	31.69
H-367	70.3	1.24	11.17	8.3	28.45
H-303	66.6	0.89	10.26	8.3	37.55
H-255	64.1	1.83	8.54	9.7	29.91
H-320	67.9	1.02	9.92	9.4	35.41
M-44/3	62.6	2.03	24.96	4.2	29.78
M-15/4	64.8	2.08	23.46	8.8	29.35
T.No.107/3	80.7	2.34	14.39	6.8	28.49
T.No. 40/1	75.2	1.62	14.68	6.1	49.04
CD at 5%		**1.421**	—	**0.8**	**3.06**

Table 1.9. Vegetative & flowering characters of cashew types in MLT- 1992 at Bhubaneshwar.

Cashew types	Height of plant (m)	Girth of plant (cm)	Canopy spread (m)		No. of flowering laterals/m^2
			E-W	N-S	
NRCC-1	4.4	69.2	7.5	7.9	21.8
NRCC-2	4.7	63.0	8.0	8.0	37.4
M 44/3	2.9	45.0	4.6	3.6	48.5
M 15/4	4.7	88.7	7.8	8.0	41.3
BPP 3/33	5.2	92.0	8.1	8.1	29.0
BPP 10/19	5.5	90.7	9.1	9.4	22.9
BPP 30/1	5.1	80.0	7.8	7.7	24.4
BPP 3/28	5.3	89.2	9.6	9.1	23.0
H 303	5.3	82.0	8.1	7.9	28.0
H 320	5.7	80.6	7.9	8.5	29.7
H 255	5.8	101.8	9.4	9.9	31.8
H 367	5.1	80.9	8.5	8.8	39.5
H 68	5.6	75.7	8.4	8.7	36.0

In the reporting year, highest nut yield (kg/plant) was observed in H 68 (11.8) followed by) H 320 (9.8) and H303 (9.6). Cumulative nut yield (kg/plant) at the 8 harvests was recorded the highest in H 320 (41.3) followed by BPP 30/1 (39.9) and H 303 (38.9). Kernel recovery was recorded maximum in H303 (31.0%) followed by NRCC-2 (30.8) and 30.5% both in H 255 & BPP 3 / 33 (Table 1.10)

Table-1.10. Yield and yield attributing characters of cashew types in MLT-1992 at Bhubaneshwar

Cashew types	Nut yield (kg/plant)	Cumulative nut yield (kg/plant)	No. of nuts/panicle	Nut weight (g)	Shelling (%)	Apple weight (g)
NRCC-1	2.8	13.5	1.7	8.2	29.6	68.5
NRCC-2	8.3	29.7	2.7	8.5	30.8	69.0
M 44/3	3.0	17.5	4.0	5.6	30.0	37.5
M 15/4	3.5	19.1	1.0	7.5	28.3	61.2
BPP 3/33	6.5	26.9	3.0	6.1	30.5	55.1
BPP 10/19	5.5	22.1	1.7	6.1	28.0	47.3
BPP 30/1	9.3	39.9	4.7	6.3	27.7	41.8
BPP 3/28	6.2	26.3	3.0	8.0	29.4	60.4
H 303	9.6	38.9	4.7	7.2	31.0	69.6
H 320	9.8	41.3	3.3	8.4	28.5	66.2
H 255	3.6	22.5	1.0	10.0	30.5	64.3
H 367	6.1	28.9	1.7	9.4	29.4	90.2
H 68	11.8	31.7	4.0	7.5	30.4	66.1

CHINTAMANI

The entries did not show significant differences with regard to plant height as well as stem girth. During the year, yield could not be analyzed due to non-bearing of trees in some of the replications. However the highest yield was recorded in the entry H-320 (17.67 kg/tree) closely followed by NRCC-2 (40/1)(16.00 kg/tree).

Over nine harvests H-367 recorded highest cumulative yield (36.36 kg/tree) followed by the entries H-303, NRCC-2 and H-320 with a cumulative yield of 35.61, 35.04 and 32.56, respectively. The cumulative yields were least in TN.10/19 and TN 3/28 (6.42 kg, and 11.18 kg/tree) respectively.

The variety H-255 recorded highest nut weight (8.27 g) followed by H-320 (7.98 g), H-367 (7.96 g), H-68 (7.51 g) and H-302 (7.34 g). The least nut weight was recorded in TN-30/1 (4.69 g) and TN-10/19 (4.81 g). The shelling percentage was highest in NRCC-1 (30.7%) and least in H-68 (25.2%). (Table 1.11)

JAGDALPUR

The following entries from Bapatla, 3/28, 3/33, 10/19, 30/1; Vengurla H 68, H 255, H 367, H 320, H 303; and Vridhachalam M 15/4, M 44/3 planted during 2000 were evaluated in this multi locational trial

The canopy spread in H-320 was found to be largest (E-W/N-S=23639 / 247.75 cm), which was at par with H-367, H-255, H-303 & H-68. The entry 30/1 had significantly higher flowering intensity/m^2 (4594.67). Number of fruits/ panicle was maximum for H-68. Yield (Kg/tree) was markedly highest for H-303 (1.23 kg). Nut weight was significantly higher for H-367 & 255 (11.56 g). Shelling percentage was recorded to be maximum for 3/33 (31.90), which was statistically similar with H-255, VRI-1, 10/19 and 30/1. (Table 1.12).

JHARGRAM

The trial could not be conducted due to local unavoidable circumstances.

Table 1.11.Growth and yield performance of cashew entries in MLT II in Chintamani

Entries	Height (m)	Girth (cm)	Yield (kg/tree) 2003	Cumulative yield (kg/tree for 9 years	Nut weight (g)	Shelling (%)
Hyb – 68	4.98	89.52	-	11.32	-	-
Hyb – 367	4.40	85.25	13.70	36.36	7.96	29.6
Hyb – 303	4.41	92.91	8.67	35.61	7.34	27.7
Hyb – 255	5.11	84.51	8.67	19.64	8.27	29.8
Hyb – 320	5.12	84.12	17.67	32.56	7.98	27.8
M 44/3	4.15	69.95	10.00	24.92	5.01	28.6
M 15/4	4.28	84.72	11.33	20.53	5.87	28.0
NRCC Sel-1	5.64	87.20	10.67	28.28	6.64	30.7
NRCC Sel -2	4.20	68.16	16.00	35.04	5.33	27.0
TN 30/1	4.14	77.21	11.33	28.29	4.69	29.0
TN 3/33	5.05	87.63	4.33	11.60	6.25	27.4
TN 10/19	4.99	85.33	2.33	6.42	4.81	30.0
TN 3/28	4.73	85.00	2.00	11.18	6.56	28.2
Ullal – 1	4.96	91.70	6.67	14.30	6.06	29.3
CD 5%	NS	NS				
Sem ±	0.67	2.25	NA			
CV %	-24.56	-4.66				

Table 1.12. Growth performance of cashew entries in MLT-II during 2003-04 at Jagdalpur

Varieties	Canopy Spread		Flowering intensity	Yield (Kg/tree)	Nut Weight (g)	Apple Weight (g)	Shelling %
	E-W	N-S	m^2				
3/28	171.03	163.75	2964.38	0.24	7.96	46.27	28.72
3/33	150.00	153.42	2155.11	0.26	7.73	36.21	31.90
30/1	180.00	181.75	4594.67	0.45	7.75	35.83	29.85
10/19	171.06	171.25	2690.67	0.31	6.19	27.50	29.94
VRI-1	118.18	100.97	2942.08	0.13	6.68	42.08	30.30
VRI-2	81.31	80.42	1706.92	0.40	4.80	35.67	28.65
H-68	195.00	196.25	2071.17	1.00	8.58	52.75	27.22
H-255	195.42	201.25	2880.68	0.50	11.56	64.39	30.40
H-367	203.75	205.83	3085.50	0.24	11.55	64.81	26.70
H-320	236.39	247.75	2859.20	0.50	9.19	60.00	29.19
H-303	198.92	215.42	3147.50	1.23	9.00	52.89	29.10
SEL-1	177.50	163.58	1879.97	0.29	8.98	50.56	26.90
SEL-2	156.81	152.36	2422.03	0.14	9.01	47.25	26.72
CD at 5%	58.44	58.48	1391.31	0.51	1.54	14.4	2.3

MADAKKATHARA

The trees of the variety T 107/3 (6.45 m) and H- 303 (6.18 m) were the tallest and that of M 44/3 (5.05 m) was the shortest. The girth of the trees of the variety T. No. 107/3 was the highest (107.0 cm) and that of H- 367 was the lowest (71.80cm). Canopy spread was highest with the variety T No. 107/3 (9.99 m) and lowest with the variety H- 320 (8.2 m). H-367 recorded the highest number of panicles/ m^2 (11.00) followed by M15/4 (9.00) and

NRCC Sel-1 (9.00). The highest nut yield (5.97 kg per tree) was obtained from the variety H-367 followed by H-303 (5.88 kg/tree) (Table 1.13).

VENGURLA

The trees of the variety T 107/3 (6.45 m) and H- 303 (6.18 m) were the tallest and that of M 44/3 (5.05 m) was the shortest. The girth of the trees of the variety T. No. 107/3 was the highest (107.0 cm) and that of H- 367 was the lowest (71.80cm).: Canopy spread was highest with the variety T No. 107/3 (9.99 m) and lowest with the variety H- 320 (8.2 m).: H-367 recorded the highest number of panicles/ m^2 (11.00) followed by M15/4 (9.00) No. 40/1 (9.00). The highest nut yield (5.97 kg per tree) was obtained from the variety H-367 followed by H-303 (5.88 kg/tree) (Table 1.14).

Table 1.13. Growth characters of cashew trees in the new MLT (93 planting) at Madakkathara

Variety	Height (m)	Girth (cm)	Canopy spread (m)	Panicle/m^2	Yield kg/tree
T.No.30/1	5.90	76.08	8.46	6.00	3.84
T 3/33	5.93	81.64	8.80	6.00	1.20
T 10/19	5.83	80.11	8.59	4.00	1.33
M 44/3	5.05	72.39	7.89	6.00	1.09
M 15/4	5.83	75.91	8.52	9.00	2.51
H-367	5.24	71.80	8.33	11.00	5.97
H-68	5.96	83.77	7.75	6.00	2.85
T 3/28	5.78	84.83	8.90	6.00	3.12
NRCC Sel-1	5.87	81.75	9.32	9.00	2.77
NRCC Sel-2	6.45	107.0	9.99	7.00	2.52
H-303	6.18	86.16	8.37	7.00	5.88
H-255	6.09	82.08	8.65	6.00	1.36
Dhana	5.61	78.58	8.29	5.00	4.92
H-320	5.90	77.33	8.2	8.00	3.01
SE		4.13	0.36		
CD (0.05)	0.61	8.44	0.73		

Table 1.14. Growth characters of cashew trees in the new MLT (93 planting) at Vengurla

Variety	Height (m)	Girth (cm)	Canopy spread (m)	Panicle/m^2	Yield kg/tree
T.No.30/1	5.90	76.08	8.46	6.00	3.84
T 3/33	5.93	81.64	8.80	6.00	1.20
T 10/19	5.83	80.11	8.59	4.00	1.33
M 44/3	5.05	72.39	7.89	6.00	1.09
M 15/4	5.83	75.91	8.52	9.00	2.51
H-367	5.24	71.80	8.33	11.00	5.97
H-68	5.96	83.77	7.75	6.00	2.85
T 3/28	5.78	84.83	8.90	6.00	3.12
(NRCC Sel-1)	5.87	81.75	9.32	9.00	2.77
(NRCC Sel-2)	6.45	107.0	9.99	7.00	2.52
H-303	6.18	86.16	8.37	7.00	5.88
H-255	6.09	82.08	8.65	6.00	1.36
Dhana	5.61	78.58	8.29	5.00	4.92
H-320	5.90	77.33	8.2	8.00	3.01
CD (0.05)	0.61	8.44	0.73		

VRIDHACHALAM

The maximum nut yield per tree (2.29 kg) was observed in M 15/4 (VRI-4) followed by M 44/3 (2.12 kg). The cumulative yield/tree was the maximum of 14.39 kg in M 44/3 (VRI-2). The number of fruits per panicle (4.0) was maximum in M 44/3 (VRI-2) and single nut weight was maximum (7.6 g) in H-320 obtained from Vengurla. The highest shelling percentage of 27.4 was observed in H-320. (Table 1.15)

Table 1.15. Performance of Cashew varieties/genotypes in MLT 92 at Vridhachalam

Variety	Flowering Period (in days)		Nut yield (kg/tree)	Cumulative Nut yield (kg/tree)	No. of fruits per panicle	Single nut weight (g)	Shelling (%)
Bapatla							
T. 30/1	Early	46.6	1.34	5.64	3.3	6.7	25.3
T. 3/33	Mid	36.6	1.59	5.61	2.5	7.0	24.3
T.10/19	Early	40.0	1.35	4.78	2.0	6.8	26.4
T. 3/28	Early	36.7	1.43	5.85	2.3	6.7	23.7
Vengurla							
H 68	Early	40.0	1.95	6.71	3.0	6.4	26.4
H 367	Early	43.4	1.64	6.93	2.3	6.5	24.9
H 303	Mid	43.0	1.89	9.89	2.5	6.8	26.4
H 255	Mid	36.6	1.28	4.50	2.0	7.0	26.3
H 320	Mid	43.3	1.66	7.37	3.0	7.6	27.4
Vridhachalam							
M 44/3	Early	45.0	2.12	14.39	4.0	6.3	24.7
M 15/4	Early	53.3	2.29	12.02	3.3	6.8	26.1
NRCC, Puttur							
107/3	Mid	36.7	1.66	4.24	3.0	6.7	27.0
40/1	Mid	36.5	1.54	7.37	2.2	7.0	26.7
S.Ed			0.27		0.24	0.28	1.78
CD (5%)			0.56		0.48	0.57	3.62

2. Performance of released varieties

Centres : East Coast

Bapatla, Bhubhaneswar, Jhargram and Vridhachalam

West Coast

Madakkathara, and Vengurla

Plains / others:

Chintamani and Jagdalpur

The objective of this project is to evaluate the performance of released varieties in different locations for their suitability to that agro-climatic region.

Summary:

Under this trial BPP-4, BPP-5 and V-5 had vigorous growth habit, while V-2, BPP-2 had the maximum bisexual flowers per panicle, and high yields were obtained from BPP-4 and BPP-5 at Bapatla and from BPP-2 at Jagdalpur. The precocious dwarf KGN-1 had similar growth characters as that of the check at Bhubaneshwar, Jhargram, Pilicode and Vridhachalam.

Experimental details :

The following varieties were evaluated; BPP-1, 2, 3, 4, 5, 6,Vengurla-1, 2, 3, 4, 5, 6, NRCC Sel-1, NRCC Sel-2, VRI-1, 2, 3, Ullal-1, 2, 3, 4 UN-50, Kanaka, Dhana, Priyanka, Chintamani-1, and 3 / 28.

BAPATLA

The variety BPP-4 recorded the maximum plant height of 2.95m while VRI-2 recorded maximum trunk girth of 47.3 cm, BPP-1 recorded the mean maximum canopy spread of 4.48m followed by Vengurle-5 of 4.47m. The maximum bisexual flowers per panicle were recorded in Vengurle-2 (293.5) followed by Kanaka (261.25). The highest mean nut yield per tree (2.15kg) was recorded in BPP-4 variety followed by BPP-5 (1.73 kg) in the third harvest (Table 1.16)

JAGDALPUR

The following cultivars were evaluated at Jagdalpur viz.,BPP-1, BPP-2, BPP-4, BPP-5, BPP-6, BPP-8, CHIN- 1, VRI-1, VRI-2, VRI-3, M -15/4, 10/19, 3/33 & H- 303.

Plant height (2.50 m) was maximum in Baptla-5. Trunk girth (53 cm), and flowering intensity/m^2 (4866) were found highest in Baptla-2. Maximum no. of fruits/panicle was recorded in Chintamani-1 (2.80). The nut yield (Kg/tree) was found highest in Baptla-2 (3.07kg), while cumulative nut yield was higher in Vridhachalam – 2 (8.41 Kg). Highest nut weight was recorded in H- 303 (9.37 g) (Table 1.17).

Table-1.16: Growth and flowering data of released varieties at Bapatla (2003)

Variety	Plant Ht (m)	Plant Spread (m)		Bi sexual flowers	Annual Nut Yield/tree (Kg) (2003-04)	Cum. Nut Yield/tree (Kg) (2001-03)
		E-W	N-S			
BPP-1	2.90	4.52	4.45	93.00	0.18	0.93
BPP-2	2.55	4.56	5.20	129.25	1.31	2.57
BPP-3	2.18	3.43	3.48	117.50	0.29	1.16
BPP-4	2.95	5.55	5.27	134.50	2.15	4.24
BPP-5	2.38	3.26	3.53	106.00	1.73	2.91
BPP-6	1.90	2.30	2.35	60.00	0.17	0.76
BPP-8	2.50	5.40	5.06	70.75	1.35	2.45
BPP-9	1.60	2.37	2.70	94.00	1.15	1.54
Kanaka	2.65	4.07	4.15	261.25	1.01	1.94
Dhana	1.40	2.54	2.90	252.00	0.31	0.79
Priyanka	2.00	3.40	3.40	164.00	0.21	0.86
Vengurle-1	2.22	4.01	3.42	92.00	0.24	0.85
Vengurle-2	2.72	3.70	3.57	293.50	0.27	1.06
Vengurle-3	2.60	3.95	3.65	122.50	0.22	0.73
Vengurle-4	2.48	3.82	3.46	169.00	0.12	1.21
Vengurle-5	2.82	4.56	4.38	101.50	0.55	2.02
BBSR-1	1.90	2.46	2.23	229.00	0.17	0.72
VRI-2	2.36	3.93	4.13	210.00	1.38	2.78
Chintamani-1	1.26	1.83	2.03	—	—	0.10
Ullal-1	1.25	1.23	1.36	88.25	—	0.10
Ullal-4	1.55	1.65	1.85	75.00	—	0.10
Ullal-5	1.93	2.40	2.76	63.75	—	—
Jhargram	1.92	2.65	2.80	54.75	—	—

Table-1.17: Evaluation of released varieties at Jagdalpur planted in 1996-97.

Variety	Height (m)	Trunk Girth (cm)	Flowering intensity/ (m^2)	No. of fruits/ panicle	Yield (Kg/tree)	Cum. nut yield (Kg) for 5 harvests	Nut weight (g)	Shelling %
BPP-1	1.10	11.50	2451.00	-	-		-	-
BPP-2	2.18	53.00	4866.00	1.90	1.83	3.07	5.20	26.20
BPP-4	1.52	33.25	3569.00	2.15	0.49	1.29	7.10	26.40
BPP-5	2.50	29.00	2256.00	1.60	0.28	0.28	5.20	23.80
BPP-6	1.15	16.00	955.00	1.00	0.13	0.13	5.80	25.00
BPP-8	0.94	10.00	2360.00	1.00	0.12	0.12	-	24.70
Chintamani-1	1.30	24.60	2558.00	2.80	0.55	1.54	7.10	-
VRI-1	1.03	11.50	2161.00	1.40	0.18	6.61	6.50	28.60
VRI-2	1.12	12.66	2324.00	1.90	1.42	8.41	6.20	26.60
VRI-3	1.19	18.00	3315.00	1.60	0.29	0.29	6.00	29.60
M -15/4	1.22	15.8	2420.00	1.40	0.10	0.64	7.30	-
10/19	1.24	16.00	2019.00	1.60	0.16	0.51	6.40	-
3/33	1.62	21.2	2265.00	1.61	0.90	0.91	7.90	30.20
H-303	1.00	16.2	1495.00	1.86	0.62	0.62	9.37	29.00

Evaluation of precocious dwarf KGN-1

BAPATLA

In this experiment 25 grafts of KGN-1 from CRS, Madakkathara has been planted along with check variety BPP-5 during 2002 and observations on growth parameters are in progress.

BHUBANESHWAR

Grafts of KGN-1 obtained from CRS, Madakkathara are planted along with the local check H 2/16 at 4m x 4m spacing. It was observed that KGN-1 has comparatively shorter internodal length (3.63cm) but it has similar plant height (0.85m) and trunk girth (7.49cm) as the check variety H 2/16 (Table 1.18)

JHARGRAM

It was observed that mean plant height, trunk girth, canopy spread and internodal length were more in case of KGN-1 than BLA-39-4 plants. The grafts of KGN-1 plants had late flowering compared to BLA-39-4 plants. Average duration of flowering was more in case of BLA-39-4. Flowering intensity, no. of fruits / panicle, and ratio of male : hermaphrodite flower were better with BLA-39-4. But yield attributes like yield (Kg/tree), nut weight, apple weight and shelling percentage were higher in case of KGN-1 as compared to BLA–39–4 (Table 1.19)

PILICODE

The experiment was started during 2002,MDK-1 the local check variety was compared with KGN-1. The observations indicated the growth rate of KGN-1 was similar and higher than that of MDK-1 (Table 1.20).

VRIDHACHALAM

Biometrical observations on plant height, stem girth, canopy shape & internodal length were recorded. The check variety VRI 2 recorded the lowest plant height, Trunk girth and internodal length (Table 1.21)

Table-1.18. Vegetative characters of preliminary evaluation of precocious dwarf (KGN-1) at Bhubaneswar.

Vegetative characters	KGN-1	H 2/16
Mean plant height (m)	0.85	0.83
Mean trunk girth (cm)	7.49	7.35
Mean internodal length (cm)	3.63	3.87

Table 1.19. Plant height, girth, canopy spread and internaodal length of KGN – 1 and check variety (BLA – 39 - 4) at Jhargram.

Growth or yield paramaeters	KGN-1	BLA-39-4
Plant height (m)	1.07	0.78
Trunk girth (cm)	7.43	6.40
Canopy Spread (m) (N-S)	0.90	0.83
(E-W)	0.73	0.87
Average internodal length (Cm)	2.38	1.82
Duration of flowering	79.67	95.71
Flowering intensity / m^2 (mean of all 4 sides)	1.27	1.64
No. of fruits / panicle	1.48	1.56
Ratio of Male flower : Hermaphrodite flower	4.47 : 1	2.76 : 1

Table 1.20 .Biometric characters of KGN-1 and MDK-1 at Pilicode

Variety	Year	Plant ht. (meter)	Trunk girth (cm)	Tree spread (meter)		Inter nodal length (cm)
				E-W	N-S	
MDK-1	I year	0.20	2.30	-	-	-
	II Year	0.62	4.30	0.25	0.25	1.19
KGN-1	I Year	0.53	3.10	-	-	-
	II year	0.70	4.71	0.28	0.31	1.27

Table 1.21. Performance of precocious dwarf KGN 1 at Vridhachalam

Variety Genotype	Plantt height	Trunk girth	Canopy shape shape	Inter nodal length	Days to first flowering
KGN 1	82.8	4.3	Compact	4.46	91.0
VRI-2	66.4	3.52	Compact	4.06	65.8

3. Hybridization and Selection

Centres : East Coast :

Bapatla, Bhubhaneswar, Jhargram and Vridhachalam

West Coast:

Madakkathara, and Vengurle

Plains / others:

Chintamani

The project aims at utilizing the high yielding accessions selected from the germplasm conserved at various AICRP centres, as parents to obtain desirable traits such as bold nut types, cluster bearing habit, compact canopy, short flowering period, late synchronized flowering and high shelling percentage.

Summary:

Under the hybridization and selection programme, 73 F_1 hybrid nuts have been obtained at Bapatla, 1049 nuts at Bhubaneswar, 600 hybrid nuts at Chintamani, and 235 hybrid nuts at Vridhachalam. At Madakkathara evaluation of hybrid nuts sown during 1993 to 2003 is in progress. At Bhubaneswar, highest nut weight of 11.0 g was observed in $F_{2\text{-}1}$, while A_6 gave highest cumulative yield of 10.6 kg in 6th harvest. At Madakkathara, H-97 (planted in 1995) gave highest yield of 5.58 kg and H-72 (planted in 1994) gave highest yield of 10.05 kg. The highest yield of 6.01 kg/tree was observed in H-10.

BAPATLA

A total of 73 F_1 hybrid nuts was obtained from the 10 cross combinations identified by the NRCC, Puttur for Bapatla centre during the year 2003.

The highest fruit set of 17.7 % was recorded in the cross combination of BPP-8 x Ullal-4. The above 73 F_1 hybrid nuts were sown for further studies. The growth parameters of F_1 seedlings planted during 1997 have been recorded. (Table 1.22)

Table-1.22. Details of crossing programme at Bapatla

Cross combinations	Number of nuts obtained during the year	Percent of fruit set
BPP-8 x Ullal-3	12	12.9
BPP-8 x Ullal-4	17	17.7
BPP-8 x BPP-3	2	2.47
BPP-8 x BPP-4	8	9.41
BPP-6 x Sel-1	9	10.71
BPP-6 x Sel-2	6	6.67
BPP-6 x Ullal-3	3	5.00
BPP-6 x Ullal-4	5	8.62
BPP-8 x T.228	2	5.00
T-228 x BPP-8	9	15.00
Total:	73	9.77

BHUBANESHWAR

During the year 2002-03; 70 different parental crossing combinations were selected. 9500 nos. of hermaphrodite flowers were pollinated out of which 1049 nos. of hybrid nuts were harvested. From a total of 813 seedlings, 616 nos. of seedlings have been planted in August 2003 and due to shortage of land the remaining 197 seedlings are maintained for planting during the next planting season. (Table 1.23)

Table 1.23. Performance of hybrids planted during different years at Bhubhaneswar

Year of planting	Hybrid. No.	Yield (Kg/plant)	Cum. Yield (Kg/plant)	Nut Wt. (g)
1995	A_6	2.7	10.6	9.5
1997	A_{1-85}	3.6	10.3	8.0
1998	D_{2-6}	0.8	2.1	9.0
	D_{2-19}	0.8	1.6	9.6
1999	F_{3-13}	1.2	1.2	10.6
	F_{2-1}	0.8	1.8	11.0

Among the 3 promising hybrid plants planted during 1995, highest cumulative yield (kg/plant) at 6 harvests was recorded in A_6 (10.6) with the highest nut weight of 9.5g , highest no. of nuts/panicle (3), highest shelling percentage of 33.7% and highest apple weight of 70.0g.

Out of the 13 promising hybrids of the year 1997, at Bhubaneswar, at 4th harvest, highest cumulative yield (kg/plant) was observed in A_{1-85} (10.3) having nut weight 8.0 g & shelling percentage (33.3). The hybrid block planted during 1998 consists of hybrid plants obtained from 8 different parental combinations, observations on their yield attributing characters such as cumulative yield (kg/plant) at 3rd harvest, their nut weight (g), no. fruits/panicle and shelling percentage (%) were as follows. The cumulative yield was recorded the highest in D_{2-6} (2.1) followed by A_{2-21} (2.0) and E_{2-13} (1.8). Highest nut weight was observed in F_{2-1}(11.0) followed by D_{2-19}(9.6) and D_{2-6}((9.0). Maximum fruits/panicle was recorded in A_{2-22} (4) followed byA_{2-21} (3), B_{2-32} (3), D_{2-4}(3) and E_{2-7} (3). Highest shelling % was observed in E_{2-13} (33.0) followed by F_{2-29} (32.3) and A_{2-13} (32.0).

In the 1999 hybrid block, the highest cumulative yield at first harvest was observed 1.2 kg/ha. in F_{3-13}. Highest nut weight (g) was observed in F_{3-13}(10.6) followed by F_{3-1}(10.0) and E_{3-22} (9.2). Highest shelling percentage (%) was observed each in D_{3-15} (33.9), E_{3-26}, (33.9) followed by F_{3-10} (33.5).

Heaviest nut weight of 10.5g was observed each in G_{4-1} and G_{4-3} followed by F_{4-35} (9.6g) and C_{4-14} (9.4g). Maximum kernel recovery percentage was recorded in G_{4-6} (32.4) followed by G_{4-3} (31.3).

CHINTAMANI

Out of 791 F_1 seeds sown , 600 hybrid seedlings were obtained and planting was taken up during June 2003. These are planted at closer spacing for further evaluation.

JHARGRAM

Hybridization was done during February – March 2003, and 9 hybrids have been planted. The performance of the hybrids planted during 2003 has been recorded for plant height, stem girth and canopy spread. (Table 1.24)

Table 1.24. Information on hybridisation during 2002 – 03 in Jhargram.

Parentage	No. of crosses	Setting %
KC–1 x BLA–39– 4	60	50
H – 2/16 x BLA–39– 4	55	25.55
BLA–39–4 x 2/9 Dicheria	61	59.01
BLA-29-4 x H-2/16	51	86.27
2/9 Dicheria x BLA-39-4	61	52.45
H-2/16 x Red Hazari	19	26.6
BLA-39-4 x Red Hazari	77	57.14
H-2/16 x V4	45	88.89
Red Hazari x WBDC – V	38	36.8
WBDC – V x Red Hazari	29	27.5

MADAKKATHARA

In total there are 213 hybrid plants in the field planted during 1993-2003. The number of hybrids produced their parentage and years of planting are given below.

Hybrid No.	Parentage	Year of planting
H 1-11	BLA-139-1 x P-3-2	1993
H 12-28	BLA - 39-4 x P-3-2	1993
H 29-56	V-5 x H-1591	1993
H 57-65	BLA - 139-1 x P-3-2	1994
H 66-81	BLA - 39-4 x P-3-2	1994
H 82-83	V-5 x H-1591	1994
H 84-91	V-5 x H-1591	1995
H 92-102	Madakkathara-1 x P-3-2	1995
H 111-132	Anakkayam-1 x P-3-2	1995
H 133-176	Madakkathara -1 x P-3-2	1995
H 177-189	BLA - 139-1 x Vettore 56	1996
H 190-195	BLA -139-1 x Vettore 56	1998
H 196-204	BLA-139-1 x Kankadi	1998
H 205	BLA 139-1 x Sulabha	2000
H 206 – 210	Madakkathara -1 x Sulabha	2000
H 211 – 213	V5 x Sulabha	2000

Out of the hybrids planted during 1994, Hybrid 72 gave the highest yield (10.05kg) during 2003, the Hybrid 71 & Hybrid 73 also performed well with higher cumulative yields of 14.70 & 14.60kg respectively. (Table 1.25).

Table 1.25. Yield of the hybrids planted during 1994 at Madakkathara

Hybrid No.	Yield kg/tree (2003)	Cum. Yield (kg)	Nut wt. (g)
58	3.70	6.70	7.80
59	3.30	4.10	7.50
60	2.85	8.15	8.92
65	0.00	0.60	7.11
66	0.00	0.20	8.93
69	5.30	5.80	9.76
70	3.92	5.99	10.05
71	8.95	14.70	9.44
72	10.05	12.95	7.91
73	8.5	14.60	6.05
80	0.00	0.0	0.00
83	0.00	0.0	0.00

Table 1.26. Yield of hybrids planted during 1995 at Madakkathara

Hybrid No.	Mean nut wt (g)	Yield (kg/tree)
84	5.70	2.5
85	6.30	2.37
87	5.80	2.60
88	6.90	4.50
89	5.80	1.30
96	0.00	0.00
97	7.60	5.58
103	7.30	3.70
104	6.80	4.46
110	0.00	4.98

Highest nut weight recorded by H-3 (13.67 g) followed by H 33 (13.09g). Out of the 27 hybrids planted during 1994, highest yield was recorded by H 72 (10.05 Kg). The yield of trees ranged from (2.85 - 10.05 Kg). H 70 recorded the highest nut weight (10.21 g).Out of the 85 hybrids planted during 1995, H 97 recorded highest yield (5.58 Kg) followed by H 110 (4.98 Kg) and H 88 (4.50 Kg). Highest nut weight was recorded for H 97 (7.60g). (Table 1.26).

The hybrids planted during 1996 at a spacing of 4 x4 m had grown lanky, hence by thinning weak trees were removed giving space for the vigorous

ones. A total of 124 hybrids were planted in 2001, 135 hybrids were planted during 2002 and 626 hybrids were planted at SCRS, Konni and 222 hybrids were planted at Cashew Research Station, Madakkathara during 2003. Network program on hybridization and selection is in progress.

VENGURLA

During the year 2003-2004, several cross combinations have been done and the seed nuts have been sown to obtain seedlings. (Table 1.27)

VRIDHACHALAM

The highest cumulative yield / tree (51.1 kg for 11 years), highest yield/tree (6.010 kg) was observed in H-10 (M 10/4 x M 26/1). H 12 recorded the highest shelling out turn (28.10%). The maximum apple weight (68.5 g) was observed in H- 3 (M 26/2 x M 26/1). (Table 1.28)

Table 1.27. Details of crossing and hybrid nuts obtained at Vengurle during 2003-04

Cross combination	No of flowers crossed	No. of fruits	No. of fruits harvest
V-2 x BT-1	130	44	19
V-2 x BT-22	116	43	13
V-2 x BT-65	107	48	18
V-2 x BT-6	108	25	12
V-2 x BT -10	68	48	16
V-2 x Kankadi	70	34	16
V-5 x BT –1	58	35	17
V-5 x BT -22	51	42	-
V-5 x BT -65	40	20	5
V-5 x BT –6	55	24	6
V-5 x BT -10	51	22	9
V-5 x Kankadi	22	16	4
V-4 x Hy 2/16	113	68	40
Hy 2/16 x V-4	92	61	42
Hy-509 x Vetore-56	61	22	7
Hy-509 x Kankadi	75	43	11
Total	1217	595	235

Table 1.28. Performance of Selected F_1 Hybrids at Vridhachalam during 2003-04

Hybrid Number	Cross Combination	Specific characters	Mean yield yield(kg/tree)	Cumulative yield (Kg/tree) for 11 years	Nut weight (g)	Shelling %	Apple weight (g)	Apple colour
H 10	M 10/4 x M 26/1	High yield	6.01	51.11	6.95	27.36	62.2	Yellow
H 11	M 10/4/ x M 45/4	TMB tolerant	5.12	32.18	6.79	26.91	64.5	Yellow
H 12	M 10/4 x M 75/3	High yield	5.46	33.87	6.68	28.10	63.2	Pinkish
H 13	M 26/2 x M 26/1	High yield	5.90	45.32	6.74	27.45	68.5	Pink
H 14	M 26/2 x M 45/4	TMB tolerant	4.31	35.43	6.63	27.50	66.5	Pink
H 15	M 26/2 x M 75/3	High yield	4.51	33.92	6.89	27.10	60.2	Red
H 16	M 44/3 x M 26/1	High yield	4.66	43.36	6.43	27.00	55.2	Yellow
H 17	M 44/3 x M 45/1	TMB tolerant	5.12	38.85	7.01	26.00	58.5	Yellow

II. CROP MANAGEMENT

2. CROP MANAGEMENT

NPK ferlilizer experiment

Centres : East Coast :
Bapatla, Jhargram and Vridhachalam

West Coast:
Madakkathara, and Vengurle

Plains / others:
Chintamani and Jagdalpur

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

Summary:

Significant differences in yield was observed only for N levels at Bapatla, Chintamani and Madakkathara while P & K levels did not induce significant differences in these centers. Under on-farm trials at Bapatla highest mean nut yields (7.25 kg/tree) were obtained at 1500:375:375g NPK. At Chintamani, 1000g N could lead to highest nut yield of 3.87 kg/tree. At Jhargram, trunk girth was maximum (103.67 cm) in 0g N 125g P_2O_5 and 250g K_2O. At Madakkathara, yield was shown to be dependant on N levels, 4.16 kg at N_o, 5.41 kg at N_1 and 6.1 kg at N_2 levels. Nut yield/tree was maximum (4.38 kg) when 1000g N, 250g P 250g K were applied at Vridhachalam center.

Experimental details :

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

BAPATLA

During the year 2002-03 the N_2 level gave significant higher yield of 3.87 kg per tree over N_0 level (1.95 kg per tree). The yields were not significant for P and K levels. The mean annual nut yield per tree was highest in the treatment N_2K_1 (4.92 kg) per tree followed by N_1K_2 (4.51 kg) per tree over control (2.49 kg) but for NPK interaction they were not significant (Table 2.1).

Significant differences in cumulative nut yield (5 harvests) were observed for Nitrogen and NP interactions only. The highest cumulative nut yield was recorded in the N_1 level (15.98 kg/tree) followed by N_2 (15.85 kg/tree) which were on par with each other. N_2P_2 gave the highest cumulative yield of 18.30 kg/tree followed by N_2P_1 (17.85 kg/tree) which was superior over control. NPK interactions were not significantly different (Table & 2.2).

Table-2.1 Annual nut yield (kg/tree) in response to N, P and K interaction at Bapatla

	P_0	P_1	P_2	Mean	K_0	K_1	K_2
N_0	1.690	1.845	2.323	1.952	2.492	1.495	1.872
N_1	3.477	3.502	3.983	3.654	2.618	3.833	4.510
N_2	3.528	4.427	3.658	3.871	4.140	4.923	2.548
Mean	2.898	3.258	3.321		3.083	3.417	2.977
K_0	2.500	3.197	2.998				
K_1	3.380	3.685	2.708				
K_2	3.370	3.370	3.223				

F test.	N	P	K	NP	NK	PK
Significance	*	NS	NS	NS	*	NS

CD at 5 % for N/P/K= 0.990 for NP/NK/PK=1.715

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

	P_0	P_1	P_2	Mean	K_0	K_1	K_2
N_0	9.654	8.041	9.086	8.927	10.705	7.539	8.537
N_1	17.529	14.556	15.856	15.980	14.086	17.065	16.789
N_2	11.414	17.849	18.295	15.853	15.041	18.352	14.165
Mean	12.866	13.482	14.412		13.277	14.319	13.164
K_0	12.913	13.759	12.684				
K_1	12.913	15.372	12.162				
K_2	14.764	13.826	14.646				

F test.	N	P	K	NP	NK	PK
Significance	*	NS	NS	*	NS	NS

CD at 5 % N/P/K = 1.046 NP/NK/PK= 1.812

On-Farm trial with higher doses of fertilizers at Bapatla

An observation trial was laid out in Andhra Pradesh Forest Development Corporation plantations in order to find out the possibility of increasing yields of existing seedling progenies of cashew with higher doses of fertilizers.

The effect of higher doses of fertilizer of NPK on the yield of cashew was observed under on farm trials at Bapatla during the year. The treatment T_3 recorded the highest mean nut yield of 7.25 kg /tree which was on par with the T_2 treatment 6.50 kg/tree over control. However, the number of panicles per square meter was highest in T_3 treatment than T_1 (Table 2.3).

CHINTAMANI

At this Centre, only the vegetative characteristics could be recorded as the trees did not yield during this year.

The maximum stem girth in response to P application was in P_2 (101.31 cm) which was significantly superior over P_0 and P_1. Further the canopy spread was not significantly influenced by N, P, K and their combinations. (Table 2.4)

Table 2.3. Nut yield at different NPK levels under on-farm trials at Bapatla.

Treatment	N g/tree	P_2O_5 g/tree	K_2O g/tree	Mean Nut yield Kg/tree	Mean No. of panicle per Sqm
Recommended dose (T_1)	500	125	125	5.25	12.0
Higher dose (T_2)	1000	250	250	6.50	14.5
Higher dose (T_3)	1500	375	375	7.25	15.5

Table-2.4. Effect of different levels of NPK on stem girth at Chintamani.

	P_0	P_1	P_2	Mean	K_0	K_1	K_2
N_0	94.51	99.32	103.11	99.10	99.63	98.23	99.44
N_1	90.80	94.32	102.11	95.74	96.34	96.47	94.43
N_2	94.95	95.28	98.71	96.62	95.93	97.22	95.80
Mean	93.54	96.31	101.31		97.30	97.31	96.56
K_0	93.94	96.47	101.33				
K_1	93.89	96.99	101.05				
K_2	92.80	95.47	101.41				

CD 5 % for N,P = 1.47; for K= NS; NP, NK, PK = 2.52

JHARGRAM

Maximum plant height (8.80m during 2002 and 2003 respectively) was recorded with the treatment $N_1P_1K_0$. There was significant difference in trunk girth in response to different doses of N, P, K fertilizer application in Jhargram – 1. Highest trunk girth was noticed with zero dose of nitrogen plus moderate dose of phosphorus and higher dose of potassium ($N_0P_1K_2$)(103.67 cm). (Table 2.5).

Table 2.5. Effect of NPK fertilizer and their interaction on growth of cashew at Jhargram.

Treatment	Plant height (m)	Trunk girth (cm)	Treatment	Plant height (m)	Trunk girth (cm)
$N_0P_0K_0$	7.98	89.00	$N_1P_2K_0$	7.73	76.33
$N_0P_0K_1$	6.92	86.33	$N_1P_2K_1$	7.22	84.00
$N_0P_0K_2$	7.13	80.67	$N_1P_2K_2$	7.52	89.17
$N_0P_1K_0$	7.40	78.00	$N_2P_0K_0$	7.92	79.33
$N_0P_1K_1$	7.38	93.67	$N_2P_0K_1$	7.55	84.00
$N_0P_1K_2$	8.06	103.67	$N_2P_0K_2$	7.24	89.33
$N_0P_2K_0$	7.33	98.00	$N_2P_1K_1$	7.19	91.00
$N_0P_2K_1$	7.68	80.67	$N_2P_1K_1$	7.42	92.33
$N_0P_2K_2$	7.53	85.67	$N_2P_1K_2$	8.23	83.33
$N_1P_0K_0$	7.07	85.33	$N_2P_2K_0$	7.30	78.00
$N_1P_0K_1$	6.72	81.00	$N_2P_2K_1$	6.97	87.00
$N_1P_0K_2$	6.72	76.50	$N_2P_2K_2$	8.22	93.67
$N_1P_1K_0$	8.80	96.00	CV%	10.51	10.73
$N_1P_1K_1$	7.77	77.00	**S.Em ±**	**0.511**	**5.291**
$N_1P_1K_2$	7.40	86.67	**C.D at 5%**	**1.45**	**15.02**

On farm trials at Jhargram

Under on farm trial conducted during 2002 BLA-39-4 variety the recommended dose and the alternate dose were evaluated. It was observed that at the initial ages the treatments were at par with respect to their effect on plant height, trunk girth, canopy height, canopy diameter and canopy area (Table 2.6)

MADAKKATHARA

The plant growth characters viz., plant canopy spread, girth of the tree and plant height were not significantly influenced either by the main effects of N, P and K or by their interactions. The nut or apple weight also did not show any significant response, however a stepwise increase in the apple weight was observed with increased N levels. The yield of the tree was found to be significantly influenced by the N levels. The yield of 4.16 kg/tree at N_0 level was found increasing to 5.41 kg/tree at N_1 and 6.10 kg/tree at N_2 levels. However no significant response to P or K levels was observed (Table 2.7).

Table 2.6 : Effect of NPK fertilizer application on growth of cashew at Banstala (Jhargram)

Treatment	Plant height	Trunk girth (cm)	Canopy Diameter (cm)	Canopy height (cm)	Canopy area (m^2)
$N_1P_1K_1$	58.00	5.0	36.83	22.00	0.167
$N_2P_2K_2$	66.67	5.83	44.50	29.33	0.261
$N_3P_3K_3$	66.67	6.33	41.33	31.67	0.257
C.D at 5%	29.40	1.51	19.53	16.76	0.236
CV	20.35%	11.65	21.08%	26.72	45.74

Table 2.7: Effect of NPK and their interaction on plant yield (kg/tree) at Madakkathara

	P_0	P_1	P_2	Mean	K_0	K_1	K_2	Mean
N_0	4.12	3.36	5.00	4.16	4.35	4.40	3.74	4.16
N_1	4.98	6.20	5.06	5.41	5.06	4.10	7.07	5.41
N_2	7.45	6.20	4.65	6.10	6.54	6.08	5.68	6.10
Mean	5.52	5.25	4.90		5.32	4.86	5.50	
K_0	6.35	5.29	4.31	5.32				
K_1	4.92	4.60	5.08	4.87				
K_2	5.28	5.87	5.33	5.49				
Mean	5.52	5.25	4.91					

Treatments	2003	
	SEm	CD
N	0.4444	1.29
P	0.4444	NS
NP	0.7698	NS
K	0.4444	NS
NK	0.7698	NS
PK	0.7698	NS
NPK	1.3333	NS

VRIDHACHALAM

The canopy area was the highest in T_{17} ($N_2P_3K_2$)(500 g N, 250 g P_2O_5 and 125 g K_2O). The nut yield/tree was the maximum (4.375 kg) and the cumulative yield/plant was also the maximum in the T_{24} treatment ($N_3P_2K_3$) (Table 2.8).

Table 2.8 : Performance of cashew in response to NPK fertilizer treatments at Vridhachalam.

Treatment No.	Treatment	Canopy area (m^2)	Nut yield (Kg/tree)	Cum. yield (kg/tree for 2 years)
T_1	$N_1P_1K_1$	23.68	1.875	2.854
T_2	$N_1P_1K_2$	25.57	2.275	3.215
T_3	$N_1P_1K_3$	24.49	2.398	3.265
T_4	$N_1P_2K_1$	20.26	3.183	4.350
T_5	$N_1P_2K_2$	22.32	2.595	3.530
T_6	$N_1P_2K_3$	18.26	3.710	4.816
T_7	$N_1P_3K_1$	21.20	2.602	3.408
T_8	$N_1P_3K_2$	22.07	2.875	3.810
T_9	$N_1P_3K_3$	19.94	2.675	3.630
T_{10}	$N_2P_1K_1$	16.56	3.543	4.403
T_{11}	$N_2P_1K_2$	21.07	3.575	4.545
T_{12}	$N_2P_1K_3$	19.73	3.478	4.410
T_{13}	$N_2P_2K_1$	20.49	3.262	4.243
T_{14}	$N_2P_2K_2$	24.21	3.350	4.331
T_{15}	$N_2P_2K_3$	21.07	3.397	4.336
T_{16}	$N_2P_3K_1$	23.23	4.055	5.158
T_{17}	$N_2P_3K_2$	24.97	4.052	5.431
T_{18}	$N_2P_3K_3$	22.68	4.030	5.540
T_{19}	$N_3P_1K_1$	19.33	4.112	5.370
T_{20}	$N_3P_1K_2$	22.29	4.117	5.375
T_{21}	$N_3P_1K_3$	22.58	4.155	5.425
T_{22}	$N_3P_2K_1$	21.68	3.920	5.316
T_{23}	$N_3P_2K_2$	23.15	4.281	5.773
T_{24}	$N_3P_2K_3$	22.98	4.375	6.160
T_{25}	$N_3P_3K_1$	21.37	3.880	5.240
T_{26}	$N_3P_3K_2$	23.91	4.150	5.555
T_{27}	$N_3P_3K_3$	19.22	4.175	5.674

Ferlilizer application in high density cashew plantations

Centres : East Coast

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast:

Madakkathara, Pilicode and Vengurle

This trial has been laid out to identify the optimum population density for cashew and suitable fertilizer doses at different high density plantings for specific regional variety.

Summary:

Plant girth was not influenced by spacing and interaction between spacing and fertilizer dosage at Bhubaneswar and Vengurla. At Vridhachalam plant height was maximum (2.85 m) with 75 N: 25P : 25 K/ kg/ha and 200 plants/ha., but yield per tree was maximum 1.750 kg/tree in 600 plants/ha and 75 N:25P:25K/ kg/ha

Experimental Details:

Design	:	Split plot
Main plot : Plant density	:	S_1 200 plants / ha (10m x 5 m) S_2 400 plants / ha (6m x 4 m) S_3 600 plants / ha (5m x 4 m)
Sub-plot : Fertilizer dose	:	M_1 75kg N, 25 kg P_2O_5, 25 kg K_2O M_2 150kg N, 50 kg P_2O_5, 50 kg K_2O M_3 225kg N, 75 kg P_2O_5, 75kg K_2O
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

BAPATLA

The above trial, laid out with BPP-8 variety in two replications is in the initial stage of growth. Due to high temperatures that prevailed during the year 2003, high mortality of plants occurred and gap filling has been done to maintain plant population.

BHUBANESHWAR

There was no significant variation due to spacing and interaction. However, the doses of fertilizer were found to significantly differ from each other regarding growth & yield parameters. M_3 (225:75:75 kg/ha NPK) was found significantly superior to M_2 (150:50:50: Kg/ha NPK) and M_1 (75:25:25 Kg/Ha NPK). There was no significant variation due to interaction between spacing and fertilizer dosage.

The yield per ha was found to be significantly influenced due to main plot (S) spacings and sub plot (M) fertilizers. M_3 was found significantly superior to M_2 S_3 (500 plants/Ha at 5x4m) was found significantly superior to S_2 (400 plants /ha 6 x 4m)

and S_1 (200 plants / Ha .at 10x5m). S_3 and S_2 were found significantly superior to S_1 in terms of yield registering 2.33, 2.00 and 0.97 quintals/ha respectively. (Table 2.9)

PILICODE

The plants receiving the treatment, S_3M_1, at the spacing of 5 m x 4 m and with fertilizer dose at 75 kg N, 25 kg P, 25 kg K/ ha performed better in vegetative growth during early stages (Table 2.10).

Table-2.9. Effect of fertilizer application and spacing on vegetative characters and yield of cashew variety H 2/16 at Bhubaneshwar.

Spacing

Treatment	Plant height (m)	Girth(cm) (cm)	Spread of the plant (m)		Yield / plant (kg)	Cumulative yield (kg/plant) 1st harvest	Yield /ha (Quintals)
			E-W	N-S			
S1	2.27	25.25	2.93	2.92	0.48	0.48	0.97
S2	2.33	24.17	2.89	2.99	0.50	0.50	2.0
S3	2.32	24.58	2.94	2.93	0.48	0.48	2.33
F 'test'	NS	NS	NS	NS	NS		*
SE (m) ±	0.10	0.48	0.11	0.038	0.016		0.086
CD (5%)	-	-	-	-	-		0.21

Doses of fertilizer

Treatment	Plant height (m)	Girth (cm)	Spread of the plant (m)		Yield / plant (kg)	Cumulative yield (kg/plant) 1st harvest	Yield /ha (Q/ha)
			E-W	N-S			
M1	2.32	24.75	2.90	2.95	0.43	0.43	1.63
M2	2.30	25.17	2.96	3.04	0.45	0.45	1.65
M3	2.28	24.08	2.90	2.86	0.57	0.57	2.03
F 'test'	NS	NS	NS	NS	*		*
SE (m) ±	0.05	0.37	0.06	0.073	0.19		0.064
CD (5%)	—	—	—	—	0.399		0.134

Table 2.10. Mean of growth characteristics of cashew under fertilizer application in high density plantations (planted in 2000) at Pilicode.

Treatment	Height (m)	Girth (cm)	Tree spread (m)	
			EW	NS
S_1M_1	1.57	16.86	1.72	1.5
S_1M_2	1.65	20.20	1.86	1.67
S_1M_3	1.83	21.70	1.75	1.75
S_2M_1	1.96	22.10	1.69	1.72
S_2M_2	1.96	21.40	1.73	1.63
S_2M_3	1.86	17.60	1.97	1.73
S_3M_1	2.11	23.00	1.84	1.76
S_3M_2	1.84	19.56	1.75	1.73
S_3M_3	1.95	22.10	1.86	1.95

VENGURLA

The growth parameters viz., plant height, stem girth and canopy spread did not vary significantly and interaction effect on these parameters was also not significant at 4th year after planting (Table 2.11).

VRIDHACHALAM

The plant height was the maximum (2.85 m) in M_1S_1 treatment (10 x 5 m spacing & 75 kg N, 25 kg P_2O_5 and 25 kg K_2O/ha). The yield /tree was maximum (1.750 kg) in M_3S_1 whereas, the yield/ha was maximum in M_3S_3 (5 x 4m, 225 kg N, 75 kg P_2O_5 and 75 kg K_2O/ha) (Table 2.12).

Table 2.11 : Effect of spacing and fertilizer on growth of cashew at Vengurle.

Treatment	Plant Height (m)			Plant Girth (cm)			Canopy spread (m)		
	M_1	M_2	M_3	M_1	M_2	M_3	M_1	M_2	M_3
S_1	2.39	2.50	2.60	0.33	0.35	0.32	3.55	3.85	3.96
S_2	2.26	2.51	2.38	0.28	0.30	0.32	2.92	2.97	3.06
S_3	2.58	2.53	2.41	0.37	0.37	0.34	3.46	4.00	3.57
Se m±			0.14			0.031			0.35
CD at 5%			NS			NS			NS

Table 2.12. Fertilizer application in high density plantation in cashew at Vridhachalam

Treatment	Plant height (m)	Plant girth (cm)	Canopy spread (m)	Nut weight (g)	Yield/ tree	Yield / ha
M_1S_1	2.85	20.53	2.65	5.90	1.450	290
M_1S_2	2.53	30.20	2.95	5.90	0.700	280
M_1S_3	2.14	18.72	2.85	5.95	0.900	350
M_2S_1	2.50	25.43	2.95	6.01	1.650	330
M_2S_2	2.65	24.51	3.15	5.90	1.400	560
M_2S_3	2.75	19.56	2.55	6.00	0.750	375
M_3S_1	2.60	28.62	3.26	6.10	1.750	350
M_3S_2	2.50	20.48	2.80	5.85	1.700	680
M_3S_3	2.70	25.62	3.10	5.90	1.600	800

High density planting – observational trials.

Centres: East Coast

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast:

Madakkathara, and Vengurla

Plains / others:

Chintamani and Jagdalpur

This trial has been laid out to identify the optimum population density for cashew to maximize the returns per unit area cultivated.

Summary:

At Bhubaneshwar, 4 x 4m spacing led to lanky tree growth with more dead wood. At Chintamani, yield ranged between 0.25 to 1.45 kg/tree under high density planting. The observational trial is being continued at other centers.

Experimental Details:

Planting of cashew at 4 x 4 m spacing with recommended fertilizer dosage.

BHUBANESHWAR

The trial was laid out with 4m x 4m spacing during the year 1996. Recommended doses of fertilizers was applied at 500 : 125 : 250g of NPK per plant. The plants attained a height of 5.2m and the canopy spread was reduced and had more of dead wood. The yield per ha was 1.31t, 1.75t and 1.16t during the year 2001, 2002 and 2003 respectively. The reduction in yield is due to reduction in canopy area, where sunlight happens to be the limiting factor.

The yield in the farmers' field by high density planting with the variety V-4 was 1.56t per ha on 3rd harvest (2003). The yield (t/ha) during 2001 and 2002 were 1.875 and 1.25 respectively.

CHINTAMANI

The high density planting trial with Chintamani-1 grafts at a spacing of 4 x 4 m. has been laid out. Observations on the 5 year old grafts were recorded on randomly selected 25 plants, the maximum plant height was 3.6 m, with a stem girth ranging between 12.0 to 33.0 cm. The yield ranged between 0.25 to 1.45 kg/tree. (Table 2.13).

Table 2.13. Effect of high density planting on growth parameters of cashew at Chintamani

Parameter	Maximum	Minimum	Mean
Pl. height (m)	3.60	1.65	2.91
Stem girth (cm)	33.00	12.00	16.33
Canopy spread (m)			
E-W	3.31	1.90	2.55
N-S	3.60	2.10	2.75
Yield (kg/tree)	1.45	0.25	0.84

Cashew based cropping systems

Centres: East Coast

Bapatla, Bhubaneshwar, Jhargram and Vridhachalam

West Coast:

Madakkathara, and Vengurla

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

Summary:

At Bhubaneshwar, turmeric as intercrop could give profit of lead to Rs.8,000/- per ha. At Jhargram, cowpea could lead to a profit of Rs.6,250/- per ha. Groundnut when cultivated as intercrop in Vridhachalam led to a profit of Rs.24,580/- per ha.

Experimental Details:

Main plot : 4
Sub plots : 3
F_0 = No additional fertilizer to the intercrop
F_1 = Additional fertilizer to the intercrop as per the state recommendation
F_3 = 50% of additional fertilizer applied to the intercrop
No. of replications : 3
Design : Split plot

BAPATLA

Black gram Var: LBG-623 and green gram-Var: LGG-460 were used as intercrops.Due to sandy soil conditions and high evapo-transpiration the total returns could not lead to profits from intercrops (Table 2.14).

BHUBANESHWAR

Maximum returns were obtained from turmeric as intercrop with cashew and minimum returns were from green gram. The other crops viz., pumpkin and cowpea could not result in profit (Table 2.15).

Table 2.14: Yield and net returns of intercrops in cashew at Bapatla.

Repl.No.	Treatments	Mean Yield from intercrops		Total cost of intercrops/ha (Rs.)	Total returns from intercrops/ha (Rs.)
		Per Plot (kg) size 2 sq.m	Per ha (kg)		
Green gram	F-0	0.015	75	3200/-	2100/-
	F-1	0.030	150	4200/-	3400/-
	F-2	0.019	97	3600/-	2800/-
Black gram	F-0	0.015	75	3400/-	2400/-
	F-1	0.033	165	4800/-	4800/-
	F-2	0.022	108	3800/-	3200/-

Table 2.15. Performance of cashew and its intercrops at Bhubaneswar.

Sl.No	Treatments	Cashew yield (Q/ha)	Returns Rs/ha	
			Cashew @ Rs. 3300/Q	Net return from intercrop
T_1	Cashew + Cowpea with no fertilizer	5.6	18480	(-)460
T_2	Cashew + Cowpea with recommended fertilizer (25:50:25Kg/ha)	7.2	23760	1800
T_3	Cashew + Cowpea with 50% recommended fertilizer	7.0	23100	310
T_4	Cashew + Pumpkin with no fertilizer	5.2	17160	(-)1000
T_5	Cashew + Pumpkin with recommended fertilizer (50:30:75Kg/ha)	6.3	20790	1800
T_6	Cashew + Pumpkin with 50% recommended fertilizer	6.4	21120	1400
T_7	Cashew + Turmeric with no fertilizer	6.4	21120	(-)5700
T_8	Cashew + Turmeric with recommended fertilizer(60:30:90 kg/ha)	6.2	20460	8000
T_9	Cashew + Turmeric with 50% recommended fertilizer	6.6	21780	3700
T_{10}	Cashew + Greengram with no fertilizer	5.6	18480	0
T_{11}	Cashew + Greengram with recommended fertilizer(25:50:25 Kg/ha)	5.2	17160	740
T_{12}	Cashew + Greengram with 50% recommended fertilizer	5.6	18480	230

JHARGRAM

The performance of intercrops in between cashew crop during the initial years cashew plantation indicatd that cowpea yielded a net profit of Rs. 6250.00 /ha while other crops millet, okra and blackgram did not yield any returns (Table 2.16).

VRIDHACHALAM

The yield of intercrops were 784.35, 663.00, 770.00 and 2115.60 kg/ha for black gram, gingelly, green gram and groundnut respectively. The net profit was maximum (Rs. 24580 /ha) when groundnut was activated as intercrop (Table 2.17).

Table 2.16 : Performance of intercrops at Jhargram.

Treatments details (intercrop)	Yield plot (kg)	Yield/ha (Q)	Total cost of intercrop/ha (Rs./ha)	Total Returns from intercrops (Rs./ha)	Net Profit (Rs./ha)
Cowpea	5	31.25	6250.00	12500.00	6250.00

Table 2.17 : Performance of different intercrops in Cashew at Vridhachalam

Sl. No.	Treatments	Yield from intercrops		Total cost of intercrops (Rs./ha)	Total returns intercrops/ha (Rs.)	Net profit (Rs./ha)	C:B ratio
		plot yield (kg)	Hectare yield (kg)				
T_1	Cashew + Black gram	2.82	784.35	5850	14118	8268	1: 2.4
T_2	Cashew + Gingelly	2.39	663.00	4200	18564	14364	1: 4.4
T_3	Cashew + Green gram	2.77	770.00	5450	16940	11490	1: 3.1
T_4	Cashew + Groundnut	7.62	2115.60	13500	38080	24580	1: 2.8
T_5	Cashew sole crop	-	-	-	-	-	-

Drip irrigation trial

Centres : East Coast:

Vridhachalam

West Coast:

Vengurla

Plains / others:

Chintamani

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

Summary:

The trial has been initiated at Chintamani and Vengurla. Observations on growth parameters of cashew are being recorded.

Experimental Details:

Treatments	:	Five		
T_1	=	No irrigation		
T_2	=	Irrigating 20% of cumulative pan evaporation		
T_3	=	Irrigating 40% of cumulative pan evaporation		
T_4	=	Irrigating 60% of cumulative pan evaporation		
T_5	=	Irrigating 80% of cumulative pan evaporation		
Spacing	=	7 x 7 m		
Planting material	=	Softwood grafts		
Variety	=	Chintamani	:	Chintamani-1
		Vengurle	:	Vengurle-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. Drip irrigation system installation work was completed. The treatments were imposed as per the technical programme during January 2003.

VENGURLA

Growth parameters such as height, stem girth and canopy spread were recorded and performance in different treatments are presented in Table 2.18. The growth parameters were not significant in the fifth year after planting.

Table 2.18 Effect of drip irrigation on the growth of cashew at Vengurle.

Treatments	Height (m)	Stem Girth at bottom (cm)	Canopy Spread	
			E - W (m)	N - S (m)
T1- No irrigation	3.50	41.04	5.08	5.06
T2- Irrigation 20% CPE	3.61	38.48	5.23	5.07
T3- Irrigation 40% CPE	3.66	43.81	5.25	4.86
T4-Irrigation 60%CPE	3.61	40.30	4.77	4.70
T5- Irrigation 80% CPE	3.32	41.35	4.77	4.82
Mean	3.54	40.99	5.02	4.90
C.D. at 5%	N.S.	N.S.	N.S.	N.S.

III. CROP PROTECTION

3. CROP PROTECTION

Chemical Control of pest complex in cashew

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

Centres : East Coast:

Jhargram and Vridhachalam

West Coast:

Madakkathara and Vengurle

Plains / others:

Chintamani and Jagdalpur

The objective of this project is to identify an effective insecticidal spray schedule for managing the tea mosquito bug (TMB) and other minor pests of cashew. The project also aims at testing the alternate chemicals in comparison with standard insecticidal spray schedule against insect pests of cashew.

Summary:

At Chintamani, inflorescence thrips were minimum in second spray (1.38 No./panicle). Second spray reduced TMB population to a minimum (0.08%) at Jagdalpur. Incidence of leaf miner, leaf and blossom webber and shoot tip caterpillar were minimum and significantly different from control in three rounds of sprays at Jhargram. The percent shoot/panicle damage was minimum (14.04%) in monocrotophos 0.05% spray after the third spray. The recommended spray schedule was found to be most effective at Vridhachalam.

Experimental Details:

T_1 = Monocrotophos (0.05%) one spray at flushing
T_2 = Endosulfan (0.05%) one spray at flowering
T_3 = Carbaryl (0.1%) one spray at fruiting
T_4 = T_1 and T_2
T_5 = T_1, T_2 and T_3
T_6 = T_1 and T_3
T_7 = T_2 and T_3
T_8 = Endosulfan (0.05%) at flowering followed by neem oil (2%) at fruiting
T_9 = Carbaryl (0.1%) at flowering stage followed by neem oil (2%) at fruiting
T_{10} = Control

CHINTAMANI :

There was no incidence of TMB during 2003, hence the first two sprays were taken up and observations were recorded on the incidence of inflorescence thrips. The minimum number of inflorescence thrips was recorded in endosulfan (0.05%) during the second spray which coincided with the flowering (1.38 per panicle) and in recommended three spray schedule (3.53 per panicle) after 30 days after third spray (Table 3.1).

Table 3.1: Incidence of inflorescence thrips in different treatments at Chintamani

Treatments		Inflorescence thrips (No./panicle)	
		30 days after II Spray	30 days after III spray
T_1	Monocrotophos (0.05%) – one spray at flushing	12.26	15.72
T_2	Endosulfan (0.05%) – one spray at flowering	1.38	14.18
T_3	Carbaryl (0.1%) - one spray at fruiting	12.32	3.81
T_4	T_1 and T_2	1.46	15.13
T_5	T_1, T_2 and T_3	1.52	3.53
T_6	T_1 and T_3	13.31	3.64
T_7	T_2 and T_3	1.96	3.71
T_8	Endosulfan (0.05%) at flowering stage followed by neem oil (2%) at fruiting	2.01	3.73
T_9	Carbaryl (0.1%) at flowering stage followed by neem oil (2%) at fruiting stage	1.68	3.66
T_{10}	Control	12.96	16.10
	SEm ±	0.34	0.33
	CD at 5%	1.02	1.00

JAGDALPUR

During 1st spray and in T_4 least per cent incidence of TMB (0.21%) was observed. In 2nd spray T_8 gave lowest incidence (0.08%) which was at par with T_5, T_2, T_1 & T_3. In case of 3rd spray T_5 gave lower incidence (0.21%) which is at par with T_6, T_1, T_7, T_4 and T_3. The mean of all three sprays show minimum incidence of TMB damage in the T_5, which happens to be the recommended spray schedule.(Table 3.2)

The natural enemies were recorded maximum in control (T_{10}) (2.89/sample) followed by T_5 (2.81/sample). The yield was higher in T_5 followed by T_2. Minimum damage by leaf caterpillar, leaf folder, as well as leaf miner occurred in T_5 which comprised of the three scheduled sprays. (Table 3.2 and 3.3)

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

Treatment	Per cent incidence of TMB (Tea mosquito bug)					Natural Enemies/sample				Yield
	Pre-treatment	30 days After Ist Spray	30days After IInd Spray	30days After IIIrd Spray	Mean	Pre Treat.	30 days After Ist Spray	30days After IInd Spray	30 darys After IIIrd Spray	kg/tree
T_1	0.39	1.36	0.13	0.28	0.59	0.65	2.04	0.77	1.42	0.350
T_2	0.00	0.00	0.11	0.83	0.31	0.68	2.14	1.84	1.42	0.750
T_3	0.00	0.00	0.22	0.61	0.28	0.48	1.15	1.35	1.55	0.310
T_4	0.00	0.21	1.16	0.53	0.63	1.27	1.78	1.77	1.30	0.115
T_5	0.00	0.42	0.09	0.21	0.24	0.73	1.70	2.18	2.81	0.780
T_6	0.00	0.41	0.40	0.26	0.36	1.21	2.13	2.22	1.58	0.450
T_7	0.00	0.85	0.72	0.32	0.63	1.00	2.38	1.79	1.19	0.380
T_8	0.77	0.63	0.08	1.82	0.84	1.20	2.81	1.15	0.93	0.050
T_9	0.87	0.43	0.21	2.09	0.91	1.22	1.64	1.14	0.92	0.020
T_{10}	0.92	1.44	1.29	2.22	1.65	1.38	3.60	2.30	2.89	0.000
SE (m) ±	0.16	0.16	0.14	0.25						0.09
CD at 0.05	0.29	0.29	0.26	0.46						0.16

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

Treatment	Mean of three sprays		
	% Leaf caterpillar damage	% Leaf folder damage	% Leaf miner damage
T_1 : Monocrotophos 0.05% one spray at flushing stage.	7.94	13.38	8.97
T_2 : Endosulfan 0.05% one spray at flowering stage.	7.97	15.09	1.39
T_3 : Carbaryl 0.1% one spray at fruiting stage.	17.16	13.16	0.69
T_4 : Monocrotophos + Endosulfan at flushing and flowering stage.	11.69	12.12	0.69
T_5 : Monocrotophos + Endosulfan + Carbaryl at flushing, flowering and fruiting stage.	7.63	10.38	0.00
T_6 : Monocrotophos + Carbaryl at flushing and fruiting stage.	13.80	21.35	0.50
T_7 : Endosulfan + Carbaryl at flowering and fruiting stage.	11.26	19.89	2.74
T_8 : Endosulfan (0.05%) spray at flowering stage followed by neem oil (2 %) at fruiting stage.	16.58	17.18	0.83
T_9 : Carbaryl (0.1%) spray at flowering stage followed by neem oil (2%) at fruiting stage.	20.90	18.27	1.88
T_{10} : Control	39.77	33.07	14.50

JHARGRAM

Due to very low incidence of TMB, the incidence of only leaf miner, leaf and blossom webber are shoot tip caterpillar were recorded . Infestation by these pests was much lower when the first and second sprays (T_4) were undertaken. After third round of spray, mean incidence of leaf miner, leaf and blossom webber and shoot tip caterpillar was 3.8, 3.1 and 5.4% respectively in T_4, while, untreated control T_{10} recorded 15.6, 17.4 and 15.4% pest incidence respectively. All the treatments were superior to control and T_4, T_5, T_6 and T_7 were superior to rest of the treatments. T_4 recorded the highest yield (4.92 Kg/tree) and control recorded lowest yield of 2.08 Kg/tree (Table 3.4).

Table 3.4 : Incidence of minor pests at Jhargram

Treatments	After first spray			After second spray			After third spray			Mean thrips damage score	Yield (kg/tree)
	LM	LBW	STC	LM	LBW	STC	LM	LBW	STC		
T_1	4.3	7.3	6.5	8.6	8.5	6.9	8.9	8.9	8.7	0.30	3.44
T_2	4.8	7.6	6.8	8.9	9.2	7.2	9.2	9.1	8.9	0.32	3.31
T_3	4.9	7.6	6.8	9.2	9.8	7.2	9.6	9.3	8.9	0.32	3.25
T_4	2.2	2.2	4.7	3.2	2.3	5.2	3.8	3.1	5.4	0.08	4.92
T_5	2.6	2.2	4.9	3.6	2.7	5.3	4.1	3.4	5.7	0.17	4.86
T_6	2.8	2.4	5.2	3.9	2.7	5.3	4.2	3.5	5.9	0.23	4.76
T_7	3.4	2.4	5.4	4.4	2.9	5.6	4.4	3.8	6.2	0.29	4.01
T_8	4.6	6.9	6.1	7.3	7.9	6.5	7.6	8.2	8.1	0.32	3.95
T_9	4.7	7.1	6.3	8.2	8.2	6.8	8.4	8.4	8.4	0.34	3.82
T_{10}	5.6	9.2	8.4	11.4	14.6	13.2	15.6	17.4	15.4	0.41	2.80
CD at 5%											

LM = Leaf miner, LBW = Leaf and blossom webber, STC = Shoot tip caterpillar

VENGURLE

It was observed that after first spray, the shoot damage by tea mosquito bug was non significantly different among the treatments. After second spray, treatment T_9 (Carbaryl 0.1% at flowering followed by neem oil 2.0 % at fruiting) was significantly superior over control and at par with T_6 (Monocrotophos 0.05 % at flushing and carbaryl 0.1% at fruiting) and T_1 (monocrotophos 0.05% at flushing). Pest damage after 3rd spray was least in T_1 (monocrotophos 0.05% at flushing) which was significantly superior over control and at par with T_4, T_5, T_6 and T_7 (Table 3.5).

Table 3.5 : Incidence of Tea mosquito bug in different treatments at Vengurle

Treatment	Average per cent shoots/ panicles damaged 30 days after		
	I spray	II spray	III spray
T1	6.44 (14.65)	10.92 (19.28)	14.04 (21.9)
T2	7.46 (15.79)	15.06 (22.79)	18.40 (25.40)
T3	9.15 (17.95)	18.82 (25.70)	24.14 (29.40)
T4	6.96 (15.23)	12.74 (20.88)	17.83 (24.95)
T5	2.68 (9.28)	13.31 (21.39)	16.40 (23.89)
T6	5.97 (14.06)	10.88 (19.19)	14.21 (22.14)
T7	7.52 (15.89)	11.80 (20.09)	18.13 (25.18)
T8	6.52 (15.89)	12.75 (20.88)	25.44 (30.26)
T9	5.28 (13.18)	9.94 (18.34)	22.82 (28.52)
T10	9.36 (17.76)	18.93 (25.77)	27.66 (31.69)
S.E.±	0.176	0.561	1.130
C.D. at 5%	N.S.	1.666	3.355

Figures in parenthesis are arc sine values

Control of minor pests : Inflorescence thrips.

Observations were done regarding the level of damage by inflorescence thrips on the nuts in the same experimental plot. At peanut stage significantly lowest incidence (14.66 %) was noticed in T_3 (carbaryl 0.1% at fruiting) and at par with T_5 (recommended spray schedule). At pebble stage the treatment T_5 (recommended spray schedule) was significantly superior over rest of the treatments except T_1 (monocrotophos 0.05% at flushing) and T_3 (carbaryl 0.1% at fruiting) which were at par with each other. The matured nuts had the least surface damage 24.16 in case of T_3 (carbaryl 0.1% at fruiting). (Table 3.6)

VRIDHACHALAM

The damage score was nil in T_5 and it was 0.5 to 0.7 in T_6, T_7, T_8 and T_9 indicating that the recommended spray schedule was effective in managing the pest. The yield was maximum (6.2 kg/tree) in T_5 followed by T_8 (5.2 kg/tree) (Table 3.7).

Control of minor pests

Three scheduled spraying consisting of monocrotophos (0.05%) during flushing, endosulfan (0.05%) during flowering and carbaryl (0.1%) during fruiting stage recorded minimum pest incidence of leaf and blossom webber (5.6% damaged laterals), leaf miner (11.2% damaged laterals and 12.4% leaf damage) (Table 3.8).

Table 3.6 : Incidence of inflorescence thrips on nut surface at Vengurle

Treatment	Average per cent nut surface damaged at		
	Peanut stage	Pebble stage	Matured nuts
T1	17.33 (24.58)	23.00 (28.66)	27.50 (31.63)
T2	20.00 (26.56)	24.00 (29.33)	26.66 (31.11)
T3	14.66 (22.55)	22.66 (28.45)	24.16 (29.47)
T4	18.00 (25.10)	25.55 (30.33)	27.77 (31.82)
T5	16.00 (23.58)	21.33 (27.49)	25.83 (30.53)
T6	18.66 (25.62)	27.77 (31.82)	27.50 (31.63)
T7	21.66 (27.76)	28.00 (31.95)	29.16 (32.71)
T8	18.88 (25.77)	29.16 (32.71)	30.83 (33.71)
T9	21.11 (27.35)	26.66 (31.11)	27.50 (31.63)
T10	24.44 (29.60)	32.33 (34.57)	32.50 (34.76)
S.E.±	0.493	0.586	0.597
C.D. at 5%	1.465	1.739	1.829

Figures in parenthesis are arc sine values.

Table 3.7. Chemical control of TMB at Vridhachalam

Treatment	TMB score (30 DAS)				Yield (kg/tree)
	Pre-treatment	I spray	II spray	III spray	
T_1 = Monocrotophos (0.05%) one spraying treatment at flushing stage	2.1	0.8	1.0	2.0	4.0
T_2 = Endosulfan (0.05%) – One spray at flowering stage	1.5	2.0	0.8	1.3	3.8
T_3 = Carbaryl 1 (0.1%) one spray at fruiting stage	1.8	2.3	2.6	1.7	3.6
$T_4 = T_1 + T_2$ 2.8	0.9	0.3	1.0	5.0	
$T_5 = T_1+T_2+T_3$	2.1	0.8	0.2	0.0	6.2
$T_6 = T_1$ and T_3	2.0	0.9	1.2	0.7	4.3
$T_7 = T_2$ and T_3	1.9	2.1	1.0	0.6	4.2
T_8 = Endosulfan (0.05%) spray at flowering stage followed by neem oil (2%) at fruiting stage	1.8	2.0	0.7	0.7	5.2
T_9 = Carbaryl (0.1%) at flowering stage followed by neem oil (2%) at fruiting stage	2.0	1.9	0.7	0.5	4.8
T_{10} = Unsprayed check	18	2.5	3.0	3.6	3.2
SED	0.18	0.12	0.14	0.11	0.28
CD	0.35	0.25	0.30	0.22	0.59

Table 3.8. Chemical control of minor pests at Vridhachalam

Treatment	% laterals damaged 30 DAS		% leaves damaged by leaf miner	Mean number of insects/ lateral	
	Leaf and blossom webber	Leaf miner		Leaf thrips	Inflorescence thrips
T_1	10.1	24.3	22.3	0.0	2.6
T_2	12.6	26.3	24.2	2.0	3.0
T_3	10.4	28.6	19.6	1.7	2.8
T_4	11.3	22.4	14.4	0.0	2.0
T_5	5.6	11.2	12.4	0.0	1.2
T_6	11.4	21.4	17.4	1.6	2.2
T_7	9.6	16.4	21.3	1.3	2.0
T_8	8.4	16.3	21.3	2.3	2.8
T_9	7.4	15.6	22.8	0.0	2.6
T_{10}	26.8	38.4	32.6	2.7	3.4
SED	1.44	1.85	1.43	0.83	0.23
CD	3.03	3.89	3.02	1.76	0.49

30 DAS = 30 days after spraying

Evaluation of new chemicals for control of TMB and other pests

Centres : East Coast:

Bapatla, Bhubhanesar and Vridhachalam

West Coast:

Madakkathara and Vengurle

Plains / others:

Chintamani and Jagdalpur

The project aims at identifying the effective insecticide amongst the newer synthetic insecticides, which are safer as well as economically feasible for managing the pests of cashew.

Summary:

At Bapatla, all the new insecticides tested were on par with recommended spray schedule. The recommended spray schedule was found to be superior compared to all other treatments at Bhubaneswar. All treatments viz., chlorpyriphos 0.05%, triazophos 0.1% and profenophos 0.05% were on par with each other and significantly superior over control at Chintamani. At Jagdalpur mean highest yield was obtained in endosulfan 0.05% at flowering, while at Jhargram recommended spray schedule led to lowest damage score by apple and nut borer, thrips, shoot tip caterpillar and leaf and blossom webber and led to highest yield of 4.689 kg/tree. L.-Cyhatothrin performed better in managing TMB, apple and nut borer as well as leaf miner at Madakkathara, Chlorpyriphos (0.05%) spray and profenophos (0.05%) spray were significantly superior over other treatments, at Vengurle and Vridhachalam respectively.

Experimental Details:

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

All the new insecticides and the recommended spray schedule along with the untreated control were found on par with each other in keeping the pest population of leaf and blossom webber under check, whereas, in the case of shoot tip caterpillar, the new insecticides and the recommended spray schedule were found on-par with each other but superior over untreated control.

The nut damage by apple and nut borer showed no significant difference among the new insecticides and the recommended spray schedule along with the un-treated control. The number of natural enemies was minimal in all treatments in comparison to control. (Table 3.9)

BHUBANESWAR

Tea mosquito bug (TMB) infestation was not observed during this year, hence infestation of shoot tip caterpillar and inflorescence thrips were studied during the experimental period.

a. Shoot tip borer (*Hypatima haligramma* M.)

On 30 days after 2nd spray the treatment T_4 is at par with the recommended spray (T_1) and the other spray schedules (T_2, T_3 and T_5) were at par and significantly lower than the control treatment. During 30 days after 3rd spray the pest incidence was negligible even in control plots.

b. Inflorescence thrips (*Frankliniella schultzei* T. *Haplotrips ceylonicus* Sch.)

Data on the incidence of inflorescence thrips indicated that 30 days after 3rd spray the damage score was reduced to a range of 0.08 to 0.25 which is significantly low as compared to untreated check (0.67) (Table 3.10)

Table 3.9. Damage due to minor pests under newer insecticides at Bapatla

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 (%)
	Spider	Ants			30 days after 3rd spray	30 days after 3rd spray
Endosulfan 0.05% at flowering and carbaryl 0.1% at nut development stage	0.17 a	0.33 a	1.62 a	0.89 a	0.21 a	0.07 a
Chlorpyriphos 0.05%(2 sprays)	0.25 a	0.25 a	1.06 a	0.86 a	0.21 a	0.14 a
Triazophos 0.1%(2 sprays)	0.17 a	0.33 a	1.74 a	0.98 a	0.21 a	0.07 a
L- Cyhalothrin 0.003%(2 sprays)	0.25 a	0.42 a	1.32 a	0.88 a	0.21 a	0.00 a
Profenophos 0.05%(2 sprays)	0.33 a	0.42 a	1.81 a	0.86 a	0.20 a	0.00 a
Untreated control	1.00 b	1.83 b	2.71 a	0.89 a	0.71 b	0.22 a

Note: Values followed by same alphabet are statistically on par

Table 3.10. Effect of new chemicals on different insect pests of cashew at Bhubaneswar

Treatment		Mean nos of shoots damaged (%) due to shoot tip cater pillar	Mean damage grade due to thrips 30 days after 3rd spray	Yield kg/tree
		30 days after 3rd spray		
T_1	Monocrotophos (0.05% at flushing, carbaryl (0.1% at fl;owering and fruiting)	1.16^{ac}	6.21^{a}	0.03
T_2	Chlorpyriphos (0.2%)	$0.96^{]ad}$	0.21^{a}	2.48
T_3	Triazophos (0.1%)	0.80^{ad}	0.19^{a}	2.15
T_4	L-cyhalothrin (0.003%)	0.16^{ac}	0.13^{a}	2.01
T_5	Profenophos (0.05%)	1.12^{bd}	0.21^{a}	2.15
T_6	Unsprayed check	2.88^{b}	0.69^{b}	1.85

Note: Values followed by same alphabet are statistically on par

c. Natural enemies and pollinators

The natural enemies observed in the experiments was spiders (*Argeopes* sp., *Oxyopes* sp), lady bird beetle (*Virania cinta*, *Menochilus sexmaculata*), mirid bug (unidentified) and pollinators like black ants (*Camponotus* sp). All the natural enemies and pollinators were significantly reduced by application of any insecticides in comparison to the untreated check (Table 3.11).

CHINTAMANI

Observations indicated that all the chemicals evaluated resulted in good control of inflorescence thrips and all the chemicals were on par with each other. The highest yield of 5.05 kg/tree was recorded in profenophos (0.05%) which was on par with all other treatments except control which recorded least yield (2.65 kg/tree) (Table 3.12).

JAGDALPUR

On shoots, the percent incidence of TMB damage was 0.00% in T_5 (recommended spray schedule) in 1st spray and 0.22% in 3rd spray as compared to 3.98% with pre- treatment, while in 2nd spray T_1 (Monocrotophos 0.05%)show good response with 0.80 percent incidence of TMB. In panicle T_1 showed less incidence of TMB damage in all three sprays followed by T_4 (Monocrotohpos 0.05% + Endosulfan 0.05% at flushing and flowering) and T_2 (Endosulfan 0.05 at flowering). The yield was highest in T_2 followed by T_3 (Carbaryl 0.1% at fruiting). (Table 3.13).

Table 3.11 Effect of different new chemicals on natural enemies/ pollinators at Bhubaneswar

Treatment	Mean no. of natural enemies /pollinators in 52 inflorescence 30 days after 3rd spray during 2003			
	Spiders	Black ants	Lady bird beetle	Mirid bug
T_1	1.00[a]	2.66[a]	0.42[a]	0.83[a]
T_2	0.67[a]	2.08[a]	0.25[a]	0.67[a]
T_3	0.92[a]	2.92[a]	0.17[a]	0.75[a]
T_4	0.50[a]	1.92[a]	0.33[a]	0.58[a]
T_5	0.75[a]	2.17[a]	0.33[a]	0.67[a]
T_6	2.42[b]	6.50[a]	1.25[b]	2.33[b]

Note: Values followed by same alphabet are statistically on par

Table-3.12: Incidence of inflorescence thrips in different treatments at Chintamani

	Treatment	Inflorescence thrips (No./panicle)		
		30 days after II spray	30 days after III spray	Yield (kg/tree)
T_1	Recommended sprays	2.12	3.08	4.52
T_2	Chlorpyriphos (0.05%)	2.08	2.32	4.69
T_3	Triazophos (0.1%)	2.03	2.41	4.58
T_4	Profenofos (0.05%)	1.99	2.18	5.05
T_5	Control	16.12	18.02	2.65
	SEm ±	0.41	0.31	0.42
	CD at 5%	1.19	0.91	1.21
	CV (%)	16.10	17.11	18.32

The population of *Brumus sp.* was maximum in T_2 followed by T_4; spider was found highest in T_4 followed by T_2, the maximum activity of ants was seen in T_1 followed by control treatment. The mirid bug population was higher than others in T_5.

In case of minor pest, leaf caterpillar damage was found lowest in T_5 (0% in 1st & 2nd spray and 2.5% in 3rd spray) followed by T3. In Leaf Folder damage, T_4 gave good response (0.64%, 8.33% and 6.36% 1st spray, 2nd spray and 3rd spray, respectively) followed by T_2. The percent Leaf Miner damage effectively reduced by T_4 as compared to pre treatment (0% in all the three sprays) followed by T_5.

JHARGRAM

Due to low incidence of TMB observations were taken on damage by shoot tip caterpillar, leaf and blossom webber, thrips and apple and nut borer. Recommended treatment T_1 was the most effective treatment and among new chemicals, profenophos (T_5) was the best which recorded 6.90per cent damage by shoot tip caterpillar and 2.54 per cent damage by leaf and blossom webber after the first round of spray. Lowest apple and nut borer damage (0.2%) was recorded in T_1 and T_5 while control (T_6) recorded 2.8 per cent damage. Lowest thrips damage score (0.09) was obtained with T_1. The highest yield (4.689 Kg/tree) was recorded in T_1 and amongst new chemicals T_5 (profenophos) recorded the highest yield (4.524 kg/tree) (Table 3.14).

Table-3.13: Efficacy of new chemicals against major pests of cashew at Jagdalpur

Treat-ment	Percent incidence of TMB (Tea mosquito bug)										Yield Kg/tree
	Shoot					Panicle					
	Pre-treatment	30days After Ist Spray	30days After IInd Spray	30days After IIIrd Spray	Mean of All three spray	Pre-treatment	30days After Ist Spray	30days After IInd Spray	30days After IIIrd Spray	Mean of All three spray	
T_1	0.24	0.00	0.80	1.24	0.68	1.27	0.00	2.08	2.51	1.53	1.12
T_2	0.00	0.00	1.49	0.73	0.74	0.17	0.04	3.09	3.83	2.32	2.39
T_3	0.20	0.03	1.12	0.45	0.53	0.32	0.02	3.00	5.24	2.75	1.60
T_4	0.20	0.72	1.88	0.75	1.12	0.56	0.42	2.95	2.62	2.00	0.15
T_5	3.98	0.00	4.05	0.22	1.42	1.35	0.03	2.54	5.33	2.63	0.22
T_6	4.81	2.19	4.35	1.68	2.74	1.85	0.62	3.14	5.99	3.25	0.15
SEm ±	0.99	0.36	0.63	0.22		0.27	0.11	0.17	0.61		3.80
	1.99	0.73	1.27	0.44		0.54	0.22	0.34	1.23		7.66

Table 3.14 : Evaluation of new chemicals for control of TMB and other pests at Jhargram

Treatment	% ABN damage	Thrips damage score	% STC damage		% LBW damage		Yield (Kg / tree)
			Before spray	After first spray	Before spray	After first spray	
T_1	0.2	0.09	6.52	6.82	5.82	2.68	4.68
T_2	0.6	0.26	6.70	7.64	6.12	4.52	4.34
T_3	0.6	0.22	5.90	7.32	5.42	4.72	4.13
T_4	0.8	0.28	6.42	8.62	5.90	7.24	3.81
T_5	0.2	0.12	6.81	6.90	5.46	2.54	4.52
T_6	2.8	0.37	6.74	8.34	5.94	7.62	2.47

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

MADAKKATHARA

Results indicated that L-cyhalothrin 5EC @ 0.003% was found to be the most effective treatment in controlling tea mosquito bug, apple and nut borer and leaf minor followed by T_2 (Chlorpyriphos 20% EC @0.05%) and T_3 (Triazophos 40% EC@ 0.1%) whereas in the case of thrips. Triazophos 40% EC@ 0.1% was found to be effective than L- cyhalothrin. Population of natural enemies was more in the case of T_4 followed by T_6 and T_2 (Table 3.15).

VENGURLE

All the treatments could significantly reduce TMB incidence over control. Amongst the insecticidal treatments T_2 (Chlorpyriphos 0.05%) was observed to be significantly superior over other treatments. Regarding flower thrips, all the treatments significantly reduced the thrips incidence over control; T_3 (Triazophos 0.01%) was found to be significantly superior over rest of the treatments (Table 3.16).

Evaluation of Boron to find out effect of incidence of thrips damage (corky patches) at Vengurle.

This experiment was conducted with objective to investigate effect of boron application on development of corky patches on nuts at Vengurle. However, significant differences were not observed among the various concentrations of Boron applied (Table 3.17).

Table 3.15 : Evaluation of newer insecticides against TMB at Madakkathara.

Treatment	Chemical insecticide	TMB Damage on 30 DAT	Mean % leaves damaged by leaf miner	Mean nut damage % by apple and nut borer 30 days after 3rd spray	Mean damage grade due to thrips 30 DAS 3rd spray	Mean no. natural enemies after 30 days after spraying
T_1	Endosulfan (0.05%) at flowering Carbaryl (0.1%) at fruiting.	0.70 a	0.00	0.01a	0.02a	28.9a
T_2	Chlorpyriphos 0.05%	0.49 ac	27.11 c	0.003ac	0.05ac	35.3ac
T_3	Triazophos 0.1%	0.77 ace	31.10 ce	0.03ade	0.01 ace	20.22ade
T_4	L-yhalothrin 0.003%	0.45 acfg	29.9 ceg	0.01aceg	0.53 aceg	41.3 bcfg
T_5	Profenophos 0.05%	1.05 adehi	33.88dehi	0.02acegi	0.03acegi	26.38abfhi
T_6	Unsprayed check		38.18dehi	0.01acegi	0.01 acegi	38.16 bcfgj

Note: Values followed by same alphabet are statistically on par

Table 3.16 : Incidence of tea-mosquito bug and thrips during at Vengurle.

	Treatment details	Tea mosquito bug				Flower thrips
		Per cent incidence 30 days after				
		First spray	Second spray	Third spray	Cum. Mean	Third spray
T1	Recommended spray schedule	9.70	19.84	27.05	18.86	27.23
T2	Chlorpyriphos 0.05%	8.80	20.08	21.62	16.83	22.67
T3	Triazophos 0.01%	8.56	21.61	24.63	18.26	21.97
T4	Profenophos 0.05%	10.78	21.79	26.73	19.78	23.09
T5	Control	13.74	26.69	31.74	24.05	33.51
	S.E.±	0.102	0.045	0.29	0.058	0.008
	C.D. at 5%	0.315	0.139	0.089	0.181	0.024

VRIDHACHALAM

After three rounds of spraying, damage score of profenophos was comparable (0.3 score) with standard scheduled spraying of monocrotophos, endosulfan and carbaryl (0.3 score) in controlling TMB. The number of caterpillars and thrips score was 3.6 and 2.8 in profenophos, which was comparable with standard scheduled spray (4.6 and 3.6 respectively). Damage intensity of leaf and blossom webber was minimum in chlorpyriphos (4.4%) followed by profenophos (4.6%). The yield was maximum (6.2 kg/tree) in standard spray schedule (5.8 kg/tree) (Table 3.18).

Table 3.17 : Incidence of inflorescence thrips at Vengurle

Treatment details	% area of matured nut damaged
T1 – 1% Boron	36.20
T2 – 2% Boron	35.20
T3 – 3% Boron	35.00
T4 - Control	39.20
C. D. at 5%	NS

Table 3.18 Evaluation of new chemicals for control of TMB and other pests at Vridhachalam.

Treatment	TMB score (30 DAS)								Leaf and blossom webber (% damage)				Yield (kg/tree)
	Pre treat	I spray	II spray	III spray	Spiders	Ants	Caterpillars	Thrips score	Pre treat	I spray	II spray	III spray	
T_1	2.10	0.90	0.40	0.00	2.60	14.60	4.60	2.60	16.30	13.80	8.40	6.80	6.20
T_2	2.00	1.50	1.00	0.80	5.40	22.20	5.40	3.20	17.80	15.50	7.80	4.40	5.00
T_3	2.30	1.50	1.00	0.90	5.40	6.80	6.20	2.80	17.30	14.40	10.80	8.80	4.90
T_4	1.80	1.30	0.8	0.80	4.20	12.20	8.20	3.00	18.30	16.20	12.40	10.80	5.20
T_5	2.40	0.90	0.50	0.30	3.40	8.40	3.60	2.80	16.80	14.60	8.40	4.60	5.50
T_6	2.40	2.60	2.80	3.70	7.80	32.40	10.40	3.40	17.80	15.40	17.80	22.80	3.20
CD	0.33	0.32	0.42	0.34	2.79	2.33	1.56	0.46	1.88	1.99	1.48	1.90	0.38

Control of cashew stem and root borer

1. Prophylactic control trial

Centres : East Coast:

Bapatla. Bhubhaneswar, Jhargram and Vridhachalam

West Coast:

Madakkathara, and Vengurle

The objective of this trial is to evaluate different pesticides and neem products for prophylactic control of the cashew stem and root borer incidence.

Summary:

Swabbing neem oil 5% thrice could prevent reinfestation by stem and root borer at Bapatla, Bhubaneswar, Jhargram, Vengurle and Vridhachalam. Mudslurry + carbaryl swabbing + lindane 0.2% at Madakkathara prevented CSRB incidence for an average of 75.3 days.

Treatments :

Experimental details:

T1 : Swabbing neem oil 5% once during October-November
T2 : Swabbing neem oil 5% twice during October-November and January-February
T3 : Swabbing neem oil 5% thrice during October-November, January-February and April- May.
T4 : Application of *Metarhizium anisopliae* spawn 250g/tree +500g. neem cake.
T5 : Application of *Beauveria bassiana* spawn 250g/tree +500g.neem cake.
T6 : Untreated check.

BAPATLA

Among the prophylactic treatments evaluated application of neem oil 5 percent thrice (T_3) at an interval of three months during October-November, January-February and April-May recorded a nil infestation of cashew stem and root borer even upto 210 days ever since the first application of treatment during October – November, where as application of neem oil 5 percent twice (T_2) during October-November and January-February recorded 25.00 percent infestation and offered protection up to 162 days ever since the first application of the treatment during October – November. Application of neem oil 5 percent once (T_1) during October – November protected the trees only up to 122 days with 30.00 percent infestation (Table 3.19).

In respect of fungal pathogens viz; *Metarrhizium anisopliae* and *Beauveria bassiana* 30.00 percent infestation occurred within 95 days 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 105 days in 35.00 percent of the trees (Table 3.19)

The zone of attack of cashew stem and root borer in affected trees was higher in collar and root (67.00 %) and leser in collar and stem (33.00 %).

BHUBANESWAR

Application of neem oil (5%) thrice (T_3), during Oct., Jan. & April was observed to effectively prevent the the CSRB infestation Most of the trees were found to be infested near collar zone (Table 3.20).

Table 3.19 Infestation levels of CSRB in different prophylactic treatments at Bapatla

Treatments	Number of trees treated	Number of trees infested	% infestation
T1 : Swabbing neem oil 5% once during October-November	20	6	30
T2 : Swabbing neem oil 5% twice during October-November and January- February	20	5	25
T3 : Swabbing neem oil 5% thrice during October-November, January- February and April- May	20	0	0
T4 : Application of *Metarhizium anisopliae* spawn 250g/tree +500g. neem cake.	10	3	30
T5 : Application of *Beauveria bassiana* spawn 250g/tree +500g.neem cake.	10	3	30
T6 : Untreated check.	20	7	35

Table-3.20 Infestation levels of CSRB in different prophylactic treatments at Bhubaneswar

Treatments	Physical parameters		No. of trees	
			Infested	Not infested
T_1 Swabbing neem oil 5% during Oct.-Nov	Stem girth	<60	2	13
	Age	10-15	2	13
	Zone	S	1	
		C+S+R	1	
T_2 Swabbing neem oil 5% during Oct.-Nov, Jan-Feb	Stem girth	<60	1	14
	Age	10-15	1	14
	Zone	C+R	1	
T_3 Swabbing neem oil 5% during Oct.-Nov, Jan-Feb and April-May	Stem girth	<60	-	15
	Age	10-15	-	15
	Zone	S	-	15
T_4 Application of Metarrhizium anisopliae spawn 250gm/tree + 500gm neem cake	Stem girth	<60	2	13
	Age	10-15	2	13
	Zone	C+R	2	13
T_5 Application of *Beauveria bassiana* spawn 250gm/tree + 500gm neem cake	Stem girth	<60	2	13
	Age	10-15	2	13
	Zone	C+S	1	
		C+R	1	
T_6 Untreated check	Stem girth	<60	2	11
		60-80	2	
	Age	10-15	4	11
	Zone	C+S	2	
		C+R	2	

C=Collar C+S=Collar+Stem C+S+R=Collar+Stem+Root

JHARGRAM

Swabbing neem oil 5% thrice (T_3) was the most effective treatment recording longest pest free duration (210 days). T_2 and T_1 were also quite effective recording 190.2 and 176.4 days free from pest attack, respectively whereas pest infestation was noticed after 20.4 days in untreated control. (Table 3.21)

MADAKKATHARA

Trees treated with mudslurry + carbaryl (0.2%) swabbing four times + lindane 0.2% (T_6) was found to be free from fresh infestation for an average of 75.3 days followed by T_3 (Neem oil 5% swabbing four times +lindane 0.2%) and T_5 (mudslurry + carbaryl (0.2%) swabbing thrice + lindane 0.2%) for a period of 68.75 and 67.25 days. (Table 3.22)

VENGURLE

Swabbing neem oil 5% during Oct. – Nov. and Jan. – Feb. (T2) provided maximum protection upto 159.70 days followed by T_1 (Swabbing Neem oil 5% during Oct – Nov) T_4 (Application of *Metarrhizium anisoplae* spawn 250gm/tree + 500gm neem cake) and T_5 (Application of *Beauveria bassiana* spawn 250gm/tree + 500gm neem cake). Cashew trees having more than 60cm girth were preferred by CSRB.

The trees above 5 years of age were more prone to the attack and maximum infested trees were placed in C + R category of zone of attack. (Table 3.23)

Table 3.21. Duration free from cashew stem and root borer infestation under prophylactic trials at Jhargram.

Treatments	Days free from pest infestation
T1 : Swabbing neem oil 5% once during October-November	170.4
T2 : Swabbing neem oil 5% twice during October-November and January- February	190.2
T3 : Swabbing neem oil 5% thrice during October-November, January- February and April- May	210.0
T4 : Application of *Metarhizium anisopliae* spawn 250g/tree + 500g. neem cake.	161.2
T5 : Application of *Beauveria bassiana* spawn 250g/tree +500g. neem cake.	146.4
T6 : Untreated check.	20.4

Table-3.22 Infestation levels of CSRB in different prophylactic treatments at Madakkathara

Treatment	Mean duration free from pest attack (in days)	Total No. of trees	No. of trees not infested
T1- Neem oil 5% twice + Lindane 0.2%	48.55	20	11
T2- Neem oil 5% thrice + Lindane 0.2%	56.14	20	11
T3- Neem oil 5% four times + Lindane 0.2%	68.75	20	13
T4- Mudslury Carbaryl (0.2%) twice + Lindane 0.2%	51.30	20	12
T5- Mudslury Carbaryl (0.2%) thrice + Lindane 0.2%	67.25	20	11
T6- Mudslury Carbaryl (0.2%) four times + Lindane 0.2%	75.30	20	10
T7- Untreated control	32.60	20	9

Table-3.23 Infestation levels of CSRB in different prophylactic treatments at Vengurle

Treatment details	Mean duration free from the pest attack (in days)
T1 – Swabbing Neem oil 5% during Oct – Nov	137.20
T2 - Swabbing Neem oil 5% during Oct – Nov., Jan – Feb.	159.70
T3 - Swabbing Neem oil 5% during Oct – Nov., Jan – Feb and April – May	113.90
T4 - Application of *Metarrhizium anisoplae* spawn 250gm/tree + 500gm neem cake	127.20
T5 - Application of *Beauveria bassiana* spawn 250gm/tree + 500gm neem cake	116.00
T6 - Untreated check	63.30

VRIDHACHALAM

Stem and root borer infestation did not occur for a maximum of 245 days when the trees were swabbed with neem oil 5% at three times during October – November, January- February and April – May, however, treatment involving the application of fungal spawn of *M. anisopliae* and *B. bassiana* had the highest number of trees not infested. (Table 3.24)

Table 3.24 Infestation levels of CSRB in different prophylactic treatments at Vridhachalam

Treatment	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
T_1	122	10	Infested	-	-	2	1	-	-	-	-
			Not infested	8	6	4	-	-	-	-	-
T_2	146	15	Infested	-	1	2	-	1	1	-	-
			Not infested	5	10	2	-	-	-	-	-
T_3	245	5	Infested	-	-	1	-	1	-	-	-
			Not infested	8	6	5	-	-	-	-	-
T_4	86	10	Infested	-	-	2	-	1	-	-	-
			Not infested	10	6	2	-	-	1	-	-
T_5	88	15	Infested	-	1	2	-	-	1	-	-
			Not infested	10	6	1	-	-	1	-	-
T_6	91	25	Infested	-	1	4	1	1	-	-	-
			Not infested	6	6	3	-	-	-	-	-

2. Curative control trial

Centres : East Coast:

Bapatla. Bhubhaneswar, Jhargram and Vridhachalam

West Coast:

Madakkathara, and Vengurle

The objective of this trial is to evaluate different pesticides and neem products for curative control of the cashew stem and root borer incidence.

Summary:

Lindane (0.2%) led to highest percentage of trees without reinfestation (75.00) at Bapatla, Chlorpyriphos (0.2%) with 83.3 percent of trees without reinfestation and carbaryl (1.0%) with all treated trees without reinfestation were the best at Bhubaneswar and Jhargram respectively. Root feeding of monocrotophos 20 ml+20ml water was most effective at Vridhachalam.

Treatments for evaluation :

T_1 = Carbaryl (1%)
T_2 = Chlorpyriphos (0.2%)
T_3 = Monocrotophos (0.2%)
T_4 = Lindane (0.2%)
T_5 = *Metarrhizium anisopliae* fungus spawn 250gm/tree + 500gm neem cake
T_6 = Control

BAPATLA

Among the curative treatments, lindane 0.2% resulted in 75.00 percent trees without re-infestation followed by carbaryl 1.0 % with 66.66 percent of treated trees without re-infestation. Other treatments 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 68.18 percent followed by collar and stem zone with 22.72 percent attack. Percentage of bark circumference damaged seems to be the key factor which decides the survival of the tree as 36.66 percent of the trees had a bark damage of 50 to >75 percent either at initial attack or at re-infestation got yellowed and succumbed even after treatment application (Table 3.25).

Table 3.25 Efficacy of certain insecticides as curative control against cashew stem and root borer at Bapatla

Treatment	% Trees without reinfestation/ persistant attack
Carbaryl 1.0%	66.66
Chlorpyriphos 0.2%	58.33
Monocrotophos 0.2%	58.33
Lindane 0.2%	75.00
Untreated check	58.33

BHUBANESWAR

The treatment Chlorpyriphos (T_2) led to maximum recovery (83.3%) and application of *Metarhizium anisopliae* spawn (T_5) caused minimum recovery (56.3%). However, the recovery levels are higher if the infested trees are treated at early stage of infestation. When the bark circumference damaged was less than 50%, then the trees could easily recover. Infested trees showed less reinfestation when the infestation was restricted to collar+stem zone, while and collar+stem+root and collar+root infested trees were more prone and succumbed due to reinfestation. (Table 3.26)

JHARGRAM

The results indicated that T_1 (Carbaryl 1%) was the most effective treatment having no reinfestation and T_2 (Chlorpyriphos 0.2%) was also quite effective showing 80% of the trees free from reinfestation / persistent attack whereas, in untreated check only 20% of trees were free from reinfestation / persistent attack. (Table 3.27)

VRIDHACHALAM

Among the curative treatments tried, the additional treatment (T_3) viz., root feeding of monocrotophos @ 20 ml + water 20 ml was effective. Re-infestation was maximum in the trees aged 10-15 years. (Table 3.28)

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

	Treatments	No. of trees treated	No. of trees without reinfestation	% of trees without reinfestation
T_1	Carbaryl 1%	30	20	66.6
T_2	Chlorpyriphos (0.2%)	30	25	83.3
T_3	Monocrotophos (0.2%)	30	22	73.3
T_4	Lindane (0.2%)	30	21	70.0
T_5	*Metarrhizium anisopliae* fungus spawn 250gm/tree + 500gm neem cake	16	9	56.3
T_6	Control	30	12	40
	Total	**166**	**109**	

Table 3.27. Percentage infestation of CSRB under curative control trial at Jhargram

Treatment	% Trees without reinfestation / persistent attack
T_1 Carbaryl 1.0%	100
T_2 Chlorpyriphos 0.2%	80
T_3 Monocrotophos 0.2%	40
T_4 Lindane 0.2%	40
T_5 Untreated check	20

Table 3.28 Percentage infestation of CSRB under curative control trial at Vridhachalam

Treatment	% 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
T_1	62.5	Not re-infested	3	2	1	1	2	3	2
		Re-infested	-	-	3	-	-	1	2
T_2	37.5	Not re-infested	-	2	1	1	-	2	2
		Re-infested	-	-	2	2	-	2	2
T_3	100.0	Not re-infested	1	1	2	3	-	4	3
		Re-infested	-	-	-	1	-	-	1
T_4	62.5	Not re-infested	-	-	1	2	-	1	2
		Re-infested	-	3	1	1	-	3	2
T_5	00.00	Not re-infested	-	-	-	1	-	1	-
		Re-infested	-	2	1	3	2	1	3

Bioecology of pests of regional importance and survey of pest complex and natural enemies

Centres : East Coast:

Bapatla. Bhubhaneswar, Jhargram and Vridhachalam

West Coast:

Madakkathara, and Vengurle

Plains / others:

Chintamani and Jagdalpur.

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

Summary:

At Bapatla, incidence of foliage, flower and nut feeders was negligible. However peak activity of thrips (foliage and inflorescence) occurred from February-May. Leaf miners and leaf folders coincided with flushing ie. September-November.

Shoot tip borer, *Hypatima haligramma* was active from July-February. At Bhubaneswar, field parasitisation of pests of regional importance was also recorded. Spiders, reduviids, and praying mantis were recorded to predate on TMB at Chintamani Leaf caterpillar was recorded as an important pest from Jagdalpur, while cashew stem and root borers, leaf and blossom webbers, shoot tip caterpillars were serious at Jhargram. At Madakkathara, apple and nut borer and leaf miner were the important minor pests but were seasonal in occurrance. Flower thrips and apple and nut borer were important at Vengurle and Vridhachalam respectively.

BAPATLA

During 2003-04 season the incidence of various foliage, flower, fruit and nut feeders of cashew was almost low and negligible.

The activity of leaf and blossom webber (LBW)was observed almost throughout the year and the shoot damage varied from a minimum of 0.06 to a maximum of 2.05 percent with a peak during June. Among the abiotic factors both maximum temperature (r = 0.293) and minimum temperature (r = 0.281) were found to exercise significant positive influence where as the Relative humidity (m) (r = -0.335) was found to have a significant negative influence.(Table 3.29)

The initial activity of leaf miner and leaf folder was found to coincide with the occurrence of new flush during the months of September and November respectively The activities of leaf miner and leaf folder were negatively influenced by maximum temperature (r = -0.413)& (r = -0.334) and the minimum temperature (r = -0.536) & (r = -0.374) while the relative humidity (m) (r = 0.460) & (r = 0.301) exercised a positive influence, respectively. The shoot tip caterpillar was observed from January onwards and no significant correlation has been observed with any of the abiotic parameters. (Table 3.29)

Peak activity of leaf thrips was observed during the months of May and June with a highest incidence of 24.08 thrips/10 leaves. Among the abiotic factors both the maximum temperature (r = 0.591) and minimum temperature (r = 0.744) exercised significant positive influence, where as the relative humidity (m) exercised significant negative influence (r = -0.581). (Table 3.29)

The activity of inflorescence thrips was restricted to the period of flowering during February to March. There was a significant negative influence on the activity of inflorescence thrips by the maximum temperature (r = -0.301) and the minimum temperature (r = -0.348) where as the relative humidity (m) has a significant positive influence (r = 0.320). (Table 3.29)

The activity of Apple and Nut borer was restricted during the period of Apple and nut formation from January to April and none of the weather factors exercised significant influence on its activity. Spiders and Ants were also observed on the crop but with out any host specificity. (Table 3.29)

The surveys revealed that the incidence of cashew stem and root borer varied from 3.0 to 15.0 percent in different coastal districts of Andhra Pradesh which warrant necessary curative and prophylactic measures by the growers. The incidence of other foliage, flower, fruit and nut feeders is either low or negligible. (Table 3.29)

BHUBANESWAR

a. Shoot tip borer : *Hypatima haligramma*

The pest was active from July to December and during January and February. The activity of the pest was negligible in summer months (March to June).Correlation indicated that the pest incidence was negatively correlated with maximum temperature. The multiple regression analysis indicated that both morning and evening RH and maximum temperature contributed 29.4% towards incidence of this pest.

b. Inflorescence thrips

i. Yellow thrips : *Frankliniella schultzei* T.

ii. Black thrips : *Haplothrips ceylonicus* Sch.

Yellow thrips were observed from January to last week of April. The black thrips occurred from 1st week of February to 1st week of May . The yellow thrips population was negatively correlated with evening RH and rainfall. Morning RH contributed 20% towards incidence of this pest. There was no significant correlation of weather factor on incidence of black thrips.

Leaf miner : *Acrocercops syngramma* M

This pest had strong correlation with hours of bright sunshine, while apple and nut borer : *Nephopteryx* sp. had significant correlation with rainfall, Leaf beetle : *Monolepta longitarsus* Jac. had significant correlation with morning RH, whereas the other two pests, leaf folder : *Caloptilia tiscelea and* leaf and blossom webber, *Lamida moncusalis* had no significant correlation with the weather parameters recorded.

Table 3.29. Correlation of weather parameters with the pests of regional importance at Bapatla.

Weather Parameters	Regional Pests						
	Lbw	Anb	Lm	Stc	Lt	It	Lf
Maximum temperature °C	0.293*	- 0.134	- 0.413*	- 0.179	0.591*	- 0.301*	- 0.334*
Minimum temperature °C	0.281*	- 0.050	- 0.536*	- 0.159	0.744*	-0.349*	- 0.374*
Relative humidity(m) (%)	-0.335*	0.091	0.460*	0.150	- 0.581*	0.320*	0.301*
Relative humidity (e) (%)	-0.189	0.130	0.207	0.032	- 0.055	0.032	0.185
Rainfall	0.088	- 0.179	-0.216	- 0.172	0.229	- 0.192	- 0.224
Rainy days	0.146	- 0.222	-0.300*	- 0.200	0.321*	- 0.246	- 0.298*

Lbw: Leaf and blossom webber **Anb**: Apple and nut borer **Lm**: Leaf miner **Stc**: Shoot tip caterpillar
Lf: Leaf folder : Leaf thrips **It**: Inflorescence thrips **m** = Morning **e**= Evening
* = Significant at 0.05 level

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 incidence was negligible during November to January. The pest was positively correlated towards maximum and minimum temperature, evening RH and rainfall and negatively correlated towards BSH

Besides this the other minor pests viz., brown aphid (*Toxoptera ordinae*), mealy bug (*Ferrisia virgata*), gundhi bug (*Leptocorisa acuta* Thruch), bark borer (*Indarbela tetraonis* M.) and termites (*Odontotermes*) were also observed. However, their extent of damage was negligible.

Natural enemies:

Study on field parasitisation of major pests of regional importance of cashew indicated that maximum parasitisation of shoot tip caterpillar (16%) by *Elasmus* sp., leaf and blossom webber (20%) by *Bracon brevicornis* and leaf miner (20%) by *Sympiesis* sp. were observed. The peak period of parasitisation coincided with the peak incidence of these pest.

The other predators present in cashew ecosystem were spider (*Argeope* sp. *Oxypes* sp.), lady bird beetle (*Virania cinta*, *Menochilus sexmaculata*), Black ant (*Camponotous* sp. and were active during flower period of the plantation.

The correlation studies of the incidence of insect pests and the natural enemies with the weather factors is presented in Tables 3.30 and 3.31 respectively.

CHINTAMANI

1. Tea mosquito *(Helopeltis antonii)*

The incidence of tea mosquito bug started during I week of February and reached maximum in II week of March (18.50%) and thereafter gradual reduction in population was noticed. It was found on guava from July to September and on neem from September to January. However, the incidence of the pest on these hosts was very negligible.

2. Leaf miner *(Acrocercops syngramma)*

The incidence of the pest was first noticed in the IV week of November and it reached maximum (10.25%) during IV week of December and thereafter gradual reduction was noticed.

Table 3.30 Correlation studies of different insect pests of cashew with weather at Bhubaneswar.

Name of the insect pest	Temperature		Relative Humidity		Rainfall	BSH
	AMX_1	PMX_2	AMX_3	PMX_4	X_5	X_6
Shoot tip caterpillar (Y_1)	-0.411*	-0.270	0.241	0.217	0.195	-0.142
Yellow thrip (Y_2)	-0.073	-0.215	0.205	-0.319*	-0.341*	0.257
Black thrips (Y_3)	0.082	0.040	0.166	-0.209	0.267	0.220
Leaf miner (Y_4)	-0.293**	0.020	0.330*	0.408*	0.352*	-0.293**
Apple and nut borer(Y_5)	0.594*	0.300*	0.021	0.260	-0.273**	0.356*
Leaf Beetle(Y_6)	0.117	0.455*	0.275**	0.841*	0.739*	-0.792*
Leaf Folder (Y_7)	-0.200	-0.065	0.356*	0.225	0.137	0.044
Leaf and Blossom Webber(Y_8)	0.751*	0.426*	-0.216	0.337*	-0.251	0.376*
Cashew Stem and Root Borer (CSRB) (Y_9)	0.393*	0.610*	0.151	0.362*	0.353*	-0.333*

* = 'r' at 5% level of significance ** = 'r' at 1% level of significance

Table-3.31. Multiple regression equation of different insect of cashew with different weather parameters at Bhubaneswar.

Name of the insect	Multiple regression equation	R^2
Shoot tip caterpillar (Y_1)	$Y_1 = -7.25+0.048X_1 - 0.221X^*_2 + 0.090X^*_3 + 0.050X^*_4 + 0.003X_5 + 0.152X_6$	0.294
Yellow thrip (Y_2)	$Y_2 = -8.09- 0.055X_1 + 0.0003X^{**}_3 + 0.163X_3 - 0.041X_4 - 0.007X_5 + 0.11X_6$	0.200
Black thrips (Y_3)	$Y_3 = -1.73 - 0.155X_1 + 0.185X_2 + 0.077X_3 - 0.045X_4 - 0.007X_5 - 0.036X_6$	0.093
Leaf miner (Y_4)	$Y_4 = -8.74 - 0.016X_1 - 0.163X_2 + 0.100X_3 + 0.057X_4 + 0.005X_5 + 0.142X_6$	0.244
Apple and nut borer(Y_5)	$Y_5 = -0.959 + 0.063X_1 + 0.005X_2 - 0.002X_3 - 0.003X_4 - 001X_5 + 0.016X_6$	0.329
Leaf Beetle(Y_6)	$Y_6 = 2.74 - 0.053X_1 + 0.065X_2 - 0.017X_3 + 0.018X_4 + 0.003X_5 - 0.011X^*_6$	0.751
Leaf Folder (Y_7)	$Y_7 = -8.96 + 0.036X_1 - 0.13X_2 + 0.088X^*_3 + 0.043X^*_4 + 0.001X_5 + 0.181X^{**}_6$	0.191
Leaf and Blossom Webber(Y_8)	$Y_8 = 2.378 +0.041X_1 + 0.064X_2 - 0.035X_3 - 0.017X^{**}_4 + 0.0003X_5 + 0.002X_6$	0.695
CSRB (Y_9)	$Y_9 = 7.448 - 0.034X^*_1 + 0.297X^{**}_2 - 0.046X_3 - 0.045X_4 + 0.0038X_5 - 0.267X_6$	0.371

3. Inflorescence thrips

Maximum incidence of the pest was noticed during fourth week of April (21.92 no./panicle) and there after gradual reduction of the pest was noticed.

4. Fruit and nut borer *(Thylocoptila panerosema)*

The incidence of the pest was first noticed during March to April and reached maximum (21.25%) during fourth week of April. The incidence of the pest was severe in off season bearing plants.

During the survey, the following natural enemies have been recorded occurring on different pests which is presented in Table 3.32.

JAGDALPUR

The incidence of leaf miner was observed through out the year except in July-August, the leaf damage ranged from 1.00 percent to 56.50 percent with relatively high incidence during Oct-Dec. Relative humidity (evening) and rainfall were found to have significant positive influence (r = 0.515 & 0.555 respectively) on the activity of leaf miner.

The leaf damage by leaf caterpillar was noticed through out the year except July and August. The peak activity was recorded during Oct-Nov with infestation range from 0.6 to 44 percent leaf damage. The minimum temperature, relative

Table 3.32. Occurrence of natural enemies in cashew ecosystem at Chinatmani.

Natural enemy	Insect host	Months of occurrence	Intensity
Predators:			
1. Spiders – *Oxypes sweta Pecicetia sp.* *Plexippus paykulli*	Tea mosquito	Oct - Mar.	Low to moderate
2. Reduviid bug *Endochus inornatus*	Tea mosquito	Oct.-April	Low
3. Preying mantis – *Oxypilus sp.*	Tea mosquito	-do-	Low
4. Coccinellid beetles *Menochilus sexmaculatus Scymnus sp.*	Aphids	Feb.-May	Low to moderate
5. Syrphids – *Paragens yerburiensis*	Aphids	-do-	Low
Parasites:			
6. Braconid parasite *Bracon brevicornis Apanteles sp.*	Leaf and blossom webber	Oct-Dec.	Low

humidity (evening) and rainfall were positively correlated (r = 0.520, 0.661 & 0.651, respectively) with leaf damage. The activity of leaf folder was observed from April to December. The peak incidence of the pest was recorded during April and May with intensity ranged from 0.96 to 20.39 percent leaf folds. The maximum temperature had positive influence (r = 0.815) on leaf fold while relative humidity had negative influence (r = - 0.512 & - 0.535) on leaf folder damage(Tsble 3.33)

The damage of TMB was seen from the month of January to June. The damage ranged from a minimum 0.01 percent to a maximum 4.0 percent with relatively high incidence in month of March. The Relative humidity (evening) had negative influence (r = - 0.696) on the incidence of TMB damage.

Cashew stem and root borer incidence was seen throughout year except in July August, but its activity was maximum during Oct-Dec. The abiotic factors were not influence the activity of CSRB. (Table 3.33)

In case of natural enemies, the spider population ranged from 0.29 to 12.50 with maximum number in month of October. The fluctuation in population of *Brumus sp.* was from 0.03 to 6.50 with maximum activity in month of March.

All observations are mean of 52 leader shoots in each tree from observation of 12 trees taken randomly.

JHARGRAM

Cashew stem and root borer :

This is a very serious pest of the region. It causes severe damage in the neglected plantations. It occurs all round the year.

Leaf and blossom webber :

This is also a serious pest in the region with population increasing rapidly and peak coinciding with the new flush during December and October to November. The pest causes moderate to high damage in different plantations.

Shoot tip Caterpillar :

It cause serious damage during September and recorded two peaks in October and February and then pest incidence declines rapidly.

Table 3.33. Occurrence of pests of regional importance at Jagdalpur

Month	Thrips	Leaf Miner damaged leaves (%)	Leaf Caterpillar damaged leaves (%)	Leaf Folder damaged leaves (%)	TMB*	CSRB **	Aphid	Mites	% damage Leaf & blossom Webber (%)
Jul-03	15.57	0	0	0.00	0	0	0	0	0
Aug-03	31.50	0	0	0.00	0	0	0	0	0
Sep-03	00.14	03.25	07.60	0.96	0	2	0	0	0
Oct-03	01.00	56.50	44.00	14.00	0	2	5.75	2.25	5.00
Nov-03	00.00	12.50	33.00	05.50	0	2	0	2	4.00
Dec-03	00.00	13.25	01.50	01.75	0	2	1.25	0	3.25
Jan-04	04.89	04.00	0.60	0.00	0.01	0	0	0.89	0.29
Feb-04	05.34	01.00	01.03	0.00	0.50	0	0	0	0.44
Mar-04	30.33	05.00	01.50	0.00	4.00	0	1.83	0.50	2.33
Apr-04	01.58	05.71	21.00	20.39	0.14	1	0.16	0	0
May-04	01.39	09.10	23.01	16.40	0.00	2	0	0	0
Jun.04	00.08	06.42	36.78	03.29	0.08	2	0	0	0

* = Mean damage score ** = No. of trees damaged.

Thrips :

Leaf thrips appear in November, reaching a peak in February and then gradually decline. Inflorescence thrips appeared in February and gradually declined as nuts matured and finally disappeared during first fortnight of April.

Leaf miner :

It caused serious damage during August, September and recorded two peaks in October and January.

Tea mosquito bug :

Pest incidence was very low in all the areas surveyed and in Jhargram, its incidence was less than 1%.

Apple and nut borer :

It appeared in March and stayed upto May. The incidence and damage was very low.

Termites :

It was recorded during October – June and cause damage to bark of plants of all age groups, in red and laterite zone.

Natural enemy complex

Spiders (6 spp.), black ants, coccinellids (4 Spp.) and braconids formed the natural enemy complex. Spiders were recorded throughout the year and black ants, coccinellids and braconids were recorded during new flushing and reproductive phase of the plant. Intensity of spiders, black ants and coccinellid was moderate and of braconids was low.

MADAKKATHARA

In unsprayed trees mean damage score, due to tea mosquito bug was comparatively less ranging from 0.13 in November to 1.23 in January where the temperature was minimum. Apple and nut borer damage was also more(3.43 to 9.33 %) during January to May season. Leaf miner damage was found to be maximum during the early flushing and flowering stages (18.34 to 52.17 %), i.e., from November to February season (Table 3.34)

Table 3.34 Seasonal occurrence of TMB 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 % damaged shots of 52 shoots
Jan. 03	1.23	0.00	3.43	0.17	9.21	0.00	0.00	0.00
Feb. 03	0.42	0.00	6.25	33.87	4.08	0.00	0.00	0.00
Mar. 03	0.46	0.00	0.00	0.00	5.58	0.00	0.00	0.00
Apr. 03	0.00	0.00	3.87	0.00	0.92	0.00	0.00	0.00
May 03	0.00	0.00	9.33	0.00	2.07	0.00	0.00	0.00
Jun. 03	0.00	0.00	0.00	0.00	1.31	0.00	0.00	0.00
Jul. 03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug. 03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep. 03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oct. 03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov. 03	0.13	0.00	0.00	34.17	0.00	0.00	0.00	0.00
Dec. 03	0.33	0.00	0.00	46.37	0.00	0.00	0.00	0.25
Jan. 04	1.34	0.00	0.00	52.17	0.00	0.00	0.00	1.33
Feb. 04	0.82	0.00	0.08	41.57	0.00	0.00	0.09	0.00
Mar. 04	0.16	0.00	0.06	18.34	0.00	0.00	0.09	0.00

VENGURLE

The intensity and period of pest attack in the cropping season at Vengurle was recorded and is presented in Table 3.35. Tea mosquito occurred from November to May months, while incidence of flower thrips started during Jan and extended till May. The stem and root borer as well as leaf miner were recorded throughout the year. The sucking insects viz., aphids and mealy bugs occurred during Jan. to Mar.

Natural enemies – Three specis of spider viz; *Uliborus krishnae* Tikader, *Neoscone nautica* L. Koch, *Oxyopes shweta* Tikader were noticied as major predatory spiders in cashew gardens and other natural enemies viz; Lady bird beetle on aphids, Praying mantis and *Chrysopa* were also observed during January - February.

VRIDHACHALAM

The observations were done in Regional Research Station plot and in farmers plantation in Cuddalore District. Fortnightly observation revealed that the stem and root borer, leaf weevil and termites were found throughout the year. Among the natural enemies, natural infection of NPV was found on larvae of hairy caterpillar (*Lymantria abuscata*) in the forest area of Kattukudalur. Details of the bio ecology of different pests and natural enemies is presented in Table 3.36 and 3.37 respectively.

Table 3.35 Occurrence of pests of cashew at Vengurle

Sr.No.	Common Name	Scientific Name	Month of Occurrence	Intensity (%) 2002-03
1	Tea-mosquito	*Helopeltis antonii*	November	12.29
			December	25.50
			January	28.50
			February	23.37
			March	19.83
			April	14.00
			May	14.00
2	Flower thrips	*Rhipiphorothrips sp.*	Jan	23.50
			February	32.50
			March	24.67
			April	14.66
			May	13.00
3	Stem and root-borer	*Plocaederus ferrugineus*	Throughout year	7.63
4	Leaf miner	*Acrocercops syngramma*	Throughout year	8.23
5	Aphid	*Toxoptera odinae*	Jan.-March	1 – 2
6	Mealy bug	*Ferrisia virgata*	Feb.-March	-
7	Leaf eating beetles	*Monolepta sp.Coenoblus sp.*	June	2
			July	2.3
			Aug	8.10
8	Leaf cutting weevils	*Deporusmarginatus*	June	4
			July	2-4
			August	8
9	Web worm	*Orthaga exvinacae*	Oct.-Nov.	Sporadic
10	Semilooper	-	Oct.-Nov.	Sporadic
11	Apple and nut borer	*Nephoplteryx sp*	January	2-5
			February	8-12
			March	8-10
			April	4-8

Table 3.36 Bio ecology of pests of regional importance and survey of pest complex and natural enemies in different parts of Tamilnadu

Sl. No	Common Name	Scientific name	Period of occurrence
1.	Stem and Root borer	*Plocaederus ferrugineus*	Round the year
2.	Tea Mosquito bug	*Helopeltis antonii*	Oct-Feb
3.	Leaf miner	*Acrocercops syngramma*	July-Feb
4.	Green leaf folder	*Sylepta aurantiacalis*	July-Jan
5.	Leaf and Blossom webber	*Lamida moncusalis*	June-Mar
6.	Diamond hairy caterpillar	*Metanastria hyrtaca*	Jan-Feb
7.	Hairy Caterpillar	*Lymantria abuscata*	Jan-Feb
8.	Apple and nut borer	*Thylocoptila panrosema*	Dec-April
9.	Leaf weevil	*Myllocerus* sp	Round the year
10.	Leaf twisting weevil	*Apoderus tranquebaricus*	Dec-Jan
11.	Leaf thrips	*Rhiphiphorothrips cruentatus*	July-Jan
12.	Flower thrips	*Scirtothrips dorsalis*	Jan-May
13.	Termites	*Odontotermes obesus*	Through out the year

Table 3.37 Occurrence of natural enemies of cashew pests in different locations in Tamilnadu

Natural enemies	Host insect	Stage affected	Period occurrence	Intensity %
Parasitoids				
Cotesia sp(*Apanteles* sp)	Green leaf folder	Larvae	Oct-Jan	12.20
Brachymeria sp	Diamond hairy caterpillar	Pupae	Sep-Jan	6.70
Predators				
Scymnus sp	Mealy bugs	Adults and Nymphs	Jan-Feb	6.00
Chryroperla carnea	Mealy bugs and thrips	Nymphs and Adults	Sep-Feb	1.80
Preying Mantids	Caterpillars and moths	Nymphs and adults	Round the year	2.80
Spiders	Caterpillars and moths	Nymphs and adults	Round the year	6.4
Fungi				
Metarihizum anisopliae	Stem and root borer	Grubs & pupae	Aug-Feb	1.0
Beauveria bassiana	Stem and root borer	Grubs & pupae	Aug-Feb	1.8
Viruses				
NPV	Hairy caterpillar	Larvae	Jan-Feb	20.4

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

Plains / others :
Chintamani

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

Summary:

Different germplasm centers showed varying incidence of shoot tip caterpillar at Bapatla and Bhubaneshwar which is an important minor pest of the region. At Jagdalpur V-2 had minimal damage by leaf and blossom webber (6.2%) and VTH-30 had least thrips population of 54 No/panicles. None of the accession/entries screened had any resistance to TMB or other minor pests.

BAPATLA

During the cropping season of 2002-2003 the incidence of various foliage feeders was very low and negligible on account of the delayed flushing and flowering due to moisture stress and prolonged dry spell .

All the evaluated entries showed less than 5.0 per cent damage by the leaf and blossom webber and shoot tip caterpillar. The numbers of the inflorescence thrips varied from 9.50 to16.50 per 10 panicles in different entries screened (Table 3.38)

BHUBANESWAR

The germplasm accessions were damaged by super cyclone. However the remaining germplasm were again planted in another location and from next year onward screening operation will be carried out. All thirteen MLT entries were screened for resistance against shoot tip caterpillar. The result indicated that non of the cashew types were free from the pest attack during its peak activity. However, the cashew type M 15/4 show lowest (0.5%) and the type NRCC-I show highest damage (22%) during the peak activity of the pest. (Table 3.39)

Estimation of thrips damage

Use of monocrotophos (0.05%) dipping of the panicles to reduce thrips damage was estimated in a field trial at Bhubhaneswar. On an average 11.9 nos. of nuts per panicle are harvested from the insecticide treated panicle (monocrotophos 0.05%) whereas 9.7 no. of nuts per panicle were harvested from untreated check panicle. An increase of 22.7 per cent of harvestable nuts could be obtained by application of chemicals. Also damage score was 0.86 in chemical applied panicle whereas 2.50 per panicle in untreated check. (Table 3.40)

Borax @ 0.5kg/tree was applied separately after application of fertilizer in 10 trees and another 10 trees were kept as untreated check. It was revealed that on an average 3.61kg of nuts/tree were collected in boron-applied plants whereas 3.1kg of nuts were harvested per plant in control plots. An increase of 18% in yield due to application of boron was noticed but the no. of thrips per panicle decreased due to boron application (Table 3.41).

Table 3.38 Screening of cashew germplasm to regional pest incidence at Bapatla

Entry	ICNO	Leaf and blossom webber damaged shoots (%) (a)	No.of Inflorscence thrips/ 10 panicles (b)	Shoot tip caterpillar damaged shoots (%) (a)
Priyanka		1.210 (6.31)	11.75 (3.49)	4.040 (11.57)
T.No.30/1		1.451 (6.83)	13.00 (3.66)	3.185 (10.27)
T.No.3/33		1.070 (5.86)	9.75 (3.20)	2.865 (9.66)
T.No.40	249784	0.990 (5.68)	15.25 (3.95)	1.790 (7.68)
T.No.129	249876	1.320 (6.58)	14.00 (3.81)	3.020 (9.99)
T.No.275	249982	0.990 (5.68)	12.75 (3.64)	2.775 (9.53)
T.No.274		0.780 (5.07)	11.00 (3.38)	2.335 (8.76)
T.No.12/1		0.970 (5.62)	10.50 (3.32)	2.325 (8.74)
T.No.12/8		0.585 (4.32)	12.25 (3.57)	3.535 (10.82)
T.No.18/3		1.335 (6.62)	13.75 (3.77)	4.185 (11.79)
PTR1-1		1.025 (5.78)	12.75 (3.64)	3.665 (10.96)
ABT-3		0.990 (5.68)	14.50 (3.87)	3.160 (10.22)
ABT-2		0.980 (5.65)	13.25 (3.70)	1.965 (8.02)
T.No.3/7		0.585 (4.32)	16.50 (4.12)	3.915 (11.40)
T.No.3 /4		0.580 (4.31)	14.00 (3.80)	3.290 (10.45)
T.No.1/1		1.335 (6.62)	14.50 (3.87)	4.570 (12.33)
T.No.1	249783	1.350 (6.66)	14.50 (3.87)	3.080 (10.09)
T.No.8/7		0.790 (4.92)	12.00 (3.54)	2.170 (8.46)
T.No.4/3		0.985 (5.66)	16.50 (4.12)	2.165 (8.45)
T.No.4/5		0.785 (5.08)	12.50 (3.59)	2.560 (9.20)
T.No.228		0.995 (5.70)	12.75 (3.63)	3.995 (11.52)
T.No.233		0.805 (5.15)	13.50 (3.74)	4.825 (12.68)
T.No.244		1.015 (5.75)	13.00 (3.67)	0.815 (5.01)
T.No.268		1.170 (6.21)	11.25 (3.40)	4.280 (11.93)
M.15/4		0.760 (5.00)	12.00 (3.54)	5.520 (13.30)
BLA 139-1		1.010 (5.74)	11.50 (3.45)	3.030 (10.02)
T.No.17/5		1.040 (5.83)	12.75 (3.64)	1.675 (7.37)
BLA 39/4		0.790 (5.10)	15.50 (3.99)	3.750 (11.14)
ABT-1		1.220 (6.34)	11.50 (3.46)	2.045 (8.17)
T.No.5/1		0.805 (5.15)	13.50 (3.74)	2.805 (9.62)
T.No.2/3		0.795 (4.94)	10.50 (3.32)	1.390 (6.75)
T.No.10/2		0.620 (4.46)	12.50 (3.61)	1.455 (6.75)
T.No.7/12		1.045 (5.84)	9.50 (3.16)	1.050 (5.85)
T.No.71		0.795 (5.11)	13.25 (3.71)	1.800 (7.69)
T.No.277		1.215 (6.33)	12.25 (3.57)	2.635 (9.34)
T.No.2/14		0.840 (5.26)	13.00 (3.67)	1.680 (7.38)
T.No.5/16		1.000 (5.71)	10.50 (3.32)	1.805 (7.71)
Cheepurugudem		0.795 (5.12)	13.00 (3.67)	2.180 (8.48)
Aswaraopet		1.015 (5.75)	11.50 (3.46)	0.605 (4.39)
BBSR-1		1.305 (6.55)	13.00 (3.67)	3.535 (10.83)
T.No.40/1		1.010 (5.74)	12.50 (3.60)	2.830 (9.66)
T.No.6/14		0.800 (5.13)	13.00 (3.67)	2.800 (9.61)
Hy 94 T-3		0.405 (3.65)	11.50 (3.46)	2.220 (8.56)
T.No.2/5		0.810 (5.16)	13.25 (3.71)	0.410 (2.87)
T.No.2/15		1.010 (5.74)	11.50 (3.46)	1.415 (6.81)
Hy 94 T-4		1.195 (6.28)	11.75 (3.50)	2.990 (9.95)
Hy 95 T-4		0.605 (4.39)	12.75 (3.64)	1.415 (6.81)
Hy 95 T-2		1.005 (5.73)	12.75 (3.64)	1.610 (7.24)
T.No.6/20		0.820 (5.20)	11.00 (3.39)	1.235 (6.38)
Hy 95 T-5		0.805 (4.97)	14.00 (3.81)	1.415 (6.81)
Hy 94 T-5		0.805 (5.15)	10.50 (3.32)	0.010 (0.57)
T.No.10/1		1.195 (6.28)	13.00 (3.67)	2.380 (8.85)
T.No.9/8		0.600 (4.37)	11.75 (3.50)	1.195 (6.18)
CD(0.05)		(1.55)	(0.46)	(2.40)
Mean		(5.51)	(3.62)	(8.77)

JAGDALPUR

23 cashew accessions were screened during 2002-2003. Incidence of TMB was very low and hence screening was done against other pests of the region. None of the accessions was found tolerant / resistant. Lowest incidence of leaf and blossom webber and recorded on Vengurle – 2 (6.2% damage) while VTH –59 recorded the lowest shoot tip caterpillar damage (6.4%). The lowest inflorescence thrips population was recorded on VTH-30 / 54 / 10 panicle) (Table 3.42).

Table 3.39. Screening of MLT-2 entries for their resistance/tolerance to shoot tip caterpillar at Bhubaneshwar

Cashew types screened	% Shoot damage by STC
M 44/3	4.5-15
M 15/4	0.0-0.5
BPP 30/1	3.2-12
H 368	1.2-5.4
H 302	6.8-12.5
H 255	2.5-6.0
BPP 3/28	1.2-2.5
H 320	2.3-6.5
H 68	1.5-6.5
BPP 3/33	1.2-2.3
BPP 10/19	2.5-8.5
NRCC-I	10.5-22
NRCC-II	9.5-18

Table-3.40 Effect of monocrotophos on inflorescence thrips at Bhubaneswar

Trees No.	Mean no. of nuts/ panicle in treated panicle	Damaged nuts after application of monocrotophos	Mean no. of nuts in control/ panicel	No. of Damaged nuts/ panicle in control	% no. of nuts increased over control
1	12.1	1.00	10.4	2.55	16.3
2	13.3	0.73	10.3	2.60	29.1
3	11.9	0.70	11.0	2.30	8.2
4	11.6	1.03	8.9	2.38	30.3
5	10.5	0.85	8.1	2.55	29.6
Average	11.9	0.86	9.7	2.50	22.7

Table 3.41. Effect of boron on inflorescence thrips at Bhubaneswar

Trees No.	Mean of thrips/ panicle in Boron applied	Yield in kg of nuts/ boron applied	Mean of no. of thrips per panicle in untreated control	Mean no. of nuts per panicle in control	% increase of nuts per panicle
1	5.25	3.90	5.65	2.85	36.8
2	3.80	3.85	6.70	3.00	28.3
3	6.25	2.95	6.40	3.85	-23.3
4	4.65	3.50	5.58	3.40	2.9
5	5.80	3.65	5.75	3.55	2.8
6	6.20	3.55	6.50	2.40	47.9
7	6.75	2.00	5.60	2.20	-9.0
8	6.20	3.65	6.15	2.45	48.9
9	6.55	5.75	7.80	4.35	32.2
10	7.55	3.30	7.15	2.90	13.8
Mean	5.9	3.61	6.35	3.1	18.13

Table 3.42: Incidence of difference insects on the germplasms screened for tolerance / resistance at Jagdalpur

Accession	LBW *		Mean no. of inflorescence thrips / 10 panicle	Mean % STC ** damage in 52 leader shoots
	Mean No. / 52 leader shoot	Mean % LBW damage in 52 leader shoots		
M – 17/4	14	11.2	69	8.6
A – 7/2	17	7.8	59	13.8
M – 4/2	13	8.2	64	9.6
M – 26/1	18	9.6	70	8.3
K – 27/1	10	8.4	68	11.5
M – 3/3	19	8.1	62	8.4
M – 76/1	14	9.2	74	12.6
Vengurle – 2	11	6.2	75	10.8
A – S/4	16	6.9	63	12.4
Vengurle 36/3	19	9.3	70	13.2
H – 1608	15	9.6	63	10.6
H – 4 – 7	18	12.8	74	9.8
Ullal – 1	13	8.4	65	9.2
Ullal – 2	19	7.4	80	7.8
VTH – 30	18	12.4	54	8.6
VTH – 59	13	9.8	65	6.4
V – 5	17	10.6	62	7.9
JGM – 47/6	19	8.6	67	13.2
Ansur – 1	17	13.3	79	16.2
Jhargram – 1	14	9.4	59	8.4
Red Hazari	23	10.2	63	12.3
DC – 5	16	9.2	86	13.1
BLA – 39 – 4	19	8.9	72	10.8
JMG –74/6	23	11.3	74	12.4

* LBW – Leaf and blossom Webber

** STC = Shoot up Caterpillar

23 cashew accessions were screened during 2002-2003. Incidence of TMB was very low and hence screening was done against other pests of the region. None of the accessions was found tolerant / resistant. Lowest incidence of leaf and blossom webber and recorded on Vengurle – 2 (6.2% damage), while VTH –59 recorded the lowest shoot tip caterpillar damage (6.4%). The lowest inflorescence thrips population was recorded on VTH-30 (54 / 10 panicle) (Table 3.43)

MADAKKATHARA

Fortnightly observations on the incidence of tea mosquito bug and other minor pests were recorded from all the accessions available in the germplasm. All accessions were susceptible to TMB and leaf miner at varying intensities (0.77 to 3.87) and as the incidence of apple and nut borer and leaf folder was negligible, no inference could be drawn.

VENGURLE

Eight released varieties, promising hybrids and other types from the germplasm field gene bank were screened against the tea mosquito bug incidence, it was observed that the intensity of TMB ranged from 16.66 to 36.66 per cent during this year. None of the accessions screened had any resistance to this pest (Table 3.44).

Table 3.43. Incidence of different insects on the germplasms screened for tolerance / resistance during 2001-2003 at Jagdalpur

Accession	LBW *		Mean no. of inflorescence thrips / 10 panicle	Mean % STC ** damage in 52 leader shoots
	Mean No. / 52 leader shoot	Mean % LBW damage in 52 leader shoots		
M – 17/4	14	11.2	69	8.6
A – 7/2	17	7.8	59	13.8
M – 4/2	13	8.2	64	9.6
M – 26/1	18	9.6	70	8.3
K – 27/1	10	8.4	68	11.5
M – 3/3	19	8.1	62	8.4
M – 76/1	14	9.2	74	12.6
Vengurle – 2	11	6.2	75	10.8
A – S/4	16	6.9	63	12.4
Vengurle 36/3	19	9.3	70	13.2
H – 1608	15	9.6	63	10.6
H – 4 – 7	18	12.8	74	9.8
Ullal – 1	13	8.4	65	9.2
Ullal – 2	19	7.4	80	7.8
VTH – 30	18	12.4	54	8.6
VTH – 59	13	9.8	65	6.4
V – 5	17	10.6	62	7.9
JGM – 47/6	19	8.6	67	13.2
Ansur – 1	17	13.3	79	16.2
Jhargram – 1	14	9.4	59	8.4
Red Hazari	23	10.2	63	12.3
DC – 5	16	9.2	86	13.1
BLA – 39 – 4	19	8.9	72	10.8
JMG –74/6	23	11.3	74	12.4

* LBW – Leaf and blossom Webber ** STC = Shoot up Caterpillar

Table 3.44 Screening of germplasm to the incidence of pests of regional importance

Sr. No.	Name of variety/ hybrid/type	Tea – mosquito intensity (%) 2002-03	Sr. No.	Name of variety/ hybrid /type	Tea – mosquito intensity (%) 2002-03
1	V-1	16.66	15	10/19	32.22
2	V-2	25.00	16	Hy - 636	28.33
3	V-3	23.33	17	Hy – 640	26.55
4	V-4	30.00	18	Hy – 641	27.50
5	V-5	26.66	19	Hy – 662	31.25
6	V-6	16.66	20	Hy – 675	36.66
7	V-7	27.50	21	Hy - 677	27.50
8	V-8	28.33	22	Hy – 681	33.75
9	H-303	32.50	23	Hy – 689	23.33
10	H-320	26.25	24	Hy - 764	25.00
11	H- 255	35.00	25	Hy - 784	33.75
12	H-26	32.50	26	3/28	31.11
13	M-44/3	25.55	27	3/33	35.00
14	M 11/3	27.50	28	30/1	39.16

VRIDHACHALAM

The TMB score was minimum in H 1608 and VTH 59/2 (2.0) followed by VTH 30/4 and H 2/15 (2.2). The shoot and blossom webber damage was 17.0 and 17.2 in H 44/3 and H 40. Thrips damage was minimum in H 1598 (4.6%) followed by on H 1600 (8.2%) (Table 3.45).

Table 3.45. Screening of MLT entries (Seedling) against cashew pests at Vridhachalam

MLT entries	TMB damage score	Shoot & Blossom Webber (%)	Thrips damage %
H 1598	2.5	21.1	4.6
H 1600	2.3	25.3	8.2
H 1608	2.0	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 fourth five year Plan in 1971. The AIC & CIP had five centres (four University Centres and one ICAR Institute based centers) identified for conducting research on cashew. These centers 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 centers 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. Standardizing agro techniques for the crop under different agroclimatic conditions; and
3. Evolving cost effective and efficient pest and disease management practices.

The first Workshop of All India Coordinated Spices and 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.

REPORT ON NATIONAL GROUP MEETING OF SCIENTISTS OF AICRP ON CASHEW HELD AT NRCC, PUTTUR

The National Group Meeting of Scientists of AICRP on Cashew, including Brainstorming session on Management of Insect Pests of Cashew was held at National Research Centre for Cashew from 4th to 6th June 2004. The National Group Meeting was inaugurated on 4th June 2004 by Dr. S.N. Pandey, Asstt. Director General (Hort. & PC), ICAR. A technical bulletin "Indigenous Technical Knowledge in Cashew" was also released by him. Dr. V. Rajagopal, Director, CPCRI, Kasaragod presided over the function. Dr. M.G. Bhat, Acting Director, National Research Centre for Cashew, and Project Co-ordinator, All India Co-ordinated Research Project on Cashew (AICRP on Cashew) presented the Project Co-ordinator's Report for the past two years.

The technical sessions were held thereafter under different sections such as, Crop Improvement, Crop Management, Crop Protection, Brainstorming Session on the Management of Insect Pests of Cashew. The research results obtained from different trials at the AICRP centers viz, Bapatla, Bhubhaneswar, Chintamani, Jagadalpur, Jhargram, Madakkathara, Pilicode, Vengurle and Vridhachalam were presented by the scientists of the respective disciplines from each centre. Results from the trials on germplasm collection and maintenance, varietal evaluation, hybridization and selection under Crop Improvement were presented. Similarly, results from trials on NPK fertilizer experiments, fertilizer requirements in high density planting, cashew based cropping systems, and drip irrigation trials were presented in Crop Management session. Findings from the trials on chemical control of pest complex in cashew, evaluation of new chemicals for control of TMB and other pests under Crop Protection were also presented. A special session, viz. Brainstorming Session on Management of Insect Pests of Cashew was held during the Group Meeting in which it was decided to tackle the insect problem through a multi-disciplinary and mission mode approach.

A technical session on Interaction between Development Departments and Research Centres was also held in which representatives of Directorate of Cashew and Cocoa Development (DCCD), Directorate of Horticulture, Karnataka and Mangalore Cashew Manufacturers' Association (MCMA) presented theme papers on development scenario in cashew production and there was good interaction between development officials and scientists in this session.

In the Plenary Session, recommendations of different technical sessions were presented and modified, wherever found necessary. Dr. S.N. Pandey in his concluding remarks emphasized the multi-disciplinary approach for improving the productivity of cashew.

Significant Achievements of the Project:

1. Regional Cashew Field Gene Bank in different AICRP centres have a total of 1250 cashew accessions, till date.
2. A dwarf type cashew accession having early bearing, non-cluster habit with small nuts identified at Manjeshwara by Pilicode centre.
3. At Bhubaneswar, H-320 had highest cumulative yield of 41.3 kg in 8th harvest under varietal evaluation trials.
4. Under hybridization and selection trials 73 F_1 hybrids nuts have been obtained at Bapatla, 1049 nuts at Bhubaneswar, 600 hybrid nuts at Chintamani, and 235 hybrid nuts at Vridhachalam have been obtained with different cross combinations.
5. The influence of N levels on plant growth, and yield was significantly proven at Bapatla, Chintamani, Madakkathara and Vridhachalam Centre.

Dr. S.N. Pandey, A.D.G (Plantation Crops & Hort.) delivering the Inaugural Address

Lighting of Lamp in Inaugural Session

Brainstorming Session on Management of Insect Pests of Cashew in progress

View of delegates attending the technical sessions

6. At Bhubaneswar, turmeric yielded a profit of Rs. 8,000/ha while Rs. 6,250/ha was the profit due to cowpea at Jhargram and groundnut led to the highest profit of Rs. 24,580/ha at Vridhachalam in trials on cashew based cropping systems.

7. Under trials on chemical control of pest complex in cashew, three spray schedule reduced pest infestation by minor pests at Vridhachalam and Jhargram, while at Chintamani and Jagadalpur these pests were reduced during second spray.

8. Swabbing neem oil 5% thrice in a year could prevent infestation by cashew stem and root borer at Bapatla, Bhubaneshwar, Jhargram, Vengurla and Vridhachalam in prophylactic control trails. Chlorpyriphos (0.2%), lindane (0.2%) and carbaryl (1.0%) could prevent reinfestation of infested treated trees.

9. During the year 83 demonstration plots have been laid out by different AICRP centres, involving soil & water conservation techniques, 24 trainings, on graft production, cashew production technology and plant protection as well as 19 campaigns on pest management for tribals were also organised.

10. A total of 5,51,021 cashew grafts were produced under this project and distributed to government and non-government agencies as well as to the cashew cultivators.

2. TRANSFER OF TECHNOLOGY

During the year, a total of 5,51,021 grafts were produced and distributed to several government and non-government organizations as well as to cashew cultivators. Information on Vengurle centre is not available. The centre wise production of cashew grafts is as follows:

Centre	No. of grafts produced
Bapatla	10,221
Bhubhaneswar	37,600
Chintamani	50,000
Jagdalpur	21,000
Jhargram	2,200
Madakkathara	80,000
Pilicode	10,000
Vridhachalam	3,40,000
TOTAL	5,51,021

BAPATLA

Scientists of this centre imparted training to cashew farmers through 5 training programmes in different parts of the state. Also, the technical know-how on cashew cultivation was disseminated through radio talks and TV programmes. Poondala village has been adopted to aid in upliftment of the rural economy by regular field visits.

BHUBANESWAR

During the year 6 demonstration plots have been laid out for cashew production technology and 19 plant protection campaigns have been conducted involving women and tribal farmers. In collaboratiio with the OSCDC Ltd., scientists of this centre were involved in one trainer's training programme and 8 district level farmers' training programme.

CHINTAMANI

The centre has aided in establishment of 46 model cashew orchards. Also field visits and technical advice on cashew cultivation is being pursued by scientists of various disciplines.

JHARGRAM

During the year 3 demonstration plots were established. Training programmes on graft production and cashew cultivation were arranged at 3 locations. The centre collaborated with various institutions to impart training on cashew production practices. This centre was also involved in a televised programme on cashew grafting.

MADAKKATHARA

Three training programmes were organized on cashew graft production, and four training programmes on Cashew production Technology for staff of agriculture department was also organized. The scientists of this centre have also participated in 14 farmers' seminars, and in this year 25 demonstration plots have been laid out. Several farmers groups have visited the station and got acquainted with cashew production techniques. Radio talks and Doordarshan programmes on cashew cultivation aspects have been performed by this centre.

PILICODE

Three demonstration plots involving soil and water conservation measures have been laid out during this year. Five seminars were conducted on cashew cultivation practices in different locations.

VRIDHACHALAM

Cashew seminars were organized in collaboration with Dept. of Horticulture and cashew field days supported by DCCD. The scientists participated in interactive meetings on cashew cultivation.

3. STAFF POSITION

HEADQUARTERS

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

PROJECT CENTRES

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

Horticulturist	:	Dr. P. Shesha Reddy
Assistant Entomologist	:	Mr. Ghouse Mohammed
Asst.Agronomist	:	Mr. B. Prasanna Kumar
Senior Technical Assistant	:	Mr. B. Krishnamurthy
Junior 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
Senior Technical Assistant	:	Mr. P.C. Swain
Junior Technical Assistant	:	Mr. K.B. Pani
Grafter	:	Vacant

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

Horticulturist	:	Mr. M.N. Narasimha Reddy
Junior Entomologist	:	Mr. N. Vijayamohan Reddy
Jr.Horticulturist	:	Mr. B.O. Santhanu
Senior Technical Assistant	:	Mr. Shivappa
Junior Technical Assistant	:	Mr. G.V.Narayanaswamy (from 8.6.2003)
Grafter	:	Mr. R. Lokesh Babu

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

Jr.Horticulturist	:	Mr. Dhananjaya Sharma
Junior Entomologist	:	Mr. Khoobhi Ram Sahu
Senior Technical Assistant	:	Vacant
Grafter	:	Mr. Jagdev

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

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

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

Horticulturist	:	Dr. P.S. John / Dr. Jose Mathew
Jr.Entomologist	:	Dr. (Mrs.) Susanamma Kurien / Dr. G.K.Mohapatra
Jr. Breeder	:	Dr. (Mrs.) V.G. Jayalekshmy / Dr. Mareen Abraham
Sr. Technical Assistant	:	Mrs. Ancy Joseph
Jr. Technical Assistant	:	Mr. M.K.Manoj
Grafter	:	Vacant

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

Jr.Horticulturist	:	Dr. B. Jayaprakasha Naik
Junior Technical Assistant	:	Vacant

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

Horticulturist	:	Dr. B.B. Sapkal
Jr.Entomologist	:	Mr. R.Gajbhiye
Jr.Breeder	:	Mr. V.N. Jalgaonkar
Sr. Technical Assistant	:	Mr. A.K. Dhuri
Jr. Technical Assistant	:	Mr. R.L. Mayekar

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

Horticulturist	:	Dr. S. Jeeva
Jr.Horticulturist	:	Dr. M. S. Aneesa Rani
Jr.Entomologist	:	Dr. V.Ambethgar
Senior Technical Assistant	:	Mr. S. Manickam
Junior Technical Assistant	:	Mr. S.Alagarsamy
Grafter	:	Mr. P. Gopalakrishnan

4. BUDGETARY PROVISION AND ACTUAL EXPENDITURE DURING 2003-04 IN RESPECT OF AICRP ON CASHEW

ALLOCATION (Rs. in lakhs)

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Grand Total	ICAR Share
Bapatla	12.00	0.23	1.20	-	13.43	10.07
Bhubaneshwar	12.00	0.23	1.20	-	13.43	10.07
Chintamani	11.68	0.23	1.20	-	13.11	9.83
Jagdalpur	5.00	0.15	0.80	-	5.95	4.46
Jhargram	9.50	0.23	1.20	-	10.93	6.20
Madakkathara	12.40	0.20	1.20	-	13.80	10.35
Pilicode	4.60	0.15	0.40	-	5.15	3.86
Vengurla	12.00	0.23	1.20	-	13.43	10.07
Vridhachalam	12.00	0.23	1.20	-	13.43	10.07
TOTAL	91.18	1.88	9.60	-	102.66	77.00

ACTUAL EXPENDITURE (Rs. in lakhs)

Centre	Pay and Allowances	TA	Recurring contingency	Non-recurring contingency	Grand Total	ICAR Share
Bapatla	8.59	0.21	1.20	-	10.01	7.50
Bhubhaneshwar	13.69	0.15	1.14	-	14.98	11.23
Chintamani	9.99	0.14	1.20	-	11.33	8.50
Jagdalpur	3.89	0.15	0.80	-	4.84	3.63
Jhargram	5.51	0.16	1.12	-	6.88	5.16
Madakkathara	13.52	0.15	1.02	-	14.69	11.02
Pilicode	3.52	0.09	0.31	-	3.92	2.94
Vengurla	7.99	0.23	1.19	-	9.41	7.06
Vridhachalam	8.92	0.20	1.20	-	10.32	7.74
TOTAL	75.62	1.48	9.18	-	86.38	64.78

5. MONITORING OF PROJECT BY PROJECT COORDINATOR

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

18.9.2003	Jagdalpur
19.9.2003	IGAU, Raipur
20.9.2003	Bhubaneshwar
23.12.2003	Chintamani
12.3.2004	BCKV, Kalyani
13.3.2004	Jhargram
20.3.2004	Pilicode

During the visit to these centres the technical programmes allotted to each of the above centres and progress made were reviewed. Inspected the field experiments of on-going projects and gave suggestions and guidelines, wherever found necessary. University authorities were met and impediments in implementing some of the programmes were also discussed.

6. FUNCTIONING OF EACH CENTRE

BAPATLA

The Centre was established in 1971. At present there are three scientists working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist. Presently three projects in Crop Improvement, four projects in Crop Management and four projects in Crop Protection are being carried out at this centre. Five trainings on cashew production technology and high density planting were conducted by the scientists of this centre.

BHUBANESWAR

The Centre was established in 1975. At present there are three scientists working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist. Presently the centre has trials under three projects in Crop Improvement, three projects in Crop Management and four projects in Crop Protection. The centre organized 19 trainings for tribal people on pest management aspects of cashew.

CHINTAMANI

The Centre was established in 1980. At present there are three scientists working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist. Research work is being conducted at this centre under three projects in Crop Improvement, five projects in Crop Management and three projects in Crop Protection.

JAGDALPUR

The Centre was established in 1993. Both the Scientific posts namely, Junior Horticulturist and Junior Entomologist have been filled in by the University and the scientists are in position. Presently two projects in Crop Improvement, one project in Crop Management and two projects in Crop Protection are operational in this Centre. Some of trials which are being conducted in farmers' fields need to be shifted to the station farm for which land area is needed and required to be allotted by Indira Gandhi Agricultural University. Regular scion bank is not existing at present. After getting additional land, scion bank of recommended cashew varieties need to be established by the Centre.

JHARGRAM

The Centre was established in 1982. At present there are two scientists working under the project in the posts of Junior Horticulturist and Junior

Entomologist. Bidhan Chandra Krishi Vishwa vidyalaya (BCKV) and Regional Research Station authorities have been requested to fill the vacant post of Horticulturist. Three projects in Crop Improvement, three projects in Crop Management and three projects in Crop Protection are being carried out presently in this centre. Three training programmes on graft production and cashew cultivation were undertaken by the scientists of this Centre.

MADAKKATHARA

The Centre was established in 1972. At present there are three scientists working under the project in the posts of Horticulturist, Junior Breeder and Junior Entomologist. Three projects in Crop Improvement, two projects in Crop Management and four projects in Crop Protection are presently being conducted at this centre. This Centre has facility for processing cashew apples.

PILICODE

The Centre was established in 1993. As this is a sub centre there is only one post of scientist and the scientist is working under the project in the post of Junior Horticulturist. Presently there are two projects, one in Crop Improvement, and another in Crop Management. The main work allotted to the centre is to collect and maintain cashew germplasm. Some work on hybridization was also allotted in order to study the performance of dwarf and compact accession, Taliparamba-1 on fruit setting on crossing it with different cashew genotypes. A trial on fertilizer application in high density cashew plantations was also allotted to the centre in the year 2000. The centre has organized three trainings on cashew graft production and four trainings on cashew production technology.

VENGURLE

The Centre was established in 1970. During the year under report there were some transfers/ adjustment of scientific staff. However, at present there are three scientists working under the project in the posts of Horticulturist, Junior Breeder and Junior Entomologist. Presently, at this centre, three projects in Crop Improvement, five projects in Crop Management and four projects in Crop Protection are being carried out. A large number of hybrids was produced under the ad-hoc project on "Network Programme on Hybridization in Cashew" at this Centre This Centre has Scientists working under other crops also. It was felt by QRT (1997-2001) that Dr. BS Konkan Krishi Vidyapeeth can recognize this Regional Fruit Research Station for post graduate studies. At this Centre cashew nursery activity is very good.

VRIDHACHALAM

The Centre was established in 1971. During the year under report there were three Research Associates working under the project in the posts of Horticulturist, Junior Horticulturist and Junior Entomologist. Tamil Nadu Agricultural University (TNAU) was requested to fill these three posts with regular scientific staff and accordingly TNAU has now filled them with regular staff. Presently research work on cashew is being conducted in three projects in Crop Improvement, five projects in Crop Management and four projects in Crop Protection. Necessary activity is being expanded. A cashew day and two cashew seminars were organized by this centre.

7. PROBLEMS IN FUNCTIONING OF THE CENTRES

BAPATLA

Organic matter content in the sandy soils of Bapatla centre is low. Effort should be made to improve the organic matter content by utilizing cashew leaf biomass. Only 17% of the cashew area in Andhra Pradesh is represented by the soil type of Bapatla. Red soil region of northern districts of Andhra Pradesh represents the major cashew growing area and hence it is desirable to locate the Cashew Research Station in those areas. This has been recommended by QRT (1997-2001) also. There is lot of trespassing by outsiders in the Cashew Research Station Farm at Bapatla Centre. A compound wall may be constructed by University authorities.

BHUBANESWAR

A small laboratory cum storage unit and drip irrigation facilities are needed at Ranasingpur farm. The Orissa University of Agriculture and Technology (OUAT) may allocate part of the revenue generated under the revolving fund scheme for creating this facility. Audit Utilization Certificate from the Statutory Auditors/Government Auditors for the past several years is pending. This has to be expedited by CRS/ OUAT.

CHINTAMANI

There is problem of flowering in cashew in NPK fertilizer experimental plot. This phenomenon needs to be discussed by the centre with the Professor of Plant Physiology / Crop Physiology at University of Agricultural Sciences (UAS), at Bangalore. Drip Irrigation treatment could not be imposed earlier due to failure of tube well. Now the treatments need to be imposed as a new tube well dug has good water yield.

JAGDALPUR

Bastar region of Chattisgarh state has lot of potentiality to expand cashew. Discussed with scientists of Jagdalpur centre and emphasized the need to increase the nursery activity by the centre. As there is no scion bank at present, it is essential to establish scion bank in Jagdalpur centre in order to supply adequate quantity of scion sticks to support increased graft production of cashew required to cover more area under cashew in Bastar region. Till the adequate scion sticks are available from scion banks of Jagdalpur centre and elsewhere in Chattisgarh state, possibility of procuring scion sticks of recommended varieties from Orissa for grafting in Chattisgarh state may be explored. It is estimated that about 40,000 ha can be covered under cashew in Bastar region. In order to cover this area about 80 lakh cashew grafts are required over a period of time. Till graft production picks up in Chattisgarh state, arrangements can be made by Chattisgarh Government to purchase cashew grafts of recommended varieties from neighbouring states such as Orissa for planting in suitable areas of Bastar region by farmers and Forest/Horticulture Departments. These aspects were discussed with Dean, S.G.College of Agriculture and Research Station, Jagdalpur and also with Director of Research, Indira Gandhi Agricultural University (IGAU), Raipur.

More land area needs to be allotted by IGAU for cashew programme at Jagdalpur for conducting agronomical and entomological experiments. Some of the experiments of these two disciplines are being presently conducted in farmers' fields. Conducting experiments in farmers' fields has several problems, especially in perennial crops like cashew. Further, about 2 ha land is required for establishing scion bank to supply adequate quantity of scion sticks for production of cashew grafts by the centre.

JHARGRAM

The graft production in the centre is not adequate. The post of Horticulturist is vacant for

long time. This needs to be filled in by the University. This point was emphasized with authorities of the centre and Bidhan Chandra Krishi Vishwa vidyalaya (BCKV) by the Project Coordinator during his visit to the Centre / University. The germplasm accessions which are presently of seedling origin have to be clonally propagated by using a plant representative of the accession as scion source and replanted in Regional Cashew Gene Field Bank.

MADAKKATHARA

In Cashew Research Station, Madakkathara the tea mosquito bug damage is more severe. The outbreak of this insect pest should be managed well by this centre so that cashew yield of the plant reflects the potentiality of the genotype, especially in breeding experiments.

PILICODE

The northern districts of Kerala especially Kannur and Kasaragod have larger area and higher production of cashew. This sub centre located in Kasaragod district needs to be upgraded to a full fledged centre. But to do so additional land of 8 ha area should be provided by the Kerala Agricultural University in addition to the existing 7 ha land. QRT (1997-2001) in its report has also recommended it. The shy bearing observed in dwarf and compact type germplasm accession, Taliparamba-1, is the major drawback of the otherwise good genotype. The reasons for this need to be investigated so that this genotype can be improved genetically and used for high density planting.

VENGURLE

This Centre has produced large number of hybrids under ICAR Ad-hoc Scheme on "Network Programme on Hybridization in Cashew". The land area available at this centre is not adequate to take up the field planting of these hybrids. Hence Dr. BS Konkan Krishi Vidyapeeth should provide more land either at RFRS, Vengurle or nearby Research Centres for taking up planting of these hybrids. Audit Utilization Certificate from Government Auditors is pending for the past several years. This has to be expedited by Regional Fruit Research Station (RFRS) / Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth (Dr. BSKKV).

VRIDHACHALAM

The organic matter content in the sandy soils of the centre should be improved. The drip irrigation trial should have started a few years back. Efforts should be made immediately to initiate drip irrigation trial.

8. METEOROLOGICAL DATA OF DIFFERENT CENTERS FOR THE YEAR 2003

BAPATLA

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No.of rainy days
	Maximum	Minimum	8.30 A.M.	3.30 P.M		
January	29.0	17.0	93	68	—	—
February	30.5	20.6	90	69	—	—
March	31.9	22.7	81	70	5.5	2
April	33.8	25.9	78	76	—	—
May	38.7	27.8	63	59	—	—
June	38.3	27.0	65	57	117.4	9
July	32.4	24.6	84	72	193.6	15
August	32.6	24.9	82	69	140.8	11
September	33.9	24.8	68	66	150.1	9
October	31.0	23.8	88	77	181.2	12
November	31.0	20.9	88	70	14.2	1
December	28.6	18.4	91	71	147.5	(Cyclone) 4
Total:	—	—	—	—	**955.7**	**64**

BHUBHANESWAR

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	Maximum	Minimum	8.30 A.M	3.30 P.M	
January	28.2	14.7	86.6	43.6	0.0
February	31.5	19.8	19.8	52.3	9.7
March	30.8	21.4	92.3	53.2	28.2
April	38.3	25.9	92.2	52.4	2.8
May	39.8	27.7	88.7	46	16.8
June	36.4	27.4	91.8	66.5	328.4
July	31.5	26.0	92.8	81.6	394.8
August	31.8	25.4	91.8	78.8	414.2
September	31.6	25.3	93.8	78.8	220.2
October	31.0	23.9	95.0	77.6	476.8
November	30.4	17.4	91.3	51.5	0.0
December	27.5	15.1	86.3	48.8	22.3
Total	—	—	—	—	**1914.2**

CHINTAMANI

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No.of rainy days
	Maximum	Minimum	8.30 A.M.	3.30 P.M		
January	27.84	NR	75.09	74.48	0.00	—
February	30.68	NR	80.46	66.42	0.00	—
March	33.04	NR	83.29	45.19	39.6	2
April	35.99	NR	83.8	52.51	0.00	-
May	30.50	NR	74.82	70.40	11.30	1
June	32.94	NR	78.39	56.03	25.20	2
July	30.06	NR	88.58	71.22	55.90	5
August	29.15	NR	83.70	80.37	10.00	2
September	29.16	NR	83.12	77.27	140.00	4
October	27.55	NR	82.82	81.00	158.9	9
November	26.87	NR	83.80	70.68	23.8	2
December	26.42	NR	85.13	82.79	0.00	—

NR = Not recorded

JAGADALPUR

Month	Temperature (°C)		Relative Humidity		Rainfall (mm)
	Maximum	Minimum	AM	PM	
January	25.5	10.2	93.9	36.5	32.8
February	26.9	12.3	92.6	36.3	19.1
March	34.8	16.9	88.8	20.1	6.4
April	35.6	20.9	69.6	22.4	45.9
May	40.4	23.6	49	15	2.4
June	36.9	25.5	58.0	32.0	110.4
July	27.9	22.4	91.0	70.4	453.2
August	27.8	22.4	90.5	74.3	332.7
September	27.9	22.0	90.8	60.9	270.4
October	28.3	20.4	93.0	71.7	321.1
November	28.3	13.7	93.3	60.5	1.5
December	25.14	10.5	93.6	50.2	16.6

JHARGRAM

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No.of rainy days
	Maximum	Minimum	8.30 A.M.	3.30 P.M		
January	23.2	11.	75.4	44.2	14.3	3
February	24.0	12.4	76.3	46.5	2.8	2
March	31.3	19.8	75.3	47.2	28.5	4
April	36.2	23.2	77.4	51.6	33.6	5
May	36.2	23.2	77.4	51.6	38.2	5
June	38.2	26.2	82.3	53.5	100.2	10
July	35.0	23.7	92.5	78.2	361.4	24
August	35.3	23.8	95.2	77.8	367.2	26
September	37.1	21.6	93.5	75.3	240.6	20
October	30.2	22.5	84.3	58.5	162.5	12
November	28.1	16.1	78.00	47.0	35.8	5
December	23.8	12.0	73.1	41.6	19.3	4

MADAKKATHARA

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No.of rainy days
	Maximum	Minimum	8.30 A.M	3.30 P.M		
January	33.2	22.9	66	34	0.0	0
February	34.7	23.6	83	43	162.0	5
March	34.6	24.1	86	47	94.8	4
April	34.6	25.0	86	58	23.8	3
May	34.0	25.0	88	56	40.3	3
June	30.9	23.8	91	68	570.6	19
July	29.5	22.2	93	74	492.6	22
August	30.6	23.4	93	73	490.6	19
September	31.0	22.7	91	66	490.1	7
October	30.8	23.1	89	73	53.7	14
November	31.5	23.9	74	58	276.6	1
December	32.2	21.9	74	47	18.20	0

PILICODE

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	8.30 A.M	3.30 P.M		
January	31.8	20.8	92	55	000.0	—
February	32.4	23.1	91	60	03.2	1
March	33.3	23.9	87	60	05.4	2
April	33.9	24.9	87	61	110.7	10
May	33.3	26.3	85	64	05.6	5
June	30.1	24.1	93	79	1068.3	23
July	28.8	23.4	97	84	897.9	29
August	29.5	23.7	95	79	532.2	27
September	30.1	23.1	93	72	150.6	13
October	30.5	23.5	94	73	199.9	10
November	32.5	22.9	92	58	23.3	3
December	32.1	19.1	90	52	000.0	—

VENGURLE

Month	Temperature (°C)		Relative Humidity (%)	Rainfall (mm)	No. of rainy days
	Maximum	Minimum			
January	32.0	18.9	71.4	—	—
February	32.0	19.6	70.7	—	—
March	32.3	21.6	70.5	—	—
April	33.0	24.6	68.1	—	—
May	33.1	27.1	68.4	—	—
June	31.2	25.8	82.6	951.6	19
July	29.3	24.9	86.1	965.2	31
August	30.1	24.9	85.0	445.0	30
September	30.3	24.4	82.6	168.0	14
October	32.4	24.1	79.2	50.0	5
November	33.9	21.6	70.7	8.4	1
December	32.9	17.9	68.4	—	—

VRIDHACHALAM

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days
	Maximum	Minimum	8.30 A.M	3.30 P.M		
January	31.0	22.5	78	69	—	—
February	32.5	21.9	71	66	—	—
March	40.4	24.4	69	63	—	—
April	41.1	22.6	67	61	9.0	1
May	40.7	23.9	71	68	52.0	7
June	40.6	21.1	71	68	55.0	3
July	38.5	22.2	78	70	61.0	4
August	36.8	23.6	76	59	146.0	11
September	37.4	25.4	81	70	4.0	1
October	33.7	24.5	79	78	142.0	5
November	29.9	24.9	80	78	262.5	11
December	31.3	25.2	87	66	7	1

9. RESEARCH PUBLICATIONS

BAPATLA

M.Lakshminarayana Reddy, Gouse Mohammed and B.Prasanna Kumar, 2002, Evaluation of High Yielding clones under Bapatla conditions for nut yield and other characters. *The Cashew* : Oct-Dec.2002, 26-31pp.

B.Prasanna Kumar, M.Lakshminarayana Reddy and A.Radhakrishna 2003. Studies on the NPK requirement of clonally multiplied cashew (*Anacardium occidentale* L.) (grafts) in sandy soils of Bapatla, Andhra Pradesh. *The Cashew* (in press)

BHUBANESWAR

P.C.Lenka, K.C.Mohapatra and S.Samal (2003). Performance of cashew types at Bhubaneswar. *The Cashew.* Vol. XVII, No.4 :2, 12-17.

S. Samal, G.Rout and P.C.Lenka (2003). Analysis of genetic relationship between population of cashew by using morphological characterization and RAPD markers. *Plant, Soil and Environment.* 49 (4): 176-182.

R.Mohapatra and P.C.Lenka (2003). Correlation of weather parameters with the incidence of major foliage pests of cashew in Orissa. *Journal of Plantation Crops.* 31(1): 64-65.

L.N.Mohapatra and R.Mohapatra (2003). Incidence of cashew leaf and blossom webber, *Lamida moncusalis* walker (Lepiodeptera : Pyralidae) in relation to its natural enemies and weather factors. *Indian Journal of Plant Protection.* Vol. 31 (1): 119-121

B.C.Jena and R.Mohapatra (2003). A short note on integrated management of stem and root borer in cashew. *The Cashew.* Vol. 17(2): 31-34.

MADAKKATHARA

Scientific books

Mini. C. and Krishnakumary K., 2004. *Leaf vegetables.* Agro Tech Publishing Academy, Udaipur. Pp. 296.

Chapters in scientific books

K.V. Peter, P. Indira and C. Mini. 2003. The cultivation and processing of Capsicum in India. 139-143 in *Capsicum: the Genus Capsicum.*; (*Medicinal and aromatic plants- Industrial profiles; Vol. 33* p-275) Ed. Amit Krishna De, Taylor and Francis, London and New York.

Scientific articles

Jayalekshmy V.G. and Sree Ranga Samy. S.R. Variability for floral traits in coconut (*Cocos nucifera*). *XVth Kerala Science Congress* 29-31January 2003 Kozhikode.

Mini. C., P. Meagle Joseph and P. G. Sadhan Kumar. 2003. Seed extraction and drying techniques in ash gourd (*Benincasa hispida*). *Seed Res.,* 31(1):53-57.

Mini. C., Krishnakumary K, and Gopalakrishnan T.R. 2004. Effect of indigenous storage techniques in maintaining cowpea seed quality. *Proc. XVIth Kerala Science Congress.* 29-31 January, Kozhikode

K. Krishnakumary and Mini. C. 2003. Influence of fruit position on seed yield and quality in okra. *Seed Res.* 31(2):246-248.

Popular articles

C. Mini. 2003. *Veetil oru poshakathottam.* Karshakasree. 8 (9) May. p.60-61

VENGURLE

B.B.Sapkal, B.P.Patil, R.C.Gajbhiye, 2003 Home/small scale processing of cashew problems and prospects. Regional Fruit Research Station, Vengurle.

B.B.Sapkal and R.C.Gajbhiye.2003. Quality parameter in cashewnut processing industry, Regional Fruit Research Station, Vengurle.

VRIDHACHALAM

D. Ananda Nayaki, V. R. Saminathan, K. Prabakaran, V. A. Sathiamoorthy, C. A. Mahalingam and P. Vindhya Varman. 2003. Technical bulletin on cashew cultivation.

Ambethgar V. 2003. Screening and selection of entomopathogenic fungi for management of cashew tree borer, *Plocaederous ferrugineus* L. (Coleopetra : Cerambycidae). *Pest Management in Horticultural Ecosystems* 9(1): 19-31.

10. LIST AND ADDRESSES OF CENTRES OF AICRP ON CASHEW

HEADQUARTERS

National Research Centre For Cashew
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