वार्षिक प्रतिवेदन

ANNUAL REPORT

2004 - '05

राष्ट्रीय काजू अनुसंधान केन्द्र

(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

ICAR

NRCC

ISSN. 0972-2637

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Correct Citation

National Research Centre for Cashew
Annual Report 2004-'05, Puttur, Karnataka, 68 pp

Published by

Dr M Gopalakrishna Bhat
Director
National Research Centre for Cashew
Puttur 574 202, DK, Karnataka
Tel No. : 08251-231530 (O), 233490 (R), 230992 (R)
EPABX : 230902, 236490
Fax : 08251 - 234350, 231590
Gram : CAJUKENDRA
E-mail : nrccaju@sancharnet.in
NRCC Website : http://www.nrccashew.org/
AICRP Cashew : http://www.nrccashew.org/index1.htm

Compiled and edited by

Dr KV Nagaraja
Dr P Shivarama Bhat
Dr R Venkattakumar

August 2005

Word processed by

R Muthuraju

Hindi Translation

Dr TN Raviprasad

Cover Photo : **A thirteen year old limb pruned tree of Ullal 1**

Printed at

Codeword Process and Printers, Mangalore
Ph: 2421418, 5261818
E-mail: codeword@sify.com

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भूमिका

राष्ट्रीय काजू अनुसंधान केन्द्र के वार्षिक प्रतिवेदन 2004-05, जिसमें 1अप्रैल 2004 से मार्च 2005 तक की कार्यकलाप शामिल है, को प्रस्तुत करने के लिए मुझे बहुत खुशी है। इस समय में केन्द्र ने फसल सुधार, फसल प्रबंधन, फसल संरक्षण, कटाई उपरान्त प्रौद्योगिकी, तकनिकी हस्तांतरण तथा कंप्यूटर उपयोग संबंधित विभिन्न परियोजनाओं को कार्यान्वित की है।

केन्द्र ने जीवद्रव्य सामग्री संरक्षण के बारे में अपना कोशिश जारी रखा और प्रधानता से उत्तर पूर्वी राज्यों से संग्रहित 16 विभिन्न प्रकारों को शामिल करने से केन्द्र के राष्ट्रीय काजू क्षेत्रीय जीन बैंक (NCFGB) में संरक्षित जीवद्रव्य एक्सेशनों की संख्या 494 तक बढ़ी। जीवद्रव्य एक्सेसनों का आण्विक चरित्रवर्णन के लिए प्रयास तीव्र की गई। प्रत्येक पेड़ सोई के साथ पौधों के बीच में अर्धचन्द्राकृति की बींद बनाना ढाल जगहों में बेहतर जल और मिट्टी संरक्षण हुए। पौधसंरक्षण को अभिग्रहण करने से काजू कांड और जड़ छेदक (CSRB) को कीट आबादी और स्वस्थ पेड़ों में नया उल्लेखन की प्रभाव में कमी आई। प्रमुख काजू उगानेवाले जगहों से संग्रहित नमूनों में काजू कीट निरीक्षण में सामान्यतः उपयोग करनेवाली कीटनाशकों का अवशेष नहीं पाया गया। केंद्र ने काजू और कोको निदेशनालय (DCCD) के सभी, श्री क्षेत्र धर्मस्थला ग्रामीण विकास परियोजना (SKDRDP), धर्मस्थला, आकाशवाणी मंगलूर तथा विकास विभागों के साथ तकनिकी हस्तांतरण के लिए सहयोग मजबूत किया है। इस संबंध में, केंद्र ने पहली बार आकाशवाणी, मंगलूर की सहयोग में, कन्नड़ा में एक रेडियो धारावाही गेरु बेळे हणद होळे यानें सुधारित काजू खेती पद्धतियों प्रस्तुत किया जिसमें 13 एपिसोड थे।

मेरे सहकर्मियों ने अपने अनुसंधित तकनिकी कार्यक्रमों की अनुष्ठान में अनुसंधान परियोजनाओं में पाए हुए परिणामों इस वार्षिक प्रतिवेदन में मूर्तिबंधित है। मैं इस प्रतिवेदन की पाठकों से इनमें अनुसंधान कोशिशों की सुधार के लिए सुझाव स्वागत करता हूँ। इस साल केंद्र के उपलब्धियों का संकलन करने के लिए मैं संपादकीय समिति की सदस्यों को आभारी हूँ।

एम. गोपालकृष्ण भट्ट

(एम. गोपालकृष्ण भट्ट)

निदेशक

स्थल : रा.का.अनु. के., पुत्तूर

दिनांक : 8 अगस्त, 2005

PREFACE

I am pleased to present the Annual report 2004-'05 of National Research Centre for Cashew , Puttur in which activities of the centre for the period from April 2004 to March 2005 are covered. During the period, the centre had implemented diverse projects in the areas of Crop Improvement, Crop Management, Crop Protection, Post- Harvest Technology, Transfer of Technology and Computer Application.

The centre continued its efforts to conserve germplasm material and with the planting of 16 diverse types collected mainly from North Eastern States, the germplasm accessions conserved has increased to 494 in National Cashew Field Gene Bank (NCFGB) of the centre. The efforts were further intensified for molecular characterization of germplasm accessions. Individual tree base terracing around the plant with crescent bund led to better soil and water conservation in slopy / steep land. Adopting phytosanitation resulted in reduction of Cashew Stem and Root Borer (CSRB) population density and reduced fresh incidence of pest in healthy trees. The residues of insecticides used in the management of pests of cashew were not detected in the samples collected from the major cashew growing areas. The centre strengthened its collaboration with Directorate of Cashewnut and Cocoa Development, Kochi, Sri Kshetra Dharmasthala Rural Development Project, Dharmasthala, All India Radio, Mangalore and Development Departments for transfer of technology efforts. In this connection, this centre in collaboration with All India Radio, Mangalore has produced for the first time a radio serial of 13 episodes in Kannada on 'Improved Cashew Cultivation Practices' entitled 'Geru Bele Hanada Holey'.

This Annual Report embodies the results of the research projects carried out by my colleagues as per the approved technical programme. I welcome the suggestions from the readers of the report for improvement of our research efforts. I am grateful to the Editorial Committee members for compilation of achievements of the centre during the year.

M. Gopalakrishna Bhat

Place : NRCC, Puttur
Date : 8th August 2005

(M. GOPALAKRISHNA BHAT)
Director

कार्यकारी सारांश

इस साल, ICAR तथा DBT का दो तदर्थ परियोजना सहित कुल 21 परियोजनाओं जारी रहा। उत्तर कर्नाटका के अपारंपरिक प्रदेशों से चार भिन्न प्रकारों संग्रहण के लिए पहचाना गया है। उत्तर पूर्वी पर्वतीय क्षेत्र (13) से और पुत्तूर (3) से संग्रहित एक्सेशनों राष्ट्रीय काजू क्षेत्र जीन बैंक (NCFGB) में रोपित होने से अब तक NCFGB में कुल 494 एक्सेशनों संरक्षित है। सन् 1993-94 में रोपित बीस जीवद्रव्य संग्रहणों रूपात्मक तथा उपज गुणों के लिए मूल्यांकित हुए, इनमें अब तक मूल्यांकित एक्सेशनों की कुल संख्या 320 हुई है। तीन हैब्रिडो, H-1250 (10 कलाई), H-438 और H 2453 (6 कलाई) क्रमशः 37.22, 18.40 और 17.28 कि.ग्रा. पेड़ का संचयी उपज देकर आशाजनक पाया गया। ताळीपरंबा, ब्रेजीलियन ड्वार्फ एक्सेशन, कोडीप्पाडी-2 का कलमनें और H-4-7 को मूलप्रकन्द पौधाघर में स्थापित हुए और ब्रेजीलियन ड्वार्फ तथा ताळीपरंबा के "इन विट्रो" संवर्धित कलचरों प्रयोगशाला में स्थापित है। काजू के चार प्रबेधों सहित 10 एक्सेशनों, *अनाकार्डियं आक्सिडेंटेल* का क्रिमोसोम, और अंतरप्रबेधीय हैब्रीडो 14 किस्म का ऐसेजेम स्क्रीन के लिए परखित हुई। उच्च पौधा घनत्व और अधिकतम उर्वरक मात्रा के संयोजन में घनत्व तथा उर्वरक ट्रीटमेंट की पारस्परिक परिणाम उपज में वृद्धि दिखाई। कलमनों को सुक्त छतरी आकार देने के प्रयत्नों में प्रधान अग्रणी, परिवर्तित अग्रणी, खुली केंद्र निकाय या झाड़ी प्रकार की छतरी प्रवृत्त कर सकेंगे। प्रत्येक पेड़ सीढ़ी के साथ (2मी व्यास) पौधा के ओरों में ढाल के निचला ओर से अर्धचंद्राकृति की बाँद (½ मी. ऊँचाई और 1 मी. चौड़ाई) बनाना पश्चिमी तटीय प्रदेशों के ढालू जगहों में जल और मिट्टी संरक्षण का उत्कृष्ट विधान है।

काजू कांड और जड़ छेदक का पुनरुत्पोडन को नियंत्रित करने में क्लोरोपैरीफॉस; मोनोक्रोटोफॉस से अधिक प्रभावी पाया गया। पौधस्वच्छता को अभिग्रहण करने से कोट आबादी और स्वस्थ पेड़ों में नया उत्पोडन का प्रमाण में कमी आई। काजू की एकफसल रूप में प्रधानता में उगानेवाले प्रदेशों में, नैसर्गिक परागण की अभाव पाया गया। दक्षिण कन्नड़ा जिल्ला से संग्रहित फार्म गेट नमूनों सामान्यतः उपयोग करनेवाली कीटनाशकों का अवशेष से मुक्त थे। चिन्तामणि (कर्नाटक का मैदानी इलाका), वृद्धाचलम् (तमिलनाडु), वापटला (आँध्र प्रदेश), भुवनेश्वर (तटीय ओडिसा) में एंडो सल्फॉन (0.003 से 0.007 ppm) तथा लिण्डेन (0.0066 से 0.007ppm) का अवशेष पाया गया।

काजू सेब फलमेश से संग्रहित पेक्टिन (2.59% उपज) में Ca, Mg, K, Na और Fe पाया गया।

नियमित और "ग्राम अभिग्रहण" योजनाओं में काजू और कोको निदेशनालय (DCCD), कोच्ची द्वारा प्रायोजित 20 कृन्तक नमूना काजू बगानों कृषकों का प्लाटों में लगाया गया है। आठ कृषकों का प्रशिक्षण कार्यक्रम आयोजित रहा, जिसमें प्रजनन कृषकों का सम्मेलन (2), विषयक आंधोलन, "जल और मिट्टी संरक्षण विधानों", "उच्च घनत्व रोपण और काजू में छाँटन" (2), विषयक आंधोलन; "काजू में सस्य संरक्षण" और प्रवीणता प्रशिक्षण "काजू में वनस्पतिक प्रवर्धन" (1) शामील थे। कुल मिलाकर 700 कृषकों प्रशिक्षित हुए। सात प्रशिक्षकों का प्रशिक्षण कार्यक्रम आयोजित थे, जिसमें "काजू उत्पादन तकनिकों" (5); "काजू में वनस्पतिक प्रवर्धन" (1) और "छाँटन और काजू में टापवर्किंग और काजू पुनरुचक्रित जीवराशी की कांपोस्टिंग" (1) शामिल थे। विविध विकास विभागों का 70 अधिकारी इसमें प्रशिक्षित थे। केरल का कण्णूर जिल्ला में काजू कृषि का सामाजिक - आर्थिक परिस्थिति के बारे में निर्धारण जारी रहा। आकाशवाणी, मंगलूर के सहयोग से 13 उपाख्यानों में "सुधारित काजू खेती पद्धति" के बारे में रेडियो धारावाहिक प्रसारित हुए। NRCC का वेबसाईट आधुनिक बनाया गया है और परिवर्तित किया गया है। लगभग एक लाख काजू कलमन प्रवर्धित करके कृषकों और विकास विभागों को बाँटा गया है।

EXECUTIVE SUMMARY

During the year, a total of 21 projects including two ad-hoc projects of ICAR and a DBT project were in operation. Four diverse types have been identified for collection from non-traditional areas of North Karnataka. Accessions collected from North Eastern Hill (NEH) region (13) and Puttur (3) were planted in National Cashew Field Gene Bank (NCFGB) bringing the total number of accessions conserved so far to 494. Twenty germplasm collections planted during 1993-94 were evaluated for morphological and yield characters, which brings the total number of accessions evaluated so far to 320. Three hybrids viz., H-1250 (10 harvests), H-2438 and H-2453 (6 harvests) were found promising with a cumulative yield of 37.22, 18.40 and 17.28 kg/tree respectively. Taliparamba-1, Brazilian Dwarf accession, Kodippady-2 and H-4-7 root stocks were established in green house and in vitro cultures (nodal cuttings) were initiated in Brazilian dwarf and Taliparamba. A total of 10 accessions including four species of cashew, cultivars of *Anacardium occidentale* and interspecific hybrids were screened for isozyme pattern of 14 enzymes.

Interaction effect of density and fertilizer levels increased yield in combination of high plant density and highest level of fertilizers. Training of grafts for the development of suitable canopy shapes indicated that various canopy shapes such as central leader, modified leader, open centre system or bush type can be induced. Individual tree base terracing of 2 m radius around the plant with crescent bund of 0.5m height and one m width at the base towards lower side of the slope is the best soil and water conservation measures in slopy land of west coast region.

Chlorpyriphos was more effective than monocrotophos in checking reinfestation by cashew stem and root borer (CSRB). Adopting phytosanitation resulted in reduction of pest population density and reduced fresh incidence of the pest in healthy trees. In areas where cashew is predominantly grown as monocrop, deficit in natural pollination was observed. Farm gate samples collected in Dakshina Kannada district were free from residues of commonly used insecticides. Few samples collected from Chintamani (maidan parts of Karnataka), Vridhachalam (Tamil Nadu), Bapatla (Andra Pradesh), Bhubaneswar (Coastal Orissa) had residues of endosulfan (0.003 to 0.007 ppm) and lindane (0.007 to 0.0066 ppm).

Pectin extracted from cashew apple pomace (yield 2.59%) contained Ca, Mg, K, Na and Fe.

A total of 20 model clonal cashew orchards were laid out at farmers' plots under regular and village adoption schemes sponsored by Directorate of Cashewnut and Cocoa Development (DCCD), Kochi. Eight farmers' training programmes were organized which included demonstration farmers meet (2), thematic campaigns on Soil and Water Conservation Measures, High Density Planting and Pruning in Cashew (2), thematic campaigns on Plant Protection in cashew (2) and skill training on Vegetative Propagation of Cashew (1). A total of 700 farmers were trained. Seven trainers training programmes were organized which included, Cashew Production Technology (5), Vegetative Propagation of Cashew (1) and Pruning, Top working in cashew and Composting of Recyclable Cashew Biomass (1). A total of 70 officials of development departments were trained. Socio-economic impact of cashew cultivation in Kannur district of Kerala was assessed. A radio serial on Improved Cashew Cultivation Practices comprising of 13 episodes was broadcast in association with All India Radio (AIR), Mangalore. NRCC website has been updated and modified. About one lakh cashew grafts were multiplied and distributed to farmers and development departments.

INTRODUCTION

Research on cashew was first initiated in the early 1950s. Indian Council of Agricultural Research (ICAR), sanctioned ad hoc schemes for Research Centres located at Kottarakkara (Kerala), Ullal (Karnataka), Bapatla (Andhra Pradesh), Daregaon (Assam) and Vengurla (Maharashtra). In 1971, ICAR also sanctioned All India Coordinated Spices and Cashew Improvement Project (AICS and CIP) with its Head Quarters located at CPCRI, Kasaragod. The CPCRI Regional Station, Vittal (Karnataka) was given the mandate to work on cashew while four University Centres (Baptala, Vridhachalam, Anakkayam and Vengurla) were assigned the research component on cashew under AICS and CIP. During the V and VI plan three more centres (Bhubaneswar, Jhargram and Chintamani) came under the fold of AICS and CIP and with shifting of work of Anakkayam centre to Madakkathara. The recommendations made by the Quinquennial Review Team (QRT) constituted by ICAR in 1982, working group on Agricultural Research and Education constituted by the Planning Commission for VII Plan Proposals and the Task Force on Horticulture constituted by ICAR has resulted in the establishment of National Research Centre for Cashew at Puttur on 18th June 1986. Subsequent to the bifurcation of AICS and CIP, the headquarters of All India Coordinated Research Project on Cashew was shifted to NRC for Cashew, Puttur. At present, this Coordinated Research Project is operating in eight centres and a sub centre distributed in major cashew growing areas of the country.

MANDATE

- To conduct mission-oriented research on all aspects of cashew for improving productivity and quality with special reference to export.
- To serve as a national repository for cashew germplasm and a clearing house for research information on cashew.
- To act as centre for training in research methodologies and technology updating of cashew and to coordinate national research projects.
- To provide consultancy regarding cashew production technology.
- To generate quality planting material.
- To collaborate with national and international agencies for achieving the mandate.

ORGANIZATIONAL SET UP AND INFRASTRUCTURE

- National Research Centre for Cashew is located at Puttur, Dakshina Kannada, Karnataka. The main campus is situated 5 KM away from Puttur town (at Kemminje: 12.45° N latitude, 75.4° E longitude and 90m above MSL).
- The main campus has an area of 68 ha with field experiments and Laboratory-cum-Administrative Block. Experimental Station at Shantigodu, which also forms part of the Research Centre is 13 Km away from the main campus and has an area of 80 ha.
- The centre has got well-established library in the field of cashew research. The library is serving as an information centre on all aspects of cashew research and development in the country. The CD database viz., CABHORT, CABPEST, AGRICOLA and AGRIS, SOIL CD, CROP CD, PLANTGENE CD and TROPAG CD are also available in the library. The library also has library automation software and bar- coding facility.
- The centre has got local area network of computers with Internet connections. The centre has got its own website which is updated at montly intervals.

- The headquarters of AICRP on Cashew is located at NRC Cashew, Puttur. It has eight Coordinating Centres and a Sub-Centre located in Karnataka, Kerala and Maharashtra in West Caost, Andhra Pradesh, Orissa, Tamil Nadu and West Bengal in the East Coast and in Chattisgarh.

Significant achievements:

- It has the largest germplasm collection of cashew in the country (National Cashew Field Gene Bank) with 494 accessions. A total of 432 cashew accessions have been assigned with National Collection numbers.
- It has released two selections, namely, NRCC Sel-1 and NRCC Sel-2, which are high yielding and medium nut types for cultivation in Karnataka.
- In micropropagation, regeneration of cashew from the seedling explants (nodal cultures) has been standardized.
- Micrografting technique for *in vitro* multiplication of cashew has been standardized and cashew plants raised by micro grafting have been potted.
- Protocols have been standardized for characterization of released varieties and cashew germplasm accessions using RAPD/IISR markers and isozymes.
- It has also demonstrated the advantage of growing intercrops like pineapple and turmeric profitably in cashew gardens.
- Glyricidia grown as intercrop during initial years contributed 5.75 t/ha of dry matter, equal to 186 kg N, 40.8 kg P_2O_5 and 67.8 kg K_2O/ha.
- Individual tree terracing with crescent bunding is the best soil and water conservation measure in sloppy lands.
- High density planting (625plants density/ha) was shown to be better than normal spacing (8m x 8m) resulting in a yield increase by 2.5 times over control in the initial ten years.
- Irrigating cashew at 60-80 litres of water/tree once in four days through drip after initiation of flowering till fruit set and development in combination with the application of 750: 187.5: 187.5 g of NPK/tree led to significant higher yields.
- Softwood grafting method has been standardized and its feasibility for the commercial multiplication has been demonstrated and this technique is beign commercially utilized for large scale production of planting material in cashew in the country.
- The rearing technique for cashew stem and root borer (CSRB) on host bark has been standardized.
- Chlorpyriphos (0.2-0.6%) was effective post-treatment prophylaxis measures against CSRB.
- Volatiles and extracts in hexane from both healthy bark and frass elicited EAG response from adult female beetles of CSRB.
- Laboratory rearing technique for tea mosquito bug (TMB) has been standardized. Among the new insecticides evaluated against the pest, λ-cyhalothrin is effective in reducing the damage under field condition.
- Sweetened and flavoured spread could be prepared from cashew kernel baby bits. Cashew kernel baby bits could be coated with different combination of flavour and colours. Cardamom flavoured and apple green / saffron coloured and sweetened cashew kernel baby bits are most preferred. Sweetened and flavoured cashew kernel baby bits could be stored without quality deterioration for 12 months at ambient temperature.
- Defatted cashew kernel flour, cashew apple pomace, cashew kernel testa of released varieties has been analysed for mineral composition and varietal variation is observed.
- Impact of Transfer of Technology (TOT) efforts of the centre was assessed and strategies were suggested for refinement of TOT efforts.
- Yield forecasting model for predicting cashew yield was developed and refined.
- The centre has established very good linkage with farmers and officials of State Departments

(Rs. In lakhs)

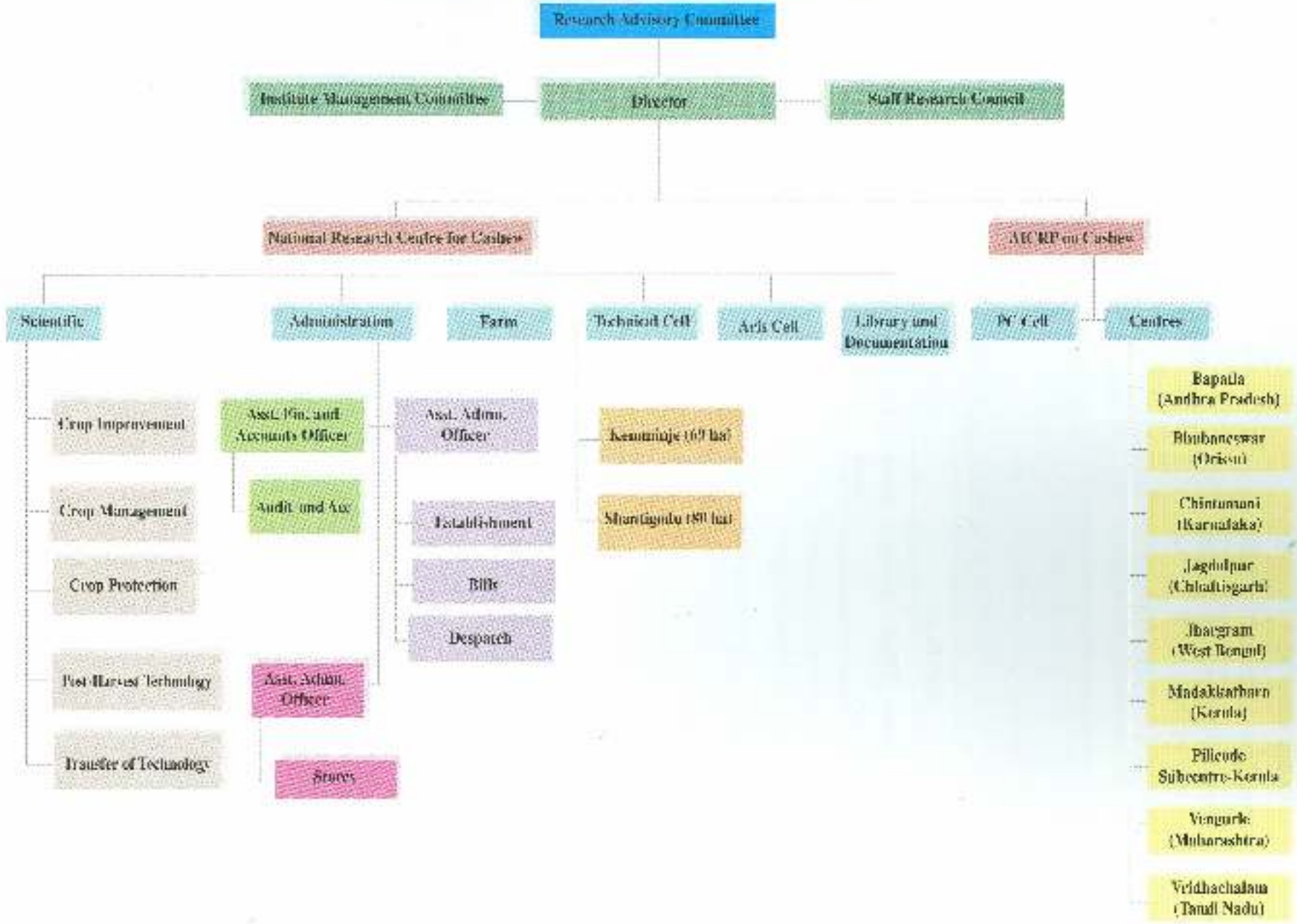
Budget (2004-'05)			
Plan	Non-Plan	External	Total
74.15	142.19	3.14	219.48

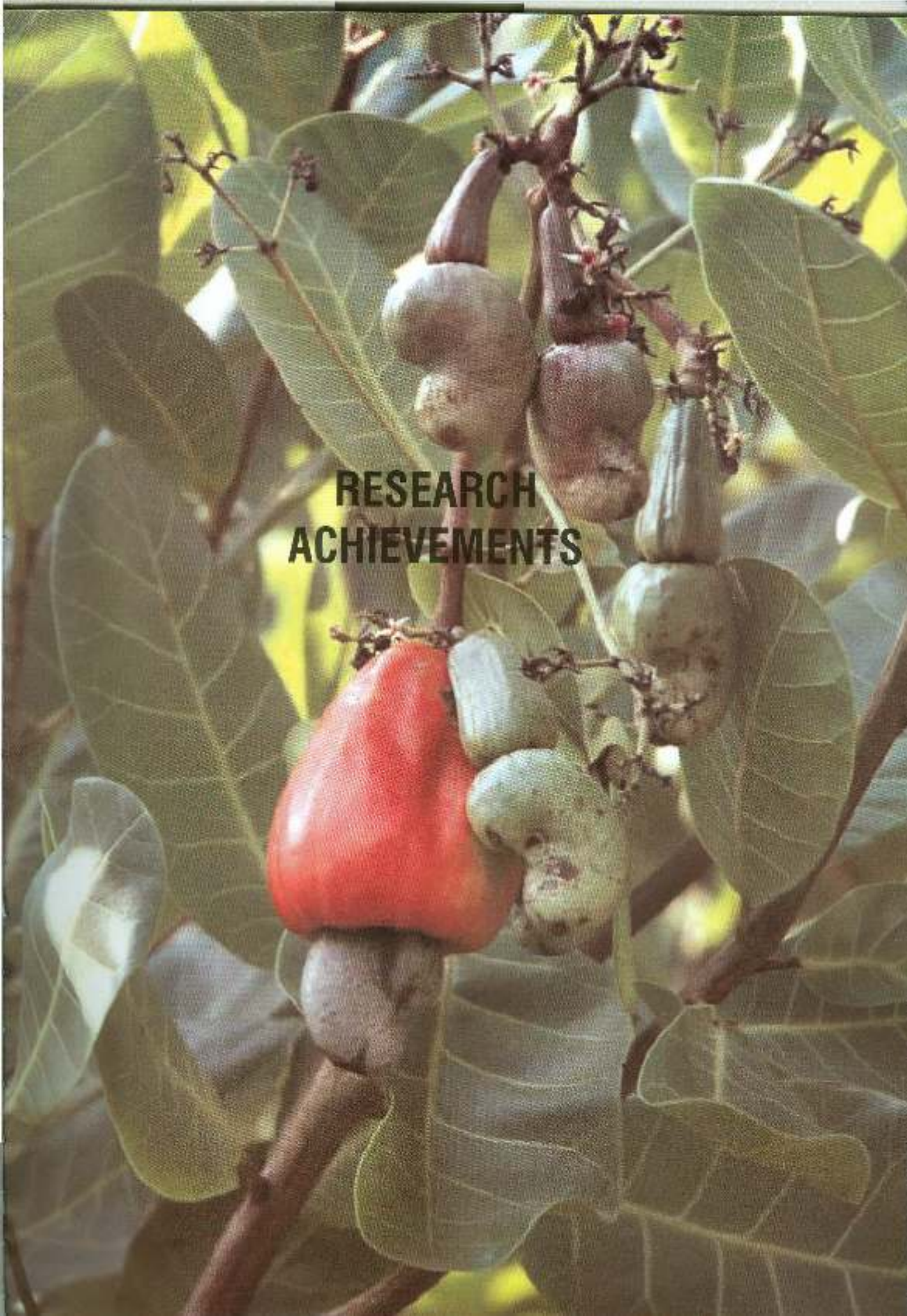
Total Manpower			
	Sanctioned	Filled	Vacant
Non Plan	94	86	8
Plan	5	-	5
Total	**99**	**86**	**13**

Staff Position as on 31.3.2005

Category	NON PLAN			PLAN			TOTAL		
	Sanct-ioned	Filled	Vacant	Sanct-ioned	Filled	Vacant	No. of Posts	No. filled	Vacant
Director (RMP)	1	-	1	-	-	-	1	-	1
Scientific	16	12	4	-	-	-	16	12	4
Technical	20	19	1	4	-	4	24	19	5
Administrative	14	13	1	1	-	1	15	13	2
Supporting	42	41	1	-	-	-	42	41	1
Canteen	1	1	-	-	-	-	1	1	-
Total	**94**	**86**	**8**	**5**	**-**	**5**	**99**	**86**	**13**

ORGANISATIONAL SETUP OF NRC-CASHEW





RESEARCH ACHIEVEMENTS

1. CROP IMPROVEMENT

1.1 Genetic resources of cashew

1.1.1 Germplasm collection

During the fruiting season of 2004-05 survey was undertaken in non-traditional area of cashew cultivation of North Karnataka particularly Belgaum, Bidar and Dharwad districts in collaboration with scientists of Kittur Rani Chennamma College of Horticulture, Arbhavi (UAS, Dharwad). During the survey four trees having boldnuts and cluster bearing habit and one tree with medium nut size and high yield were identified for collection. A tree with semi vigorous and medium nut type with high yield was identified in drought prone areas of Bidar district for collection.

1.1.2 Germplasm conservation

Grafts of 13 collections made from NEH region and three from Puttur were planted in National Cashew Field Gene Bank bringing the total number of collections planted so far to 494. (Table 1.1).

1.1.3 Characterization of germplasm

Twenty germplasm collections planted during 1993-94 were evaluated for morphological and yield characters during the fruiting season of 2003-04. The total number of collections evaluated so far is 320. Among the 20 accessions evaluated, majority had upright and open canopy shape (11), oval leaf shape (15), extensive branching pattern (20), yellowish red apple type (20), mid season flowering (12), cylindrical cashew apples (17), intermediate nut weight (14), medium apple weight (12), intermediate attachment of nut to apple (11), intermediate shell thickness (20), medium apple to nut ratio (13), intermediate kernel weight (18), loose attachment of peel to kernel (13) and low yield (14). (Table 1.2).

1.2 Varietal improvement of cashew

1.2.1 Evaluation of hybrids/selfs

Hybrids H 24/4 (BLA 139-1 x A 18/4) and H 6/18 (BLA 139-1 x 13/5 Kodur) performed well for cumulative yield (16.81 kg/tree and 15.88 kg/tree respectively for six harvests) as against cumulative yield of 9.31 kg/tree in case of VRI-2 (control) in a replicated trial. The highest annual yield was recorded in H 6/18 (5.61 kg/tree in sixth harvest) as against annual yield of 4.28 kg/tree in case of VRI-2 (control).

A hybrid H 1250 (VRI-2 x VTH 40/1) was found promising under medium nut size category with an annual yield of 14.65 kg/tree in tenth harvest and cumulative yield of 37.22 kg/tree for 10 harvests. In another trial, two hybrids, namely, H 2438 and H 2453 (cross of BLA 139-1 x VTH 711/4) with an annual yield of 9.6 kg/tree and 6.9 kg/tree in sixth harvest respectively and cumulative yield of 18.4 kg/tree and 17.29 kg/tree respectively from six harvests were promising.

A precocious dwarf and compact type KGN-1 from Madakkathara (Thrissur) Centre of AICRP-Cashew planted at 4m x 4m spacing in 2002 was evaluated along with NRCC Sel-2 (control) for plant growth characters. The growth of KGN-1 was relatively less with respect to plant height, stem girth and mean canopy spread compared

Table 1.1 Germplasm holding in NCFGB, Puttur

State	Number of accessions		
	Existing 2004	Planted during	Total
Andhra Pradesh	102	-	102
Assam	-	3	3
Goa	45	-	45
Karnataka	118	2	120
Kerala	70	-	70
Maharashtra	45	-	45
Meghalaya	-	7	7
Orissa	21	-	21
Tamil Nadu	42	-	42
Tripura	-	3	3
West Bengal	14	-	14
Exotic	21	1	22
Total	**478**	**16**	**494**

Table 1.2 Germplasm accessions evaluated and characterized during 2004 fruiting season

Data field	Descriptor		Descriptor Status	Number of accessions
07	Tree habit	3.	Upright & Compact	-
		5.	Upright & Open	11
		7.	Spreading	9
09	Leaf shape	1.	Oblong	-
		2.	Obovate (Club-Shaped)	5
		3.	Oval	15
16	Branching pattern	1.	Extensive	20
		2.	Intensive	-
19	Colour of young leaves	1.	Red	-
		2.	Yellow Red	20
		3.	Green Yellow	-
		4.	Purple	-
28	Season of flowering	3.	Early (Nov-Dec)	4
		5.	Mid (Dec-Jan)	12
		7.	Late (Jan-Feb)	4
31	Colour of mature apple	1.	Yellow	6
		2.	Red	10
		3.	Yellow Red	4
		4.	Red Purple	-

Data field	Descriptor		Descriptor Status	Number of accessions
32	Shape of cashew apple	1.	Cylindrical	17
		2.	Conical-Obovate	2
		3.	Round	-
		4.	Pyriform	1
35	Nut weight	3.	Low (<5 g)	3
		5.	Intermediate (5-7 g)	14
		7.	High (>7 g)	3
43	Weight of cashew apple	3.	Low (<27 g)	-
		5.	Medium (27-52 g)	12
		7.	High (>52 g)	8
50	Attachment of nut to cashew apple	3.	Loose	7
		5.	Intermediate	11
		7.	Tight	2
57	Shell thickness	3.	Thin (<2.5 mm)	-
		5.	Intermediate (2.5-4.0 mm)	20
		7.	Thick (>4.0 mm)	-
60	Flowering duration	3.	Short (<60 days)	-
		5.	Medium (60-90 days)	12
		7.	Long (>90 days)	8
62	Apple to nut ratio	3.	Low (<6.0)	1
		5.	Medium (6.0-12.0)	13
		7.	High (>12.0)	6
64	Kernel weight	3.	Low (<1.2 g)	-
		5.	Intermediate (1.2-2.5 g)	18
		7.	High (>2.5 g)	2
65	Attachment of peel to kernel	3.	Loose	
		7.	Tight	13 7
68	Cumulative yield per plant (6 annual harvests)	3.	Low (<9 kg)	14
		5.	Medium (9-19 kg)	6
		7.	High (>18 kg)	-

to NRCC Sel-2 (control) at two and half years of age. Internodal length of KGN-1, however, was slightly more compared to control (NRCC Sel-2) (Table 1.3).

1.3 Molecular characterization

1.3.1 Micro propagation of rootstocks and elite lines

Grafts of rootstock varieties (Taliparamba-1, Brazilian Dwarf accession, Kodippady-2, H-4-7) were established in green house and in vitro cultures (nodal cuttings) were initiated in Brazil dwarf and Taliparamba. Similarly nodal cultures from young grafts (1-2 years) of five elite varieties (NRCC Sel-2, Ullal-3, Ullal-4, VRI-3 and Goa 11/6) were initiated on half-MS containing 2 g/l activated charcoal, 4% sucrose and gelled with 2.25 g/l phytagel. Incorporation of cytokinins in media had no advantage over hormone free medium. Contamination was high during rainy and winter months and less during January to April.

Table 1.3 Performance of KGN-1, compact and dwarf genotype, for plant growth characters.

Character	KGN-1 (Mean of 27 plants)	NRCC Sel-2 (check variety) (Man of 10 plants)
Plant Height (m)	2.40	2.62
Girth (cm)	21.14	25.21
EW Canopy spread (M)	2.30	2.62
NS Canopy spread (M)	2.35	2.82
Mean Canopy spread (M)	2.32	2.72
Inter nodal length (cm)	2.97	2.25

Contamination ranging from 5-91%; bud break of 7 to 56% and shoot development of 0-14 % were observed in different months.

1.3.2 Induction of somatic embryogenesis

Nucellus cultures were initiated from bisected ovules of immature nuts of Kanaka, BPP-6, Ullal-3, Ullal-4 and Goa 11/6 on modified MS medium supplemented with various levels of 2,4-D alone and in combination with picloram, spermidine and BAP (8 sets). Somatic embryogenesis was induced in callus on induction media in Kanaka and BPP-6 and in other varieties on subculture of callus on media containing very low levels of 2,4-D and in hormone free medium. Media containing 2,4-D and picloram in combination helped embryogenesis in BPP-6 and Kanaka.

Somatic embryos of BPP-6 could be multiplied on semi-solid Raj Bhansali (1990) medium (RBM). They were further scaled up on the same medium in suspension culture and matured on medium containing ABA. Germination attempted on a modified MS medium supplemented with filtered extract of cotyledon (10, 100, 1000, 10,000 µl/250 ml of medium) and incubating in dark resulted in root formation (1-3 cm) in 85% of these cultures with poor shoot differentiation. Germination of somatic embryos of Kanaka in another modified MS liquid medium containing GA_3 or NAA + BAP resulted in 60% germination with good root differentiation and rudimentary leaf development in shoot.

1.3.3 Evaluation of micropropagated plants in field

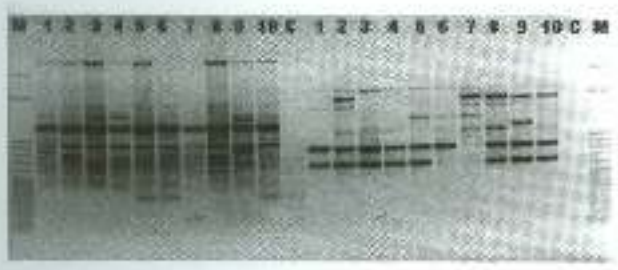
Evaluation of micropropagated plants and grafts of two varieties (H-4-7 and VRI-2) in a replicated trial planted during 1999 revealed significant difference for growth parameters (girth, plant height and spread). Among the treatments, only varietal effects were significant for all the characters. Micropropagated and grafted plants showed significant difference only for plant height .In another trial, H-4-7 had better growth performance and micropropagated dwarf plants continued to grow slow and remained dwarf. The growth performance of micrografts and nursery grafts were identical in field.

Among the micropropagated plants of four varieties planted during1997 (observation trial), BLA 39-4 performed better with 3.4 kg/plant followed by VRI-1 (1.4 kg/plant) while dwarf performed least with no yield. In the replicated trial planted (1999) with micropropagated and grafted plants of two varieties, significant difference was not observed for yield/tree. However, VRI-2 gave higher yield (1.01 kg/tree) than H-4-7 (0.73 kg/tree).

1.3.4 Molecular characterization of cashew

DNA extraction on large scale using liquid nitrogen from leaves of 36 released varieties and 60 germplasm accessions of cashew was attempted. Quality of DNA was assessed by 0.8% agarose electrophoresis. DNA extracted was found to be good and could be used for DNA amplification (PCR).

PCR protocol for RAPD was standardized. DNA concentration of 50 ng and 200 µM each of the dNTPs was found to give clear bands and bands were resolved on 1.2% agarose gels. A total of 25 random primers (M/S.Operon Tech.) were screened for polymorphism in RAPD. Among the 25 primers screened, 14 primers gave polymorphic bands with the five test varieties used. DNA of all the 36 released varieties was scored for polymorphism using three selected primers namely OPB-17, OPQ-19 and OPA-05.



RAPD banding pattern in accessions of cashew with two primers.
[M-Markers 50 bp, 1 to 10 - accessions, C - control]

PCR protocol was standardized for ISSR for each primers (using five varieties and one control). For PCR, using ISSR primers, 100 Pico moles of the primer per 25ml reaction with 40 cycles of amplification gave clear bands. Among the different agarose concentration tried, 2.3% agarose gave better resolution of bands. The reaction products were also resolved on 6% PAGE, after staining with either silver staining or ethidium bromide.

SSR marker studies were initiated by procuring nine custom made primer pairs. PCR protocol was standardized.

Isozyme patterns of 10 accessions including four species of cashew, cultivars of *Anacardium occidentale* and interspecific hybrids were studied in 14 enzyme systems. Polymorphism was observed in peroxidase, esterase, acid phosphatase, malate dehydrogenase, galactose dehydrogenase, leucine amino peptidase, shikimate dehydrogenase, aspartate amino transferase and 6-P gluconate dehydrogenase. Glucose 6 phosphate dehydrogenase was monomorphic. Polymorphic data of these isozymes were used to differentiate species, interspecific hybrids and types of *Anacardium occidentale*.

2. CROP MANAGEMENT

2.1 Planting systems and spacing trials

The study was initiated to understand growth behaviour of cashew under different systems of planting and spacing both under pruned and unpruned conditions. The experiment was laid out in 1990 following split plot design with three replications. The main plot treatments included square systems namely 5.0 m x 5.0 m (400 plants/ha), 6.5 m x 6.5 m (236 plants/ha) and 8.0 m x 8.0 m (156 plants/ha) and hedge systems namely 5 m x 4 m (500 plants/ha), 6.5 m x 4.0 m (384 plants/ha) and 8.0 m x 4.0 m (312 plants/ha) with pruning and no pruning as sub plot treatments.

2.1.1 Yield

Highest yield was recorded in medium tree density and high tree density situations though not significant in fourteenth year (950 kg with 384 trees/ha and 932 to 944 kg with 500 and 236 trees/ha respectively under pruned conditions). The lowest yield of 583 and 582 kg/ha at 8mx8m spacing (156 trees/ha) was recorded under pruned and unpruned conditions respectively. Highest cumulative yield of 5417 and 4894 kg/ha over 14 years (10harvests) was recorded under pruned and unpruned conditions respectively at plant density of 500 trees/ha. The next highest yield of 5336 and 5043 kg/ha under pruned and unpruned conditions respectively was achieved with 384 trees/ha (Fig. 2.1).

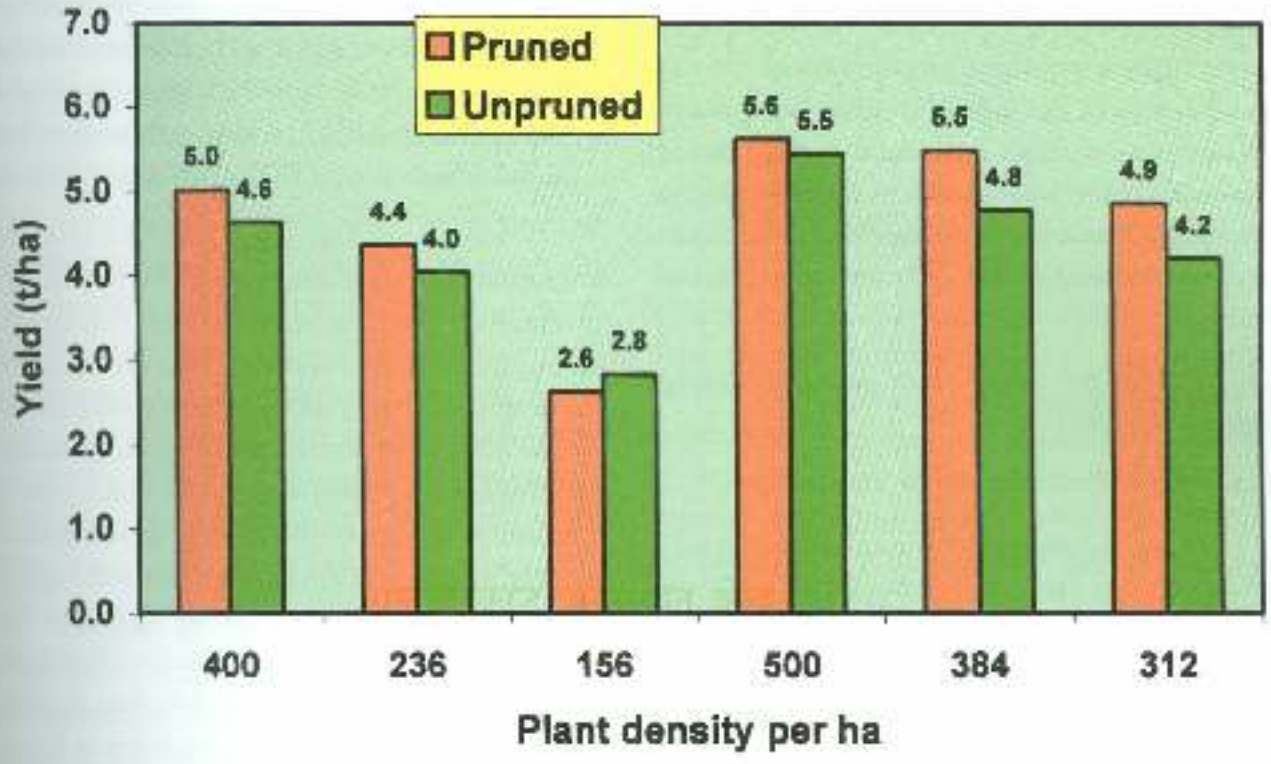


Fig. 2.1. Cumulative yield (11 harvests) realized at different plant densities

Table 2.1 Economics of high density planting upto fourteenth year (1991-2004)

Particulars	Pruned/ Un-Pruned	Density/Spacing					
		400 (5x5m)	236 (6.5x6.5m)	156 (8x8 m)	500 (5x4 m)	384 (6.5x4m)	312 (8x4 m)
Cost of cultivation	Pruned	51313	42587	29387	60880	51064	46161
	Un-Pruned	50138	41382	29092	59700	49889	44258
Income	Pruned	173635	151095	90755	189595	186760	162015
	Un-Pruned	149695	141295	80115	171290	176505	153895
Profit	Pruned	122322	108508	61368	128715	135696	115854
	Un-Pruned	99557	99913	51023	111590	126616	109637

Table 2.2 Ground coverage by tree canopy in relation to different tree densities and fertilizer levels (%)

Density (Trees/ha)	Fertilizer dose			
	Low (M1)	Medium (M2)	High (M3)	Mean
S1 - 200	9.81	11.44	16.08	12.44
S2 - 400	15.79	20.89	27.52	21.13
S3 - 416	13.84	22.56	28.28	21.56
Mean	13.14	18.29	23.96	

2.1.2 Economics

Highest profit of Rs.1. 35,696 and 1.26,616 was realized from plot with 384 trees/ha under pruned and unpruned conditions up to 14 years after planting which was 221 to 248% of amount realized from plot with normal plant density (156 trees/ha-Rs. 61,368 and Rs. 51023/ha under pruned and unpruned conditions (Table 2.1)

2.2 Fertilizer application and pruning in high density plantation

2.2.1 Ground coverage by the tree canopy

Ground coverage by the tree canopy in the high density plot was significantly more (21.13 and 21.56 % of the given area) compared to normal tree density plot (12.44%). Among the subplots (manurial doses) it increased significantly with increased fertilizer level from M1 (13.14%) to M3 (23.96%). Interaction effect of density and fertilizer levels showed increased trend in combination of high tree density and highest level of fertilizers (S2M3 and S3M3 significantly superior to rest of the combinations). Similarly the combinations S2M2 and S3M2 are significantly superior to all the three densities with lowest fertilizer level and combination of lowest tree density with medium and higher levels of fertilizer (S1M2 and S1M3) (Table 2.2).

Yield in the high tree density plot (416 and 500trees/ha) was significantly more (467 and 370 kg/ha) compared to normal tree density plot (232 kg/ha). Among the subplots (manurial doses) the yield increased significantly with increased fertilizer level from M1 (220.4 kg/ha) to M3 (466.3 kg/ha). Interaction effect of density and fertilizer levels increased yield in combination of high tree density and highest level of fertilizers (S2M3-615.9kg/ha and S3M3-482.5 kg/ha) and it was significantly superior to rest of the combinations. Similarly the combinations S2M2 and S3M2 are significantly superior to all the three densities with lowest fertilizer level and combination of lowest tree density with medium and higher levels of fertilizer (S1M2 and S1M3). The combination S1M1 yielded the lowest of 154.3kg/ha (Table 2.3).

Table 2.3 Yield in relation to tree density and fertilizer doses (kg/ha)

Density (Trees/ha)	Fertilizer dose			
	Lower (M1)	Medium (M2)	High (M3)	Mean
S1 - 200	154.4	241.2	300.4	232
S2 - 416	299.5	485.8	615.7	467
S3 - 400	207.2	420	482.4	369.9
Mean	220.36	382.33	466.16	

2.3 Canopy management in cashew

Four cashew varieties viz., VRI-1, Ullal-1, VTH 30/4 and NRCC Sel-1 were used for the study. Pruning treatments were imposed annually soon after the harvest of the crop since 1995 onwards and during the year fifth cycle of pruning has been imposed. The canopy redevelopment by limb pruning (beheading the old exhausted canopy) was done between May and June 2003 as the declined yield was observed due to overlapping of canopy.

The trees produced new flushes from the dormant buds on trunk and new canopy was developed in pruned trees. In variety VTH 30/4, 2% of the panicles flowered in regular flowering season and later remained vegetative and very low yield was realised. In the second year of pruning the pruned trees produced higher yield over control. The variety NRCC Sel-1 remained vegetative in both the years with negligible yield. In varieties VRI-1 and Ullal-1 in the first season more than 60% of the flushes flowered though the yield was less compared to control while in second season.the yield was significantly higher over the control. In pruned trees, all the varieties had delayed flowering by 20-30 days over unpruned control in both the years (Table 2.4).

In the observational trial on canopy architecturing, training of grafts for the development of suitable canopy shapes indicated that various canopy shapes such as central leader, modified leader, open centre system or bush type can be induced. Pruning the grafts of variety Ullal-3 to bush shape by removing the annual growth immediately after the harvest produced normal flowering and fruiting till fifth year after planting but in the sixth year the bush pruned trees were mostly vegetative with negligible yield.

2.4 Efficacy of soil and water conservation coupled with organic and inorganic manuring in cashew grown in slopy areas

For developing suitable soil and water conservation technique to boost cashew yield, a field experiment was laid out in 1999 and continued up to 2005 on ten years old cashew grafts of VRI-1 variety. Main plot treatments consisted of (1) S1: terrace with catch pit (semi-circular catch pits of 0.45m depth, 0.3 m width at 2 m radius around the plant), (2) S2: terrace with crescent bund (terrace of 2 m radius around the plant with crescent bund of 0.5 m height and 1 m width at the base), (3) S3: staggered trenches between trees (eight trenches of 2 m x 0.45 m x 0.45 m size in the middle of four plants) and (4) S4: control plot without any soil and water conservation technique. Subplot treatments consisted of a) M1: recommended doses of fertilizers, b) M2: recommended doses of fertilizers+10 kg poultry manure and c) M3: application of only 20 kg poultry manure/tree/year. The experimental layout was split plot design and had four replications with 20 plants each in main plot and four plants each in subplot. The slope of the land ranged from 3-15%.

2.4.1 Soil moisture studies

Soil samples at three different depths were collected from December 2004 to April 2005 for determining the variation of SMC under different

Table 2.4:. Effect of limb pruning on yield

Treatment	Kg/tree		Weight (g)	
	2003-04	2004-05	Nut	Apple
A: Variety				
VRI-1	1.62	3.19	6.39	62.24
Ullal-1	2.95	4.42	7.25	55.54
V'I'H 30/4	1.18	4.61	8.59	92.87
NRCC Sel-1	0.72	1.23	8.25	85.73
CD for A (P=0.05)	0.44	0.45	0.37	1.14
B: Pruning				
No pruning	3.25	3.01	7.67	74.14
Yearly pruning	2.00	3.71	7.61	73.81
Alternate year pruning	0.97	3.76	7.68	74.56
Shape pruning	1.05	3.55	7.52	73.88
Mean	1.62	3.51	7.62	74.09
CD for B (P=0.05)	0.44	0.45	NS	NS
CD for A x B (P=0.05)	0.88	0.90	NS	NS

treatments. In March there was no precipitation. For the first layer of soil, significant difference in soil moisture content was observed in the case of individual tree terracing with crescent bund and catch pit treatments compared to control. For the second and third layer of soil, significant difference in SMC was observed in the case of all the three treatments with SWC structures compared to control. Maximum soil moisture availability was observed within 1.5 m radius of the plant at the base in the case of crescent bund with terrace treatment (17.0 to 21.2% db in Dec.; 16.3 to 18.8 % db in Jan.; 15.3 to 17.3 % db in Feb. and 14.6 to 16.2 % db in Mar.) and least in the case of control plot (12.5 to 14.4 % db in Dec.; 12.4 to 13.8 % db in Jan.; 11.9 to 13.3 % db in Feb. and 10.9 to 12.2 % db in Mar.) with no soil and water conservation structure. A total of 66.5 mm of rainfall (5 rainy days) was recorded in April (from 5th to 27th) before the soil sample collection. It was observed that the SMC in the first layer was similar (15.4 to 15.8 % db) in all the treatments including control. Maximum SMC in the second and third layer was observed in the case of crescent bund with terrace treatment (15.5 % db in the second and 17.3 % db in the third layer) and minimum in control plot (12.9 % db in the second and 12.2 % db in the third layer). In the case of treatments with soil and water conservation structures, the SMC in the second and third layers was high due to the conservation of pre-monsoon rainfall.

2.4.2 Soil moisture depletion

The SMC in the first layer of soil was reduced by 0.1 to 0.7 % db in Jan., 0.6 to 1.7% db in Feb. and 1.4 to 2.8% db in Mar. in all the treatments including control compared to Dec. The SMC in the second and third layer of the soil was reduced by 0.5 to 2.3 % db in Jan., 0.9 to 2.7 % db in Feb. and 1.8 to 5.0 % db in Mar compared to Dec.

2.4.3 Soil moisture retention

Terrace with crescent bund treatment conserved the maximum soil moisture. It has retained around 5.6% (db) more soil moisture in Dec., 4.6% (db) more in Jan. and 3.6 to 3.8% (db) more in Feb. and Mar. In April, due to pre-monsoon rainfall, it has conserved around 5.1% (db) more moisture than the control plot at lower layers.

2.4.4 Economics

The cost of cultivation and income for three years from 2002 to 2004 indicated that highest profit of Rs. 40,966/ha/year (165% of control) was realized

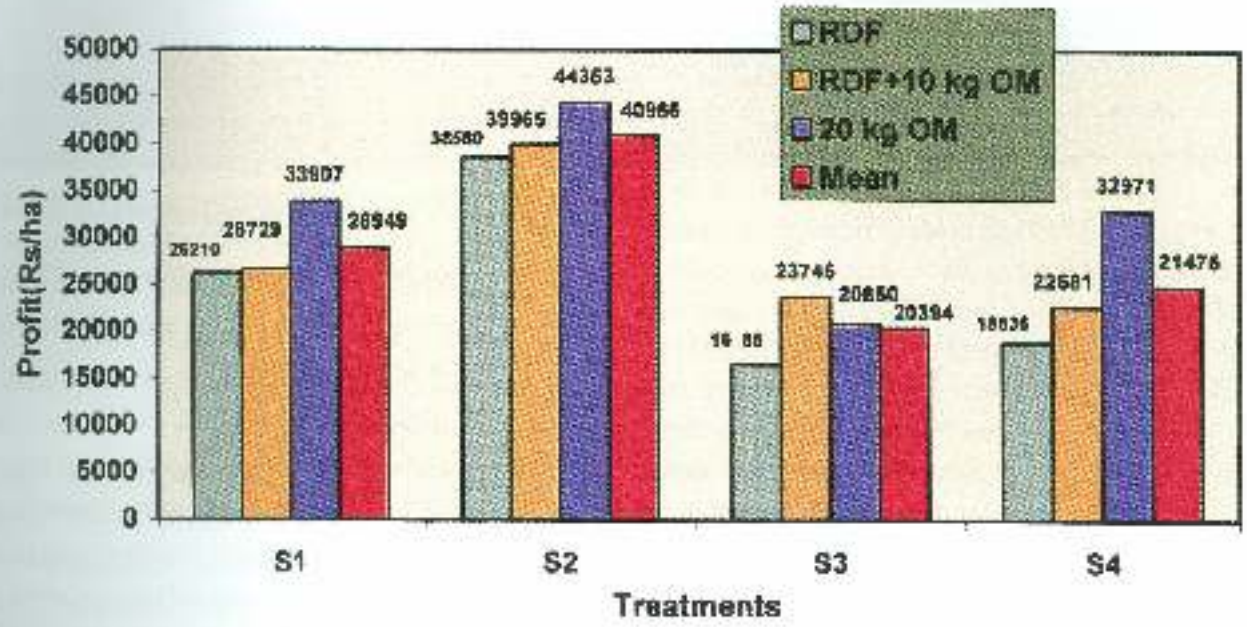


Fig.2.2. Profit for three years (Rs/ha)

from plot with terrace with crescent bund treatment (Fig.2.2). The profit from control plot (without soil and water conservation structure) was Rs. 24,812/ha/year. Among the subplots, application of poultry manure alone (20 kg/tree) fetched highest profit of Rs. 33,020/ha/year which was 131.8% of control treatment (application of recommended doses through inorganic fertilizers only). The combination of terrace with crescent bund and application of poultry manure resulted in highest profit of Rs. 44,353/ha/year compared to rest of the treatment combinations.

Individual tree base terracing with crescent bunding is the best soil and water conservation measures in slopy land of West Coast region. The terrace should be 2m radius around the plant with bund of 0.5m height and 1m width at the base towards lower side of slope. Cost involved per tree for this structure is Rs. 30 at the present rate of wages in Dakshina Kannada.

Terrace with crescent bund

2.5 Experiment 2: Evaluation of different soil and water conservation measures in relation to soil moisture availability and yield of cashew plantations grown in steep slopes

The field experiment was laid out in 2003 with cashew grafts of Madakkathara-2 variety. The treatments consisted of (1) T1: modified crescent bunding with vetiver (Bio Engg), (2) T2: staggered trenches with coconut husk burial between two rows of cashew, (3) T3: reverse terraces, (4) T4: catch pits and (5) T5: control plot without any soil and water conservation measure. The experimental layout was RBD and had four replications with 25 plants each. The four replications were laid on 4-15% slope, 18-23% slope, 25-33% slope and 34-43% slope.

2.5.1 Soil moisture studies

Soil samples at 0-30 cm, 30-60 cm and 60-90 cm depths were collected at 1 m radius of the plant from Dec. 2004 to Apr. 2005 for determining the variation of soil moisture content under different treatments. For the first layer of soil, the soil moisture content (SMC) in the coconut husk burial and the crescent bund treatments was found to be highly significant. The SMC in the reverse terrace, catch pit and control treatments remained at par. For the second and third layers of the soil, the SMC in the coconut husk burial, crescent bund and reverse terrace treatments were more significant

and catch pit treatment remained on par with control. Maximum soil moisture availability was observed within 1 m radius of the plant at the base in the case of coconut husk burial treatment (18.1 to 21.4 % db in Dec., 16.9 to 20.2 % db in Jan., 14.7 to 19.7 % db in Feb. and 13.5 to 17.9 % db in Mar.) and modified crescent bund treatment (16.65 to 20.67 % db in Dec., 15.95 to 19.90 % db in Jan., 14.12 to 18.42 % db in Feb. and 13.5 to 16.8 % db in Mar.) and least in the case of control plot (13.4 to 16.5 % db in Dec., 12.1 to 15.5 % db in Jan., 11.1 to 14.3% db in Feb. and 10.5 to 13.1 % db in Mar.). After the pre-monsoon rainfall of 50 mm in Apr. almost same SMC was observed in the first two layers in all the treatments including control (20.0 to 21.4% db in first layer and 18.0 to 20.3% db in second layer). SMC in the third layer was maximum in the coconut husk burial and crescent bund treatments (19.1 and 19.0% db) and minimum in the control plot (16.6% db).

2.5.2 Soil moisture depletion

The SMC was reduced by 0.4 to 1.3% db in Jan., 0.8 to 3.4 % db in Feb. and 1.5 to 4.5% db in Mar. in all the treatments. Compared to Dec. Maximum soil moisture depletion was observed in Mar. in all the treatments compared to other months (Table 2.5).

2.5.3 Soil moisture retention

Staggered trenches with coconut husk burial between two rows of cashew conserved the maximum soil moisture. It has retained about 5.0% (db) more soil moisture in Dec., 4.9% (db) more in Jan., 4.5% (db) more in Feb. and 4.1% (db) more in Mar. compared to control. In Apr., due to pre-monsoon rainfall, it has conserved around 5.1% (db) more moisture than the control plot at lower layers.

2.5.4 Runoff and soil loss

Extent of soil erosion in the three best treatments and the control plot was assessed. Annual runoff from modified crescent bunding, staggered trenches with coconut husk burial between two rows of cashew, reverse terraces and control plots was 27.6%, 18.6%, 29.5% and 36.3% of the annual rainfall and soil loss was 2.59, 1.73, 3.02 and 3.89 t/ha/yr respectively. Annual precipitation was 3297 mm.

2.5.5 Growth observation

Significant increase in stem girth and plant height was observed in the case of modified crescent bund treatment and staggered trenches with coconut husk burial between two rows of cashew compared to control.

Table 2.5: Soil moisture content (% dry basis) in Mar. 2005

Treatment	Depth (cm)			
	0-30	30-60	60-90	Mean
Modified crescent bunding with vetiver (Bio Engg)	13.50	15.60	16.80	15.30
Staggered trenches with coconut husk burial between 2 rows of cashew	13.50	16.10	17.80	15.80
Reverse terraces	12.80	15.20	17.40	15.10
Catch pits	12.00	13.20	15.30	13.50
Control plot without any soil and water conservation measure	10.40	11.60	13.10	11.70
Mean	**12.50**	**14.30**	**16.10**	
CD Treatment				2.65
CD Depth				0.32
TxD				0.75

Available soil moisture ranged from 12 to 22% (db)

3. CROP PROTECTION

3.1 Cashew Stem and Root Borer (CSRB)

3.1.1 Post extraction prophylaxis (PEP)

Under these trials, conducted at NRCC experimental plots and farmers' plots, cashew trees infested by CSRB, at initial and moderate stages of attack were identified. The pest at different stages viz., grubs, pre-pupae and pupae in the stem and root zones of such trees were physically extracted. Subsequently, these trees were treated by swabbing the infested area and drenching the root zone with either chlorpyriphos (0.2%, 0.4% or 0.6%) or monocrotophos (0.2%, 0.4% or 0.6%) and observed for reinfestation.

Maximum number of trees without fresh incidence of CSRB occurred with 0.6% chlorpyriphos swabbing (96%). Monocrotophos (0.2%) had the lowest effectiveness and resulted in 56% of the trees without reinfestation, which was on par with monocrotophos (0.4% and 0.6%) as well as with chlorpyriphos (0.2%) all of which had 72 per cent of the treated trees without fresh infestation. Chlorpyriphos was comparatively more effective than monocrotophos in checking reinfestation by CSRB (Table 3.1).

Table 3.1 Recovery levels of CSRB infested trees after post extraction prophylaxis.

Insecticide	Concentration (%)	Mean % of trees without reinfestation *
Monocrotophos	0.2	56.00 a
	0.4	72.00 ab
	0.6	72.00 ab
Chlorpyriphos	0.2	72.00 ab
	0.4	76.00 b
	0.6	96.00 c

*Values followed by the same alphabet are statistically not significant

3.1.2 Efficacy of phytosanitation

Phytosanitation was adopted by removing dead trees due to CSRB infestation, trees beyond recovery, and the CSRB at different stages in other infested cashew trees. The mean number of CSRB grubs per infested tree during 2004-05 was comparatively lesser than that of 2003-04 during most of the months in three experimental plots (canopy management trials, integrated nutrient management trials and drip irrigation trials).

The number of trees freshly infested by the CSRB was also comparatively lesser in these plots during 2004-05 in comparison with 2003-04. Adopting phytosanitation is for reduction of pest population density and reduced fresh incidence of the pest in healthy trees (Table 3.2).

3.1.3 Field evaluation of ovipositional deterrence

Selected branches of healthy cashew trees were treated with chlorpyriphos (0.2%- 0.6%) and monocrotophos (0.2%-0.6%) and adult beetles (2 pairs) were allowed for oviposition on treated tree branches in a wire cage (third day and fifth day after treatment). On the third day, the ovipostion was either minimum or nil. The least mean oviposition by CSRB females on fifth day after treatment was noticed in chlorpyriphos (0.6%)

Table 3.2 **Mean number of CSRB grubs encountered / infested tree in different experimental plots at Shantigodu**

	Canopy management trial				Integrated nutrient management trial				Drip irrigation trial			
	Mean No. of CSRB grubs/ infested tree		No. of CSRB infested trees		Mean No. of CSRB grubs/ infested tree		No. of CSRB infested tree		Mean No. of CSRB grubs/ infested tree		No. of CSRB infested tree	
Month	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05
July	2.6	1.52	0	2	0.60	0.70	0	4	4.34	2.11	6	4
Aug.	1.5	0.70	0	7	2.22	1.11	5	0	9.67	3.60	0	5
Sept.	2.14	1.11	7	3	4.10	2.14	1	2	3.93	1.70	0	0
Oct.	9.17	4.60	0	0	3.30	3.00	0	0	2.76	4.40	0	0
Nov.	8.62	3.27	0	2	4.67	2.80	0	0	2.50	0.70	4	0
Dec.	6.67	6.25	0	0	10.1	5.0	0	0	4.34	3.30	0	0
Jan.	2.8	1.10	1	0	9.17	6.67	1	0	2.76	1.50	0	0
Feb.	3.55	0.76	0	0	2.50	2.80	0	0	2.17	1.10	0	0
Mar.	1.07	0.42	2	0	1.78	1.10	4	0	2.50	0.65	0	0
Apr.	3.07	1.07	3	0	2.17	0.70	14	0	2.80	2.50	0	0
May	2.11	2.1	5	4	2.50	1.10	6	0	2.80	2.11	0	0
Jun.	-	-	-	-	3.21	2.11	4	0	2.50	2.50	22	8

(3.31 eggs/female) while monocrotophos (0.2%) had the least deterrence activity leading to 12.11 eggs/female (Table 3.3).

3.2 Tea Mosquito Bug (TMB)

3.2.1 Chemical control

3.2.1.1 Lepidopteran flower and fruit pest of cashew

In the west coast (coastal Karnataka), seven species of lepidopteran flower pests were encountered. Among them, the common apple and nut borer (*Thylocoptila paurosema*) infested both flowers and fruits and its larval hymenoptran parasitoid was observed from Dec. to Mar. The larval parasitism ranged from 15.3 to 50 per cent. In the east coast (Tamil Nadu), the shoot tip caterpillar (*Hypatima haligramma*) and leaf roller (*Sylepta auranticalis*) damaged emerging panicles. But in the flowers, *H. haligramma* population was highest and 10-15 caterpillars/sq.m canopy were collected that were hanging within one hour after insecticidal spray. One species of hymenopteran larval parasitoid was collected. The spider *Oxyopes* sp. and ant, *Camponotus* sp. were observed in all locations as general predators. But in one of the locations (Killikulam, Thuthoogudi District) of east coast, the common predatory ant *Crematogaster* sp. was found damaging the flowers and puncturing the ripened apples.

Paired panicles (110 numbers) having initiation of flowering were tagged at random on seven trees and half of the number of panicles were protected with λ cyhalothrin as dip method twice at three weeks interval. The untreated panicles were excluded from tea mosquito (TMB) by mechanical killing on every day. On seventieth day, the pairs of panicles having TMB attack were omitted and finally 91 pairs of panicles without any TMB damage were observed to record final harvestable fruit set due to impact of flower

Table 3.3 Number of eggs laid by female beetles of CSRB under ovipositional deterrence trials

Insecticide	Concentration %	Month	Number of eggs laid	Mean
Monocrotophos	0.2	Mar.	11.75	
		Apr.	13.50	
		May	13.20	
		June	10.00	12.11
	0.4	Mar.	14.00	
		Apr.	10.00	
		May	14.30	
		June	9.50	11.90
	0.6	Mar.	12.40	
		Apr.	8.50	
		May	6.25	
		June	5.00	7.90
Chlorpyriphos	0.2	Mar.	10.00	
		Apr.	9.50	
		May	6.75	
		June	6.25	8.13
	0.4	Mar.	6.25	
		Apr.	5.00	
		May	5.00	
		June	3.00	4.81
	0.6	Mar.	3.50	
		Apr.	3.25	
		May	3.25	
		June	3.25	3.37

pests. The protected panicles recorded 3.9±0.3 (SEM) fruits/panicle whereas, unprotected panicle having flower pest damage and without any TMB damage recorded only 1.0±0.1 fruit/panicle. Thus in the absence of TMB attack, timely protection of lepidopteran flower pests alone especially during flushing and flowering stages led to three fold increase in yield (Table 3.4).

In a large plot having 110 trees, three rounds of sprays with two insecticides were undertaken. But overall damage on the developing fruits even in untreated control was found to be negligible. However, immediately after second and third sprays, the numbers of flower infesting caterpillars were collected by drop cloth method at the ground level of the tree. Six hours after spread of cloth, the larvae fallen on the cloth were counted. Flower infesting caterpillars were collected only after second spray and 1.0 and 0.5 caterpillars/sq.m were collected in carbaryl and λ – cyhalothrin treatments respectively indicating the overall population load of the pest (Table 3.5). After third round of spray, no flower pests except low number of TMB adults were collected on the drop cloth. The yield in the insecticide treated plot doubled over untreated control in spite of low damage in the untreated control.

3.2.1.2 Foraging behaviour of pollinators of cashew

Under coastal Karnataka, six species of hymenopterans maintained constancy on cashew flowers besides honeybees. They were identified as *Pseudapis oxybeloides*, *Lasioglossum* sp., *Braunsapis* sp., *Ceratina heiroglyphica*, *Pithitis smaragdula* and *Halictus* sp. Among them, halictid bee *Pseudapis oxybeloides* was found to be predominant. The honeybees were rarely sighted on cashew flowers. Further, honeybees visited mostly bisexual flowers and

Table 3.4 Yield loss assessment due to lepidopteran flower and fruit pests

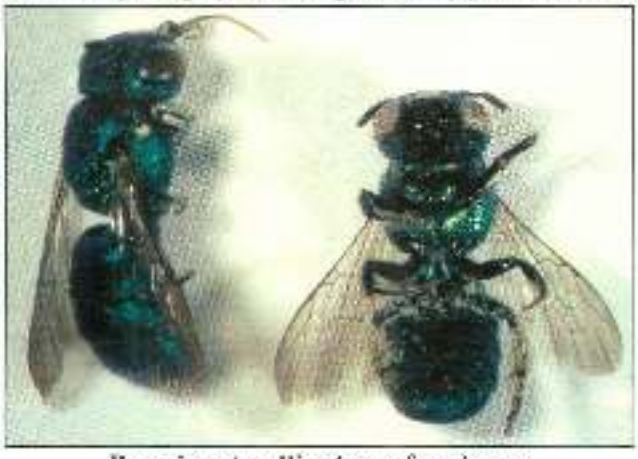
Details	Protected	Unprotected
No. of panicles tagged at random	110	110
No. of panicles without TMB damage	91	91
Panicles with harvestable fruit set (%)	94.5	51.7
Mean no. of harvestable fruits per panicle	3.85 ± 0.31a	0.98 ± 0.14 b
Relative variation of harvestable fruits (%)	8.05	14.29
Range of harvestable fruits per panicle	0-16	0-8

± Values are Standard Error of Mean. In the row, values followed by different letters indicates significant difference by paired 't' test at 1.0% level.

Table 3.5 Evaluation of promising insecticides against flowerpests in large plot trial

Treatment	Flower infesting caterpillars* (no. / sq.m)	Yield (kg/tree±s.em)	
		Sample trees	Whole plot
Carbaryl 0.1%	1.0	7.05 ± 1.18Ba (93.15)	6.75 (61.10)
λ–cyhalothrin 0.003%	0.5	7.63 ± 0.74Ba (109.04)	6.80 (62.29)
Control	N.R	3.65 ± 0.58A	4.19

* Estimated by drop cloth method.
Figures in parentheses indicate the percentage over control
N.R - Not recorded, S.EM - Standard Error of Mean
Values in a column followed by capital letter indicate the comparisons of untreated control versus respective chemical treatment and by small letter indicates comparison between chemical treatments. Values in a column followed by common letter of any category are not significant by paired 't' test at 5% level.



Prominent pollinators of cashew :
Left : *Pithitis smaragdula* Right : *Homalictus* sp.

collected nectar only. When such bees were collected and examined, those were loaded with low level of slimy cashew pollen grains in their respective corbiculae. Whereas, in the coastal Tamil Nadu, visit of hymenoptera bees was at a very low level. However, four species were collected and identified as *Homalictus* sp., *Braunsapis* sp., *Pithitis smaragdula* and *Pseudapis oxybeloides*. Among them, *Homalictus* sp. was found to be quite prominent in the traditional cashew areas. In the coastal Tamil Nadu also, the activities of honeybees including rock bees were very low.

The extent of pollen load removed or probably exhausted by the pollinators was assessed on long stamens of both male and hermaphrodite flowers in the field with 20x folding hand lens and in the laboratory with stereoscopic dissection microscope. The extent of pollination was assessed by observing deposit of pollen grains on the stigma of hermaphrodite flowers with stereoscopic dissection microscope. In total, seven varieties (V-1, V-4, Goa 11/6, NRCC-Sel-2, Ullal-3, Dhana and VRI-3) were examined under west coast situation. In the east coast, the observation was confined to VRI-3 only. In the west coast, more than 50 per cent of pollen grains was found removed/ exhausted in 80.4 to 92.5 per cent of long stamens of hermaphrodite flowers, whereas, among male flowers, 33.6 to 88.3 per cent of long stamens were found in the same above level of exhausted condition. In the east coast, in the monocrop ecosystem of cashew (Vridhachalam), 24.8 and 6 per cent hermaphrodite and male flowers respectively had above level of pollen removal. The extent of pollination in general varied from 16.9 to 49 per cent. However, in Vridhachalam,

Table 3.6 **Extent of pollen grains exhausted from the long stamen of male and bisexual flowers and extent of pollination in different varieties/accessions of cashew.**

Variety/ Accession	Flowers having > 50.0% pollen load exhausted (%)		Extent of pollination (%)#
	Male*	Bisexual#	
V-1	33.6	81.0	37.0
V-4	44.6	87.2	49.0
Goa 11/6	88.3	88.3	42.3
NRCC-Sel-2	86.5	83.9	37.2
Ullal-3	81.3	92.5	28.7
Dhana	81.6	80.4	27.7
VRI-3			
Shanthigodu	81.7	49.3	28.4
Vridhachalam-RRS	6.0	24.8	16.9
Vridhachalam-Forest	26.1	53.7*	N.R
Tirunelveli	100.0	72.6	45.5

N.R. — Not recorded. * Observed through 20X hand lens.
Observed through stereoscopic dissection microscope

the extent of pollination (16.9%) as well as the extent of removal of pollen grains (6.0 – 24.8%) from long stamens was found at a very low level. This gives an indication about deficit in natural pollination in cashew especially in the monocrop areas of cashew (Table 3.6).

3.3 Studies on the determination of insecticide residues in cashew kernels

3.3.1 Determination of residues of insecticides in farm gate samples

Samples were obtained from farm gates of Dakshina Kannada district. The kernels obtained after processing were analysed for the insecticide residues which are commonly used or recommended for the management of TMB and CSRB. The samples were also got analysed from Cashew Export Promotion Council of India (CEPCI) Laboratory at Kollam. The detection limit for endosulfan and carbaryl which are recommended /used for the management of TMB was 10 ppb. The detection limit was same for chlorpyriphos and lindane, which are recommended/ used for the management of CSRB. Residues of any of the above insecticides were not detected in the samples analyzed.

3.3.2 Determination of residues of insecticides in the samples collected from the major cashew growing states

Raw cashew nut samples obtained from Chintamani (maidan parts of Karnataka (5), Vridhachalam (10), Bapatla (10), Bhubaneswar (5) (Coastal Orissa) were got analyzed for the residues of the commonly recommended insecticides for the management of cashew pests at CEPCI., Kollam. The residues of endosulfan, lindane, chlorpyriphos and carbaryl were not detected in the kernels analysed. However, few samples had residues of endosulfan (0.003 to 0.007 ppm) and lindane (0.0066 to 0.0007ppm).

4. POST-HARVEST TECHNOLOGY

4.1 Mineral composition of cashew apple pomace

Cashew apple pomace from 29 released varieties has been analysed for mineral composition. Cashew apple pomace is rich in P and it varied among released varieties between 0.03 (VRI-1) and 0.25 (BPP-3) mg/100mg. Copper was not detected in Ullal-2, V-1, V-6 and Kanaka. Similarly Se was not detected in BPP-1, 3, 4, 5, 6 and 8, Goa-1, Bhubaneswar-1, NRCC Sel-1, BLA 139-1 and Ullal 1. Among the 29 released varieties, Se was detected in 17 varieties and among these varieties it varied from 0.55 to 20.91 µg/100 mg. Variability in mineral composition of released varieties is presented in Table 4.1.

4.2 Mineral composition of cashew kernel testa

Cashew kernel testa from released varieties collected from NRC Cashew, Co-ordinating Centres of AICRP Cashew, ICAR Research Complex for Goa, Goa, and ARS Ullal has been analysed for mineral composition. The mineral composition of a particular variety from different sources differed. Se was not detected in number of varieties collected from different sources. Variability in mineral composition of cashew kernel testa among the released varieties collected from NRC Cashew is presented in Table 4.2.

4.3 Nutraceuticals from cashew apple

Pectin has been extracted from cashew apple pomace with an yield of 2.59%. The ash content of cashew pectin was less (2.59%) compared to commercial pectin (7.31%). Equivalent weight (166.52) and methyoxyl content (8.7%) of pectin from cashew apple pomace was less compared to commercial pectin whose equivalent weight and methoxyl content were 447.9 and 15.4% respectively. Acetyl content of cashew apple pomace (0.289%) was, however, less compared to commercial pectin. Cashew apple pectin contained Ca, Mg, K, Na and Fe. Copper, Mn, Zn and Se were not detected. Pectin has also been extracted from sundried cashew apple powder (sun dried for 5 days @ 8h/day followed by drying in cabinet dryer at 70°C for 2 days) with an yield of 1 to 1.5%. Pectin yield from cashew apple powder is less compared to cashew apple pomace.

Table 4.1. Variability in concentration of minerals in pomace among different released varieties.

Minerals	Concentration in cashew apple pomace	Lowest	Highest
P	0.03 - 0.25	VRI-1	BPP-3
Na	3.01 - 12.71	Ullal-1	V-4
K	14.34 - 177.63	Goa-1	Ullal-1
Ca	1.72 - 38.11	Ullal-1	Jhargram-1
Mg	10.12 - 24.30	Ullal-2	Jhargram-1 and VRI-1
Cu	0.26 - 5.83	Ullal-1	BPP-1
Mn	1.45 - 6.62	Dhana	BPP-5
Zn	1.20 - 5.16	V-2	Priyanka
Fe	0.15 - 40.61	Dhana	BPP-5
Se	0.55 - 20.91	V-1	VRI-1

Values are expressed as µg/100 mg except P which is mg/100 mg

Table 4.2 **Variability in concentration of minerals in cashew kernel testa among different released varieties (µg/100 mg).**

Minerals	Concentration	Lowest	Highest
P	19.19 - 157.51	BPP-3	Ullal-1
Na	6.29 - 31.55	Ullal-2	NRCC Sel-1
K	10.75 - 151.71	BPP-1	NRCC Sel-1
Ca	21.97 - 288.70	VRI-2	NRCC Sel-2
Mg	13.42 - 35.13	Ullal-2	NRCC Sel-2
Cu	0.77 - 2.77	VRI-3	NRCC Sel-1
Mn	4.44 - 24.62	K-22-1	V-6
Zn	1.45 - 9.03	Ullal-2	BPP-6
Fe	2.35 - 11.31	K-22-1	BLA-139-1
Se	2.20 - 23.69	Ullal-3	BPP-1

5. TRANSFER OF TECHNOLOGY

5.1 Laying out new demonstration plots

Under regular scheme financed by DCCD, Kochi on Model Clonal Cashew Garden, nine demonstration plots were laid out at farmers' plots both under high and normal density planting systems. These farmers were imparted training about recommended cashew cultivation practices on ICAR Foundation Day during which more than 30 farmers participated.

Under a new scheme on "Village Adoption" started during 2004-05 funded by DCCD, Kochi, two villages of Puttur taluk viz., 'Kavu' and 'Idkidu' were selected for laying out demonstration plots. Nine farmers from 'Kavu' and two farmers from 'Idkidu' have taken up demonstration. These farmers were imparted training on recommended cashew cultivation practices during which more than 15 farmers participated.

5.2 Organizing thematic campaigns

Two thematic campaigns on SWC measures in cashew and HDP and Pruning in cashew were organized at Kolthige and Kadiyur villages of Puttur taluk in collaboration with SKDRDP, Puttur. A total of 200 farmers participated.

Two thematic campaigns on Plant Protection in Cashew were organized at Perla, Kasaragod district of Kerala and Kudkadi village at Puttur taluk of Karnataka in collaboration with Farm Information Exchange Club, Perla and SKDRDP, Puttur respectively. A total of 275 farmers participated in these two programmes.

5.3 Cashew Day

The annual Cashew Day was organized at NRCC, Puttur on 24-2-2005. The theme of the programme was increasing profitability in cashew gardens through irrigation, cultivating intercrops, adoption of high density planting, canopy management and maintenance of optimum plant population by effective control of CSRB. There was a field visit both at Kemminje and Shantigodu campuses of NRCC, Puttur to experimental plots and nursery. An exhibition was organized including computerized slideshow of photographs of cashew cultivation practices. A seminar on the theme of the programme was also organized including a progressive farmer and scientists shared their experience with the participants. More than 175 farmers participated in the programme.

5.4 Socio-economic impact of cashew cultivation in Kannur district of Kerala

5.4.1 Profile of the cashew growers

Majority of the respondents were old (>45 years) and had education upto high school level with agriculture as their primary occupation. They had low level of operational holding (< 3.3. ha) both under agriculture in common and cashew in particular. Majority of them had more than 24 years of farming experience and had raised cashew plantations with seedlings with a plant population of 60-95 trees/acre yielding 2 to 4 quintals/acre. Majority of the farmers had 40-70% of area under cashew out of their total area.

5.4.2 Factors responsible for cashew cultivation

Most of the cashew growers informed the following reasons for taking up cashew cultivation. (i) Cashew needs less supervision, (ii) after getting planting material from State Department of Agriculture under subsidy, (iii) Cashew is less labour intensive crop, (iv) To utilize waste and degraded lands and (v) no marketing problem for raw cashewnuts.

5.4.3 Extent of knowledge and adoption of the cashew growers about the recommended cashew cultivation practices

Majority of the cashew growers (76.67%) had lower extent of knowledge about the recommended cashew cultivation practices. However, most of them (83.33%)

had low to medium level of adoption of the recommended cashew cultivation practices. The medium extent of adoption of the respondents was due to following of their own cashew cultivation practices. The technology-wise knowledge and adoption level of them is given in Table 5.1.

5.4.4 Perception of cashew growers towards the recommended cashew cultivation practices

Most of the cashew growers perceived that the recommended cashew varieties were high yielding but at the same time they were susceptible to pest attack. They perceived that the plant protection measures recommended against tea mosquito bug were cost-effective and adoption of plant protection measures against the damage of CSRB was imperative to save the cashew garden. But the perception of them towards other recommended cashew cultivation practices except for plant protection measures was under "undecided" category only which implies that majority of the cashew growers did not adopt the recommended cashew cultivation practices other than protection measures. However, they had adopted their own practices (Table 5.1).

5.4.5 Correlation analysis

The correlation studies showed that the extent of knowledge of the cashew growers about the recommended cashew cultivation practices had significantly influenced their extent of adoption, perception towards recommended practices and inturn the yield of their cashew gardens. The increase in extent of knowledge will increase the adoption behaviour and thereby increase the yield. Hence it could be implied that the cashew cultivation scenario in Kannur district of Kerala could be improved by providing intensive training to the cashew growers which will improve the extent of knowledge of the cashew growers.

5.4.6 Socio-Economic impact of cashew cultivation

The following are the impact observed in Kannur district as a result of cashew cultivation.

5.4.6.1 Impact on farming

The cashew growers purchased new lands (36.67%), leased in new lands (25%) under cashew from others and leased out cashew areas on contact to other cashew growers or agricultural labours (33.35%) as a result of cashew cultivation. The cashew growers had both increase in their area under cashew (41.67%) and decrease (11.67%). Some farmers (20%) had both increase in area under other crops viz., rubber and coconut and decrease (13.33%) as a result of cashew cultivation. These changes were mainly dependent on the profit realised from cashew cultivation. The small and marginal cashew growers (56.67%) had increase in family labour engagement in cashew whereas, 55 per cent of them had increase in outside labour engagement mainly for weeding at the time of harvesting and during nut collection.

Table 5.1 Knowledge and adoption level of cashew growers.

Technology	Knowledge level (%)	Adoption level		
		Recommended adoption (%)	Modified adoption (%)	No adoption (%)
Variety	16.67	16.67	-	83.33
Planting technique	31.67	23.33	76.67	0.00
SWC measures	23.33	10.00	68.33	12.67
Manures and fertilizers	23.33	16.67	80.00	3.33
Irrigation	23.33	3.33	30.00	66.67
Initial training and pruning	23.33	16.67	81.67	1.66
PP measures against TMB	38.33	31.67	58.33	10.00
PP measures against CSRB	38.33	28.33	35.00	31.67

5.4.6.2 Economic impact

All the cashew growers had an increase in farm expenditure which increased their overall family expenditure (86.62%). However, all of them agreed that their farm income was increased as a result of cashew cultivation which inturn increased their family income (58.33%) also. Since majority of them had low level of operational holdings and 40-70% of their area under cashew, cashew is their livelihood. So the economic impact of cashew cultivation on these cashew growers was clearly visible.

5.4.6.3 Social impact

Majority of them (68.33%) had increased social participation, increased contact with extension agency (56.67%) and increased in mass media exposure (50.00%) as a result of cashew cultivation. Some of them (16.67%) became the opinion leaders in their area due to their experience and expertise in cashew cultivation.

5.4.7 Constraints faced by the cashew growers

The problems faced by the cashew growers are given in Table 5.2 based on their priority.

The researchers and officials of the development departments listed the following as the constraints in cashew cultivation in Kannur district of Kerala.

- Non availability of sufficient good quality cashew grafts.
- Damage by CSRB and TMB.
- Majority plantations are under senile conditions with seedling origin.
- Flower dropping and reduction in nut quality due to pre-monsoon showers.
- Cultivation of cashew in marginal and degraded lands.
- Less profitable than rubber in the prevailing conditions which influences the adoption behaviour of cashew growers and investment in cashew.

5.4.8 Training needs of the cashew growers

Plant protection measures in cashew (71.67%), general cultivation practices (35%), recommended cashew varieties (40%), grafting technique in cashew (26.67%) and cashew apple utilization (13.33%) were the major training needs of the cashew growers.

5.4.9 Suggestions to improve cashew cultivation in Kannur district of Kerala

The following are the suggestions given by the researchers as well as the development department officials in Kannur district of Kerala:

- Intensifying replanting programme with good quality cashew grafts.
- Developing early maturing cashew varieties

Table 5.2 Constraints in cashew cultivation (response by farmers)

Constraints	Per cent
Cashew stem and root borer damage.	66.67
Flower dropping and reduction in the quality of nuts due to pre-monsoon showers.	60.00
Damage by tea mosquito bug.	56.67
Non-availability of sprayers and water scarcity while spraying.	56.67
Non-availability and more cost of agricultural labours.	36.67
Unawareness and non-availability of high yielding varieties.	30.00
Low fertility of the lands.	20.00
Insufficient extension programmes by the development departments.	18.33
Poor quality of the planting material supplied by the department.	10.00

(before March) to escape the damage by pre monsoon showers.

- Enhancing the compensation for uprooting the senile cashew plants.
- Intensive area expansion programmes.
- Large scale production and supply of quality planting material by Dept. of Agriculture.
- Establishing model cashew apple utilization and small scale processing units by the Dept. of Agriculture to motivate the cashew growers.
- Training the cashew growers on plant protection measures and cashew apple and nut processing.

5.5 Organizing training programmes for development personnel / SHG members

The following training programmes were organized for the officials of development departments / SHG members.

5.6 Effectiveness of cashew production technology training programmes

An attempt has been made to assess the effectiveness of the 12 training programmes conducted by NRC Cashew, Puttur between 2000-2004 on "Cashew Production Technology" for extension personnel of the development departments of cashew growing states. It was found that the difference of distribution of participants (150) of the special and refresher courses between their mean pre and post-evaluation knowledge level was highly significant (Table 5.3). The difference between mean pre and post-evaluation scores of participants of both the courses was also highly significant (Table 5.4). Correlation analysis implied that the participants of refresher courses with lower educational status, experience and cadre and the participants of special courses with higher cadre should be given additional attention while imparting training in order to have more effectiveness.

Name of the course and duration	Sponsorers	No. of participants
Pruning, Topworking in cashew and Composting of RCB (6-8, July, 2004)	DOH, AP	19
Vegetative Propagation of Cashew (20-21, August, 2004)	KCDC Ltd., Karnataka, Aralam Farm, Kerala	4
Cashew Production Technology (Refresher) (30, August - 1, September, 2004)	DOH, Tamil Nadu	17
Vegetative Propagation of cashew (9-9-2004)	SKDRDP, Puttur and NRCC	15
Cashew Production Technology (Special) (6-10, September, 2004)	DOH, Tamil Nadu	18
Cashew Production Technology (Special) (13-17, December, 2004)	DOH, Nagaland	1
Cashew Production Technology (Refresher) (17-19, January, 2005)	ITDA, AP; DAE, TN; TAFCORN, TN; GFDC Ltd, Goa, KCDC Ltd, Kar.	8
Cashew Production Technology (Refresher) (19-21, January, 2005)	DOH, Maharashtra	3

Table 5.3 Distribution of participants of training programmes according to their pre and post-evaluation knowledge level. (N=150)

Knowledge level	Refresher Courses (n=90)				X^2 value	Special Courses				X^2 value
	Pre-evaluation		Post-evaluation			Pre-evaluation		Post-evaluation		
	No.	%	No.	No.		No.	%	No.	%	
Low	4	4.45	0	0.00	25.779%	5	8.33	0	0.00	31.579**
Medium	20	25.33	2	2.22		20	33.33	0	0.00	
High	63	70.00	88	97.78		35	58.33	60	100.00	
Total	90	100.00	90	10.00		60	100.00	60	100.00	

** Significant at 1% level

Table 5.4 Effectiveness of training programmes (N=150)

Training Programme Number	Refresher Courses		't' value	Special Courses		't' value
	Mean% Pre-evaluation score	Mean% Post-evaluation score		Mean% Pre-evaluation score	Mean% Post-evaluation score	
1	82.50	100.00	8.3642**	61.70	100.00	4.5079**
2	55.00	74.00		82.50	95.00	
3	83.33	93.33		77.00	94.00	
4	80.50	95.80		35.60	85.60	
5	63.40	89.00		54.50	100.00	
6	83.20	100.00		81.00	98.50	

** Significant at 1% level

Transfer of Technology (TOT) Efforts

Inauguration of Plant Protection Campaign

Interaction of farmers with scientist during Cashew Field Day

Visit to Nursery during Cashew Day

Annual Cashew Day

6. COMPUTER APPLICATION

6.1 Computer application in cashew

6.1.1 Database on cashew information

State-wise area under cashew production and trade figures for year 2003-04 were collected. Area under cashew and production figures of different cashew growing countries were also collected. The collected data were updated in cashew database. This cashew database is a user friendly and menu driven database developed in Visual Basic as a front end tool and Microsoft Access as a back end tool. The database tables were developed using normalization techniques to store data in systematic way and to avoid duplication of data. A total of 39 user interface forms were developed. All these forms are interlinked with each other. A total of 28 data reports were developed for this database. Out of these, 23 reports are dynamic data reports. These reports provide both numerical and graphical information. This package is fully menu driven.

6.1.2 Forecasting of cashew yield

Based on the existing forecasting model, the estimated yield for 2004-05 is given below.

State	Production (M.T)
Andhra Pradesh	93,138
Goa	35,624
Karnataka	54,315
Kerala	1,01,312
Maharastra	1,01,244
Orissa	55,474
Tamil Nadu	69,947
West Bengal	7,172
Others	5,461
TOTAL	**5,23,687**

6.1.3 Updating of NRCC webpage

As per ICAR instructions, the current webpage has been modified using HTML pages with Java Script.

6.2 Database for cashew germplasm

Passport information for 1358 cashew accessions was collected. Cluster analysis data of 284 accessions were collected from NRCC, Puttur. The number of accessions from different centres for which the corresponding passport information was collected is given below.

Centre Name	Passport data of accessions
NRCC	433
Bapatla	129
Bhubaneshwar	9
Chintamani	104
Jhargram	83
Madakkathara	113
Pilicode	64
Vengurle	161
Vridhachalam	262
TOTAL	**1358**

7. CONCLUDED PROJECTS

7.1 Planting systems and spacing trials

Project Leader	Dr. N. Yadukumar
Project Associate	Ms. R.Rejani (from October 2001)
Project Number	2.2
Project Duration	6 years (1999-2005)

7.1.1 Introduction

The experiment was laid out in 1990 following split plot design with three replications. The main plot treatments included square systems namely 5.0 m x 5.0 m (400 plants/ha), 6.5 m x 6.5 m (236 plants/ha), 8.0 m x 8.0 m (156 plants/ha) and hedge systems namely 5 m x 4 m (500 plants/ha), 6.5 m x 4.0 m (384 plants/ha) and 8.0 m x 4.0 m (312 plants/ha) with pruning and no pruning as sub plot treatments

7.1.2 Objectives

i) To understand growth and yield behaviour of cashew under different systems of planting and spacing under pruned and unpruned conditions.

ii) To study the nutrient requirement per unit area for three different plant density plots.

7.1.3 Results and Discussion

7.1.3.1 Effect of plant density on growth parameters

The plant height after fourteen years of planting reached 5 to 5.8 m which was significantly higher in high tree density plot (500 trees/ha) compared to low tree density plot (4.6m in 156 trees /ha plot). The plant density had no effect on girth of stem. Effective canopy height was significantly more in low tree density plots than high tree density plots of 400 and 500 trees /ha (Table 7.1).

Table 7.1 Effect of plant density on growth parameters after thirteen years of planting

Spacing (m)	Plant density Nos./ha	Stem girth(cm)			Tree height(m)			Canopy height(m)			Canopy spread		
		A	B	Mean	A	B	Mean	A	B	Mean	A	B	Mean
5 x 5	400	68.0	67.0	67.5	4.5	5.5	5.0	1.25	1.23	1.24	5.8	5.8	5.8
6.5 x 6.5	236	63.8	60.2	62.0	4.8	4.5	4.7	1.56	1.53	1.55	6.1	6.2	6.2
8.0 x 8.0	156	63.7	63.7	63.7	4.6	4.6	4.6	1.63	1.31	1.47	6.6	7.4	7.0
5.0 x 4.0	500	63.4	71.7	67.6	5.0	5.8	5.4	1.41	1.28	1.35	5.7	6.6	6.2
6.5 x 4.0	384	67.2	71.4	69.3	5.6	6.0	5.8	1.43	1.36	1.40	5.5	5.6	5.5
8.0 x 4.0	312	70.2	64.4	67.3	5.4	5.2	5.3	1.31	1.31	1.31	5.8	6.1	5.9
Mean		66.1	66.4	66.2	5.2	5.3		1.43	1.34		5.9	6.3	
CD for MP(p=0.05)				12.9			1.01			0.4			0.92
CD for SP (p=0.05)				2.7			0.66			0.12			0.33
CD for Int(CD=0.05)				12.9			1.53			0.46			1.08

7.1.3.2 Ground coverage and light interception

Ground coverage by canopy was significantly more in high plant density plots (100 % in 500 and 90.5 % in plots of 384 and 400 plants/ha) than in low tree density plot (56.38 %) fourteen years after planting (Table 7.2). In pruning treatment every year overlapping branches were removed to bring background coverage on an average to 85% so that light interception was maintained at 80%. Light interception was significantly higher (87.5 to 93 %) in high density plots (384 to 500 trees/ha) than in low tree density plot (46 % in plot of 156 plants/ha)

7.1.3.3 Total biomass produced in relation to plant density

Highest dried branches were collected from high plant density plots (3.32 to 6.47 t/ha) and lower in normal plant density plot (0.8 t/ha, in 156 trees/ha plot) after thirteen years of planting (Table 7.3 and 7.4). Cashew leaf deposit was 9.08 to 13.61 t/ha/year in high plant density plots. In normal density plot it was as low as 5.26 t/ha. The weed biomass collected per year was maximum in the case of low plant density plot and minimum in high plant density plot.

Table 7.2 Ground coverage (%)and light interception(%) in different plant densities after 14 years of planting

Spacing(m)	Density (Nos./ha)	Ground coverage			Light interception		
		Pruned	Unpruned	Mean	Pruned	Unpruned	Mean
5 x 5	400	98.5	92.67	95.59	91	86	80.5
6.5 x 6.5	236	70.0	71.40	70.70	68	70	69.0
8 x 8	156	54.0	69.00	61.50	50	58	54.0
5 x 4	500	86.0	100.00	98.00	93	96	94.5
6.5 x 4	384	91.0	90.00	90.50	86	84	85.0
8 x 4	312	83.0	92.00	87.50	89	90	89.5

Table 7.3 Dry branches (t/ha) collected per year 13 years after planting from different plant density plots

Density	Pruned	Unpruned	Mean
400	4.78	7.35	6.07
236	1.20	1.40	1.30
156	0.79	0.81	0.80
500	4.82	8.17	6.49
384	3.20	4.50	3.85
312	2.80	3.50	3.15

Table 7.4 Annual leaf deposit and weed biomass in relation to plant density after 13 years of planting

Spacing (m)	Density (Nos./ha)	Leaf deposit (dry wt-t/ha)			Weed biomass (dry wt-t/ha)		
		Pruned	Unpruned	Mean	Pruned	Unpruned	Mean
5 x 5	400	9.3	8.86	9.08	1.2	0.43	0.81
6.5 x 6.5	236	6.53	7.78	7.12	1.66	1.58	1.62
8 x 8	156	4.51	6.01	5.26	2.69	2.79	2.78
5 x 4	500	12.17	15.05	13.61	1.29	1.41	0.85
6.5 x 4	384	8.95	12.97	10.96	1.02	1.08	1.05
8 x 4	312	6.55	10.61	8.58	2.01	1.94	1.97

7.1.3.4 Soil nutrient contents

It was observed that organic matter available in soil up to 1m depth was higher (OM-3.25%, Av. N 412kg/ha) in high plant density plots than in low plant density plot (OM 1.78%, Av. N 256 kg/ha). However, no definite trend was observed with respect to P and K contents in soil among different plant density plots.

7.1.3.5 Soil temperature and moisture content

Soil temperature at the top two depths was significantly low in high plant density plot during peak summer season compared to low plant density plot (Fig. 7.1) Nearly 3.35 to 3.53% less moisture level was observed at the top 30 cm depth in low plant density plot compared to high plant density plot. At deeper layer (60-90cm) 6 % less moisture level in high plant density compared to low plant density plot was observed (Fig. 7.2).

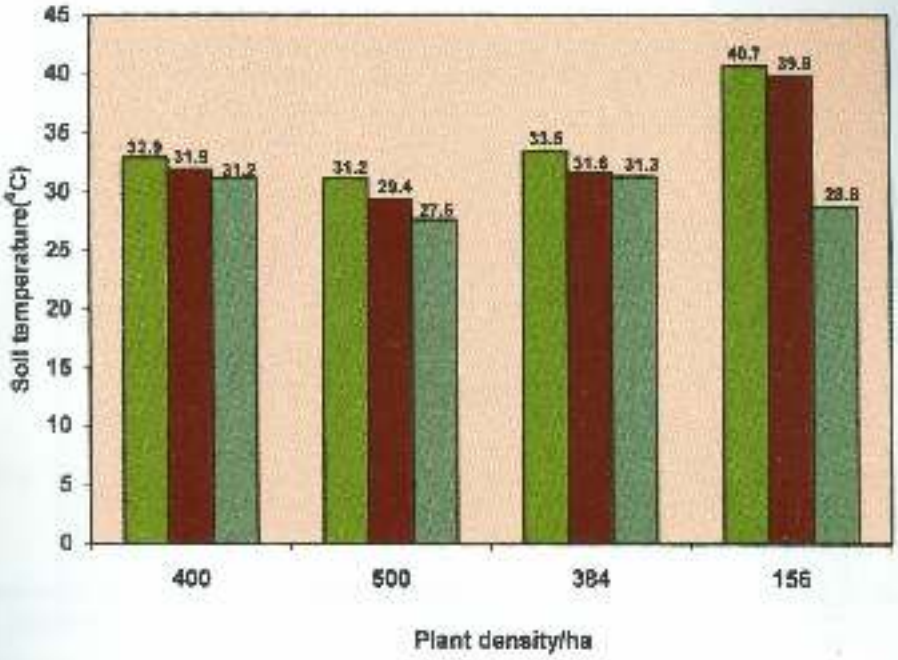


Fig. 7.1 Soil temperature at different depths during summer in relation to plant density

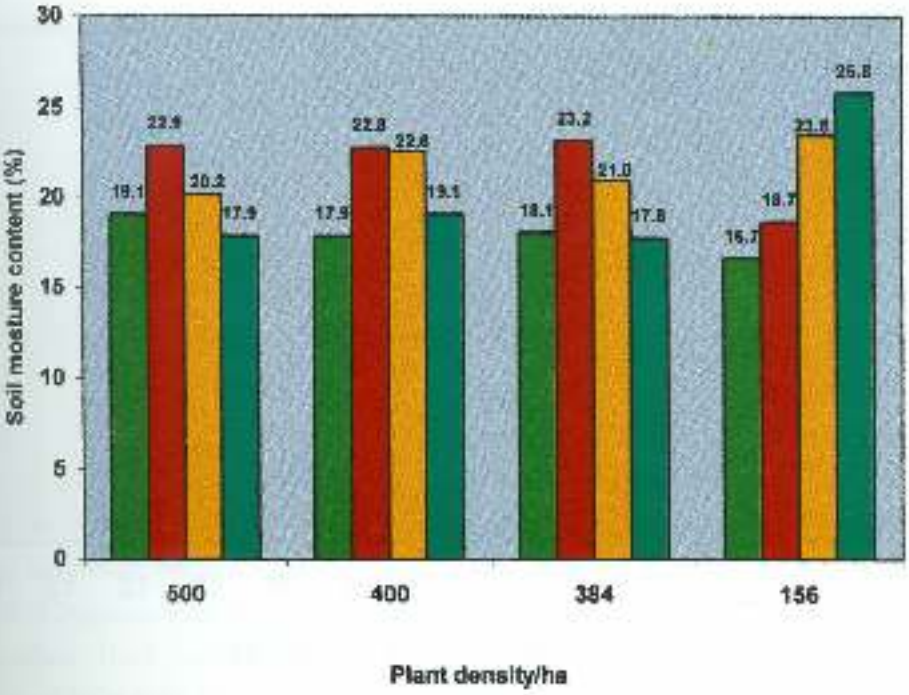


Fig. 7.2 Soil moisture content during peak summer in plots of different plant densities

7.1.3.5 Yield

Highest yield was recorded in medium plant density and high plant density situations right from first harvest upto 11th harvest (Fig 7.3 a and b). Highest cumulative yield of 5417 and 4894 kg/ha over 14 years (10harvests) was recorded under pruned and unpruned conditions respectively in treatment plot with plant density of 500 trees/ha. The next highest yield of 5336 and 5043 kg/ha under pruned and unpruned conditions respectively was achieved from treatment plot of 384 trees/ha (Fig 7.4).

7.1.3.6 Economics

Highest profit of Rs.1, 35,696 and 1,26,616 was realized from plot with 384 trees/ha under pruned and unpruned conditions up to 14 years after planting which was 221 to 248% of normal plant density plot (156 trees/ha-Rs. 61, 368 and Rs. 51023 kg/ha under pruned and unpruned conditions) (Table 7.5).

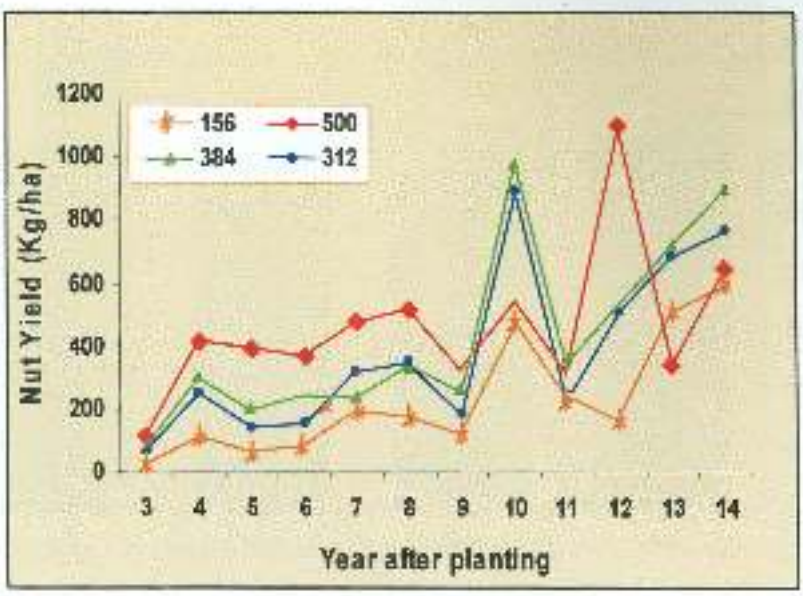


Fig. 7.3a Plant density Vs annual yield

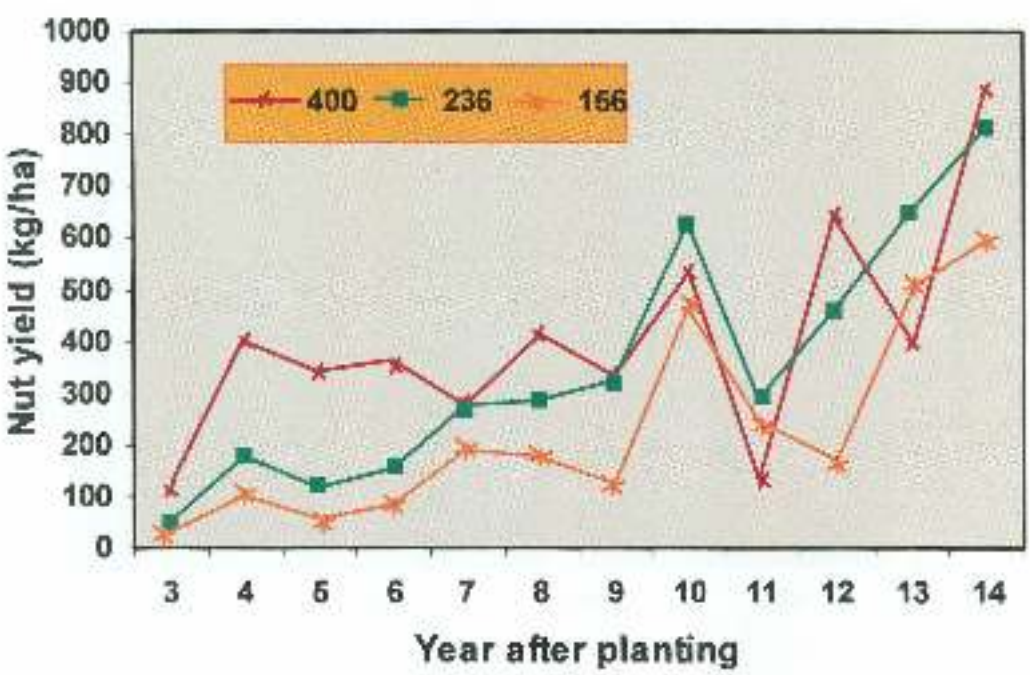


Fig. 7.3b Plant density Vs annual yield

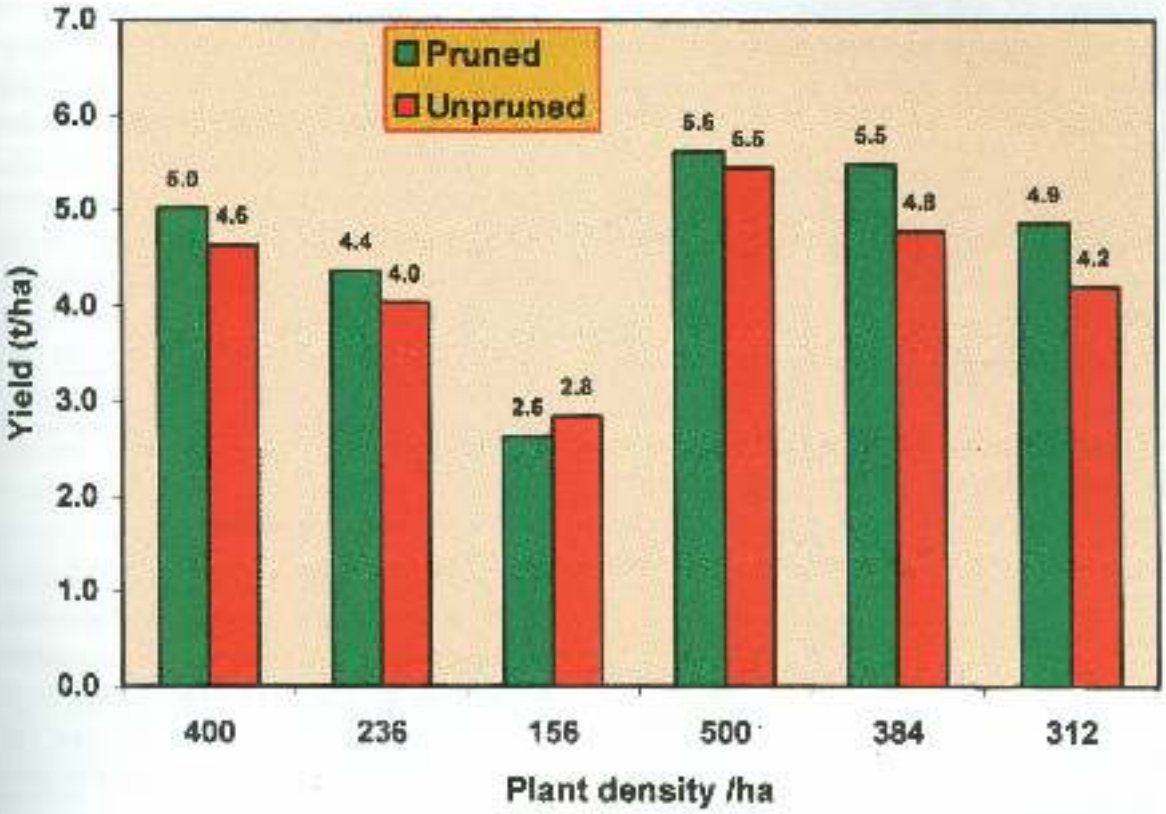


Fig. 7.4 Cumulative yield in relation to plant density (total of 11 harvests)

Table 7.5 Economics of high density planting compared to normal density planting from 1st to 14th year (1991-2004)

Density / Spacing		400 (5 x 5m)	236 (6.5 x 6.5m)	156 (8 x 8 m)	500 (5 x 4 m)	384 (6.5 x 4m)	312 (8 x 4 m)
Cost of cultivation	Pruned	51313	42587	29387	60880	51064	46161
	Unpruned	50138	41382	29092	59700	49889	44258
Income	Pruned	173635	151095	90755	189595	186760	162015
	Unpruned	149695	141295	80115	171290	176505	153895
Profit	Pruned	122322	108508	61368	128715	135696	115854
	Unpruned	99557	99913	51023	111590	126616	109637

7.1.4 Conclusion

High density planting system with 384 trees/ha by adopting hedgerow system (6.5mx4m) of planting is ideal for getting maximum yield and profit under typical laterite soil of Dakshina Kannada District upto 14 years after planting. High density planting has definite advantage of increased yield over normal density planting system. In the long run the soil fertility has also improved due to considerable deposit of leaf litter (dry leaves) to the tune of 10t /ha/year 13 years after planting. High density planting has also increased soil moisture content and reduced soil temperature during the peak summer season compared to normal

7.2 Efficacy of soil and water conservation coupled with organic and inorganic manuring in cashew garden grown in slopy areas (Experiment -1).

Project Leader : Dr. N. Yadukumar
Project Associate : Ms. R.Rejani (from October 2001)
Project Duration : 6 years (1999-2005)

7.2.1 Introduction

Cashew is generally grown on neglected land prone for high degree of soil erosion. The average productivity of cashew in the country and in Karnataka are 0.865 and 0.470 t/ha/year respectively as against the target of 1 t/ha/year. However, there is possibility of increased production in the Country and in Karnataka state in particular if proper soil and water conservation measures are taken up. In the Malabar region of Kerala and Western Ghats of Karnataka, cashew experiences severe moisture stress from Dec. to May which adversely affects flowering and fruit set causing nut drop. *In situ* water conservation in the soil profile is the most economic and practical means of ensuring sustainable availability of water to the plants during the dry spells. Along with sufficient water, availability of nutrients is also essential for the higher yield.

7.2.2 Objectives

- To select a suitable soil and water conservation measure that can reduce the runoff and soil loss and can increase the soil moisture content and yield.
- To find the best soil and water conservation measure technique coupled with organic or inorganic manuring for the maximum yield.

7.2.3 Materials and methods

The field experiment was laid out in 1999 and continued up to 2005 on ten year old cashew grafts of VRI-1 variety. Main plot treatments consisted of (1) S1: terrace with catch pit (Semi-circular catch pits of 0.45m depth, 0.3 m width at 2 m radius around the plant), (2) S2: terrace with crescent bund (Terrace of 2 m radius around the plant with crescent bund of 0.5 m height and 1 m width at the base), (3) S3: staggered trenches between trees (8 trenches of size 2 m x 0.45 m x 0.45 m in the middle of 4 plants) and (4) S4: control plot without any soil and water conservation technique. Subplot treatments consisted of a) M1: recommended doses of fertilizers, b) M2: recommended doses of fertilizers+10 kg poultry manure and c) M3: application of only 20 kg poultry manure/tree/year. The experimental layout was split plot design and had four replications with 20 plants each in main plot and four plants each in subplot. The soil at experimental site (Kemminje) is lateritic, characterised by very low water holding capacity (23% in field capacity). Texturally, the soil of the experimental field is classified as sandy clay loam. The soil is slightly acidic, medium in N content and low in P2O5 and K2O content. The slope of the land ranges from 3-15%.

7.2.3.1 Soil moisture content

The soil samples at 0-30 cm, 30-60 cm and 60-90 cm depths were collected at 1.5 m radius of the plant using augur hole method during second fortnight of Mar. in all the three years (2002-2004) and Dec. 2004 to April 2005 in the fourth year and SMC under the different treatments was determined by gravimetric method

7.2.3.2 Nut yield

Yield was recorded tree wise and year wise in each treatment. Nuts were collected manually from the ground under each tree and counted and weighed. A sub sample counting of 100 nuts was set-aside in each tree. Fresh and dry weights were determined.

7.2.3.3 Run off and soil loss

The coshokton wheel and its accessories were fixed in the field in each treatment plot of one replication to determine the runoff and soil loss. During rainy season the stage level recorder was set daily to determine the runoff. The peak runoff for each intensity of rainfall was recorded and cumulative run off for the whole rainy season was calculated. Total soil collected in the drum fitted to coshocton wheel was collected annually and total soil loss was calculated per hectare basis as below.

$$\text{Soil loss (t/ha/year)} = \frac{\text{(Weight of soil collected in kg)}}{\text{(1000 x watershed area in ha)}} \times 100$$

7.2.4 Results and discussion

7.2.4.1 Soil moisture studies

During 2002-04 it was found that individual tree base terracing with crescent bund resulted in significant

increase in the mean soil moisture content (SMC) over the control (14.5% dry basis compared to 11.2% in control) (Tables 7.6 and 7.7). The catch pit and staggered trench treatments have increased the SMC to 13 and 12.3% respectively. For all the three layers of soil, the SMC in the terrace with crescent bund treatment was found to be significantly higher than that in catch pit, staggered trench and control treatments. Maximum soil moisture availability was observed within 1 m radius of the plant at the base in the case of terrace with crescent bund treatment (12.1 to 17.4% dry basis) and least in the case of control plot (9.2 to 12.3% dry basis) receiving no soil and water conservation measures. A total of 5.3, 24.1 and 14 mm of rainfall was recorded during March 2002, 2003 and 2004 respectively after the soil sample collection.

Soil samples at three different depths were collected from Dec. 2004 to Apr. 2005 for determining the variation of SMC under the different treatments. No rainfall occurred upto March. For the first layer of soil, significant difference in soil moisture content was observed in the case of individual tree terracing with crescent bund and catch pit treatments compared to control. For the second and third layers of soil, significant difference in SMC was observed in the case of all the three treatments with SWC structures compared to control. Maximum soil moisture availability was observed within 1.5 m radius of the plant at the base in the case of crescent bund with terrace treatment (17 to 21.2% db in Dec., 16.3 to 18.8% db in Jan.; 15.3 to 17.3% db in Feb. and 14.6 to 16.2% db in Mar.) and least in the case of control plot (12.5 to 14.4% db in Dec.; 12.4 to 13.8% db in Jan.; 11.9 to 13.3% db in Feb. and 10.9 to 12.2% db in Mar.) with no soil and water conservation structure. A total of 66.5 mm of rainfall (5 rainy days) was recorded in Apr. (from 5th to 27th) before the soil sample collection. It was observed that the SMC in the first layer was almost same (15.4 to 15.8 % db) in all the treatments including control. Maximum SMC in the second and third layers was observed in the case of crescent bund with terrace treatment (15.5% db in the second and 17.3% db in the third layer) and minimum in control plot (12.9% db in the second and 12.2% db in the third layer). In the case of treatments with soil and water conservation structures, the SMC in the second and third layers were high due to the conservation of pre-monsoon rainfall.

7.2.4.2 Soil moisture depletion

Compared to Dec., the SMC in the first layer of soil was reduced by 0.1 to 0.7 % db in Jan., 0.6 to 1.7% db in Feb. and 1.4 to 2.8% db in Mar. in all the treatments including control. Compared to Dec., the SMC in the second and third layers of the soil was reduced by 0.5 to 2.3% db in Jan., 0.9 to 2.7% db Feb. and 1.8 to 5.0% db in Mar.

7.2.4.3 Soil moisture retention

Terrace with crescent bund treatment conserved the maximum soil moisture. It has retained around 5.6% (db) more soil moisture in Dec., 4.6% (db) more in Jan. and 3.6 to 3.8% (db) more in Feb. and Mar. In Apr., due to pre-monsoon rainfall, it has conserved around 5.1% (db) more moisture than the control plot at lower layers.

7.2.4.4 Nut yield

Soil conservation measures like terrace with crescent bund resulted in significantly higher production of nuts (707.3, 1157.7 kg/ha respectively) than the rest of the treatments during 2003 and 2004 (Table 7.8). During the first year (2002) significant difference among the treatments was not observed. The mean yield data over three years indicated that terrace with crescent bund resulted in significantly higher production of nuts (732 kg/ha-167.5% of control) than rest of the treatments including control (497.2 kg/ha). Application of recommended doses of fertilizer with poultry manure (635.7 kg/ha) and poultry manure alone (654.5 kg/ha) resulted in significantly higher yield during 2004 and mean of three years compared to recommended doses of fertilizers only (560 kg/ha in 2004 and 524.0 kg/ha-mean of three years). Significant interaction effects of both soil conservation measures and manures were observed only in 2004 and mean of three years. It was found that individual terrace with crescent bund coupled with the application of 20kg poultry manure resulted in maximum yield of 1211 kg/ha (S2M3) in 2004, and mean of three years was 775.0 kg/ha compared to rest of the treatments including control (S4M1-560 kg/ha in 2004, 362.3 kg/ha-mean of three years). The yield increased with increased soil moisture content (Fig.7.5).

Table 7.6 Soil moisture (% dry basis) content under different treatments (2002- 2004)

Treatment	Year												Mean (0-90 cm depth)	% of control
	2002				2003				2004					
	Depth (cm)				Depth (cm)				Depth (cm)					
	0-30	30-60	60-90	Mean	0-30	30-60	60-90	Mean	0-30	30-60	60-90	Mean		
Individual tree base terracing with catch pit	8.0	11.6	11.3	10.3	10.3	13.9	14.6	12.9	12.2	16.5	18.2	15.6	13.0	116
Individual tree base terrace with crescent bund	10.1	12.6	13.5	12.1	11.7	14.5	15.5	13.9	13.0	18.7	20.5	17.4	14.5	129
Staggered trenches between two rows of cashew	7.1	9.9	11.5	9.5	10.3	13.5	14.1	12.6	11.7	14.8	17.4	14.6	12.3	110
Control plot without any soil conservation technique	8.0	9.7	10.0	9.2	10.2	12.7	13.2	12.0	11.4	11.9	13.5	12.3	11.2	100
Mean	8.3	10.9	11.5		10.6	13.7	14.4		12.1	15.5	17.4			
CD Treatment (P=0.05)				0.25				0.15				2.62	0.65	
CD Depth (P=0.05)				0.16				0.10				2.26	0.37	
T x D				0.31				0.20				NS	0.75	

Available soil moisture ranged from 12 to 22.5% (Mean of all the three depths)

Table 7.7 Soil moisture content (% dry basis) under different soil and water conservation treatments (2002-2004)

Treatment	Mean SMC for three years (%)			
	Depth (cm)			Mean
	0-30	30-60	60-90	
S1	10.2	14.0	4.7	13.0
S2	11.6	15.3	16.5	14.5
S3	9.7	12.7	14.3	12.3
S4	9.9	11.4	12.2	11.2
Mean	10.3	13.4	14.4	
CD (0.05) for SWC				0.65
CD (0.05) for depth				0.37
CD (0.05) for Interaction				0.75

Available soil moisture ranged from 12 to 22%

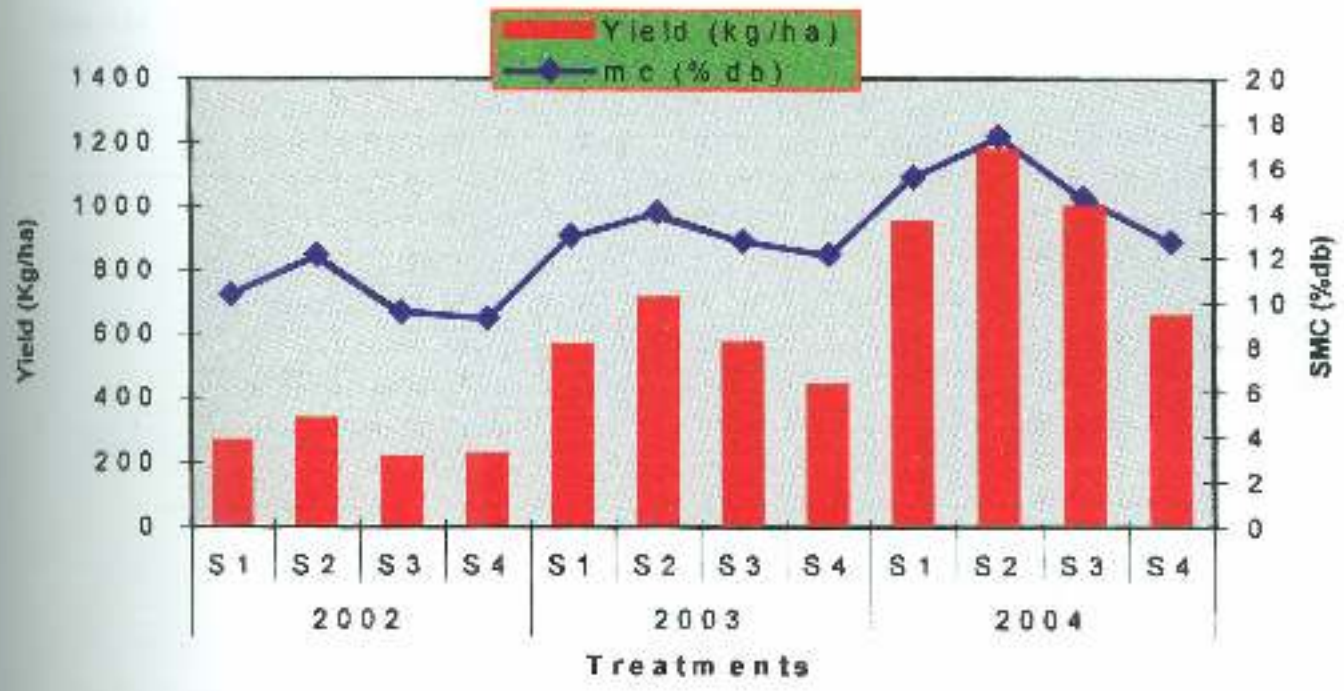


Fig.7.5 Effect of soil and water conservation on SMC and nut yield (2002-2004)

Table.7.8 Effect of soil and water conservation coupled with manuring on nut yield (kg/ha.) for three years (2002 to 2004)

Treatment	Year															
	2002				2003				2004				Mean			
	M1	M2	M3	Mean	M1	M2	M3	Mean	M1	M2	M3	Mean	M1	M2	M3	Mean
S1	202	295	294	263.7	538	553	604	565.0	869	947	1068	961.33	536.3	598.3	655.3	596.6
S2	301	290	402	331.0	674	734	714	707.3	1050	1212	1211	1157.67	675.0	745.3	775.6	732.0
S3	189	195	257	213.7	548	620	538	568.7	831	1129	1032	997.0	522.7	648.0	609.0	593.2
S4	151	202	315	222.7	376	438	502	438.7	560	614	776	650.0	362.3	418	5431	437.1
Mean	210.7	245.5	317.0		534.0	586.2	589.5		687.5	822.0	827.7		524.0	602.4	642.7	
CD for Main plot (P=0.05)				NS				4.93				127				64.7
CD for Sub plot (P=0.05)				68.4				NS				112				29.5
Main x Sub				NS				NS				120				80.5

7.2.4.5 Economics

Maximum cost of cultivation, Rs. 41,895 was incurred in the treatment with staggered trenches (Table 7.9) and maximum income of Rs. 76,860 was obtained from treatment with crescent bund (Table 7.10) for three years from 2002 to 2004. Highest profit of Rs. 40,966/ha/year (165% of control) was realized from plot with terrace with crescent bund treatment. The profit from control plot (without soil and water conservation structure) was Rs. 24,812/ha/year. Among the subplots, application of poultry manure alone (20 kg/tree) fetched highest profit of Rs. 33,020/ha/year which was 131.8% of control treatment (application of recommended doses through inorganic fertilizers only). The combination of terrace with crescent bund and poultry manure application resulted in highest profit of Rs. 44,353/ha/year compared to rest of the treatment combinations. (Fig. 7.6)

Individual tree base terracing with crescent bunding is the best soil and water conservation measures in slopy land of West Coast region. The terrace should be 2 m radius around the plant with bund of 0.5m height and 1 m width at the base towards lower side of slope. Cost involved per tree for this structure is Rs. 30 at the present rates of wages in Dakshina Kannada.

Table 7.9 Cost of cultivation (Rs./ha) for 3 years (2002-2004)

	M1	M2	M3	Mean
S1	30105	36095	34903	33701
S2	32295	38295	37092	35894
S3	38295	44295	43095	41895
S4	19209	21209	24009	21476
S5	29976	34974	34775	

Table 7.10 Income (Rs./ha) for three years (2002-2004)

	M1		M2		M3		Mean
	Yield	Income	Yield	Income	Yield	Income	Yield
S1	1609	56315	1795	62825	1966	68810	62650
S2	2025	70875	2236	78260	2327	81445	76860
S3	1568	54880	1944	68040	1827	63945	62288
S4	1087	38045	1254	43890	1629	56980	46305
Mean		55029		63254		67795	

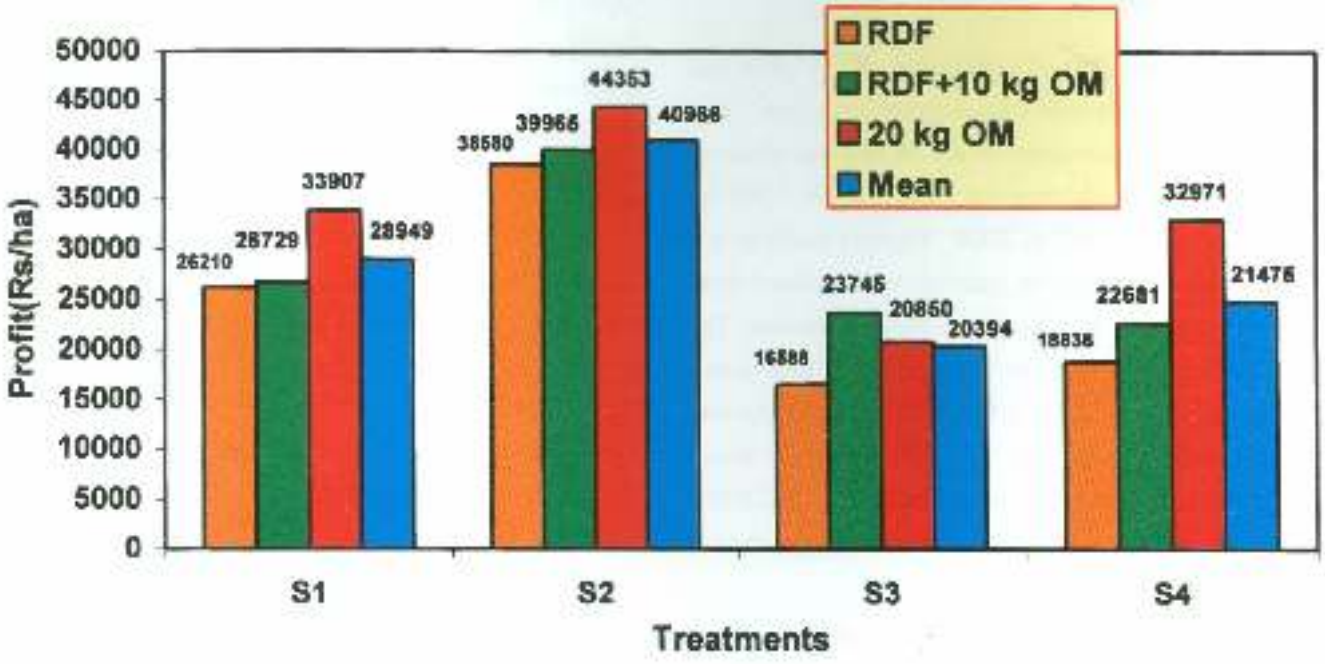


Fig.7.6 Profit for three years (Rs/ha)

7.2.5 Conclusion

The terrace with crescent bund treatment increased the soil moisture significantly (14.5% dry basis compared to 11.2% in control), reduced the peak runoff (4.6 l/s/ha compared to 5.1 l/s/ha in control) and soil loss (0.77 t/ha/year compared to 1.54 t/ha/year in control plot) and resulted an increased cashew yield (732 kg/ha compared to 497.2 kg/ha in control). Compared to December, more soil moisture depletion was observed in March and more moisture retention was observed in April (due to pre-monsoon rainfall conservation). Hence, the available water during pre-monsoon, monsoon and post-monsoon season can be efficiently harvested and used for higher yields using proper soil and water conservation techniques like terrace with crescent bund treatment coupled with the application of 20kg poultry manure. The combination of terrace with crescent bund and poultry manure application resulted in highest profit of Rs. 44,353/ha/year compared to control (Rs. 24,812/ha/year). Cost involved per tree for this structure is Rs.30 at the present rates of wages in Dakshina Kannada.

7.2.6 Research Publications

N.Yadukumar and R.Rejani. (2004). Evaluation of soil and water conservation techniques coupled with manuring in cashew grown under medium slope. *J. Plantation Crops*, 32 (Suppl.), pp. 190-195.

ADDITIONAL INFORMATION

8. EDUCATION AND TRAINING

- Training on "Vegetative Propagation of Cashew" was organized during 20-21 August, 2004 in which four trainees sponsored by KCDC Ltd., Karnataka and Aralam farm, Kerala were trained on softwood grafting technique and nursery management. Similar training was also organised for Self Help Groups sponsored by Sri Kshetra Dharmasthala Rural Development Project (SKDRDP), Puttur on 9.9.2004 in which 15 trainees have participated.
- Training programmes on "Pruning , Top working in Cashew and Composting of Recyclable Cashew Biomass were organized for the officials of Department of Horticulture, Andhra Pradesh during 6-8 July, 2004 in which 19 trainees have participated.
- Two special training programmes on cashew production technology were organized during 6-10 September, 2004 for 18 officials from Department of Horticulture, Tamil Nadu and during 13-17 December, 2004 for one official from Department of Horticulture, Nagaland.
- Three refresher courses were organized for the officials of development departments representing five states (Tamil Nadu, Andhra Pradesh, Goa, Karnataka and Maharashtra) during 30 August - 1 September, 2004; 17-19 January, 2005 and 19-21 January 2005. A total 28 participants were trained on improved aspects of cashew cultivation out of the three training programmes.

9. LINKAGES / COLLABORATION

Name of the organizations	Type of collaboration
Central Food Technological Research Institute, Mysore	DBT funded project on nutraceuticals in cashew
PDBC, Bangalore	EAG and GCMS studies
SKDRDP, Puttur	Thematic campaigns, laying out demonstration plots, trainings and annual cashew day
Directorate of Cocoa and Cashew Development, Kochi	Laying out demonstration plots / farmers training
Cashew Export Promotion Council of India, Kollam.	Insecticide residue analysis
All India Raio, Mangalore	Production and Broadcast of Radio serial on Improved Cashew cultivation
Farm Information Exchange Club, Perla, Kasaragod.	Thematic campaigns and farmers training programme.
Department of Horticulture, Karnataka	
Karnataka Cashew Manufacturer's Association, Mangalore.	Farmers' training programmes
Agricultural Research Station, Ullal, Mangalore.	

10. AICRP - CASHEW CENTRES

Headquarters

The Director and Project Coordinator (Cashew), National Research Centre for Cashew, Puttur - 574202, DK, Karnataka.

Phone : 08251-231530, 230902, 236490 (0); 230992 (R).

Fax : 08251-231590, 234350

State Agricultural University centres

1. Cashew Research Station, (Acharya NG Ranga Agricultural University), Bapatla 522 101, Guntur Dist., Andhra Pradesh.
   Phone : 08643-225304
2. Cashew Research Station, Department of Horticulture, (Orissa University of Agriculture and Technology), Bhubaneswar 751 003, Orissa.
   Phone : 0674-2405383
3. Agricultural Research Station, (University of Agricultural Sciences), Chintamani 563 125, Kolar District, Karnataka.
   Phone : 08154-452118, 450420
4. S.G. College of Agriculture and Research Station, (Indira Gandhi Krishi Vishwa Vidyalaya), Jagdalpur 494 005, Kumharawand, Bastar District, Chhattisgarh
   Phone : 07782-229150, 229360
5. Regional Research Station, (Bidhan Chandra Krishi Viswa Vidyalaya), Jhargram Farm, PO JHARGRAM - 721 507, Midnapore (west) District.West Bengal.
   Phone : 03221-255593
6. Cashew Research Station, (Kerala Agricultural University), Madakkathara 680656,Thrissur Dist., Kerala.
   Phone : 0487-2370339
7. Regional Agricultural Research Station, (Kerala Agricultural University), Pilicode 671 353, Kasaragod District, Kerala.
   Phone : 0467-2260632
8. Regional Fruit Research Station, (Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth), Vengurle 416 516, Sindhudurg District, Maharashtra
   Phone : 02366-262234, 263275, 262693
9. Regional Research Station, (Tamil Nadu Agricultural University), Vridhachalam 606 001, Cuddalore District, Tamil Nadu.
   Phone : 04143-260231, 260412

11. PUBLICATIONS

11.1 Research Publication

Nagaraja, K.V. and Padma, S. 2005. Studies on coated cashew kernel baby bits. *J. Food Sci. Technol.* 42,89-92.

Sreekanth, P.D. Yadukumar, N. and Gangadhara Nayak 2004. Cashew yield forecasting under different plant densities. *J. Plantation crops.* 32(2) : 58-63.

Sundararaju, D. 2004 Influence of spiders and insect predators on incidence of tea mosquito bug. *The Cashew* XVIII (1) : 9-13.

Sundararaju, D. 2004 Evaluation of certain insecticides against tea mosquito bug cashew. *The Cashew* XVIII (2) : 22-26.

Sundararaju D. 2004 Evaluation of promising new insecticides against tea mosquito bug. *J. Plantation crops.* 32(Suppl.):285-288.

Venkattakumar, R. and Bhat P.S. Yadukumar N. and Raviprasad T.N. 2004. Thematic campaigns in field training of cashew growers-an analysis. *The Cashew* XVIII (1): 14-19.

Venkattakumar, R., Bhuvaneswari, S., Shirly R. Anil and Bhat P.S. 2004 . Training rural women on cashew apple utilization. *The Cashew* XVIII (2): 27-34.

Venkattakumar,R., Sreekanth, P.D. and H.Muralikrishna , 2004. Analysis of state - wise availability of cashew grafts *The Cashew* XVIII (4): 9-17.

Yadukumar, N.and Rejani 2004 Evaluation of soil and water conservation techniques coupled

with manuring in cashew grown under medium slope. *J. Plantation crops*. 32(Suppl.): 192-195.

11.2 Popular Articles

Bhat, M.G., Nayak M.G. Nagaraja, K. V. and Bhat P.S. 2004. Cashew research in the past and strategies for the future. Orissa Krushak Samaj - Souvenir - 2004. pp 66-73.

Venkattakumar, R. and Bhat M.G. 2004. Research and development activities of NRC Cashew - An overview. In: Field Day on Cashew souvenir of OSCIDC Ltd., Bhubaneswar, Orissa 36-42.

Bhat M.G. and Venkattakumar, R. 2004 Present status and future prospects of cashew research in India. In: Kissan Mela cum Exhibition souvenir of IIHR, Bangalore.

Bhat M.G. and Venkattakumar, R. 2005 Progress of cashew research. In: The Hindu : Survey of Indian Agriculture 2005 pp 119-121.

11.3 Papers presented in Symposia / Workshop / Seminar

Bhat, M. G. 2004. Present status, constraints and opportunities in import and export of cashew. In: First Indian Horticulture Congress- 2004 (Improving productivity, quality, post harvest management and trades in Horticultural crops) held at PUSA, New Delhi during 6-9 November 2004.

Bhat P.S. and Raviprasad T. N. 2004. Status of pheromone research on mirid bugs. In: Proceedings of National Group Meeting of Scientists of AICRP on Cashew held during 4-6 June 2004. pp 6-9.

Bhat P.S. and Sundararaju. 2005. Biological Control of Pests of Cashew In: Symposium on Biological Control of pests of Horticultural Crops: New Thrusts at Project Directorate of Biological Control, Bangalore on 19 March 2005.

Nayak M.G., Bhat M.G. and N. Yadukumar 2004 Status and need for mechanisation of production and post production operations in cashew. In: Proceedings of National Working Group Meeting on Mechanisation Needs of Horticulture and Hill Agriculture for Production and Post Production Operation and Value Addition held at CIAE, Bhopal on 16-17 April 2004. pp 82-85.

Nayak M.G., Bhat M.G and Raviprasad. T.N. 2004. Training and pruning techniques for high - density orcharding and rejuvenation in cashew. Poster paper In: First Indian Horticulture Congress- 2004 (Improving productivity, quality, post harvest management and trades in Horticultural crops) held at PUSA, New Delhi during 6-9 November 2004.

Raviprasad. T.N. 2004 . Status of management of cashew stem and root borer (CSRB) on cashew. In: Proceedings of National Group Meeting of Scientists of AICRP on Cashew held during 4-6 June 2004. pp21-23.

Sundararaju. D. 2004. Status of management of tea mosquito bug (TMB) of cashew. In: Proceedings of National Group Meeting of Scientists of AICRP on Cashew held during 4-6 June 2004. pp 12-16.

11.4 Technical Reports / Bulletins / Compendia

All India Coordinated Research Project on Cashew. 2004. Annual Report 2003-04. NRC Cashew, Puttur, Karnataka. 91pp (Eds. Nagaraja, K.V, Bhat, P.S and Venkattakumar, R.)

National Research Centre for Cashew. 2004. Annual Report 2003-04, Puttur, Karnataka, 100 pp. (Eds. Nagaraja, K.V. Bhat, P.S and Venkattakumar, R.)

National Research Centre for Cashew. 2004. Cashew News, Newsletter. Vol. 9 (1) and 2, Puttur, Karnataka. 8 pp. (Eds. Nagaraja, K.V. Bhat, P.S and Venkattakumar, R.)

Nayak, M.G. Yadukumar. N. Venkattakumar, R. and Raviprasad T.N. 2004. Indigenous Technical Knowledge in Cashew. NRC-Cashew. Puttur, Technical Bulletin No.9 20 pp.

National Research Centre for Cashew, 2004. Research Highlights 2004-05. Puttur, Karnataka. 40 pp.

11.5 Extension bulletins / pamphlets

High Density Planting in Cashew - NRCC Extension Handout No.11.

"Sudharitha geru hesava kramagalu" NRCC: Extension Bulletin No.3, 40pp

12. LIST OF ONGOING RESEARCH PROJECTS

Project No.	Project Title
	1. CROP IMPROVEMENT
1.1	Collection, conservation, evaluation and cataloguing of cashew germplasm (MG Nayak,MG Bhat and PS Bhat)
1.2	Varietal improvement of cashew (MG Bhat and MG Nayak)
1.5	Micropropagation for clonal root stocks, somatic embryogenesis and rooting in cashew (Shirly R Anil and Thimmappaiah).
1.6	Molecular characterization of cashew using RAPD and isozyme markers (Thimmappaiah and Shirly R Anil)
	2. CROP MANAGEMENT
2.2	Planting systems and spacing trials in cashew (N Yadukumar)
2.3	Canopy management studies in cashew (MG Nayak and N Yadukumar)
2.8	Efficacy of soil and water conservation with organic and inorganic manuring in cashew garden grown in slopy areas (N Yadukumar and R Rejani)
Ad-hoc	Influence of fertigation on yield and quality of cashew (N Yadukumar).
	3. CROP PROTECTION
3.6	Studies on determination of insecticide residues in cashew kernels (PS Bhat and TN Raviprasad).
3.7	Studies on pheromones of tea mosquito bug *Helopeltis antonii* S. (PS Bhat and TN Raviprasad)
3.8	Integrated pest management of cashew stem and root borer (CSRB) - Phase-II (TN Raviprasad and PS Bhat).
3.9	Bioecology and management of lepidopteran flower and fruit pests of cashew (D Sundararaju).
3.10	Foraging behaviour of pollinators of cashew (D Sundararaju).
3.11	Investigations on insect fauna associated with Cashewnut (TN Raviprasad and PS Bhat)
	4. POST HARVEST TECHNOLOGY
4.8	Mineral composition of cashew kernel, testa and apple pomace of released varieties (KV Nagaraja).
4.9	Studies on preparation of nutraceuticals from cashew apple (KV Nagaraja).
DBT	Nutraceuticals for health and speciality foods through biotechnological approaches (KV Nagaraja).
	5. TRANSFER OF TECHNOLOGY
5.1	Transfer of technology programmes in cashew (R. Venkattakumar, N. Yadukumar, P.S. Bhat and M.G. Nayak)
5.3	Socio- economic impact of cashew cultivation - An analysis (R Venkattakumar)
	6. COMPUTER APPLICATION
6.2	Computer application in cashew (PD Sreekanth)
6.3	Database for cashew germplasm (PD Sreekanth and MG Nayak)

13. IMPORTANT MEETINGS AND SIGNIFICANT DECISIONS

13.1 Research Advisory Committee

1.	Dr. M.V.Rao. Former Special Director General, Indian Council of Agricultural Research.	Chairman
2.	Dr. A.N. Maurya. Former Director, Institute of Agricultural Sciences, Banaras Hindu University.	Member
3.	Prof. V.C. Patil, Professor and Head. Department of Agronomy, University of Agricultural Sciences, Dharwad.	Member
4.	Dr. M. Udaya Kumar, Professor and Head. Department of Crop Physiology. University of Agricultural Sciences, Bangalore	Member
5.	Dr. Amerika Singh, Director, NRC for Integrated Pest Management, LBS Building. Pusa Campus, New Delhi	Member
6.	Dr. K.V. Ramana, Assistant Director General (PC), Indian Council of Agricultural Research, Krishi Bhavan, New Delhi	Member
7.	Dr. P.M. Haldankar. Horticulturist, Dept. of Hort., College of Agri., Dr. BSSKKV, Dapoli, Ratnagiri District, Maharashtra	Member
8.	Dr. G.K. Naidu, Kacharavedu Village, Alapakam Post, Nindra Mandal, Chittor district, Andhra Pradesh	Member
9.	Dr. M.G. Bhat. Acting Director, NRC-Cashew, Puttur, Karnataka-574 202	Member
10.	Dr. K.V. Nagaraja. Principal Scientist (Biochemistry), NRC-Cashew, Puttur, Karnataka - 574 202	Member Secretary

Third meeting of third RAC (9th meting) of NRCC was held on 20th and 21st Feb. 2005 under the chairmanship of Dr. M.V. Rao. Dr. K.V. Ramana, ADG(PC), Dr. A.N. Maurya, Prof. Amerika Singh, Prof. M. Udayakumar, Dr. V.C. Patil, Dr. P.M. Haldakar, Mr. G.K. Naidu, Dr. M.G. Bhat, Dr. K. V. Nagaraja and scientists of centre participated in the meeting where progress made under research projects was discussed. It was decided that a team of scientists of NRCC to visit Tsunami affected areas to identify salt tolerant cashew trees.

13.2 Institute Management Committee

1.	Dr. M.G. Bhat, Acting Director, NRC-Cashew. Puttur	Chairman
2.	Dr. S.N. Pandey. Asst. Director General (Hort and PC), ICAR, Krishi Bhavan, New Delhi 110 001	Member
3.	Dr. D. Sundararaju, Principal Scientist (Ent), NRC for Cashew, Puttur	Member
4.	Dr. B.M.C. Reddy. Project Coordinator (Tropical Fruits), Indian Institute of Horticulture Research, Bangalore	Member
5.	Dr. K.R. Jayaram, Joint Director of Horticulture (PC), Department of Horticulture, Bangalore - 560 004	Non-official Member
6.	Sri. G.K. Naidu. Kacharvedu Village, Alapakam Post, Nintramandal, Chittor District, Andhra Pradesh	Member
7.	Dr. P. Sadashiva Rao, Joint Director of Horticulture, Deparment of Horticulture (Agency), O/O Commissioner of Horticulture, Hyderabad, Andhra Pradesh	Member

8.	Dr. T.R. Guruprasad, Associate Professor and Head, Agricultural Research Station, Ullal, Dakshina Kannada, Mangalore, Karnataka	Member
9.	Dr. P.M.Haldankar, Horticulturist, Dept. of Horticulture, College of Agriculture, Dr. BSKKV, Depoto, Ratnagiri Dist., Maharashtra	Non-Official Member
10.	Dr. M.G. Nayak, Senior Scientist (Hort), NRC Cashew, Puttur	Member
11.	Sri. K. Sanjeeva, Assistant Administrative Officer, NRC Cashew, Puttur	Member-Secretary

The Institute Management Committee met twice on 9 12 2004 ad 22 3 2005 and reviewed the progress of research project and ad-hoc projects. The equipments to be purchased and the works to be undertaken during the current year of X Plan period were finalized during the meetings.

13.3 Staff Research Council Meeting

The seventeenth Staff Research Council Meeting of NRCC. Puttur was held during 28- 29 June 2004 to review the progress made in the ongoing projects of the centre. Dr. Parthasarathy, Director. IISR, Calicut (Crop Improvement), Dr.D.P.Kumar, Professor and Head, Department of Horticulture, UAS, Bangalore (Crop Management), Dr.Gavi Gowda Professor and Head, Department of Apiculture UAS, Bangalore (Crop Protection), Dr. P.G. Adsule, Acting Director, NRC Grapes, Pune (Post Harvest technology), Dr. Arulraj, Head, Division of Social Sciences , CPCRI, Kasaragod(Transfer of Technology) chaired the sessions. During the inauguration Dr.Parthasarathy released the publication Research Highlights 2003-04 of the centre. Five new projects were also approved for implementation.

13.4 Institute Joint Staff Council (IJSC)

Official Side

Dr. M.G. Bhat	Chairman
Dr. N. Yadukumar	Member
Dr. M.G. Nayak	Member
Sri. K.Sanjeeva	Member
Sri. A.K. Shabaraya	Member
Sri. P.D. Sreekanth	Secretary

Staff Side

Sri. K. Umanath	Member (CJSC)
Sri. K.R. Padmanabhan Nair	Member-Secretary
Smt. B. Jayashree	Member
Sri. K. Umashankar	Member
Sri. K. Narayana	Member
Sri. V. Sundara	Member

The IJSC met 4 times at quarterly intervals during the year to discuss about staff welfare activities.

13.5 राजभाषा कार्यान्वयन एवं प्रगती

राजभाषा कार्यान्वयन समिति

1.	डॉ एम. जी. भट्	अध्यक्ष
2.	डॉ टी. एन. रविन्द्रनाद	सदस्य
3.	श्री लक्ष्मीपती	सदस्य
4.	श्री प्रकाश जी भट्	सदस्य

5.	श्री के. एम. जयराम नाइक	सदस्य
6.	श्री के. सीताराम	सदस्य
7.	श्री उगाशंकर	सदस्य
8.	कुमारी विद्या लोधी	सदस्य
9.	श्री रविशंकर प्रसाद	सदस्य
10.	श्री के. संजीव	सदस्य सचिव

राजभाषा कार्यान्वयन एवं प्रगती

केन्द्र में राजभाषा कार्यान्वयन की प्रगती आशाजनक रहा । समिती के एक सदस्य स्थानांतरण पर केन्द्र से गया और एक नया सदस्य को समिती में शामिल किया गया । बैठकों में हिन्दी कार्यान्वयन की प्रगती के लिए जरूरी अनेक विषयों पर चर्चा किया गया और निर्णय भी लिया गया । केन्द्र सरकार से आए प्रमुख पत्रों के बारे में भी चर्चा हुई और विकास के लिए जरूरी आदेशों को अमल करने की कोशिश किया गया ।

केन्द्रीय अनुवाद ब्युरो के सहयोग से केन्द्र के प्रशासन विभाग के सभी ज्ञपत्रों को द्वभाषी करवाया गया । अनेक कर्मचारी पत्राचार द्वारा हिन्दी प्रशिक्षण पाने के लिए नाम दर्ज किए । कर्मचारियों को हिन्दी सीखने के लिए जरूरी साफ्टवेर जैसे लीला प्रबोध, प्रवीण, प्राज्ञ की सीडी, टंकण के लिए 'लीप आफिस' की सीडीयों की व्यवस्था किया गया । फिल हाल केन्द्र के स्थित सभी 28 कंप्यूटरों में हिन्दी साफ्टवेर लगाया गया है । केन्द्र में हिन्दी में काम करने वालों को प्रोत्साहन देने की दृष्टी से नकद पुरस्कार योजना जारी है । हिन्दी रुझवाड़ा का आयोजन बहु यशस्वी और प्रेरणादायक रहा ।

पुत्तूर नगर राजभाषा कार्यान्वयन समिती (नराकास)

पुत्तूर नगर और फिल्ड में स्थित केन्द्र सरकार के विभिन्न कार्यालयों के राजभाषा कार्यान्वयन गतिविधियों को समन्वित करने कोलए और उसे बढ़ावा देने के लिए पुत्तूर नराकास कोशिश करती है । राष्ट्रीय काजू अनुसंधान केन्द्र इसके संयोजक के रूप में काम कर रहा है । कुल 24 सदस्य कार्यालय पुत्तूर नराकास के अधीन है ।

इस वर्ष नराकास की दो अर्धवार्षिक बैठक आयोजित हुई । सदस्य कार्यालयों के प्रमुखों ने बैठक में भाग लिए और सभी कार्यालयों की हिन्दी कार्यान्वयन की स्थिति की समीक्षा किया गया । विशेष रूप से दैनंदिन काम - काज में आनेवाले बाधाएं, शंका और तकलीफों के बारे में चर्चा हुई और बैठक में उपस्थित क्षेत्रीय कार्यान्वयन कार्यालय बेंगलोर से आए राजभाषा अधिकारी ने मार्गदर्शन किया । सदस्यों के सुविधा के लिए एक दिन की हिन्दी कार्यशाला आयोजन किया गया जिसमें श्री अजय कुमार श्रीवास्तव, सहायक निदेशक, (कार्यान्वयन) प्रशिक्षार्थियों को मार्गदर्शन किए । सितंबर 14-28 एक पंद्रह दिन के लंबा हिन्दी पखवाड़ा मनाया गया । कार्यक्रम के अवसर पर सदस्यों के लिए विभिन्न प्रतियोगिता आयोजन किया गया था । इनाम केन्द्र के अलावा सी पी सी आर आई फिल्ड, भारतीय जीवन बीमा निगम, कि एस एस एल आदी कार्यालयों ने प्रदान किया । समापन समारोह में हिन्दी कार्यान्वयन के लिए सर्वश्रेष्ठ प्रोत्साहक हे रहे आदरणीय महोदयों को और हिन्दी परीक्षा में उच्च अंक प्राप्त किए विद्यार्थियों को सम्मान किया गया । सभी सदस्य कार्यालयों के कर्मचारियों को केन्द्र में उपलब्ध साफ्टवेर द्वारा प्रशिक्षण पाने के लिए मुक्त अवसर दिया गया है ।

14. PARTICIPATION IN SYMPOSIA / CONFERENCES / SEMINARS / MEETINGS

All Scientists	National Agricultural Seminar at Puttur	1-3 April 2004
M.G. Bhat M.G. Nayak M. Yadukumar	National Working Group meeting on mechanization needs of horticulture and hill agriculture. CIAE, Bhopal	16-17 April 2004
All Scientists	Group Meeting on cashew flower panicle drying NRCC, Puttur	3 May 2004
All Scientists	National Group meeting of scientists of AICRP on Cashew, NRCC, Puttur	4-6 June 2004
M.G. Nayak	Group meeting of germplasm utilization held at NBPGR, New Delhi	5-7 October 2004
M.G. Bhat M.G. Nayak	First Indian Horticulture Congress, New Delhi.	6-9 November 2004
M.G. Bhat K.V. Nagaraja N. Yadukumar D. Sundararaju	PLACROSYM XVI - Reorientation o f plantation crops research in WTO regime, CPCRI. Kasaragod.	14-17 December 2004
M.G. Bhat K.V. Nagaraj	Launching of golden Jubilee celebrations and renaming of Mangalore Cashew Manufacturers' Association (MCMA), Mangalore as Karnataka Cashew Manufacturers' Association (KCMA), Mangalore.	30 December 2004
D. Sundararaju PS Bhat	Interactive meeting on Bio Pesticides in Horticulture Crops jointly organized by IIHR, Bangalore and Institute of Agricultural Technologists, Bangalore and DBT, New Delhi, Bangalore.	16 February 2005
M.G. Nayak	Regional group meeting of FAO sponsored information sharing mechanism on germplasm for global action plan NBPGR (RS), Hyderabad	7-8 March 2005
PS Bhat	Symposium on Biological Control of Pests of Horticulture Crops, PDBC. Bangalore	19 March 2005

15. FARMERS DAY/KRISHIMELA/EXHIBITION/CAMPAIGNS

N.Yadukumar M.G.Nayak R. Venkattakumar	Campaign on "Pruning, High Density Planting and Soil and Water Conservation Measures in Cashew", Kolthige and Kaniyur villages of Puttur taluk	24 May 2004 26 May 2004
P.S. Bhat T.N. Raviprasad R. Venkattakumar	Campaign on "Protection in Cashew" at Perla, Kasaragod and Kudkadi. Puttur	25 November 2004 27 November 2004
M.G. Bhat P.S. Bhat T.N. Raviprasad R. Venkattakumar	Cashew Day, ARS, Ullal, Mangalore	9 January 2005
All scientists and staff	Cashew Day, NRCC, Puttur	24 February 2005
M.G. Bhat N.Yadukumar R. Venkattakumar	Cashew seminar, Mooduperara, Ishwarakatte, Mangalore organized jointly by Horticulture Department. Government of Karnataka , Karnataka Cashew Manufacturer's Association. Mangalore and National Horticultural Board, Bangalore.	9 March 2005
P.S. Bhat R.Venkattakumar	Krishi Mela cum Exhibition. IIHR. Bangalore	22-23 March 2005

16. DELEGATION / TRAINING

D Sundararaju	Winter School on "Pollination Ecology in Agro-Ecosystems" Zonal Agricultural Research Station, University of Agricultural Sciences, Moodigere	6-26 September
R.Venkattakumar	Training programme on "Use and maintenance of plantation crops information system" CPCRI, Kasaragod.	25 September 2004

17. RADIO TALK/ INTERVIEW

M.G. Bhat	New varieties in cashew crop for Karnataka and their maintenance	29 July 2004
M.G. Bhat	Introduction of NRCC to radio serial on cashew	16 February 2005
M.G. Bhat	Recommended varieties of cashew for Karnataka State.	23 February 2005
M.G. Nayak	Vegetative Propagation and nursery management in cashew	March to June 2005
N. Yadukumar	Establishment and management of cashew orchards	
N. Yadukumar	Improved cashew cultivation practices	
M.G. Nayak	Training, pruning and topworking in cashew	
P. S. Bhat	Tea mosquito bug and its management	
T.N. Raviprasad	Cashew stem and root borer and its management	
K.V. Nagaraja	Harvesting and processing of cashew and Utilization of cashew apple	
R. Venkattakumar	Transfer of technology programmes in cashew	

18. DISTINGUISHED VISITORS

Dr. R.Naidu, Director, Coffee Board, Central Coffee Research Institute, Balehonnur, Chikkamagalore district	10 May 2004
Dr. K.D. Kokate, Director of Extension Education, DBSKKV. Dapoli-415712. Ratnagiri. Maharashtra.	3 September 2004
Sri. G.S. Prabhu, IFS. Chief Conservator of Forests and Managing Director, KCDC, Mangalore	8 October 2004
Dr. B.P. Vashishth, Director, NRC on Seed Spices, Ajmer, Rajasthan.	16 October 2004
Dr.K.L. Chadha, former DDG(Horticulture), ICAR, New Delhi 110 070	18 December 2004
Dr. M.V. Rao Dr. K.V. Ramana Dr. M. Udayakumar Prof. V.C. Patil Dr. A.R. Maurya Dr. Anerika Singh Dr. Halankar Mr. G.K.Naidu — Chairman and Members of Research Advisory Committee	20-21st February 2005

19. PERSONNEL

Managerial

Acting Director — Dr. M.G. Bhat

Scientific

Discipline	Scientist	Scientist (Sr.Scale)	Sr.Scientist	Pr.Scientist	Total (Incl. Vacant Posts)
Agricultural Engg. (ASPE)	D. Balasubramanian*	—	—	—	1
Agricultural Entomology	—	—	P.S. Bhat T.N.Raviprasad	D.Sundararaju	3
Agril.Extension	R. Venkattakumar	—	—	—	1
Biochemistry (Pl.Sci.)	—	—	—	KV Nagaraja	1
Biotechnology	—	—	—	Thimmappaiah (Gen.& Cyto.)	1
Computer Application	PD.Sreekanth	—	—	—	1
Genetics and Cytogenetics	—	Shirly R Anil (Upto 10.3.2005)	—	—	1(1)
Horticulture	Vacant	—	MG Nayak (Hort.)	M.G. Bhat (Pl. Br.) Vacant	4 (2)
Plant Physiology	Vacant	—	—	—	1 (1)
Soil Science	—	—	—	N Yadukumar (Agr.)	1
Soil and Water Cons. Engg.	R. Rejani	—	—	—	1
Total	6 (2)	1(1)	3	6 (1)	16 (4)

* On study leave for Ph.D. at TNAU, Coimbatore

Figures in the parantheses indicate number of vacant posts.

TECHINICAL

Sri.K.Muralikrishna,	Farm Superintendent (T 7-8)
Sri. P. Adbulla,	Farm Superintendent (T6)
Sri.R.Arulmony,	Tech. Officer (lib.) (T-6)
Sri.A.Padmanabha Hebbar,	Tech. Officer (Elec.) (T-5)
Sri.Prakash G Bhat,	Tech. Officer (T-5)
Sri.N.Manikandan	Technical Officer (T-5)
Sri. R. Muthuraju	Technical Officer (Computer) (T-5)
Sri. K. Seetharama	Technical Officer (T-5) (Farm)

Sri. Lakshmipathi, Sri.R.Lakshmisha, Sri.K.V.Ramesh Babu (T-4); Sri.KR.Padmanabhan Nair, Sri. A.Poovappa Gowda, Sri. B. Prabhakara (T-3); Sri. Ravishankar Prasad, Sri. K.Babu Poojary, (T-2); Drivers: Sri. Bejmi Veigus, Sri.KK.Madhavan (T-2); Sri. K.Umanath (T-1)

ADMINISTRATIVE

Sri.A.Keshava Shabaraya,	Assistant Finance and Accounts Officer (Upto 30-6-2004)
Sri. H. Ganesha	Assistant Finance and Accounts Officer (w.e.f. 13-9-2004)
Sri.K.Sanjeeva,	Assistant Administrative Officer
Sri. K. M. Jayarama Naik,	Assistant Administrative Officer (Stores)

Ms. B. Jayashree, Sri. O.G.Varghese (Stenographers); Sri.K.M.Lingaraja (Assistant); Ms.M.Ratna Ranjini (Assistant w.e.f. 13.1.2005), Ms.Winne Lobo, Sri.Rosario Mascarenhas, Ms. M. Leela (Sr.Clerks); Sri.Uma Shankar; Ms. K. Padmini Kurry, (Jr Clerks); Sri.K.Balappa Gowda (Gestetner Operator)

20. MISCELLANEOUS

20.1 Radio Serial on "Improved Cashew Cultivation Practices"

A radio serial on "Improved Cashew Cultivation Practices" was broadcast during February to June, 2005 in collaboration with AIR, Mangalore. A total of 13 episodes were broadcast on various aspects of cashew cultivation.

20.2 Planting material production and distribution

A total of 98,758 saleable cashew grafts have been produced and distributed to farmers and development departments during 2004-05 which includes 50,463 grafts of Kemminje and 48,295 grafts of Shantigodu nurseries.

20.3 Hosting nursery information on NRCC, Website

Information on availability of more than 12 lakh cashew grafts produced in 15 nurseries of seven cashew growing states viz., Maharashtra, Karnataka, Kerala, Goa, Tamil Nadu, Orissa and Andhra Pradesh was hosted on NRCC, Website for the benefit of cashew growers/farmers.

20.4 Visitors

More than 500 visitors viz., farmers, development department besides large number of B.Sc. (Agri.) students of UAS, Bangalore and UAS, Dharwad visited NRCC, Puttur during the period. They were briefed on the research and development activities of NRCC, Puttur.

20.5 Exhibition

Six exhibitions on Cashew Production Technology were organized during Thematic Campaigns, Cashew Day and Seminars.

20.1 Weather data (2004-2005)

Month	Temperature (°C)		Humidity (%)		Rainy days	Rainfall (mm)	Sunshine hours	Evaporation (mm)
	Max	Min	FN	AN	(No.)			
Apr. '04	36.5	24.2	90	51	7	72.3	6.8	5.0
May	31.2	23.8	95	78	20	383.2	2.8	2.2
Jun.	29.7	23.4	95	79	22	793.4	2.4	2.6
Jul.	29.0	22.8	96	83	32	1064.3	1.0	2.7
Aug.	29.7	22.6	95	74	21	434.7	2.7	2.9
Sept.	31.2	22.7	95	68	11	214.0	2.9	3.2
Oct.	32.5	22.7	94	63	12	244.2	5.1	3.0
Nov.	33.5	20.5	91	49	2	77.0	6.2	3.0
Dec.	33.8	16.9	92	38	0	0	8.4	3.7
Jan. '05	34.0	19.2	94	44	0	0	7.0	3.6
Feb.	36.2	18.5	94	39	0	0	8.8	4.7
Mar.	36.8	22.0	92	42	0	0	7.6	6.1

LIST OF NRCC PUBLICATIONS

Sl. No.	Publication	Price Rs.
1	Cashew Production Technology (Revised)	50.00
2	Softwood grafting and nursery management in cashew	35.00
3	Annotated Bibiliography on Cashew	75.00
4	Catalogue of Minimum Descriptors of Cashew	
	Germplasm accessions - I	165.00
	Germplasm accessions - II	125.00
	Germplasm accessions - III	128.00
5	Question and Answers regarding Cashew Cultivation (English)	31.00
6	Status of Cashew Germplasm Collection in India (Booklet)	
7	High Density Planting of Cashew (Booklet)	
8	Compendium of Concluded Research Projects (1986 - 2001)	
9	Indigenous Technical Knowledge in Cashew	
10	Sudharitha Geru Besaya Kramagalu (Booklet in Kannada)	15.00
11	Cashew Nutritive Value (Brochure)	

Address your equiries to the Director, NRCC, Puttur - 574 202, DK, Karnataka.

Price indicated above does not include postage.